

# NATIONAL SKILL GAP STUDY FOR HIGH GROWTH SECTORS

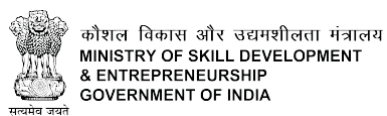


*Submitted to the  
Government of India*

Ministry of Skill Development and  
Entrepreneurship

March 2025





# NATIONAL SKILL GAP STUDY FOR HIGH GROWTH SECTORS

Ministry of Skill Development & Entrepreneurship Govt. of India,  
Kaushal Bhawan, New Moti Bagh,  
New Delhi-110023





जयन्त चौधरी  
Jayant Chaudhary



सत्यमेव जयते

कौशल विकास और उद्यमशीलता  
राज्य मंत्री (स्वतंत्र प्रभार) एवं  
शिक्षा राज्य मंत्री  
भारत सरकार  
Minister of State (Independent Charge)  
Skill Development and Entrepreneurship;  
Minister of State for Education  
Government of India

### **MESSAGE**

I extend my congratulations to the Ministry of Skill Development and Entrepreneurship (MSDE) and the National Council of Applied Economic Research (NCAER) for developing '*Methodology for Assessing Skill Shortages and Gaps*', which provides comprehensive unified framework and methodology to assess and anticipate skill shortages, as well as a report on the '*National Skill Gap Study for High Growth Sectors*'.

This innovative framework marks a significant step forward in enabling State Skill Development Missions (SSDMs) and Sector Skill Councils (SSCs) to adopt a common approach to skill assessment.

In a country as large and diverse as ours, the need for a unified, yet flexible approach to skill gap analysis cannot be overstated. This framework will not only bridge existing informational gaps but also help generate timely and actionable insights to support targeted skilling interventions. Adoption of a unified and standardized framework will also ensure comparability between skill gap studies conducted by SSCs and SSDMs.

I am confident that stakeholders across the States and Sectors will find this framework valuable and will actively utilize it to build a stronger, data-driven skill development ecosystem.

(M)

**(Jayant Chaudhary)**

सबको शिक्षा-अच्छी शिक्षा



कौशल भारत-कुशल भारत

MSDE-Room No. 201, 2nd Floor, Kaushal Bhawan, New Moti Bagh, New Delhi -110023 Phone : +91-11-26773201  
E-mail : minister-msde@gov.in



अतुल कुमार तिवारी, भा.प्र.से.

सचिव

**Atul Kumar Tiwari, IAS**

Secretary



भारत सरकार  
कौशल विकास और उद्यमशीलता मंत्रालय  
GOVERNMENT OF INDIA  
MINISTRY OF SKILL DEVELOPMENT  
AND ENTREPRENEURSHIP



### MESSAGE

Under the World Bank-aided Skill Acquisition and Knowledge Awareness for Livelihood Promotion (SANKALP) project, the Ministry of Skill Development and Entrepreneurship (MSDE), in collaboration with the National Council of Applied Economic Research (NCAER), undertook a significant initiative of *National Skill Gap Study for Seven High-Growth Sectors*. One of the critical elements of the study was to design a dynamic and standardised framework for skill gap assessment across sectors and States/UTs. Such a framework is aimed at enabling regular and robust assessment and analysis of evolving skill needs in response to changing economic and technological landscapes.

Skill demand is inherently linked to demand for goods and services. Also, as industries transform and new technologies emerge, the nature of work and required skills shift accordingly. Anticipating these changes requires a forward-looking, evidence-based approach.

To address this need, the MSDE-NCAER study has developed a unified '*Methodology for Assessing Skill Shortages and Gaps*', that combines both quantitative and qualitative techniques bringing together traditional and modern approaches. Importantly, it offers a standardised framework that can be applied across States and Sectors, helping to align skill development efforts as per needs and fill a long-standing gap in both policy and practice. Using the framework developed by NCAER, a report on '*National Skill Gap Study for High Growth Sectors*' has also been prepared by NCAER.

I complement SANKALP team at MSDE, and the experts at NCAER for their collaborative effort in developing this framework and for identifying skill gaps across seven high-growth sectors. This work provides a valuable tool for policymakers, training institutions, and Sector Skill Councils to plan effectively and respond strategically to emerging skill needs.

  
(Atul Kumar Tiwari)



कमरा न. 301, तीसरा तल, कौशल भवन, न्यू मोती बाग, नई दिल्ली - 110 023  
Room No. 301, 3rd Floor, Kaushal Bhawan, New Moti Bagh, New Delhi - 110 023  
Tel.: 011-26773005 E-mail: [secy-msde@nic.in](mailto:secy-msde@nic.in) Website: [www.skillindia.gov.in](http://www.skillindia.gov.in)





# Foreword

The National Council of Applied Economic Research (NCAER) in collaboration with the Ministry of Skill Development and Entrepreneurship (MSDE) has developed a methodology to assess and anticipate skills shortage and gaps at the State and Sectoral levels. It is a dynamic and unified framework for skill gap assessment that can be regularly updated to predict skill requirements in line with the evolving economic landscape.

This framework has been developed based on a study of seven high growth sectors including agriculture (growing of cereals (including rice), leguminous crops and oil seeds); animal husbandry (raising of cattle and buffaloes); textiles (weaving of textiles); auto industry (manufacturing of motor vehicles and parts and components of motor vehicles and maintenance and repair of motor vehicles); power generation (electric power generation of solar energy and other non-conventional sources); retail (retail sale of food, clothing, footwear, leather articles in specialised stores); and, (computer programming activities. This report titled '*National Skill Gap Study of Seven High-Growth Sectors*' encapsulates the learnings based on a combination of quantitative & qualitative methodologies from these sectors. It is a rich report which examines these sectors using both available secondary data, current forecasts for jobs and also future skill gaps based on detailed stakeholder interactions.

And, the seven-part unified methodology, titled, '*Methodology for Assessing Skill Shortages and Gaps*' presents the methodological framework in a simplified format for the ease of policymakers, Sector Skill Councils and State Skill Development Missions.

I hope this study serves as a significant contribution in terms of better understanding and designing of skill initiatives at the national and State levels.

With regards,

Anil K Sharma  
Secretary and Operations Director  
National Council of Applied Economic Research





# Acknowledgements

In January 2018, the Ministry of Skill Development & Entrepreneurship (MSDE), Government of India (GoI) had launched a World Bank-assisted programme – Skills Acquisition and Knowledge Awareness for Livelihood Promotion (SANKALP). Under the above programme the MSDE undertook the ‘**National Skill Gap Study for High Growth Sectors**’ with the objective of developing a framework and methodology for conducting skill demand assessments at the sectoral and state level. The study was undertaken by National Council for Applied Economic Research (NCAER).

I am grateful to the MSDE for reposing trust in us to carry out the important study. I am especially obliged to the Honourable Secretary, MSDE, Shri Atul Kumar Tiwari and the Senior Economic Advisor, Shri Nilambuj Saran for their constant encouragement, support and guidance at every stage of the work. Their keen involvement in the work made the research that much richer. We are also grateful to the Director of Sankalp, Shri V S Arvind for his enthusiastic support and participation in the work. We are appreciative of the rest of the SANKALP team and MSDE officials for their critical comments and enthusiastic cooperation which enriched the work.

I acknowledge all stakeholders whom we met during the course of the study, which included relevant officers from various Ministries, representatives from Sector Skills Councils (SSCs), Industry Associations, Training Centres, firms, and academia, for sharing their invaluable information and insights. All of them took out a significant time out of their busy schedules to talk to us and give us critical comments on the report.

I thank the State and Union Territory government representatives for participating in the national and regional workshops, sharing their findings with us and also giving us critical insights in the report.

I am grateful to the NCAER Director General Dr Poonam Gupta and Dr Anil K. Sharma for their active support and guidance. Support of the IT team led by Mr Rakesh Srivastava is also highly acknowledged.

I thank our Senior Advisors Dr Aradhna Aggarwal, Dr Shish Pal Bansal, Dr Shashanka Bhide, Prof Sonalde Desai, Dr G C Manna, Dr Sudipto Mundle, and Prof Sanjib Pohit for their constant support, guidance and critical comments. I am also especially beholden to Mr Devender Pratap for his guidance on input-output modelling.

It has been a humbling and learning journey. However, this journey would have been incomplete without my colleagues who led the sectoral research namely Dr Saurabh Bandyopadhyay, Dr Ashish Desai, Dr Laxmi Joshi, Dr Charu Jain, Mr Ajaya Sahu and Dr Isha Dayal. I also thank the editorial team of Dr Renu Gupta, Mr Pradip Bagchi, Ms Mini Narayan and Mr Jagbir S Punia. Lastly, I deeply appreciate the administrative team who are the backbone of this work including Ms Poonam Dhawan, Mr Praveen Sachdeva and Ms Shalini Aggarwal.

Bornali Bhandari  
*Professor*  
NCAER



# NCAER Study Team

## **Project Leader**

Bornali Bhandari

## **Senior Advisors**

Aradhna Aggarwal

Shish Pal Bansal

Shashanka Bhide

Sonalde Desai

G C Manna

Sudipto Mundle

Sanjib Pohit

Devender Pratap

## **Team Members**

### ***Senior Fellow***

Saurabh Bandyopadhyay

### ***Visiting Senior Fellow***

Ashish Desai

### ***Fellows***

Isha Dayal

Charu Jain

Laxmi Joshi

Ajaya K Sahu

### ***Associate Fellow***

K S Urs

### ***Research Analysts/Associates***

CH S S Bharadwaja, Somdev Singh Deora, Kenneth Gomes, Denipreet Kaur, Falak Naz, Nishika Pal, Karan Raj, Kushagra Thakral, and Sharon Thomas

### ***Interns***

R. Abhiram (External), Tarun Agrawal (External), Ahan Bansal, Somdyuti Gupta, Gaurav Mahalingam, Shruthi Muruganandam (External), Ayushman Rathore, and Jigisha Sharma

### ***Research Support Team***

Shalini Aggarwal, Poonam Dhawan, and Praveen Sachdeva



# Abbreviations

|         |                                                               |
|---------|---------------------------------------------------------------|
| ACMA    | Automotive Component Manufacturers Association of India       |
| AI      | Artificial Intelligence                                       |
| ASC     | Australian Skills Classification                              |
| ASCI    | Agriculture Skill Council of India                            |
| ASDC    | Automotive Skills Development Council                         |
| ASI     | Annual Survey of Industries                                   |
| ASUSE   | Annual Survey of Unincorporated Sector Enterprises            |
| BCA     | Bachelor of Computer Applications                             |
| BESS    | Battery Energy Storage Systems                                |
| BPM     | Business Process Management                                   |
| B.Tech  | Bachelors of Technology                                       |
| CAGR    | Compound Annual Growth Rate                                   |
| CEDEFOP | European Centre for the Development of Vocational Training    |
| CEO     | Chief Executive Officer                                       |
| CHC     | Custom Hiring Centres                                         |
| CRDI    | Common Rail Direct Injection                                  |
| C&SI    | Consulting & System Integration                               |
| CNC     | Computer Numerical Control                                    |
| DAP     | District Agriculture Plan                                     |
| DCS     | Dairy Cooperative Societies                                   |
| DGCIS   | Directorate General of Commercial Intelligence and Statistics |
| DPIIT   | Department for Promotion of Industry and Internal Trade       |
| ECU     | Electronic Control Unit                                       |
| ESCO    | European Skills, Competencies, Qualifications and Occupations |
| Er&D    | Engineering Research and Development                          |
| ETF     | European Training Foundation                                  |
| EV      | Electric Vehicle                                              |
| EY      | Ernst and Young                                               |
| FAO     | Food and Agriculture Organization of the United Nations       |
| FDI     | Foreign Direct Investment                                     |
| FGD     | Focus Group Discussion                                        |
| FPOs    | Farmer Producer Organisations                                 |
| FY      | Financial Year                                                |
| GCCs    | Global Capability Centers                                     |
| GCF     | Gross Capital Formation                                       |
| GDP     | Gross Domestic Product                                        |
| GIS     | Geographic Information System                                 |
| GoI     | Government of India                                           |
| GSTN    | Goods & Services Tax Network                                  |
| GVA     | Gross Value Added                                             |
| GDP     | Gross Domestic Product                                        |
| GVO     | Gross Value of Output                                         |
| h.h.    | Household                                                     |
| HR      | Human Resources                                               |
| ICAR    | Indian Council of Agricultural Research                       |
| ICE     | Internal Combustion Engine                                    |
| ICT     | Information and Communication Technology                      |
| ILO     | International Labour Organization                             |
| IMF     | International Monetary Fund                                   |
| I-O     | Input-Output                                                  |
| IoT     | Internet of Things                                            |

|         |                                                                     |
|---------|---------------------------------------------------------------------|
| IT      | Information Technology                                              |
| ITI     | Industrial Training Institute                                       |
| ITS     | Information Technology Services                                     |
| KPMG    | Klynveld Peat Marwick Goerdeler                                     |
| L&D     | Learning and Development                                            |
| LFPR    | Labour Force Participation Rate                                     |
| LMIS    | Labour Market Information System                                    |
| MBA     | Master of Business Administration                                   |
| MCA     | Ministry of Corporate Affairs                                       |
| MIG     | Metal Inert Gas                                                     |
| ML      | Machine Learning                                                    |
| MNRE    | Ministry of New and Renewable Energy                                |
| MoLE    | Ministry of Labour and Employment                                   |
| MoSPI   | Ministry of Statistics and Programme Implementation                 |
| MoU     | Memorandum of Understanding                                         |
| MSDE    | Ministry of Skill Development and Entrepreneurship                  |
| MSMEs   | Micro, Small and Medium Enterprises                                 |
| M.Tech  | Masters of Technology                                               |
| MVs     | Motor Vehicles                                                      |
| NAS     | National Accounts Statistics                                        |
| NASSCOM | National Association of Software and Services Companies             |
| NCAER   | National Council of Applied Economic Research                       |
| n.e.c.  | Not Elsewhere Classified                                            |
| NCR     | National Capital Region                                             |
| NCO     | National Classification of Occupations                              |
| NDDB    | National Dairy Development Board                                    |
| NIC     | National Industry Classification                                    |
| NISE    | National Institute of Solar Energy                                  |
| NIWE    | National Institute of Wind Energy                                   |
| NSDC    | National Skill Development Corporation                              |
| OJT     | On-the-job training                                                 |
| NSQF    | National Skills Qualification Framework                             |
| O*NET   | Occupational Information Network                                    |
| OECD    | Organisation for Economic Co-operation and Development              |
| O&M     | Operations and Maintenance                                          |
| OEM     | Original Equipment Manufacturers                                    |
| OWES    | Occupational Wage Employment Survey                                 |
| PACS    | Primary Agricultural Credit Society                                 |
| PES     | Public Employment Services                                          |
| PLFS    | Periodic Labour Force Survey                                        |
| POS     | Point of Sale                                                       |
| POSH    | Prevention of Sexual Harassment                                     |
| QP      | Qualification Pack                                                  |
| RA      | Result Areas                                                        |
| RE      | Renewable Energy                                                    |
| RAS     | Relative Actual Shift                                               |
| RASCI   | Retailers Association's Skill Council of India                      |
| RBI     | Reserve Bank of India                                               |
| R&D     | Research and Development                                            |
| RPL     | Recognition of Prior Learning                                       |
| SAIDP   | State Agriculture Infrastructure Development Plan                   |
| SANKALP | Skills Acquisition and Knowledge Awareness for Livelihood Promotion |
| SAP     | State Agriculture Plan                                              |
| SCGJ    | Skill Council for Green Jobs                                        |
| SIAM    | Society of Indian Automobile Manufacturers                          |



|      |                                                  |
|------|--------------------------------------------------|
| SMEs | Small and Medium Enterprises                     |
| SPD  | Software Product Development                     |
| SSC  | Sector Skill Council                             |
| SST  | Singapore Skills Taxonomy                        |
| SUTs | Supply-Use Tables                                |
| TCM  | Technology Cluster Manager                       |
| TCSP | Technology Centre System Programme               |
| TLPD | Thousand Litres Per Day                          |
| TVET | Technical and Vocational Education and Training  |
| WDRA | Warehousing Development and Regulatory Authority |



# Executive Summary

The Ministry of Skill Development and Entrepreneurship (MSDE) had undertaken the study titled '**National Skill Gap Study for High Growth Sectors**' under the Skills Acquisition and Knowledge Awareness for Livelihood Promotion (SANKALP) programme. This study was undertaken by the National Council of Applied Economic Research (NCAER).

The primary aim of the study is to create a dynamic framework for skill gap assessment that can be regularly updated to predict skill requirements in line with the evolving economic landscape. To ensure uniformity and standardisation a methodology for conducting demand assessments at both sectoral and State levels has been developed. This effort will significantly inform the design of skill initiatives at the national and State levels.

## I. Objectives

The specific objectives of the study included:

1. To identify seven high growth potential sectors.
2. To analyse industry feedback on identifying industry-specific key skill (cognitive, socio-emotional, technical & vocational, and knowledge) requirements in the seven identified industries.
3. To map the key job roles/ professions and geographic clusters aligned with the seven selected sectors along with the qualification and skill requirements associated with these job roles and provide estimates of current employment.
4. To identify the existing and potential job roles for enhancing female workforce participation in the seven identified sectors.
5. To provide projections and forecasts of future skill needs for the seven selected sectors for a period of three years based on anticipated changes in the labour market, technological advancements, and industry trends at the national and international levels.
6. To provide a framework for regular updation of demand assessment results at predefined intervals to provide continuous insights for skill planning for the selected seven sectors.
7. To provide detailed methodology for undertaking skill demand assessment at the sectoral level, as also guidelines / methodology for undertaking similar assessments at the State level.
8. To seek recommendations for improving the design and effectiveness of the skill programmes.
9. To provide policy recommendations to address systemic issues contributing to skill gaps.
10. To provide recommendations to MSDE on enhancing skill training programmes, curriculum development, and skill initiatives to align them with the identified skill gaps; sector-wise upskilling or reskilling initiatives;

apprenticeship, vocational, or on-the-job trainings; areas of collaboration with industry including opportunities for establishing partnerships; industry-led training programmes, internships, or mentorship programmes to bridge the gap between industry needs and the skills possessed by the workforce.

## II. Definitions

“Skills are personal qualities with three key features – (i) productive: using skills at work are productive of value; (ii) expandable: skills are enhanced by training and development and; (iii) social: skills are socially determined” (Green, 2013; pp. 10).<sup>1</sup> NCAER (2018) delineated three types of skills and they are:<sup>2</sup>

- **Cognitive skills** are *basic skills* of literacy and numeracy, applied knowledge and problem- solving aptitudes and *higher-order skills* such as experimentation, reasoning, and creativity.
- **Technical and Vocational Education and Training skills (TVET)** are the physical and mental ability to perform specific tasks using tools and methods in any occupation.
- **Social and behavioural skills** include working well with others, communicating and listening well, and being agreeable and outgoing.

The study develops methodology to assess skills shortage at sectoral level and skill gap at the worker level in a particular sector.

**Skills shortage** describes the situation where a job vacancy is hard to fill because of a lack of applications with the needed skills.<sup>3</sup> For example, one is looking for accountants but is unable to find any with the appropriate degree, qualifications, experiences and skills.

A **skill gap** occurs where an employee’s competence to do the job is called into question (typically by his/her manager).<sup>4</sup> For example, one is looking for accountants and finds several with the appropriate degree and qualifications but not the appropriate skill set.

## III. Methodology and Results

A hybrid methodology using quantitative and qualitative techniques were used to assess skill shortages and skill gaps.

- A. **Selection of Sectors:** Using shares of Gross Value Added (GVA), workers, input & output multipliers, identification of key sunrise sectors and policy inputs, seven sectors were selected for analysis.

---

<sup>1</sup> Green, F. 2013. *Skills and Skilled Work: An Economic and Social Analysis*. Oxford University Press, United Kingdom.

<sup>2</sup> NCAER. 2018. *Skilling India: No time to lose*.  
[http://www.ncaer.org/publication\\_details.php?pID=300](http://www.ncaer.org/publication_details.php?pID=300), New Delhi, India.

<sup>3</sup> Green, F. 2013. *Skills and Skilled Work: An Economic and Social Analysis*. Oxford University Press, United Kingdom.

<sup>4</sup> Ibid.

1. Growing of cereals (including rice), leguminous crops and oil seeds
2. Raising of cattle and buffaloes
3. Weaving of textiles
4. Manufacturing of motor vehicles (MVs) and parts and components of motor vehicles
5. Electric power generation of solar energy and other non-conventional sources
6. Retail sale of food, clothing, footwear, leather articles in specialised stores and maintenance and repair of motor vehicles (this was clubbed with the auto sector).
7. Computer programming activities

## **B. Forecasting Jobs and Occupations Using Input-Output (I-O) Analysis**

The input-output analysis was used to forecast jobs for 2026–27.

- In the baseline scenario, the sectoral Gross Value of Output (GVO) was assumed to be based on the average growth rate of the past five years excluding the pandemic years of 2020–21 and 2021–22. Using the International Monetary Fund (IMF) projections for India, alternative growth scenarios were also derived.
- The assumptions were used to project GVO in 2026–27 at 2022–23 prices.
- The number of (direct and indirect) jobs were estimated by multiplying employment multiplier with the projected GVO at the 64 I-O sectors for the seven sectors.
- Using projected sectoral GVO, direct and indirect sectoral jobs for 2026–27 was projected. Technology was assumed to be constant.
- Jobs for the sub-sectors (that were selected in the NCAER-MSDE analysis) by taking the job shares of the sub-sectors in the main sectors for the years 2022–23 (Table ES.1).
- Distribution across occupations of ONLY direct jobs based on share of occupations for the year 2022–23 were computed from Periodic Labour Force Survey (PLFS).
- Using the same shares, projections for the top five occupations were projected for 2026–27.
- For comparison purposes, top five occupations in the seven sectors are estimated from the PLFS 2022–23 (see Tables 3.5 to 3.11 in the report).

The key challenge with using I-O analysis is that technology is assumed to be constant. Technological cycles have become short and all industries are experiencing rapid technological changes. Table ES.2 shows the key technological changes that are affecting the selected sub-sectors. Therefore, relying on I-O analysis is not enough and one has to substantiate that with stakeholder interactions/survey.

**Table ES.1: Projected jobs in 2026–27 for selected sub-sectors**

| <i>lakh jobs</i>                                                                                             | <i>Growing of cereals, leguminous crops and oilseeds</i> | <i>Raising of cattle and buffaloes</i> | <i>Weaving of textiles</i> | <i>Manufacturing of motor vehicles, parts &amp; accessories of motor vehicles</i> | <i>Electric power generation using solar energy and other non-conventional sources</i> | <i>Retail sale of food, clothing, footwear and leather articles in specialised stores and maintenance &amp; repair of MVs</i> | <i>Computer programming activities</i> |
|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------|----------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| <b><i>2022–23 from PLFS*</i></b>                                                                             |                                                          |                                        |                            |                                                                                   |                                                                                        |                                                                                                                               |                                        |
|                                                                                                              | 1,789.6                                                  | 206.1                                  | 22.6                       | 13.9                                                                              | 1.1                                                                                    | 261.3                                                                                                                         | 25.9                                   |
| <b><i>2022–23 using I-O Analysis</i></b>                                                                     |                                                          |                                        |                            |                                                                                   |                                                                                        |                                                                                                                               |                                        |
| Direct jobs                                                                                                  | 1,849.9                                                  | 207.6                                  | 29.9                       | 17.6                                                                              | 1.1                                                                                    | 281.0                                                                                                                         | 26.4                                   |
| Direct + Indirect jobs                                                                                       | 2,034.8                                                  | 394.5                                  | 101.7                      | 145.7                                                                             | 7.5                                                                                    | 393.3                                                                                                                         | 76.6                                   |
| <b><i>Scenario 1 using Past Growth Rates: Projections for 2026–27</i></b>                                    |                                                          |                                        |                            |                                                                                   |                                                                                        |                                                                                                                               |                                        |
| Direct jobs                                                                                                  | 2,066.3                                                  | 259.4                                  | 26.4                       | 24.9                                                                              | 1.3                                                                                    | 399.7                                                                                                                         | 43.7                                   |
| Direct+ Indirect jobs                                                                                        | 2,272.9                                                  | 492.8                                  | 89.8                       | 206.5                                                                             | 9.2                                                                                    | 559.5                                                                                                                         | 126.6                                  |
| % Change in direct jobs over 2022–23 using I-O Analysis*                                                     | 11.7                                                     | 24.9                                   | -11.6                      | 41.7                                                                              | 22.4                                                                                   | 42.3                                                                                                                          | 65.3                                   |
| <b><i>Scenario 2 using International Monetary Fund (IMF) Growth Projections; Projections for 2026–27</i></b> |                                                          |                                        |                            |                                                                                   |                                                                                        |                                                                                                                               |                                        |
| Direct jobs                                                                                                  | 2,157.5                                                  | 241.9                                  | 23.2                       | 35.8                                                                              | 1.4                                                                                    | 414.4                                                                                                                         | 42.1                                   |
| Direct+ Indirect jobs                                                                                        | 2,373.3                                                  | 459.7                                  | 78.9                       | 297.4                                                                             | 9.8                                                                                    | 580.1                                                                                                                         | 122.2                                  |
| % Change in direct jobs over 2022–23 using I-O Analysis*                                                     | 16.6                                                     | 16.5                                   | -22.4                      | 104.1                                                                             | 30.1                                                                                   | 47.5                                                                                                                          | 59.6                                   |

Source: NCAER Computations.

**Table ES.2: Technological Changes**

| <b>Sector</b>                                                           | <b>Digital technologies</b>                                                                                                                                                                                     | <b>Sector-Specific technology</b>                                                                                                                                                                                                                                                                                                      | <b>Others</b>                                                    |
|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Growing of cereals, leguminous crops and oilseeds (farms)               | Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), Big Data and Blockchain                                                                                                          | Farm machinery, Point of Sale (PoS) and Soil data                                                                                                                                                                                                                                                                                      | Drones, satellite data, and statistical model                    |
| Raising cattle and buffaloes                                            | AI                                                                                                                                                                                                              | Artificial Insemination                                                                                                                                                                                                                                                                                                                | Improved refrigeration technologies for better milk preservation |
| Weaving of textiles                                                     | AI, ML, automation & digital technologies, supply chain invocations (traceability, block chain, etc.)                                                                                                           | <ul style="list-style-type: none"> <li>Sustainable technologies (Eco-friendly chemicals/dyes)</li> <li>Circular/ green/ recycled/ sustainable textiles</li> <li>Advanced materials (technical textiles, smart textiles, etc.)</li> </ul>                                                                                               |                                                                  |
| Electric power generation using solar and other non-conventional energy | Software to read and forecast solar and wind data                                                                                                                                                               | RE is a new technology in electricity sector; automation in Operations and Maintenance (O&M); Higher efficiency solar and wind modules, taller windmills                                                                                                                                                                               | Offshore wind; green hydrogen                                    |
| Manufacturing of MVs and its auto parts and repair                      | AI/ML; software and cybersecurity                                                                                                                                                                               | BS4 to BS6 (transition to BS7); electric, hybrid, and flex fuel vehicles; electronics in motor vehicles; automation and robotics in manufacturing and repair and maintenance                                                                                                                                                           | New materials and light-weighting components                     |
| Retail sale of food, clothing and shoes                                 | AI, Digitized supply chain—IoS, GPS and RFID technology, Cloud/hybrid storage, AI/ML, Blockchain, Automated data loggers Barcode pricing                                                                        | Electronic retail-Modern retail and e-Commerce; remote monitoring of stores                                                                                                                                                                                                                                                            | Data analytics                                                   |
| Information Technology (IT) sector                                      | <ul style="list-style-type: none"> <li>Python – AI/ML</li> <li>Full stack developer</li> <li>Image and signal processing</li> <li>Natural Language Processing</li> <li>Large language model building</li> </ul> | <ul style="list-style-type: none"> <li>For Agri-tech, commerce and Electric Vehicle (EV) <ul style="list-style-type: none"> <li>Remote sensing</li> <li>Drip technology with cloud computing</li> </ul> </li> <li>For Manufacturing <ul style="list-style-type: none"> <li>Robotics</li> <li>Embedded computing</li> </ul> </li> </ul> |                                                                  |

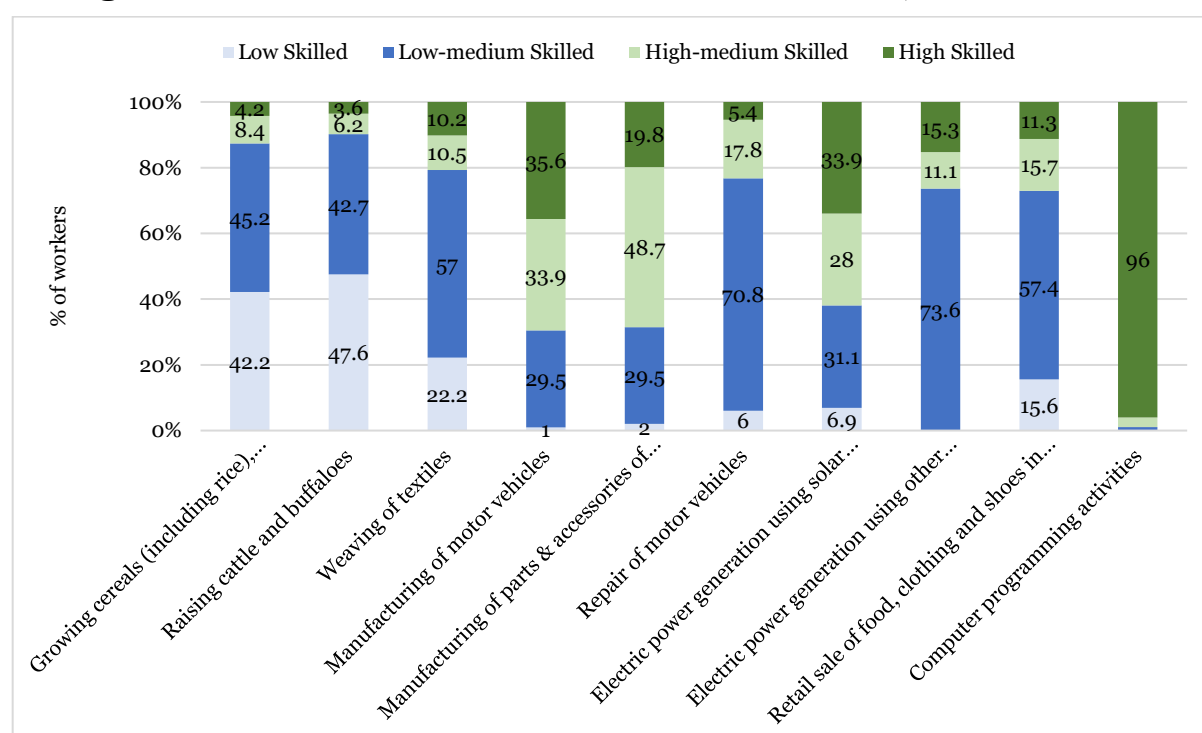


| Sector | Digital technologies                                                                                                                                                                                                                                                                                        | Sector-Specific technology                                                                                                                                                                                                                                                                                                                                          | Others |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
|        | <ul style="list-style-type: none"> <li>• Small language model building</li> <li>• Deep neural networks</li> <li>• Cyber cloud security</li> <li>• Cybersecurity:</li> <li>• Cloud computing</li> <li>• Data protection</li> <li>• Econometric modelling</li> <li>• Block chain and 5G technology</li> </ul> | <ul style="list-style-type: none"> <li>○ Digital Twin</li> <li>• Pharmaceutical and medical               <ul style="list-style-type: none"> <li>○ 3D modeling</li> <li>○ 3D Printing</li> <li>○ Robotics: Virtual and Augmented Reality (VR/AR)</li> <li>○ Nanotechnology</li> <li>○ Digital twin</li> <li>○ CRISPR</li> <li>○ Bio printing</li> </ul> </li> </ul> |        |

Source: NCAER Conceptualisation from literature review and stakeholder interviews.

- C. **Workforce Characteristics:** Workers' characteristics were identified across States, general education, technical and vocational education, skills (see Figure ES.1), type of worker, occupation, gender (Figure ES.2) and engagement. Female workers across job roles were also analysed for each sectors. The presence of women in leadership roles is quite limited.

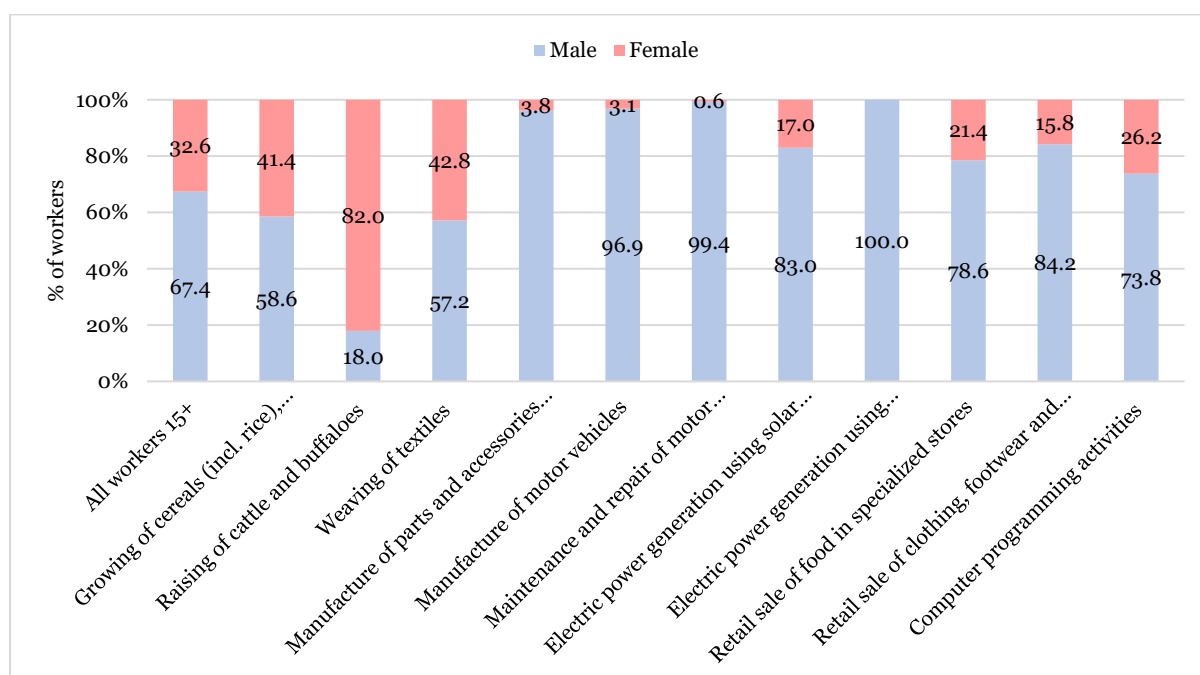
**Figure ES.1: Sectoral share of workers across skills, 2022–23**



Source: NCAER Analysis from PLFS 2022–23.

Note: See Annexure 4.2 for definition of skills.

**Figure ES.2: Sectoral share of workers across gender, 2022–23**



Source: NCAER Analysis from PLFS 2022–23.

**D. Geographical Clusters:** Porter (1990) defined an industry cluster as a geographically proximate group of firms and associated institutions in related industries, linked by economic and social interdependencies. Delgado et al. (2014) defined clusters as “geographic concentrations of industries related by knowledge, skills, inputs, demand, and/or other linkages.” In the primary sector and Information Technology (IT) sector, the Delgado et al. definition is used to define clusters and in the secondary sector & retail trade, the Porter (1990) definition is used. A step-wise ranking method is used to compile the indicators. The top five geographical clusters are shown in Table ES.3. Detailed results are available in the report.

The concentration of workers by States and by agglomeration are compared to indicate spatial mismatch, if any.

**Table ES.3: Top five geographical clusters in each sector**

| S. No. | Growing cereals<br>(including rice),<br>leguminous crops and<br>oilseeds | Raising of<br>cattle and<br>buffaloes | Weaving of<br>textiles | Manufacture of<br>Motor Vehicles<br>(MVs) | Manufacture of parts<br>& accessories of MVs | Repair and<br>maintenance of MVs | Generation<br>of solar<br>energy | Generation of<br>wind energy | Retail sale of<br>food,<br>clothing,<br>footwear &<br>leather<br>articles in<br>specialised<br>stores | Computer<br>programm<br>ing activities |
|--------|--------------------------------------------------------------------------|---------------------------------------|------------------------|-------------------------------------------|----------------------------------------------|----------------------------------|----------------------------------|------------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------|
| 1.     | Uttar Pradesh                                                            | Karnataka                             | Tamil Nadu             | Maharashtra                               | Maharashtra                                  | Maharashtra                      | Gujarat                          | Gujarat                      | Maharashtra                                                                                           | Maharashtra                            |
| 2.     | Maharashtra                                                              | Maharashtra                           | Uttar Pradesh          | Haryana                                   | Tamil Nadu                                   | Tamil Nadu                       | Karnataka                        | Tamil Nadu                   | Karnataka                                                                                             | Tamil Nadu                             |
| 3.     | Rajasthan                                                                | Rajasthan                             | West Bengal            | Karnataka                                 | Uttar Pradesh                                | Uttar Pradesh                    | Rajasthan                        | Karnataka                    | Uttar Pradesh                                                                                         | Karnataka                              |
| 4.     | Madhya Pradesh                                                           | Gujarat                               | Andhra Pradesh         | Tamil Nadu                                | Haryana                                      | Kerala                           | Tamil Nadu                       | Maharashtra                  | West Bengal                                                                                           | Uttar Pradesh                          |
| 5.     | Gujarat                                                                  | Bihar                                 | Gujarat                | West Bengal                               | Gujarat                                      | Gujarat                          | Andhra Pradesh                   | Rajasthan                    | Tamil Nadu                                                                                            | Gujarat                                |

Source: NCAER analysis from various sources.

E. **Occupational Mapping:** The PLFS gives 3-digit National Classification of Occupations (NCO) 2015 code. Using the NCO 2015, we derived the 8-digit NCO codes under those specific NCO 3-digit codes to understand job roles that are 'used' in the industry. Further, the Sector Skill Council (SSC) job roles available on website were mapped to the identified NCO 8-digit codes, wherever applicable. Through this process, derived a universal list of possible job roles for each sector.

F. **Stakeholder Surveys:** Total 191 interviews were conducted across seven sectors (Table ES.4).

**Table ES.4: Distribution of stakeholder surveys**

| <i>Sector</i>                                    | <i>Growing of cereals, leguminous crops and oilseeds</i> | <i>Raising cattle and buffaloes</i> | <i>Weaving of textiles</i> | <i>Manufacturing of MVs &amp; its auto parts and repair</i> | <i>Electric power generation using solar and other non-conventional energy</i> | <i>Computer programming activities</i> | <i>Retail sale of food, clothing and shoes</i> | <i>Total</i> |
|--------------------------------------------------|----------------------------------------------------------|-------------------------------------|----------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------|------------------------------------------------|--------------|
| Ministry                                         | 1                                                        | 1                                   | No response                | No response                                                 | No response                                                                    | 1                                      | 1                                              | 4            |
| Sector Skill Council(SSCs)                       | 1                                                        | 1                                   | 1                          | 1                                                           | 1                                                                              | 1                                      | 1                                              | 7            |
| National-level Industry Association <sup>1</sup> | 1                                                        | 1                                   | 1                          | 3                                                           | 2                                                                              | 1                                      |                                                | 9            |
| No of Farms/<br>Firms                            | Micro/ Small                                             | 7                                   | 6                          | 11                                                          | 3                                                                              | 3                                      | 7                                              |              |
|                                                  | Medium                                                   | 5                                   | 3                          | 6                                                           | 4                                                                              | 4                                      | 4                                              |              |
|                                                  | Large                                                    | 3                                   | 6                          | 3                                                           | 6                                                                              | 7                                      | 4                                              |              |
|                                                  | Total                                                    | 15                                  | 15                         | 20                                                          | 13                                                                             | 14                                     | 17                                             | 115          |
| No. of placement cells/TVET Institutions         | 5                                                        | 3                                   | 5                          | 2                                                           | 2                                                                              | 3                                      | 2                                              | 17           |
| Recruitment agencies                             |                                                          |                                     |                            | 1                                                           | 1                                                                              | 1                                      | 1                                              | 4            |
| Other stakeholders                               | 9                                                        | 5                                   |                            | 7                                                           | 6                                                                              | 3                                      | 2                                              | 32           |
| Firms plus other stakeholders                    | 24                                                       | 20                                  | 20                         | 20                                                          | 20                                                                             | 20                                     | 21                                             | 148          |
| Total                                            | 32                                                       | 26                                  | 27                         | 27                                                          | 26                                                                             | 27                                     | 26                                             | 191          |

### Supply-side Challenges

The supply-side challenges are:

- **Limitations of Current Statistics:** From the perspective of assessing skills, the Periodic Labour Force Survey (PLFS) suffers from some key limitations. It only captures job roles at the 3-digit NCO code. Some job roles like the solar panel

technician are not consistently captured. The Annual Survey of Industries (ASI) and Annual Survey of Unincorporated Sector Enterprises (ASUSE) does not capture NCO codes at all. Further, databases do not always match in terms of numbers. Chapter 6 especially discusses the issues of the differences between PLFS, Enterprise Survey, and Handloom Census data. The National Classification of Occupations (NCO) also has major challenges that has repeatedly come up in the sectoral chapters.

- ❖ Existing job roles are also not intuitive because the data are published at the 3-digit NCO code whereas occupations are identified at the 8-digit NCO code.
- ❖ Difficult to match new and emerging job roles to NCO codes
- ❖ Job roles do not capture different skill sets
- ❖ The Skill India Digital Hub and National Career Services need to ramp up their integration and communication with each other to improve the effectiveness of both.
- There are several mismatches in the workers market due to both supply and demand issues:
  - ❖ Mismatch between employers and employees due to poor foundational skills that cannot be improved by skill training programmes (Industrial Training Institutes (ITIs) or other short-term training programmes)
  - ❖ Poor quality of education and TVET systems due to poor quality of teachers, curriculum and low emphasis on practical worker
  - ❖ Local skilling mismatch between industries and training providers
  - ❖ Mismatch of traditional sectors' needs and youth aspirations: For example, weaving jobs, milker, manufacturing jobs at the entry level are perceived as tedious and not remunerative enough. Youth are aspiring towards jobs which do not require much arduous training or skilling but pay equally well such as delivery jobs.
  - ❖ Retention problem in jobs as workers leave after a few months
  - ❖ Wage mismatch – What youth are aspiring or expecting do not match what firms are offering.
  - ❖ Poorly skilled workers are not able to adapt to rapid technological changes.
- Low female Labour Force Participation Rate (LFPR) due to supply-side issues.

### *In-demand Job Roles across Sectors*

Firms were asked about the job roles where they face a shortage, i.e., they are not able to fill in vacancies or find it difficult to fill it (skills shortage). Even if they fill the vacancies, the employees are missing certain skills (skills gap). The list of in-demand job roles across sectors are:

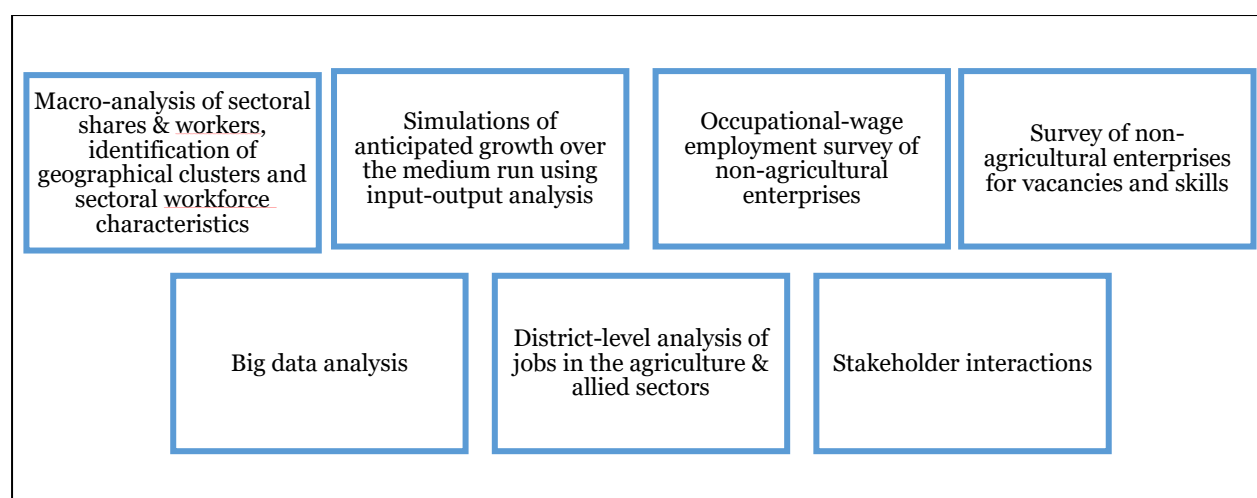
1. Growing of cereals (including rice), leguminous crops and oil seeds: Drone Operators, Agriculture Advisor/Crop Advisor (Agri-tech), IT-GIS (Geographic information system) Specialist, MIG Welding Operator and Farm Machinery Service Technician.

2. Raising of cattle and buffaloes: Veterinary Technician Assistant, Mechanic—Refrigeration and Air Conditioning, Dairy Technologist and Manager—Dairy Farm.
3. Weaving of textiles: Weaver-Handloom (Jacquard/ Loin loom), Weaver Power loom and Weaver Assistant (Handloom)
4. Manufacturing of motor vehicles and parts and components of motor vehicles: Machine/CNC Operator; Turner; Grinder; Tool and Die Maker and Technician /Mechanic; Motor Mechanic, Power / Micro electronics Engineers; AI/ML Expert, Embedded Software Engineers; Vehicle Software Developer and AI Data Science Engineers; Automotive Cybersecurity Specialist
5. Electric power generation of solar energy and other non-conventional sources: Solar Project Manager; Solar Installer; Solar PV Installer and O&M Technician (Surya Mitra), O&M Technicians— Mechanical and Electrical, Engineers: Electrical Engineers—Power Systems Design; Civil and Electrical Engineers; Project Engineers and Resource Assessment; Site Surveyor; Resource Analysis, Site Managers / In-charge /Supervisor; Construction / Project Managers and Asset Management; Quality and Vendor Management Engineers.
6. Retail sale of food, clothing, footwear, leather articles in specialised stores and maintenance and repair of motor vehicles (maintenance and repair of motor vehicles was clubbed with the auto sector): Customer Service Representative/Sales Associate/Sales Person/e-Commerce Marketing Assistant/Manager, Merchandising Manager/ Associate, Logistics Manager/ Associate and Information and Communication Technology(ICT) Personnel/ Computer Operator.
7. Computer programming activities: Data Engineering, Business Analyst-Technical, Data Security and Functional/Domain Analyst.

## G. Recommended Methodology

The uniform and standardised methodology proposed consists of seven components (Figure ES.3).

**Figure ES.3: Components of methodology**



Source: NCAER conceptualisation

The suggested research frameworks/ methodology is as follows:

1. Identification of sectors (industries) and occupations
  - a. Identification of Sectors (Industries): This involves the following steps:
    - i. Identify sectors at the desired level of aggregation that will be used for analysis
    - ii. Map National Industry Classification (NIC) sectors to sectoral sub-sectors
    - iii. Data Source: NIC Classifications by Ministry of Statistics and Programme Implementation (MoSPI) and Centre and Sector Skill Councils (SSCs)
  - b. Identification of Occupations: This involves the following steps:
    - i. Update mapping of NCO 2015 job roles with job roles identified by the Sector Skill Councils (SSCs)
    - ii. Out of the 3,600+ occupations identified in the NCO-2015, select occupations that will be used for analysis for all the components of assessing skills shortages and gaps
    - iii. Data Source: NCO-2015 by Ministry of Labour and Employment (MoLE), Centre and Sector Skill Councils (SSCs)
2. Macro-analysis of sectoral shares and workers, identification of geographical clusters and sectoral workforce characteristics
  - a. Selection of sectors and sub sectors: This involves the following steps:
    - i. Use of Input-Output analysis for estimating income and employment Multipliers, sectoral share in GVA and workers; ranking of sectors based on the four parameters mentioned, taking into account the sunrise sectors over and above the ranking of sectors.
    - ii. Analysis of value chains for the selected sectors to know the associated job roles at various levels of the value chains.
    - iii. Data sources: Periodic Labour Force Survey (PLFS), National Accounts Statistics (NAS)
  - b. Sectoral Workforce Characteristics: This involves analysis of workers in the selected sectors on parameters like educational qualifications (general, technical and vocational education), engagement type (self-employed versus workers), occupation (NCO 3-digit), gender wise distribution, etc.
3. Identification of Geographical Clusters: The approach may vary from sector to sector based on availability of relevant parameters. Parameters like agglomerations of units, institutions, etc. may be considered. Further, workforce distribution across regions also may be done to analyse spatial mismatch, if any. The Centre can do a State-wise analysis, States can do district-wise analysis.
4. Simulations for forecasting jobs and occupations:
  - a. The first step is making growth assumptions for the selected sectors. Past growth trends, projections by organisations like International Monetary Fund (IMF), Reserve Bank of India (RBI) or by States (if any) may be considered. Then using the growth assumptions, GVO numbers may be projected for future

years over a base year. Base year could be the latest normal year for which data are available.

- b. The next step is the estimation of employment multiplier based on the Leontief inverse matrix (measure of interlinkages among the sectors) and Labour/ Output ratios for the selected sectors.
  - c. Jobs projection by multiplying employment multiplier with the projected GVO numbers.
5. Demand projections using Occupation-Wage-Employment Survey for non-agricultural enterprises: The limitation of I-O analysis is that it assumes the technology to remain constant and so it cannot capture the sectoral dynamics in the economy. This can be captured through the Occupation-Wage-Employment Survey. This involves re-designing the existing Occupation-Wage Survey to capture wages in all geographies, employment (number) across qualifications and skills, and select specified number of occupations across firms. Ministry of Corporate Affairs (MCA) database can be taken as the universe. The Centre can design the questionnaire and methodology and Centre-State collaboration is required for conducting survey.
  6. Assess skill shortages and gaps in non-agriculture sectors using vacancy data for non-agricultural enterprises: This involves the following steps.
    - a. Firms should be sampled across size, ownership, regions, and sub-sectors that have been identified previously.
    - b. Vacancy data may be analysed in the short-run.
    - c. The Ministry of Corporate Affairs (MCA)/ Goods and Services Tax Network/Economic Census may be used as the universe.
    - d. The occupations list should be the same as identified in the beginning.
    - e. The Centre should define a skill shortage. If vacancies last for more than three months, then it should be defined as a skill shortage.
    - f. Using this definition, Sector Skill Councils (SSCs) can use a common assessment framework to feed into MSDE policymaking
    - g. Centre should be designing the survey and State Sector Councils should be implementing it.
  7. Big Data Analysis of Non-agricultural Enterprises: The Sector Skill Councils (SSCs) should undertake big data analysis within their sub-sectors of advertised job positions on an annual basis. They should design the work and collect data across various job sites. The sub-sectors should be in sync with other definitions in the large schema of work. The data should be collected across sectors and across various geographies/clusters especially cities —Tier 1 and Tier 2 cities—to understand the dynamics of the skill markets, spatial needs, sub-sector specialisation in particular clusters etc.
  8. District-level analysis of jobs in agriculture and allied sectors: Secondary sources like Agriculture Census, Situation Assessment Survey of Farmers, States specific databases may be analysed and it could be complemented by primary survey of stakeholders.
  9. Stakeholders interactions: Interactions with stakeholders at various levels of the value chains are crucial to ascertain skill shortage and gaps in the selected sectors.



Interactions could be through Focus Group Discussions (FGDs) and survey through structured questionnaires.

The following table summarises the various methodologies for India to assess skill gaps and shortages.

**Table ES.5: Objectives and methodology**

| <i><b>S.No.</b></i> | <i><b>Type of analysis</b></i>                              | <i><b>Study lead in design</b></i>                                                                                       | <i><b>Objectives and methods</b></i>                                                                                                                                            | <i><b>Implementing agency</b></i>       |                                    | <i><b>Frequency of analysis</b></i> |
|---------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------|-------------------------------------|
| 1.                  | Macro analysis of sectoral shares and labour force          | MSDE                                                                                                                     | <ul style="list-style-type: none"> <li>Descriptive data analysis from secondary data</li> <li>Identification of geographical clusters</li> <li>Input-output analysis</li> </ul> | MSDE                                    | All-India and State-level analysis | Annual Basis                        |
|                     |                                                             |                                                                                                                          |                                                                                                                                                                                 | State                                   | District-level analysis            |                                     |
| 2.                  | Macro analysis (optional)                                   | MSDE                                                                                                                     | (3 to 5 year) forecasts of occupations accounting for stated policy goals, technological changes (and simulations for scenario building)                                        | MSDE                                    | All-India                          | 3 to 5 years                        |
|                     |                                                             |                                                                                                                          |                                                                                                                                                                                 | State                                   | State-level analysis               |                                     |
| 3.                  | Demand projections of jobs of non-agricultural sectors      | MSDE & MoLE (design of questionnaires, sampling strategy based on universal company data sourced from MCA)               | Occupational-wage employment survey of non-agricultural enterprises (panel data)                                                                                                | MoSPI with district-level participation |                                    | 3 to 5 years                        |
| 4.                  | Assess skill shortages and gaps of non-agricultural sectors | MSDE (design of questionnaires, sampling strategy based on universal company data sourced from MCA/GSTN/Economic Census) | Survey of non-agricultural firms for data on vacancies and skills                                                                                                               | Sector Skill Councils (SSCs)            |                                    | Annual                              |
| 5.                  | Analysis of jobs in sub-sectors of non-agricultural sectors | SSCs                                                                                                                     | Big data analysis                                                                                                                                                               | SSCs                                    |                                    | Annual                              |
| 6.                  | Analysis of agriculture & allied sectors                    | State Government                                                                                                         | District-level secondary data analysis                                                                                                                                          | State Skill Missions                    |                                    | Annual                              |
|                     |                                                             | MSDE (design of questionnaires, identification of stakeholders, etc.)                                                    | Survey, FGDs of farms, cooperatives, other stakeholders in the value chain, etc.                                                                                                | State and District Skill Missions       |                                    | Annual                              |

Source: NCAER.

# Table of Contents

|                                                                                                 |               |
|-------------------------------------------------------------------------------------------------|---------------|
| <b>Message from Honourable Minister, MSDE.....</b>                                              | <b>i</b>      |
| <b>Message from Secretary, MSDE .....</b>                                                       | <b>iii</b>    |
| <b>Foreword .....</b>                                                                           | <b>v</b>      |
| <b>Acknowledgements.....</b>                                                                    | <b>vii</b>    |
| <b>Study Team.....</b>                                                                          | <b>ix</b>     |
| <b>Abbreviations.....</b>                                                                       | <b>xi</b>     |
| <b>Executive Summary.....</b>                                                                   | <b>xv</b>     |
| <br>                                                                                            |               |
| <i>List of Tables.....</i>                                                                      | <i>xxxiii</i> |
| <i>List of Figures .....</i>                                                                    | <i>xxxvii</i> |
| <i>List of Boxes.....</i>                                                                       | <i>xli</i>    |
| <i>List of Annexures.....</i>                                                                   | <i>xliii</i>  |
| <i>List of Questionnaires .....</i>                                                             | <i>xlvi</i>   |
| <br>                                                                                            |               |
| <b>1. Introduction.....</b>                                                                     | <b>1</b>      |
| 1.1 Background .....                                                                            | 1             |
| 1.2 Objectives of the Study .....                                                               | 2             |
| 1.3 Literature Review .....                                                                     | 3             |
| 1.4 Definitions .....                                                                           | 7             |
| 1.5 Objectives.....                                                                             | 8             |
| 1.6 Structure of the Report .....                                                               | 9             |
| <br>                                                                                            |               |
| <b>2. Selection of Sectors and Sub-Sectors .....</b>                                            | <b>13</b>     |
| 2.1 Introduction.....                                                                           | 13            |
| 2.2 Estimating Income and Output Multipliers and Ranking Them .....                             | 13            |
| 2.3 Secondary Data Analysis .....                                                               | 14            |
| 2.4 Ranking Sectors .....                                                                       | 16            |
| 2.5 Sunrise Sectors .....                                                                       | 18            |
| 2.5 Selected Sectors: Intermediate Step.....                                                    | 18            |
| 2.6 Policymakers' Inputs.....                                                                   | 19            |
| 2.7 Identification of Sub-sectors .....                                                         | 20            |
| 2.8 Summary .....                                                                               | 22            |
| <br>                                                                                            |               |
| <b>3. Forecasting Jobs and Occupations Using Input-Output Analysis .....</b>                    | <b>23</b>     |
| 3.1 Introduction.....                                                                           | 23            |
| 3.2 Projecting Gross Value of Output for 2026–27 .....                                          | 23            |
| 3.3 Projecting Jobs for 2026–27 .....                                                           | 25            |
| 3.4 Projecting Jobs for 2026–27 across main occupations in the seven selected sub-sectors ..... | 27            |

|                                                                                                                                                      |           |
|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 3.5 Limitations of I-O Analysis .....                                                                                                                | 32        |
| 3.6 Conclusion.....                                                                                                                                  | 34        |
| <b>4. Agriculture: Growing of Cereals (including Rice), Leguminous Crops and Oilseeds.....</b>                                                       | <b>35</b> |
| 4.1 Definition of the Sector.....                                                                                                                    | 35        |
| 4.2 Value Chain .....                                                                                                                                | 35        |
| 4.3 Workforce Characteristics.....                                                                                                                   | 38        |
| 4.4 Geographical Clusters .....                                                                                                                      | 43        |
| 4.5 Occupational Mapping .....                                                                                                                       | 46        |
| 4.6 Stakeholders' Survey .....                                                                                                                       | 46        |
| 4.7 Recommended Methodology .....                                                                                                                    | 53        |
| <b>5. Livestock: Raising Cattle and Buffaloes .....</b>                                                                                              | <b>55</b> |
| 5.1 Definition of the Livestock Sector .....                                                                                                         | 55        |
| 5.2 Value Chain .....                                                                                                                                | 57        |
| 5.3 Workforce Characteristics.....                                                                                                                   | 59        |
| 5.4 Geographical Clusters .....                                                                                                                      | 63        |
| 5.6 Stakeholders' Survey .....                                                                                                                       | 67        |
| 5.7 Recommended Methodology.....                                                                                                                     | 75        |
| <b>6. Manufacturing of Textiles and Cotton Ginning: Weaving of Textiles .....</b>                                                                    | <b>77</b> |
| 6.1 Definition of the Sector.....                                                                                                                    | 77        |
| 6.2 Background .....                                                                                                                                 | 77        |
| 6.3. Value Chain .....                                                                                                                               | 78        |
| 6.4 Workforce Characteristics.....                                                                                                                   | 82        |
| 6.5 Identification of Geographical Clusters .....                                                                                                    | 88        |
| 6.6 Occupational Mapping .....                                                                                                                       | 90        |
| 6.7 Stakeholders' Survey .....                                                                                                                       | 91        |
| 6.8 Recommended Methodology .....                                                                                                                    | 95        |
| <b>7. Manufacture of Transport: Manufacturing of Motor Vehicles and Its Parts and Accessories, and Repair and Maintenance of Motor Vehicles.....</b> | <b>99</b> |
| 7.1 Definition of the Sector.....                                                                                                                    | 99        |
| 7.2 Value Chain .....                                                                                                                                | 99        |
| 7.3 Workforce Characteristics .....                                                                                                                  | 101       |
| 7.4 Geographical Clusters .....                                                                                                                      | 108       |
| 7.5 Occupational Maps.....                                                                                                                           | 114       |

|                                                                                                              |            |
|--------------------------------------------------------------------------------------------------------------|------------|
| 7.6 Stakeholders' Survey .....                                                                               | 114        |
| 7.7 Recommended Methodology.....                                                                             | 133        |
| <b>8. Electricity: Electric Power Generation using Solar Energy and Other Non-conventional sources .....</b> | <b>136</b> |
| 8.1 Definition of the Sector .....                                                                           | 136        |
| 8.2 Value Chain .....                                                                                        | 136        |
| 8.3 Workforce Characteristics.....                                                                           | 138        |
| 8.4 Geographical Clusters .....                                                                              | 143        |
| 8.5 Occupational Maps.....                                                                                   | 147        |
| 8.6 Stakeholders' Survey.....                                                                                | 147        |
| 8.7 Recommended Methodology .....                                                                            | 168        |
| <b>9. Trade: Retail Trade in Food, Clothing, Footwear and Leather Articles in Specialised Stores... ..</b>   | <b>170</b> |
| 9.1 Definition.....                                                                                          | 170        |
| 9.2 Background .....                                                                                         | 170        |
| 9.3 Value Chain in the Retail Sector .....                                                                   | 171        |
| 9.4 Workforce Characteristics.....                                                                           | 175        |
| 9.5 Geographical Clusters in the Retail Sector.....                                                          | 181        |
| 9.6 Occupational Mapping.....                                                                                | 182        |
| 9.7 Stakeholders' Survey .....                                                                               | 183        |
| 9.8 Recommended Methodology .....                                                                            | 187        |
| <b>10. Computer Programming Activities .....</b>                                                             | <b>189</b> |
| 10.1 Definition of the Sector.....                                                                           | 189        |
| 10.2 Background .....                                                                                        | 189        |
| 10.3 Value Chain .....                                                                                       | 190        |
| 10.4. Workforce Characteristics .....                                                                        | 191        |
| 10.5 Identification of Geographical Clusters.....                                                            | 196        |
| 10.6 Occupational Map .....                                                                                  | 199        |
| 10.7 Sectoral Findings .....                                                                                 | 199        |
| 10.8 Web Scraping / Big Data Methodology.....                                                                | 207        |
| 10.9 Policy Recommendations .....                                                                            | 208        |
| 10.10 Recommended Methodology.....                                                                           | 208        |

|                                                         |            |
|---------------------------------------------------------|------------|
| <b>11. Policy Recommendations and Way Forward .....</b> | <b>211</b> |
| 11.1 Introduction.....                                  | 211        |
| 11.2 Comparison of Methodologies .....                  | 211        |
| 11.3 Methodology .....                                  | 212        |
| 11.4 Policy Recommendations.....                        | 223        |
| 11.5 Summary .....                                      | 226        |
| <b>Annexures .....</b>                                  | <b>227</b> |
| <b>Questionnaires .....</b>                             | <b>281</b> |

# List of Tables

|                                                                                                                                                                               |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Table ES.1: Projected jobs in 2026–27 for selected sub-sectors .....                                                                                                          | xviii  |
| Table ES.2: Technological Changes .....                                                                                                                                       | xix    |
| Table ES.3: Top five geographical clusters in each sector .....                                                                                                               | xxii   |
| Table ES.4: Distribution of stakeholder surveys .....                                                                                                                         | xxiii  |
| Table ES.5: Objectives and methodology .....                                                                                                                                  | xxviii |
| Table 1.1: Examples of national and regional taxonomies.....                                                                                                                  | 10     |
| Table 1.2: List of skills.....                                                                                                                                                | 12     |
| Table 2.1: Top 25 sectors with the highest GVA and employment multipliers (2021–22).....                                                                                      | 14     |
| Table 2.2: Top 25 sectors with the highest share of GVA and employment, 2021–22.....                                                                                          | 16     |
| Table 2.3: No. of top 25 lists that the sector appears in (max = 4).....                                                                                                      | 17     |
| Table 2.4: Sunrise sectors .....                                                                                                                                              | 18     |
| Table 2.5: Integrated sectors from Tables 2.3 and 2.4 to select sectors.....                                                                                                  | 19     |
| Table 2.6: Final selected sectors after policy direction.....                                                                                                                 | 20     |
| Table 2.7: Choosing sub-sectors at the NIC 4-digit level-I.....                                                                                                               | 22     |
| Table 3.1: Assumptions of GVO growth rates from both scenarios for 2026–27.....                                                                                               | 24     |
| Table 3.2: GVO projections in Rs lakh crore for 2026–27 at 2022–23 prices .....                                                                                               | 25     |
| Table 3.3: Employment multipliers.....                                                                                                                                        | 26     |
| Table 3.4: Projected jobs in 2026–27 for selected sub-sectors .....                                                                                                           | 27     |
| Table 3.5: Projected jobs (in lakhs) across top five NCO codes in ‘growing of cereals, leguminous crops and oilseeds’ .....                                                   | 28     |
| Table 3.6: Projected jobs (in lakhs) across top five NCO codes in ‘raising of cattle and buffaloes’ .....                                                                     | 29     |
| Table 3.7: Projected jobs (in lakhs) across top five NCO codes in ‘weaving of textiles’ .....                                                                                 | 29     |
| Table 3.8: Projected jobs (in lakhs) across top five NCO codes in ‘manufacturing of motor vehicles (MVs), parts & accessories of MVs and repair and maintenance of MVs’ ..... | 30     |
| Table 3.9: Projected jobs (in lakhs) across top five NCO codes in ‘electric power generation using solar energy and other non-conventional sources’ .....                     | 31     |
| Table 3.10: Projected jobs (in lakhs) across top five NCO codes in ‘retail sale of food, clothing, footwear, and leather articles in specialised stores’ .....                | 31     |
| Table 3.11: Projected jobs (in lakhs) across top five NCO codes in ‘computer programming activities’ .....                                                                    | 32     |
| Table 3.12: Technological changes in sector (industries) .....                                                                                                                | 33     |
| Table 4.1: Definition of the agricultural sub-sector used in the analysis .....                                                                                               | 35     |
| Table 4.2: Usage of technologies at various stages of agriculture value chain .....                                                                                           | 37     |
| Table 4.3: Stakeholders at various stages of value chain.....                                                                                                                 | 38     |

|                                                                                                                                                            |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Table 4.4: Engagement status (%) of agricultural (growing of cereals (including rice), leguminous crops and oilseeds) workers, 2022–23 .....               | 43  |
| Table 4.5: Geographical clusters in agriculture (growing of cereals (including rice), leguminous crops and oilseeds).....                                  | 45  |
| Table 4.6: Total number of stakeholders covered in the survey of ‘growing of cereals, leguminous crops, and oilseeds’ .....                                | 47  |
| Table 4.7: Stakeholders visited in Gurugram, Faridabad, Hisar, and Karnal .....                                                                            | 48  |
| Table 4.8: Assessment of current and future skills shortage for top five job roles in “growing of cereals, leguminous crops, and oilseeds’ .....           | 51  |
| Table 5.1: Engagement status (%) of workers in ‘raising of cattle and buffaloes’ .....                                                                     | 63  |
| Table 5.2: ‘Raising cattle and buffaloes’ clusters in India .....                                                                                          | 65  |
| Table 5.3: Stakeholders visited in Gurugram, Faridabad, Hisar, Karnal in Haryana and North 24 Parganas in West Bengal (raising cattle and buffaloes) ..... | 67  |
| Table 5.4: Total number of stakeholders covered in the survey of ‘raising cattle and buffaloes’ .....                                                      | 68  |
| Table 5.5: Assessment of current and future skills shortage for top five job roles in ‘raising cattle and buffaloes’ .....                                 | 73  |
| Table 6.1: Definition of the agricultural sub-sector used in the analysis .....                                                                            | 77  |
| Table 6.2: Engagement status of workers.....                                                                                                               | 87  |
| Table 6.3: Geographical clusters for ‘weaving of textiles’ .....                                                                                           | 89  |
| Table 6.4: List of stakeholders covered for textile weaving industry .....                                                                                 | 91  |
| Table 6.5: Frequency of firms location .....                                                                                                               | 91  |
| Table 6.6: Assessment of current & future skills shortage for top job roles in ‘weaving of textiles’ .....                                                 | 94  |
| Table 7.1: State-wise percentage share of workers engaged in motor vehicles sector.....                                                                    | 102 |
| Table 7.2: Engagement status of workers (%) .....                                                                                                          | 106 |
| Table 7.3: Geographical clusters in the auto sector .....                                                                                                  | 110 |
| Table 7.4: Rankings based on share of labour force and geographical clusters .....                                                                         | 112 |
| Table 7.5: Stakeholder consultations.....                                                                                                                  | 115 |
| Table 7.6: Details of in-demand job roles .....                                                                                                            | 130 |
| Table 8.1: Green energy workers by their occupations, 2022–23 (%) .....                                                                                    | 141 |
| Table 8.2: Engagement status of workers (%) .....                                                                                                          | 142 |
| Table 8.3: Geographical concentration of solar and wind energy generation, as on 31 March 2024 .....                                                       | 144 |
| Table 8.4: Stakeholder consultations .....                                                                                                                 | 149 |
| Table 8.5: Details of in-demand job roles.....                                                                                                             | 162 |
| Table 9.1: NIC codes in the retail sector .....                                                                                                            | 170 |
| Table 9.2: Artificial intelligence-enabled value chain in retail.....                                                                                      | 174 |

|                                                                                                                                                                                                                         |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Table 9.3: Engagement status of retail workers (%).....                                                                                                                                                                 | 180 |
| Table 9.4: Geographical clusters in the retail sector .....                                                                                                                                                             | 181 |
| Table 9.5: Survey of stakeholders .....                                                                                                                                                                                 | 183 |
| Table 9.6: Assessment of current and future skills shortage (findings from stakeholder consultations): retail sale of food, clothing, and shoes in specialised stores: demand shortage is there in four job roles ..... | 185 |
| Table 10.1: Definition of the technology sub-sector used in the analysis.....                                                                                                                                           | 189 |
| Table 10.2: Engagement status of workers (%) .....                                                                                                                                                                      | 196 |
| Table 10.3: Geographical clusters framework for the IT sector .....                                                                                                                                                     | 197 |
| Table 10.4: Geographical cluster of the IT sector .....                                                                                                                                                                 | 197 |
| Table 10.5: Distribution of stakeholder interactions in the IT sector .....                                                                                                                                             | 200 |
| Table 10.6: Technology changes .....                                                                                                                                                                                    | 200 |
| Table 10.7: Cognitive and non-cognitive skills .....                                                                                                                                                                    | 202 |
| Table 10.8: Assessment of current and future skills shortage (findings from stakeholder consultations) in computer programming activities Demand shortage is there in four job roles.....                               | 203 |
| Table 10.9: Skills gap summary: based on years of experience and type of skills .....                                                                                                                                   | 206 |
| Table 11.1: Comparison of methodologies .....                                                                                                                                                                           | 211 |
| Table 11.2: Representative questions for OWES .....                                                                                                                                                                     | 220 |
| Table 11.3: Details about vacancies.....                                                                                                                                                                                | 221 |
| Table 11.4: Objectives and methodology.....                                                                                                                                                                             | 222 |





# List of Figures

|                                                                                                                                                                                                                                                                                           |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Figure ES.1: Sectoral share of workers across skills, 2022–23 .....                                                                                                                                                                                                                       | xx  |
| Figure ES.2: Sectoral share of workers across gender, 2022–23 .....                                                                                                                                                                                                                       | xxi |
| Figure ES.3: Components of methodology .....                                                                                                                                                                                                                                              | xxv |
| Figure 3.1: Summarised steps to forecast jobs and occupations .....                                                                                                                                                                                                                       | 23  |
| Figure 4.1: Agriculture value chain .....                                                                                                                                                                                                                                                 | 36  |
| Figure 4.2: 75 per cent of the workers engaged in growing cereals (including rice),<br>leguminous crops, and oil seeds are concentrated in 9 States namely Uttar Pradesh, Madhya<br>Pradesh, Bihar, Maharashtra, Chhattisgarh, West Bengal, Rajasthan, Odisha and Andhra<br>Pradesh ..... | 39  |
| Figure 4.3: Percentage share of female workers (aged 15+) in growing cereals (including<br>rice), leguminous crops, and oilseeds .....                                                                                                                                                    | 39  |
| 2022–23 .....                                                                                                                                                                                                                                                                             | 39  |
| Figure 4.4: Percentage of agricultural (cereals including rice, leguminous crops, and<br>oilseeds) workers by educational attainment, 2022–23 .....                                                                                                                                       | 40  |
| Figure 4.5: Percentage of agricultural (cereals including rice, leguminous crops, and oil<br>seeds) workers (aged 15+) who have not received technical education and workers who have<br>received vocational education 2022–23 .....                                                      | 40  |
| Figure 4.6: A large proportion of female workers in cereal (including rice), leguminous crops,<br>and oil seeds growing workers are low-skilled whereas a larger proportion of male farmers<br>are low-medium skilled .....                                                               | 41  |
| Figure 4.7: Majority (69.4 per cent) of the agricultural (cereals including rice, leguminous<br>crops, and oilseeds) workers are market gardeners and crop growers, 2022–23 .....                                                                                                         | 41  |
| Figure 4.8: Percentage of female workers (aged 15+) across job roles in growing of cereals<br>(including rice), leguminous crops and oilseeds, 2022–23 .....                                                                                                                              | 42  |
| Figure 4.9: Framework to identify agricultural (growing of cereals (including rice),<br>leguminous crops, and oilseeds) clusters .....                                                                                                                                                    | 44  |
| Figure 4.10: Rankings using share of workers and geographical clusters for ‘growing cereals<br>(including rice), leguminous crops, and oilseeds’ .....                                                                                                                                    | 46  |
| Figure 5.2: Value chain in the livestock sector .....                                                                                                                                                                                                                                     | 57  |
| Figure 5.3: 28.3 per cent of the workers in ‘raising cattle and buffaloes’ sector are in Uttar<br>Pradesh .....                                                                                                                                                                           | 59  |
| Figure 5.4: State-wise distribution of female workers engaged in ‘raising of cattle and<br>buffaloes’, 2022–23 (%) .....                                                                                                                                                                  | 60  |
| Figure 5.5: Educational attainment of workers (aged 15+) engaged in ‘raising cattle and<br>buffaloes’ (%), 2022–23 .....                                                                                                                                                                  | 60  |
| Figure 5.6: Majority of workers in the ‘raising of cattle and buffaloes’ sector are low skilled<br>(aged 15+), 2022–23 .....                                                                                                                                                              | 61  |
| Figure 5.7: Percentage of female workers (aged 15+) in ‘raising cattle and buffaloes’ sector<br>across occupations, 2022–23 .....                                                                                                                                                         | 62  |

|                                                                                                                                                                                                                                |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Figure 5.8: Rankings using share of workers and geographical clusters for the ‘raising cattle and buffaloes’ sector .....                                                                                                      | 66  |
| Figure 6.1: Value chain for textiles sector.....                                                                                                                                                                               | 79  |
| Figure 6.2: State-wise share of labour force (%) .....                                                                                                                                                                         | 83  |
| Figure 6.3: State-wise distribution of female workers (aged 15+) in the ‘weaving of textiles’ sector, 2022–23 .....                                                                                                            | 83  |
| Figure 6.4: Percentage share in general education for workers (15+) in textile weaving .....                                                                                                                                   | 85  |
| Figure 6.5: Percentage share of workers (aged 15+) engaged in weaving of textiles who have received either formal or non-formal vocational/technical training (%).....                                                         | 85  |
| Figure 6.6: Majority of workers in the ‘weaving of textiles’ sector are low-medium skilled (aged 15+), 2022–23.....                                                                                                            | 86  |
| Figure 6.7: Percentage of female workers (aged 15+) in job roles, 2022–23 .....                                                                                                                                                | 87  |
| Figure 6.8: Rankings using share of labour force and geographical clusters for the ‘weaving of textiles’ sector .....                                                                                                          | 90  |
| Figure 7.1: Automotive value chain .....                                                                                                                                                                                       | 100 |
| Figure 7.2: State-wise distribution of female workforce in the ‘manufacturing of motor vehicles’, ‘manufacturing of parts and accessories for motor vehicles’ and ‘maintenance and repair of motor vehicles’, 2022–23 (%)..... | 103 |
| Figure 7.3: General educational attainment of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%).....                                                     | 104 |
| Figure 7.4: Technical educational attainment of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%).....                                                   | 104 |
| Figure 7.5: Vocational educational attainment of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%).....                                                  | 105 |
| Figure 7.6: Skill level of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%).....                                                                        | 105 |
| Figure 7.7: Percentage share of female workers (aged 15+) in job roles in manufacturing of motor vehicles and its parts & accessories, 2022–23 (%) .....                                                                       | 107 |
| Figure 7.8: Percentage share of female workers (aged 15+) in job roles in maintenance and repair of motor vehicles, 2022–23 (%).....                                                                                           | 108 |
| Figure 7.9: Methodology.....                                                                                                                                                                                                   | 116 |
| Figure 8.1: Electric power generation using solar and wind energy .....                                                                                                                                                        | 137 |
| Figure 8.2: Green energy workers (aged 15+) are concentrated in 13 states, 2022–23(%) ..                                                                                                                                       | 139 |
| Figure 8.3: General education of workers (aged 15+) engaged in electric power generation using solar energy, and electric power generation using other non-conventional sources, 2022–23 (%) .....                             | 140 |
| Figure 8.4: Skill-level of workers (aged 15+) engaged in electric power generation using solar energy, and electric power generation using other non-conventional sources, 2022–23 (%)                                         | 140 |
| Figure 8.5: Percentage of female workers (aged 15+) across job roles in green energy (%), 2022–23.....                                                                                                                         | 143 |

|                                                                                                                                                                           |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Figure 8.6: Methodology.....                                                                                                                                              | 150 |
| Figure 9.1: Defining value chain for retail sale of food in specialised stores.....                                                                                       | 172 |
| Figure 9.2: Defining value chain for retail sale of clothing and footwear in specialised stores<br>172                                                                    |     |
| Figure 9.3: State-wise share of workers (aged 15+) in retail sale of food and clothing,<br>footwear and leather articles in specialised stores' .....                     | 175 |
| Figure 9.4: State-wise percentage of female workers (aged 15+) in retail sale of food and<br>clothing, footwear and leather articles in specialised stores', 2022–23..... | 176 |
| Figure 9.5: General educational attainment of retail sector workers (aged 15+), 2022–23 ..                                                                                | 177 |
| Figure 9.6: Vocational/technical training attainment of retail sector workers (aged 15+),<br>2022–23.....                                                                 | 178 |
| Figure 9.7: Skill levels of retail sector workers (aged 15+), 2022–23 .....                                                                                               | 178 |
| Figure 9.8: Percentage share of workers (aged 15+) across occupations (NCO 3-digit).....                                                                                  | 179 |
| Figure 9.9: Job roles-wise percentage of female workers, 2022–23 .....                                                                                                    | 179 |
| Figure 9.10: State-wise rankings based on geographical clusters and share of labour force                                                                                 | 182 |
| Figure 10.1: Software value chain and role .....                                                                                                                          | 191 |
| Figure 10.2: Percentage of female workers (aged 15+) across states/UTs, 2022–23 .....                                                                                     | 192 |
| Figure 10.3: Share of female IT workers in job role, 2022–23.....                                                                                                         | 192 |
| Figure 10.4: State-wise distribution of workers (aged 15+) in the IT sector (%), 2022–23..                                                                                | 193 |
| Figure 10.5: General educational attainment of IT workers, 2022–23 .....                                                                                                  | 194 |
| Figure 10.6: Attainment of technical education of IT workers (aged 15+), 2022–23 .....                                                                                    | 194 |
| Figure 10.7: Share of workers (aged 15+) who have received vocational training, 2022–23<br>(%)                                                                            | 195 |
| Figure 10.8: State-wise rankings based on geographical clusters and share of labour force                                                                                 | 199 |
| Figure 10.9: Analytics using web data .....                                                                                                                               | 208 |



# List of Boxes

|                                                                                                        |     |
|--------------------------------------------------------------------------------------------------------|-----|
| Box 1.1: Types of mismatches.....                                                                      | 4   |
| Box 1.2: LMIS in Netherlands.....                                                                      | 6   |
| Box 5.1: Snapshot of the livestock sector .....                                                        | 56  |
| Box 6.1: Type of looms .....                                                                           | 78  |
| Box 6.2: Corrigendum for workers in textile sector in Haryana .....                                    | 84  |
| Box 7.1: Which job is more attractive?.....                                                            | 124 |
| Box 7.2: Prospect for women employment in the auto sector .....                                        | 125 |
| Box 8.1: Note on data mismatch between solar and wind clusters and associated presence of workers..... | 146 |
| Box 8.2: Which job is more attractive?.....                                                            | 156 |
| Box 8.3: Prospect for women employment in the green electricity sector .....                           | 158 |



# List of Annexures

|                                                                                                                                          |     |
|------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Annexure 2.1: Periodic Labour Force Survey Data.....                                                                                     | 229 |
| Annexure 2.2: Input-Output Analysis .....                                                                                                | 230 |
| Annexure 2.3: Alternative Sectors .....                                                                                                  | 232 |
| Annexure 2.4: Summary Tables of Sectors & Sub-sectors .....                                                                              | 233 |
| Annexure 4.1: Yield of Cereals, Pulses and Oilseeds .....                                                                                | 235 |
| Annexure 4.2: Definition of Skills Using PLFS.....                                                                                       | 236 |
| Annexure 4.3: Agricultural Clusters .....                                                                                                | 237 |
| Annexure 4.4: Indicators of Cereals (including Rice), Leguminous Crops and Oilseeds<br>Producing Clusters.....                           | 242 |
| Annexure 4.5: Occupational Mapping of Job Roles Listed in PLFS and Agriculture Skill<br>Council of India in the Agriculture Sector ..... | 245 |
| Annexure 4.6: Indicative Computation of the Extent of the Need & Vacancy Rate (NCAER<br>computations for 2026–27).....                   | 249 |
| Annexure 5.1: State-wise Productivity Indicators in Milk Production in India, 2022–23...                                                 | 250 |
| Annexure 5.2: Indicators of Dairy Producing Clusters.....                                                                                | 251 |
| Annexure 5.3: Occupational Mapping in the Livestock Sector .....                                                                         | 253 |
| Annexure 6.1: Defining Textile Clusters .....                                                                                            | 255 |
| Annexure 6.2: List of Data Sources .....                                                                                                 | 256 |
| Annexure 6.3: Occupation Mapping from Periodic Labour Force, NCO-2015 and Textile<br>Sector Skill Council Job Roles .....                | 257 |
| Annexure 7.1: Occupations and Job Roles in the Automotive Sector .....                                                                   | 266 |
| Annexure 8.1: Occupations and Job Roles in Solar Electricity Generation .....                                                            | 272 |
| Annexure 8.2: Occupations and Job Roles in Electricity Generation using Other non-<br>Conventional Sources (for Wind) .....              | 274 |
| Annexure 9.1: Occupations in the Retail Sector .....                                                                                     | 275 |
| Annexure 10.1: Mapping of the Occupations of the IT Sector .....                                                                         | 278 |





# List of Questionnaires

|                                                                                                                  |     |
|------------------------------------------------------------------------------------------------------------------|-----|
| Questionnaire 1: Agri-tech Firms .....                                                                           | 283 |
| Questionnaire 2: Questionnaire for Farmer Producer Organisations (FPOs) .....                                    | 291 |
| Questionnaire 3: Raising Cattle and Buffaloes in Dairy Farms/Bulk Chilling Centres/Milk Collection Centres ..... | 295 |
| Questionnaire 4: Questionnaire for Textile Weaving Industry .....                                                | 303 |
| Questionnaire 5: Questionnaire for Manufacturing of Motor Vehicles .....                                         | 311 |
| Questionnaire 6: Questionnaire for Manufacturing of Parts and Accessories of Motor Vehicles .....                | 315 |
| Questionnaire 7: Questionnaire for Maintenance and Repair of Motor Vehicles .....                                | 319 |
| Questionnaire 8: Questionnaire for Generation of Green Electricity .....                                         | 327 |
| Questionnaire 9: Questionnaire for Retail Trade .....                                                            | 335 |
| Questionnaire 10: Questionnaire for Computer Programming Activities (Information Technology Sector) .....        | 343 |



# 1. Introduction

## 1.1 Background

Demand for workers, and therefore skills, is an indirect demand. When there is demand for a particular good or service, demand for workers employed in that sector goes up along with the need for skills in that particular job role. The nature of skills evolves with technological changes in production. The type of goods and services in demand may itself change over time and therefore need for particular sets of workers may decline in some sectors and rise in another. One needs a dynamic approach to anticipate such rise and fall in the demand for workers, and therefore skills, in particular sectors.

While the Government of India has scaled up the supply-side ecosystem, it has to match the demand-side. India needs a model on ‘**anticipating and adapting**’ skills regularly at the national and sub-national level.<sup>1</sup> There is a need to understand what skills are in demand now and what will be needed in future to adapt our skilling ecosystem accordingly. What are the core skills; what are transferrable skills and what skills need to be regularly updated?

On 19 January, 2018, the Ministry of Skill Development & Entrepreneurship (MSDE), Government of India (GoI) had launched a World Bank-assisted programme—Skills Acquisition and Knowledge Awareness for Livelihood Promotion (SANKALP). The programme aims to improve short-term skill training qualitatively and quantitatively through strengthening institutions, bringing in better market connectivity and inclusion of marginalised sections of society. The key result areas (RA) under SANKALP are: institutional strengthening (RA1); enhancing market relevance and quality (RA2); and inclusion and access of marginalised communities (RA3).

In the rapidly changing world, it is vital to maintain an agile and responsive skill ecosystem. This requires continuous monitoring of global and local economic and job market trends to identify emerging industries, evolving job roles, and new skill requirements. The consistent evaluation of the emerging trends of the global and local economy and job markets can help in adopting better skill development initiatives to ensure that the workforce possesses the necessary skills to succeed in the dynamic labour market.

“A skill gap study is often the Achilles' heel of skilling efforts. Identifying these gaps is crucial for targeting training and educational programmes effectively. Challenges such as outdated data, regional disparities, the evolving technological landscape, and various economic factors underscore the need for a continuously evolving framework” (Tiwari, 2024).<sup>2</sup>

Assessing skill gaps has evolved over time in India. National Skill Development Corporation (NSDC) had conducted sector-wise skill gap studies for 19 high priority sectors in 2008–09.<sup>3</sup> In 2012, the National Skills Development

---

<sup>1</sup> National Council of Applied Economic Research (NCAER). 2018. Skilling India: No Time to Lose. <https://ncaer.org/publication/skilling-india-no-time-to-lose/>. New Delhi, India.

<sup>2</sup> Tiwari, A.K. 2024. “National Skill Gap Study for High Growth Sectors”. Inaugural Speech. July 19.

<sup>3</sup> National Skills Development Corporation website. <https://nsdcindia.org/nsdcreports>.

Corporation, in partnership with Klynveld Peat Marwick Goerdeler (KPMG), had carried out detailed assessment for human resource and skill requirements in 25 sectors and key states. The mandate included sector and sub-sector level analysis; demand-supply projection; estimation of incremental man-power requirement between 2013–2017 and 2017–2022; identification of key-employment clusters; and SWOT analysis of each sector. The pandemic would have affected all forecasts.

This was followed by skill gap assessments by States and other sectors later. MSDE (2021) did a study on assessment and anticipation of current and future skill requirement in the Indian manufacturing sector.<sup>4</sup> NSDC also had carried out assessments in 2022. Automotive Skills Development Council (ASDC) and Ernst and Young (EY) carried out an assessment for the auto sector in 2022 and forecast requirements for 2026.<sup>5</sup> The National Association of Software and Services Companies (NASSCOM) and Retailers Association's Skill Council of India (RASCI) have also carried out human skill requirement studies for the IT and retail sectors respectively.<sup>6</sup>

The difference between 2012 assessments and the current round of assessments starting 2021 was that each study was carried out using a different methodology, making it challenging for the policymaker to have a holistic view on assessing skills demand. Moreover, it is ambiguous what were measured by each of these studies and whether they were in line with what the policymakers want. Further, while individual sectors are able to make forecasts for their sectors, there are occupations that are in demand across sectors. It is necessary to capture those changes. Plus, given the rapid technological changes, one is not sure how long will these forecasts hold, if at all.

This document contributes towards developing a single methodology which will help assess skills shortage and gap across sectors.

## 1.2 Objectives of the Study

The specific objective of this project is to develop a prototype for ‘anticipating and adapting’ skills at the national level, essentially a Labour Market Information System (LMIS) at the national level which will assess current skill shortages and anticipate future skills. The prototype will provide a dynamic framework for skill demand assessment that can be regularly updated in alignment with the emerging needs of the

---

<sup>4</sup> Ministry of Skill Development and Entrepreneurship. 2021. “Skill Assessment and Anticipation Study: Manufacturing Sector”. <https://www.msde.gov.in/sites/default/files/2021-06/FINAL%20-%20MSDE%27s%20Skill%20Assessment%20and%20Anticipation%20Study%20Report.pdf>. New Delhi.

<sup>5</sup> Automotive Skills Development Council and EY. 2022. Human Resource and Skill Requirements in the Auto and Auto Components Sector in (2026). <https://skillsip.nsdcindia.org/sites/default/files/kps-document/skillreqinautomotivesector.pdf>. New Delhi.

<sup>6</sup> NASSCOM, Indeed.com and Draup. 2023. India Tech Industry Demand and Supply Analysis 2023. <https://nasscom.in/knowledge-center/publications/india-tech-industry-digital-talent-demand-and-supply-2023>. March 2.

Wazir Advisors and Retailers Association’s Skill Council of India. 2024. Mapping of Employment Scope & Skill Gaps in Retail till FY26. <https://www.rasci.in/pdf/RASCI%20Skill%20Gap%20Report%20upto%202026.pdf>. Mumbai, India.

economy. Further, the prototype can be replicated at sub-national and sectoral levels.

The specific objectives of the study include:

1. To identify seven high growth potential sectors.
2. To analyse industry feedback on identifying industry-specific key skill (cognitive, socio-emotional, technical & vocational, and knowledge) requirements in the seven identified industries.
3. To map the key job roles/ professions and geographic clusters aligned with the seven selected sectors along with the qualification and skill requirements associated with these job roles and provide estimates of current employment.
4. To identify the existing and potential job roles for enhancing female workforce participation in the seven identified sectors.
5. To provide projections and forecasts of future skill needs for the seven selected sectors for a period of three years based on anticipated changes in the labour market, technological advancements, and industry trends at the national and international levels.
6. To provide a framework for regular updation of demand assessment results at predefined intervals to provide continuous insights for skill planning for the selected seven sectors.
7. To provide detailed methodology for undertaking skill demand assessment at the sectoral level as also guidelines / methodology for undertaking similar assessments at the state level.
8. To seek recommendations for improving the design and effectiveness of the skill programmes;
9. To provide policy recommendations to address systemic issues contributing to skill gaps.
10. To provide recommendations to MSDE on enhancing skill training programmes, curriculum development, and skill initiatives to align them with the identified skill gaps; sector- wise upskilling or reskilling initiatives; apprenticeships, vocational training, or on-the-job training; areas of collaboration with industry including opportunities for establishing partnerships; industry-led training programmes, internships, or mentorship programmes to bridge the gap between industry needs and the skills possessed by the workforce.

### **1.3 Literature Review**

The 2015 Policy of the MSDE notes, “our country presently faces a dual challenge of paucity of highly trained workforce, as well as non-employability of large sections of the conventionally educated youth, who possess little or no job skills.”<sup>7</sup>

---

<sup>7</sup> Ministry of Skill Development and Entrepreneurship (MSDE). 2015. National Policy for Skill Development and Entrepreneurship 2015. <http://www.msde.gov.in/National-Policy-2015.html>.

### 1.3.1 Skill Mismatches

India has skilling, upskilling and reskilling challenges. Green (2013) points out that mismatches between supply and demand occur due to imperfect adjustments, whether through prices or quantities.<sup>8</sup> The potential consequences of a mismatch are lost productivity, lower pay and reduced well-being. Mismatches can be of various types and can occur due to a variety of reasons (Box 1.1). In this research work, the focus is on skills shortage. The objective is to develop a Labour Market Information System (LMIS) model for India, which can assess and anticipate skills shortage and eliminate or minimise any present/future skills shortage.

How are skill gaps/mismatch measured? It is still a new and evolving topic. Skill mismatch can exist both at the macro and micro level (Pellizzari and Fichen 2017).<sup>9</sup> Pellizzari and Fichen describe macro mismatch as “aggregate mismatch as the existence of an allocation of workers to jobs that could improve the realized equilibrium in terms of either employment levels or output. The same definition could be applied to other (or multiple) dimensions of heterogeneity, such as workers’ skills and jobs’ requirements. It is the concept of an aggregate notion of mismatch which is a feature of the joint distribution of workers’ and jobs’ characteristics.” In macro, one is modeling skills shortage. Skills shortage is a macro term (Box 1.1).

#### Box 1.1: Types of mismatches

**Skills Shortage** describes the situation where a job vacancy is hard to fill because of a lack of applications with the needed skills.

A **skill gap** occurs where an employee’s competence to do the job is called into question (typically by his/her manager).

**Skills underutilisation** occurs when a worker has work-related skills not used (or used at too low a level) in the job.

**Unemployment** occurs where workers are not employed yet available and looking for a job, indicating that all their skills are unused.

**Workers’ training barriers** occur when individuals are unable to form and achieve a demand for learning that would be best for them, given their circumstances, e.g., lack of information, lack of access to credit, etc.

**Employer training barriers** occur when employers lack sufficient information or capacity to assess the benefits of training for their organisation or if external providers are unavailable.

Source: Green, F. 2013. *Skills and Skilled Work: An Economic and Social Analysis*. Pages 31-32. Oxford University Press, United Kingdom.

The micro definition of skill mismatch “is constructed by comparing the skills (or qualifications) of an employed worker with the skill (or qualification) requirements of

<sup>8</sup> Green, F. 2013. *Skills and Skilled Work: An Economic and Social Analysis*. Oxford University Press, United Kingdom.

<sup>9</sup> Pellizzari, M., Fichen, A. 2017. “A new measure of skill mismatch: theory and evidence from PIAAC”. *IZA J Labor Econ* 6, 1. <https://doi.org/10.1186/s40172-016-0051-y>.

her job (hence, the non-employed and vacancies are completely disregarded). In the micro concept, one is assessing skill gaps. Then, any given job-worker pair can be classified as a good match if the skills (or qualifications) of the employee are compatible with the requirements of the job. If the worker is more skilled (or qualified) than required, she is classified as over-skilled (over-qualified) and under-skilled (or under-qualified) in the opposite case” (Pillizzari and Fichen, 2017). For measuring the micro mismatch, there is need to conduct employer-employee studies. Skills can be measured by education or actual skills of workers. There is a substantial literature which shows skills as a better measure of human capital than education (Hanushek and Woessmann, 2008 and Hanushek, 2013).<sup>10</sup>

There are various indicators of skill mismatch/gap (Green 2013; p 53).<sup>11</sup>

1. *“Perceived under-utilisation: Skills under-utilisation.*
2. *Difference between highest education required and completed: This measures over-education/under-education and education-subject mismatch.*
3. *Managers’ assessment of employees’ competence to measure skill gaps.*
4. *Hard-to-fill vacancies for skills reasons: skill shortages.*
5. *Unemployment and indicators of discrimination, lack of capacity, and self-esteem: These measure learning barriers.*
6. *Absence of formal training needs analysis; perceived lack of information training/capacity measures employer training barriers.*
7. *Benchmarking against other similar countries/regions: This measures skill deficit”.*

### **1.3.2 International Evidence on Labour Market Information System**

Anticipating and building skills for the future are essential in rapidly changing markets. The International Labour Organisation (ILO), Organisation for Economic Co-operation and Development (OECD), European Centre for the Development of Vocational Training (CEDEFOP), and European Training Foundation (ETF) conducted a joint survey on governance mechanisms and institutional frameworks that steered relevance of training provisions to the labour market needs in over 60 countries in 2017.<sup>12</sup> The survey was conducted among key stakeholders in skill governance: ministries of labour and of education, worker unions and employer associations. This report collates empirical evidence generated through the survey. Skill anticipation relies on various methods that collate and summarise labour market information (LMI) to analyse skill shortages and labour market

---

<sup>10</sup> Hanushek, E.A. 2013. “Economic Growth in Developing Countries: The Role of Human Capital”. *Economics of Education Review*. 37: 204–212.

Hanushek, E.A. and L. Woessmann. 2008. “The Role of Cognitive Skills in Economic Development”. *Journal of Economic Literature*. 46 (3): 607–668.

<sup>11</sup> Green, F. 2013. *Skills and Skilled Work: An Economic and Social Analysis*. Oxford University Press, United Kingdom.

<sup>12</sup> International Labour Organisation (ILO), the Organisation for Economic Co-operation and Development (OECD), the European Centre for the Development of Vocational Training (CEDEFOP), and the European Training Foundation (ETF). 2017. *Skill Needs Anticipation: Systems and Approaches: Analysis of stakeholder survey on skill needs assessment and anticipation*. [https://www.cedefop.europa.eu/files/2223\\_en.pdf](https://www.cedefop.europa.eu/files/2223_en.pdf). ILO, Geneva.



imbalances. They are often forward- looking and can be combined to provide a more detailed and multifaceted picture of the labour market.

ILO, OECD, CEDEFOP and ETF (2017) document the various instruments, data sources and surveys that are used for LMIS. The report also documents the best practices of countries like the Netherlands (Box 1.2).<sup>13</sup> There are many methods to do this including qualitative methods, sector studies, employer-employee surveys, enterprise surveys, quantitative forecasting models, graduate surveys/tracer studies and vacancy surveys. Data can be also collected in a myriad of ways. Analysis can be done using formal, national level, quantitative model-based projections using econometric techniques or computable general equilibrium or similar models or partial quantitative-based projections. Sectoral-based models can also be done. Foresight methods includes focus groups/roundtable, Delphi style methods, scenario development analysis, sectoral/occupational/regional (sub-national) studies and/or Observatories (using both quantitative and qualitative evidence).

### **Box 1.2: LMIS in Netherlands**

Skills assessment in the Netherlands includes various instruments and data sources, some based on surveys from statistical offices.

- Regular surveys are conducted with graduates entering the labour market.
- Administrative data from Public Employment Services (PES), education ministry and social security insurance contributions.
- Various bodies and skills councils contribute qualitative (and additional quantitative) material to help understand detailed problems.
- Long and medium-term forecasting models assess skills imbalances by detailed occupation and qualification (combination of field and level) using survey data.
- There are also tracer studies of all major training programmes that elicit school-to-work transitions from recent graduates (one to two years after graduation).
- Several sector studies are also conducted within the same organisation.
- The PES generates several short-term specific labour market forecasts and analyses, including of vacancies.
- Within sector councils, ministries and tripartite policy groups, labour market or education and training system responses are discussed and incorporated into recommendations.

*Source:* International Labour Organisation (ILO), the Organisation for Economic Co-operation and Development (OECD), the European Centre for the Development of Vocational Training (CEDEFOP), and the European Training Foundation (ETF). 2017. Skill Needs Anticipation: Systems and Approaches: Analysis of stakeholder survey on skill needs assessment and anticipation. [https://www.cedefop.europa.eu/files/2223\\_en.pdf](https://www.cedefop.europa.eu/files/2223_en.pdf). ILO, Geneva.

The Bureau of Labour Statistics has one of the most sophisticated LMI systems. It is dynamic and online. <https://www.onetonline.org/>. The Occupational Information

<sup>13</sup> International Labour Organisation (ILO), the Organisation for Economic Co-operation and Development (OECD), the European Centre for the Development of Vocational Training (CEDEFOP), and the European Training Foundation (ETF). 2017. Skill Needs Anticipation: Systems and Approaches: Analysis of stakeholder survey on skill needs assessment and anticipation. [https://www.cedefop.europa.eu/files/2223\\_en.pdf](https://www.cedefop.europa.eu/files/2223_en.pdf). ILO, Geneva.

Network (O\*NET) Programme is the nation's primary source of occupational information. Valid data are essential to understanding the rapidly changing nature of work and how it impacts the workforce and US economy. From this information, applications are developed to facilitate the development and maintenance of a skilled workforce. Table 1.1 shows examples of various national and regional taxonomies (at the end of the chapter).

The Content Model is the conceptual foundation of O\*NET. The Content Model provides a framework that identifies the most important types of information about work and integrates them into a theoretically and empirically sound system. The Content Model was developed using research on job and organisational analysis. It embodies a view that reflects the character of occupations (via job-oriented descriptors) and people (via worker-oriented descriptors). The Content Model also allows occupational information to be applied across jobs, sectors, or industries (cross-occupational descriptors) and within occupations (occupational-specific descriptors). These descriptors are organised into six major domains, which enable the user to focus on areas of information that specify the key attributes and characteristics of workers and occupations.

## 1.4 Definitions

“Skills are personal qualities with three key features – (i) productive: using skills at work are productive of value; (ii) expandable: skills are enhanced by training and development and; (iii) social: skills are socially determined” (Green, 2013; p. 10).<sup>14</sup> NCAER (2018) delineated three types of skills and they are:<sup>15</sup>

- **Cognitive skills** are *basic skills* of literacy and numeracy, applied knowledge and problem-solving aptitudes and *higher-order skills* such as experimentation, reasoning, and creativity.
- **Technical and Vocational Education and Training skills (TVET)** are the physical and mental ability to perform specific tasks using tools and methods in any occupation.
- **Social and behavioral skills** include working well with others, communicating and listening well, and being agreeable and outgoing.

The detailed list of skills is shown in Table 1.2 (at the end of the chapter). The study develops methodology to assess skills shortage at sectoral level and skill gap at the worker level in a particular sector.

**Skills shortage** describes the situation where a job vacancy is hard to fill because of a lack of applications with the needed skills.<sup>16</sup> For example, one is looking for accountants but is unable to find any with the appropriate degree, qualifications, experience, and skills.

**A skill gap** occurs where an employee's competence to do the job is called into

---

<sup>14</sup> Green, F. 2013. *Skills and Skilled Work: An Economic and Social Analysis*. Oxford University Press, United Kingdom.

<sup>15</sup> NCAER. 2018. *Skilling India: No time to lose*.  
[http://www.ncaer.org/publication\\_details.php?pID=300](http://www.ncaer.org/publication_details.php?pID=300), New Delhi, India.

<sup>16</sup> Green, F. 2013. *Skills and Skilled Work: An Economic and Social Analysis*. Oxford University Press, United Kingdom.

question (typically by his/her manager).<sup>17</sup> For example, one is looking for accountants and finds several with the appropriate degree and qualifications but not the appropriate skill set.

## 1.5 Objectives

The objective is to assess skill shortages and gaps. Given that 46 per cent of the workers in India were still employed in the agriculture and allied sector in 2023–24, one cannot use the standard international methods to analyse this work.<sup>18</sup> Further unlike the United States model, the O\*NET, India cannot afford to ignore the self-employed workers or the unincorporated enterprises.<sup>19</sup> In 2023–24, 39 per cent of workers were self-employed in India with only three per cent as employers.<sup>20</sup>

India collects and publishes vast data—national accounts, household survey, and enterprise data for both organised and unorganised sectors. However, organised data are only collected for the manufacturing sector. Further, there are administrative data across various ministries.

Ideally, to assess skill shortages and gaps, India should have started with Occupational Wage Employment Survey (OWES) of pre-identified occupations across sectors. The Labour Bureau under the Ministry of Labour and Employment does conduct occupational wage surveys on a periodic basis but the associated employment and skills data are not available.<sup>21</sup> Even the wage data are not available spatially. Unit level data are also not available for further analysis.

Given the data constraints and a lack of theoretical construct, the Centre has to design the exercise, which will be implemented in coordination with States and Sector Skill Councils (SSCs).

In order to assess skill shortages and gaps in the short-run (less than one year), medium-run (3 to 5 years) and long-run (more than 15 years), what does India need to do? Looking at international literature, India needs to adopt multiple methodologies to understand both the on-going and anticipated changes and challenges. The methodology consists of seven components to assess skill shortages and skill gaps. The Centre and states have to work in a collaborative manner for a holistic assessment. The seven components are:

---

<sup>17</sup> Ibid.

<sup>18</sup> MoSPI, Government of India. 2024b. INDIA - Periodic Labour Force Survey (PLFS), July, 2022–June, 2023. [https://microdata.gov.in/nada43/index.php/catalog/210/related\\_materials](https://microdata.gov.in/nada43/index.php/catalog/210/related_materials). November 8.

<sup>19</sup> “The Occupational Employment and Wage Statistics (OEWS) programme of the Bureau of Labour Statistics Department, United States produces employment and wage estimates for approximately 830 occupations based on a survey of business establishments (employers). The OEWS survey covers wage and salary workers in nonfarm establishments and does not include the self-employed, owners and partners in unincorporated firms, household workers, or unpaid family workers.”

BLS website. [https://www.bls.gov/oes/oes\\_emp.htm](https://www.bls.gov/oes/oes_emp.htm).

<sup>20</sup> MoSPI, Government of India. 2024b. INDIA - Periodic Labour Force Survey (PLFS), July, 2022–June, 2023. [https://microdata.gov.in/nada43/index.php/catalog/210/related\\_materials](https://microdata.gov.in/nada43/index.php/catalog/210/related_materials). November 8.

<sup>21</sup> Labour Bureau website. <https://www.labourbureau.gov.in/occupational-wage-survey>.

1. Macro Analysis of Sectoral Shares of Gross Value Added (GVA) and Workers; Identification of Geographical Clusters and; Sectoral Workforce Characteristics using secondary data.
2. Simulations to forecast jobs and opportunities. This may be implemented both at the Central and state levels. NCAER has used I-O analysis to understand occupational trends.
3. Demand projections of jobs of non-agricultural sectors using OWES of non-agricultural enterprises. The OWES will be a detailed database of selected occupations which will give wages rates, number of workers, gender, other social background characteristics, qualifications and skills across geographies. The data will be representative at the district level.
4. Assess skill shortages and gaps of non-agricultural sectors using survey of non-agricultural firms for data on vacancies and skills: Vacancy rates across sectors needs to be estimated along with identification of occupations and associated qualifications that are vacant for more than a defined period of time.
5. Analysis of jobs in sub-sectors of non-agricultural sectors using big data methodologies. Analysis of job roles being advertised across web will inform about the real-time trends on the demand-side especially sub-sectoral trends and differences across geographies.
6. District-level analysis of jobs in the agriculture and allied sectors. A bottom-up strategy is adopted for analysis of agriculture and allied sectors. Secondary data analysis methods are used to understand district-wise trends. FGDs and stakeholders' analysis coupled with surveys will help identify job trends.
7. Stakeholder interactions to understand economic and technological changes that are anticipated but may not show up quantitatively. Focus Group Discussions (FGDs) and structured interviews are tools which will be used for consultations with all stakeholders across the value chain of the sector and the skilling/training process in that sector. This strategy informs us about new and evolving sectoral technologies; emerging job roles; upcoming job trends; identify changing skills needed for job roles; academia-industry partnerships; best practices; recruitment practices; internships/apprenticeships; upskilling/reskilling needs; and what firms are doing to encourage female workers or attract female workers, etc.

## **1.6 Structure of the Report**

Chapter 2 shows the selection process of the seven sectors. Chapter 3 presents the simulation exercises for each of the sectors using I-O analysis. Chapters 4 to 10 present the results from each of the sectors. The last but not the least, Chapter 11 presents the conclusions and policy recommendations.

**Table 1.1: Examples of national and regional taxonomies**

| <i>Items</i>      | <i>Occupational Information Network (O*NET)</i>                                                                                | <i>European Skills, Competencies, Qualifications and Occupations (ESCO)</i>                                                                                                 | <i>UK Skills Taxonomy</i>                                 | <i>Singapore Skills Taxonomy (SST)</i>                                                                                                                                                                                                                                                                                                          | <i>Australian Skills Classification (ASC)</i>                                                                                | <i>Canada Skills and Competency Taxonomy</i>                                                                                                                              |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Approach          | Quantitative and Qualitative                                                                                                   | Quantitative and Qualitative                                                                                                                                                | Quantitative (Data driven)                                | Quantitative and Qualitative                                                                                                                                                                                                                                                                                                                    | Quantitative and Qualitative                                                                                                 | Quantitative and Qualitative                                                                                                                                              |
| Data source       | Analysts' input; Surveys to job incumbents and employers                                                                       | Collaboration between sectoral and occupational experts, review of existing classifications and qualifications, desk research by main trend by sector, job adverts, and CVs | Online job adverts in the UK                              | Collaboration between stakeholders from various sectors on vision, transformation, occupation and skill needs, education institutions, unions and Government In progress Development of Job Skills Repository using data from foresight exercises, online job adverts, and CVs, census, skills frameworks, training consumption and supply data | O*NET; Australian Employability Skills Framework; Employer surveys; Job adverts; Education and training course documentation | Career handbook, Skills and Knowledge Checklist, Essential Skills profiles, O*NET, Stakeholder consultations; Surveys to job incumbents and employers; Online job adverts |
| Developer / Owner | US Bureau of Labor Statistics                                                                                                  | European Commission, DG EMPL                                                                                                                                                | Nesta (Private company)                                   | SkillsFuture Singapore                                                                                                                                                                                                                                                                                                                          | National Skills Commission                                                                                                   | Employment and Social Development Canada                                                                                                                                  |
| Granularity       | 1016 occupations, 177 elements covering skills, knowledge, abilities, work activities and work styles, and around 18,000 tasks | 3008 occupations, 13,890 skills/competence, knowledge                                                                                                                       | 41 million adverts, 10,500 skills                         | 1,692 occupations, 10,000 skills (Critical core skills, technical skills, and competencies)                                                                                                                                                                                                                                                     | 857 occupations, 10 core competencies, 2,136 specialist tasks, and 70 technology tools                                       | 900 occupations, around 250 elements covering skills, abilities, attributes, knowledge, interests, work context, work activities, and tools and technologies.             |
| Structure         | 6 domains (occupation-specific information, occupational requirements, workforce                                               | 3 pillars (occupations, skills/competence, qualifications)                                                                                                                  | 4 layers (Broad clusters, skills groups, skills clusters, | 5 layers (Level 1-4 clusters, branching out to "unique skills")                                                                                                                                                                                                                                                                                 | 3 layers (Cluster family, Cluster, task)                                                                                     | 8 domains (Skills, Abilities, Personal attributes, Knowledge, Interests,                                                                                                  |

| <b>Items</b>                                                                   | <b>Occupational Information Network (O*NET)</b>                                            | <b>European Skills, Competencies, Qualifications and Occupations (ESCO)</b>                                                                 | <b>UK Skills Taxonomy</b>       | <b>Singapore Skills Taxonomy (SST)</b>                                                                                                                                                            | <b>Australian Skills Classification (ASC)</b>                                    | <b>Canada Skills and Competency Taxonomy</b>           |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------|
|                                                                                | characteristics, experience requirements, worker requirements, and worker characteristics) |                                                                                                                                             | and unique skills)              |                                                                                                                                                                                                   |                                                                                  | Work context, Work activities, Tools and technologies) |
| Skills “importance” rating (i.e., How important a skill is for an occupation)  | Scale of 1–5                                                                               | Binary (Essential / Optional)                                                                                                               | % in job adverts                | Ranking of top 5 critical core skills                                                                                                                                                             | N/A                                                                              | Currently being explored                               |
| Skills “level” rating (i.e. What level of skill is required for an occupation) | Level (1–7)                                                                                | N/A                                                                                                                                         | N/A                             | Technical skills and competencies (Proficiency Level 1–6)<br>Critical core skills (Basic, Intermediate, Advanced)                                                                                 | Scale of 1–10 and respective 3 levels (Basic 1–3, Intermediate 4-6 and High 8–9) | Currently being                                        |
| Link with qualifications                                                       | No direct link                                                                             | Yes (to rely on Europass for information at the EU level, pilot project in 2019 of linking learning outcomes of qualifications with skills) | No direct link                  | Yes in terms of levels (Technical skill levels correspond to Singaporean qualification levels)                                                                                                    | No direct link                                                                   | No direct link                                         |
| Data dissemination                                                             | Website (Interactive interface, Excel format, API)                                         | Website (Hierarchical structure, API)                                                                                                       | Website (Interactive interface) | Website (Interactive interface)<br>By industry, sector information, career pathways, occupation and job roles, existing and emerging skills, training programmes for skills upgrading and mastery | Website (Interactive interface, Excel format)                                    | Forthcoming Website (Interactive interface)            |
| Updates                                                                        | Regularly                                                                                  | Regularly                                                                                                                                   | Ad-hoc                          | Regularly                                                                                                                                                                                         | Regularly                                                                        | N/A                                                    |
| Cost implications                                                              | High                                                                                       | High                                                                                                                                        | Low                             | High                                                                                                                                                                                              | High                                                                             | High                                                   |

Source: Directly sourced from ILO and OECD. 2023. “Global skills gaps measurement and monitoring: Towards a collaborative framework”. *Technical paper prepared for the 1st meeting of the Employment Working Group under Indian presidency.* [https://labour.gov.in/sites/default/files/iloissaoecd\\_global\\_skills\\_gaps\\_measurement\\_and\\_monitoring.pdf](https://labour.gov.in/sites/default/files/iloissaoecd_global_skills_gaps_measurement_and_monitoring.pdf). January.

**Table 1.2: List of skills**

| <b><i>Foundational cognitive skills</i></b>                       | <b><i>Advanced cognitive skills</i></b> | <b><i>Foundational socio-emotional skills</i></b>   | <b><i>Advanced socio-emotional skills</i></b> | <b><i>Knowledge</i></b> | <b><i>Sector/Job-specific skills</i></b> |
|-------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------|-----------------------------------------------|-------------------------|------------------------------------------|
| Reading Literacy                                                  | Learning strategies                     | Civic and digital citizenship                       | Instructing                                   | General                 | Occupational                             |
| Writing                                                           | Critical thinking                       | Seek and value diversity                            | Negotiation                                   | Sectoral                | Technical                                |
| Speaking                                                          | Creativity                              | Conscientiousness (including attitude towards work) | Persuasion                                    |                         | Innovation                               |
| Communication                                                     | Independent research                    | Openness to experiences                             |                                               |                         | Physical                                 |
| Language Skills 1                                                 | Judgement and decision-making           | Extraversion                                        |                                               |                         |                                          |
| Language Skills 2                                                 | Systems analysis                        | Agreeableness                                       |                                               |                         |                                          |
| Numeracy/Mathematics                                              | Systems evaluation                      | Neuroticism/Emotional stability                     |                                               |                         |                                          |
| Information and Communication Technology (ICT) Literacy to Skills | Financial resources                     | Social skills at work                               |                                               |                         |                                          |
| Self-learning to Active (Independent) Learning                    | Material resources                      |                                                     |                                               |                         |                                          |
| Active Listening                                                  | Personnel resources                     |                                                     |                                               |                         |                                          |
| Science                                                           | Time management                         |                                                     |                                               |                         |                                          |
| Problem Solving                                                   |                                         |                                                     |                                               |                         |                                          |

Source: Bhandari, B. 2021. "Policy for the Full Range of Employability Skills". NCAER Working Paper No. 123. [https://www.ncaer.org/wp-content/uploads/2022/09/1623156388WP-123\\_NCAER\\_Skill\\_Working\\_Paper.pdf](https://www.ncaer.org/wp-content/uploads/2022/09/1623156388WP-123_NCAER_Skill_Working_Paper.pdf). NCAER, New Delhi, India.



## 2. Selection of Sectors and Sub-Sectors

### 2.1 Introduction

Ideally the assessment and anticipation of skills should be estimated for all the sectors. However, if sectors are to be selected, this chapter illustrates how they can be selected using scientific criteria. The idea is to develop a methodology which would be replicable at the regional (state/district) and sectoral level. Further, the data required should be freely available from credible data sources like national statistics available from the Ministry of Statistics and Programme Implementation (MoSPI) and administrative data. The methodology to choose the seven sectors as per the Terms of Reference (ToR) in the “National Skill Gap Study for High Growth Sectors” are demonstrated here in a step-wise fashion, even mentioning the different pathways that were examined and dropped.

### 2.2 Estimating Income and Output Multipliers and Ranking Them

- I. As a first step, the national I-O model for 64 sectors was used to estimate output, income, and employment multipliers for 2021–22. The national I-O tables are derived from the Supply-use Table (SUTs) provided by the MoSPI at that level of aggregation. Input-output analysis is a technique invented by Professor Wassily W. Leontief in 1951. It is used to analyse inter-industry relationship in order to understand the inter-dependencies and complexities of the economy and thus the conditions for maintaining equilibrium between supply and demand.<sup>1</sup> Annexures 2.1 and 2.2 give a detailed explanation about deriving direct employment numbers from Periodic Labour Force Survey and I-O analysis respectively.
  - An income multiplier is defined as total income generated in the economy due to one unit of output generated in the said sector. Income is measured by the Gross Value Added (GVA).<sup>2</sup>
  - An output multiplier is defined as total output generated in the economy due to one unit of output generated in the said sector. Output in an economy is measured by the Gross Value of Output (GVO).<sup>3</sup>
  - An employment multiplier is defined as total direct and indirect employment generated in the economy due to change in one unit of final demand in that sector.
- II. The income and employment multipliers are estimated and ranked. The top 25 sectors are reported in Table 2.1.

---

<sup>1</sup>Sharma, J.L. undated.

[https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004160614287891JaiLakshmi\\_App\\_I\\_nput\\_Output\\_Analysis.pdf](https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004160614287891JaiLakshmi_App_I_nput_Output_Analysis.pdf).

<sup>2</sup> Gross Value Added is the value of all final goods and services produced in an accounting period in a particular industry or sector or region.

<sup>3</sup> GVO is a measure of the value of production of new goods and services during an accounting period. It represents the total value of sales by producing enterprises (their gross revenue or turnover) in an accounting period, before subtracting the value of intermediate goods used up in production from the value of sales.



**Table 2.1: Top 25 sectors with the highest GVA and employment multipliers (2021–22)**

| S. No. | GVA Multiplier                                                                                                                 | Employment Multiplier                                                                                                                                                                           |
|--------|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | Iron ore                                                                                                                       | Agriculture                                                                                                                                                                                     |
| 2.     | Crude petroleum and natural gas                                                                                                | Other services*                                                                                                                                                                                 |
| 3.     | Non-ferrous metal ores                                                                                                         | Manufacture of wearing apparel, except custom tailoring                                                                                                                                         |
| 4.     | Trade                                                                                                                          | Manufacture of grain mill products, etc. and animal feeds                                                                                                                                       |
| 5.     | Insurance services                                                                                                             | Manufacture of tobacco products                                                                                                                                                                 |
| 6.     | Manufacture of coke and refined petroleum products                                                                             | Printing and reproduction of recorded media except publishing                                                                                                                                   |
| 7.     | Natural gas                                                                                                                    | Hotels and restaurants                                                                                                                                                                          |
| 8.     | Gas                                                                                                                            | Manufacture of other food products                                                                                                                                                              |
| 9.     | Railway transport                                                                                                              | Livestock                                                                                                                                                                                       |
| 10.    | Education and research                                                                                                         | Production, processing and preservation of meat, fish, fruit, vegetables, oils, and fats                                                                                                        |
| 11.    | Communication                                                                                                                  | Manufacture of electronic component, consumer electronics, magnetic and optical media; Manufacture of computer and peripheral equipment and repair; and Installation of machinery and equipment |
| 12.    | Livestock                                                                                                                      | Manufacture of dairy products                                                                                                                                                                   |
| 13.    | Manufacture of chemical and chemical products except pharmaceuticals, medicinal and botanical products                         | Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting material                                                                  |
| 14.    | Community, social, and personal services                                                                                       | Construction                                                                                                                                                                                    |
| 15.    | Real estate activities                                                                                                         | Manufacture of textiles + cotton ginning                                                                                                                                                        |
| 16.    | Manufacture of basic precious and non-ferrous metals + Casting of non-ferrous metals                                           | Trade                                                                                                                                                                                           |
| 17.    | Ownership of dwellings                                                                                                         | Manufacture of furniture                                                                                                                                                                        |
| 18.    | Fishing and aquaculture                                                                                                        | Community, Social, and personal services                                                                                                                                                        |
| 19.    | Manufacture of basic iron and steel + Casting of iron and steel                                                                | Other manufacturing                                                                                                                                                                             |
| 20.    | Electricity                                                                                                                    | Manufacture of leather and related products                                                                                                                                                     |
| 21.    | Agriculture                                                                                                                    | Storage and warehousing                                                                                                                                                                         |
| 22.    | Forestry and logging                                                                                                           | Land transport                                                                                                                                                                                  |
| 23.    | Other business services#                                                                                                       | Manufacture of beverages                                                                                                                                                                        |
| 24.    | Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting material | Manufacture of fabricated metal products, except machinery and equipment                                                                                                                        |
| 25.    | Manufacture of rubber and plastic products                                                                                     | Renting of machinery and equipment                                                                                                                                                              |

Source: NCAER computations.

Note: At the time of initiation of the work, the latest GVA data available was from 2021–22.

\*includes Services of membership organisations, Arts, entertainment & recreation, Private household with employed person, Remediation & other utility services electricity, gas, water supply)

# includes Administrative & support service activities and other professional services like Employment activities (placement activities), Travel agency, tour operator and other reservation service activities, Security and investigation activities, Services to buildings and landscape activities, Office administrative, office support and other business support activities.

## 2.3 Secondary Data Analysis

III. Other variables are examined which can support the above analysis and give a holistic perspective. For that, one looks at the size of the sectors, current and future

growth prospects, labour employed, and capital & labour productivity. All variables are derived from nationally available statistics which are freely available for the same year 2021–22.

- Gross Value Added (GVA)
  - Ten-year average share of GVA
  - Ten-year average growth rate of GVA
  - Ten-year average ratio of GVA to Gross Value of Output (GVO)
- Gross Capital Formation (GCF)
  - Ten-year average growth of GCF
  - Ten-year average share of GCF to GVA
  - Ten-year average share of GCF to GVO
- Labour
  - Five-year average share of workers (Periodic Labour Force Survey is available from 2017–18 onwards on an annual basis)
  - Five-year average share of labour inputs to GVO
  - Percentage share of female workers
  - Average intensity of work (average hours worked in a week)
- Forecasting
  - Auto-regressive integrated moving forecasting model.

One could additionally look at trade (exports and imports data from the Directorate General of Commercial Intelligence and Statistics (DGCIS)) and Foreign Direct Investment (FDI) from Department for Promotion of Industry and Internal Trade (DPIIT) & RBI). However, there are many challenges with the above variables. They are:

1. While data on merchandise trade are available from the DGCIS, data on service exports by region, either state or district are not available. The methodology would not be consistent across sectors and therefore these variables were dropped.
2. FDI data are not mapped to the National Industrial Classification code and therefore hard to classify and map with the data provided by the National Accounting System. The available data are available at the State-level but not district level.
3. Data on GCF are not available at the regional level, either state or district.
4. ARIMA forecasting can give erroneous results given the rapid technological changes and various transitions involved like transition to a green economy.

Therefore, two variables are chosen—the percentage share of GVA and percentage share of workers in the economy—and that also for only one year, 2021–22. This is to ensure that there is mapping to the I-O analysis. Then sectors are ranked separately based on the above two indicators. The top 25 sectors are chosen that appear in both the separate lists are shown in Table 2.2.<sup>4</sup>

---

<sup>4</sup> Depending on one's goal, one can choose different indicators to select sectors. For example, Bhandari and Sahu (2025) show that one can choose percentage share of workers and employment intensity to select sectors that maximise employment.

Bhandari, B. and Sahu, A.K. 2025. "Moving Workers from Agriculture to Where?" *Economic & Political Weekly*. <https://www.epw.in/engage/article/moving-workers-agriculture-where>. March 2.

**Table 2.2: Top 25 sectors with the highest share of GVA and employment, 2021–22**

| <i>S.No.</i> | <i>Share of GVA</i>                                                                                    | <i>Share of Employment</i>                                                                                                                                                                      |
|--------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.           | Trade                                                                                                  | Agriculture                                                                                                                                                                                     |
| 2.           | Agriculture                                                                                            | Construction                                                                                                                                                                                    |
| 3.           | Construction                                                                                           | Trade                                                                                                                                                                                           |
| 4.           | Computer related services                                                                              | Livestock                                                                                                                                                                                       |
| 5.           | Public administration and defence                                                                      | Land transport                                                                                                                                                                                  |
| 6.           | Ownership of dwellings                                                                                 | Education and research                                                                                                                                                                          |
| 7.           | Financial services                                                                                     | Manufacture of wearing apparel, except custom tailoring                                                                                                                                         |
| 8.           | Livestock                                                                                              | Other services                                                                                                                                                                                  |
| 9.           | Education and research                                                                                 | Hotels and restaurant                                                                                                                                                                           |
| 10.          | Other business services                                                                                | Public administration and defence                                                                                                                                                               |
| 11.          | Land transport                                                                                         | Manufacture of textiles + cotton ginning                                                                                                                                                        |
| 12.          | Manufacture of textiles + cotton ginning                                                               | Medical and health                                                                                                                                                                              |
| 13.          | Manufacture of basic iron and steel + Casting of iron and steel                                        | Community, social and personal services                                                                                                                                                         |
| 14.          | Manufacture of transport                                                                               | Computer related services                                                                                                                                                                       |
| 15.          | Communication                                                                                          | Manufacture of electronic component, consumer electronics, magnetic and optical media; Manufacture of computer and peripheral equipment and repair; and Installation of machinery and equipment |
| 16.          | Electricity                                                                                            | Manufacture of other non-metallic mineral products                                                                                                                                              |
| 17.          | Medical and Health                                                                                     | Financial services                                                                                                                                                                              |
| 18.          | Manufacture of chemical and chemical products except pharmaceuticals, medicinal and botanical products | Other business services                                                                                                                                                                         |
| 19.          | Forestry and Logging                                                                                   | Manufacture of fabricated metal products, except machinery and equipment                                                                                                                        |
| 20.          | Manufacture of machinery and equipments n.e.c.                                                         | Manufacture of tobacco products                                                                                                                                                                 |
| 21.          | Manufacture of other non-metallic mineral products                                                     | Other manufacturing                                                                                                                                                                             |
| 22.          | Manufacture of pharmaceutical; medicinal chemicals and botanical products                              | Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting material                                                                  |
| 23.          | Manufacture of coke and refined petroleum products                                                     | Manufacture of furniture                                                                                                                                                                        |
| 24.          | Fishing and aquaculture                                                                                | Manufacture of other food products                                                                                                                                                              |
| 25.          | Trade                                                                                                  | Printing and reproduction of recorded media, except publishing                                                                                                                                  |

Sources: NCAER computations from

1. Ministry of Statistics and Programme Implementation, Government of India. 2023. *Periodic Labour Force Survey (PLFS), July 2021-June 2022*. Document No.: DDI-IND-CSO-PLFS-2021-22. <https://microdata.gov.in/nada43/index.php/catalog/165/study-description>.
2. Ministry of Statistics and Programme Implementation, Government of India. 2024. National Accounts. <https://mospi.gov.in/data>.

## 2.4 Ranking Sectors

IV. The top 25 sectors which have the highest share of GVA are first ranked. The rankings of these sectors regarding share of jobs, GVA and employment multiplier

are mapped. Table 2.3 shows the summarised results—the number of times a sector appears in the top 25 lists using the four indicators. For example, the agricultural sector appears in the top 25 rankings of all the four indicators. However, manufacture of transport sector only appears in one top 25 ranking namely the share of GVA.

**Table 2.3: Number of top 25 lists that the sector appears in (max = 4)**

| <b>Sector</b>                                                                                          | <b>No. of top 25 lists that the sector appears in (Max=4)</b> |
|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Trade                                                                                                  | 4                                                             |
| Agriculture                                                                                            | 4                                                             |
| Livestock                                                                                              | 4                                                             |
| Community, social & personal services                                                                  | 4                                                             |
| Construction                                                                                           | 3 (Share of GVA, Share of Jobs & Employment Multiplier)       |
| Education and research                                                                                 | 3 (Share of GVA, Share of Jobs & GVA Multiplier)              |
| Other business services                                                                                | 3 (Share of GVA, Share of Jobs & GVA Multiplier)              |
| Land transport                                                                                         | 3 (Share of GVA, Share of Jobs & Employment Multiplier)       |
| Manufacture of textiles + cotton ginning                                                               | 3 (Share of GVA, Share of Jobs & Employment Multiplier)       |
| Computer related services                                                                              | 2 (Share of GVA & Share of Jobs)                              |
| Public administration and defence                                                                      | 2 (Share of GVA & Share of Jobs)                              |
| Ownership of dwellings                                                                                 | 2 (Share of GVA & GVA Multiplier)                             |
| Financial services                                                                                     | 2 (Share of GVA & Share of Jobs)                              |
| Manufacture of basic iron and steel + Casting of iron and steel                                        | 2 (Share of GVA & GVA Multiplier)                             |
| Communication                                                                                          | 2 (Share of GVA & GVA Multiplier)                             |
| Electricity                                                                                            | 2 (Share of GVA & GVA Multiplier)                             |
| Medical and health                                                                                     | 2 (Share of GVA & Share of Jobs)                              |
| Manufacture of chemical and chemical products except pharmaceuticals, medicinal and botanical products | 2 (Share of GVA & GVA Multiplier)                             |
| Forestry and logging                                                                                   | 2 (Share of GVA & GVA Multiplier)                             |
| Manufacture of other non-metallic mineral products                                                     | 2 (Share of GVA & Share of Jobs)                              |
| Manufacture of coke and refined petroleum products                                                     | 2 (Share of GVA & GVA Multiplier)                             |
| Fishing and aquaculture                                                                                | 2 (Share of GVA & GVA Multiplier)                             |
| Manufacture of transport                                                                               | 1 (Share of GVA)                                              |
| Manufacture of machinery and equipment n.e.c.                                                          | 1 (Share of GVA)                                              |
| Manufacture of pharmaceutical; medicinal chemicals and botanical products                              | 1 (Share of GVA)                                              |

Source: NCAER computations.

## 2.5 Sunrise Sectors

- V. From the Union Budget Speech of the Honourable Finance Minister 2022–23, the sunrise sectors are identified—Agri-tech, Artificial intelligence, Deep tech and digital economy, Geospatial systems and drones, Semiconductor and its eco-system, Space economy, Genomics and pharmaceuticals, pharma, Green energy, Clean mobility systems and Climate action.<sup>5</sup> These sectors are then mapped on to the 64 sectors. Table 2.4 shows that correspondence map.

**Table 2.4: Sunrise sectors**

| <i>S.No.</i> | <i>Sunrise Sector<br/>(mentioned in Union<br/>Budget 2022–23)</i> | <i>Sector</i> | <i>Sub-sector</i>                                                                  | <i>Ranks</i>                               |
|--------------|-------------------------------------------------------------------|---------------|------------------------------------------------------------------------------------|--------------------------------------------|
| 1.           | Agri-tech                                                         | Primary       | Agriculture                                                                        | Top 25 GVA and<br>Employment<br>Multiplier |
| 2.           | Artificial intelligence,<br>deep tech and digital<br>economy      | Tertiary      | Computer related services                                                          | GVA Multiplier<br>Rank 28                  |
| 3.           | Geospatial systems and<br>drones                                  | Secondary     | Manufacture of computer,<br>electronic and optical products                        | GVA Multiplier<br>Rank 63                  |
| 4.           | Semiconductor and its<br>eco-system                               | Secondary     | Manufacture of<br>communication equipment                                          | GVA Multiplier<br>Rank 62                  |
| 5.           | Space economy                                                     | Tertiary      | Air transport                                                                      | GVA Multiplier<br>Rank 30                  |
| 6.           | Genomics and<br>pharmaceuticals,<br>pharma                        | Secondary     | Manufacture of<br>pharmaceutical; medicinal<br>chemicals and botanical<br>products | GVA Multiplier<br>Rank 55                  |
| 7.           | Green energy                                                      | Secondary     | Electricity                                                                        | Top 25 GVA                                 |
| 8.           | Clean mobility systems                                            | Secondary     | Manufacture of transport                                                           | GVA Multiplier<br>Rank 59                  |
| 9.           | Climate action                                                    |               |                                                                                    |                                            |

Source: NCAER Conceptualisation from the Ministry of Finance, Government of India. 2023. Union Budget 2022–23.  
<https://www.indiabudget.gov.in/budget2022-23/>.

## 2.6 Selected Sectors: Intermediate Step

- VI. The Inception Report had mentioned that two sectors each from the Primary, Secondary, and Tertiary sectors were to be selected. Table 2.3 gives information about a sector's current competitiveness and Table 2.4 about a sector's future potential. Therefore, in each broad sector of primary, secondary, and tertiary, one sector each is chosen for its current competitiveness (Table 2.3) and one for its future potential (Table 2.4). Table 2.5 shows the selected sectors. Alternative sectors to the six ones selected are presented in Annexure 2.3.

<sup>5</sup> Newer sunrise sectors may have emerged after the Union Budget 2022–23, like technical textiles in the 'weaving of textiles sector'. The analysis would or should incorporate new and emerging sectors.

**Table 2.5: Integrated sectors from Tables 2.3 and 2.4 to select sectors**

| <b>S. No.</b> | <b>Sector</b> | <b>Sub-sector</b>         | <b>Appears in all 4 top 25 lists of Multipliers and Shares</b> | <b>Sunrise Sector (mentioned in Union Budget 2022–23)</b> | <b>Sector Skill Council(SSC)</b>              |
|---------------|---------------|---------------------------|----------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------|
| 1.            | Primary       | Agriculture               | 4                                                              | Agri-tech*                                                | Agriculture Skill Council of India (ASCI)     |
| 2.            | Primary       | Livestock                 | 4                                                              |                                                           | ASCI                                          |
| 3.            | Tertiary      | Trade                     | 4                                                              |                                                           | Retailers' Association Skill Council of India |
| 4.            | Tertiary      | Computer related services | 2                                                              | Artificial intelligence, Deep tech and digital economy    | IT-ITeS Sector Skill Council-NASSCOM          |
| 5.            | Secondary     | Construction              | 3                                                              |                                                           | Construction Sector Skill Council             |
| 6.            | Secondary     | Electricity               | 2                                                              | Green Energy                                              | Skill Council for Green Jobs                  |

Source: NCAER computations.

Notes: \* Agri-tech enterprises are registered as information technology sectors and can be classified too.

## 2.7 Policymakers' Inputs

VII. The last step involved taking in the policymakers' inputs. It was suggested to replace construction with manufacturing sectors. From Annexure 2.1, the top manufacturing sector in that list is manufacturing of textiles. That was selected. The sunrise manufacturing sector is manufacturing of electrical vehicles and therefore manufacturing of automotive sector was chosen. Consequently, instead of six as proposed in the ToR, seven sectors were selected (Table 2.6). The seven sectors selected are:

1. Primary
  - a. Agriculture
  - b. Livestock
2. Secondary
  - a. Manufacturing of textiles
  - b. Manufacturing of auto
  - c. Generation of green electricity
3. Tertiary
  - a. Retail
  - b. Computer-related services (Information Technology or IT)

**Table 2.6: Final selected sectors after policy direction**

| <b>S. No.</b> | <b>Sector</b> | <b>Sub-sector</b>                             | <b>Appears in all 4 top 25 lists of Multipliers and Shares</b> | <b>Sunrise Sector (mentioned in Union Budget 2022–23)</b> | <b>Sector Skill Council</b>                   |
|---------------|---------------|-----------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------|
| 1.            | Primary       | Agriculture                                   | 4                                                              | Agri-tech                                                 | ASCI                                          |
| 2.            | Primary       | Livestock                                     | 4                                                              |                                                           | ASCI                                          |
| 3.            | Tertiary      | Trade                                         | 4                                                              |                                                           | Retailers' Association Skill Council of India |
| 4.            | Tertiary      | Computer related services                     | 2 (Share of GVA & Share of Jobs)                               | Artificial intelligence, deep tech and digital economy    | IT-ITeS Sector Skill Council-NASSCOM          |
| 5.            | Secondary     | Manufacturing of Textiles plus cotton ginning | 3 (Share of GVA, Share of Jobs & Employment Multiplier)        |                                                           | Textiles Sector Skill Council                 |
| 6.            | Secondary     | Manufacture of Transport                      | 1 (Share of GVA)                                               | Clean mobility systems                                    | Automotive Sector Skill Council               |
| 7.            | Secondary     | Electricity                                   | 2 (Share of GVA and GVA Multiplier)                            | Green energy                                              | Skill Council for Green Jobs                  |

Source: NCAER Computations.

## 2.8 Identification of Sub-sectors

VIII. There are many sub-sectors within the above mentioned seven sectors. Therefore, it was recommended to narrow them down further. Data on GVA are not available at a disaggregated level on a consistent basis. Therefore, share of workers was used to select the largest sub-sector (using National Industrial Classification (NIC) codes) within each of the above seven sectors (Table 2.7).<sup>6</sup>

The sub-sectors selected within the seven sectors were the following (see Table 2.7) and Annexure 2.4 shows the summary data of all the above sectors and sub-sectors.

- Primary
  - Agriculture: Initially only growing of cereals (excluding rice), leguminous crops and oil seeds was selected but stakeholder interviews suggested that it was hard to separate out technology and skilled labour required for rice and other cereals. It was eminently more sensible to take the whole of cereals production and therefore one looks at cereal production wholly.

<sup>6</sup> “The National Industrial Classification (NIC) is an essential statistical standard for developing and maintaining comparable data base according to economic activities. Such classifications are frequently used in classifying the economically active population, statistics of industrial production and distribution, the different fields of labour statistics, and other economic data such as national income. Comparability of statistics available from various sources, on different aspects of the economy, and usability of such data for economic analysis, are prerequisite for standardization of a system of classification.”

Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India. National Industrial Classification 2008.  
[https://www.ncs.gov.in/Documents/NIC\\_Sector.pdf](https://www.ncs.gov.in/Documents/NIC_Sector.pdf).

- Growing of cereals (including rice), leguminous crops and oil seeds
  - Livestock
    - Raising of cattle and buffaloes
- Secondary
  - Manufacturing of textiles
    - Weaving of textiles was selected although not the largest sector within the 'manufacture of textiles' sector, it was more homogenous. The largest sub-sector 'manufacture of other textiles n.e.c.' was too diverse and mapping its skill needs within a particular a time frame would be challenging.
  - Manufacturing of auto
    - Manufacture of parts and accessories for motor vehicles
    - Manufacture of motor vehicles
    - Maintenance and repair of motor vehicles- While this sector is classified under retail, it will be included in the auto sector, enabling a holistic skill gaps assessment of motor vehicles sector.
  - Generation of green electricity
    - Electric power generation using solar energy
    - Electric power generation using other non-conventional sources
- Tertiary
  - Retail
    - Retail sale of food in specialised stores
    - Retail sale of clothing, footwear and leather articles in specialised stores
  - IT
    - Computer programming activities



**Table 2.7: Choosing sub-sectors at the NIC 4-digit level-I**

| S.No. | Sector    | Sub-sector                                    | Sub-Sector (Share of Jobs within the sector)                                                                                                                                                                |
|-------|-----------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.    | Primary   | Agriculture                                   | 1. Growing of cereals (except rice), leguminous crops and oil seeds (39%)<br>2. Growing of rice (33%)<br>3. Growing of fibre crops (6.6%)                                                                   |
| 2.    | Primary   | Livestock                                     | 1. Raising of cattle and buffaloes (46%)<br>2. Raising of sheep and goats (8.1%)<br>3. Raising of poultry (3.15%)                                                                                           |
| 3.    | Secondary | Manufacturing of Textiles plus cotton ginning | 1. Manufacture of other textiles n.e.c. (34.2%)<br>2. Weaving of textiles (32.3%)<br>3. Finishing of textiles (9.5%)                                                                                        |
| 4.    | Secondary | Manufacture of Transport                      | 1. Manufacture of parts and accessories for motor vehicles (49%)<br>2. Manufacture of motor vehicles (18.7%)<br>3. Manufacture of motorcycles (15.5%)                                                       |
| 5.    | Secondary | Electricity                                   | 1. Electric power generation by coal-based thermal power plants (22%)<br>2. Electric power generation using solar energy (6%)**<br>3. Electric power generation using other non-conventional sources (1.2%) |
| 6.    | Tertiary  | Trade                                         | 1. Retail sale of food in specialised stores (33.9%)<br>2. Retail sale of clothing, footwear and leather articles in specialised stores (8.4%)<br>3. Maintenance and repair of motor vehicles (3.7%)        |
| 7.    | Tertiary  | Computer related services                     | 1. Computer programming activities (49.7%)<br>2. Other information technology and computer service activities (34.3%)<br>3. Computer consultancy and computer facilities management activities (9.1%)       |

Source: NCAER Computations from Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2021-June 2022. Document No.: DDI-IND-CSO-PLFS-2021-22. <https://microdata.gov.in/nada43/index.php/catalog/165/study-description>.

Note: \*\*Selecting the largest sub-sector (using NIC codes) within the broad sector was not followed here because the focus was to capture the sunrise sectors within the broad sector.

## 2.9 Summary

This chapter shows a scientific measure of selecting sectors for analysis, which includes both growth and employment considerations while simultaneously thinking about future growth. The seven sectors selected for analysis in this report are:

1. Growing of cereals (including rice), leguminous crops and oil seeds
2. Raising of cattle and buffaloes
3. Weaving of textiles
4. Manufacturing of motor vehicles and parts & components of motor vehicles
5. Electric power generation of solar energy and other non-conventional sources
6. Retail sale of food, clothing, footwear, leather articles in specialised stores and maintenance and repair of motor vehicles (this was clubbed with the manufacturing of motor vehicles and parts & components of motor vehicles sector).
7. Computer programming activities.

## 3. Forecasting Jobs and Occupations Using Input-Output Analysis

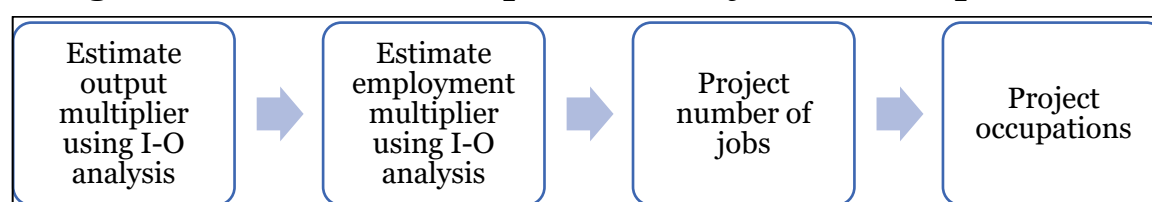
### 3.1 Introduction

The next step is to make a projection of jobs and occupational distribution of jobs within the selected sectors. Input-Output (I-O) analysis is used here (see Annexure 2.2 about background on I-O analysis). The advantages of this analysis are that it is a simultaneous approach across sectors and it gives an indication of both direct jobs in the specific sector and indirect jobs being created in other sectors too. However, projections about occupations can only be made about direct jobs. Projections are made for the year 2026–27.

The challenge is one of growth assumptions for each sector. Here the suggestion is that while one can look at past growth rates to develop assumptions, it is strongly recommended that it should be supported by alternative simulations.

The rest of the chapter illustrates the step-wise process for the baseline case where growth assumptions are made from past growth rates. The summarised steps for projecting jobs and occupations are illustrated in Figure 3.1.

**Figure 3.1: Summarised steps to forecast jobs and occupations**



Source: NCAER conceptualisation.

### 3.2 Projecting Gross Value of Output for 2026–27

The first step is projecting Gross Value of Output (GVO) for the year 2026–27 (as jobs creation is the result of output generation) based on certain growth assumptions for GVO. GVO numbers at current and constant (2011–12) prices are sourced from the MoSPI (2024a).<sup>32</sup> The broad (agriculture, livestock, manufacturing of textiles plus cotton ginning, manufacture of transport, electricity, trade and computer related services) sectors provided here are grouped in such a way that it corresponds to the 64 sector I-O tables estimated using the Supply Use Tables (SUTs) for 2018–19. Since the latest available data for GVO was 2022–23, this was assumed as the baseline year. For projecting GVO numbers for 2026–27 over the base year 2022–23, assumptions about two scenarios were made.

<sup>32</sup> MoSPI, Government of India. 2024a. INDIA – National Accounts Statistics 2024. <https://www.mospi.gov.in/publication/national-accounts-statistics-2024>.

### 3.2.1 Assumptions about GVO growth rates (real, i.e., in constant prices)

#### 3.2.1.1 Scenario 1: Past growth scenario

In this scenario, average of annual growth rates of real GVO (constant price GVO) at the broad sectoral levels for the past three normal years (2018–19, 2019–20 and 2022–23) are used as the growth rates for 2026–27 GVO projections (Table 3.1).

**Table 3.1. Assumptions of GVO growth rates from both scenarios for 2026–27**

| Sector                    | Scenario 1          | Scenario 2                      |
|---------------------------|---------------------|---------------------------------|
|                           | Past Growth Trend   | De-composition of IMF Forecasts |
|                           | GVO Growth Rate (%) | GVO Growth Rate (%)             |
| Agriculture               | 3                   | 4                               |
| Livestock                 | 6                   | 4                               |
| Textiles                  | (–)3                | (–)6                            |
| Transport                 | 9                   | 19                              |
| Electricity               | 5                   | 7                               |
| Trade                     | 9                   | 10                              |
| Computer-related services | 13                  | 12                              |

Source: NCAER computations with data sourced from NAS (GVA and GVO) and IMF (growth projections).

Note: Alternative credible projections may be explored based on availability of data and feasibility.

#### 3.2.1.2 Scenario 2: Overall Gross Domestic Product (GDP) growth projection being taken from the IMF (2024)<sup>33,34</sup>

The International Monetary Fund (IMF) projects Gross Domestic Product (GDP) growth rates for all countries. To calculate the GVO growth equivalent of the IMF projected GDP growth rate, following steps were followed.

- Used projection of 6.5 per cent GDP growth from the IMF World Economic Outlook for 2024–25 to 2026–27 (A)
- Since the ratio of real GDP growth rate to real Gross Value Added (GVA) growth rate for the years, 2018-19, 2019-20 and 2022–23 was 1.0, this ratio was used to derive the GVA growth rate of India for those years (B)
- Since the ratio of real GVO growth rate to real GVA growth rate for the years, 2018-19, 2019-20 and 2022–23 was 1.3, this was used to derive the GVO growth rate of India (C)

<sup>33</sup> International Monetary Fund. 2024. *World Economic Outlook Databases October 2024*. <https://www.imf.org/en/Publications/WEO/weo-database/2024/October>.

<sup>34</sup> Alternative growth assumptions may be made based on these alternative growth scenarios. Chaudhary, Pratap and Pohit (2024) use the alternative NITI Aayog assumptions to simulate the impact of net zero transition on employment. Similarly, if assumptions, policy priorities, goals and targets have to be modelled for either all 64 or selected sectors, one can tentatively estimate both the overall and sectoral impact on jobs and occupations.

Chaudhuri, C., Pratap, D. & Pohit, S. 2024. “Effect of Energy Transition Under Net-Zero Target on Employment.” *Ind. J. Labour Econ.* <https://doi.org/10.1007/s41027-024-00528-y>. November 30.

Thus, projected GVO growth rate for the economy using the IMF GDP growth projection number was estimated as  $A*B*C$  ( $6.5*1*1.3$ ), which comes to 8.5 per cent.

Using the projected growth rate for the economy as a whole, sectoral growth assumptions were estimated by using the following formula:

$$\text{Sectoral Contribution to overall GVO growth} = (\text{GVO Growth rate of the sector} * \text{GVO Share of the sector in overall GVO}) / \text{Overall GVO growth rate}$$

This can be re-written as,

$$\text{GVO growth rate of the sector} = (\text{Sectoral Contribution to overall GVO growth} * \text{Overall GVO growth rate}) / \text{GVO Share of the sector in overall GVO}$$

### 3.2.2 Projecting GVO in levels

The sectoral (real) growth rates are used to project real GVO for the year 2026–27 with 2022–23 being treated as a base year. Using GVO of 2022–23 and multiplying that with the assumed growth rates yields the 2026–27 real GVO. The projected GVO numbers for the seven broad sectors using growth assumptions from both scenarios are given in Table 3.2.

**Table 3.2: GVO projections in Rs lakh crore for 2026–27 at 2022–23 prices**

| Sector                    | GVO (₹ lakh crore) in 2022–23 prices |            |            |
|---------------------------|--------------------------------------|------------|------------|
|                           | 2022–23                              | 2026–27    |            |
|                           |                                      | Scenario 1 | Scenario 2 |
| Agriculture               | 31.2                                 | 34.9       | 36.4       |
| Livestock                 | 17.2                                 | 21.5       | 20.1       |
| Textiles                  | 11.5                                 | 10.2       | 8.9        |
| Transport                 | 18.2                                 | 25.8       | 37.2       |
| Electricity               | 11.0                                 | 13.5       | 14.4       |
| Trade                     | 35.9                                 | 51.1       | 52.9       |
| Computer-related services | 20.6                                 | 34.0       | 32.8       |

Source: NCAER computations with data sourced from NAS (GVA and GVO) and IMF (growth projections).

### 3.3 Projecting Jobs for 2026–27

Projecting jobs for 2026–27 involves the following steps:

- Deriving the labour inputs numbers for the 64 sectors by using the 2022–23 PLFS micro data released by the MoSPI. The details about this is mentioned in Annexure 2.1. Labour inputs (jobs) at the both selected sectoral and sub-sectoral levels are estimated by using the selected NIC codes. This gives the direct jobs estimated through PLFS numbers.
- Estimating the employment multiplier for the broad sectors by using the labour output ratio (L/Y) for 2022–23 and Leontief inverse for 2018–19. Estimation of employment multiplier is discussed in Annexure 2.2.<sup>35</sup>

<sup>35</sup> This I-O analysis only focusses on backward linkages.

The employment multipliers for the selected seven broad sectors are given in Table 3.3. The figures denote number of jobs created in the economy due to output worth Rs 1 crore in the said sector.

**Table 3.3: Employment multipliers**

| <b><i>Sector</i></b>      | <b><i>Employment<br/>Multiplier 2022–23</i></b> |
|---------------------------|-------------------------------------------------|
| Agriculture               | 91.2                                            |
| Livestock                 | 49.7                                            |
| Textiles                  | 27.4                                            |
| Transport                 | 11.8                                            |
| Electricity               | 9.4                                             |
| Trade                     | 24.1                                            |
| Computer-related services | 7.5                                             |

*Source:* NSS computations.

- The projected sectoral GVO for 2026–27 (Table 3.2) are used to project direct and indirect sectoral jobs for 2026–27. The method of jobs projection using employment multiplier and GVO is discussed in Annexure 2.2.  
Since the GVO numbers for 2026–27 are at 2022–23 prices, multiplying these with employment multipliers for 2022–23, we get number of projected jobs which is neutral of price change between 2022–23 and 2026–27. For example, if the GVO numbers were nominal, jobs projections would not be price change neutral. Output might have increased in nominal terms but real increase would be smaller, and so projected jobs would be higher than what it should be.
- The sub-sectors' proportion of jobs within the broad sectors are available from the PLFS for 2022–23. Those proportions are used to estimate the number of jobs for the selected sub-sectors for both the scenarios (Table 3.4).

**Table 3.4: Projected jobs in 2026–27 for selected sub-sectors**

| Lakh jobs                                                               | Growing of cereals, leguminous crops and oilseeds | Raising of cattle and buffaloes | Weaving of textiles | Manufacturing of motor vehicles, parts & accessories of motor vehicles | Electric power generation using solar energy and other non-conventional sources | Retail sale of food, clothing, footwear and leather articles in specialised stores and maintenance & repair of MVs | Computer programming activities |
|-------------------------------------------------------------------------|---------------------------------------------------|---------------------------------|---------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>2022–23 from PLFS</b>                                                |                                                   |                                 |                     |                                                                        |                                                                                 |                                                                                                                    |                                 |
| Direct Jobs                                                             | 1,789.6                                           | 206.1                           | 22.6                | 13.9                                                                   | 1.1                                                                             | 261.3                                                                                                              | 25.9                            |
| <b>2022–23 using I-O Analysis</b>                                       |                                                   |                                 |                     |                                                                        |                                                                                 |                                                                                                                    |                                 |
| Direct jobs                                                             | 1,849.9                                           | 207.6                           | 29.9                | 17.6                                                                   | 1.1                                                                             | 281.0                                                                                                              | 26.4                            |
| Direct + Indirect jobs                                                  | 2,034.8                                           | 394.5                           | 101.7               | 145.7                                                                  | 7.5                                                                             | 393.3                                                                                                              | 76.6                            |
| <b>Scenario 1 using Past Growth Rates: Projections for 2026–27</b>      |                                                   |                                 |                     |                                                                        |                                                                                 |                                                                                                                    |                                 |
| Direct jobs                                                             | 2,066.3                                           | 259.4                           | 26.4                | 24.9                                                                   | 1.3                                                                             | 399.7                                                                                                              | 43.7                            |
| Direct+ Indirect jobs                                                   | 2,272.9                                           | 492.8                           | 89.8                | 206.5                                                                  | 9.2                                                                             | 559.5                                                                                                              | 126.6                           |
| % Change in direct jobs over 2022–23 using I-O Analysis                 | 11.7                                              | 24.9                            | -11.6               | 41.7                                                                   | 22.4                                                                            | 42.3                                                                                                               | 65.3                            |
| <b>Scenario 2 using IMF Growth Projections; Projections for 2026–27</b> |                                                   |                                 |                     |                                                                        |                                                                                 |                                                                                                                    |                                 |
| Direct jobs                                                             | 2,157.5                                           | 241.9                           | 23.2                | 35.8                                                                   | 1.4                                                                             | 414.4                                                                                                              | 42.1                            |
| Direct+ Indirect jobs                                                   | 2,373.3                                           | 459.7                           | 78.9                | 297.4                                                                  | 9.8                                                                             | 580.1                                                                                                              | 122.2                           |
| % Change in direct jobs over 2022–23 using I-O Analysis                 | 16.6                                              | 16.5                            | -22.4               | 104.1                                                                  | 30.1                                                                            | 47.5                                                                                                               | 59.6                            |

Source: NCAER computations.

### Projecting Jobs for 2026–27 across main occupations in the seven selected sub-sectors

The PLFS, apart from giving details of workers as per their industry of engagement (NIC codes at 5–digits), also gives the occupations of the workers. These are at the National Classification of Occupations (NCO) 3–digit level.<sup>36</sup> The projected jobs for

<sup>36</sup> “The NCO-2015 has 8-digit coding structure which was mapped and aligned to ISCO-2008 with the addition of 2 digits. There is one to one correspondence between ISCO-2008 and the NCO-2015 with

the year 2026–27 can be distributed across occupations. However, this has to be done by taking the proportion of each occupation at the 2022–23 level. Plus, only account of the direct jobs associated with sectors can be given. The reason being engagement of indirect jobs created by a sector due to its interlinkages cannot be assigned to particular sectors due to layers of interlinkages playing in the background.

The distribution of direct jobs across major occupations in the seven sub-sectors are given in Tables 3.5 to 3.11.

**Table 3.5: Projected jobs (in lakhs) across top five NCO codes in ‘growing of cereals, leguminous crops and oilseeds’**

| NCO<br>2015<br>Code | Name                                         | Description                                                                                                | PLFS                                         |                                     | Projections                          |                                      |
|---------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|
|                     |                                              |                                                                                                            | Share in<br>Total<br>Jobs,<br>2022–23<br>(%) | Total<br>Jobs<br>2023–23<br>(lakhs) | Scenario 1<br>Projections<br>(lakhs) | Scenario 2<br>Projections<br>(lakhs) |
| 611                 | Market gardeners & crop growers              | Cultivator, tree and shrub crop growers, gardeners, mixed crop growers, agriculture information management | 69.4                                         | 1,116.6                             | 1,433.3                              | 1,496.6                              |
| 921                 | Agricultural, forestry and fishery labourers | Crop farm labourers, livestock farm labourers, garden and horticultural labourers                          | 19.6                                         | 315.9                               | 406.0                                | 423.9                                |
| 631                 | Subsistence crop farmers                     | Tree trimmer and pruner                                                                                    | 8.9                                          | 143.4                               | 184.3                                | 192.4                                |
| 613                 | Mixed crop and animal workers                | Seed grower/quality seed grower, seed processing worker                                                    | 1.0                                          | 15.4                                | 19.18                                | 20.7                                 |
| 633                 | Subsistence mixed crop and livestock farmers |                                                                                                            | 0.4                                          | 6.9                                 | 8.9                                  | 9.3                                  |

Source: NCAER Computations.

the first digit representing the Division (Major Group), second digit representing Sub-Division (Sub-Major Group), third digit representing the Group (Minor Group) and the fourth digit representing the Family (Unit Group), a decimal is introduced after the first four digits in order to create a distinction between the Families and individual Occupations.”

National Career Services. 2016. National Classification of Occupations 2015.  
[https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20\\_Vol%20I-%202015.pdf](https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20_Vol%20I-%202015.pdf)

Directorate General of Employment, Ministry of Labour and Employment, Government of India, New Delhi.



**Table 3.6: Projected jobs (in lakhs) across top five NCO codes in ‘raising of cattle and buffaloes’**

| NCO<br>2015<br>Code | Name                            | Description                                                          | PLFS                                      |                                     | Projections           |                       |
|---------------------|---------------------------------|----------------------------------------------------------------------|-------------------------------------------|-------------------------------------|-----------------------|-----------------------|
|                     |                                 |                                                                      | Share in<br>Total Jobs,<br>2022–23<br>(%) | Total<br>Jobs<br>2023–23<br>(lakhs) | Scenario 1<br>(lakhs) | Scenario 2<br>(lakhs) |
| 612                 | Animal producers                | Livestock and dairy producers, animal producers n.e.c.               | 87.3                                      | 209.1                               | 226.4                 | 211.2                 |
| 521                 | Street and market salespersons  | Stall and market salespersons, street food salespersons (milkman)    | 4.0                                       | 9.7                                 | 10.5                  | 9.8                   |
| 632                 | Subsistence livestock farmers   |                                                                      | 3.8                                       | 9.2                                 | 10.0                  | 9.3                   |
| 613                 | Mixed crop and animal workers   | Artificial breeding technician, mixed crop and animal workers, other | 2.8                                       | 6.7                                 | 7.2                   | 6.7                   |
| 611                 | Market gardeners & crop growers | Mixed crop growers, agriculture information management               | 0.6                                       | 1.5                                 | 1.6                   | 1.5                   |

Source: NCAER Computations.

**Table 3.7: Projected jobs (in lakhs) across top five NCO codes in ‘weaving of textiles’**

| NCO<br>2015<br>Code | Name                                      | Description                                                                                                                                                                 | PLFS                                      |                                     | Projections           |                       |
|---------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-------------------------------------|-----------------------|-----------------------|
|                     |                                           |                                                                                                                                                                             | Share in<br>Total Jobs,<br>2022–23<br>(%) | Total<br>Jobs<br>2023–23<br>(lakhs) | Scenario 1<br>(lakhs) | Scenario 2<br>(lakhs) |
| 731                 | Handicraft workers                        | Handicraft workers in textiles, leather and related materials                                                                                                               | 66.8                                      | 13.3                                | 17.7                  | 15.5                  |
| 815                 | Textile, fur and leather products machine | Fibre preparing, spinning and winding machine operators, weaving and knitting machine operators, sewing machine operators, bleaching, dyeing and cleaning machine operators | 12.4                                      | 2.5                                 | 3.3                   | 2.9                   |
| 753                 | Garment and related trades workers        | Garment and related pattern makers and cutters, sewing, embroiderers and related workers                                                                                    | 8.0                                       | 1.6                                 | 2.1                   | 1.9                   |
| 112                 | Managing directors and chief executives   | Director manufacturing                                                                                                                                                      | 3.6                                       | 0.7                                 | 1.0                   | 0.8                   |
| 632                 | Manufacturing labourers                   |                                                                                                                                                                             | 2.0                                       | 0.4                                 | 0.5                   | 0.5                   |

Source: NCAER computations.



**Table 3.8: Projected jobs (in lakhs) across top five NCO codes in ‘manufacturing of motor vehicles (MVs), parts & accessories of MVs and repair and maintenance of MVs’**

| NCO<br>2015<br>Code | Name                                               | Description                                                                                                 | PLFS                                   |                                     | Projections                          |                                      |
|---------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|
|                     |                                                    |                                                                                                             | Share in<br>Total Jobs,<br>2022–23 (%) | Total<br>Jobs<br>2023–23<br>(lakhs) | Scenario 1<br>Projections<br>(lakhs) | Scenario 2<br>Projections<br>(lakhs) |
| 723                 | Machinery mechanics and repairers                  | MV mechanics and repairers                                                                                  | 58.5                                   | 18.3                                | 26.0                                 | 30.8                                 |
| 932                 | Manufacturing labourers                            |                                                                                                             | 6.9                                    | 2.2                                 | 3.1                                  | 3.6                                  |
| 112                 | Managing director and chief executive              |                                                                                                             | 4.2                                    | 1.3                                 | 1.9                                  | 2.2                                  |
| 821                 | Assemblers                                         | Mechanical machinery assemblers, electrical and electronic equipment assemblers                             | 3.5                                    | 1.1                                 | 1.6                                  | 1.9                                  |
| 312                 | Mining, manufacturing and construction supervisors | Manufacturing supervisors                                                                                   | 2.7                                    | 0.9                                 | 1.2                                  | 1.4                                  |
| 311                 | Physical and engineering science technicians       | Electrical engineering technicians, electronics engineering technicians, mechanical engineering technicians | 2.4                                    | 0.8                                 | 1.1                                  | 1.3                                  |

Source: NCAER computations.

**Table 3.9: Projected jobs (in lakhs) across top five NCO codes in ‘electric power generation using solar energy and other non-conventional sources’**

| NCO<br>2015<br>Code | Name                                          | Description                                                                | PLFS                                         |                                     | Projections           |                       |
|---------------------|-----------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------|-------------------------------------|-----------------------|-----------------------|
|                     |                                               |                                                                            | Share in<br>Total<br>Jobs,<br>2022-23<br>(%) | Total<br>Jobs<br>2023-23<br>(lakhs) | Scenario 1<br>(lakhs) | Scenario 2<br>(lakhs) |
| 541                 | Protective service workers                    | Fire fighters, security guards                                             | 25.4                                         | 0.2                                 | 0.3                   | 0.4                   |
| 413                 | Keyboard operators                            | Typists and word processing operators, data entry clerks                   | 10.1                                         | 0.1                                 | 0.1                   | 0.1                   |
| 741                 | Electrical equipment installers and repairers | Electrical mechanics and fitters, electrical line installers and repairers | 9.7                                          | 0.1                                 | 0.1                   | 0.1                   |
| 932                 | Manufacturing labourers                       |                                                                            | 9.5                                          | 0.1                                 | 0.1                   | 0.1                   |
| 411                 | General office clerks                         |                                                                            | 7.8                                          | 0.1                                 | 0.1                   | 0.1                   |

Source: NCAER computations.

**Table 3.10: Projected jobs (in lakhs) across top five NCO codes in ‘retail sale of food, clothing, footwear, and leather articles in specialised stores’**

| NCO<br>2015<br>Code | Name                                    | Description                                                                       | PLFS                                         |                                     | Projections           |                       |
|---------------------|-----------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------|-----------------------|-----------------------|
|                     |                                         |                                                                                   | Share in<br>Total<br>Jobs,<br>2022-23<br>(%) | Total<br>Jobs<br>2023-23<br>(lakhs) | Scenario 1<br>(lakhs) | Scenario 2<br>(lakhs) |
| 522                 | Shop salespersons                       | Shopkeepers, shop supervisors, shop sales assistants                              | 76.5                                         | 173.6                               | 281.2                 | 291.6                 |
| 521                 | Street and market salespersons          | Stall and market salespersons, street food salespersons                           | 8.3                                          | 18.9                                | 30.5                  | 31.7                  |
| 112                 | Managing directors and chief executives | Director, retail trade, working proprietor, retail trade/proprietor, retail trade | 7.2                                          | 16.3                                | 26.4                  | 27.4                  |
| 952                 | Street vendors (excluding food)         | Hawker, street vendors, non-food products, other                                  | 2.3                                          | 5.1                                 | 8.3                   | 8.6                   |
| 524                 | Other sales workers                     |                                                                                   | 2.0                                          | 4.6                                 | 7.4                   | 7.7                   |

Source: NCAER computations.

**Table 3.11: Projected jobs (in lakhs) across top five NCO codes in ‘computer programming activities’**

| NCO<br>2015<br>Code | Name                                                       | Description                                                                                   | PLFS                                         |                                     | Projections              |                       |
|---------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------|--------------------------|-----------------------|
|                     |                                                            |                                                                                               | Share in<br>Total<br>Jobs,<br>2022–23<br>(%) | Total<br>Jobs<br>2023–23<br>(lakhs) | Scenario<br>1<br>(lakhs) | Scenario 2<br>(lakhs) |
| 251                 | Software and application developers, and analysts          | System analysts, software developers, web and multimedia developers, applications programmers | 77.4                                         | 19.6                                | 33.8                     | 32.6                  |
| 133                 | Information and communications technology services manager | Information and communication technology (ICT) services                                       | 5.0                                          | 1.3                                 | 2.2                      | 2.1                   |
| 112                 | Managing directors and chief executives                    |                                                                                               | 2.1                                          | 0.5                                 | 0.9                      | 0.9                   |
| 216                 | Architects, planners, surveyors and designers              | Graphic and multimedia designers                                                              | 2.1                                          | 0.5                                 | 0.9                      | 0.9                   |
| 413                 | Keyboard operators                                         | Typists and word processing operators, data entry clerks                                      | 2.0                                          | 0.5                                 | 0.9                      | 0.8                   |

Source: NCAER computations.

### 3.5 Limitations of I-O Analysis

The objective is to assess skills shortages and gaps, which may be done at the occupational level. However, the I-O analysis has some shortcomings for this particular analysis:

- The NIC codes are insufficient to capture the technological changes that are taking place in the industries. For example,
  - The wind energy sector is a new and upcoming sector in India, but it is not captured separately. NIC code 35106 captures electric power generation using other non-conventional sources and the wind energy sector is subsumed under this.
  - The Information Technology (IT) sector has only NIC code, 6201, for ‘computer programming activities’. But IT has several sub-sectors—IT Services (ITS), Business Process Management (BPM), Engineering Research and Development (ER&D), Software Products Development (SPD), Future Skills, etc.
  - A new emerging area in ‘weaving, manufacturing of man-made fibre and manmade mixture fabrics’ (NIC code 13124) is the technical textiles sector. It can be produced using either Power loom or shuttle-less technologies, which may require new job roles. Other types of textiles are

emerging like 3-D textiles, circular textiles, etc. which are not fully captured in NIC codes.

- Table 3.12 shows a summary of the technological changes that are affecting the seven industries considered under this report. They will be discussed in detail in the next section.
- Given that the PLFS data are only available at the NCO–3–digit level, it does not give precise information about which job code is actually in need. For example, the code 731 is for handicraft workers. However, the code for a power loom weaver is 7318.5500 and that for a handloom weaver is 7318.5800. It is challenging to understand from the I-O analysis where the need for jobs precisely are—handloom weaver or power loom weaver. The skill requirements for each job role would presumably would be very different.
- Further, while the code for a power loom weaver is available, it would be capturing four different types of technologies (plain loom, semi-automatic loom, automatic loom and shuttle-less loom), each of which would require different technical skills. The existing codes are unable to capture these nuances.

Therefore, I-O analysis is a necessary methodology but not a sufficient one. It has to be supplemented by other types of analysis to analyse demand for skills, skill shortages and gaps.

**Table 3.12: Technological changes in sector (industries)**

| <b>Sector</b>                                                           | <b>Digital technologies</b>                                                                                                | <b>Sector-Specific technology</b>                                                                                                                                                                                                               | <b>Others</b>                                                    |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Growing of cereals, leguminous crops and oilseeds (farms)               | Artificial intelligence, machine learning (ML), internet of things (IoT), big data and blockchain                          | Farm machinery, point of sale (PoS) and soil data                                                                                                                                                                                               | Drones, satellite data and statistical model                     |
| Raising cattle and buffaloes                                            | Artificial intelligence                                                                                                    | Artificial insemination                                                                                                                                                                                                                         | Improved refrigeration technologies for better milk preservation |
| Weaving of textiles                                                     | Artificial intelligence, ML, automation & digital technologies, supply chain invocations (traceability, block chain, etc.) | <ul style="list-style-type: none"> <li>• Sustainable Technologies (Eco-friendly chemicals/ dyes)</li> <li>• Circular/ Green/ Recycled/ Sustainable textiles</li> <li>• Advanced materials (technical textiles, smart textiles, etc.)</li> </ul> |                                                                  |
| Electric power generation using solar and other non-conventional energy | Software to read and forecast solar and wind data                                                                          | RE is a new technology in electricity sector; automation in O&M; Higher efficiency solar and wind modules, taller windmills                                                                                                                     | Offshore wind; green hydrogen                                    |
| Manufacturing of MVs & its auto parts and repair                        | Artificial intelligence/ML; software and cybersecurity                                                                     | BS4 to BS6 (transition to BS7); electric, hybrid, and flex fuel vehicles; electronics in motor                                                                                                                                                  | New materials and light-weighting components                     |

| <b>Sector</b>                           | <b>Digital technologies</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Sector-Specific technology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Others</b>                 |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | vehicles; automation and robotics in manufacturing and repair and maintenance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |
| Retail sale of food, clothing and shoes | Artificial intelligence, Digitised Supply Chain-IoT, GPS and RFID technology, Cloud/hybrid storage, AI/ML, blockchain, Automated data loggers barcode pricing                                                                                                                                                                                                                                                                                                                               | Electronic retail—Modern retail and e-Commerce; remote monitoring of stores                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Data analytics                |
| Information technology sector           | <ul style="list-style-type: none"> <li>• Python – AI/ML</li> <li>• Full stack developer</li> <li>• Image and signal processing</li> <li>• Natural language processing</li> <li>• Large language model building</li> <li>• Small language model building</li> <li>• Deep neural networks</li> <li>• Cyber cloud security</li> <li>• Cybersecurity:</li> <li>• Cloud computing</li> <li>• Data protection</li> <li>• Econometric modelling</li> <li>• Blockchain and 5G technology</li> </ul> | <ul style="list-style-type: none"> <li>• For Agri-tech, commerce and EV <ul style="list-style-type: none"> <li>○ Remote sensing</li> <li>○ Drip technology with cloud computing</li> </ul> </li> <li>• For Manufacturing <ul style="list-style-type: none"> <li>○ Robotics</li> <li>○ Embedded computing</li> <li>○ Digital twin</li> </ul> </li> <li>• Pharmaceutical and Medical <ul style="list-style-type: none"> <li>○ 3D modeling</li> <li>○ 3D printing</li> <li>○ Robotics: virtual and augmented reality (VR/AR)</li> <li>○ Nanotechnology</li> <li>○ Digital twin</li> <li>○ CRISPR</li> <li>○ Bioprinting</li> </ul> </li> </ul> | Information technology sector |

Source: NCAER conceptualisation from literature review and stakeholder interviews.

### 3.6 Conclusion

Input-Output analysis is a holistic way of studying the overall impact of a sector on the entire economy as it includes all the sectors of the economy and studies the interlinkages among the sectors of the economy. However, it has limitations like it assumes the technology to remain constant at the year for which the I-O tables are available. Thus, the sectoral dynamism remains uncaptured through the I-O analysis. In addition, due to limitations of data, it can forecast occupations at a very aggregated level, which does not completely answer the question at hand about forecasting demand for occupations.

This has to be supplemented by stakeholder interviews. The sectoral chapters in the next part give insights on this aspect.

## 4. Agriculture: Growing of Cereals (including Rice), Leguminous Crops and Oilseeds

### 4.1 Definition of the Sector

The specific sub-sectors in agriculture sector used in this report for analysis are NIC codes 0111 and 0112 (see Table 4.1). Annexure 4.1 shows the state-wise yield of cereals, pulses, and oilseeds.

**Table 4.1: Definition of the agricultural sub-sector used in the analysis**

| S.No. | NIC<br>4-digit<br>Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | NIC 5-digit<br>Code | Descriptions                                                                                    |
|-------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------|
| 1.    | 0111                   | Growing of cereals (except rice), leguminous crops and oil seeds: This class includes all forms of growing of cereals, leguminous crops and oil seeds in open fields, including those considered organic farming and the growing of genetically modified crops. The growing of these crops is often combined within agricultural units. This includes growing of wheat, jowar, bajra, millets, other cereals, pulses (dal) and other leguminous crops such as peas and beans, not used as oilseeds, mustard oil seed, groundnut oil seed, sunflower oil seed, soya bean oil seed, other oil seeds | 01111               | Growing of wheat                                                                                |
|       |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 01112               | Growing of jowar, bajra, and millets                                                            |
|       |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 01113               | Growing of other cereals                                                                        |
|       |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 01114               | Growing of pulses (dal) and other leguminous crops such as peas and beans, not used as oilseeds |
|       |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 01115               | Growing of mustard oil seed                                                                     |
|       |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 01116               | Growing of groundnut oil seed                                                                   |
|       |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 01117               | Growing of sunflower oil seed                                                                   |
|       |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 01118               | Growing of soya bean oil seed                                                                   |
|       |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 01119               | Growing of other oil seeds                                                                      |
| 2.    | 0112                   | Growing of rice: This class includes the growing of rice, including organic farming and the growing of genetically modified rice.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                                                                                 |

Source: Central Statistical Organisation, Ministry of Statistics and Programme Implementation. 2008. *National Industrial Classification (All Economic Activities)*. 2008. [https://www.ncs.gov.in/Documents/NIC\\_Sector.pdf](https://www.ncs.gov.in/Documents/NIC_Sector.pdf).

### 4.2 Value Chain

A value chain in agriculture identifies the set of actors and activities that bring a basic agricultural product from production in the field to final consumption, where at each stage value is added to the product. The various stages in the agricultural value chain and the usage of technologies in the various stages are explained below (Figure 4.1 and Table 4.2). Various stakeholders involve across the value chain are listed in Table 4.3.

- **Crop Planning:** The selection of a cropping plan is one of the initial stages in crop production at the farm level (Figure 4.1). The decision-making process

involves choosing which crops to cultivate, determining the acreage for each crop, and allocating them to specific plots, commodity price, and weather conditions.

Usage of Artificial Intelligence, Machine Learning, and use of Big data may help in improving yield (Table 4.2).

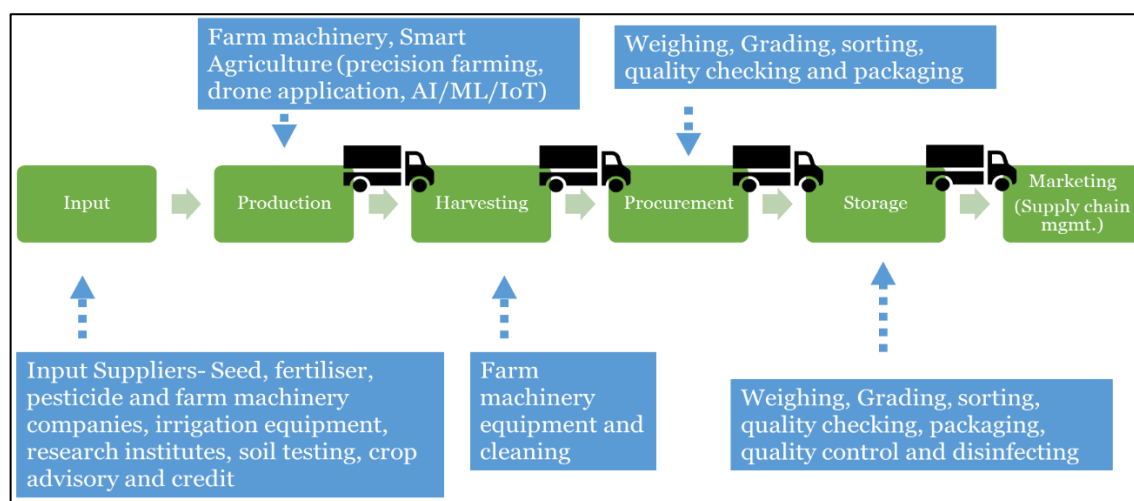
Skilling needs would arise for farmers, agri-startups, input suppliers, technical and extension personnel.

- **Cultivation (Input & Production):** Cultivation deals with the preparation of fields for agriculture (Figure 4.1). This includes preparation of soil, access to credit, sowing of seeds, irrigation, and application of manure, pesticides, and fertilisers to the crops.

Satellite and drone imagery are used alongside other internet of things (IoT) sensors to monitor crop health and soil conditions (Table 4.2). The data collected by these devices can be used to optimise irrigation schedules, predict weather patterns and digitize pest control. Modern tractors are highly automated and come with a range of features, such as GPS navigation, automated steering systems and hydraulic attachments, which increase efficiency.

Skilling needs would arise for farmers, farm mechanics, farm machine operators, financial institutions which give credit to farmers like Primary Agricultural Cooperative Societies, extension personnel, input suppliers like Custom Hiring Centres (CHCs) and soil testing laboratories.

**Figure 4.1: Agriculture value chain**



Source: NCAER Conceptualisation from Literature.

- **Harvesting:** Once the crops are mature or fully ripe, they are cut and gathered (reaping), collectively called harvesting (Figure 4.1). Harvesting depends on factors such as season, crop variety, and maturity period. In recent times, machines called harvesters have been used for harvesting, especially in large-scale farming.

Skilling needs would arise for farm machinery operators, crop harvesters, CHCs and farm machinery training centres. Female farmers need to be skilled so as to enable them to use farm machinery and agri-tech.



Sarkar (2020) and Aryal et al. (2021) show that the probability of ownership of farm machinery increases with education and/or training in agriculture<sup>1</sup>.

- **Supply Chain, Market, Quality:** This covers post-production activities like processing, grading and sorting, storage, transportation, marketing, and commodity pricing. Procurement and storage are included in these processes (Figure 4.1).

Supply chain technologies such as blockchain, big data analysis, and machine learning can help farmers, growers, and manufacturers track their produce from farm to table. Better supply chain management leads to greater efficiency in resource use, reduced waste, more accurate forecasting, and improved customer satisfaction.

Skilling needs arise in processing, grading, and sorting stages. This can be done both manually and mechanically. This needs workers with the knowledge of shape, size, moisture content, etc. Storage needs workers in warehouses who check the quality of produce, fumigate produce to maintain its quality, etc. Even mandis need workers to track the arrival of produce, awareness of annual price trends, current and future market prices. These workers are setting the prices in the mandis. Skilled workers like loaders, packers working in mandis offer better packaging technologies, which reduce post-harvest wastage.

**Table 4.2: Usage of technologies at various stages of agriculture value chain**

| <b>S. No.</b> | <b>Theme/Segment of agriculture value chain</b> | <b>Value-added service innovative service</b> | <b>Technologies to be used</b>                                                                                   |
|---------------|-------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| 1.            | Crop Planning                                   | Micro and Macro Crop Planning                 | Artificial Intelligence (AI), Machine Learning (ML), Statistical Models, Soil data, Big Data, and Satellite Data |
| 2.            | Cultivation (Input & Production)                | Smart Farming                                 | Farm machinery, AI, ML, IoT, Drones, Satellite Data, and PoS                                                     |
| 3.            | Harvesting                                      |                                               | Farm machinery                                                                                                   |
| 4.            | Supply Chain                                    | Logistics                                     | Blockchain                                                                                                       |
| 5.            | Market                                          | Market Connect                                | AI, Satellite Data, and IoT                                                                                      |
| 6.            | Quality                                         | Quality Testing & Traceability                | IoT, Blockchain                                                                                                  |

Source: Adapted from Department of Agriculture, Cooperation and Farmer Welfare. 2021. Consultation Paper on IDEA: India Digital Eco-system of Agriculture.

<sup>1</sup> Sarkar, A. 2020. "Agricultural Mechanisation in India: A Study on the Ownership and Investment in Farm Machinery by Cultivator Households across Agro-ecological Regions". *Millennial Asia* 11. (2): 160–186.

Aryal, J.P., Rahut, D.B., Thapa, G., and Simtowe, F. 2021. "Mechanisation of Small-Scale farms in South Asia: Empirical evidence derived from farm households survey". *Technology in Society* 65: 1–14.



**Table 4.3: Stakeholders at various stages of value chain**

| Stage                 | Stakeholders                                                                                                                                                                                                                                  |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Crop Planning         | Farmers, Krishi Vigyan Kendras, Agriculture Ministry at National and State Level, Indian Council of Agricultural Research (ICAR) Institutes and State Agricultural Universities, Soil Testing Labs, Seed Testing labs, Agri-tech Start-ups    |
| Cultivation           | Farmers, Seed companies/dealers; Fertiliser Companies/dealers; Farm Machinery companies/dealers; Irrigation Pump Manufacturers/dealers; Custom Hiring Centres, Credit Institutions, Farmer Producer Organisations (FPOs), Agri-tech Start-ups |
| Harvesting            | Farmers, Custom hiring Centres, Farm machinery dealers/operators, Farmer Producer Organisation, Agri-tech Start-ups                                                                                                                           |
| Storage and Transport | Warehouses/Cold Storage, Transporter, Farmer Producer Organisation, Agri-tech Start-ups                                                                                                                                                       |
| Marketing             | APMC Mandis, Farmer Producer Organisations(FPOs), State Marketing Federations, Procurement Agencies, Farmer Producer Organisations, Agri-tech Start-ups                                                                                       |

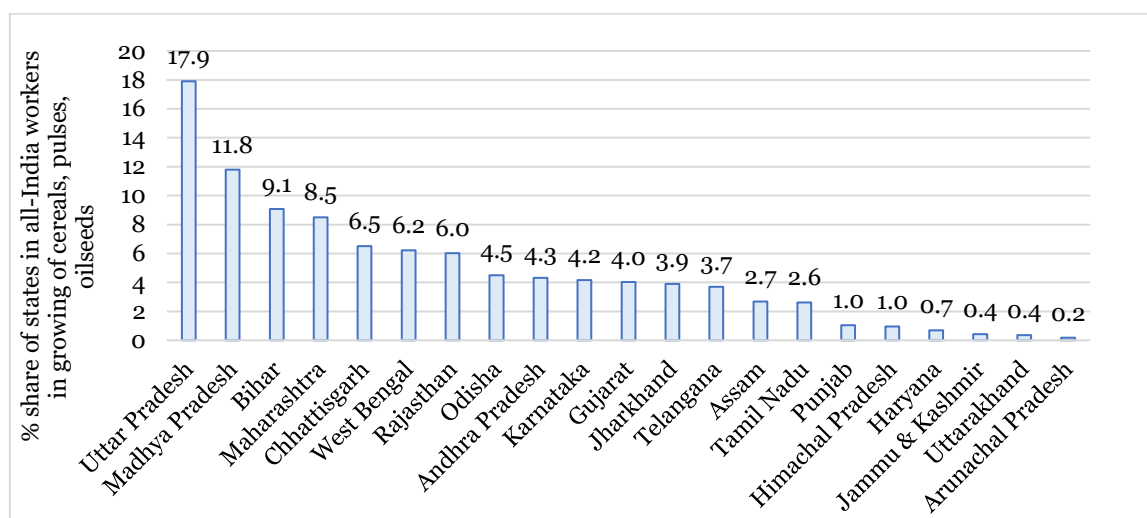
Source: NCAER conceptualisation.

### 4.3 Workforce Characteristics

The workers in this sub-sector are either low-skilled or low-medium skilled, concentrated in occupation. Nine states employ 75 per cent of the workers. Females form 41.4 per cent of the workers in this sector. They are low-skilled and 50 per cent of the workers are employed as helpers. Any skilling programme has to be designed keeping women in mind.

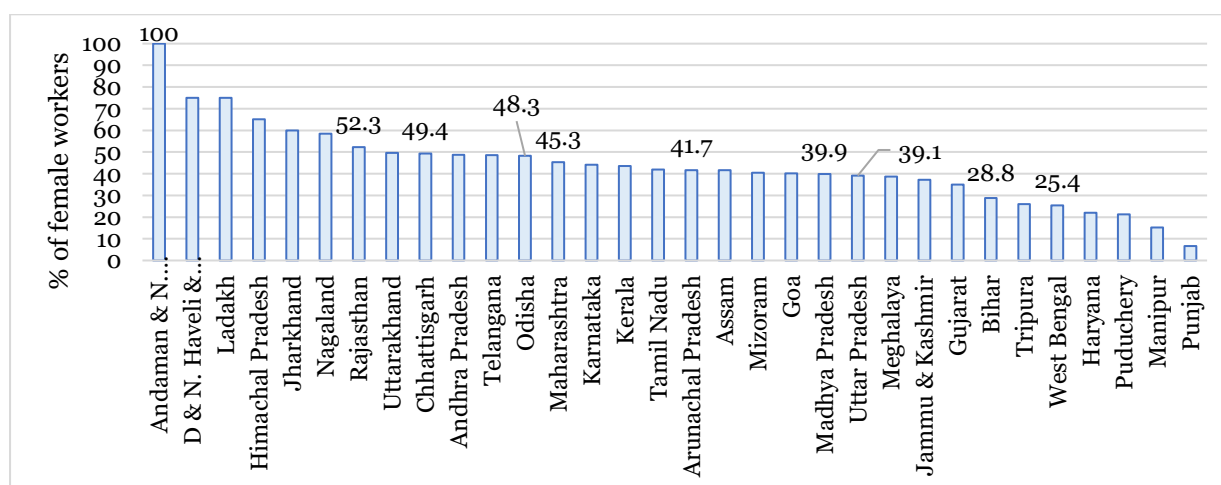
- 41.4 per cent of workers engaged in growing of cereals (including rice), leguminous crops and oil seeds are females.
- Across States: 75 per cent of the workers engaged in growing cereals (including rice), leguminous crops and oil seeds are concentrated in nine states namely Uttar Pradesh, Madhya Pradesh, Bihar, Maharashtra, Chhattisgarh, West Bengal, Rajasthan, Odisha, and Andhra Pradesh (Figure 4.2). Female workers at 52.4 per cent and West Bengal the lowest at 25.4 per cent (Figure 4.3).
- Across Education: Overall 35 per cent of workers in the sector are not literate. The corresponding numbers for male workers are 25 per cent and females are 50 per cent (Figure 4.4). Almost all the workers have not received any technical education. 32.2 per cent of workers have received non-formal vocational education, mostly through hereditary means (Figure 4.5).

**Figure 4.2: 75 per cent of the workers engaged in growing cereals (including rice), leguminous crops, and oil seeds are concentrated in 9 States namely Uttar Pradesh, Madhya Pradesh, Bihar, Maharashtra, Chhattisgarh, West Bengal, Rajasthan, Odisha and Andhra Pradesh**



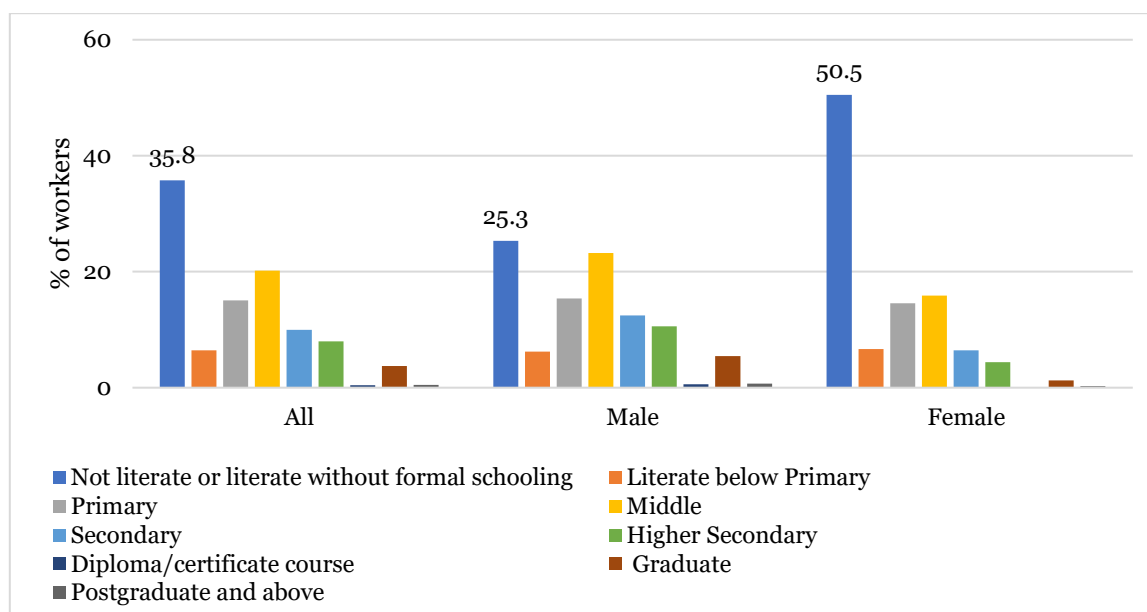
Source: NCAER computations from Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022–June 2023. Document No.: DDI-IND-CSO-PLFS-2022–23. <https://microdata.gov.in/nada43/index.php/catalog/179/study-description>. (PLFS 2022–23)

**Figure 4.3: Percentage share of female workers (aged 15+) in growing cereals (including rice), leguminous crops, and oilseeds 2022–23**



Source: NCAER analysis from PLFS 2022–23.

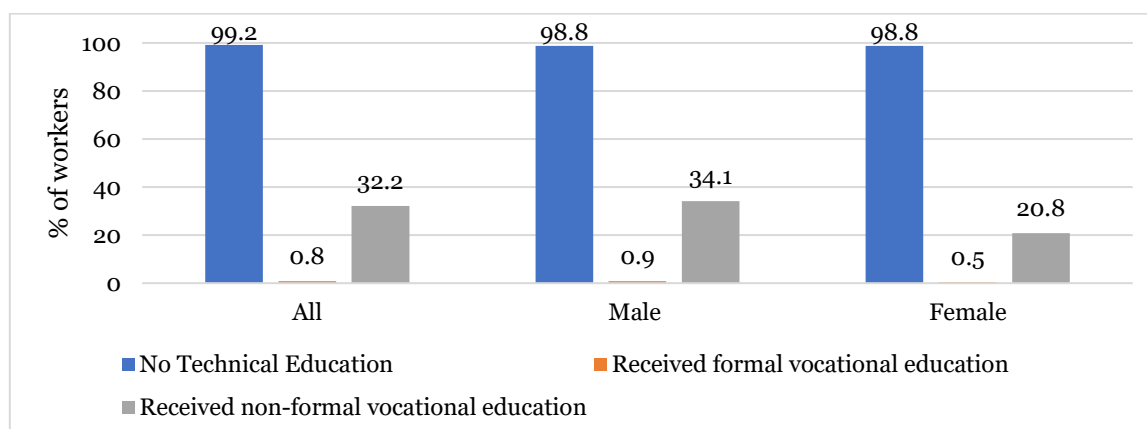
**Figure 4.4: Percentage of agricultural (cereals including rice, leguminous crops, and oilseeds) workers by educational attainment, 2022–23**



Source: NCAER analysis from PLFS 2022–23.

Note: Not Literature includes data from the following four categories - Not literate, Literate without formal schooling: EGS/ NFEC/ AEC, TLC and not literate\_Others.

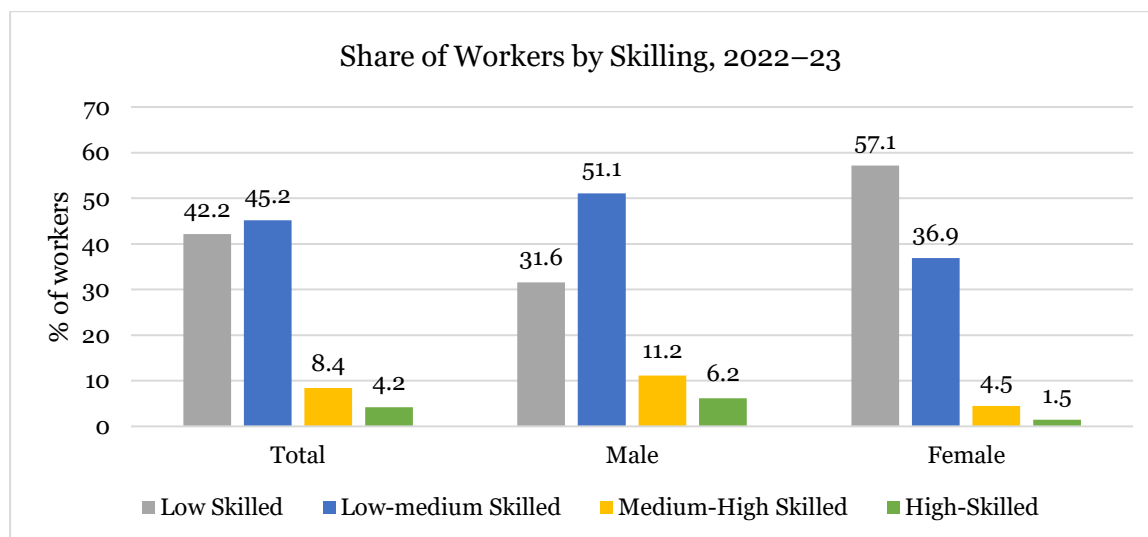
**Figure 4.5: Percentage of agricultural (cereals including rice, leguminous crops, and oil seeds) workers (aged 15+) who have not received technical education and workers who have received vocational education 2022–23**



Source: NCAER analysis from PLFS 2022–23.

- d. **Skills:** Majority of the workers are low-skilled or low-medium skilled (see Annexure 4.2 for definition of skills). However, majority of the female workers are low-skilled while male workers are low-medium skilled (Figure 4.6).

**Figure 4.6: A large proportion of female workers in cereal (including rice), leguminous crops, and oil seeds growing workers are low-skilled whereas a larger proportion of male farmers are low-medium skilled**

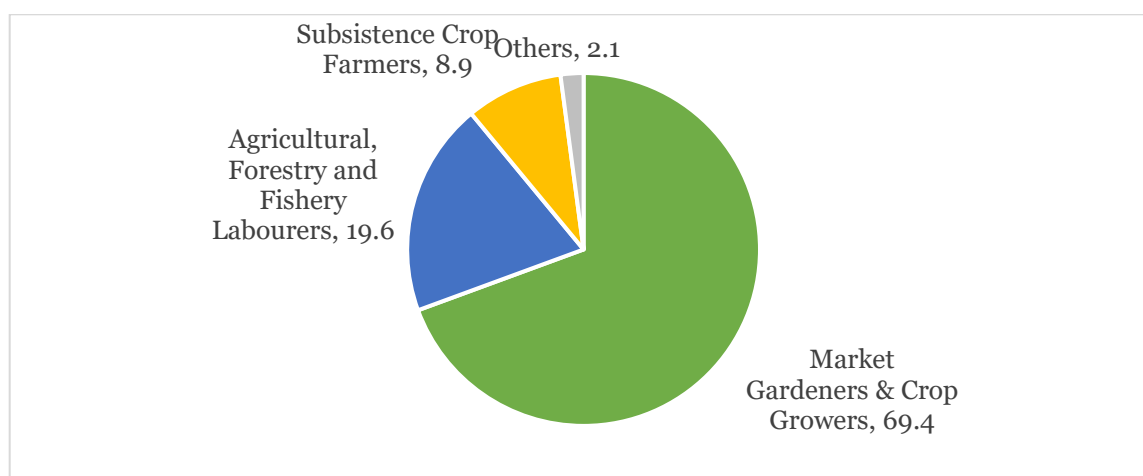


Source: NCAER computations from Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022-June 2023. Document No.: DDI-IND-CSO-PLFS-2022-23. <https://microdata.gov.in/nada43/index.php/catalog/179/study-description>.

Note: Check Annexure 4.2 for definition of skills.

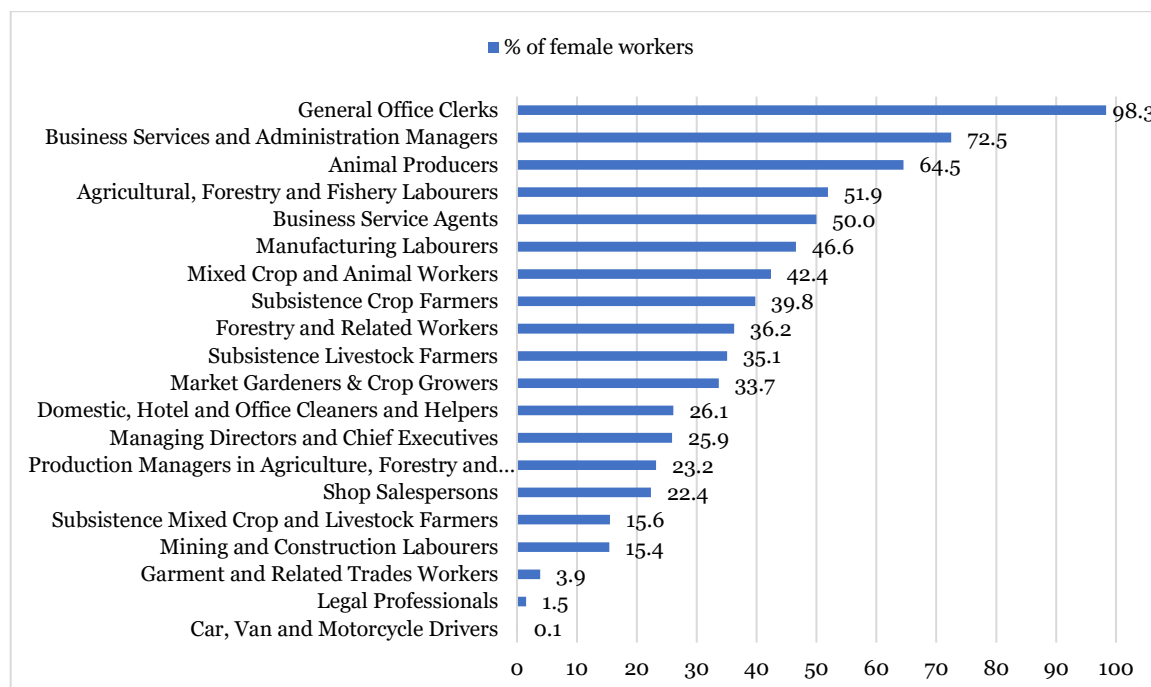
- e. **Occupations:** Among the number of jobs, 70 per cent of the jobs are in the occupational role of market gardeners and crop growers and in that occupation 33.7 per cent were women (Figures 4.7 and 4.8). Twenty per cent of the workers in 'cereals (including rice), leguminous crops, and oil seeds' are agricultural, forestry and fishery labourers and within that 52 per cent are women. Nine per cent of the workers are subsistence crop farmers and within that 40 per cent are women. Figure 4.8 shows that there are some job roles dominated by women.

**Figure 4.7: Majority (69.4 per cent) of the agricultural (cereals including rice, leguminous crops, and oilseeds) workers are market gardeners and crop growers, 2022-23**



Source: NCAER analysis from PLFS 2022-23.

**Figure 4.8: Percentage of female workers (aged 15+) across job roles in growing of cereals (including rice), leguminous crops and oilseeds, 2022–23**



Source: NCAER analysis from PLFS 2022–23.

- f. **Engagement Status:** Majority of the workers are self-employed. 39.5 per cent of workers are own-account workers (Table 4.4), 3.2 per cent are employers and 38.2 per cent are unpaid family workers. 19 per cent work as casual wage labour. 59.0 per cent of male workers are own-account workers, 5.0 per cent are employers and 20.8 per cent of workers are unpaid family workers. 15 per cent of workers work as casual wage labour. In case of females, 63 per cent are engaged as unpaid family workers. 11.8 per cent of females are own-account workers and 0.5 per cent work as entrepreneurs. 24.7 per cent of female workers work as casual wage workers.

**Table 4.4: Engagement status (%) of agricultural (growing of cereals (including rice), leguminous crops and oilseeds) workers, 2022–23**

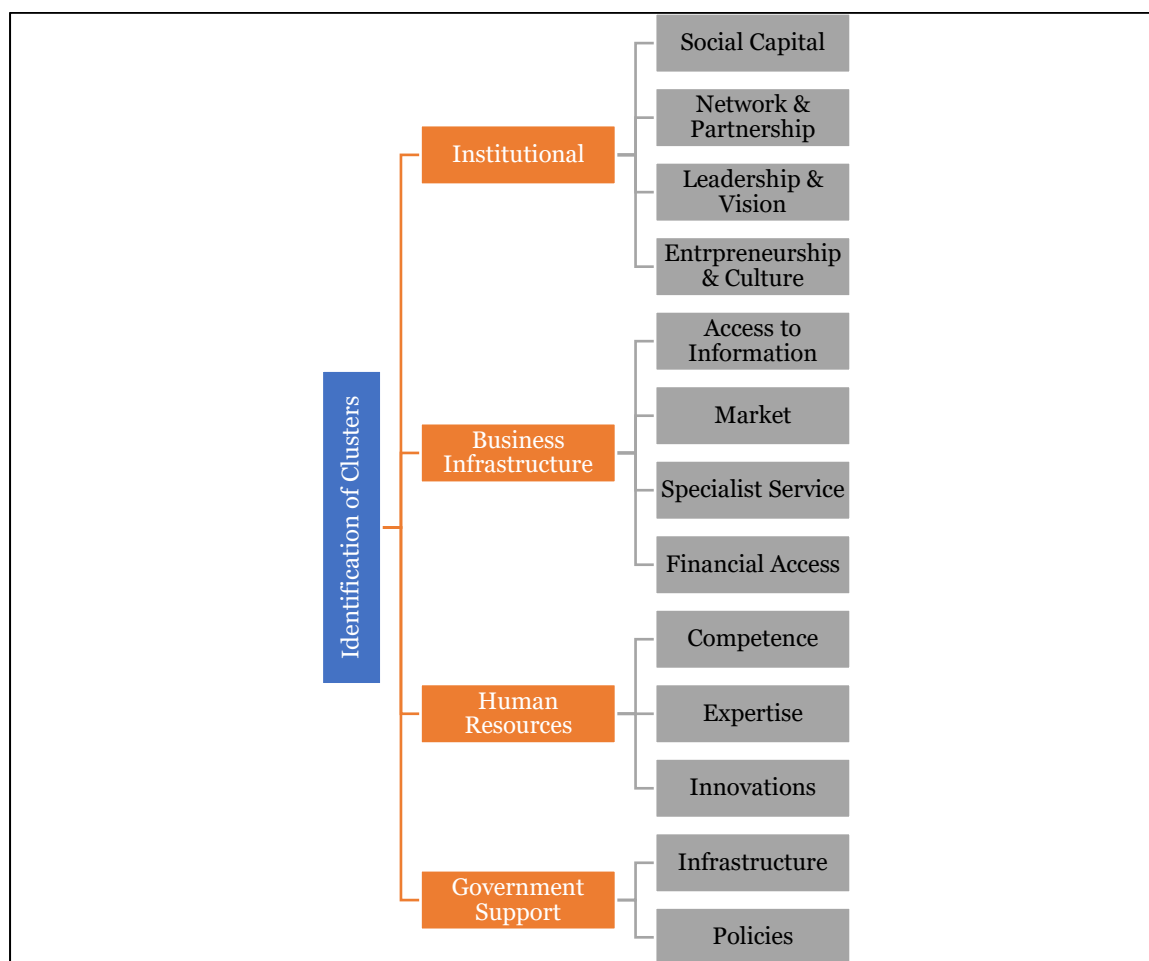
| Sectors                                                                | All Workers (aged 15+)   |          |                                                                           |                                          |                          | Total |
|------------------------------------------------------------------------|--------------------------|----------|---------------------------------------------------------------------------|------------------------------------------|--------------------------|-------|
|                                                                        | Self-employed            |          |                                                                           | Regular<br>salaried/<br>wage<br>employee | Casual<br>Wage<br>Labour |       |
|                                                                        | Own<br>account<br>worker | Employer | Worked as<br>helper in h.h.<br>enterprise<br>(unpaid<br>family<br>worker) |                                          |                          |       |
| Growing of cereals<br>(incl. rice), leguminous<br>crops, and oil seeds | 39.5                     | 3.2      | 38.2                                                                      | 0.2                                      | 19.0                     | 100.0 |
| All workers 15+                                                        | 35.6                     | 3.2      | 18.6                                                                      | 21.4                                     | 21.2                     | 100.0 |
| All Male Workers (aged 15+)                                            |                          |          |                                                                           |                                          |                          |       |
| Growing of cereals<br>(incl. rice), leguminous<br>crops, and oil seeds | 59.0                     | 5.0      | 20.8                                                                      | 0.2                                      | 15.0                     | 100.0 |
| All workers 15+                                                        | 39.6                     | 4.5      | 9.5                                                                       | 24.0                                     | 22.3                     | 100.0 |
| All Female Workers (aged 15+)                                          |                          |          |                                                                           |                                          |                          |       |
| Growing of cereals<br>(incl. rice), leguminous<br>crops, and oil seeds | 11.8                     | 0.5      | 63.0                                                                      | 0.0                                      | 24.7                     | 100.0 |
| All workers 15+                                                        | 27.3                     | 0.6      | 37.4                                                                      | 15.9                                     | 18.8                     | 100.0 |

Source: NCAER Analysis from PLFS 2022–23.

#### 4.4 Geographical Clusters

There are many different definitions and different ways of estimating agricultural clusters (Annexure 4.3). The one that is used in this report is ‘geographical clusters’. Geographical clusters in India arise due to specific agro-ecological conditions and resource availability. For instance, the Western Ghats region hosts geographical clusters of spice cultivation, including pepper, cardamom, and cinnamon, owing to its tropical climate and hilly terrain.

**Figure 4.9: Framework to identify agricultural (growing of cereals (including rice), leguminous crops, and oilseeds) clusters**



Source: Adapted from Sutawi, Prihartini I., Zalizar L., Wahyudi A., Hendraningsih L. 2022. "The Success Indicators of a Dairy Farming Cluster in Indonesia: A Case in Malang Regency of East Java Province". *Asian Journal of Dairy and Food Research*. 41(1): 22-27. doi: 10.18805/ajdfr.DR-242.

Delgado et al. (2014) defined clusters as "geographic concentrations of industries related by knowledge, skills, inputs, demand, and/or other linkages. This definition of clusters is used here in this chapter with the framework to identify geographical clusters being adapted from Sutawi et al. (2022).<sup>2</sup> The steps involved in defining an agriculture cluster are shown in Figure 4.9 and Annexure 4.4 shows the detailed methodology. A step-wise ranking approach is used to identify the clusters in this sector (Table 4.5).

<sup>2</sup> Delgado, M., Porter, M. E., & Stern, S. 2014. "Defining clusters of related industries". NBER Working Paper No. w20375. [https://www.nber.org/system/files/working\\_papers/w20375/w20375.pdf](https://www.nber.org/system/files/working_papers/w20375/w20375.pdf). Boston: MA: National Bureau of Economic Research.

Sutawi, Prihartini I., Zalizar L., Wahyudi A., Hendraningsih L. 2022. "The Success Indicators of a Dairy Farming Cluster in Indonesia: A Case in Malang Regency of East Java Province". *Asian Journal of Dairy and Food Research*. 41(1): 22-27. doi: 10.18805/ajdfr.DR-242.

**Table 4.5: Geographical clusters in agriculture (growing of cereals (including rice), leguminous crops and oilseeds)**

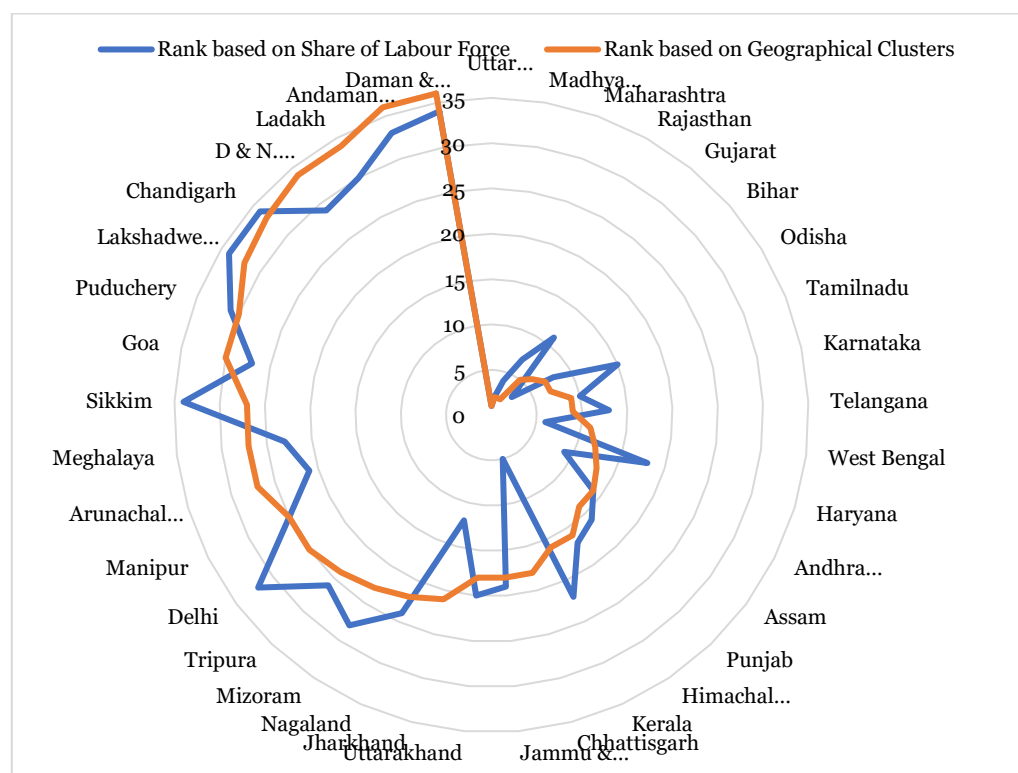
| <i>State</i>              | <i>Institutional</i> | <i>Infrastructure</i> | <i>Government Support</i> | <i>Human Resource</i> | <i>Average of all the Rankings</i> |
|---------------------------|----------------------|-----------------------|---------------------------|-----------------------|------------------------------------|
| Uttar Pradesh             | 2                    | 3                     | 3                         | 1                     | 2                                  |
| Maharashtra               | 1                    | 2                     | 14                        | 2                     | 5                                  |
| Rajasthan                 | 8                    | 4                     | 2                         | 5                     | 5                                  |
| Madhya Pradesh            | 6                    | 1                     | 10                        | 4                     | 5                                  |
| Gujarat                   | 5                    | 8                     | 6                         | 6                     | 6                                  |
| Bihar                     | 10                   | 13                    | 4                         | 3                     | 8                                  |
| Odisha                    | 12                   | 9                     | 7                         | 11                    | 10                                 |
| Tamil Nadu                | 9                    | 7                     | 5                         | 20                    | 10                                 |
| Karnataka                 | 7                    | 10                    | 12                        | 14                    | 11                                 |
| Telangana                 | 4                    | 11                    | 20                        | 8                     | 11                                 |
| West Bengal               | 18                   | 21                    | 1                         | 7                     | 12                                 |
| Haryana                   | 14                   | 6                     | 21                        | 10                    | 13                                 |
| Andhra Pradesh            | 11                   | 5                     | 23                        | 15                    | 14                                 |
| Assam                     | 23                   | 20                    | 8                         | 9                     | 15                                 |
| Punjab                    | 13                   | 14                    | 17                        | 16                    | 15                                 |
| Kerala                    | 3                    | 19                    | 19                        | 21                    | 16                                 |
| Himachal Pradesh          | 21                   | 16                    | 11                        | 17                    | 16                                 |
| Jammu & Kashmir           | 22                   | 17                    | 9                         | 18                    | 17                                 |
| Chhattisgarh              | 20                   | 12                    | 24                        | 13                    | 17                                 |
| Uttarakhand               | 17                   | 15                    | 18                        | 19                    | 17                                 |
| Jharkhand                 | 19                   | 18                    | 25                        | 12                    | 19                                 |
| Nagaland                  | 15                   | 22                    | 16                        | 25                    | 20                                 |
| Mizoram                   | 16                   | 25                    | 15                        | 32                    | 22                                 |
| Tripura                   | 26                   | 23                    | 13                        | 30                    | 23                                 |
| Manipur                   | 24                   | 29                    | 27                        | 22                    | 26                                 |
| Delhi                     | 25                   | 24                    | 30                        | 24                    | 26                                 |
| Meghalaya                 | 28                   | 30                    | 29                        | 23                    | 28                                 |
| Arunachal Pradesh         | 31                   | 32                    | 22                        | 28                    | 28                                 |
| Sikkim                    | 27                   | 28                    | 32                        | 26                    | 28                                 |
| Goa                       | 29                   | 31                    | 28                        | 27                    | 29                                 |
| Puducherry                | 30                   | 26                    | 31                        | 29                    | 29                                 |
| Lakshadweep               | 32                   | 27                    | 34                        | 36                    | 32                                 |
| Chandigarh                | 37                   | 34                    | 26                        | 34                    | 33                                 |
| Dadra & Nagar Haveli      | 35                   | 33                    | 35                        | 31                    | 34                                 |
| Ladakh                    | 34                   |                       |                           | 33                    | 34                                 |
| Daman & Diu               | 33                   | 36                    |                           |                       | 35                                 |
| Andaman & Nicobar Islands | 36                   | 35                    | 33                        | 35                    | 35                                 |

Source: NCAER Computations.



The rank-wise correlation of the states using share of workers employed in growing cereals, leguminous crops, and pulses (Figure 4.2) and the geographical clusters of these crops (Table 4.5) is 0.9. Figure 4.10 shows the rankings of the states using both the parameters. While the rankings overlap for many States, there are exceptions like Gujarat and West Bengal. While the share of workers employed in Gujarat is lower relative to its clusters ranking, West Bengal is the opposite.

**Figure 4.10: Rankings using share of workers and geographical clusters for ‘growing cereals (including rice), leguminous crops, and oilseeds’**



Sources: NCAER computations from Table 4.5 and PLFS 2022–23.  
Note: Lower ranking means higher concentrations.

## 4.5 Occupational Mapping

The PLFS publishes occupations at the 3-digit level. The corresponding 8-digit occupational codes from the National Classification of Occupations were identified based on the researchers’ knowledge, literature review, etc. (wherever feasible). Further, they were mapped to the list of job roles in Agriculture Skill Council of India (ASCI) job roles, where they could be identified. Annexure 4.5 shows the list of occupations/job roles for the agricultural sector.

## 4.6 Stakeholders’ Survey

### 4.6.1 Approach and Stakeholders Identification

As agriculture undergoes rapid transformation due to technology and market demands, targeted upskilling and reskilling initiatives are crucial for keeping farmers competitive and adopting modern practices. Skill assessment in agriculture is particularly challenging due to the complexity and diversity of the sector. Agriculture

is largely self-employed, with farmers managing their operations independently, leading to variations in skill sets. Diverse agro-climatic conditions require region-specific expertise, and the sector's vast array of activities—crop production, mechanisation, marketing, and sustainability practices—demand specialised knowledge.

Given the diversity within agriculture, it is more effective to assess skill needs at a granular level. Tailored assessments, focusing on specific regions, crops, or farming practices, provide a clearer picture of local requirements. In recognition of this, a district-level approach was adopted for this study, rather than a generalised, cluster-based analysis, to accurately identify skill gaps. Haryana, specifically the four districts of Haryana namely Faridabad, Gurugram, Hisar, and Karnal were selected for this study. All of them are key agricultural hubs, home to prestigious research and teaching institutions which provide a strong foundation for training in mechanisation, precision farming, and cutting-edge agricultural technologies. The districts combine traditional farming practices and increasing adoption of modern technologies makes it an ideal region for skill development interventions. The districts benefit from access to advanced seed and soil testing labs, agri-tech innovations, and its proximity to leading start-ups and Farmer Producer Organisations (FPOs), facilitating rapid skilling and technology transfer. Collaborations with these key institutions further strengthen efforts to address gaps in mechanisation, AI-driven farming, and market linkages.

Field visits were conducted in the above-mentioned districts, offering direct engagement with stakeholders across the value chain. These interactions provided valuable insights into the skill requirements for each stage—from crop planning to market access—highlighting the need for localised, tailored training programs. Table 4.6 shows the distribution of stakeholders and Table 4.7 shows who all NCAER interacted with at the district level against who were identified as stakeholders in the value chain. The questionnaire for agri-tech companies and farmer producer companies are attached (Questionnaires 1 and 2 respectively).

**Table 4.6: Total number of stakeholders covered in the survey of ‘growing of cereals, leguminous crops, and oilseeds’**

| <b>Sector</b>                            | <b>Number of stakeholders</b> |
|------------------------------------------|-------------------------------|
| Ministry                                 | 1                             |
| Sector Skill Council                     | 1                             |
| National-level Industry Association      | 1                             |
| Micro/Small                              | 7                             |
| Medium                                   | 5                             |
| Large                                    | 3                             |
| Total                                    | 15                            |
| No of Farms/Firms                        |                               |
| No. of Placement Cells/TVET Institutions | 5                             |
| Recruitment Agencies                     | Not Applicable                |
| Other Stakeholders                       | 9                             |
| Firms plus Other Stakeholders            | 24                            |
| Total                                    | 32                            |

Source: NCAER.

**Table 4.7: Stakeholders visited in Gurugram, Faridabad, Hisar, and Karnal**

| <i>Stage</i>        | <i>Core Activities</i>                                                                                   | <i>Primary Stakeholders<br/>(✓ indicates that these stakeholders<br/>were visited)</i>                                                                                                       |
|---------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Crop Planning       | Determining crops, acreage, plot allocation, and weather conditions.                                     | Farmers (✓), Krishi Vigyan Kendras, Agriculture Ministry (National & State)(✓), ICAR Institutes(✓), State Agricultural Universities (✓), Soil/Seed Testing Labs (✓), Agri-tech Start-ups (✓) |
| Cultivation         | Soil preparation, credit access, sowing seeds, irrigation, applying fertilisers, pesticides, and manure. | Farmers(✓), Seed/Fertiliser Companies & Dealers (✓), Farm Machinery Providers(✓), Irrigation Pump Manufacturers, Custom Hiring Centres (✓), Credit Institutions, Agri-tech Start-ups (✓)     |
| Harvesting          | Cutting, collecting, cleaning, sorting, and grading crops.                                               | Farmers, Custom Hiring Centres (✓), Farm Machinery Operators(✓), Farmer Producer Organisations (FPOs) (✓), Agri-tech Start-ups (✓)                                                           |
| Storage & Transport | Grading, sorting, storing, and transporting produce.                                                     | Warehouses (✓), Cold Storage Facilities, Transporters, FPOs(✓), Agri-tech Start-ups (✓)                                                                                                      |
| Marketing           | Developing and executing marketing strategies, and determining commodity pricing.                        | APMC Mandis (✓), FPOs (✓), State Marketing Federations(✓), Procurement Agencies, Agri-tech Start-ups (✓)                                                                                     |

Source: NCAER.

#### **4.6.2 Sectoral Findings about Skill Shortages and Skill Gaps from Stakeholders' Survey**

The key relevant result that emerged from discussions was that there was no formal method to assess skill shortages in this sub-sector, but government targets served as a guiding metric. The NCAER approach was to systematically identify the stakeholders in the sector in the district and conduct interviews/FGDs with them.

There are challenges on the supply-side. There is a lack of industry readiness and entrepreneurial aptitude among agricultural university graduates, making it essential to strengthen practical training, improve industry internships, and implement robust skill evaluation mechanisms. Vocational training institutes face several challenges, including a lack of practical aptitude among students, limited exposure to emerging technologies, and difficulties with student placement. Many students show little enthusiasm for hands-on training, which undermines the practical application of their theoretical knowledge. Additionally, the current curriculum predominantly focuses on traditional trades, leaving students unprepared for industries like Renewable Energy (RE), digital applications, and drone technology.

On the demand-side, district-specific job roles may arise given the agro-climatic conditions in the district. Further, any job role in this sector needs to be given hands-on technical skills and entrepreneurship skills given the nature of the sector. These new, emerging and some old job roles will strengthen the agricultural ecosystem, improving efficiency, product quality, and market access for farmers. Because of the approach taken to examine the length and breadth of the eco-system, one sometimes ended up with job roles, which are not a direct fit in the agriculture but needs to be

included in the narrative to strengthen the eco-system. There are three key findings from stakeholders' survey about job roles:

1. Farmers and extension service providers need continuous re-skilling and upskilling. While agri-tech companies are providing knowledge and IT tools, farmers are not digitally literate/ready to utilise them to the fullest potential. Farmers' traditional knowledge needs to be upgraded with technical skills and entrepreneurship skills.<sup>3</sup>
2. New & Emerging Job Roles focussing in the 'sunrise' aspects of the sector: Some of the new job roles are:
  - Repair and maintenance of modern farm machinery especially brand-specific tractor skills.
  - Groundwater detection technologists: Groundwater detection technologists specialise in locating and assessing underground water sources. They use geophysical, geological, and hydrological methods to evaluate water availability and quality for agricultural, industrial, and domestic use. These are especially useful job roles in areas where ground level water is low like in the districts of Haryana. The required education is Diploma or Bachelor's Degree in Geology/Hydrology/Environmental Science. Technical skills required are use of groundwater detection equipment.
  - Farm mechanics need upskilling with knowledge of latest technologies such as Common Rail Direct Injection (CRDI) Tractor Engine Mechanics. A CRDI Tractor Engine Mechanic specialises in diagnosing, repairing, and maintaining Common Rail Direct Injection (CRDI) diesel engines used in tractors and other agricultural machinery. This role involves working with electronic fuel injection systems, sensors, actuators, and ECU (Electronic Control Unit) to ensure optimal engine performance, fuel efficiency, and emissions. Minimum Qualification required are ITI in Diesel Mechanic, Automobile Engineering, or Agricultural Machinery/Diploma in Mechanical Engineering or Automobile Engineering. Technical Skills required are familiarity with fuel injectors, sensors, actuators, and ECU operations.
  - Warehouse workers need technical and operational skills in grain handling, pest control, inventory management, and the use of modern technology for monitoring storage conditions. Key roles in warehouses, such as managers, quality control inspectors, procurement officers, and maintenance technicians, require expertise in logistics, safety standards, and quality assurance.
  - In FPOs, roles like General Manager, Marketing Manager, and Agricultural Extension Officer need to focus on leadership, procurement planning, quality control, and field operations to ensure smooth coordination and value addition for farmers.
  - Marketing Committees also require enhanced digital skills, market analysis, financial management, and stakeholder engagement to

---

<sup>3</sup> Sughanti, Sebastian and Sethi (2024) surveyed agri-tech start-ups and found that lack of skills adaptability was a major challenge for tech-adoption by farmers. This supports the findings from the NCAER stakeholders' survey too.

Sughanti, D., Sebastian, J. and Sethi, M. 2024. "Agri-Tech Startups and Innovations in Indian Agriculture". *RBI Bulletin*. Reserve Bank of India(RBI), Mumbai. November.

optimise auction processes and ensure compliance with regulatory standards.

- Community advisors are also job roles that may arise especially when it comes to advising farmers or communities about new farming techniques. The qualifications required for them are Agricultural Graduate/Diploma/ National Skills Qualification Framework (NSQF) Aligned Course.
  - Agronomic Consultants deliver specialised technical expertise to enhance agricultural productivity and sustainability. They conduct comprehensive on-field assessments, analyzing factors like soil health, weather patterns, and crop performance to develop customized solutions. Their guidance covers areas such as crop rotation, pest and disease management, and the implementation of sustainable farming practices. Key competencies include advanced knowledge of agronomy, analytical skills, and proficiency in data-driven decision-making.
3. Job Roles which are deemed as difficult to fill: The top 5 job roles which are currently facing and will face a skills shortage over the next 3 years are presented in Table 4.8. Their qualification and skills requirements have been mapped.
- Drone Operator is someone who knows how to operate drones.
  - Agriculture Advisor/Crop Advisor (Agri-tech): This is a job role that specifically arises in the Agri-tech sector. Agricultural Sales Advisors serve as vital links between input suppliers and farmers, offering tailored advice on crop management and the effective use of agricultural products such as seeds, fertilisers, and plant protection agents. They assess individual farm needs, recommend suitable products, and provide ongoing support to optimise product efficacy. A deep understanding of local farming practices, strong communication skills, and the ability to build lasting customer relationships are essential for success in this role.
  - IT-GIS Specialist (Agri-tech): Job roles in agri-tech sector which focus on using Geographic Information Systems to analyse data.
  - MIG-Welding Operator (Agro-tech): Job roles needed in agro-tech sector. Technically they are not in the agriculture sector.
  - Farm Machinery Service Technician: Job role that provides farm machinery services to farmers.

**Table 4.8: Assessment of current and future skills shortage for top five job roles in “growing of cereals, leguminous crops, and oilseeds”**

| Items                                                                                                          | Drone operator                                                                                                                                                                                                                                                                                                                                                                                                                            | Agriculture advisor/Crop advisor (Agri-tech)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | IT-GIS specialist (Agri-tech)                                                                                                                                                                                                                                                                                                                                               | MIG-welding operator#                                                                                                                                                                                                                                                                                                                                                              | Farm -machinery service technician                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NCO 3/8-digit code                                                                                             | 834                                                                                                                                                                                                                                                                                                                                                                                                                                       | 132                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Not classified in NCO                                                                                                                                                                                                                                                                                                                                                       | 821                                                                                                                                                                                                                                                                                                                                                                                | 723                                                                                                                                                                                                                                                                                                                                                             |
| NCO 8-digit / QP code                                                                                          | 8341.0200 (AGR/Q1006)                                                                                                                                                                                                                                                                                                                                                                                                                     | 1324.9900                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | DGT/2012                                                                                                                                                                                                                                                                                                                                                                    | 8212.1901                                                                                                                                                                                                                                                                                                                                                                          | 7233                                                                                                                                                                                                                                                                                                                                                            |
| Match from Job Projections in Chapter 3 (611, 921, 631, 613 and 633) @                                         | No                                                                                                                                                                                                                                                                                                                                                                                                                                        | No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | No                                                                                                                                                                                                                                                                                                                                                                          | No                                                                                                                                                                                                                                                                                                                                                                                 | No                                                                                                                                                                                                                                                                                                                                                              |
| No. of stakeholders which mentioned this (32)                                                                  | 6                                                                                                                                                                                                                                                                                                                                                                                                                                         | 14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3                                                                                                                                                                                                                                                                                                                                                                           | 8                                                                                                                                                                                                                                                                                                                                                                                  | 9                                                                                                                                                                                                                                                                                                                                                               |
| Indicative computation of the extent of the need & vacancy rate (NCAER computations for 2026-27-Annexure 4.6)* | 4,35,313 (if 25% net sown area is covered by drones)                                                                                                                                                                                                                                                                                                                                                                                      | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                                                                                                                                                                                                                                                                                                                                                                           | -                                                                                                                                                                                                                                                                                                                                                                                  | 5,56,510 (If 70% of farmers use farm machinery)                                                                                                                                                                                                                                                                                                                 |
| Geography (survey was done): Bottom-up approach in Haryana                                                     | Karnal, Kaithal, Hisar & Faridabad, Haryana                                                                                                                                                                                                                                                                                                                                                                                               | Gurugram, Haryana and Pune, Maharashtra                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Hisar, Haryana                                                                                                                                                                                                                                                                                                                                                              | Karnal, Faridabad & Hisar, Haryana                                                                                                                                                                                                                                                                                                                                                 | Karnal, Faridabad & Hisar, Haryana                                                                                                                                                                                                                                                                                                                              |
| Average monthly income (₹)                                                                                     | ₹30,000                                                                                                                                                                                                                                                                                                                                                                                                                                   | ₹20,000-₹30000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ₹42,746                                                                                                                                                                                                                                                                                                                                                                     | ₹ 16,000-₹23,000                                                                                                                                                                                                                                                                                                                                                                   | ₹ 15,000                                                                                                                                                                                                                                                                                                                                                        |
| Educational Qualifications                                                                                     | ITI Graduate/Short-term Skilling Programmes like PMKVY                                                                                                                                                                                                                                                                                                                                                                                    | Agricultural Graduate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Graduate                                                                                                                                                                                                                                                                                                                                                                    | ITI Graduate                                                                                                                                                                                                                                                                                                                                                                       | ITI Graduate                                                                                                                                                                                                                                                                                                                                                    |
| Skills required at the competency level (3 and more)                                                           | <b>Cognitive:</b> Advanced reading skills, active listening, problem solving, communication skills, mathematical skills, digital skills, financial and resource management (entrepreneurial)<br><b>Socio-emotional:</b> Agreeable (entrepreneurial skills)<br><b>Technical &amp; Vocational Education and Training Skills (TVET):</b> Understanding of remote sensing, data analysis techniques, actual drone operations, physical skills | <b>Cognitive:</b> Advanced reading skills, active listening, advanced digital skills, communication skills (including talking to farmers), business and local languages, problem-solving, judgement & decision-making, mathematical reasoning and science<br><b>Socio-emotional:</b> Skills needed for customer relationship (Agreeable, Extraversion), Conscientiousness (efficient), work independently in field settings, negotiation skills<br><b>TVET:</b> Agricultural knowledge, understanding of remote sensing, data analysis techniques, | <b>Cognitive:</b> Advanced reading skills, advanced digital skills, mathematical skills, mathematical reasoning, problem-solving, critical thinking, judgement & decision-making skills, communication skills and critical thinking<br><b>Socio-emotional:</b> Conscientiousness and agreeable<br><b>TVET:</b> Proficiency in Geographic Information Systems (GIS) software | <b>Cognitive:</b> Reading literacy, speaking, communication, time management<br><b>Socio-emotional:</b> Conscientiousness (resilience), Agreeable (team-work), openness to experiences and emotional stability<br><b>TVET:</b> Expertise in MIG welding techniques and safety protocols and Ability to read and interpret technical drawings and specifications<br>Physical Skills | <b>Cognitive:</b> Reading literacy, numeracy, customer service skills – active listening, problem solving, communication skills, financial and resource management (entrepreneurial)<br><b>Socio-emotional:</b> Agreeable (entrepreneurial skills)<br><b>TVET:</b> Knowledge of mechanical systems and electronic controls in modern equipment, physical skills |

| <i>Items</i>                                                                                  | <i>Drone operator</i>                                                                                                                                                                                                                              | <i>Agriculture advisor/Crop advisor (Agri-tech)</i>                                                                                                                                                      | <i>IT-GIS specialist (Agri-tech)</i>                                                                                                                                            | <i>MIG-welding operator*</i>                                                                                                                                                                       | <i>Farm -machinery service technician</i>                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                               |                                                                                                                                                                                                                                                    | Precision Agriculture Techniques, Using AI, machine learning, and robotics, familiarity with blockchain for traceability and supply chain transparency                                                   |                                                                                                                                                                                 |                                                                                                                                                                                                    |                                                                                                                                                                                                                              |
| Skills Shortage (as defined in Chapter 1)                                                     | Yes                                                                                                                                                                                                                                                | Yes                                                                                                                                                                                                      | Yes                                                                                                                                                                             | Yes                                                                                                                                                                                                | Yes                                                                                                                                                                                                                          |
| Skills Gap (as defined in Chapter 1)                                                          | Not Applicable (NA)                                                                                                                                                                                                                                | Yes                                                                                                                                                                                                      | NA                                                                                                                                                                              | Yes                                                                                                                                                                                                | Yes                                                                                                                                                                                                                          |
| Relevance of TVET System                                                                      | NA                                                                                                                                                                                                                                                 | Limited exposure to advanced agricultural technology<br>Agricultural University graduates do not have the appropriate skills to work with farmers                                                        | NA                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Not taught in TVET</li> <li>Practical, hands-on training missing</li> <li>Shortage of master trainers</li> </ul>                                            | <ul style="list-style-type: none"> <li>Practical, hands-on training missing</li> <li>Limited exposure to advanced agricultural machinery</li> </ul>                                                                          |
| Gender (Challenges)                                                                           | NA                                                                                                                                                                                                                                                 | No issue                                                                                                                                                                                                 | No issue                                                                                                                                                                        | Not Aspirational for women because of physical skills required at job                                                                                                                              | Not Aspirational for women because of physical skills required at job                                                                                                                                                        |
| Challenges Faced by Industries in Meeting Skill Requirements                                  | NA                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Multi-disciplinary knowledge about agriculture and IT is missing</li> <li>Academia-industry collaboration limited</li> <li>Lack of trainers</li> </ul>            | No issue                                                                                                                                                                        | <ul style="list-style-type: none"> <li>MIG Welders not found</li> <li>Skills shortage being addressed by in-migration</li> <li>Apprenticeship system is a gap; needs to be strengthened</li> </ul> | <ul style="list-style-type: none"> <li>Shortage of master trainers</li> <li>Not enough TVETs</li> <li>Inadequate training at Vocational Institutes with theoretical training emphasised; need training thereafter</li> </ul> |
| Industry-specific interventions that facilitate skill & capacity development (best practices) | NA                                                                                                                                                                                                                                                 | No issue                                                                                                                                                                                                 | No issue                                                                                                                                                                        | Offered permanent jobs with written contracts of more than 1 year and social safety nets to attract workers                                                                                        | <ul style="list-style-type: none"> <li>Industry developing labs in both higher education and vocational training institutes</li> </ul>                                                                                       |
| Policy Recommendations                                                                        | <b>Skill Training Programme:</b> Need to be expanded, i.e., more programmes need to be introduced to train people as a Drone operator, thereby increasing supply; Strengthen the new training programme and ensure its spread all over the country | <b>Skill Training Programme:</b> Needs to be expanded<br><b>Curriculum Development:</b> Latest TVET skills, case studies, field studies with live practice on field, practical training courses in post- | <b>Skill Training Programme:</b> Needs to be expanded, Introduce new programmes in agricultural universities; dual degree programmes in IT and agriculture<br><b>Curriculum</b> | <b>Skill Training Programme:</b> Needs to be expanded; this should be introduced in the ITIs<br><b>Curriculum Development</b> : Arch and MIG welding need to be taught in ITIs<br><b>Gender:</b>   | <b>Skill Training Programme:</b> Needs to be expanded, new programmes on upskilling and re-skilling on latest machinery<br><b>Curriculum Development:</b> Entrepreneurial skills should be                                   |



| Items | Drone operator                                                                                                                                                                                                                                                                                                                                                                        | Agriculture advisor/Crop advisor (Agri-tech)                                                                                                                                                                                                                                                                     | IT-GIS specialist (Agri-tech)                                                                                                                        | MIG-welding operator <sup>#</sup>                                                                                                                                                                                                 | Farm -machinery service technician                                                                                                                                                                                                                                                                                                                             |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       | <b>Curriculum Development:</b> Entrepreneurial skills should be taught along with TVET skills<br><b>Gender:</b> Drone-Didi programme has already started and this can be further strengthened by ensuring that the curriculum includes socio-emotional & entrepreneurial skills especially targeted for women.<br><b>Skill Initiatives:</b> Apprenticeships should be made mandatory. | harvest management, oral fluency in multiple (business plus local) languages and socio-emotional skills<br><b>Gender:</b> Strengthen socio-emotional skills and interaction with women farmers<br><b>Skill Initiatives:</b> Apprenticeships should be made mandatory; Encourage academia-industry collaboration. | <b>Development:</b> TVET skills<br><b>Gender:</b> Will be attractive to women<br><b>Skill Initiatives:</b> Repeated summer internships in programmes | Females can be encouraged for this job role<br><b>Skill Initiatives:</b> Local mismatches to be solved by increased coordination between industry and ITIs; Apprenticeships should be made mandatory for ITI students in welding. | taught along with TVET skills<br><b>Gender:</b> Females can be encouraged for this job role and special training programmes may be designed for women like 'Drone Didi'<br><b>Skill Initiatives:</b> Farm machinery companies should be providing training & certification and also offer re-skilling & upskilling courses. Take lessons from the auto sector. |

Source: Findings from stakeholder consultations.

Notes: # MIG Welding Operator is a role that does not fall in the agriculture sector directly. However, lack of them affects the agro-tech sector which produces farm machinery.

@ Pink shade indicates no match between I-O quantitative top 5 occupation projections and survey-based top 5 occupation projections. Not matching makes sense as the I-O analysis, projects top 5 job occupations where most of the workers are there. However, in the survey, stakeholders were asked that in which job roles, i.e. they are trying to hire people but are not able to hire. Plus, technological changes have created new job roles.

\*Computation methodology presented in Annexure 4.6.

## 4.7 Recommended Methodology

This sector requires a bottom-up strategy, i.e., given the diverse nature of the country, a district-wise approach is recommended.

- Secondary data analysis using available data needs to be carried out to ascertain needs that can arise in the region by using available statistics at the Central and State level.
  - Ministry of Statistics and Programme Implementation: Several data are published by MoSPI including data on value of output, Situation Analysis of Farmers can inform about the districts.
  - Ministries' publications including the Agricultural Census, soil, water statistics, etc.
  - States own statistical publications
- FGD Stakeholder Interactions using qualitative techniques.
  - The value chain needs to be specified.
  - Identify the stakeholders along the value chain who are present in the district or nearby districts.
  - It is important to identify three things—reskilling/upskilling needs, job roles that face shortage and identify new/emerging job roles.
  - Conduct interviews/Focus Group Discussions (FGDs) with all stakeholders.



- Farms- Traditional and Modern: Conducting FGDs with both traditional and modern farmers provides qualitative insights into the challenges and opportunities within the agricultural sector. These discussions can reveal perceptions about technological adoption, training needs, and labour requirements.
- Firms with farming linkages present in the district: Engaging with agribusinesses and firms linked to farming activities helps understand the demand for specific skills, technological needs, and workforce expectations. This interaction can highlight gaps between current educational outputs and industry requirements.
- Annual stakeholder discussions with education and skill training institutes: Regular discussions with educational and training institutions ensure that curricula align with evolving market needs. These discussions can lead to the development of targeted training programs addressing identified skill gaps.
- Annual joint stakeholder consultations with farms at the district level: Such consultations can lead to community-specific strategies for skill development and employment generation.

The combination of quantitative and qualitative techniques will inform about skill shortages and gaps in this sector. It is important to identify the jobs which are likely to face skills gap and identify the ‘missing’ skills. This can also feed into the State requirements. This information should link to the district skill plans.

Beyond shortages, it's crucial to identify jobs where existing employees or candidates lack essential skills. This involves mapping current skill sets against job requirements to uncover discrepancies. Addressing these gaps may involve curriculum adjustments, professional development opportunities, or recruitment strategies focused on acquiring the missing skills. Such insights are helpful for State-level workforce development policies.

It is important to identify upskilling and re-skilling requirements especially digital and financial literacy skills. This involves analysing trends to determine which skills are becoming obsolete and which are emerging as critical. Developing programs to equip the workforce with these new skills ensures adaptability and competitiveness in a changing economic landscape. Recognition of prior learning combined with bridge training will especially help farmers.

## 5. Livestock: Raising Cattle and Buffaloes

### 5.1 Definition of the Livestock Sector

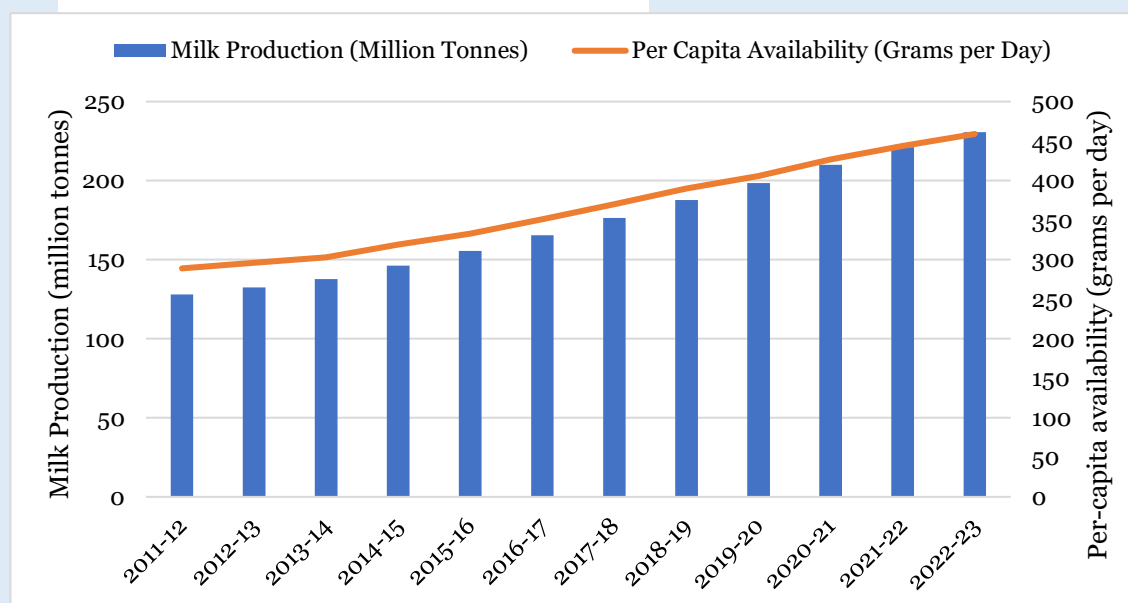
The livestock sub-sector that is used in this report for analysis is the NIC code, 0141 which includes ‘raising of cattle and buffaloes’. Box 5.1 gives a small snapshot of the dynamics of this sub-sector. This sub-sector includes the following NIC codes at the 5-digit level:

- Raising and breeding of cattle and buffaloes (01411): Industries whose main activity is the raising of cattle fall under this category (including animals for dairy herd replacements). It includes things like breeding buffalo as well as cattle. The care, feeding, and genetic selection of these animals—as well as their production—are the main topics of discussion.
- Production of milk from cows or buffaloes (01412): Industries that produce milk largely from dairy cows and buffaloes fall under this category. It includes all operations pertaining to the production, delivery, and processing of milk.
- Production of bovine semen (01413): Industries that produce bovine (cattle) semen primarily for artificial insemination fall under this category. Bovine frozen semen is an essential resource for enhancing genetic diversity among bovine herds through the spread of better germplasm. Minimal requirements are followed during the production procedure to guarantee high-quality semen for AI applications.
- Support activities for animal production (01620): This class includes agricultural activities on a fee or contract basis such as activities to promote propagation, growth and output of animals, herd testing services, droving services, agistment services, poultry caponising, coop cleaning, etc. activities related to artificial insemination, stud services, sheep shearing, farm animal boarding and care, activities of farriers.

## Box 5.1: Snapshot of the livestock sector

According to the FAOSTAT production data, India ranked as the world's greatest producer of milk in 2021–2022, contributing 24.6 per cent of the world's milk production. Available data indicate that milk production has been over 230 million tons in 2022–23 (Figure 1) and expanding at about 5.3 per cent annually at a compounding rate since 2013–14, matching growth in demand as higher incomes spur more consumption of fluid milk and dairy products, which is nutritionally important component of average diets with per capita availability of 459 grams per day. Despite being the world's largest producer of milk, India accounts for only 1.5 per cent of the world's total milk exports.

**Figure 5.1: Milk production (in million tons) and per capita availability (grams per day) in India, 2011–12 to 2022–23**



Source: Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, 2023. Basic Animal Husbandry Statistics-2023. <https://dahd.nic.in/sites/default/files/BAHS2023.pdf>. Krishi Bhawan, New Delhi.

One of the prime reasons is the low yield of Indian cows. The milk yield of Indian cows is only about two-thirds of the global average, and it is significantly lower than that of cows in developed nations, according to the FAO. The USA tops the list with a milk yield of about 10,189 litres per lactation while India with only 1,318 litres per lactation is nowhere near it. As per Integrated Sample Survey average annual productivity of cattle in India during 2019–20 was 1,777 kg per animal per year as against the world average of 2,699 kg per animal per year during 2019 (as per FAO Statistics). Annexure 5.1 shows the state-wise productivity indicators. The sector is largely informal with cooperatives formed in a few regions shows how fragmented this sector is leading to the production of poor-quality milk. The concerned authorities need to address the lack of infrastructure, logistics and subsequent bottlenecks in the supply chain using technological support. One major barrier is the lack of knowledge and instruction among farmers regarding the benefits of modern dairy farming techniques. The key to overcoming this challenge is to provide training and knowledge dissemination to encourage innovation in milking techniques. The Government has taken up various schemes and implemented them to upgrade the dairy practices of India.

### Sources:

Ministry of Fisheries, Animal Husbandry and Dairying, 2021. "Productivity of Dairy Animals".

<https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1707187#:~:text=As%20per%20Integrated%20Sample%20Survey%20average%20annual%20productivity,per%20year%20during%202019%20%28as%20per%20FAO%20Statistics%29,> March 2.

Ministry of Fisheries, Animal Husbandry and Dairying, 2023. "India ranks first in milk production in the world contributing 24 per cent of global milk production". PIB. <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1897084>, February 7.

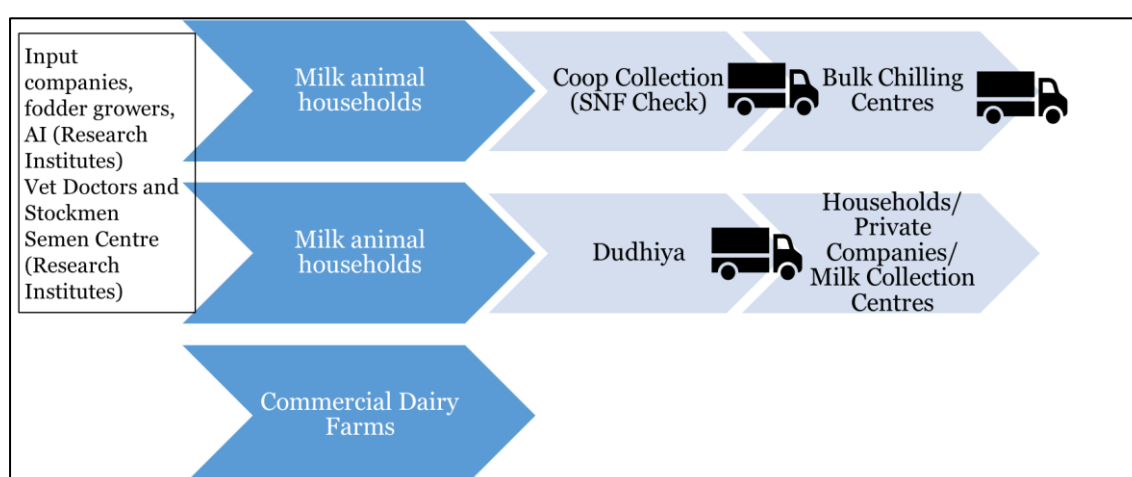
## 5.2 Value Chain

The dairy value chain encompasses the entire journey from production to consumption, ensuring that dairy products reach consumers in optimal condition. For dairy products to reach customers in the best possible condition, the entire manufacturing and consumption process is included in the value chain (Figure 5.2). There are two core starting points for milk production, first is milk animal households and the other is Commercial Dairy Farms.

The process starts with input chains, covering broadly the collection and distribution of animal feed and fodder. Animal health and breeding are captured through veterinary services, artificial insemination, and bovine semen. The milk production part starts with milk animal households, which have two broad categories of value chain mechanisms. The first is through the Cooperative Collection Centre and the second is through ‘Dudhiyas’. The major mechanism is explained below:

1. From milk animal households, the milk is collected by:
  - i) Cooperatives formed by the dairy farmers who send it to their Bulk Chilling Centres. This collected milk is pasteurised, homogenised, and only after conducting quality control checks, is then further distributed through wholesalers and retailers. They are generally found at the State and sub-national level.
  - ii) The *Dudhiya* community generally collects milk from dairy farmers in clean and germ-free containers. From there on, they either sell the collected milk to households or Private Companies or bring their milk to Collection Centres where it undergoes quality tests and then processed.
2. Commercial Dairy Farms, in most cases, breed their cattle and buffaloes. They invest in them, from feed and fodder to veterinarians as well as maintain a Research and Development wing to ensure quality milk is produced. They directly take the milk to the Bulk Chilling Centres, where the milk is further processed and then distributed through their supply chain.

**Figure 5.2: Value chain in the livestock sector**



Source: NCAER conceptualisation from literature review.

Sector and digital technological advancements collectively contribute to higher yields, better animal health, and improved dairy sector profitability, ultimately

strengthening rural livelihoods and sustainable dairy farming practices. There are four ways in which technology is transforming the dairy sector:<sup>1</sup>

1. *Precision Feeding*

- a. Precise amounts of feed provided to cows ensure optimal balance of nutrients.
- b. This decreases feed wastage as well as increases milk productivity.
- c. Sector-specific innovations, like artificial insemination, improved breeding efficiency and genetic quality, leading to superior livestock with enhanced milk production and disease resistance.

2. *Automated Milking Systems*

- a. By decreasing labour costs, it is possible to increase efficiency.
- b. Optimises milking schedules and ensures consistency and precision.
- c. By recording and monitoring cow's milk yield, we can identify the anomalies on time.

3. *Data-driven decision making*

- a. Aid in gaining invaluable insights into herd's well-being and productivity.
- b. Data-driven decisions can be made on breeding, nutrition, and health of cows.
- c. Health monitoring systems can be used to track vital signs and behaviour.
- d. Can detect illness thereby enabling timely intervention, and reducing the need for antibiotics.
- e. Further, digital technologies, such as artificial intelligence, enhance herd management, disease detection, and automated feeding systems, enabling farmers to monitor livestock health in real-time and optimize nutrition for higher milk yields.
- f. The integration of blockchain technology is also emerging, ensuring greater transparency in milk procurement, fair pricing, and traceability from farm to consumer.

4. *Environmental Monitoring*

- a. Environmental monitoring system tracks and manages water usage, waste management and energy efficiency.
- b. By monitoring resource consumption, we can identify sustainable areas to invest in.
- c. Improved refrigeration technologies ensure better milk preservation, reducing spoilage and enhancing supply chain efficiency, which is particularly crucial for dairy farmers in remote areas.

---

<sup>1</sup> TT Consultants. 2023. "Digital Innovation in Dairy: Sustainable Tech Solutions. TT CONSULTANTS". <https://ttconsultants.com/the-moo-vement-towards-tech-companies-shaping-the-digital-dairy-landscape/>. September 27

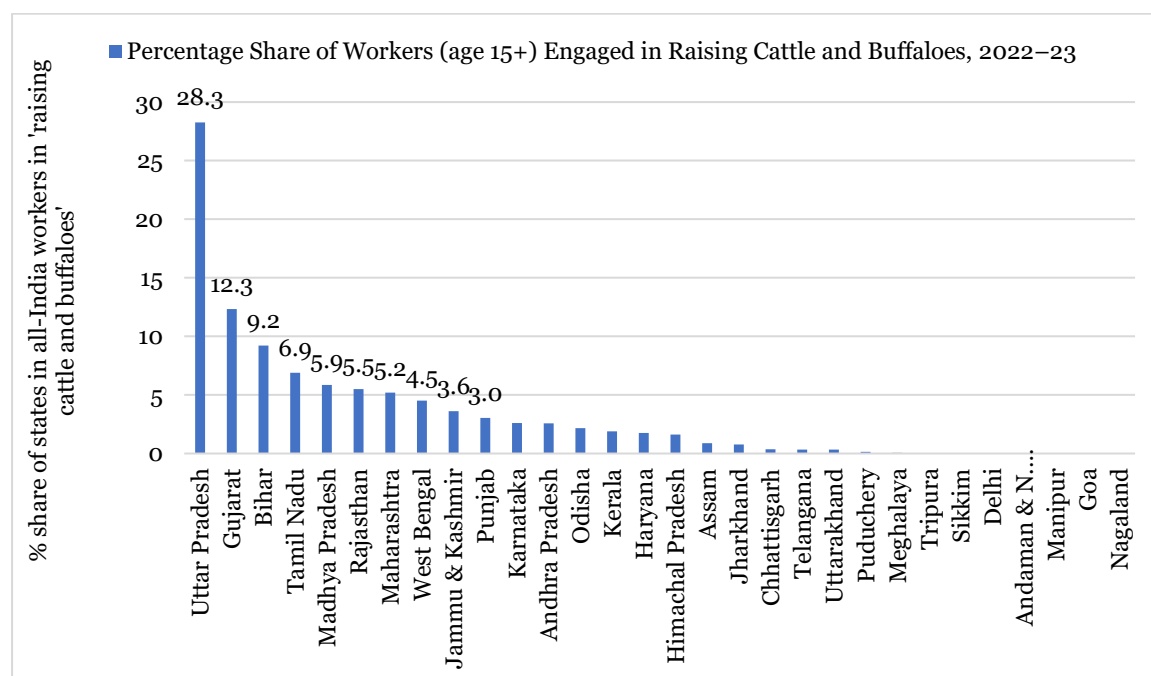
2. Dennis, M. 2023. "The 3 tech trends taking the dairy farming industry by storm". *Food Infotech*. <https://www.foodinfotech.com/the-3-tech-trends-taking-the-dairy-farming-industry-by-storm/>. September 11.

### 5.3 Workforce Characteristics

- a. **Female Workers:** 82 per cent of the workers in this sector are women.
- b. **State-wise distribution:** 78 per cent of the workers in this sector belong to 8 States namely Uttar Pradesh, Gujarat, Bihar, Tamil Nadu, Madhya Pradesh, Rajasthan, Maharashtra and West Bengal (Figure 5.3). About a third of the workers engaged in 'raising cattle and buffaloes' sectors are only in Uttar Pradesh. However, its worker productivity (milk produced per worker) is fairly low at 5.0 tonnes per worker (Annexure 5.1). It is lower than the national average of 9.1 tonnes per worker. Figure 5.4 shows the state-wise distribution of female workers.

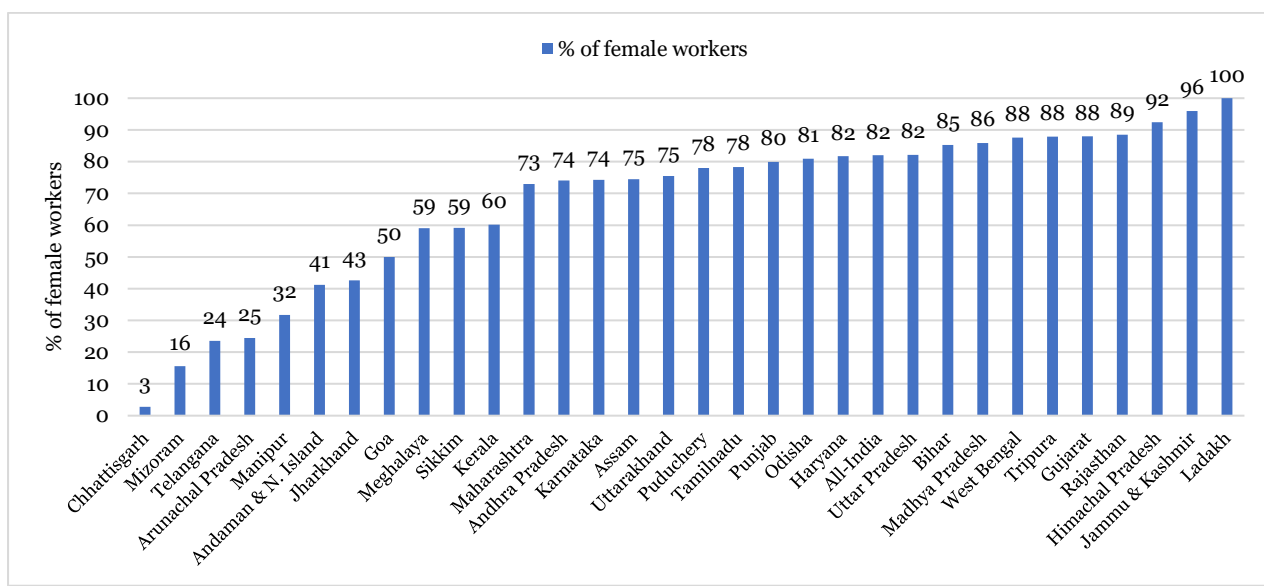
There are different varieties of cows and buffaloes—exotic cows, crossbred cows, indigenous cows, non-descript cows, indigenous buffalo, and non-descript buffalo. Exotic cows have the highest productivity amongst all the animals.

**Figure 5.3: 28.3 per cent of the workers in 'raising cattle and buffaloes' sector are in Uttar Pradesh**



Source: NCAER analysis from PLFS 2022–23.

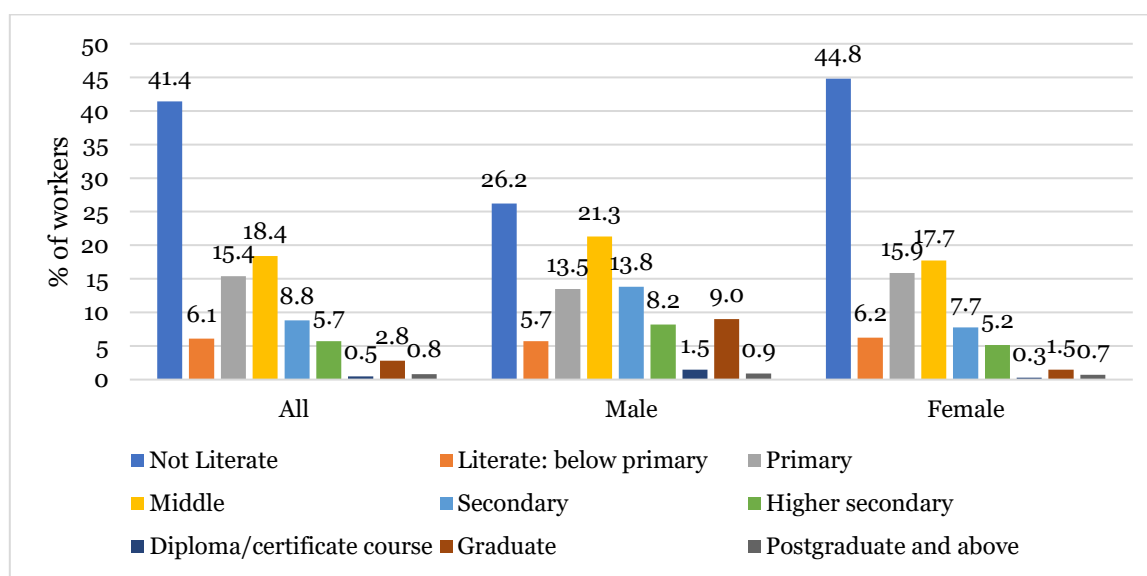
**Figure 5.4: State-wise distribution of female workers engaged in ‘raising of cattle and buffaloes’, 2022–23 (%)**



Source: NCAER analysis from PLFS 2022–23.

- c. **Education Level:** A large share of the workers is not literate (41.4 per cent). More female workers are not literate as compared to male workers (Figure 5.5). 99 per cent of the workers, neither male nor female have technical education. 1.4 per cent of workers have received formal vocational training and 29.5 per cent have received non-formal vocational training. 1.8 per cent of male workers have received formal vocational training. 1.4 per cent of female workers have received formal vocational training.

**Figure 5.5: Educational attainment of workers (aged 15+) engaged in ‘raising cattle and buffaloes’ (%), 2022–23**

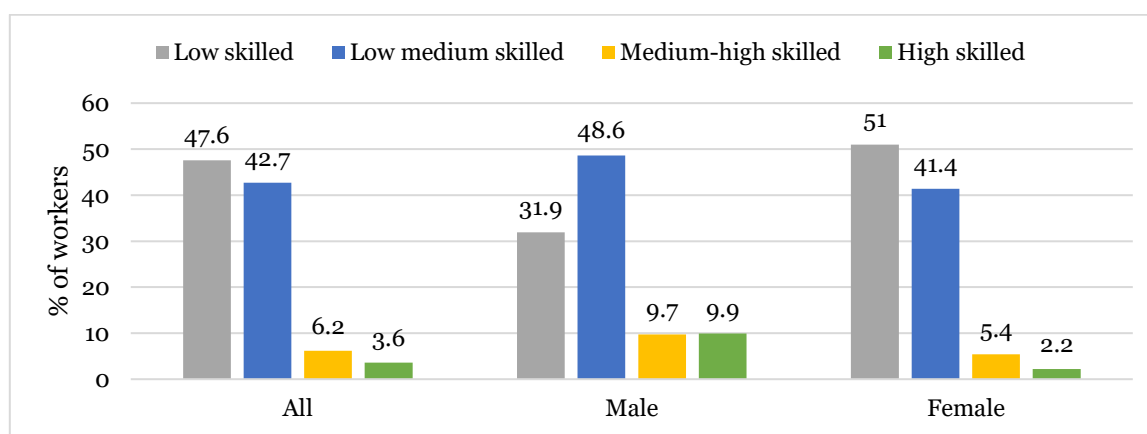


Source: NCAER analysis from PLFS 2022–23.

Note: Not Literate includes data from the following four categories - Not literate, Literate without formal schooling: EGS/ NFEC/ AEC, TLC and not literate Others.

- d. **Skills:** The sector is classified by low skills (Figure 5.6). A larger proportion of male workers are low-medium skilled as compared to women workers who are low-skilled. The share of female workers in low-skilled, low-medium skilled, high-skilled and high-medium skilled are 88 per cent, 80 per cent, 72 per cent and 50 per cent respectively.

**Figure 5.6: Majority of workers in the ‘raising of cattle and buffaloes’ sector are low skilled (aged 15+), 2022–23**



Source: NCAER analysis from PLFS 2022–23.

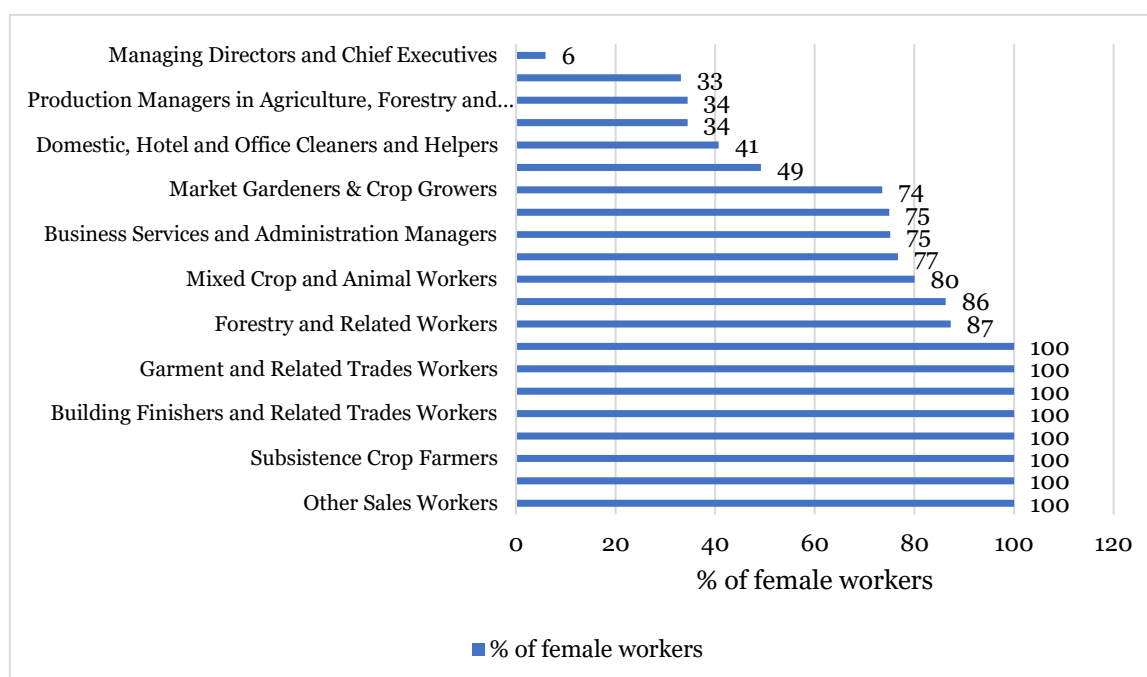
Note: Look at Annexure 4.2 for the definition of skills.

- e. **Occupations:** 87 per cent of the workers are animal producers. 89 per cent of the female workers are animal producers. However, an examination of occupations at the 3-digit level from the PLFS shows high concentration of women in several other job roles (Figure 5.7). Most interesting, while this sector is female-dominated but the share of females in leadership roles such as ‘Managing Director & CEOs’ is very small.

People engaged in a sector can be shown as number of jobs versus number of workers. As mentioned earlier, jobs as per PLFS is defined as sum of workers engaged in the sector in their principal capacity and subsidiary capacity. Workers in a sector can be shown as sum of workers engaged in the sector in their principal capacity and those workers who are engaged in the sector in their subsidiary capacity and they not having any working engagement in their principal capacity. In the sector, ‘raising of cattle and buffaloes’ sub-sector, percentage of female jobs being more than percentage of female workers (73 per cent vs 64 per cent) shows that relatively more female workers than male workers are engaged in the sector in their subsidiary capacity who have also working engagement in their principal activity.



**Figure 5.7: Percentage of female workers (aged 15+) in ‘raising cattle and buffaloes’ sector across occupations, 2022–23**



Source: NCAER analysis from PLFS 2022–23.

- f. **Engagement Status:** Majority of the workers are self-employed in this sector (Table 5.1). 76.9 per cent of workers are self-employed and 0.7 per cent of workers are employers and 21.5 per cent are unpaid family workers. The corresponding statistics for male workers are 67.6 per cent, 2.5 per cent and 25.1 per cent respectively. The corresponding statistics for female workers are 79.0 per cent, 0.3 per cent and 20.7 per cent respectively. 0.7 per cent of workers are employed as regular salaried workers and this is 100 per cent of males. A very small proportion of workers work as casual wage workers (0.2 per cent) and this is also 100 per cent of male workers.

**Table 5.1: Engagement status (%) of workers in ‘raising of cattle and buffaloes’**

| All Workers (aged 15+)          |                          |          |                                                                           |                                          |                          |       |
|---------------------------------|--------------------------|----------|---------------------------------------------------------------------------|------------------------------------------|--------------------------|-------|
| Sector                          | Self-employed            |          |                                                                           | Regular<br>salaried/<br>wage<br>employee | Casual<br>wage<br>labour | Total |
|                                 | Own<br>account<br>worker | Employer | Worked as<br>helper in h.h.<br>enterprise<br>(unpaid<br>family<br>worker) |                                          |                          |       |
| Raising of cattle and buffaloes | 76.9                     | 0.7      | 21.5                                                                      | 0.7                                      | 0.2                      | 100.0 |
| All Male Workers (aged 15+)     |                          |          |                                                                           |                                          |                          |       |
| Raising of cattle and buffaloes | 67.6                     | 2.5      | 25.1                                                                      | 3.5                                      | 1.3                      | 100.0 |
| All Female Workers (aged 15+)   |                          |          |                                                                           |                                          |                          |       |
| Raising of cattle and buffaloes | 79.0                     | 0.3      | 20.7                                                                      | 0.0                                      | 0.0                      | 100.0 |

Source: NCAER analysis from PLFS 2022–23.

## 5.4 Geographical Clusters

### 5.4.1 Definition of Clusters

Clusters are defined as non-random (Ellison and Glaeser, 1997) geographical agglomeration of firms with comparable or closely complementary capabilities (Richardson, 1972).<sup>2</sup> Precisely, in the geographical concentration of enterprises, specific suppliers, service providers, associated institutions, and organisations settled themselves in a certain arena that competes with each other but also co-operates themselves. The geographical proximity of units gives rise to specialised labour, develops subsidiary industries, stimulates state-of-the-art activity, and enables technological spill-overs that makes the economic and non-economic inter-firm linkages feasible.

The prospects for India’s role in the dairy markets mostly hinge on its ability to improve the low productivity of its milking herd with considerable skill gaps in various categories of employment and on the growth and competitiveness of its emerging dairy product sectors. The key to productivity gains will be the continued expansion of relatively high-yielding crossbred dairy herd, along with continued growth in buffalo milk production which is the largest share of milk output. In both cases, output gains are likely to be increasingly dependent on improving the deficient supplies of feeds and enhancing genetics, both of which may provide ample trade opportunities. India’s cooperative and private-sector dairy processors have, so far been successful in meeting the growing domestic demand for dairy products. In the cluster form of production, one way to reinforce competitiveness was the skill management of cluster-based dairy farming, based on the farms’ production potential.

<sup>2</sup> Ellison, G., & Glaeser, E. L. 1997. “Geographic concentration in US manufacturing industries: a dartboard approach”. *Journal of Political Economy*, 105(5): 889–927.

Richardson, G. B. 1972. “The Organisation of Industry”. *The Economic Journal*, 82 (327): 883–896. September.

In this count, the strategy for cluster development by the government is intended to benefit the dairy enterprises to augment their productivity and develop advanced-level innovative products suitable for the national and international market. Michael Porter asserts that an industrial cluster is a set of industries related through buyer-supplier relationships, or by common technologies, common buyers or distribution channels, or common labour pools.<sup>3</sup> Such a relationship leads to improved efficiency and international competitiveness.

The idea behind the dairy farming cluster was that clustering of dairy farms, processing, commercial support services, education and extension within a restricted area that creates a more efficient regional dairy chain (Zijlstra and Lee, 2015).<sup>4</sup> Similar to the previous chapter, the Delgado et al. (2014) definition of clusters is used here in this chapter with the Sutawi et al. (2022) framework being adopted.<sup>5</sup> The cluster development framework is the same as Figure 4.9. The indicators used in estimating clusters in ‘raising cattle and buffaloes’ are shown in Annexure 5.2. Please note that Annexure 5.2 is indicative and not exhaustive. As there are several indicators, that are inter-aligned and non-measurable.

The Dairy Cluster Analysis offers a comprehensive assessment of the dairy industry in India through a structured approach focusing on four main pillars: institutional, business infrastructure, human resources, and government support. Each pillar is divided into sub-pillars, which are further segmented into specific indicators that reflect the operational and developmental aspects of dairy clusters across various States.

### **5.4.2 Methodology**

#### **A. Pillar Structuring**

- a. Each pillar addresses distinct aspects of the dairy sector, broken down into sub-pillars that target granular elements crucial for State-by-State evaluation.
- b. Indicators under each sub-pillar provide a metric-based approach to assess different facets of dairy cluster operations and influences.

#### **B. State Ranking based on indicators**

- a. States are ranked based on their performance in each indicator. These rankings are used to evaluate relative strengths and weaknesses across a standardised set of criteria.
- b. For each sub-pillar, the ranks of all its indicators are averaged to compute an overall rank for each state within that sub-pillar.

---

<sup>3</sup> Porter, M. 1998. “Clusters and the new economics of competitiveness”. *Harvard Business Review*. 77–90. December.

<sup>4</sup> Zijlstra, J. and Lee, J. 2015. “Dairy Cluster Design for Myanmar”. *Livestock Research Report 866*. Wageningen University and Research Centre.

<sup>5</sup> Delgado, M., Porter, M. E., & Stern, S. 2014. “Defining clusters of related industries”. NBER Working Paper No. w20375. [https://www.nber.org/system/files/working\\_papers/w20375/w20375.pdf](https://www.nber.org/system/files/working_papers/w20375/w20375.pdf). Boston: MA: National Bureau of Economic Research.

Sutawi, Prihartini I., Zalizar L., Wahyudi A., Hendraningsih L. 2022. “The Success Indicators of a Dairy Farming Cluster in Indonesia: A Case in Malang Regency of East Java Province”. *Asian Journal of Dairy and Food Research*, 41(1): 22–27. doi: 10.18805/ajdfr.DR-242.

### C. Final State Selection

- The average rankings from each sub-pillar are used to derive a final ranking for each State under the respective pillar. This ranking represents an aggregate measure of State performance relative to the specified operational criteria of the dairy cluster.

### D. Consolidation Across Pillars

- Separate sheets are dedicated to each pillar where States are ranked per sub-pillar and an overall ranking is provided based on average values.
- The final sheet amalgamates the State selections (final rankings) from all pillars, presenting a cohesive view. States are ranked based on their average rankings across all pillars, culminating in a final composite ranking that illustrates the comprehensive performance landscape.

Using the pillars of the indicators in Annexure 5.2, Table 5.2 reports the dairy cluster states in India by using the rank-average method.

**Table 5.2: ‘Raising cattle and buffaloes’ clusters in India**

| S.No. | State             | Institutional | Business Infrastructure | Human Resources | Government Support | Average Ranking |
|-------|-------------------|---------------|-------------------------|-----------------|--------------------|-----------------|
| 1     | Karnataka         | 1             | 6                       | 4               | 6                  | 4.3             |
| 2     | Maharashtra       | 6             | 1                       | 2               | 15                 | 6               |
| 3     | Rajasthan         | 4             | 4                       | 6               | 10                 | 6               |
| 4     | Gujarat           | 2             | 2                       | 10              | 14                 | 7               |
| 5     | Bihar             | 7             | 3                       | 3               | 26                 | 9.8             |
| 6     | Kerala            | 10            | 23                      | 11              | 1                  | 11.3            |
| 7     | Odisha            | 14            | 16                      | 9               | 7                  | 11.5            |
| 8     | Tamil Nadu        | 5             | 9                       | 7               | 25                 | 11.5            |
| 9     | Uttar Pradesh     | 3             | 7                       | 1               | 35                 | 11.5            |
| 10    | West Bengal       | 15            | 10                      | 8               | 17                 | 12.5            |
| 11    | Madhya Pradesh    | 8             | 11                      | 5               | 31                 | 13.8            |
| 12    | Chhattisgarh      | 17            | 21                      | 18              | 2                  | 14.5            |
| 13    | Himachal Pradesh  | 20            | 12                      | 15              | 11                 | 14.5            |
| 14    | Andhra Pradesh    | 16            | 8                       | 17              | 18                 | 14.8            |
| 15    | Haryana           | 9             | 18                      | 14              | 23                 | 16              |
| 16    | Assam             | 19            | 17                      | 13              | 19                 | 17              |
| 17    | Jharkhand         | 26            | 13                      | 12              | 20                 | 17.8            |
| 18    | Punjab            | 11            | 14                      | 16              | 32                 | 18.3            |
| 19    | Uttaranchal       | 12            | 19                      | 20              | 24                 | 18.8            |
| 20    | Arunachal Pradesh | 33            | 20                      | 23              | 5                  | 20.3            |
| 21    | Telangana         | 13            | 15                      | 19              | 36                 | 20.8            |
| 22    | Goa               | 24            | 5                       | 30              | 27                 | 21.5            |
| 23    | Tripura           | 25            | 28                      | 22              | 13                 | 22              |
| 24    | Jammu & Kashmir   | 18            | 22                      | 21              | 28                 | 22.3            |
| 25    | Manipur           | 21            | 24                      | 24              | 22                 | 22.8            |
| 26    | A & N Islands     | 31            | 30                      | 29              | 4                  | 23.5            |
| 27    | D & N Haveli      | 32            | 31                      | 33              | 3                  | 24.8            |
| 28    | Meghalaya         | 29            | 35                      | 31              | 8                  | 25.8            |
| 29    | Mizoram           | 30            | 34                      | 27              | 12                 | 25.8            |
| 30    | Sikkim            | 22            | 27                      | 25              | 29                 | 25.8            |
| 31    | Nagaland          | 27            | 36                      | 28              | 16                 | 26.8            |
| 32    | Daman & Diu       | 36            | 29                      | 35              | 9                  | 27.3            |

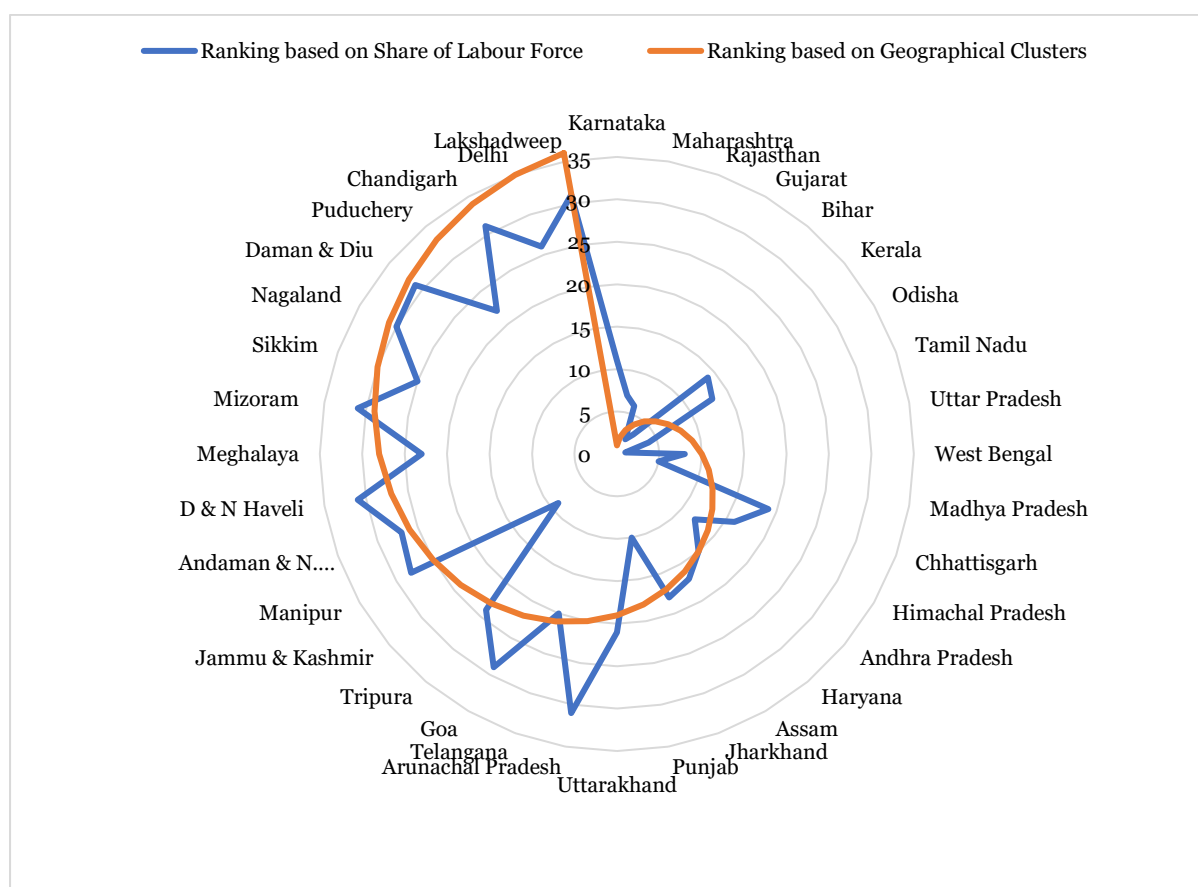
| S.No. | State       | Institutional | Business Infrastructure | Human Resources | Government Support | Average Ranking |
|-------|-------------|---------------|-------------------------|-----------------|--------------------|-----------------|
| 33    | Puducherry  | 23            | 33                      | 26              | 30                 | 28              |
| 34    | Chandigarh  | 34            | 25                      | 34              | 21                 | 28.5            |
| 35    | Delhi       | 35            | 26                      | 32              | 34                 | 31.8            |
| 36    | Lakshadweep | 28            | 32                      | 36              | 33                 | 32.3            |

Source: NCAER Computations.

This report employs a methodological approach to rank States in a quantifiable manner, highlighting key areas of performance and opportunities for enhancement within India's dairy clusters. The final rankings offer a strategic tool for comparative assessment and benchmarking of State performance in comparison to national standards.

The correlations between State-wise rankings of share of workers in this sector and rankings of geographical clusters is 0.8. Figure 5.8 shows State-wise rankings using both the variables. For majority of the States, rankings are same or similar with significant exceptions. While Maharashtra is ranked seventh in terms of share of workers, it is ranked second in terms of being a cluster. And Uttar Pradesh is ranked first in terms of share of workers but ranked ninth when looked at it from a cluster perspective. It signals relatively lower labour productivity in the State.

**Figure 5.8: Rankings using share of workers and geographical clusters for the 'raising cattle and buffaloes' sector**



Sources: NCAER Computations from Table 5.3 and PLFS 2022–23.

Note: Lower ranking means better performance.

## 5.5 Occupational Mapping

The PLFS publishes occupations at the NCO 3-digit level. The corresponding 8-digit occupational codes from the National Classification of Occupations were identified based on the researchers' knowledge, literature review, etc. (wherever feasible). Further, they were mapped to the list of job roles in Agriculture Skill Council of India (ASCI) job roles, where they could be identified. Annexure 5.3 shows the occupational mapping for the 'raising cattle and buffaloes' sector.

## 5.6 Stakeholders' Survey

### 5.6.1 Approach and Stakeholders Identification

States and districts within States have varying composition of various species of cattle and buffaloes. This requires dedicated knowledge and skilling to enhance productivity of the animal. Therefore, a bottom-up approach was used where stakeholders' survey was carried out in various districts to identify skill shortages. Specifically, four districts of Haryana namely Faridabad, Gurugram, Hisar and Karnal were selected for this study. Further, stakeholders from Karnataka, West Bengal, Rajasthan and Maharashtra were also interviewed.

Stakeholders were identified from the value chain (see Figure 5.2) and systematically covered (Table 5.3). Separate questionnaires were developed for each set of stakeholders—Ministry, Sector Skill Council, Industry Association, Farmers/FPOs, training partners, research institutes and other stakeholders. The questionnaire for the livestock sector (Questionnaire No. 3) is given at the end of the report in the questionnaires section. The total number of stakeholders interviewed are shown in Table 5.4.

**Table 5.3: Stakeholders visited in Gurugram, Faridabad, Hisar, Karnal in Haryana and North 24 Parganas in West Bengal (raising cattle and buffaloes)**

| <i>Stage</i>              | <i>Core Activities</i>                                                             | <i>Primary Stakeholders (✓ indicates that these stakeholders were visited)</i>                                                                                                 |
|---------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Breed Selection & Rearing | Selection of high-yield breeds, cattle rearing, nutrition, and disease management. | Dairy Farmers (✓), ICAR Research Institutes (✓), Veterinary Universities (✓), State Animal Husbandry Department (✓), Livestock Feed Suppliers (✓) and Veterinary Services (✓)  |
| Milk Production           | Feeding, milking techniques, animal health management, and fodder cultivation.     | Dairy Farmers (✓), Cooperative Dairy Societies (✓), Private Dairy Firms (✓), Veterinary Services (✓), State Animal Husbandry Department (✓), Agri-tech/Dairy-tech Startups (✓) |
| Chilling & Storage        | Chilling, cold storage, and transportation of milk and dairy products.             | Warehouses (✓), Cold Storage Facilities (✓), Dairy Cooperatives (✓)                                                                                                            |
| Marketing & Sales         | Developing marketing strategies, distribution, and pricing of dairy products.      | State Dairy Federations (✓), Retailers (✓), E-commerce & Online Dairy Platforms (✓), Dairy-tech Startups (✓)                                                                   |

Source: NCAER.

**Table 5.4: Total number of stakeholders covered in the survey of ‘raising cattle and buffaloes’**

| <b>Sector</b>                            | <b>Number of Stakeholders</b> |
|------------------------------------------|-------------------------------|
| Ministry                                 | 1                             |
| Sector Skill Council                     | 1                             |
| National-level Industry Association      | 1                             |
| Micro/Small                              | 6                             |
| Medium                                   | 3                             |
| No of Farms/Firms                        | 6                             |
| Large                                    | 6                             |
| Total                                    | 15                            |
| No. of Placement Cells/TVET Institutions | 3                             |
| Recruitment Agencies                     | Not Applicable                |
| Other Stakeholders                       | 5                             |
| Firms plus Other Stakeholders            | 20                            |
| Total                                    | 26                            |

Source: NCAER.

### **5.6.2 Sectoral Findings about Skill Shortages and Skill Gaps from Stakeholders’ Survey**

The survey of the dairy and livestock sector highlighted both current and future skill shortages in key occupations such as veterinary technicians, refrigeration mechanics, dairy technologists, and dairy farm managers. These shortages stem from a combination of factors, including an outdated education and training system, industry-specific challenges, and mismatches between employer expectations and available workforce skills. While some job roles face a skills shortage due to an insufficient number of trained workers, others suffer from a skills gap, where workers lack the necessary competencies despite being employed.

A major concern in the education and TVET (Technical and Vocational Education and Training) system for dairy and livestock jobs is the outdated curriculum, which does not adequately incorporate modern dairy technologies such as automated milking systems, AI-driven cattle health monitoring, and cold chain logistics. The shortage of qualified trainers and practical training facilities further weakens the skill pipeline. Many institutions lack modern laboratories for animal breeding, milk quality testing, and refrigeration system management, making it difficult for graduates to gain hands-on experience. Moreover, weak academia-industry linkages mean that many dairy processors and large farms struggle to find workers with practical knowledge in farm management, milk processing, and quality control. The lack of structured apprenticeship and internship programmes further exacerbates the issue.

Female workforce participation in the dairy and livestock sector faces both demand-side and supply-side challenges. From the industry’s perspective, jobs requiring physical labour—such as handling cattle or managing dairy processing plants—are considered less aspirational for women, and senior leadership opportunities for women in dairy management remain limited. On the supply side, cultural norms and safety concerns deter women from taking up livestock roles,

particularly in field-based operations. However, technological advancements, such as farm automation, can reduce physical labour requirements, making these jobs more accessible to women. Furthermore, improving workplace safety, offering transport, and providing permanent contracts can encourage greater female participation.

To address the skills gap, some large dairy firms and cooperative societies, such as AMUL and Mother Dairy, have initiated their own training academies to develop dairy technologists and farm managers. Best practices from leading firms show that providing permanent contracts, health insurance, and structured career growth opportunities improves workforce retention. Additionally, introducing specialised training programmes for women, offering transport facilities, and implementing better workplace safety policies can further enhance female participation in the sector.

The findings highlight the need for expanding skill training programmes, incorporating modern dairy technologies into curricula, strengthening industry-academia partnerships, and addressing gender-specific barriers in the workforce. Targeted policy interventions, such as apprenticeship mandates, summer internships, and skill development programmes focusing on women, can help bridge the existing skill gaps and prepare the dairy and livestock sector for future labour market demands.

The fragmented nature of the dairy sector poses a significant challenge in identifying clusters, as regional variations add complexity to the research process. Moreover, the informal structure of the sector makes it difficult to quantify workforce participation, leading to a lack of official data and records. Additionally, inadequate infrastructure and logistical constraints have stagnated productivity, resulting in inefficiencies across dairy farming operations. Lastly, there is an urgent need to establish structured educational and training programmes that align with future job demands by integrating advanced technical skills into their curricula.

There are three key findings from stakeholders' survey about job roles-ones which require re-skilling & upskilling, new and emerging job roles and job roles which are difficult to fill. They are discussed in detail below.

1. Job roles which require re-skilling and upskilling:

- Milker (not shown in Table 5.5))<sup>6</sup>
  - Milking the cattle as required
  - Collecting various feed mixes and feeding the animals
  - Regulating the timing for milking
  - Cleaning and disinfecting buckets and other containers used in milking
  - Tying the hind legs of animals and washing their hindquarters with chlorinated water
  - Cleaning and disinfecting hands and udder with plain chlorinated water and massaging them by hand
  - Pressing udders alternatively with fingers to extract maximum milk
  - Stimulating the flow of milk from udder by repeated supply of feed
  - Transferring milk to a specified storing place
  - Treating udder and other minor injuries by applying antiseptic powder, ointment, etc.
  - Selling milk in the market
  - Preparing ghee, butter, and cream

---

<sup>6</sup> National Career Service website. <https://www.ncs.gov.in/Pages/default.aspx>.



This has been a traditional job role where the skills were taught within families but with youth aspiring for jobs outside the livestock sector, it has become challenging to fill these roles. Therefore, it is recommended that these traditional job roles need to be taught in formal settings with Recognition of Prior Learning and bridge education and training playing a major part. The knowledge and skills required are the following:

- The minimum education requirement is 5th standard.
  - Animal husbandry which include the following are required:
    - Understanding the breeding and genetics of dairy breeds;
    - Nutrition Management: Knowledge of balanced diets to ensure optimal milk production and animal health;
    - Health Management: Skills in identifying and treating common diseases like mastitis, which can affect milk quality
  - Physical skills
  - Cognitive skills including communication skills.
2. New & Emerging Job Roles focussing in the 'sunrise' aspects of the sector: Scrap Manager is someone who manages all aspects of scrap materials generated from raw material process waste across organisation and ensures inventory control, vendor management, and revenue maximisation. Qualifications required are B.Tech. in Dairy Technologist.
  3. Job Roles which are deemed as difficult to fill: The top four job roles that are difficult to fill are shown in Table 5.5 and the rest are explained below.
    - Veterinary Technician/Assistant: The National Career Service defines two types of Veterinary Assistants—Field and Clinical.<sup>7</sup>
      - The tasks a Veterinary Field Assistant is expected to perform include:
        - Assisting veterinarians in controlling and restraining domesticated farm/wild animals and poultry
        - Implementing regular preventive animal health care programme
        - Assisting in provisional diagnosis of common animal diseases (including poisoning and injury)
        - Providing curative treatment for common animal diseases
        - Conducting minor surgical procedures in the field
        - Assisting government agencies in animal disease control
        - Assisting in animal identification, data collection, and documentation of practices (including socio-economic aspects)
        - Assisting in implementation of veterinary public health and other regulatory activities
        - Assisting in implementation of animal breeding services
      - The tasks a Veterinary Clinical Assistant is expected to perform include:
        - Implementing regular preventive animal health care programme
        - Assisting in provisional diagnosis of common animal diseases
        - Providing curative treatment for common animal diseases
        - Assisting during veterinary surgery in hospital/clinic setting
        - Providing companion animal care
        - Assistance in veterinary hospital/clinic management
        - Conducting common laboratory tests on animals
        - Implementing veterinary public health and other regulatory activities
        - Implementing animal breeding services

---

<sup>7</sup> National Career Service website. <https://www.ncs.gov.in/Pages/default.aspx>.

- Assisting in animal welfare, breed conservation and disaster management
- Assisting in livestock farm management
- Mechanic-Refrigeration and Air Conditioning:<sup>8</sup> The tasks involve the following:
  - Installing and repairing refrigeration or air conditioning units
  - Replacing defective parts, re-seating valves, refitting coils, insulating, requiring electrical connections, soldering, etc.
  - Installing at site assembled air conditioning unit and refrigerators giving necessary power connections
  - Making changes to units as necessary
  - Examining faulty equipment
  - Dismantling equipment if required
  - Replacing or repairing defective parts to units by re-seating valves, refitting coils, re-insulating system, etc.
  - Over hauling and reassembling units after cleaning components
  - Replacing defective or worn out parts of pumps, compressors, motors, etc.
  - Removing faulty sealed units or sub-units of refrigerators or air conditioning plants
  - Conducting vacuum and pressure test of pipe lines and charging system with fresh refrigerant
  - Setting plant to desired cooling conditions, preventing leakage and ensuring attainment and maintaining required temperature
  - Getting burnt out motors or generators repaired and installing repaired ones to plant giving necessary electrical connections
- Dairy Technologist:<sup>9</sup> The tasks include:
  - Applying principles of bacteriology, chemistry, physics, engineering and economics to produce milk and milk products
  - Developing new and improved methods in production, preservation and utilisation of milk, cheese, ice-cream, etc.
  - Conducting experiments in preventing bacterial increase in milk during handling and processing
  - Improving pasteurisation methods
  - Designing better packaging materials, dairy equipment or supplies
  - Managing sanitation, storage, etc. according to the product, such as ice-cream, cheese, etc.
- Manager-Dairy Farm<sup>10</sup>: The tasks include:
  - Managing the dairy farm on behalf of the employer
  - Producing milk, butter, ghee, etc.
  - Supervising selection and purchase of animals, in consultation with their employer
  - Making proper arrangements for housing, feeding and treatment of milch animals
  - Pairing animals for breeding on basis of pedigree
  - Arranging artificial insemination for the development of good breed
  - Taking proper care of animals during birth of young

---

<sup>8</sup> National Career Service website. <https://www.ncs.gov.in/Pages/default.aspx>.

<sup>9</sup> Ibid.

<sup>10</sup> Ibid.

- Ensuring that hygienic methods are observed
- Arranging the transportation and marketing of the products
- Controlling office and field staff, and co-ordinating their work
- Sales manager (not shown in Table 5.5):<sup>11</sup> A sales manager in the dairy farm industry, as classified by the National Career Service (NCS), is responsible for managing and overseeing all aspects of sales and marketing activities, including building relationships with customers, achieving sales targets, and ensuring customer satisfaction. They should have a Bachelors in Commerce and good communication skills.
- Farm Worker (not shown in Table 5.5): A farm worker is someone who works on the farm. The workers are involved in the production process of milk and packaging it. They have to ensure that cows are well-fed, cut fodder, clean barns and the animals are not injured or wounded. Their education level can be below Class X. It is difficult to find young farm workers as youth are not aspirational and churning is also quite high. One organic farmer reported that 30 per cent of their employees were farm workers. One farm said that digital communication skills, i.e., how to use mobiles and how to make good reels on social media are additional benefits. There are spatial gaps. It was difficult to find workers in Uttar Pradesh but not in Uttarakhand. Basically, closer to the city, you get, it is harder to find farm workers. Since the farm was an organic one, they preferred to use hands versus machinery. Another farmer reported the same problem. This again points to the issue that there are no takers for traditional jobs. Families cannot be relied upon to teach them and one need to teach traditional skills in formal settings.
- Delivery Worker: They deliver milk in the morning at 4 a.m., i.e., provide transport. They are in-between phases of life either unemployed or studying. In one organic farm, 25 per cent of their employees (30 workers) were delivery workers and all of them were part-time.

---

<sup>11</sup> National Career Service website. <https://www.ncs.gov.in/Pages/default.aspx>.

**Table 5.5: Assessment of current and future skills shortage for top five job roles in ‘raising cattle and buffaloes’**

| <i>Items</i>                                              | <i>Veterinary Technician/Assistant</i>                                                                                                                                                                                                                                  | <i>Mechanic—Refrigeration and Air Conditioning</i>                                                                                                                                                                                                                                           | <i>Dairy Technologist</i>                                                                                                                                                                                                                                                                                                                                                             | <i>Manager—Dairy Farm</i>                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NCO Code                                                  | 324                                                                                                                                                                                                                                                                     | 712                                                                                                                                                                                                                                                                                          | 214                                                                                                                                                                                                                                                                                                                                                                                   | 131                                                                                                                                                                                                                                                                                                                                             |
| NCO 3/8-digit (QP code)                                   | 3240.9900 (AGR/Q4801; AGR/Q4802)                                                                                                                                                                                                                                        | 7127.0100 (FIC/Q9502)                                                                                                                                                                                                                                                                        | 2141.1900                                                                                                                                                                                                                                                                                                                                                                             | 1311.1400 (AGR/Q4101)                                                                                                                                                                                                                                                                                                                           |
| Match from Job Projections (612, 521, 632, 613 and 611) @ |                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                 |
| No. of stakeholders which mentioned this                  | 12                                                                                                                                                                                                                                                                      | 14                                                                                                                                                                                                                                                                                           | 13                                                                                                                                                                                                                                                                                                                                                                                    | 15                                                                                                                                                                                                                                                                                                                                              |
| Location of firms/farms                                   | Karnal, Hisar & Faridabad, Haryana; Pune & Kolhapur, Maharashtra; Jodhpur, Rajasthan and; North 24 Parganas, West Bengal                                                                                                                                                | Karnal, Hisar & Faridabad, Haryana; South Bengaluru, Karnataka; Pune & Kolhapur, Maharashtra; Mohali, Punjab; Jodhpur, Rajasthan and; Bareilly, UP                                                                                                                                           | Karnal, Hisar & Faridabad, Haryana; South Bengaluru, Karnataka; Pune & Kolhapur, Maharashtra; Mohali, Punjab; Jodhpur, Rajasthan and; Bareilly, UP                                                                                                                                                                                                                                    | Karnal, Hisar & Faridabad, Haryana; South Bengaluru, Karnataka; Pune & Kolhapur, Maharashtra; Mohali, Punjab; Jodhpur, Rajasthan and; Ghaziabad & Bareilly, UP                                                                                                                                                                                  |
| Average monthly income (Rs.)                              | 25 to 30,000                                                                                                                                                                                                                                                            | 35 to 40,000                                                                                                                                                                                                                                                                                 | 55 to 60,000                                                                                                                                                                                                                                                                                                                                                                          | 50 to 60,000                                                                                                                                                                                                                                                                                                                                    |
| Educational Qualifications                                | Bachelor of Veterinary Science/Diploma Holder/NSQF Aligned Course                                                                                                                                                                                                       | Industrial Training Institute (ITI) and NCVT/SCVT certification                                                                                                                                                                                                                              | B.Tech/M.Tech degree from NDRI/CCSHAU etc.                                                                                                                                                                                                                                                                                                                                            | Management degree in Dairy Business/Diploma Holder/NSQF Aligned Course                                                                                                                                                                                                                                                                          |
| Skills required at the competency level (3 and more)      | <b>Cognitive Skills:</b> Reading, writing, numeracy, digital Skills, Resource Management (Entrepreneurship skills)<br><b>Socio-emotional Skills:</b> Extraversion<br><b>TVET:</b> Animal behaviour, breeding, disease awareness and Application of medicine and surgery | <b>Cognitive:</b> Reading, writing, numeracy and digital skills<br><b>Socio-emotional Skills:</b> Agreeable<br><b>TVET:</b> <ul style="list-style-type: none"> <li>Troubleshoot and repair electrical and air-filled control systems &amp; its management</li> </ul> Bulk cooling management | <b>Cognitive Skills:</b> Reading, writing, numeracy and digital skills<br><b>Socio-emotional Skills:</b> Conscientiousness<br><b>TVET:</b> <ul style="list-style-type: none"> <li>Applying chemistry and microbiology, to dairy production processes to ensure quality and efficiency</li> </ul> Expertise in techniques to enhance milk production and preserve milk to extend shelf | <b>Cognitive Skills:</b> Reading, writing, speaking, knowledge of local language and English/Hindi/local language, digital skills, independent learner, active listening, creativity, learning strategies (learn & train their own staff), judgement & decision-making, resource management (time management, financial & resource management), |

| <i>Items</i>                                                                                  | <i>Veterinary Technician/Assistant</i>                                                                                                                                                                                                                                        | <i>Mechanic—Refrigeration and Air Conditioning</i>                                                                                                                                                                                                                                        | <i>Dairy Technologist</i>                                                                                                                                                                                                                | <i>Manager—Dairy Farm</i>                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                               |                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                           | life and maintain nutritional value.<br>Awareness of modern technologies                                                                                                                                                                 | communication skills (effectively communicate with employees, suppliers, buyers, and customers to build relationships and ensure smooth business operations)<br><b>Socio-emotional Skills:</b> Extraversion, Agreeable and Emotional Stability<br><b>TVET:</b> Knowledge about the sector |
| Skills Shortage                                                                               | Yes                                                                                                                                                                                                                                                                           | Yes                                                                                                                                                                                                                                                                                       | Yes                                                                                                                                                                                                                                      | Yes                                                                                                                                                                                                                                                                                       |
| Skills Gap                                                                                    | No                                                                                                                                                                                                                                                                            | Yes                                                                                                                                                                                                                                                                                       | No                                                                                                                                                                                                                                       | No                                                                                                                                                                                                                                                                                        |
| Relevance of TVET System                                                                      | Good quality                                                                                                                                                                                                                                                                  | Practical skills missing; skills mismatch                                                                                                                                                                                                                                                 | Good quality                                                                                                                                                                                                                             | Good quality                                                                                                                                                                                                                                                                              |
| Gender (Challenges)                                                                           | No issue                                                                                                                                                                                                                                                                      | Not aspirational                                                                                                                                                                                                                                                                          | No issue                                                                                                                                                                                                                                 | No issue                                                                                                                                                                                                                                                                                  |
| Challenges Faced by Industries in Meeting Skill Requirements                                  | Prevalence of unqualified workers                                                                                                                                                                                                                                             | MSMEs face challenges because they do not have the capacity to skill                                                                                                                                                                                                                      | Finding workers                                                                                                                                                                                                                          | Finding workers                                                                                                                                                                                                                                                                           |
| Industry-specific interventions that facilitate skill & capacity development (best practices) | Large and new-age farms are opening their own veterinary units                                                                                                                                                                                                                | None                                                                                                                                                                                                                                                                                      | Research & Development on farms                                                                                                                                                                                                          | On-job training given                                                                                                                                                                                                                                                                     |
| <b>Policy Recommendations</b>                                                                 | <b>Skill Training Programme:</b> Needs to be expanded<br><b>Curriculum Development:</b> Entrepreneurship skills need to be added to curriculum<br><b>Gender:</b> Maybe encouraged with additional socio-emotional skills<br><b>Skill Initiatives:</b> Special focus for women | <b>Skill Training Programme:</b> Needs to be expanded<br><b>Curriculum Development:</b> Practical skills to be made mandatory; curriculum needs to be aligned with present needs<br><b>Gender:</b> Maybe encouraged<br><b>Skill Initiatives:</b> Apprenticeships should be made mandatory | <b>Skill Training Programme:</b> Needs to be expanded<br><b>Curriculum Development:</b> Incorporate modern technologies in curriculum<br><b>Gender:</b> Maybe encouraged<br><b>Skill Initiatives:</b> Summer internships are recommended | <b>Skill Training Programme:</b> Needs to be expanded;<br><b>Curriculum Development:</b> Socio-emotional skills need to be incorporated in the curriculum<br><b>Gender:</b> Maybe encouraged<br><b>Skill Initiatives:</b> Special training for women                                      |

Source: NCAER Conceptualisation.

Notes: @ Pink shade indicates no match between I-O quantitative top 5 occupation projections and survey-based top 5 occupation projections. Not matching makes sense as the I-O analysis, projects top 5 job occupations where most of the workers are there. However, in the survey, stakeholders were asked that in which job roles, i.e., they are trying to hire people but are not able to hire. Plus, technological changes have created new job roles.

## 5.7 Recommended Methodology

The development of India's dairy sector requires a bottom-up (district-wise) strategy, given its diverse agro-climatic and socio-economic landscape. A district-wise approach is essential to address regional variations in dairy production, workforce capabilities, and infrastructure gaps. This necessitates a multi-pronged strategy combining secondary data analysis, stakeholder consultations, and labour market assessments to ensure evidence-based policy interventions.

A rigorous secondary data analysis using statistics at the Central and state levels can provide valuable insights into regional needs. The Ministry of Statistics and Programme Implementation (MoSPI) publishes data on the *Situation Assessment of Farmers* and the value of agricultural output, which can help identify district-level production trends and economic conditions. Additionally, reports from the Ministry of Fisheries, Animal Husbandry & Dairying, including *Animal Husbandry Statistics* and *Annual Reports*, along with State government publications, can offer critical information on livestock population, milk yield, and sectoral investments.

However, beyond secondary data, stakeholder consultations through Focus Group Discussions (FGDs) are crucial for capturing qualitative aspects such as farmer challenges, technology adoption, and skill gaps. These discussions can provide nuanced insights into regional constraints in dairy production and processing, allowing for more targeted interventions.

A key area requiring in-depth assessment is workforce composition, skill shortages, and emerging employment trends in the dairy sector. An Occupational-Wage-Employment Survey can provide critical insights into new and evolving roles such as dairy technologists, farm management specialists, and veterinary service providers. This organised and formal part of the dairy sector may be included in the OWES sector. Additionally, technological advancements in artificial insemination, feed optimisation, disease management, and precision dairy farming have created demand for specialised skill sets. However, existing skill shortages—especially in refrigeration mechanics for milk preservation, dairy processing, and cold-chain logistics—highlight the need for targeted skill development programs.

Furthermore, vacancy surveys can be used to assess real-time workforce shortages in critical areas such as dairy farm management, veterinary services, and milk processing.

Moreover, Big Data analytics can be leveraged to track labour trends, workforce mobility, and skill utilisation in commercial dairy farms, processing units, and retail dairy chains. This can provide policymakers with real-time insights into employment patterns and help bridge regional mismatches in skill availability and industry demand.

By integrating data-driven decision-making with skill enhancement and inclusive employment strategies, the dairy sector can optimise productivity, address labour market asymmetries, and enhance job creation—particularly for women and marginalized communities. A structured, evidence-based approach that combines statistical insights with qualitative assessments can drive policies that are not only responsive to local needs but also aligned with the broader vision of a modern, inclusive, and sustainable dairy ecosystem.



## 6. Manufacturing of Textiles and Cotton Ginning: Weaving of Textiles

### 6.1 Definition of the Sector

The focus of this study is on ‘weaving of textiles, NIC code 1312 as mentioned in the above section. This consists of four sub-sectors which are defined in Table 6.1.

**Table 6.1: Definition of the agricultural sub-sector used in the analysis**

| <i>NIC Code</i> | <i>Description</i>                                                        |
|-----------------|---------------------------------------------------------------------------|
| 13121           | Weaving, manufacture of cotton and cotton mixture fabrics.                |
| 13122           | Weaving, manufacture of silk and silk mixture fabrics.                    |
| 13123           | Weaving, manufacture of wool and wool mixture fabrics.                    |
| 13124           | Weaving, manufacturing of man-made fibre and man-made mixture fabrics.    |
| 13129           | Weaving of jute, mesta and other natural fibres including blended natural |

Source: Central Statistical Organisation, Ministry of Statistics and Programme Implementation. 2008. National Industrial Classification (All Economic Activities). 2008. [https://www.ncs.gov.in/Documents/NIC\\_Sector.pdf](https://www.ncs.gov.in/Documents/NIC_Sector.pdf).

### 6.2 Background

The Indian textile industry is the second largest producer of manmade fibre after China, third largest exporter of Textiles & Apparel in the world.<sup>1</sup> India’s textiles and clothing industry is one of the mainstays of the national economy. India has a share of 4.6 per cent of the global trade in textiles and apparel. Major textile and apparel export destinations for India are USA, EU 27 and UK, accounting for approximately 50 per cent of India’s textiles and apparel exports. The textile industry can be further sub-divided into handloom or power loom sectors. Even the power loom is heterogeneous as there are many types of power looms (Box 6.1).

Handloom industry being one of the largest in terms of employment potential, with 28.2 lakh looms, plays a very important role in the country’s economy, producing both for domestic as well as international consumption. The major handloom export centres are Karur, Panipat, Varanasi, and Kannur where handloom products like bed linen, table linen, kitchen linen, toilet linen, floor coverings, embroidered textile materials, curtains, etc. are produced for export markets. According to the Handloom Census 2019–20, about 35.2 lakh handloom workers were employed across the country, out of which 25.5 lakhs were women workers with a share of 72.3 per cent of the total handloom workers. Among all, the States of Assam, Tamil Nadu, and Manipur accounts for highest number of women workers in the sector.

On the other hand, power loom sector contributes nearly 58.4 per cent to total cloth production and more than 60 per cent of fabric meant for export in the country. With about 3.85 lakh power loom units in India, most of these units are concentrated in

---

<sup>1</sup> Ministry of Textiles, GoI. 2023. Annual Report 2022–23. [https://texmin.nic.in/sites/default/files/English%20Final%20MOT%20Annual%20Report%202022-23%20%28English%29\\_0.pdf](https://texmin.nic.in/sites/default/files/English%20Final%20MOT%20Annual%20Report%202022-23%20%28English%29_0.pdf)



semi-urban, or rural areas. Within the larger textiles sector, the focus of this study is on 'weaving of textiles, NIC code 1312 as mentioned in the above section.

### **Box 6.1: Type of looms**

There are four types of handlooms—pit looms (with Dobby/Jacquard and others), frame looms (with Dobby/Jacquard and others), loin looms, and others. Power looms can be broadly categorised into plain loom, semi-automatic looms, automatic looms, and shuttleless types. The shuttleless looms further divided into air jet, water jet, and rapier looms, each utilising different methods for weft yarn insertion.

**Plain loom:** Plain loom denotes the loom without any warp or weft stop automatic control mechanisms. Also, the take-off motions may not be present in the loom. However, in such looms dobby, jacquard or drop box attachment may be present as additional attachments according to the requirement of the weaver.

**Semi-automatic loom:** This type of loom is basically the plain loom with additional attachments of automatic electronic/mechanical warp stop as well as weft stop motions along with positive let off motions. As in the case of plain looms, the semi-automatic loom may have additional attachment of dobby or jacquard or drop box as the case may be.

**Automatic loom:** An automatic loom is basically one that has auto pirn changing mechanism along with all the automatic warp and weft stop motions as well as positive let off motions.

**Shuttleless Looms:** These looms insert the weft yarn without using a shuttle, offering faster weaving speeds and lower noise levels. These looms eliminate the shuttle and use alternative methods for weft insertion, enabling wider fabrics. Shuttleless looms have various advantages like: higher weaving speeds, lower noise levels, and suitability for a wider range of fabrics. Example: Sulzer shuttleless weaving machines. Shuttle less looms can be of following types:

- Air Jet Loom: Uses compressed air to propel the weft yarn across the warp yarns.
- Water Jet Loom: Uses water jets to insert the weft yarn.
- Rapier Loom: Employs mechanical rapiers to carry the weft yarn across the warp yarns.

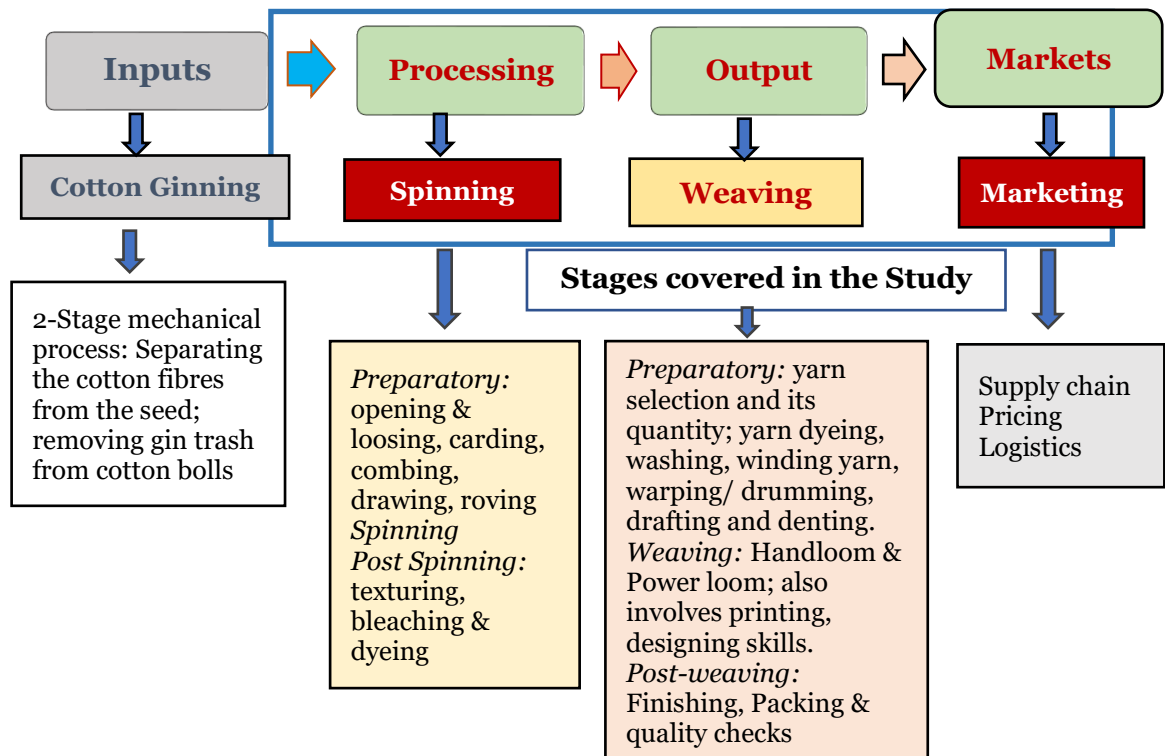
*Sources:*

Ministry of Textiles. 2020. Status of Power loom Sector in Tamil Nadu— Focus on Modernisation. Chapter 4. <https://www.textilescommittee.nic.in/status-Power-loom-sector-tamil-nadu-focus-modernisation>. November 7.  
Office of the Development Commissioner of Handlooms, Ministry of Textiles, Government of India.2019. Fourth All-India Handloom Census 2019-20. New Delhi, India.

### **6.3. Value Chain**

The value chain for textile sector is given in Figure 6.1. The stages of processing which are taken up in the study include a pre-weaving stage (including spinning), and output stage (i.e., weaving and marketing stage).

**Figure 6.1: Value chain for textiles sector**



Source: Author's conceptualisation based on literature review.

These stages are defined here:

- **Ginning:** Process in which the cotton fibres are separated from the cotton seeds or lint.
- **Spinning:** Process of winding together drawn-out strands of fibres to form a yarn.
- **Weaving and Finishing:** Process of interlacing two sets of yarn that cross each other at right angles to create fabric.
- **Marketing:** Process of supply chain of final products (carpets, blanket, towels, sarees, etc.).

### **Digital Technologies in the 'Weaving of Textiles'**

The advent of digital technologies has affected both the production process and the nature of textiles being produced. Here are some examples.

#### Production Process

- **Artificial Intelligence and Machine Learning:** Traditionally, textile production has encompassed several manual and machine-based steps like

spinning fibres, weaving or knitting, dyeing, and finishing.<sup>2,3,4,5</sup> These methods depended heavily on skilled labour, often resulting in errors and fabric waste. Artificial intelligence can help in textile production by handling tasks like predictive maintenance and fabric inspection while improving quality and cutting down on waste. By making machines smarter, AI reduces the need for constant human input, is making production faster, more accurate, and less wasteful and helps streamline the entire process. AI can help optimise spinning and weaving by analysing sensor data like machine vibrations, speed, and tension. It makes real-time adjustments to ensure consistent quality and predicts maintenance needs to reduce downtime.

- **Automation & Digital Technologies:** In the textile production department, automation and digital technologies can revolutionise processes, from design and production to quality control, by using robotic sewing, computerised cutting, and digital printing systems, leading to increased efficiency and product quality.<sup>6</sup>
- **Supply Chain Invocations (Traceability, Blockchain, etc.):** Blockchain is an encrypted ledger of digital data that is continuously authenticated with every new change by linking transactions in the form of a chain.<sup>7</sup> The entire process is automated and hence transparency and efficiency are ensured for various parties involved including—dealers, distributors, suppliers, and third parties. The information or data is stored digitally in blocks, spread over thousands or millions of computers through an integrated network having algorithms to authorise/ check the authenticity of transactions. It helps reduce time and effort by removing activities like manual recording, inaccurate pickups, inaccurate deliveries, etc., thus making the entire process much more accurate and faster.
- **Sustainable Technologies (Eco-friendly chemicals/ dyes):** Sustainable technologies, including eco-friendly chemicals and dyes, focuses on minimising environmental impact through the use of natural, biodegradable, and renewable resources, offering alternatives to conventional, often harmful, synthetic options.

---

<sup>2</sup> Nagesh, J. Salanke, P. and S. Kumar, S. 2022. “Digital Revolution in Textiles”. *Asian Textile Journal*. 58. March-April.

<sup>3</sup> Shah, D. 2023. “Impact of Digital Technologies on the Textile Industry”. *Fibre2fashion.com*. <https://www.fibre2fashion.com/industry-article/9622/impact-of-digital-technologies-on-the-textile-industry>. April.

<sup>4</sup> Rahman, M.M. 2020. “Applications of the digital technologies in textile and fashion industry”. *Technium* 3(1): 114-127.

<sup>5</sup> Vina, A. 2024. “The Future of Textile Production with AI-Driven Manufacturing”. <https://www.ultralytics.com/blog/the-future-of-textile-production-with-ai-driven-manufacturing>. November 19.

<sup>6</sup> Mohapatra, L. 2023. “Automation in Garment Making”. *Fibre2fashion.com*. <https://www.fibre2fashion.com/industry-article/9744/automation-in-garment-making#:~:text=Advantages%20of%20Automation,%E2%80%A2>. August.

<sup>7</sup> <https://www.investopedia.com/terms/b/blockchain.asp>

## New Types of Textiles

- **Circular textiles:** A circular textile system aims to minimise waste and pollution throughout the textile lifecycle by focusing on sustainable sourcing, eco-friendly production, and the ability to recycle or compost textiles after use, ultimately keeping products and materials in use for as long as possible.
- **Green textiles:** (or eco-textiles) are part of the sustainable fashion and eco-friendly trends, providing alternatives to the otherwise pollution-heavy products of conventional textile industry, which is deemed the most ecologically damaging industry.
- **Recycled textiles:** Textile recycling is the process of recovering fibre, yarn, or fabric and reprocessing the material into new, useful products.<sup>8</sup> Textile waste is split into pre-consumer and post-consumer waste and is sorted into five different categories derived from a pyramid model.
- **Sustainable textiles:** The sustainable production and consumption of eco-friendly textiles which improves employment and working conditions of textile artisans.<sup>9</sup> This includes fabrics produced with minimal environmental impact and ethical labour practices, often using organic or recycled materials and processes that reduce waste, energy, and water consumption.<sup>10</sup>
- **Advanced Materials (Technical Textiles, Smart Textiles, etc.):** Technical textile are fabrics and products designed for functional, non-aesthetic purposes, used in diverse industries like automotive, medical, construction, and agriculture, prioritising performance and durability over aesthetics. Smart textiles on the other hand, also known as e-textiles or smart fabrics, are fabrics that incorporate electronic components like sensors, microcontrollers, and batteries, enabling them to sense and respond to environmental changes or stimuli.

The technical textiles is an advanced technology backed sunrise sector which is steadily gaining ground in India. Technical textiles are functional fabrics that have applications across various industries including automobiles, civil engineering and construction, agriculture, healthcare, industrial safety, personal protection, etc. This is a futuristic and niche segment of textiles, which are used for various applications ranging from agriculture, roads, railway tracks, sportswear, health on one end to bullet proof jacket, fireproof jackets, high altitude combat gear and space applications on another end of spectrum. Technical textiles are textiles materials and products manufactured primarily for technical performance and functional properties rather than aesthetic characteristics. Technical textiles may be produced using either power loom technology or shuttle-less loom (see Box 6.1 for definitions of different types of power looms).

---

<sup>8</sup> Hawley, J.M. “8—Understanding and improving textile recycling: A systems perspective”. In Sustainable Textiles; Blackburn, R.S., Ed.; Woodhead Publishing Series in Textiles; Woodhead Publishing: Cambridge, UK, 2009; pp. 179–199. ISBN 978-1-84569-453-1.

<sup>9</sup> UN Climate Change website. <https://unfccc.int/climate-action/momentum-for-change/activity-database/sustainable-textiles-for-sustainable-development>

<sup>10</sup> Cottonmonk.com website. <https://www.cottonmonk.com/blog/sustainable-textiles-the-future-of-eco-friendly-fabric-production/#:~:text=Sustainable%20textiles%20are%20fabrics%20produced%20in%20ways,reduce%20waste%2C%20energy%20consumption%2C%20and%20water%20usage>.

With a view to position the country as a global leader in technical textiles, National Technical Textiles Mission (NTTM) was created with the approval of Cabinet Committee on Economic Affairs (CCEA) at an outlay of Rs 1,480 crores with a four-year implementation period from FY 2020–21 to 2023–24, and it has been extended till 2026.<sup>11</sup> To promote domestic production of technical textile products such as agro-textiles, medical textiles, and geo textiles at competitive prices, the recent budget 2025 has added two more types of shuttle-less looms to the list of fully exempted textile machinery.<sup>12,13</sup>

## 6.4 Workforce Characteristics

This section of the chapter gives the macro trends for the textile sector in terms of labour participation in textile industry, female workforce, educational attainment, types of skills, etc. based on various available renowned secondary data sources.

- a. ***Share of female workers***: 42.8 per cent of workers engaged in ‘weaving of textiles’ are women.
- b. ***State***: The Periodic Labour Force Survey data indicates that 80 per cent of the workers engaged in ‘weaving of textiles’ were concentrated in six States, namely Tamil Nadu, Assam, Gujarat, Andhra Pradesh, West Bengal, and Uttar Pradesh in 2022–23 (Figure 6.2). Figure 6.3 shows the State-wise distribution of female workers. In majority of the North-Eastern States, 100 per cent of workers in this sector are women. Assam accounts for 50 per cent of women workers in India for handloom sector.<sup>14</sup> However, the PLFS can also give erroneous results like in the case of Haryana. Box 6.2 expands on the subject. Therefore, for the manufacturing sectors, enterprise data such as data from the Annual Survey of Industries (ASI) and Annual Survey of Unincorporated Sector Enterprises (ASUSE) are used to support the PLFS data.

---

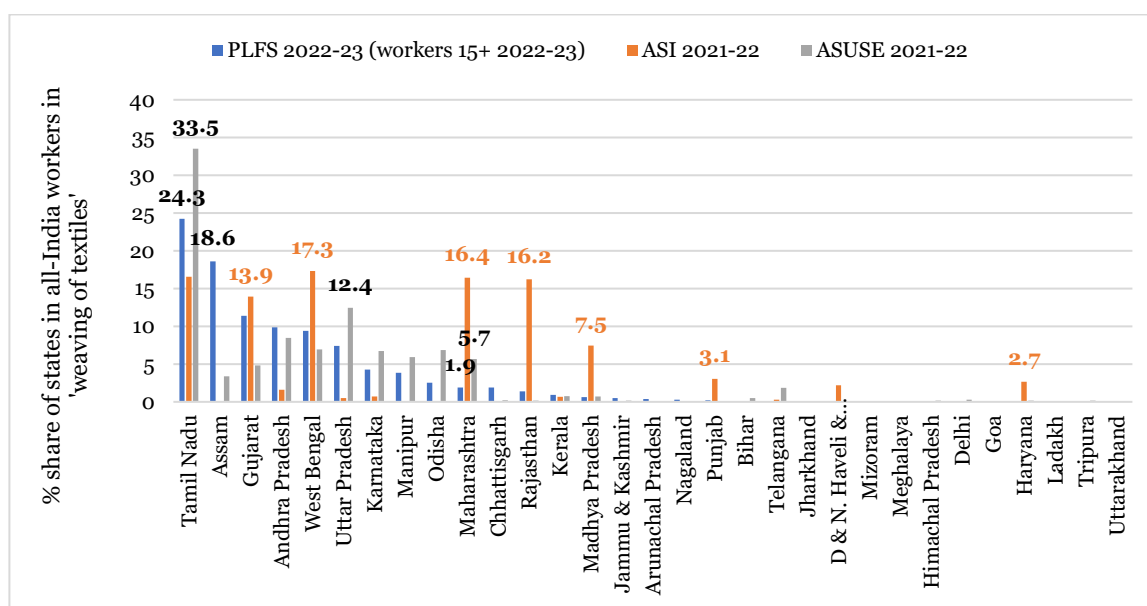
<sup>11</sup> National Technical Textiles Mission website. <https://nttm.texmin.gov.in/PI/AboutMission>.

<sup>12</sup> Ministry of Textiles. 2025. “Budget announces Rs 5272 crores for the Ministry of Textiles for the FY 2025–26”. *PIB*. <https://pib.gov.in/PressReleasePage.aspx?PRID=2099411>. February 4.

<sup>13</sup> Ministry of Textiles. 2024. “Ministry of Textiles approved Startups in Technical Textiles to boost innovation: Textiles Secretary”. *PIB*. <https://pib.gov.in/PressReleasePage.aspx?PRID=2025052>. June 13.

<sup>14</sup> Ministry of Textiles. 2022. “Power loom sector contributes nearly 58.4% to total cloth production and more than 60% of fabric meant for export in the country”. *PIB*. <https://pib.gov.in/PressReleasePage.aspx?PRID=1814211>. April 6.

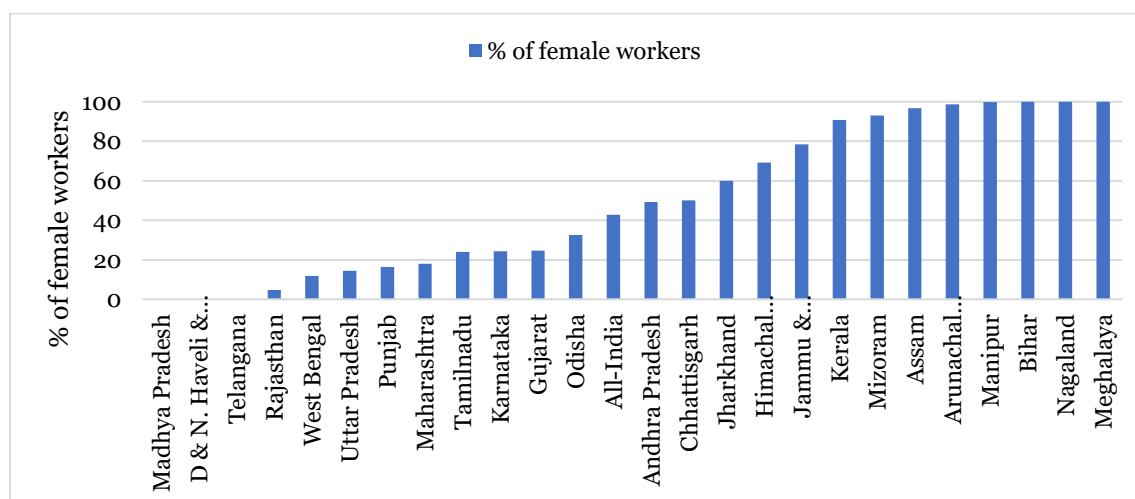
**Figure 6.2: State-wise share of labour force (%)**



Source: NCAER analysis from: 1. PLFS 2022–23; 2. Ministry of Statistics and Programme Implementation (MOSPI), Govt. of India. 2024. Annual Survey of Industries 2021-22. DDI-IND-NSO-ASI-2021-22. <https://microdata.gov.in/nada43/index.php/catalog/188>. (ASI 2021-22); 3. MoSPI. 2024. Annual Survey of Unincorporated Sector Enterprises (ASUSE) of 2021-2022. DDI-IND-MOSPI-SSO-ASUSE2122. <https://microdata.gov.in/nada43/index.php/catalog/196>. (ASUSE 2021-22)

Notes: 1. PLFS gives age-wise data but ASI and ASUSE do not. PLFS is a household survey data and the latter two are enterprises data. 2. All three sources of data report zero labour employed for the missing States in the graph.

**Figure 6.3: State-wise distribution of female workers (aged 15+) in the 'weaving of textiles' sector, 2022–23**



Source: NCAER analysis from PLFS 2022–23.

Note: One critical comment that was received was that in Assam and North East, all workers in the 'weaving of textiles' sector are women. However, the PLFS shows that 97 per cent of the workers were women. Then the occupation status of the workers were checked and it was found that they all fell in the 'handicraft workers' NCO code of 731. NCO code 7318 are Handicraft Workers in Textiles, Leather and Related Materials. And under that there are several 8-digit NCO codes. Men could be employed in supportive roles. Without detailed 8-digit NCO codes, these kinds of puzzles would continuously arise. A further problem is that different sources of data (PLFS, Enterprise Surveys and All-India Handloom Census) are yielding different numbers of weavers in the country (Bhandari, Jain and Sahu, 2025)<sup>15</sup>

<sup>15</sup> Bhandari, B., Jain, C. and Sahu, A.K. 2025. "Counting Handloom Weavers in India". Fibre2Fashion. <https://www.fibre2fashion.com/industry-article/10408/counting-handloom-weavers-in-india>. April 30.

### Box 6.2: Corrigendum for workers in textile sector in Haryana

The PLFS 2022–23 shows that there are zero labour force employed in the sector (NIC 1312) ‘weaving of textiles’ in Haryana despite the fact that the State includes mega cluster for handloom industries and cooperatives and also have certain number of power loom mills. There could be two reasons for this data anomaly. First reason could be that due to small sample, the data on particular sub-sector may not have been captured. Second reason could be that the PLFS is a household survey, which is not capturing the workforce, which is primarily composed of migrant workers. In that case enterprise data are more useful.

Discussions with the Textile Skills Council (TSC) revealed that more than 90 per cent of the workforce migrate in the textile sector for employment. The major source States for textile workers to other States have been from Odisha, Bihar, Jharkhand, Chhattisgarh, and Uttar Pradesh.

Deep dive in enterprise surveys shows employment in this sector. According to 4th All India Handloom Census 2019–20 by Office of DC Handlooms, MoT, more than 14,000 of women workers were working in the unorganised sector, viz. Handlooms and Handicrafts sector of the textile industry. As per ASI 2021–22 and ASUSE 2021–22 data, the labour force working in weaving of textile sector was 11,445 and 1,909 in Haryana.

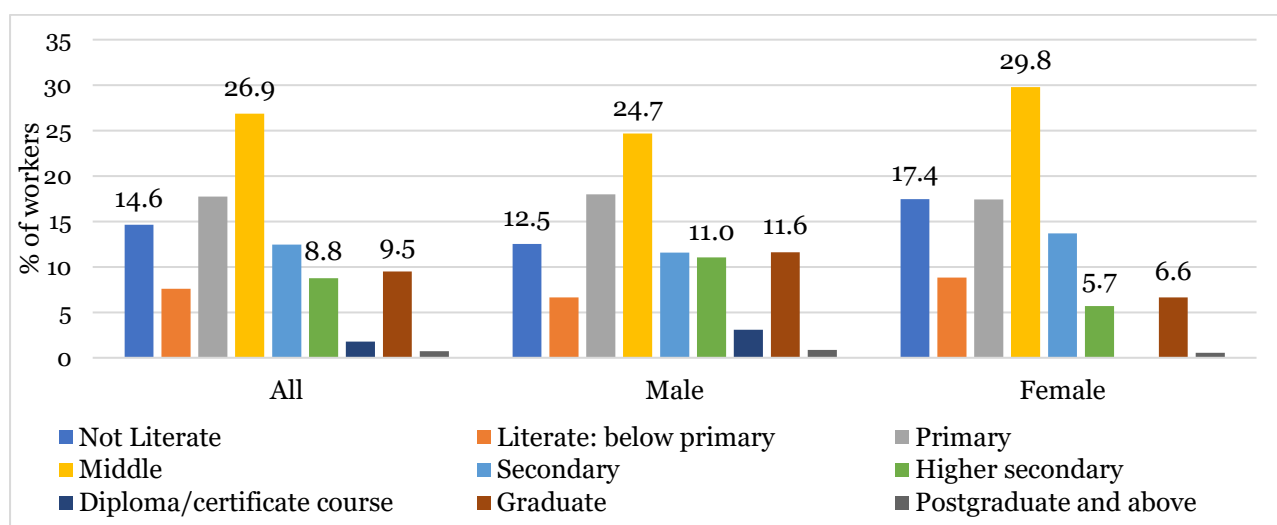
In regions and sectors characterised by high migration, one should look at the combination of household surveys such as PLFS and enterprises surveys to get an idea about the labour employed. Otherwise it may lead to erroneous results.

Source: NCAER analysis from PLFS 2022–23.

- c. **Education:** The distribution of workers in weaving activities (15+) by their level of general education is given in Figure 6.4. Compared to agriculture and livestock, a small proportion of workers are not literate in this sector. However, 52 per cent of the workers have education ranging from basic literacy (below primary) to middle school level. The corresponding number for female workers is 56 per cent. 12 per cent of all workers have attained either diploma/certificate or graduate and above degrees. The corresponding numbers for males are 15 per cent and females are 7.2 per cent. About 2.4 per cent of the workers in this sector have technical education. A higher proportion of male workers have technical education (3.8 per cent) versus female workers (0.5 per cent).

In this sector, majority of workers have received vocational training; 2.5 per cent of workers have received formal vocational/technical training and 61.6 per cent of workers have received non-formal vocational/technical training. The share of female workers who have received non-formal vocational/technical training was 69.8 per cent in 2022–23 (Figure 6.5). 26 per cent of workers have received non-formal vocational training through hereditary means and 18 per cent through on-the-job training.

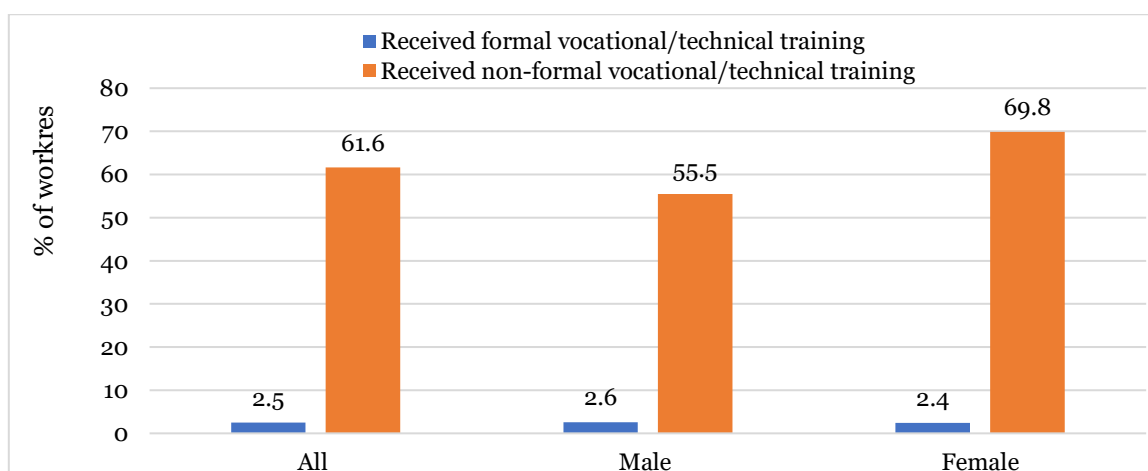
**Figure 6.4: Percentage share in general education for workers (15+) in textile weaving**



Source: NCAER analysis from PLFS 2022–23.

Note: Not Literature includes data from the following four categories — Not literate, Literate without formal schooling: EGS/ NFEC/ AEC, TLC and not literate-Others.

**Figure 6.5: Percentage share of workers (aged 15+) engaged in weaving of textiles who have received either formal or non-formal vocational/technical training (%)**



Source: NCAER Analysis from PLFS 2022–23.

- d. **Skill:** Majority of the workers in the sector are low-medium skilled with a relatively larger share of female workers being low-medium skilled (Figure 6.6.). A higher share of male workers are medium-high skilled and high skilled.



**Figure 6.6: Majority of workers in the ‘weaving of textiles’ sector are low-medium skilled (aged 15+), 2022–23**



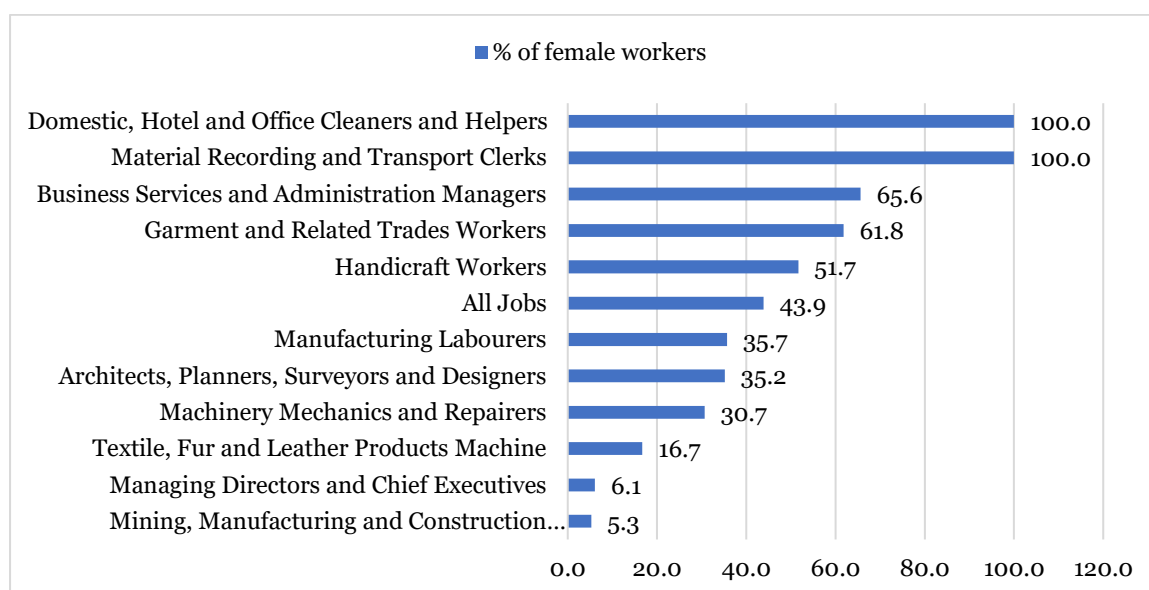
Note: Look at Annexure 4.2 for the definition of skills.

Source: NCAER analysis from PLFS 2022–23.

- e. **Occupation:** 95.5 per cent of workers in this sector work in these job roles—handicraft workers; textile, fur, and leather products machine workers; garment and related trades workers; managing directors and chief executives; manufacturing labourers; mining, manufacturing, and construction supervisors and; business services and administration managers. About 67 per cent of workers are handloom workers. The gender distribution reveals that 79 per cent of female workers are handloom workers whereas only 57.5 per cent of male workers are handloom workers. About 12.4 per cent of workers are textile, fur and leather products machine’ operators. 18.5 per cent of male workers work in this job role but only 4.7 per cent of female workers work in this job role. 8 per cent of workers are ‘garment and related trades workers’. 5.5 per cent of males and 11.3 per cent of female workers work in this job role.

Figure 6.7 shows the share of female workers in job roles. The share of women is high in ‘weaving of textiles’ in the North Eastern States. A larger share of female workers being low-medium skilled. A higher share of male workers is medium-high skilled and high skilled. The presence of women in ‘Managing Directors and Chief Executives’ job roles is fairly small at 6.1 per cent. The share of female workers who are working as Supervisors is also low. In contrast, 100 per cent of women work in the job role — ‘domestic, hotel, and office cleaner and helpers’ and ‘material recording and transport clerk’. In the job role, ‘handicraft workers’, 51 per cent of workers are females. There is a need to encourage women in non-traditional job roles.

**Figure 6.7: Percentage of female workers (aged 15+) in job roles, 2022–23**



Source: NCAER analysis from PLFS 2022–23.

- f. **Engagement Status:** 73 per cent of workers are self-employed in this sector, of which 46.7 per cent are own-account workers, 3.7 per cent are employers and 22.3 per cent are unpaid family workers (Table 6.2). Nearly 23 per cent of workers are regular wage workers and 4.2 per cent are casual wage workers. The corresponding statistics for male workers in this sector are 38.5 per cent, 6.0 per cent, 14.7 per cent, 35.1 per cent and 5.7 per cent respectively. In contrast, the corresponding statistics for female workers are 57.6 per cent, 0.6 per cent, 32.6 per cent, 7.1 per cent and 2.2 per cent respectively.

**Table 6.2: Engagement status of workers**

| Sector              | Self-employed                 |          |                                                                        | Regular<br>salaried/<br>wage<br>employee | Casual<br>Wage<br>Labour | Total |
|---------------------|-------------------------------|----------|------------------------------------------------------------------------|------------------------------------------|--------------------------|-------|
|                     | Own account<br>worker         | Employer | Worked as<br>helper in h.h.<br>enterprise<br>(unpaid family<br>worker) |                                          |                          |       |
|                     | All Workers (aged 15+)        |          |                                                                        |                                          |                          |       |
| Weaving of textiles | 46.7                          | 3.7      | 22.3                                                                   | 23.1                                     | 4.2                      | 100.0 |
| All workers 15+     | 35.6                          | 3.2      | 18.6                                                                   | 21.4                                     | 21.2                     | 100.0 |
|                     | All Male Workers (aged 15+)   |          |                                                                        |                                          |                          |       |
| Weaving of textiles | 38.5                          | 6.0      | 14.7                                                                   | 35.1                                     | 5.7                      | 100.0 |
| All workers 15+     | 39.6                          | 4.5      | 9.5                                                                    | 24.0                                     | 22.3                     | 100.0 |
|                     | All Female Workers (aged 15+) |          |                                                                        |                                          |                          |       |
| Weaving of textiles | 57.6                          | 0.6      | 32.6                                                                   | 7.1                                      | 2.2                      | 100.0 |
| All workers 15+     | 27.3                          | 0.6      | 37.4                                                                   | 15.9                                     | 18.8                     | 100.0 |

Source: NCAER Analysis from PLFS 2022–23.

## 6.5 Identification of Geographical Clusters

There are many ways of identifying geographical clusters. The Ministry of Textiles has defined handloom and power loom clusters (see Annexure 6.1). Since the objective in this research work is to have a unified methodology across sectors, the Porter (1990) definition is used here to define clusters.<sup>16</sup> Industry cluster is defined as a geographically proximate group of firms and associated institutions in related industries, linked by economic and social interdependencies.

Amongst the many potential sources of data (see Annexure 6.2), there are four key data sources that are used here in this report to identify clusters in the ‘weaving of textiles’ sub-sector.

- The Annual Survey of Industries (ASI) is the principal source of industrial statistics in India conducted by Ministry of Statistics and Programme Implementation (MoSPI), collecting the data on registered manufacturing and repairing units. ASI gives data of organised sector. Data for 2021–22 has been used.
- The MoSPI also conducts enterprises survey of the unorganised sector. Now it is conducting Annual Survey of Unincorporated Sector Enterprises (ASUSE). Data for 2021–22 was used to compute the spread of units State-wise.
- The Ministry of Textiles<sup>17</sup> also provides latest data on number of units. State-wise separately for handloom and power loom sectors in India for 2021–22. According to this data, there are about 28.2 lakh handloom units and 3.85 lakh power loom units in India. For power loom sector, Maharashtra, Tamil Nadu, and Uttar Pradesh are among the top five States, and for handloom sector, Assam and Tamil Nadu are among top five.

Given the disparate information at different dates, each information is ranked separately—number of units from ASI in 2021–22, number of units from the ASUSE in 2021–22 and number of power loom & handloom units in 2021–22. The average of the rankings informs us about the clusters. If any State/UT has only one source of information, that State/UT is dropped.

The results are shown for the sector in Table 6.3. Tamil Nadu is the topmost cluster followed by Uttar Pradesh and West Bengal.

---

<sup>16</sup> Porter, M. E. 1990. *Competitive advantage of nations*. New York: Free Press.

<sup>17</sup> Ministry of Textiles. 2022. “Power loom sector contributes nearly 58.4% to total cloth production and more than 60% of fabric meant for export in the country”. PIB. <https://pib.gov.in/PressReleasePage.aspx?PRID=1814211>. April 6.

**Table 6.3: Geographical clusters for ‘weaving of textiles’**

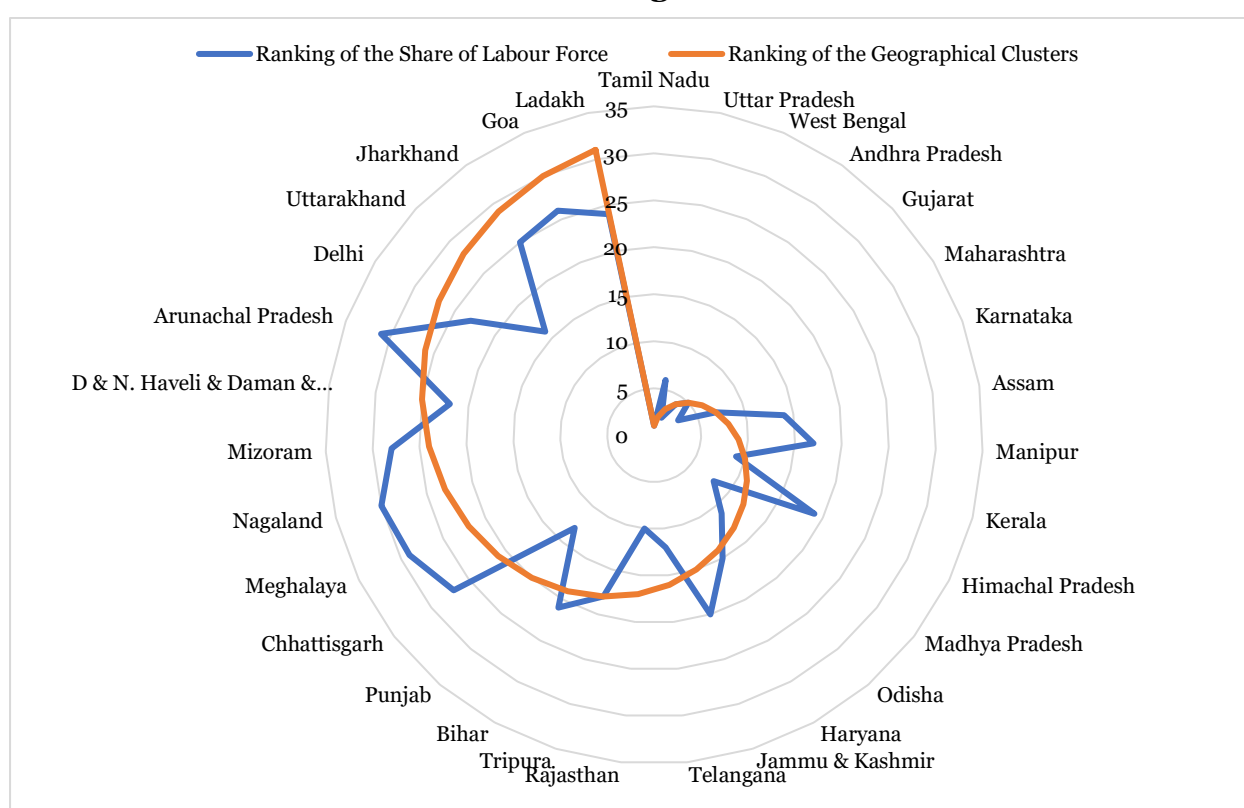
| <i>States/ UT</i>                          | <i>Rank<br/>using<br/>ASI<br/>2021–22</i> | <i>Rank<br/>using<br/>ASUSE<br/>2021–22</i> | <i>Ranking using no.<br/>of power loom<br/>units from the<br/>MoT, April 2022</i> | <i>Ranking using<br/>number of<br/>handloom units<br/>from the MoT,<br/>April 2022</i> | <i>Average</i> |
|--------------------------------------------|-------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------|
| Tamil Nadu                                 | 2                                         | 1                                           | 2                                                                                 | 5                                                                                      | 2.5            |
| Uttar Pradesh                              | 8                                         | 5                                           | 3                                                                                 | 7                                                                                      | 5.8            |
| West Bengal                                | 12                                        | 3                                           | 9                                                                                 | 2                                                                                      | 6.5            |
| Andhra Pradesh                             | 10                                        | 4                                           | 6                                                                                 | 9                                                                                      | 7.3            |
| Gujarat                                    | 1                                         | 10                                          | 4                                                                                 | 22                                                                                     | 9.3            |
| Maharashtra                                | 3                                         | 9                                           | 1                                                                                 | 26                                                                                     | 9.8            |
| Karnataka                                  | 11                                        | 8                                           | 5                                                                                 | 16                                                                                     | 10.0           |
| Assam                                      | 16                                        | 6                                           | 20                                                                                | 1                                                                                      | 10.8           |
| Manipur                                    | 20                                        | 2                                           | 21                                                                                | 3                                                                                      | 11.5           |
| Kerala                                     | 9                                         | 11                                          | 16                                                                                | 15                                                                                     | 12.8           |
| Madhya Pradesh                             | 14                                        | 13                                          | 7                                                                                 | 20                                                                                     | 13.5           |
| Odisha                                     | 18                                        | 7                                           | 18                                                                                | 11                                                                                     | 13.5           |
| Haryana                                    | 5                                         | 24                                          | 10                                                                                | 21                                                                                     | 15.0           |
| Jammu & Kashmir                            | 20                                        | 17                                          | 11                                                                                | 12                                                                                     | 15.0           |
| Telangana                                  | 13                                        | 12                                          | 21                                                                                | 18                                                                                     | 16.0           |
| Rajasthan                                  | 4                                         | 19                                          | 17                                                                                | 25                                                                                     | 16.3           |
| Tripura                                    | 25                                        | 16                                          | 21                                                                                | 6                                                                                      | 17.0           |
| Bihar                                      | 23                                        | 14                                          | 8                                                                                 | 24                                                                                     | 17.3           |
| Punjab                                     | 7                                         | 22                                          | 11                                                                                | 31                                                                                     | 17.8           |
| Chhattisgarh                               | 19                                        | 18                                          | 19                                                                                | 19                                                                                     | 18.8           |
| Meghalaya                                  | 25                                        | 27                                          | 21                                                                                | 3                                                                                      | 19.0           |
| Nagaland                                   | 25                                        | 21                                          | 21                                                                                | 10                                                                                     | 19.3           |
| Mizoram                                    | 15                                        | 27                                          | 21                                                                                | 17                                                                                     | 20.0           |
| Dadra & Nagar<br>Haveli and Daman &<br>Diu | 6                                         | 27                                          | 21                                                                                | 31                                                                                     | 21.3           |
| Arunachal Pradesh                          | 31                                        | 27                                          | 21                                                                                | 8                                                                                      | 21.8           |
| Delhi                                      | 20                                        | 20                                          | 21                                                                                | 27                                                                                     | 22.0           |
| Uttarakhand                                | 23                                        | 25                                          | 11                                                                                | 31                                                                                     | 22.5           |
| Jharkhand                                  | 25                                        | 27                                          | 21                                                                                | 23                                                                                     | 24.0           |
| Goa                                        | 25                                        | 27                                          | 21                                                                                | 30                                                                                     | 25.8           |
| Ladakh                                     | 31                                        | 23                                          | 21                                                                                | 31                                                                                     | 26.5           |
| Puducherry                                 | 31                                        | 27                                          | 21                                                                                | 28                                                                                     | 26.8           |
| Chandigarh                                 | 31                                        | 27                                          | 21                                                                                | 31                                                                                     | 27.5           |
| Lakshadweep                                | 31                                        | 27                                          | 21                                                                                | 31                                                                                     | 27.5           |
| Sikkim                                     | 32                                        | 28                                          | 21                                                                                | 29                                                                                     | 27.5           |

*Sources:*

1. Ministry of Statistics and Programme Implementation (MOSPI), Govt. of India. 2024. *Annual Survey of Industries 2021-22*. DDI-IND-NSO-ASI-2021-22. <https://microdata.gov.in/nada43/index.php/catalog/188>.
2. MoSPI. 2024. *Annual Survey of Unincorporated Sector Enterprises (ASUSE) of 2021-2022*. DDI-IND-MOSPI-NSSO-ASUSE2122. <https://microdata.gov.in/nada43/index.php/catalog/196>.
3. Ministry of Textiles. 2022. “Power loom sector contributes nearly 58.4% to total cloth production and more than 60% of fabric meant for export in the country”. PIB. <https://pib.gov.in/PressReleasePage.aspx?PRID=1814211>. April 6.

As mentioned earlier the share of labour force are computed from the PLFS, ASI and ASUSE and are individually ranked. The average ranking of the share of labour force are compared to the average ranking computed for the geographical clusters. The correlation between the rankings of the States using share of the labour force and geographical clusters is 0.8 (Figure 6.8). Tamil Nadu, Gujarat and Karnataka have exactly the same ranks using either of the same variables. Manipur and Assam are ranked lower (higher concentration) in geographical clusters but higher in share of labour force (lower shares). Punjab is the opposite – ranked higher in clusters (lower concentration) but ranked lower (higher shares) in share of labour force. Spatial mismatch suggests that gaps are met by migrant workers.

**Figure 6.8: Rankings using share of labour force and geographical clusters for the ‘weaving of textiles’ sector**



Sources: NCAER Computations from Table 6.3 and PLFS 2022–23, ASI 2021–22 and ASUSE 2021–22.

Note: Lower ranking means that shares are higher.

## 6.6 Occupational Mapping

Following procedure was adopted for mapping of the job roles:

- The PLFS gives 3–digit NCO 2015 code.
- Using the NCO 2015, we derived the 8–digit NCO codes under those specific NCO 3–digit codes to understand job roles that are ‘used’ in the industry.
- Mapped the SSC job roles available on website to the identified NCO 8–digit codes, wherever applicable.

Annexure 6.3 shows the occupations mapped between PLFS NCO 3–digit and the job roles offered by the TSC.

## 6.7 Stakeholders' Survey

### 6.7.1 Sampling

To get the detailed industry insight, various stakeholders were reached out in the textile weaving industry including Ministry of Textiles, TSC, National-level industry associations, TVET institutions, research institutes, and the respective firms/industries. Interviews with these stakeholders were more of a conversation rather than just asking questions from the questionnaire from the respondents. Separate questionnaires were developed for each stakeholder. It helped NCAER to gain a holistic perspective from all stakeholders. The questionnaire for firms in the 'weaving of textiles' sub-sector is attached at the end of the report (Questionnaire No. 4).

Successful interactions were held with the 27 stakeholders in the sector as given in Table 6.4.

**Table 6.4: List of stakeholders covered for textile weaving industry**

| <b>Sector</b>                                                                         |             | <b>Number of Stakeholders</b> |
|---------------------------------------------------------------------------------------|-------------|-------------------------------|
| Ministry                                                                              |             | No response                   |
| Sector Skill Council                                                                  |             | 1                             |
| National-level Industry Association – Confederation of Indian Textile Industry (CITI) |             | 1                             |
| No of Firms                                                                           | Micro/Small | 11                            |
|                                                                                       | Medium      | 6                             |
|                                                                                       | Large       | 3                             |
|                                                                                       | Total       | 20                            |
| No. of Placement Cells/TVET Institutions                                              |             | 5                             |
| Firms plus Other Stakeholders                                                         |             | 27                            |

Source: NCAER.

Note: Response Rate – 12 per cent.

Out of the firms that were covered, about 9 were Private Limited firms, 8 were cooperatives and 3 were public limited firms (majorly textile mills). The interviews were conducted with the officials holding following positions: Cooperative owners/Proprietor (16), Human Resource/Learning & Development Managers/Director (Training) (3), and Production-in charge/Designer (2).

The firms/ cooperatives/mills covered in the study were majorly taken from handloom/ power loom clusters. The survey was conducted at different locations in Uttar Pradesh (Varanasi), Odisha (Bargarh), Karnataka (Bangalore), Punjab (Ludhiana) and Himachal Pradesh (Solan) where handloom cooperatives and power loom mills/ industries / private firms were situated (Table 6.5).

**Table 6.5: Frequency of firms location**

| <b>Sector</b>    | <b>Frequency of Firms</b> |
|------------------|---------------------------|
| Himachal Pradesh | 2                         |
| Karnataka        | 3                         |
| Odisha           | 1                         |
| Punjab           | 1                         |
| Uttar Pradesh    | 13                        |
| Total            | 20                        |

Source: NCAER.

### **6.7.2. Sectoral findings about skill shortages and skill gaps from stakeholders' survey**

The survey revealed some key challenges that the 'weaving of textiles' sector is facing:

- Handloom
  - Loss of market share due to competition from the power loom sector. The power loom sector can produce relatively cheaply at scale with a fast turnaround time.
  - Handloom is known for its pure silk and unique designs which is not possible in power loom.
  - Jobs in this sector are non-aspirational for youth due to low wages, tedious work. Middle/senior generation working currently in handloom; youth attracted towards power loom.
  - Due to expensive nature of handloom products, customer base is small.
  - Lack of access to market for weavers or entrepreneurs/ cooperatives.
  - Lack of entrepreneurship skills—limited market access/ networks and lack of finances.
  - Issues of genuine 'handloom mark' that reflects purity of the silk and protect handloom weavers.
  - Big weavers still able to survive being retailer/ wholesalers-networks for selling their product on offline and online mode; small weavers facing market crunch.
  - Small weavers/cooperatives suffering most for handloom—not able to get loans easily even under Mudra scheme, provision for Electronic Jacquard' not reachable under various govt. schemes due to high waiting period of more than 2 years and intermediaries' involvement like Weaving Service Centre (WSC).
- Difficulty in getting weavers and weaving assistants for handloom, power loom not facing any skill shortage/ human resource issues as such.
- Only problem in power loom is of high electricity.

Primarily the firms were asked which job roles were difficult to fill and their associated qualifications and skills. Three job roles emerged which are facing skill shortages in the textile weaving industry. These key job roles are:

#### **1. Weaver-Handloom (Jacquard/ Loin loom)**

- “A Jacquard handloom weaver weaves various types of jacquard woven fabrics and artistic textiles on a jacquard handloom, using different kinds of yarns—cotton/raw silk on a fly-shuttle or throw-shuttle handloom. The jacquard weaver is responsible for carrying out pre-weaving activities mend broken ends, weft picks, change jacquard punch cards and carry weft replenishment activities to produce defect-free jacquard woven fabrics.”<sup>18</sup>
- “A Loin Loom Weaver is the one who weaves various types of fabrics and artistic textiles by hand using a Loin Loom. A weaver can weave basic weaves Plain and its variations, using different kinds of yarns—cotton/wool/silk on

---

<sup>18</sup> Textile Sector Skill Council and National Skills Development Corporation website.  
[https://texskill.in/wp-content/uploads/QP-docs/QP/TSC\\_Q7306\\_v2.0.pdf](https://texskill.in/wp-content/uploads/QP-docs/QP/TSC_Q7306_v2.0.pdf).

- a fly-shuttle or throw-shuttle Loin Loom as per pattern or design provided.”<sup>19</sup>
2. Weaver- Power loom: The tasks that a power loom operator is supposed to operate are the following<sup>20</sup>:
    - Operating the power-loom to weave cloth
    - Checking that the looms shuttles are in position
    - Supplying the full weft bobbins into the loom
    - Ensuring that the wrap yarn is not broken and that the set-up is ready
    - Checking the looms for defects in weaving
    - Ensuring that the broken ends of the warp yarn are mended
    - Ensuring that the ties are of short length so that the yarn is there at the broken end of the warp beam
    - Drawing the end through the drop wire
    - Healding and reeding by making use of the reed hook in the loom
    - Tying the reeds to the other end with a weaver's knot
    - Removing all the defects caused in the loom by the mispicks
    - Cutting and pulling out the filling of the weft yarn up to a point of defect
    - Adjusting and starting the loom every time a repair is done
    - Replacing the empty bobbin in the shuttles
    - Cutting the cloth when the cloth roll becomes full in the loom
  3. Weaving Assistant (Handloom): Assists the Master trainer, should have loom training and helps out in preparation process to weaving, including preparing samples, assisting with yarn sizing and winding, etc.

The indicative computation for the number of vacancies for these job roles is given in Table 6.6.

---

<sup>19</sup> Textile Sector Skill Council and National Skills Development Corporation website. [https://texskill.in/wp-content/uploads/QP-NOS/TSC\\_Q7307\\_v1.0.pdf](https://texskill.in/wp-content/uploads/QP-NOS/TSC_Q7307_v1.0.pdf).

<sup>20</sup> National Career Services website. <https://www.ncs.gov.in/content-repository/Pages/ViewNcoDetails.aspx?List=8db9be14%2D2b47%2D4f30%2D97fb%2D5de315d871c0&ID=5635&ContentTypeId=ox01003FEA8C7117A78D4F93DC52780D878B2F0015F91119E23A874E9006BoFo68F1089C>.



**Table 6.6: Assessment of current & future skills shortage for top job roles in ‘weaving of textiles’**

| <i>Items</i>                                                                         | <i>Weaver-Handloom<br/>(Jacquard/ Loin loom)</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>Weaver- Power<br/>loom</i>                     | <i>Weaving Assistant<br/>(Handloom)</i>         |
|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------|
| NCO-3/8 digit code                                                                   | 731                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 731                                               | No code available                               |
| NCO 8-digit (QP code)                                                                | TSC/Q7306, TSC/Q7307 (7318.58)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | TSC/Q2210 (7318.55)                               | No code available                               |
| Match from Job Projections (731, 815, 753, 112, 632) @                               | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Yes                                               | No                                              |
| No. of all stakeholders mentioned this (22)                                          | 16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 11                                                | 16                                              |
| Indicative computation of the extent of the need & vacancy rate (NCAER computations) | <p>Dominated by unorganised sector; Weavers working from their own workspace at home using own looms/cooperatives. Unutilized capacity—more weavers, more output</p> <p>Dominated by organised sector; Migrated workers. Unutilised capacity— more weavers, more output</p> <p>Dominated by unorganised sector; Weavers working from their own workspace at home using own looms/at cooperatives. Unutilised capacity— more weavers, more output</p> <p>There are 28.2 lakh handlooms in the country. Assuming that each loom requires one weaver and one weaver assistant, makes the requirement 56.4 lakh weavers in the country. In the power loom sector, there are 3.85 lakh looms. Assuming, on average, one weaver operates 8 looms simultaneously, one would need 0.5 lakh power loom weavers. In total the need is for 57 lakh weavers However, in the PLFS 2022–23, there were 13.3 lakh workers under the NCO code 731. Therefore, the skill gap under NCO code 731 is 43.7 lakh. However, this estimate is indicative as many handlooms are non-functional due to a variety of reasons and there may be other occupations under NCO 731. Even then just in the case of weavers, the skills gap is high. More precise numbers requires a survey.</p> |                                                   |                                                 |
| Manpower projection by 2030 (NCAER computations)*                                    | <p>Weavers required by 2030 = 0.5 million,<br/>Allied workers required by 2030 = 0.2 million</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                   |                                                 |
| Location of firms                                                                    | Varanasi, UP & Bengaluru, Karnataka                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Ludhiana, Punjab and Solan, HP                    | Varanasi, UP & Bargarh, Odisha                  |
| Average daily income (₹)                                                             | Up to ₹ 600 per day, Product-based payment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ₹ 450-500 per day, less working hrs than handloom | ₹ 200-300 per day                               |
| Educational Qualifications                                                           | Primary/Matric/Diploma/NSQF Aligned Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Primary/Matric                                    | Primary/Matric/Diploma/NSQF Aligned Course      |
| Skills required at the competency level (3)                                          | <p><b>Cognitive Skills:</b> Reading, numeracy, Active Learning (Ability to learn new skills), Creative thinking—Ability to create new design patterns with different colour combinations; Digital Skills, Financial Management, Resources Management and Entrepreneurship Skills,<br/><b>Socio-emotional Skills:</b> Conscientiousness (efficiency, patience), instruction, persuasion, negotiation and networking skills<br/><b>TVET:</b> Weaving, setting up the loom and warp and how to manipulate threads and patterns, Basic knowledge of fabrics, yarn count, colours, designing and card punching skills, types of weaves &amp; looms, quality parameters, marketing skills, Health consciousness due to heavy loom handling;<br/><b>Physical Skills—</b> hand-eye coordination, ability to sit for long</p>                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                   |                                                 |
| Skills Shortage                                                                      | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Yes                                               | Yes                                             |
| Skills Gap                                                                           | No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | No                                                | No                                              |
| Relevance of TVET System                                                             | It is relevant and providing basic skills for weaving and allied activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | It is relevant and providing basic                | Apprenticeship programme should be strengthened |

| Items                                                                                         | Weaver-Handloom<br>(Jacquard/ Loin loom)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Weaver- Power<br>loom                                                                                                               | Weaving Assistant<br>(Handloom)                                       |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
|                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | skills for weaving<br>and allied activities                                                                                         |                                                                       |
| Gender<br>(Challenges)                                                                        | Women are not able to operate heavy handlooms; they are involved in allied activities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | No issue                                                                                                                            | Varies by region depending on the nature of the loom                  |
| Challenges Faced by Industries in Meeting Skill Requirements                                  | Skills shortage; spatial mismatch; tedious work conditions; low wages; not aspirational; spatial mismatch (unemployed weavers in one place and industry in another)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Skills shortage                                                                                                                     | Skills shortage; tedious work conditions; low wages; not aspirational |
| Industry-specific interventions that facilitate skill & capacity development (best practices) | <ul style="list-style-type: none"> <li>Cooperatives help weavers acquire looms and set them up at their homes-this enables them to work from home and make it aspirational for the youth</li> <li>Cooperatives helped weavers to on-board on government schemes (schools, scholarships, etc.), which enable their longer tenure at the cooperative</li> <li>Females employed in allied activities of knitting, stitching, designing, dyeing, etc.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Firms are providing training for specific skills</li> <li>Providing accommodation</li> </ul> |                                                                       |
| Policy Recommendations                                                                        | <p><b>Skill Training Programme:</b> Introducing basic weaving skills on handloom and power loom and setting up of looms, creative designing, usage of new fabrics/yarns &amp; technologies, RPL needs to be encouraged</p> <p><b>Curriculum Development:</b> Digital skilling, Automation and Digital Technologies, Sustainable Technologies Circular/ Green/ Recycled/ Sustainable textiles, Advanced Materials, Supply Chain invocations, Artificial Intelligence and Machine Learning, Entrepreneurial training</p> <p><b>Gender:</b> Encourage women in new areas— designing (computerised), ICT skills which use CAD technology, new dyes (computerised), green textile</p> <p><b>Skill Initiatives:</b> Encourage academia-industry collaboration, Guest faculties from industries, Vocational skilled teachers getting industrial training; industry visits; ITI adopted by large industry (like in the auto sector, Apprenticeships should be encouraged at the cooperative level</p> <p><b>Others:</b> Improve spatial matching of industry and workers; Government in collaboration with industries may take initiatives to set up exhibition cum sale outlets with right customer group for weavers to directly sell their products, e.g. one group did it recently for handloom; help with marketing; forecasting; designing</p> |                                                                                                                                     |                                                                       |

Source: NCAER Conceptualisation.

Notes: @ Pink shade indicates no match between I-O quantitative top 3 occupation projections and survey-based top 3 occupation projections. Green shade indicates a match.

\*Manpower does not change frequently in this industry. In alignment with the textile industry, manpower projections have been done till 2030.

## 6.8 Recommended Methodology

The ‘weaving of textiles’ sector is going through a transition. While the relatively more traditional sub-sector of handloom within the ‘weaving of textiles’ sector suffers from many challenges but technological changes and innovations in new types of textiles have opened up new opportunities in other parts of the sector. As mentioned in the introductory chapters of this report, weaving skills is an indirect demand, i.e., it is linked to the products that are being demanded. While the demand for traditional

handloom products lag, the demand for new-age products will soar. The challenge is how to help the lakhs of workers who derive their livelihoods from traditional sectors to more modern aspects of the same sector. A complex combination of youth aspirations and low wages are already driving workers to move out of the handloom sub-sector. Skills has a critical role to play in navigating this path.

Therefore, the overall recommendations for skilling are the following:

- Power loom—Recognition of prior learning (RPL) followed by Upskilling and Reskilling and Fresh training.
- Handloom—Majorly RPL followed by Upskilling and Reskilling and Fresh training.
- Textile Mill Sector (Spinning/ Weaving Mills/Technical/ Composite units): Majorly Fresh skilling followed by RPL and Upskilling and Reskilling.

Based on the above, the recommended methodology to assess skills shortages and skill gaps for this sector is the following:

1. Map the sub-segments of the sector to the NIC code. The sub-segments maybe based either on the type of textiles or types of looms. The Textiles Sector Skill Council should do this mapping so that the sector can be tracked in that manner. The shares of the sub-sectors both in terms of workers and share of industries should be spelled out.
2. Update mapping of NCO 2015 job roles with job roles identified by the Sector Skill Councils.
  - a. For example, 731 is the NCO code for handicraft workers.
  - b. Code for a power loom weaver is 7318.5500 whereas that for a handloom weaver is 7318.5800.
  - c. The power loom weaver code captures four different types of technologies (plain loom, semi-automatic loom, automatic loom and shuttle-less loom). All these need to be delineated and spelled out.
  - d. The SSCs (along with MSDE) should also coordinate with the National Career Services to refine the job roles.
3. The Handloom Census needs to start using occupation codes in their surveys and also probe about skill sets that the workers may have, the orientation and training programmes that the workers may have undergone, etc.
4. In coordination with the MSDE, the Sector Skill Council needs to implement surveys on a regular (at least annual) basis, which captures vacancies of firms. The job roles should be mapped/matched with job roles identified in Step 1. Ideally the Economic Census forms the frame for any survey. Given the lack of data, the Ministry of Corporate Affairs' database or Goods and Services Tax Network are the other sources of universal data, from where data may be used to derive the universe. That universe needs to be divided into the sub-sectors as defined in Step 1. Then proper sampling strategy needs to be adopted to understand the validity of the results. Biases needs to be addressed. Response rates should also be collected.
5. Big Data analysis is highly recommended for SSCs using various job sites. They should also use/assess data from National Career Services and various employment exchanges around the country. The job roles should be mapped/matched with previously identified job roles.
6. Stakeholder interactions needs to be carried out as an annual exercise based on templates designed by the MSDE. It will capture jobs which are difficult to fill but also get a holistic view of the sector in terms of emerging technological

trends, emerging jobs, detailed qualitative needs for qualifications and skills, hiring practices, best practices of firms, migration trends, practices to encourage female labour force participation, etc.

7. Last but not the least, the MSDE, Ministry of Labour and Employment, and Ministry of Statistics and Programme Implementation should design an occupation-wage-employment survey. It is absolutely important to identify the occupation codes mentioned in Step 2. Ideally the Economic Census forms the frame for any survey.



## **7. Manufacture of Transport: Manufacturing of Motor Vehicles and Its Parts and Accessories, and Repair and Maintenance of Motor Vehicles**

### **7.1 Definition of the Sector**

Within the sector, manufacturing of transport, this chapter focusses on two sub-sectors namely manufacturing of motor vehicles and manufacturing of parts & accessories of motor vehicles. The third sub-sector of 'repair and maintenance of motor vehicles' is derived from the selected sector of 'trade'. These three sub-sectors include the following:<sup>1</sup>

- NIC 2910: Manufacture of motor vehicles
  - 29101: Manufacture of passenger cars
  - 29102: Manufacture of commercial vehicles such as vans, lorries, over-the-road tractors for semi-trailers, etc.
  - 29103: Manufacture of chassis fitted with engines for the motor vehicles included in this class
  - 29104: Manufacture of motor vehicle engines
  - 29109: Manufacture of motor vehicles n.e.c.
- NIC 2930: Manufacture of parts and accessories for motor vehicles
  - 29301: Manufacture of diverse parts and accessories for motor vehicles such as brakes, gearboxes, axles, road wheels, suspension shock absorbers, radiators, silencers, exhaust pipes, catalysers, clutches, steering wheels, steering columns and steering boxes, etc.
  - 29302: Manufacture of parts and accessories of bodies for motor vehicles such as safety belts, airbags, doors, bumpers
  - 29303: Manufacture of car seats
  - 29304: Manufacture of motor vehicle electrical equipment, such as generators, alternators, spark plugs, ignition wiring harnesses, power window and door systems, assembly of purchased gauges into instrument panels, voltage regulators, etc.
- NIC 4520: Maintenance and repair of motor vehicles<sup>2</sup>

### **7.2 Value Chain**

The automotive sector in India is large and growing. From an economic standpoint, the sector's importance emerges from its contribution to India's manufacturing GDP and GVA, as well as the number of people employed in the sector—directly and indirectly.

The manufacturing segment of the automotive value chain, comprising component and vehicle manufacturers, is organised in a tiered structure. Manufacturers at the lower tiers (say at tier 2 or 3) supply smaller components to tier 1 sub-assembly

---

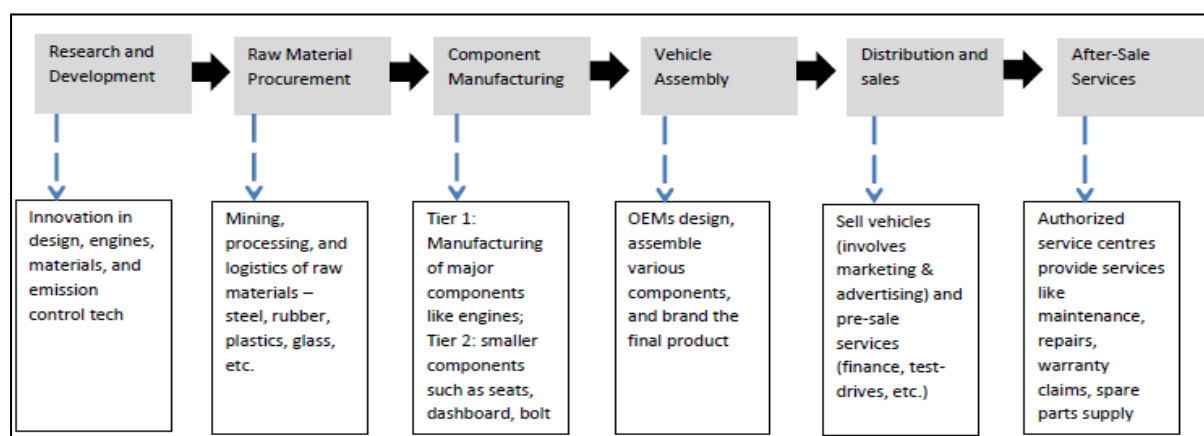
<sup>1</sup> Central Statistical Organisation, Ministry of Statistics and Programme Implementation. 2008. National Industrial Classification (All Economic Activities). 2008. [https://www.ncs.gov.in/Documents/NIC\\_Sector.pdf](https://www.ncs.gov.in/Documents/NIC_Sector.pdf).

<sup>2</sup> While this sector is classified under retail, it will be included in the auto sector, enabling a holistic skill gaps assessment of motor vehicles sector.

manufacturers, with the final vehicle assembly undertaken by the vehicle manufacturer (Figure 7.1). Manufacturing is preceded by research and development and procurement of raw materials, and followed by marketing and sales. These stages are outside the scope of the present study.

The focus of the study is concerns component manufacturing, vehicle manufacturing and assembly, and after-sales services—thereby aligning with the definition of the sector, as presented though the NIC 4-digit codes above.

**Figure 7.1: Automotive value chain**



Source: NCAER compilation, adapted from various sources<sup>3</sup>.

With the growing advent of Electric Vehicles (EVs), flex-fuels, and connected cars, the type and number of components required in a motor vehicle are changing, and hence the manufacturers involved in the value chain are changing too. For instance, the powertrain of an Electric Vehicle (EV) is completely different from that of an internal combustion engine (ICE) vehicle—requiring the need for specialised EV component manufacturers and assemblers in the value chain. The use of artificial intelligence and electronic features in connected cars has brought in the need for another set of hardware and software suppliers.

Changes in technology are therefore constantly brining in the need for new skills in the auto sector. To meet the government’s vision of 30 per cent EV adoption by 2030, a recent report released by Society of Indian Automobile Manufacturers (SIAM) highlights the need to double the number of EV-ready workers joining the sector from 15,000 per year to 30,000 per year till 2030, if 100 per cent localisation of EV components has to be achieved.<sup>4</sup> It particularly highlights the need for fresh skilling, given the technical differences between EVs and ICE vehicles; as well as re-skilling in job roles where there may be certain technical overlap. At the same time, with the

<sup>3</sup> Key references include:

Sturgeon, T., Chagas, L. and Barnes, J. 2017. “Inovar Auto: Evaluating Brazil’s Automotive Industrial Policy to Meet the Challenges of Global Value Chains”. 10.1596/28947.

Sturgeon, T.J., Daly, J., Frederick, S., Bamber, P.G., and Gereffi, G. 2016. “The Philippines in the Automotive Global Value Chain”.

<sup>4</sup> SIAM and Deloitte 2024. *EV Talent Landscape in India: Bridging the Skill Gap for 2030*. SIAM. The report has received wide media coverage: [https://www.business-standard.com/industry/auto/auto-industry-needs-200k-skilled-people-by-2030-to-meet-30-ev-target-124071600619\\_1.html](https://www.business-standard.com/industry/auto/auto-industry-needs-200k-skilled-people-by-2030-to-meet-30-ev-target-124071600619_1.html); accessed on 16 July 2024.

advent of flex fuels, AI, robotics, automation, and connected vehicles, Automotive Skill Development Council (ASDC) has introduced new skilling courses as well as qualification packs (QPs) for job roles to meet the changing needs of the automotive manufacturing sector.<sup>5</sup>

The following sections delve into the employment, skills and jobs in the sector, using a wide variety of secondary data available in public domain.

### 7.3 Workforce Characteristics

- a. ***Share of female workers***: 3.8 per cent of the workforce in the sector, ‘manufacture of parts and accessories for motor vehicles’ are females. The corresponding number for ‘manufacturing of motor vehicles’ is 3.1 per cent and ‘maintenance and repair of motor vehicles’ is 0.6 per cent.
- b. ***States***: The workers are concentrated in four States—Tamil Nadu, Maharashtra, Gujarat and Karnataka (Table 7.1).
  - The PLFS data shows that:
    - The maximum share of workers employed in ‘manufacturing of motor vehicles’ is in Maharashtra, Tamil Nadu, and Madhya Pradesh.
    - The maximum share of workers employed in ‘manufacturing parts & accessories of motor vehicles’ are located in Gujarat, Maharashtra, and Tamil Nadu. There is little or negligible presence of female workers in the States.
    - The maximum share of workers employed in ‘*maintenance and repair of motor vehicles*’ are located in Tamil Nadu, Maharashtra, Gujarat, Karnataka, and Uttar Pradesh.
  - Figure 7.2 shows that the presence of female workers across the States in these three sectors is few and far between. Haryana is a notable exception where the share of female workers is 50.8 per cent in the manufacture of motor vehicles.
  - The enterprises data from ASI 2021–22 and ASUSE 2021–22 broadly conform to the PLFS data trends. However, they both throw up some surprises like Jharkhand, which employs 5 per cent of the workers in ‘manufacturing of motor vehicles’ as per the ASI data. The ASUSE data shows that 53 per cent of the workers in unincorporated enterprises in this sector are located in West Bengal and 41.3 per cent in Punjab. Haryana also shows much larger presence of auto workers as per both the data sources across the three sectors than PLFS does.

---

<sup>5</sup> Courses include: Fundamentals of Connected Vehicle (V2X) Technology, IIoT Application in Cyber Security (Manufacturing), IIoT Application in Predictive Maintenance (Manufacturing), Foundation course in Flex Fuel Engine Design. Job roles include: Automotive Robotics and Automation Manager, Automotive Robotics and Automation Simulation Engineer, Automotive IIoT Application Engineer/ Technician/ Specialist, Automotive Automation and Robotics Engineer, Automotive Flex Fuel Engine Designer, Automotive Cyber Security Engineer/ Specialist, Advanced Driver Assistance System (ADAS) Engineer (Source: ASDC).



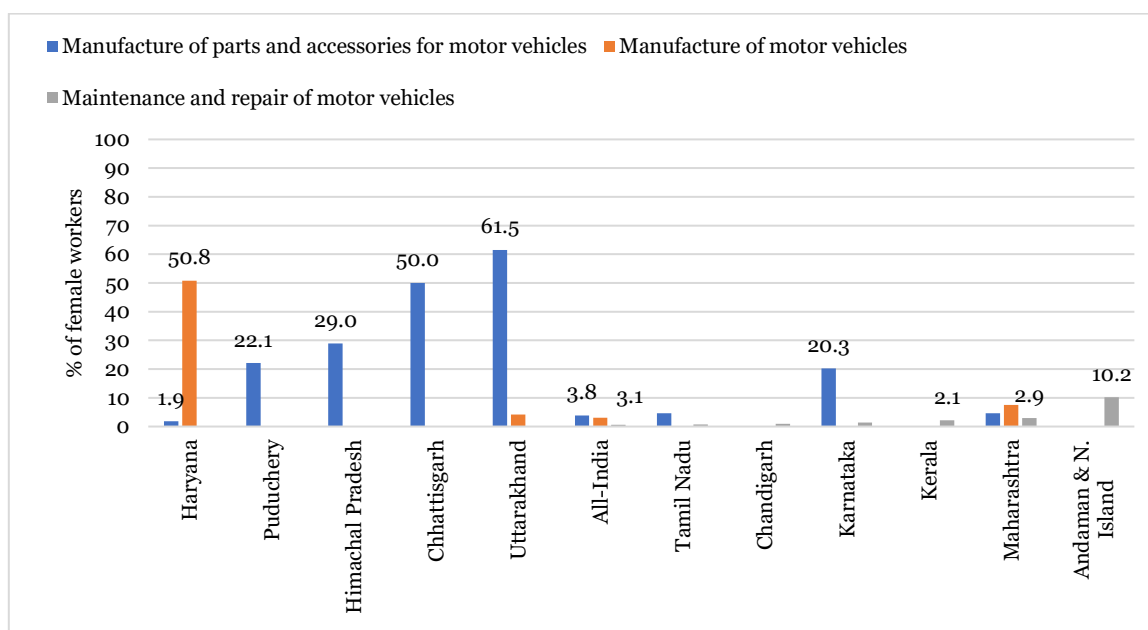
**Table 7.1: State-wise percentage share of workers engaged in motor vehicles sector**

| State/UT                           | NIC 2910<br>Manufacture of motor vehicles |                    |                      | 2930. Manufacture of parts and accessories for motor vehicles |                    |                      | 4520. Maintenance and repair of motor vehicles |                    |                      |
|------------------------------------|-------------------------------------------|--------------------|----------------------|---------------------------------------------------------------|--------------------|----------------------|------------------------------------------------|--------------------|----------------------|
|                                    | PLFS<br>2022–<br>23                       | ASI<br>2021–<br>22 | ASUSE<br>2021–2<br>2 | PLFS<br>2022–<br>23                                           | ASI<br>2021–<br>22 | ASUSE<br>2021–2<br>2 | PLFS<br>2022–<br>23                            | ASI<br>2021–<br>22 | ASUSE<br>2021–2<br>2 |
| Maharashtra                        | 29.4                                      | 24.8               | 0.0                  | 18.8                                                          | 20.4               | 8.3                  | 9.5                                            | 10.8               | 12.0                 |
| Tamil Nadu                         | 19.6                                      | 20.5               | 0.0                  | 18.3                                                          | 23.8               | 14.2                 | 9.6                                            | 14.0               | 7.9                  |
| Madhya Pradesh                     | 14.3                                      | 4.4                | 0.0                  | 2.4                                                           | 2.2                | 0.3                  | 4.2                                            | 2.7                | 5.1                  |
| Rajasthan                          | 7.3                                       | 3.3                | 3.7                  | 3.1                                                           | 2.5                | 5.6                  | 6.3                                            | 4.6                | 8.9                  |
| Andhra Pradesh                     | 6.3                                       | 3.5                | 0.0                  | 0.1                                                           | 1.8                | 0.3                  | 5.0                                            | 5.6                | 2.7                  |
| Uttar Pradesh                      | 6.1                                       | 2.0                | 0.5                  | 4.4                                                           | 4.1                | 11.0                 | 7.3                                            | 8.8                | 10.6                 |
| Karnataka                          | 4.5                                       | 6.0                | 0.8                  | 6.8                                                           | 6.6                | 3.6                  | 8.3                                            | 8.5                | 7.2                  |
| Uttarakhand                        | 3.5                                       | 4.5                | 0.7                  | 0.4                                                           | 4.4                | 0.0                  | 1.3                                            | 0.5                | 1.1                  |
| Gujarat                            | 3.3                                       | 8.3                | 0.0                  | 27.8                                                          | 3.7                | 7.1                  | 9.1                                            | 6.2                | 8.1                  |
| West Bengal                        | 2.3                                       | 0.1                | 53.1                 | 1.7                                                           | 2.1                | 3.8                  | 4.5                                            | 2.8                | 3.9                  |
| Haryana                            | 1.4                                       | 14.8               | 0.0                  | 8.1                                                           | 21.7               | 16.5                 | 2.2                                            | 5.8                | 1.2                  |
| Telangana                          | 0.7                                       | 1.6                | 0.0                  | 0.0                                                           | 0.2                | 0.0                  | 3.1                                            | 3.3                | 3.2                  |
| Kerala                             | 0.6                                       | 0.0                | 0.0                  | 0.0                                                           | 0.1                | 3.2                  | 7.0                                            | 7.6                | 9.4                  |
| Jharkhand                          | 0.5                                       | 5.0                | 0.0                  | 1.4                                                           | 2.3                | 4.6                  | 1.1                                            | 2.1                | 3.5                  |
| Andaman & Nicobar Island           | 0.0                                       | 0.0                | 0.0                  | 0.0                                                           | 0                  | 0.0                  | 0.1                                            | 0.02               | 0.02                 |
| Assam                              | 0.0                                       | 0.0                | 0.0                  | 0.0                                                           | 0.002              | 1.0                  | 2.1                                            | 0.9                | 0.7                  |
| Bihar                              | 0.0                                       | 0.0                | 0.0                  | 0.0                                                           | 0.0                | 4.4                  | 7.1                                            | 0.8                | 1.5                  |
| Chandigarh                         | 0.0                                       | 0.0                | 0.0                  | 0.2                                                           | 0.0                | 0.4                  | 0.1                                            | 0.6                | 2.5                  |
| Chhattisgarh                       | 0.0                                       | 0.0                | 0.0                  | 0.1                                                           | 0.0                | 0.8                  | 1.5                                            | 2.0                | 1.2                  |
| Delhi                              | 0.0                                       | 0.0                | 0.0                  | 0.3                                                           | 0.2                | 6.4                  | 1.1                                            | 4.5                | 0.6                  |
| Himachal Pradesh                   | 0.0                                       | 0.0                | 0.0                  | 0.3                                                           | 0.7                | 0.0                  | 1.3                                            | 0.4                | 0.7                  |
| Jammu & Kashmir                    | 0.0                                       | 0.0                | 0.0                  | 0.0                                                           | 0.0                | 3.1                  | 1.1                                            | 0.9                | 0.7                  |
| Manipur                            | 0.0                                       | 0.0                | 0.0                  | 0.0                                                           | 0.0                | 0.0                  | 0.3                                            | 0.0                | 0.2                  |
| Meghalaya                          | 0.0                                       | 0.0                | 0.0                  | 0.1                                                           | 0.0                | 0.5                  | 0.2                                            | 0.1                | 0.4                  |
| Nagaland                           | 0.0                                       | 0.0                | 0.0                  | 0.0                                                           | 0.0                | 0.0                  | 0.2                                            | 0.1                | 0.1                  |
| Odisha                             | 0.0                                       | 0.0                | 0.0                  | 0.2                                                           | 0.1                | 1.6                  | 2.7                                            | 1.6                | 3.0                  |
| Puducherry                         | 0.0                                       | 0.0                | 0.0                  | 0.9                                                           | 0.3                | 0.0                  | 0.0                                            | 0.2                | 0.1                  |
| Punjab                             | 0.0                                       | 1.0                | 41.3                 | 4.5                                                           | 2.5                | 3.2                  | 3.5                                            | 3.4                | 2.6                  |
| Tripura                            | 0.0                                       | 0.0                | 0.0                  | 0.0                                                           | 0.0                | 0.0                  | 0.2                                            | 0.2                | 0.1                  |
| Arunachal Pradesh                  |                                           | 0.0                | 0.0                  |                                                               | 0.0                | 0.0                  |                                                | 0.0                | 0.1                  |
| Dadra & Nagar Haveli & Daman & Diu |                                           | 0.0                | 0.0                  |                                                               | 0.2                | 0.0                  |                                                | 0.0                | 0.1                  |
| Goa                                |                                           | 0.0                | 0.0                  |                                                               | 0.0                | 0.0                  |                                                | 0.7                | 0.6                  |
| Mizoram                            |                                           | 0.0                | 0.0                  |                                                               | 0.0                | 0.0                  |                                                | 0.0                | 0.1                  |

Sources: NCAER analysis using PLFS 2022–23, ASI 2021–22 and ASUSE 2021–22.

Notes: 1. PLFS gives age-wise data but ASI and ASUSE do not. PLFS is a household survey data and the latter two are enterprises data. 2. All three sources of data report zero labour employed for the missing States in the table.

**Figure 7.2: State-wise distribution of female workforce in the ‘manufacturing of motor vehicles’, ‘manufacturing of parts and accessories for motor vehicles’ and ‘maintenance and repair of motor vehicles’, 2022–23 (%)**



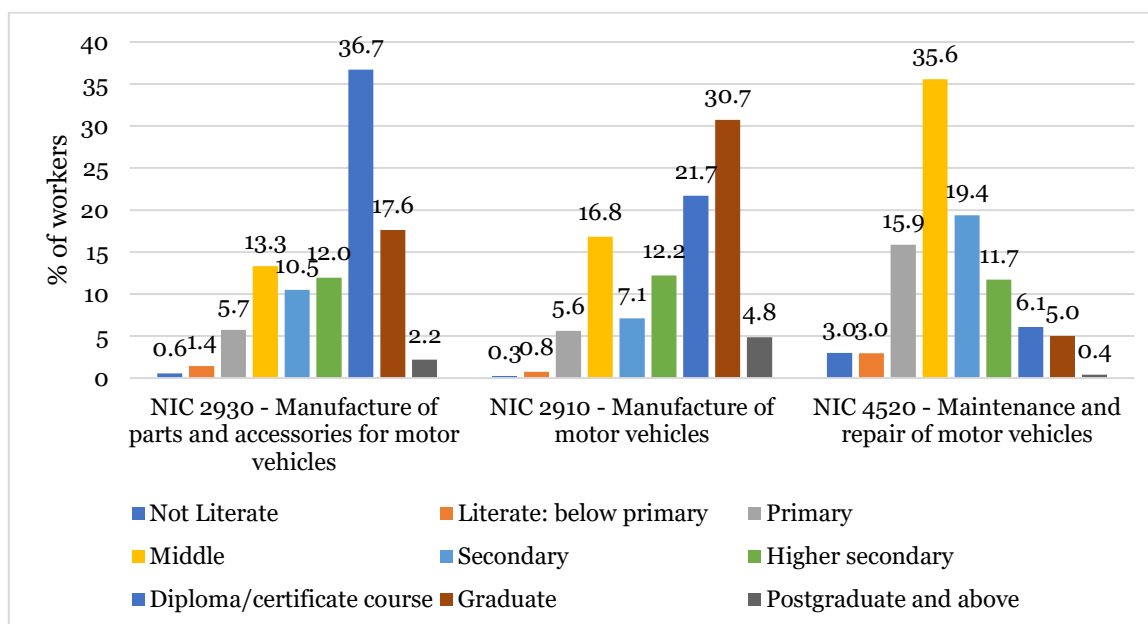
Source: NCAER analysis from PLFS 2022–23.

### c. Across Education Levels:

- When analysed across levels of general education (Figure 7.3), majority of workers involved in:
  - Manufacture of motor vehicles are graduates.
  - Manufacture of parts and accessories of motor vehicles are diploma / certificate course holders.
  - Maintenance and repair of motor vehicles are educated until middle school.
- When analysed across levels of technical education (Figure 7.4), majority of workers involved in:
  - 53 per cent workers in manufacture of motor vehicles do not have technical education. 22 per cent of workers have technical degree, 16.6 per cent of workers have technical education in engineering/technology below graduate level and 0.9 per cent above graduate level. 5.4 per cent of workers also have technical education in other subjects.
  - 57 per cent workers in manufacture of parts and accessories of motor vehicles do not have technical education. 35 per cent of workers have technical education below graduate level.
  - 93 per cent workers in maintenance and repair of motor vehicles do not have technical education. Barely 3.4 per cent of workers have technical education in engineering/technology below graduate level.

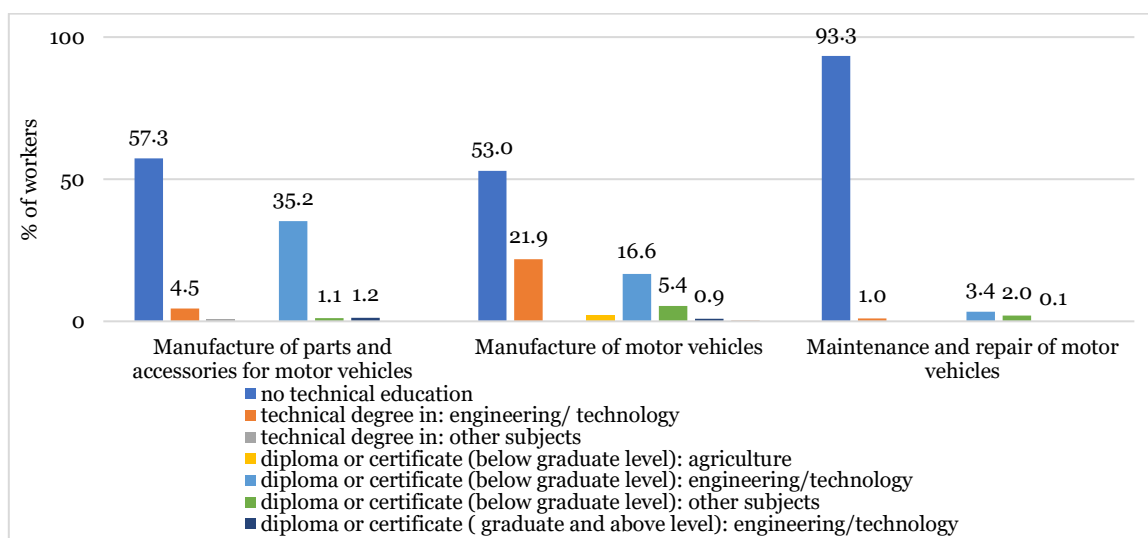
- Vocational Education (Figure 7.5): A third of the workers in the manufacturing of parts and accessories for motor vehicles have formal vocational training and a third non-formal vocational training. 23 per cent of workers engaged in manufacturing of motor vehicles have received formal vocational training. However, in repair and maintenance of motor vehicles sector, 60 per cent of workers have received non-formal vocational training.

**Figure 7.3: General educational attainment of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%)**



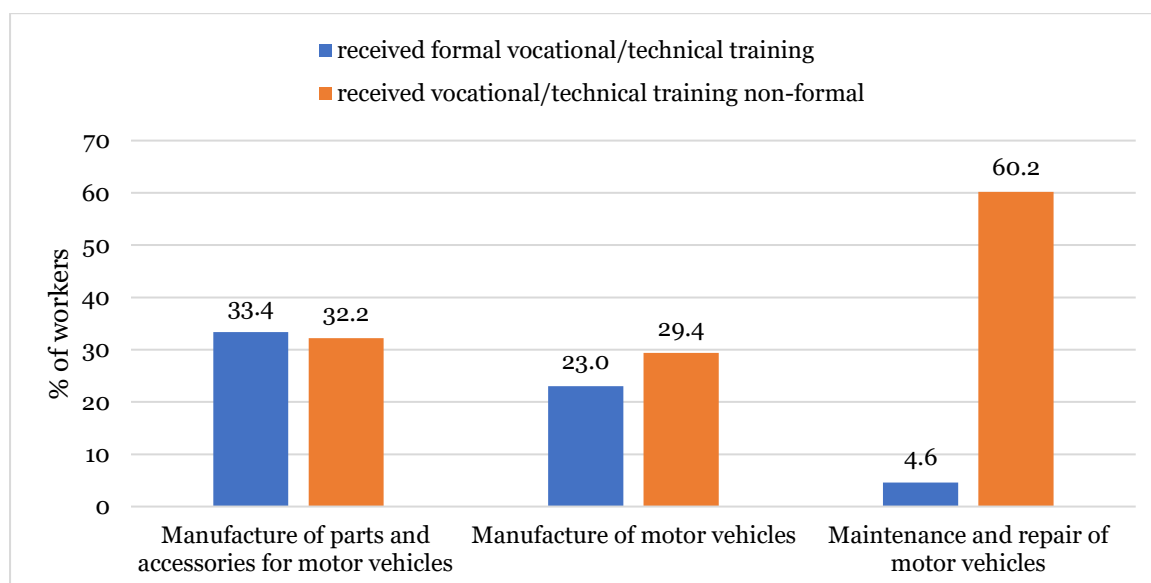
Source: NCAER analysis using PLFS data 2022–23.

**Figure 7.4: Technical educational attainment of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%)**



Source: NCAER analysis using PLFS data 2022–23.

**Figure 7.5: Vocational educational attainment of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%)**

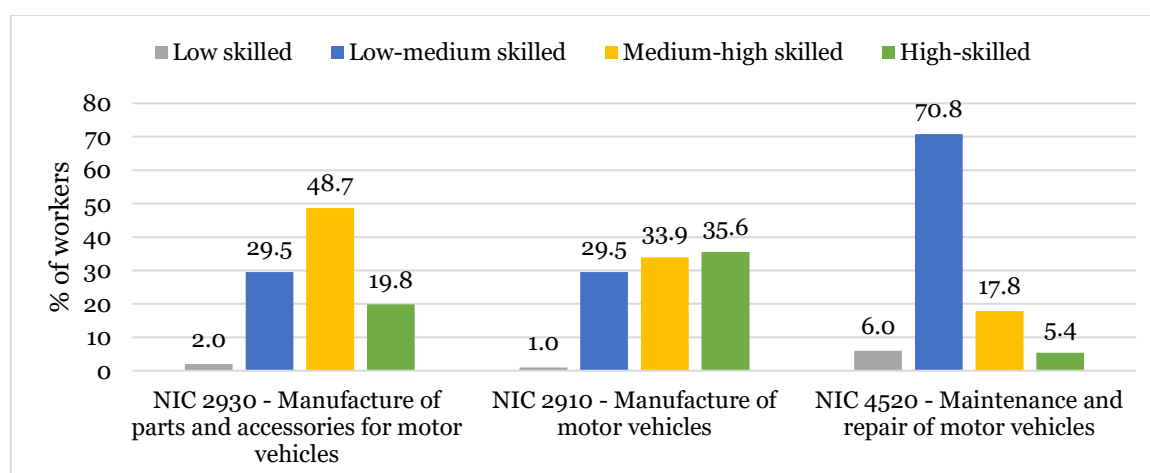


Source: NCAER analysis using PLFS data 2022–23

d. **Across Skills:** Aligned with the levels of education, majority of workers involved in (Figure 7.6):

- Manufacture of motor vehicles are high skilled.
- Manufacture of parts and accessories of motor vehicles are medium skilled.
- Maintenance and repair of motor vehicles are low medium skilled.

**Figure 7.6: Skill level of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%)**



Source: NCAER analysis using PLFS data 2022–23.  
Note: Look at Annexure 4.2 for the definition of skills.

- e. **Across Occupations:** In the auto industry, workers are involved in several occupations. Certain occupations however stand-out, given the relatively large number of workers engaged in them. For instance:
- Majority of workers in manufacture of motor vehicles (NIC 2910) are Assemblers (14 per cent), and Physical and Engineering Science Technicians (12 per cent).
  - Majority of workers in manufacture of parts and accessories of motor vehicles (NIC 2930) are Machinery Mechanics and Repairers (27 per cent) and Manufacturing Labourers (20 per cent).
  - Majority of workers in repair and maintenance of motor vehicles (NIC 4520) are Machinery Mechanics and Repairers (79 per cent of workers in NIC 4520)
- f. **Engagement Status:** 96.3 per cent of workers are regular-wage workers in the manufacture of parts and accessories for motor vehicles (Table 7.2). The corresponding number for workers in manufacture of motor vehicles are 93.8 per cent. However, in the sector, repair and maintenance of motor vehicles, the trends are markedly different—29 per cent are own-account workers, 8.2 per cent are employers, 3.5 per cent are unpaid family workers, 53.3 per cent work as regular wage employees, and 6.0 per cent as casual wage workers. This sector employs a very small proportion of females but 97 per cent of them are regular wage employees.

**Table 7.2: Engagement status of workers (%)**

| All Workers (aged 15+)                                  |                          |          |                                                                     |                                       |                          |       |
|---------------------------------------------------------|--------------------------|----------|---------------------------------------------------------------------|---------------------------------------|--------------------------|-------|
| Items                                                   | Self-employed            |          |                                                                     | Regular<br>salaried/ wage<br>employee | Casual<br>Wage<br>Labour | Total |
|                                                         | Own<br>account<br>worker | Employer | Worked as helper<br>in h.h. enterprise<br>(unpaid family<br>worker) |                                       |                          |       |
| Manufacture of parts and accessories for motor vehicles | 1.5                      | 1.4      | 0.4                                                                 | 96.4                                  | 0.3                      | 100.0 |
| Manufacture of motor vehicles                           | 0.5                      | 4.0      | 0.0                                                                 | 93.8                                  | 1.7                      | 100.0 |
| Maintenance and repair of motor vehicles                | 28.9                     | 8.2      | 3.5                                                                 | 53.3                                  | 6.0                      | 100.0 |
| All Male Workers (aged 15+)                             |                          |          |                                                                     |                                       |                          |       |
| Manufacture of parts and accessories for motor vehicles | 1.6                      | 1.5      | 0.3                                                                 | 96.3                                  | 0.3                      | 100.0 |
| Manufacture of motor vehicles                           | 0.5                      | 4.1      | 0.0                                                                 | 93.6                                  | 1.7                      | 100.0 |
| Maintenance and repair of motor vehicles                | 29.1                     | 8.3      | 3.5                                                                 | 53.0                                  | 6.0                      | 100.0 |
| All Female Workers (aged 15+)                           |                          |          |                                                                     |                                       |                          |       |
| Manufacture of parts and accessories for motor vehicles | 0.0                      | 0.0      | 1.4                                                                 | 98.6                                  | 0.0                      | 100.0 |
| Manufacture of motor vehicles                           | 0.0                      | 0.0      | 0.0                                                                 | 100.0                                 | 0.0                      | 100.0 |
| Maintenance and repair of motor vehicles                | 0.0                      | 0.0      | 1.9                                                                 | 97.9                                  | 0.2                      | 100.0 |

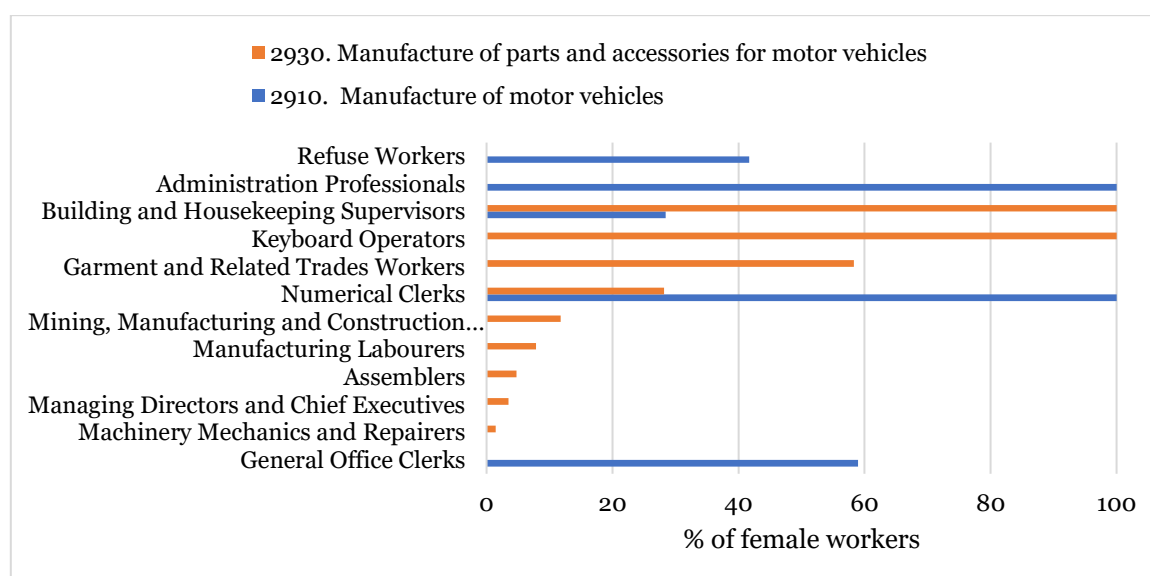
Source: NCAER Analysis from PLFS 2022–23.

g. ***Concentration of Females in Specific Job Roles:*** While there are very few women employed in the auto industry, these too are concentrated in specific job roles, in particular (Figure 7.7):

- For manufacture of motor vehicles, occupations such as Numerical Clerks and Administration Professionals have only women workers. Among all General Office Clerks, more than 50 per cent are women.
- For manufacture of parts and accessories of motor vehicles, occupations such as Keyboard Operators and Building and Housekeeping Supervisors only have women workers.
- For repair and maintenance of motor vehicles, occupations such as Administration Professionals, Keyboard Operators, and Garment and Related Trades Workers have only women. Among all Finance professionals, 71 per cent are women (Figure 7.8).

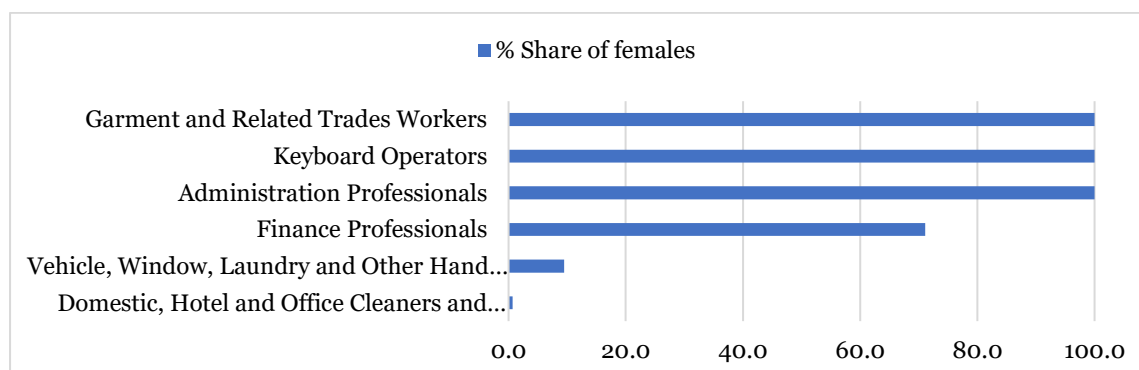
It is evident that women are employed in job roles which ‘support’ the core activities of manufacturing and repair and maintenance in the auto industry, considering that the ‘core’ occupations’, which have the largest share of workers in all the three NIC categories, i.e., Physical and Engineering Science Technicians, and Manufacturing Labourers, Machinery Mechanics and Repairers, and Assemblers – primarily have men engaged in them.

**Figure 7.7: Percentage share of female workers (aged 15+) in job roles in manufacturing of motor vehicles and its parts & accessories, 2022–23 (%)**



Source: NCAER analysis using PLFS data 2022–23.

**Figure 7.8: Percentage share of female workers (aged 15+) in job roles in maintenance and repair of motor vehicles, 2022–23 (%)**



Source: NCAER analysis using PLFS data 2022–23.

## 7.4 Geographical Clusters

“Clusters are geographic concentrations of interconnected companies and institutions in a particular field”, encompassing “an array of linked industries”, including for instance “suppliers of specialised inputs such as components, machinery, and services, and providers of specialised infrastructure.” (Porter 1998, p.78<sup>6</sup>).

The automobile industry in India is organised around key geographic clusters, with the presence of automobile original equipment manufacturers (OEMs) and their component suppliers in close proximity. Services and infrastructure facilities, supporting the automobile and auto component units, can also be found within these clusters. The clustering feature of automobile manufacturing industry in India is well documented, with the key clusters located in Delhi-Gurgaon-Faridabad (Delhi-NCR) in the North, Mumbai-Pune-Nashik-Aurangabad (Maharashtra) and Sanand-Hansalpur-Vithalpur (Gujarat) in the West, Chennai- Bengaluru-Hosur (Tamil Nadu/Karnataka) in the South, and Jamshedpur-Kolkata in the East (Ministry of MSME & KPMG 2020, p.287; IBEF<sup>8</sup>; Govt of Gujarat 2024<sup>9</sup>).

Latest available data from Annual Survey of Industries (2021–22) and ASUSE (2021–22) helps identify the States where there are a rather large number of units engaged in manufacturing, as well as repair and maintenance, of motor vehicles and

<sup>6</sup> Porter 1998, Clusters and the New Economics of Competition, *Harvard Business Review*, November-December 1998. Available at: [https://backonline.apswiss.ch/6001/porter\\_clusters\\_and\\_the\\_new\\_economics\\_of\\_competition.pdf](https://backonline.apswiss.ch/6001/porter_clusters_and_the_new_economics_of_competition.pdf)

<sup>7</sup> Ministry of MSME & KPMG 2020, White Paper – Automotive Industry, Technology Cluster Manager (TCM) Technology Centre System Program (TCSP), Office of DC MSME, Ministry of MSME, October 2020. Available at: [https://www.dcmsme.gov.in/white\\_paper/1.%20Whitepaper-Automotive%20Sector-Year%201.pdf](https://www.dcmsme.gov.in/white_paper/1.%20Whitepaper-Automotive%20Sector-Year%201.pdf)

<sup>8</sup> Automobile and components clusters depicted on a map: <https://www.ibef.org/industry/india-automobiles>; <https://www.ibef.org/industry/autocomponents-india>; accessed on 15 May 2024.

<sup>9</sup> Government of Gujarat. 2024, Setting up of Multiskilling & Certification Centre for Automotive Sector at Sanand, Gujarat Skill Development Mission, Industrial Extension Bureau, Govt of Gujarat. Available at: [https://indextb.com/files/2024/2/a66c536e-5033-4b01-84e2-3f744a8144c3\\_Setting%20up%20of%20Multiskilling%20&%20Certification%20Centre%20for%20Automotive%20Sector.pdf](https://indextb.com/files/2024/2/a66c536e-5033-4b01-84e2-3f744a8144c3_Setting%20up%20of%20Multiskilling%20&%20Certification%20Centre%20for%20Automotive%20Sector.pdf); <https://indextb.com/sector/automobile-component>; accessed on 15 May 2024.

parts and accessories for motor vehicles (Table 7.3). A larger number of manufacturing units (i.e., factories) and repair and maintenance units (i.e., workshops) in a State, which represents a higher concentration of units associated with automotive manufacturing and repair and maintenance, in effect depicts the geographical locations *where* there is also a demand for skilled workers in the sector.

Considering that the units in existing automobile clusters are also accommodating technological changes, concerning Electric Vehicles (EVs), and batteries and bio-fuels, *future skills and job roles* are also likely to be demanded within the existing clusters—be they within the existing units, or within new units added to the existing clusters.

It may be noted that the data available from ASI and ASUSE are at the State-level. To identify units at the district level within the State, information from Ministry of Corporate Affairs (MCA)/Goods & Services Tax Network/Economic Census or industry associations such as Society of Indian Automobile Manufacturers (SIAM<sup>10</sup>) and Automotive Component Manufacturers Association of India (ACMA<sup>11</sup>) may be requested.

At the State-level, it is clear that Tamil Nadu and Maharashtra are the top clusters for the three sub-sectors in the motor vehicles industry. Table 7.4 shows that there are differences between concentration of labour force and geographical clusters such as Haryana and West Bengal in the case of ‘manufacturing of motor vehicles’. Their respective rankings based on shares of labour force are much lower compared to their concentration of automotive units. This happens in the case of Kerala too in the sector ‘manufacture of parts & accessories for motor vehicles’. The correlation of the rankings for the sector, ‘maintenance and repair of motor vehicles’ is 0.99 indicating that that both are giving the same information.

It must also be noted that the rankings are based on data relating to formal as well as informal automotive units, as are available with India’s national industrial statistics of ASI and ASUSE respectively. It is potentially due to this reason that States which may not normally be associated with a large concentration of automotive units (and hence considered a ‘cluster’), tend to come up among the top automotive clusters in this exercise, such as West Bengal in manufacture of motor vehicles and Uttar Pradesh in manufacture of parts and accessories for motor vehicles.

Considering that any automotive unit, formal or informal, will be hiring workers—any exercise on skilling of workers in the sector should be considerate to the skill needs of informal enterprises as well.

---

<sup>10</sup> SIAM members list: <https://www.siam.in/members.aspx?mpgid=1&pgidtrail=4>; accessed on 15 May 2024.

<sup>11</sup> ACMA member search: <https://www.acma.in/index.php>; accessed on 15 May 2024.



**Table 7.3: Geographical clusters in the auto sector**

| <i>Parts and Accessories of Motor Vehicles</i> |                 |                   |                  | <i>Motor Vehicles</i>       |                 |                   |                  | <i>Repair and Maintenance of Motor Vehicles</i> |                 |                   |                  |
|------------------------------------------------|-----------------|-------------------|------------------|-----------------------------|-----------------|-------------------|------------------|-------------------------------------------------|-----------------|-------------------|------------------|
| <i>State/UT</i>                                | <i>ASI Rank</i> | <i>ASUSE Rank</i> | <i>Avg. Rank</i> | <i>State/UT</i>             | <i>ASI Rank</i> | <i>ASUSE Rank</i> | <i>Avg. Rank</i> | <i>State/UT</i>                                 | <i>ASI Rank</i> | <i>ASUSE Rank</i> | <i>Avg. Rank</i> |
| Maharashtra                                    | 2               | 2                 | 2                | Maharashtra                 | 1               | 7                 | 4                | Maharashtra                                     | 3               | 2                 | 2.5              |
| Tamil Nadu                                     | 1               | 3                 | 2                | Haryana                     | 2               | 7                 | 4.5              | Tamil Nadu                                      | 1               | 4                 | 2.5              |
| Uttar Pradesh                                  | 5               | 1                 | 3                | Karnataka                   | 4               | 5                 | 4.5              | Uttar Pradesh                                   | 5               | 1                 | 3                |
| Haryana                                        | 3               | 5                 | 4                | Tamil Nadu                  | 3               | 7                 | 5                | Kerala                                          | 2               | 6                 | 4                |
| Gujarat                                        | 7               | 4                 | 5.5              | West Bengal                 | 10              | 1                 | 5.5              | Gujarat                                         | 6               | 5                 | 5.5              |
| Karnataka                                      | 4               | 8                 | 6                | Gujarat                     | 4               | 7                 | 5.5              | Karnataka                                       | 4               | 7                 | 5.5              |
| Punjab                                         | 8               | 7                 | 7.5              | Uttar Pradesh               | 8               | 4                 | 6                | Rajasthan                                       | 11              | 3                 | 7                |
| Rajasthan                                      | 11              | 10                | 10.5             | Madhya Pradesh              | 6               | 7                 | 6.5              | Andhra Pradesh                                  | 7               | 12                | 9.5              |
| Jharkhand                                      | 10              | 12                | 11               | Jharkhand                   | 7               | 7                 | 7                | Telangana                                       | 8               | 11                | 9.5              |
| Kerala                                         | 20              | 6                 | 13               | Rajasthan                   | 12              | 3                 | 7.5              | Madhya Pradesh                                  | 14              | 8                 | 11               |
| Uttarakhand                                    | 6               | 22                | 14               | Punjab                      | 14              | 2                 | 8                | Punjab                                          | 10              | 13                | 11.5             |
| Madhya Pradesh                                 | 9               | 19                | 14               | Uttarakhand                 | 10              | 6                 | 8                | West Bengal                                     | 13              | 10                | 11.5             |
| Delhi                                          | 12              | 16                | 14               | Telangana                   | 9               | 7                 | 8                | Jharkhand                                       | 15              | 9                 | 12               |
| West Bengal                                    | 15              | 15                | 15               | Andhra Pradesh              | 12              | 7                 | 9.5              | Haryana                                         | 12              | 17                | 14.5             |
| Odisha                                         | 20              | 11                | 15.5             | Odisha                      | 15              | 7                 | 11               | Delhi                                           | 9               | 23                | 16               |
| Andhra Pradesh                                 | 14              | 18                | 16               | Kerala                      | 15              | 7                 | 11               | Odisha                                          | 19              | 14                | 16.5             |
| Jammu & Kashmir                                | 25              | 9                 | 17               | Jammu & Kashmir             | 17              | 7                 | 12               | Bihar                                           | 18              | 16                | 17               |
| Himachal Pradesh                               | 13              | 22                | 17.5             | Himachal Pradesh            | 17              | 7                 | 12               | Chhattisgarh                                    | 17              | 18                | 17.5             |
| Chandigarh                                     | 18              | 20                | 19               | Chandigarh                  | 17              | 7                 | 12               | Chandigarh                                      | 22              | 15                | 18.5             |
| Puducherry                                     | 16              | 22                | 19               | Delhi                       | 17              | 7                 | 12               | Assam                                           | 16              | 21                | 18.5             |
| Bihar                                          | 25              | 13                | 19               | Bihar                       | 17              | 7                 | 12               | Uttarakhand                                     | 20              | 19                | 19.5             |
| Assam                                          | 24              | 14                | 19               | Sikkim                      | 17              | 7                 | 12               | Himachal Pradesh                                | 23              | 20                | 21.5             |
| Telangana                                      | 17              | 22                | 19.5             | Arunachal Pradesh           | 17              | 7                 | 12               | Goa                                             | 21              | 24                | 22.5             |
| Chhattisgarh                                   | 23              | 17                | 20               | Nagaland                    | 17              | 7                 | 12               | Jammu & Kashmir                                 | 24              | 22                | 23               |
| D & N. Haveli & Daman & Diu                    | 19              | 22                | 20.5             | Manipur                     | 17              | 7                 | 12               | Tripura                                         | 25              | 29                | 27               |
| Goa                                            | 22              | 22                | 22               | Mizoram                     | 17              | 7                 | 12               | Manipur                                         | 30              | 25                | 27.5             |
| Meghalaya                                      | 25              | 21                | 23               | Tripura                     | 17              | 7                 | 12               | Meghalaya                                       | 29              | 26                | 27.5             |
| Sikkim                                         | 25              | 22                | 23.5             | Meghalaya                   | 17              | 7                 | 12               | Puducherry                                      | 28              | 27                | 27.5             |
| Arunachal Pradesh                              | 25              | 22                | 23.5             | Assam                       | 17              | 7                 | 12               | Nagaland                                        | 26              | 30                | 28               |
| Nagaland                                       | 25              | 22                | 23.5             | Chhattisgarh                | 17              | 7                 | 12               | Mizoram                                         | 27              | 32                | 29.5             |
| Manipur                                        | 25              | 22                | 23.5             | D & N. Haveli & Daman & Diu | 17              | 7                 | 12               | Arunachal Pradesh                               | 33              | 28                | 30.5             |
| Mizoram                                        | 25              | 22                | 23.5             | Goa                         | 17              | 7                 | 12               | Andaman & N. Island                             | 30              | 33                | 31.5             |
| Tripura                                        | 25              | 22                | 23.5             | Lakshadweep                 | 17              | 7                 | 12               | D & N. Haveli & Daman & Diu                     | 33              | 31                | 32               |

| <b>Parts and Accessories of Motor Vehicles</b> |                 |                   |                  | <b>Motor Vehicles</b> |                 |                   |                  | <b>Repair and Maintenance of Motor Vehicles</b> |                 |                   |                  |
|------------------------------------------------|-----------------|-------------------|------------------|-----------------------|-----------------|-------------------|------------------|-------------------------------------------------|-----------------|-------------------|------------------|
| <b>State/UT</b>                                | <i>ASI Rank</i> | <i>ASUSE Rank</i> | <i>Avg. Rank</i> | <b>State/UT</b>       | <i>ASI Rank</i> | <i>ASUSE Rank</i> | <i>Avg. Rank</i> | <b>State/UT</b>                                 | <i>ASI Rank</i> | <i>ASUSE Rank</i> | <i>Avg. Rank</i> |
| Lakshadweep                                    | 25              | 22                | 23.5             | Puducherry            | 17              | 7                 | 12               | Sikkim                                          | 32              | 35                | 33.5             |
| Andaman & N. Island                            | 25              | 22                | 23.5             | Andaman & N. Island   | 17              | 7                 | 12               | Ladakh                                          | 33              | 34                | 33.5             |
| Ladakh                                         | 25              | 22                | 23.5             | Ladakh                | 17              | 7                 | 12               | Lakshadweep                                     | 33              | 36                | 34.5             |

Sources: 1. Ministry of Statistics and Program Implementation (MOSPI), Govt. of India. 2024. Annual Survey of Industries 2021-22. DDI-IND-NSO-ASI-2021-22. <https://microdata.gov.in/nada43/index.php/catalog/188>.

2. MoSPI. 2024. Annual Survey of Unincorporated Sector Enterprises (ASUSE) of 2021-2022. DDI-IND-MOSPI-NSSO-ASUSE2122. <https://microdata.gov.in/nada43/index.php/catalog/196>.

Note: Units in ASUSE refers to number of establishments. ASUSE includes surveys on medium and small industrial establishments and own-account enterprises not covered by ASI.

**Table 7.4: Rankings based on share of labour force and geographical clusters**

| <i>Manufacture of motor vehicles</i> |                                               |                                                | <i>Manufacture of parts and accessories for motor vehicles</i> |                                               |                                                | <i>Maintenance and repair of motor vehicles</i> |                                               |                                                |
|--------------------------------------|-----------------------------------------------|------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|-------------------------------------------------|-----------------------------------------------|------------------------------------------------|
| <i>State/UT</i>                      | <i>Ranking based on Geographical Clusters</i> | <i>Ranking based on Shares of Labour Force</i> | <i>State/UT</i>                                                | <i>Ranking based on Geographical Clusters</i> | <i>Ranking based on Shares of Labour Force</i> | <i>State/UT</i>                                 | <i>Ranking based on Geographical Clusters</i> | <i>Ranking based on Shares of Labour Force</i> |
| Maharashtra                          | 1                                             | 1                                              | Maharashtra                                                    | 1                                             | 3                                              | Maharashtra                                     | 1                                             | 1                                              |
| Haryana                              | 2                                             | 8                                              | Tamil Nadu                                                     | 1                                             | 1                                              | Tamil Nadu                                      | 1                                             | 2                                              |
| Karnataka                            | 2                                             | 3                                              | Uttar Pradesh                                                  | 3                                             | 5                                              | Uttar Pradesh                                   | 3                                             | 3                                              |
| Tamil Nadu                           | 4                                             | 2                                              | Haryana                                                        | 4                                             | 2                                              | Kerala                                          | 4                                             | 5                                              |
| Gujarat                              | 5                                             | 6                                              | Gujarat                                                        | 5                                             | 4                                              | Gujarat                                         | 5                                             | 4                                              |
| West Bengal                          | 5                                             | 11                                             | Karnataka                                                      | 6                                             | 6                                              | Karnataka                                       | 5                                             | 5                                              |
| Uttar Pradesh                        | 7                                             | 10                                             | Punjab                                                         | 7                                             | 8                                              | Rajasthan                                       | 7                                             | 7                                              |
| Madhya Pradesh                       | 8                                             | 5                                              | Rajasthan                                                      | 8                                             | 7                                              | Andhra Pradesh                                  | 8                                             | 8                                              |
| Jharkhand                            | 9                                             | 12                                             | Jharkhand                                                      | 9                                             | 9                                              | Telangana                                       | 8                                             | 11                                             |
| Rajasthan                            | 10                                            | 4                                              | Kerala                                                         | 10                                            | 18                                             | Madhya Pradesh                                  | 10                                            | 10                                             |
| Punjab                               | 11                                            | 13                                             | Delhi                                                          | 11                                            | 11                                             | Punjab                                          | 11                                            | 12                                             |
| Telangana                            | 11                                            | 14                                             | Madhya Pradesh                                                 | 11                                            | 13                                             | West Bengal                                     | 11                                            | 9                                              |
| Uttarakhand                          | 11                                            | 6                                              | Uttarakhand                                                    | 11                                            | 12                                             | Jharkhand                                       | 13                                            | 16                                             |
| Andhra Pradesh                       | 14                                            | 8                                              | West Bengal                                                    | 14                                            | 10                                             | Haryana                                         | 14                                            | 13                                             |
| Kerala                               | 15                                            | 15                                             | Odisha                                                         | 15                                            | 16                                             | Delhi                                           | 15                                            | 18                                             |
| Odisha                               | 15                                            | 16                                             | Andhra Pradesh                                                 | 16                                            | 16                                             | Odisha                                          | 16                                            | 15                                             |
|                                      |                                               |                                                | Jammu & Kashmir                                                | 17                                            | 22                                             | Bihar                                           | 17                                            | 14                                             |
|                                      |                                               |                                                | Himachal Pradesh                                               | 18                                            | 15                                             | Chhattisgarh                                    | 18                                            | 17                                             |
|                                      |                                               |                                                | Assam                                                          | 19                                            | 24                                             | Assam                                           | 19                                            | 18                                             |
|                                      |                                               |                                                | Bihar                                                          | 19                                            | 19                                             | Chandigarh                                      | 19                                            | 22                                             |
|                                      |                                               |                                                | Chandigarh                                                     | 19                                            | 20                                             | Uttarakhand                                     | 21                                            | 20                                             |
|                                      |                                               |                                                | Puducherry                                                     | 19                                            | 14                                             | Himachal Pradesh                                | 22                                            | 22                                             |
|                                      |                                               |                                                | Telangana                                                      | 23                                            | 22                                             | Goa                                             | 23                                            | 24                                             |
|                                      |                                               |                                                | Chhattisgarh                                                   | 24                                            | 21                                             | Jammu & Kashmir                                 | 24                                            | 20                                             |

| Manufacture of motor vehicles |                                        |                                         | Manufacture of parts and accessories for motor vehicles |                                        |                                         | Maintenance and repair of motor vehicles |                                        |                                         |
|-------------------------------|----------------------------------------|-----------------------------------------|---------------------------------------------------------|----------------------------------------|-----------------------------------------|------------------------------------------|----------------------------------------|-----------------------------------------|
| State/UT                      | Ranking based on Geographical Clusters | Ranking based on Shares of Labour Force | State/UT                                                | Ranking based on Geographical Clusters | Ranking based on Shares of Labour Force | State/UT                                 | Ranking based on Geographical Clusters | Ranking based on Shares of Labour Force |
|                               |                                        |                                         | D & N. Haveli & Daman & Diu                             | 25                                     | 24                                      | Tripura                                  | 25                                     | 26                                      |
|                               |                                        |                                         | Goa                                                     | 26                                     | 27                                      | Manipur                                  | 26                                     | 27                                      |
|                               |                                        |                                         | Meghalaya                                               | 27                                     | 24                                      | Meghalaya                                | 26                                     | 25                                      |
|                               |                                        |                                         |                                                         |                                        |                                         | Puducherry                               | 26                                     | 29                                      |
|                               |                                        |                                         |                                                         |                                        |                                         | Nagaland                                 | 29                                     | 28                                      |
|                               |                                        |                                         |                                                         |                                        |                                         | Mizoram                                  | 30                                     | 31                                      |
|                               |                                        |                                         |                                                         |                                        |                                         | Arunachal Pradesh                        | 31                                     | 30                                      |
|                               |                                        |                                         |                                                         |                                        |                                         | Andaman & N. Island                      | 32                                     | 32                                      |
|                               |                                        |                                         |                                                         |                                        |                                         | D & N. Haveli & Daman & Diu              | 33                                     | 33                                      |
| Correlation                   |                                        | 0.7                                     |                                                         |                                        | 0.9                                     |                                          |                                        | 0.99                                    |

Sources: NCAER computations based on Table 7.1 and Table 7.3.

Note: Lower rankings means higher concentration of labour force or manufacturing units.

## 7.5 Occupational Maps

The National Classification of Occupations (NCO) are occupations in which workers are employed within the automotive manufacturing and repair and maintenance sectors, according to the periodic labour force survey (PLFS) data. NCAER has mapped and supplemented these occupations with the job roles from Automotive Skills Development Council (ASDC) for a complete occupational mapping of the sector (Annexure 7.1).<sup>12</sup> The latter has been useful for incorporation of new job roles which have emerged over the years, since NCO occupations (2015) are dated.

## 7.6 Stakeholders' Survey

The scope of the auto sector included manufacture of passenger and commercial vehicles, manufacture of automotive components, and repair and maintenance of motor vehicles. To assess skill shortages in the sector, a variety of stakeholders were contacted, including the sector skill council, industry associations, skilling institutions, automotive firms, and experts and other stakeholders.<sup>13</sup> This section provides the methodology adopted to assess skill shortage in the sector, determine specific job roles in which firms are faced with a shortage at present and are likely to face a shortage in next three years, and the reasons thereof. Based on the findings, suggestions to carry forward the exercise have been provided.

### 7.6.1 Sampling

Data on the number of automotive factories and service workshop across States, both formal and informal from the Annual Survey of Industries (ASI) and Annual Survey of Unincorporated Sector Enterprises (ASUSE) respectively, helped identify the automotive clusters, i.e., States where there are a large number of automotive units, and where there are fewer. Given that the present stage of the study only involved reaching out to a small sample of firms, it was considered useful to have a spatial spread of units in the choice of firms (a firm can have several automotive units)– to capture any regional variation in skill shortage. In the case of the auto sector, it was attempted to interview firms with factories and workshops across Maharashtra, Tamil Nadu, Gujarat, Delhi-NCR, Uttarakhand and West Bengal. Within these States, automotive clusters are known to be in the belts in and around Pune, Chennai, Sanand-Hansalpur-Vithalpur, Delhi-Gurgaon-Manesar, Pantnagar-Haridwar and Kolkata. To understand if skill shortage varied by firm size, it was also attempted that firms operating across the selected regions are of different sizes.

To achieve an ideal sample, it is necessary to have a comprehensive list of all the automotive firms in India, with details of their size, where their plants and workshops are located, as well as a guarantee that personnel at the chosen firms are willing to meet to discuss the issue of skill shortages. Amidst a glaring lack of such data, NCAER

---

<sup>12</sup> The exercise has been proof-read by ASDC staff, and is aligned with their NCO code mapping.

<sup>13</sup> In line with the study's agenda, interviews involve meetings with 25 stakeholders, including the sector skill council (1 no.), industry association (1 no.), training centres (2 no.s), firms (20 no.s), and a recruitment agency. Depending on the scope of the sector and stakeholder availability, these numbers have varied in practice. For instance, instead of one industry association, NCAER has met with 3 industry associations, to cover all three aspects of motor vehicle manufacturing, auto component manufacturing, and repair and maintenance workshops. Meeting industry experts, belonging to different firms, has also been insightful to understand the issues of skill shortages. As of 8 Nov. 2024, NCAER has met with sector skill council (1), industry associations (3), training centres (2), firms and industry experts (20), recruitment agency (1) – taking the total stakeholder meetings to 27.

tried to seek help from the stakeholders (in particular the sector skill council and the industry associations), and also tried to reach out to any known prior contacts.

A total of 55 firms were contacted over email and telephone, of which personnel from only 13 firms have met to discuss skill shortages, resulting in a response rate of 24 per cent. Response rate tends to be low in business surveys, despite reaching out to multiple personnel within the same firm. Yet, NCAER has been successful in ascertaining a spatial spread in firms' plant locations, as well as in conducting interviews with firms of different sizes. In addition to the firms who have provided their insights to the questionnaire, expert consultations with personnel from some other firms and industry members have also been useful in supplementing the findings (Table 7.5).

**Table 7.5: Stakeholder consultations**

| <i>Stakeholders (No.)</i>                      |                 | <i>Location of Firms (No.)</i> |   | <i>Ownership Type (No. of Firms)</i>    |   | <i>Designation of Interviewees (No. of Interviewees *)</i>                          |   |
|------------------------------------------------|-----------------|--------------------------------|---|-----------------------------------------|---|-------------------------------------------------------------------------------------|---|
| Ministry                                       | No response     | Delhi                          | 2 | Public Sector                           | 0 | Proprietor                                                                          | 2 |
| Sector Skill Council                           | 1               | Gujarat                        | 1 | Public Limited                          | 4 | Human Resource/<br>Learning &<br>Development<br>Managers/<br>Director<br>(Training) | 8 |
| National-level<br>Industry Association         | 3               | Haryana                        | 3 | Private Limited                         | 2 | Managing<br>Director/ CEO                                                           | 1 |
| No. of Firms                                   | Micro/<br>Small | Maharashtra                    | 3 | Individual<br>Ownership/Part<br>nership | 4 | Senior Managerial<br>Positions-<br>Operations                                       | 4 |
|                                                | Medium          | Rajasthan                      | 1 | MNC                                     | 3 |                                                                                     |   |
|                                                | Large           | Tamil Nadu                     | 1 | Limited Liability<br>Partnership        | 0 |                                                                                     |   |
|                                                | Total           | Telangana                      | 1 | Cooperatives                            | 0 |                                                                                     |   |
| No. of Placement<br>Cells/TVET<br>Institutions | 2               | West Bengal                    | 1 | Others                                  | 0 |                                                                                     |   |
| Recruitment<br>Agencies                        | 1               |                                |   |                                         |   |                                                                                     |   |
| Other Stakeholders                             | 7               |                                |   |                                         |   |                                                                                     |   |
| Firms plus Other<br>Stakeholders               | 20              |                                |   |                                         |   |                                                                                     |   |
| <b>Total</b>                                   | <b>27</b>       |                                |   |                                         |   |                                                                                     |   |

Source: NCAER Survey

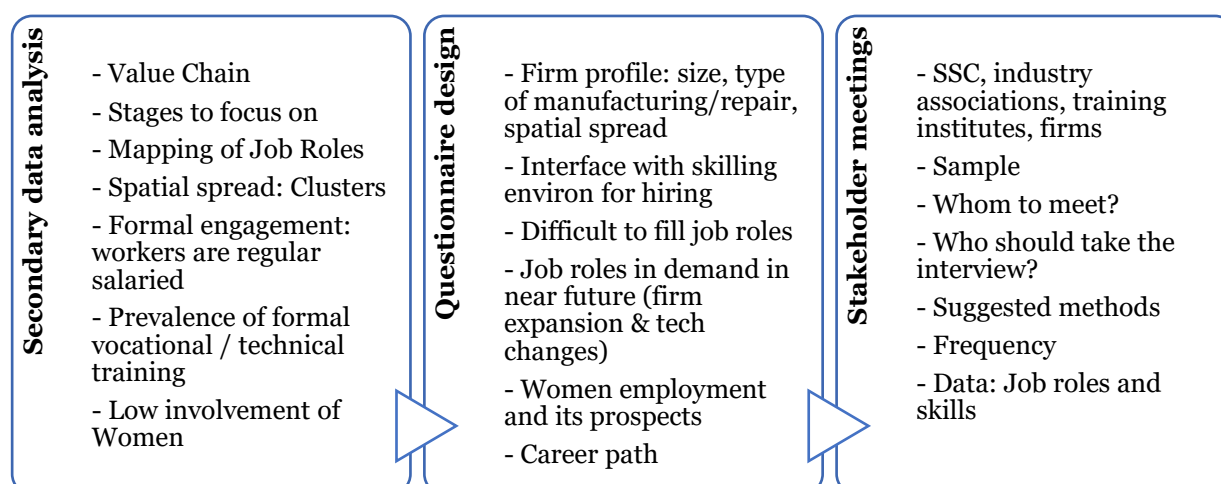
Note: \* NCAER team attempted to speak with multiple personnel at the firms.

### 7.6.2 Methodology of Assessing Skill Shortages

The NCAER recommends to approach the assessment of skill shortages from the lens of 'data triangulation'—by utilising different sources of data (secondary and primary), accessing multiple personnel at firms to speak with, and collating data through a team of investigators.

In the methodology adopted and tested by NCAER, NCAER undertook detailed secondary analysis to understand the sector, developed the key instrument for data collection (i.e. the questionnaire), and undertook stakeholder meetings to gather detailed insights on the sector and test the questionnaire and methodology of data collection on skill shortages. This process is summarised in Figure 7.9.

**Figure 7.9: Methodology**



Source: NCAER's conceptualisation.

### **7.6.3 How to Assess Skill Gaps?**

A firm is faced with a skill shortage when they find difficulty in, or are unable to fill an advertised job role. To get the stakeholders familiar with the various job roles, NCAER put together a list of occupations where personnel in the sector are employed (from the PLFS data) and mapped it onto the different job roles for which qualification packs have been designed by the sector skill council.

To collate specific job roles in which there is a skill shortage, questionnaires were structured to profile the firm on its size (small/medium/large), type of manufacturing/repair, spatial spread of plants/workshops, and the interface with the skilling environment for hiring purposes. They were designed particularly to help the respondents think through:

- Given the firm profile, what are the different job roles at the company
- For which job roles has there been a difficulty in finding the 'right' candidates
- For such 'difficult to fill job roles', what are the qualifications and skills that the company is looking out for in the 'right' candidate
- In near future, given the firm-level/technological changes, which job roles (and corresponding skills) will be required at the company, and how easy or difficult would it possibly be to find the appropriately skilled people
- Also, if difficulty in finding the appropriate skill sets are across India, or only in particular States/geographic regions
- Women employment at the firm—overall, specific job roles where there are more / no women, and prospects of increasing women employment in particular job roles
- Availability of factors supporting employee retention and gender diversity at workplace—career path, creche facility, policies to hire female employees, and policy and procedures for prevention of sexual harassment at workplace (POSH).

The questionnaire is an important instrument facilitating the collation of detailed information on job roles, and it has worked well on-field. Three questionnaires and

supporting documents have been designed for firms involved in manufacturing of motor vehicles, manufacture of auto components, and workshops in repair and maintenance of motor vehicles. The firms' questionnaires are attached at the end of the report (Questionnaires 5, 6, and 7).

- Based on the job roles identified during stakeholder meetings, the occupational map has been updated to segregate the job roles, where: i) workers are employed according to PLFS (at NCO-3 digit), ii) those which do not show workers employed in PLFS but the NCOs are aligned with a qualification pack of Automotive Skill Development Council (ASDC), and iii) those which neither show PLFS worker data nor are aligned with any ASDC qualification pack (QP). This has been useful to highlight the job roles which do not get captured in the PLFS survey, but are in-demand in the sector – with the skill council running training programs for some of these.<sup>14</sup>
- Salary is an important component as came up during the stakeholder meetings, and appears to be a key deciding factor whether an individual takes up a job in the automotive sector. Therefore, it is recommended to collect information on the 'salary offered' by the firm for the respective in-demand job roles, within the supporting document of the questionnaire.

#### **7.6.4 Who to Talk to?**

The first task is to find the right person to speak with at the firm. A firm is a black box, where individual contact details are difficult to find.<sup>15</sup>

Tasks related to preparing job descriptions, advertising job roles and facilitating interviews and onboarding, fall under the purview of the firms' human resource (HR) departments. Given the present aim to find details of 'difficult to fill' job roles, it is quite natural to consider the HR personnel as the key points of contact. However, the HR personnel are usually at the corporate/head office and responding to the demands of the operation managers, learning and development divisions, and senior directors while advertising job roles. While the HR may be able to check the data concerning number of jobs advertised and those which took longer or were not filled, further details on the skills of the applicants and how well they meet/do not meet the requirement of the company can be better gauged by the individuals overseeing the manufacturing / servicing operations and on-the-job training (OJT). Also, in large firms, the HR personnel are a group of people, managing different departments, and therefore one person is unlikely to have all the information. In addition, before sharing any information with an outside party, consent from the corporate bosses is likely to be needed.

---

<sup>14</sup> The list of job roles where there are workers accounted for in PLFS, and the qualification packs (QPs) developed by the sector skill council appear to be comprehensive, with the latter advancing towards recognizing design and new technology as well. Yet, there are nuances. For instance, job roles which are gaining importance amidst the increasing use of software in cars but found to be missing among the PLFS NCOs and ASDC QPs, are Embedded Software Engineer and Vehicle Software Developer. These have been added to the occupational mapping.

<sup>15</sup> As noted earlier, NCAER requested the sector skill council for contacts at firms located within the chosen clusters. While they did share the names and contact numbers of several firms, covering all selected regions, many contacts turned out to be of personnel at junior levels (storage department, technician, spare part manager, manufacturing operator, ex-apprentice, and ex-supervisor), who said they cannot talk about skill shortages.



In NCAER's experience of talking to senior HR personnel, from firms with several plants around India, the respondent was able to talk about their specific department (e.g., plastic processing and painting department) at their base plant location only. HR personnel at the group level, overseeing multiple departments, were able to provide a relatively bigger picture.

It may be noted that instead of bypassing the HR, the above pointers highlight the need to keep the individuals in the position of CEOs, Manager—Plant and Operations, individuals heading the R&D Divisions and Global Capability Centres,<sup>16</sup> and those heading the learning and skill development divisions, among the key points of contact. Reaching out to these sets of personnel at the firm should be ideal to get a full understanding of skill shortages, at every level, department, and plant location of the firm.

At the OEMs, upon sharing the study agenda with the available contact, NCAER was directed to reach out to personnel heading the training and skill development divisions who were able to provide details on the skill gaps they were attempting to bridge and the difficulty in finding industry-ready personnel. They were also able to share details about the firms' interface with the skilling ecosystem, such as tie-ups with ITI and colleges for imparting skills, providing internships / apprenticeships, and deployment procedures. It is important to note that OEMs are large firms, where the skill development division looking after the needs of manufacturing will tend to be different from that looking after the skill needs of workshops and dealerships. To capture skill shortages on each side, personnel from each of these divisions—manufacturing and repair and maintenance—would need to be met.

Apart from the training and skill development divisions, the plant / workshop managers, who look after all the operations, were also able to share details about the jobs they are unable to find people for, and the full set of skills they look out for.

Therefore, if the task is to carry out a large-scale survey of all automotive firms, the following steps may be followed:

- **Organise an awareness creation workshop/webinar**

- At the outset, an awareness creation workshop or webinar must be organised, in partnership with the national and regional / State level industry associations, with invitations going to the Chief Executive Officer (CEOs) and all senior personnel at the corporate office of the firms.
- Once all senior members of the corporate office have been explained the agenda and they find the usefulness of the labour market information system, they should be able to help connect with the HR heads, R&D divisions, plant / workshop managers, and learning and skill development personnel at all of the firms' plant locations. After all, the firms' organisational chart is known best by those at the top.

---

<sup>16</sup> Several stakeholders have highlighted how the automotive industry in India is upgrading to higher value-added segments, such as those of design and R&D, and there are skill requirements there too. The present exercise's focus on manufacturing and repair and maintenance segments of the value chain has rendered design and R&D outside of scope. While it was attempted to include aspects of design and R&D in the questionnaire, along with manufacturing and servicing aspects, the respondents primarily focused on the core manufacturing and servicing job roles. It is likely that meeting CEOs and heads of design and R&D divisions at firms would be useful for insights on the in-demand design and R&D job roles and the skill shortages thereof.

- **Compile a database of firm-level contacts, which should be periodically updated (Ideally the universe of firms should be sourced from Ministry of Corporate Affairs/Goods & Services Tax Network/Economic Census)**
  - A comprehensive database should be created from the above exercise, which should also be updated on at least a semi-annual basis if the aim is to have a dynamic labour market information system, since:
    - Firms may be opening new plants, workshops, R&D divisions, or even closing some
    - Individuals may be shifting between companies, and those who are the key points of contact at one point in time, may have shifted to another company when the survey is repeated.
- **Frequency of conducting the survey**
  - While the exercise is extensive, data on skill shortages should be collated from the firms on an annual basis—due to the dynamic nature of the industry and constant changes in technologies.

### 7.6.5 Who Should Take the Interview?

Given the novel nature of this exercise, it is important that the interviews are conducted in-person—either online or offline. On average, each interview takes about one hour, and hence the respondents should be requested to spare at least an hour to ensure completeness of information.

Taking the interviews requires a team of interviewers who should be talking to the firms' key points of contact (discussed in the previous section), to gather holistic data on skill shortages.

Considering the seriousness of this exercise and the benefit it promises, even the individuals communicating with the key points of contact (i.e. the respondents)—either through written or verbal means—should be 'skilled interviewers', with the following traits:

- *Clarity of thought*: The interviewer should be able to impart the importance and essence of the exercise to the respondents in a clear and concise manner, and have a keen understanding of all components of the questionnaire to be able to explain it well to the respondents.
- *Focused, polite and persistent*: It must be remembered that the senior personnel being contacted for the survey are busy, and a single email or tele-call cannot guarantee an interview. One has to remain focused on the task and be polite and persistent with regular follow-ups. Of course, if one proceeds with gathering contact details using the steps mentioned in the previous section (i.e., via the Corporate HQ), the chances of easily getting an interview, without much persistence, are higher.
- *Organised, detail-oriented, and honest*: They should be able to keep a log of all data—who was contacted, when were they contacted, and what were the responses, to be able to undertake follow-ups and organise meetings in a professional manner. The task would also be useful in helping with constant updation of the firm level data and key points of contact. All of this should be done with full transparency and honesty, if the real benefit of the exercise has to be achieved. That is, the interviewers should neither fudge data, nor talk to just about 'anybody' and claim they have collated accurate data. Just fulfilling hollow 'numbers' (i.e. 'this' many firms and respondents were contacted),

instead of striving for good quality information, will lead to a failure of this extensive exercise.<sup>17</sup>

- *Confident, curious, transparent*: The interviewer should be able to engage in a discussion with confidence, keep the discussion on track, and ask questions as necessary to ensure completeness of information. It is also a good idea if the interviewer is transparent with sharing the questionnaire with the respondent, and noting the answers in consultation with respondents as it helps enhance trust and in turn allows the respondent to be confident in sharing data. It also helps ensure data accuracy and replicability of the method by overcoming the bias / inaccuracy that may arise in translating respondents' answers to the skills framework in the questionnaire. In an online meeting, screen-sharing while filling answers is a good idea, which has also worked well in practice.
- *Advanced communication skills and knowledge of language*: To confidently deliver on each of the above, the interviewer needs to have advanced communication skills, with a superior knowledge of grammar and sentence structure to be able to communicate with respect and clarity in written (e.g., emails, filling questionnaire) and verbal (e.g., tele-calls, in-person meetings) formats. In a diverse country like ours, in addition to knowledge of English and Hindi, having interviewers who are conversant (or even proficient) in the local language will be extremely useful in helping the respondents be at ease in sharing the requisite details.
- *Teamwork and cultural sensitivity*: Considering that firms in the sector are spread across the country, with plants and workshops in diverse geographies, it would be useful to have a team of interviewers, who can take on conducting interviews for the same sector, while focusing on different geographies depending on their knowledge of language and culture. Given the vastness of India, and the automotive sector, a culturally diverse team will make the task at hand more efficient in terms of time and cost, and effective in assimilating the requisite information.
- *Computer skills*: Along with a knowledge of MS Office and email communication, the interviewers should also be skilled at conducting online interviews through software such as Zoom, MS Teams, Webex, etc. Online interviews tend to be more convenient and time and cost effective, from the side of the respondents and interviewers, and the screen-sharing feature helps maintain transparency—in what is being asked of the respondent, and the answers being noted by the interviewer.
- *Ability to reflect towards the bigger picture*: Firms are profit oriented, and in many instances, it is likely that the respondent will ask: “what benefit do I get?”, “will you train those people for me?”, “what if you take information from me on what the industry needs, but the skilled people join another firm?”. The interviewers should be ready for such questions, and be able to explain how the contribution of each firm helps build an information system to benefit the industry and each of its players.

---

<sup>17</sup> Incidentally, among the contacts shared by the sector skill council, several contacts in locations away from Delhi (such as Chennai, Gujarat, and Kolkata) belonged to personnel who had never worked in the auto sector or they did not know of the sector skill council itself. This raises questions on ‘who is conducting the interviews’ and if the on-ground field team have been: i) honest about speaking with personnel from automotive firms, ii) while providing full information on their own role of collating data for the sector skill council.

- *Education and knowledge:* While the above traits are necessary, it is more likely that an advanced degree in economics or a related field, with an interest / work / research experience in the particular sector and the skilling literature, will be helpful. Not only would it allow the interviewer to always have the bigger picture at the back of their mind (as economists are taught how to connect the micro with the macro), but an interest in the sector will be a constant source of curiosity.

#### **7.6.6 Key Findings from the Stakeholders' Survey**

This section provides an overview of the findings from interviews with the stakeholders, followed by details on the in-demand job roles.

Skill shortage is an issue in the automotive sector, and is intensified due to the technologically dynamic nature of the sector:

- With India leapfrogging from BS4 to BS6 (and now looking at a transition to BS7) in internal combustion engine technology
- The advent of electric, hybrid, and flex fuel vehicles
- The increasingly integral role of electronics, software, and cybersecurity in motor vehicles
- The adoption of automation, robotics, artificial intelligence (AI) and machine learning (ML) in manufacturing and repair and maintenance
- Advent of new materials and efforts towards light-weighting components

Therefore, while the traditional blue-collar job roles, requiring ITI trained people to work on the shop floor are, and will continue to remain, in-demand (with training updated to new technology, as required), there will also be an increasing demand for new and niche engineering job roles. The point to note is that for each of these sets of job roles, finding people is perceived to be rather 'difficult'. There were found to be several reasons behind this, both from the side of the skilling ecosystem (supply-side) and the industry (demand-side).

#### *Supply side issues:*

- According to the PLFS data on employment characteristics, vocational and formal education and training is rather high in demand in the automotive sector, thereby laying emphasis on the curriculums of the ITI and engineering colleges. A key reason for 'difficulty' in filling job roles was that the candidates lack the "skills to do the job". While they may have the theoretical understanding, lack of practical knowledge of working with the latest machines renders them unemployable, and even if employed, unable to actually do the job at hand.
- Performing well on-the-job requires soft-skills as well. These include good communication skills, team-spirit, conscientiousness, self-discipline, emotional stability, psychomotor skills, safety awareness, cultural and gender sensitivity, etc. While these are meant to be a part of the curriculum (especially at ITI), training on these parameters is said to be missing.
- Some firms' requirements are very specific, which are not imparted at any ITI. One such is that for the automotive wiring harness, where it was learnt that there are no courses in India providing any skilling with respect to the job roles concerning the manufacture of wiring harness.
- Firms usually look out for a locally available workforce, especially since people prefer to work closer to home and in familiar environments (culture, language, food, weather). This means that a locally trained workforce must be available,

which in many instances may not be enough to fulfil the firms' requirements—be it at manufacturing plants or repair and maintenance workshops. Uttarakhand came out as a classic case, where stakeholder firms with plants in Pantnagar pointed at not being able to fill vacancies due to lack of a young, locally trained workforce in blue-collar automotive trades. Another stakeholder stated the issues of not finding enough blue-collar workers from automotive ITI trades in Gujarat.

- Engineering colleges have not kept up pace with the changing technologies and demands of new job roles in the automotive sector, be it in design, EV batteries, software, or cybersecurity.
  - The training institutes and the sector skill council particularly highlighted advanced job roles in electric vehicles, battery technology, software, and cybersecurity, which were attempted to be captured through meetings with some stakeholders dealing with new technologies. The training ecosystem is trying to meet the demand for these job roles by offering short-term top-up courses to the standard ITI and engineering training—which in their view is in line with industry requirements. How far the skilling ecosystem has been able to match up to the demand of the industry in such advanced job roles can only be ascertained from firm-level interviews with senior personnel at the corporate office and those at the R&D divisions. Though, according to a few stakeholders: i) availability of other well-paying avenues (particularly in IT sector) for software and data science personnel, ii) lack of well-trained engineers (particularly in specialised fields, e.g., mechatronics), and iii) absence of courses for battery technologies have resulted in a shortage of skilled personnel to fill such job roles in the auto sector.
- Questions have also arisen on 'who is training' and the need to bring in personnel from the industry to impart practical and socio-emotional knowledge at both ITI and engineering colleges, and provide the necessary guidance, counselling, and mentoring to students—which can help them be placed in jobs that align with their interest and ambitions. The sector skill council admitted that while several new courses / qualification packs (QPs) have been formulated on automation and robotics, talks are still on with engineering colleges to start these, since there are no trainers at present. In addition, some certification courses introduced at engineering colleges, on EV technology and design, are all 'online'—and there is no data with regard to student placements.<sup>18</sup>

The poor education and skilling environment have rendered it necessary for automotive firms to provide on-the-job practical and soft-skill training to all freshers, which in their view, should already have been imparted through the education and skilling system. All engineering and diploma graduates, too, are commonly employed as Graduate Engineer Trainees and Diploma Engineer Trainees. Along with being an added cost to the firm, it is a factor that increases their manufacturing lead times as well.

Some firms have tie-ups with ITI, where they offer inputs to curriculum by offering practical training and insights, and set up labs with latest machines and bring in

---

<sup>18</sup> This is especially since one of the stakeholders highlighted that the training institutes did not have idea of where the students were being placed, if automotive industry was the employer, and whether they were being placed at all. Rather, the prime focus was the financial considerations and how the money from the fees was divided between the marketing organisation (which mobilized students) and the college that ran the courses and gave certification.

industry trainers. This is for training workers across the automotive value chain—manufacturing, sales, and repair and maintenance—from where the candidates may potentially be hired by the firm engaged in training, or even by other firms in the industry. While this has helped build an industry-ready pool of workers, the numbers trained are nowhere enough to fulfil the industry’s demand.

Given the disconnect with industry, and the need for ITI/diploma/engineering graduates to be trained again at the firm, smaller firms (particularly the independent service workshops and component manufacturers) resort to hiring unskilled workers who can be moulded and trained to the firms’ requirements, even multi-skilled (for instance the same individual performing the role of AC technician and electrician)—at a lower salary, and thereby also helping the firm save on cost.

Despite the firms’ efforts to skill their workforce (and any parallel improvements in the skilling ecosystem itself), it must be noted that the automotive industry is likely to still face a shortage due to certain issues arising from the side of the industry (demand-side):

### Box 7.1: Which job is more attractive?

As highlighted in this section, automotive job roles are not-aspirational, particularly with the availability of alternative work avenues. Stakeholders in automotive manufacturing, be they in the national capital territory region or in Gujarat, have pointed out that youth may prefer to take up the job of a delivery worker in a city, rather than that of a motor mechanic at an automotive plant in the suburbs. A comparison of recent job offerings in Delhi-NCR and Gujarat, from well-known leading companies in the two sectors, indicates why the auto sector is potentially facing a shortage of its much-needed workforce.

| Comparator         | Motor Vehicle Mechanic (Gurgaon) / Technician (Hansalpur)                                                                                                                                                                                                                                                                                                                                                                     | Food Delivery Worker (Delhi) / Delivery Boy (Surat)                                                                                                                                                                            |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Education required | 10 <sup>th</sup> pass + ITI                                                                                                                                                                                                                                                                                                                                                                                                   | All education levels acceptable (at least 10 <sup>th</sup> pass)                                                                                                                                                               |
| Skills required    | Knowledge of ITI Trades - Fitter, Welder, Painter (General), Electrician, Turner, Diesel Mechanic, Machinist, Tool & Die, Motor Mechanic Vehicle, Tractor Mechanic, Electronic, plastic processing operator                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Deliver packages from one place to another safely and on time</li> <li>Collect payments where needed</li> <li>Good communication with customers (English and local language)</li> </ul> |
| Entry conditions   | <ul style="list-style-type: none"> <li>Min. 40% marks in class 10<sup>th</sup> and 50% marks in ITI</li> <li>Year of passing ITI: 2017, 2018, 2019, 2020, 2021, 2022 &amp; 2023</li> <li>18-26 years (on the day of joining)</li> <li>Interview in Gurgaon / Ahmedabad</li> <li>Documents required: Resume, 10<sup>th</sup> Marksheet, ITI Marksheet &amp; Certificate, Aadhar Card, Pan Card, Passport Size Photo</li> </ul> | <ul style="list-style-type: none"> <li>Interview in Delhi / Surat</li> <li>Vehicle, driving license, Smartphone, PAN Card, Aadhaar Card</li> </ul>                                                                             |
| Work experience    | Freshers                                                                                                                                                                                                                                                                                                                                                                                                                      | Freshers (0 - 6 months)                                                                                                                                                                                                        |
| Type of contract   | Contractual / Fixed term (Duration: as per company requirement)                                                                                                                                                                                                                                                                                                                                                               | Pay structure based on delivery performance                                                                                                                                                                                    |
| Benefits           | Uniform, shoes, subsidised meals, subsidised dormitory accommodation, leaves (as per company policy)                                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>Day shift (full-time), insurance, medical benefits (Delhi);</li> <li>Day shift (full-time or part time), performance-based incentives and additional benefits (Surat)</li> </ul>        |
| Place of work      | Gurgaon (Delhi-NCR) / Hansalpur (Gujarat)                                                                                                                                                                                                                                                                                                                                                                                     | Delhi / Surat (Gujarat)                                                                                                                                                                                                        |
| Gender             | Only males (Hansalpur)                                                                                                                                                                                                                                                                                                                                                                                                        | Male and females (Delhi and Surat)                                                                                                                                                                                             |
| No. of vacancies   | 50 (Gurgaon)                                                                                                                                                                                                                                                                                                                                                                                                                  | 30 (Delhi) / 50 (Surat)                                                                                                                                                                                                        |
| Salary per month   | Rs. 15,001 to Rs.25,000 (Gurgaon)/ 21,500 CTC (Hansalpur)                                                                                                                                                                                                                                                                                                                                                                     | Rs. 30,000-Rs. 40,000 (Delhi) / Rs. 35,000 – Rs. 40,000 (Surat)                                                                                                                                                                |

Source: NCAER Analysis, using information from advertised positions on online job-portals.

Note: The Motor Vehicle Mechanic / Technician details are taken from two Maruti Suzuki advertisements for their Delhi-NCR and Hansalpur plants, available at: <https://www.shramin.com/job/workmen-marutisuzukiindialimited-manesar-007461f7-3a8c-4f15-9e78-8599cf816574>; <https://www.justjob.co.in/6734/fix-term-contract>

The Food Delivery worker / Delivery Boy details are taken from two Zomato advertisements, for work in Delhi and Surat, available at: <https://www.jobhai.com/delivery-food-delivery-job-in-zomato-ashok-vihar-south-delhi-delhi-o-to-o-years-1726223091-4608934-jid>; <https://www.vihu.com/in/en/job/P-106016/Delivery-Boy-Jobs-in-Zomato-Surat-Gujarat-India>

- The automotive job roles, particularly the blue-collar job roles, are non-aspirational. The work environment is perceived to be physically taxing and dirty, and connected with employing primarily a male workforce.
- Even if people may be trained in a relevant automotive trade at the ITI or engineering colleges, they may not necessarily join the automotive sector, especially if there are alternative avenues available at the same or higher salary. For blue-collar workers, working as a delivery worker in the hometown may be more lucrative (see Box 7.1), and for advanced engineering graduates, joining the IT sector may be more lucrative. Once people join the auto firm, they may quickly leave resulting in high attrition rates.
- That the automotive sector offers a career path, where an entry-level technician can rise up to managerial level positions and firms themselves offer support for reskilling and upskilling, is a facet which needs to be promoted and imparted to potential candidates at ITI and engineering colleges.

- Any question concerning female employees, particularly in non-traditional job roles, raises eyebrows—with the perception that women cannot perform manufacturing-related jobs. At a time when machines are involved with lifting/loading /unloading, policies pertaining to prevention of sexual harassment (POSH) becoming a norm, and at a time when it is anyway difficult to find male candidates for the job—this perception needs to change. There are success stories of all-female automotive assembly lines functioning efficiently, which indicate the benefits that can be garnered from a simple change of perception and enacting policies and facilities (e.g., toilets and crèche) to support a female workforce. A stakeholder mentioned how advent of EVs is helping change the perception and paving the way for more involvement of women on the EV assembly line. The potential for employment of women in the auto sector is provided in Box 7.2.
- As highlighted by a stakeholder, the attitude of the staff which hires for the industry matters in attracting and retaining potential employees. If the human resource personnel and supervisory staff are not sensitive to the questions and concerns of the potential and present employees, a skill shortage at the firm is likely.

### **Box 7.2: Prospect for women employment in the auto sector**

As found from secondary data and primary assessment, there are few women in the automotive industry. The number is minuscule among blue-collar workers on the shop floor (although it varies between firms), and women are mostly in the administrative and customer support positions.

Several firms have expressed their willingness to have gender diversity in the core manufacturing roles, but most are unable to fulfil the same due to:

- Lack of women at ITI which offer training in automotive manufacturing trades. It is also highlighted that ITI need hostels to ensure safety for all students, particularly women commuting over long distances.
- Lack of women applicants for core automotive roles (as women themselves are hesitant to take up automotive job roles due to social norms)
- Pre-conception among shop-floor workers / managers about women being unable to perform physically taxing tasks.

Stakeholders highlighted the importance of firm level policies in attracting more women. Examples include the successfully operating all-women assembly lines at Kirloskar Brothers and Ola Electric. Rather, it was pointed out by a stakeholder that the experience of Ola Electric is encouraging other EV manufacturers to also hire more women in the core manufacturing and assembly job roles. This shift in technology to EVs could possibly help increase the number of female employees in the automotive sector.

While the perceptions may take time to change, a positive finding has been the emphasis placed by several firms in enacting POSH policies and committees, and providing crèche facilities on office/plant premises. It is also being perceived that prospects of increasing women employment are higher in:

- White-collar roles, particularly in finance and human resources, and R&D
- Computer/keyboard operators and customer support executives
- Core manufacturing job roles, such as plastic moulding, parts assembly, machine operators, packing labourers, and other blue-collar job roles (where machines are involved, and physical workload is less).

*Source: NCAER Stakeholders' Survey.*

It is important for the automotive industry to take serious note of the above. If the industry requires people for its growth, it is important that they create the right conditions to attract the skilled workforce—be it by i) offering a competitive salary, ii) mentorship and counselling to set expectations, better skill matching, and inform trainees of a career path and growth within the firm, iii) generating awareness of a physically non-strenuous work environment to attract male and female candidates, and/or iv) creating an environment of inclusivity, respect, and consent.



The existence of skill shortage in the automotive sector is not new. A study undertaken in 2019<sup>19</sup> by the Automotive Skill Development Council (ASDC) and in 2024<sup>20</sup> by the industry association Society of Indian Automobile Manufacturers (SIAM) have highlighted the job roles which are endangered, which require re-skilling and up-skilling and those which will be entirely new. The expected number of jobs which will be created by the industry in future is also estimated. However, persistence of skill shortage requires digging deeper into the reasons, as came out during NCAER's stakeholder meetings. A stakeholder from the skill council, when asked how their 2019 predictions have performed thus far, was frank to note that the qualitative findings on the expected job roles had performed well, while the quantitative estimations on the number of jobs did not. There was also an emphasis laid on conducting surveys more frequently, to regularly tweak the skilling programs and number of people required in line with the industry needs.

### *Job Roles in-Demand*

Having had detailed discussions with the firms, training institutes, and sector skill council, several job roles came into view, where:

- There is a skill shortage at present (i.e., there are not enough people, but the skills are high in demand by industry).
- There is likely to be a skill shortage in near future, three years from now (i.e., which will be in demand in future, but finding skilled personnel for the same may be difficult too).

Although the study's aim has been to develop a methodology and results from a small sample of firms cannot determine all possible job roles in shortage, yet there was an overlap between the views of the different stakeholders. Job roles mentioned by the stakeholders are detailed in Table 7.6.

Incidentally, all job roles in shortage at present are also perceived to remain in shortage in near future. This is because of the issues on the 'supply side' of the skilling ecosystem and the lack of aspiration on part of candidates to join the auto industry. It reflects the quality of training and mentoring at ITI and engineering colleges, which is not up to the mark to meet the firms' requirements.

All stakeholders agreed that along with technical training, soft-skills are equally important and are in-demand for the stated job roles. Interviews with stakeholders have been successful at collating details on job descriptors, including the different cognitive, socio-emotional and technical and vocational skills needed for the job role, at different levels of proficiency. Considering that cognitive and socio-emotional skills start developing at the school level, the importance of good quality school education has also been reiterated in stakeholder meetings.

Along with a list of qualifications and skills, the questionnaire has also helped capture the number of personnel required by firms in the stated job roles—both at present and in near future to help anticipate demand, along with the geographic

---

<sup>19</sup> ASDC and EY 2019. Human Resource and Skill Requirements in the Automotive Sector (2026). Available at: <https://www.asdc.org.in/uploads/reports/1097810937280524030736.pdf>; accessed on 1 April 2024.

<sup>20</sup> SIAM and Deloitte 2024. EV Talent Landscape in India: Bridging the Skill Gap for 2030. SIAM. The report has received wide media coverage: [https://www.business-standard.com/industry/auto/auto-industry-needs-200k-skilled-people-by-2030-to-meet-30-ev-target-124071600619\\_1.html](https://www.business-standard.com/industry/auto/auto-industry-needs-200k-skilled-people-by-2030-to-meet-30-ev-target-124071600619_1.html); accessed on 16 July 2024.

regions where the skilled personnel are required. Though it must be highlighted that these numbers are only indicative. It is rather difficult for the companies themselves to make projections on the ‘numbers’, considering that auto companies will be going for automation where use of automated systems and robotics will decrease the need for people / lesser people will be needed (i.e., a lot of manual roles will get automated), and additionally there will be a convergence in job roles (i.e., job roles will also be fewer).

Additionally, any attempt to project the number of jobs required in the sector in the future using the existing PLFS database (as performed using the input-out analysis) is likely to be misleading (Chapter 3). There are several job roles in-demand now and in the near future, but there are no individuals employed in their corresponding NCOs according to the PLFS database. It implies that while people may be working in those job roles now and increasingly in near future, any labour demand projections using PLFS will exclude such workers. This includes job roles relating to data science, cybersecurity, and automotive software—which emerged among the in-demand job roles by the interviewed firms, and the sector skill council (ASDC) has even developed some qualification packs (QPs) for training personnel in these in-demand roles (see Table 7.6).

Therefore, an annual national survey of automotive firms is recommended to ascertain the demand for job roles and associated skills in times to time, while working alongside to improve the skilling ecosystem and industry-academia collaborations in line with the sector’s evolution.

The top 5 job roles are shown in Table 7.6. It may be noted that there were certain other job roles which also came up in stakeholders’ meetings—that are in-demand but difficult to find people for. However, they are covered under NCOs other than those in the Table 7.6 and were mentioned by a single firm / stakeholder. All the job roles and their brief descriptions are given below:

1. Machine/Computer Numerical Control (CNC) operator; Turner; Grinder; Tool and die maker (Table 7.6)
  - The tasks a CNC Operator is expected to perform include;<sup>21</sup>
    - Maintaining and operating the CNC machine
    - Monitoring gauges and dials
    - Programming and setting CNC machinery
  - A turner works Turner; Lathe Operator makes metal articles to required specifications using lathe and cutting tools. Studies drawings and other specifications of parts to be made.<sup>22</sup>
  - Grinder, Tool and Cutter grinds machine tools and cutter to correct specifications by special grinding machines and wheel. Studies drawings and other specifications to understand nature of grinding operation required.<sup>23</sup>

---

<sup>21</sup> National Career Service website. <https://www.ncs.gov.in/content-repository/Pages/ViewNcoDetails.aspx?List=8db9be14%2D2b47%2D4f30%2D97fb%2D5de315d871c0&ID=3496&ContentTypeId=ox01003FEA8C7117A78D4F93DC52780D878B2F0015F91119E23A874E9006BoFo68F1089C>

<sup>22</sup> National Career Services. 2016. National Classification of Occupations 2015. [https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20\\_Vol%20I-%202015.pdf](https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20_Vol%20I-%202015.pdf). Directorate General of Employment, Ministry of Labour and Employment, Government of India, New Delhi.

<sup>23</sup> Ibid.

- Tool and Diemaker: Tool and Die Makers build, repair and modify custom made prototypes or special tools, Dies, Moulds, Die casting Moulds and various types of mechanical devices.<sup>24</sup>
- 2. Technician / Mechanic; Motor mechanic (Table 7.6): Mechanic, Automobile repairs overhauls and services motor vehicles to keep them in good running condition.<sup>25</sup>
- 3. Power / Microelectronics engineers; AI/ML expert (Table 7.6)
  - Microelectromechanical Systems (MEMS) Engineer: Designing and developing miniature mechanical and electrical devices, such as sensors and actuators, for various applications, including biomedical devices, consumer electronics, and automotive systems.<sup>26</sup>
  - AI/ML expert: In the automotive sector, AI/ML experts develop and implement machine learning models for various applications, from autonomous driving and predictive maintenance to enhancing the driver experience and optimising manufacturing processes.<sup>27</sup>
- 4. Embedded Software Engineers; Vehicle Software Developer (Table 7.6)
  - The Embedded Software Engineer is also called 'Embedded Software Developer', the Embedded Software Engineer is responsible for developing software module for the embedded system. The individual at work assesses the embedded systems' specification requirement, develops software, tests and validates the software in co-ordination with Design Engineers for system integration.<sup>28</sup>
  - A vehicle software developer, or automotive software engineer, designs, develops, and tests software for various vehicle systems, encompassing everything from engine control to infotainment and autonomous driving technologies.<sup>29</sup>
- 5. AI Data Science Engineers; Automotive Cybersecurity Specialist (Table 7.6)

---

<sup>24</sup> Directorate General of Training, Ministry of Skill Development and Entrepreneurship, Government of India. 2022. "Tool & Die Maker (Dies and Moulds)". [https://dgt.gov.in/sites/default/files/2023-12/TDM%20%28D\\_M%29\\_CTS2.0\\_NSQF-4.pdf](https://dgt.gov.in/sites/default/files/2023-12/TDM%20%28D_M%29_CTS2.0_NSQF-4.pdf). July.

<sup>25</sup> National Career Services. 2016. National Classification of Occupations 2015. [https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20\\_Vol%20I-%202015.pdf](https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20_Vol%20I-%202015.pdf). Directorate General of Employment, Ministry of Labour and Employment, Government of India, New Delhi.

<sup>26</sup> Rochester Institute of Technology. [https://www.rit.edu/articles/hot-careers-in-microelectronics#:~:text=Microelectromechanical%20Systems%20\(MEMS\)%20Engineer%3A,consumer%20electronics%2C%20and%20automotive%20systems](https://www.rit.edu/articles/hot-careers-in-microelectronics#:~:text=Microelectromechanical%20Systems%20(MEMS)%20Engineer%3A,consumer%20electronics%2C%20and%20automotive%20systems).

<sup>27</sup> Bharadwaj, C. 2025. "How is AI in Automotive Industry Transforming the Future of Business? Benefits and Use Cases". <https://appinventiv.com/blog/ai-in-automotive-industry/#:~:text=AI%20in%20the%20automotive%20industry%20is%20used%20to%20improve%20vehicle,decisions%20based%20on%20that%20data>. March 21.

<sup>28</sup> National Career Services. 2016. National Classification of Occupations 2015. [https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20\\_Vol%20I-%202015.pdf](https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20_Vol%20I-%202015.pdf). Directorate General of Employment, Ministry of Labour and Employment, Government of India, New Delhi.

<sup>29</sup> Moontechnolabs website. <https://www.moontechnolabs.com/blog/automotive-software-development/#:~:text=Automotive%20software%20development%20is%20pivotal,to%20enabling%20autonomous%20driving%20capabilities>.

- AI Data Science Engineers: Application of Data science and machine learning to the processes and products with automatic learning and optimisation to be used in the automotive industry of the future.<sup>30</sup>
  - Automotive Cybersecurity Specialist: Individuals at this job are responsible for the execution of security processes, the detection of threats and security incidents to devices, automation systems, robots and machineries in the IIOT networks and report to appropriate people for investigation and action. He /She also enhance analytics on security & threat data to improve decision making & data accuracy.<sup>31</sup>
6. Customer relationship manager (NCO: 3322.1101 or ASC/Q1104: Automotive Customer Relationship Manager) /customer care executive (NCO: 5242.0301): This occupation requires personnel to handle customer communication, tends to employ some women, and a locally available workforce at auto workshops across the country is preferred. More than any educational qualification, good communication skills are necessary for this role—reading, writing, speaking, listening, communication, language skills (English, local language), along with skills relating to MS office, problem solving, critical thinking, decision making, time management, value of cultural and gender diversity, positive attitude, emotional stability, and physically fit and cheerful to talk to customers on phone and in-person. It is difficult for the firm to find people with good communication skills, and additionally there is the problem of attrition—resulting in skill gap as well as a shortage. The firm requires 300–400 people for this role, and provides specialised on-the-job training for this role. When asked about any formal automotive training programmes for this role, the firm mentioned that no training centre offers training on the sector skill council’s QP for ‘Automotive Customer Relationship Managers’. This is a gap must be noted for taking forward local skilling initiatives.
  7. EV service technician (NCO: 3115.0602 = ASC/Q1429: Electric Vehicle Service Technician); Battery management system engineer (NCO: 8212.0100 ASC/Q8315: Automotive Battery Management System (BMS) Engineer; ASC/Q8314: Automotive Electric Vehicle BSS (Battery Swapping System) Planning Engineer); Autonomous vehicle engineer/ Automotive IIOT Application Engineer (NCO: 2144.0801 = ASC/Q6412: Automotive IIOT Application Engineer): These job roles were mentioned by stakeholders on the training side, and ASDC has developed QPs for training personnel in these roles. EV technician is for auto service workshops, and engineering roles are at the design and R&D stage. More information with regard to their shortage and firms’ skill requirements can be garnered from interviews with the firms which are hiring personnel in such occupations.

---

<sup>30</sup> Hofmann, Martin & Neukart, Florian & Bäck, Thomas. 2017. “Artificial Intelligence and Data Science in the Automotive Industry”. 10.48550/arXiv.1709.01989.

<sup>31</sup> Automotive Skills Development Council and National Skills Development Corporation. 2024. “Automotive Cyber Security Specialist Quality Pack”. [https://www.asdc.org.in/job-roles-2024/Automotive\\_Cyber\\_security\\_Specialist/ASC\\_Q8313\\_v1.0.pdf](https://www.asdc.org.in/job-roles-2024/Automotive_Cyber_security_Specialist/ASC_Q8313_v1.0.pdf). New Delhi, India.

**Table 7.1: Details of in-demand job roles**

| <b>Job roles</b>                                                       | <b>1) Machine/CNC operator; Turner; Grinder; Tool and die maker</b>                                                                                                                                         | <b>2) Technician / mechanic; Motor mechanic</b>                                                                                 | <b>3) Power / Microelectronics engineers; AI/ML expert</b>                                                                                 | <b>4) Embedded software engineers; Vehicle software developer</b> | <b>5) AI Data science engineers; Automotive cybersecurity specialist</b>                                                                                                                                           |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NCO 3/8-digit                                                          | 722- Blacksmiths, Tool Makers and Related Trades Workers                                                                                                                                                    | 7231.0100: Mechanic, Automobile                                                                                                 | 215- Electrotechnology Engineers                                                                                                           | 2512.0501: Embedded Software Engineer                             | 252- Database and Network Professionals<br>ASC/Q8313: Automotive Cybersecurity Specialist                                                                                                                          |
| NCO 8-digit (QP code) <sup>@</sup>                                     | ASC/Q3503: Automotive CNC Machining Technician<br><br>ASC/Q3510: Automotive Conventional Machining Technician (matched to Turner)<br><br>ASC/Q4101: Automotive Tool Room Technician (matched to tool maker) |                                                                                                                                 | ASC/Q6415: Automotive IIOT Application Specialist                                                                                          |                                                                   | ASC/Q6419: Automotive Data Science Head<br><br>ASC/Q1438: Automotive Dealership Data Analyst<br><br>ASC/Q1440: Automotive Dealership Data Science Specialist<br><br>ASC/Q8313: Automotive Cybersecurity Specialist |
| No. of stakeholders which mentioned this                               | 7                                                                                                                                                                                                           | 6                                                                                                                               | 2                                                                                                                                          | 2                                                                 | 2                                                                                                                                                                                                                  |
| Match from job projections (723, 932, 112, 821, 312 and 311) *         | No                                                                                                                                                                                                          | Yes                                                                                                                             | No                                                                                                                                         | No                                                                | No                                                                                                                                                                                                                 |
| Extent of the need (sum of the numbers from stakeholder consultations) | 15,000 + (now) & 20,000+ (three years from now)                                                                                                                                                             | 15,000 + (now) & 20,000+ (three years from now)                                                                                 | 100 (now) & 150 (3 years from now)                                                                                                         | 400 (now) & 2000 (3 years from now)                               | 300 (now) & 1500 (3 years from now)                                                                                                                                                                                |
| Geography (where?)                                                     | RJ (Alwar), HR (Gurgaon), UK (Rudrapur), MP (Bhopal), GJ (Sanand-Hansalpur), MH (Pune), TN (Hosur), KR (Bangalore), JH (Jamshedpur)                                                                         | Repair & maintenance: At workshops/dealerships across the country, in every city<br>Manufacturing: HR (Gurgaon); GJ (Hansalpur) | MH (Pune); UK (Pantnagar); JH (Jamshedpur); UP (Lucknow); GJ (Sanand); KA (Dharwad); TN (Chennai)                                          | MH, TN(Chennai), KA                                               | TN (Chennai), Delhi NCR, MH (Pune), KA (Bangalore)                                                                                                                                                                 |
| Monthly income (₹)                                                     | ~ 15,000 – 20,000                                                                                                                                                                                           | ~ 15,000 – 20,000                                                                                                               | ~ 1,00,000 – 3,50,000                                                                                                                      | 1,00,000 – 4,00,000                                               | 1,25,000 – 1,70,000                                                                                                                                                                                                |
| Educational qualifications                                             | Diploma /ITI (electrical/ automotive/ fitter) / B.E. (automobile, mechanical or production engineering)                                                                                                     | ITI (motor mechanics)                                                                                                           | B. Tech /M. Tech Engg (Power electronics/ Electrical/ Electronics / Communication / Instrumentation) ; M.Tech/PhD. Engg + AI/ML programmes | B. Tech /M. Tech Engg (Electronics / Computer Science)            | B. Tech /M. Tech Engineering (AI and Data Science; or Computer Science/IT + Cybersecurity Certificate)                                                                                                             |
| Skills required at the                                                 | <b>Cognitive Skills:</b> Reading; writing; speaking;                                                                                                                                                        | <b>Cognitive Skills:</b> Reading; writing; speaking;                                                                            | <b>Cognitive Skills:</b> Reading; writing;                                                                                                 | <b>Cognitive Skills:</b> Reading; writing;                        | <b>Cognitive Skills:</b> Reading; writing;                                                                                                                                                                         |

| <b>Job roles</b>     | <b>1) Machine/CNC operator; Turner; Grinder; Tool and die maker</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>2) Technician / mechanic; Motor mechanic</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>3) Power / Microelectronics engineers; AI/ML expert</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>4) Embedded software engineers; Vehicle software developer</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>5) AI Data science engineers; Automotive cybersecurity specialist</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| competency level (3) | <p>communication skills; language (English/Hindi/local); Numeracy/ Mathematics; Active listening / learning; problem solving; creativity, independent research; time-mgmt; gender diversity;</p> <p><b>Socio-emotional Skills:</b> Conscientiousness; Agreeable; emotional stability; Persuasion Physical skills</p> <p><b>TVET:</b> Work on computers that runs machines involved in manufacturing wiring harness, knowledge of industrial safety (Machine operator in wire harness industry); operate the CNC machine which is numerically computerised, understand component drawing, tolerance, able to read instruments, Vernier caliper, micrometer and air gauges, etc. (CNC operator)</p> | <p>communication skills (communication to supervisors); language (English/Hindi or Local); Numeracy/ Mathematics; Active listening / learning; problem solving; critical thinking; judgement; systems analysis; time mgmt.; diversity; ICT skills, gender diversity</p> <p><b>Socio-emotional Skills:</b> Conscientiousness (punctuality, discipline, target-oriented, workplace etiquette, personal grooming, safety &amp; quality mindset); open to experience; agreeable (teamwork); emotional stability (anger management) Physical skills</p> <p><b>Global competence</b></p> <p><b>TVET:</b> Perform vehicle repair &amp; maintenance, basic knowledge of computers, knowledge of electrical &amp; electronic components (and familiar with high voltage modules), diagnostic tools, assembly operations, component loading &amp; unloading of machines (motor technician), cost consciousness, environmental focus, information security, fire safety, use of personal protective equipment, and <i>familiarity with hydrogen vehicles (future)</i></p> | <p>speaking; communication skills; language (English); Numeracy/ Math (advanced); digital skills; Active listening / learning; science; problem solving; critical thinking; creativity; independent research; judgement; systems analysis/evaluation; resource/time mgmt.; diversity;</p> <p><b>Socio-emotional Skills:</b> Conscientiousness; Agreeable; emotional stability; instructing; negotiation; Persuasion</p> <p><b>TVET:</b> Power electronics engineer: Apply power electronics in auto industry, design power conversion devices (convertors, AC/DC convertors, charges), develop test protocols, analyze performance in lab and in-field; Micro electronics engineer: Apply power electronics in auto industry, design PCB and controllers (every aspect of automobile is controlled by hyper-controllers); AI/ML expert: Knowledge of bringing intelligence into the system (working on sensors, gesture control etc.), develop a training programme in AI/ML which is specific to</p> | <p>speaking; communication skills; language (English); Numeracy/ Math (advanced); digital skills; Active listening / learning; science; problem solving; critical thinking; creativity; independent research; judgement; systems analysis/evaluation; resource/time management; diversity;</p> <p><b>Socio-emotional Skills:</b> open to exp.; conscientiousness; Agreeable; emotional stability; Adaptability</p> <p><b>TVET:</b> Knowledge of automotive software, embedded systems, real-time operating systems, write embedded software (efficient codes) that can run micro controllers, develop and test software for vehicle control systems and diagnostics, Languages: 'C' (C/C++), Python, AUTOSAR, MATLAB</p> | <p>speaking; communication skills; language (English); Numeracy/ Math (advanced); digital skills; Active listening / learning; science; problem solving; critical thinking; creativity; independent research; judgement; systems analysis/evaluation; resource/time management; diversity;</p> <p><b>Socio-emotional Skills:</b> open to exp.; conscientiousness; Agreeable; emotional stability; Adaptability</p> <p><b>TVET:</b> AI Data Science Engineers: Use legacy/big data to predict vehicle diagnostics (for predictable replacement cycles), predict demand to avoid buildup of inventory and cater to emerging demand as well, knowledge and applications of Gen AI, knowledge of 'R' Automotive Cybersecurity Specialist: Analyze and secure automotive systems, security analysis, Fundamental cybersecurity principles and Cybersecurity frameworks, automotive protocols (like CAN), knowledge of security analysis tools, intrusion detection systems</p> |

| <b>Job roles</b>                                                                              | <b>1) Machine/CNC operator; Turner; Grinder; Tool and die maker</b>                                                                                                                                                                                                             | <b>2) Technician / mechanic; Motor mechanic</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>3) Power / Microelectronics engineers; AI/ML expert</b>                                                                                                                                                                                                                                                                                                                                          | <b>4) Embedded software engineers; Vehicle software developer</b>                           | <b>5) AI Data science engineers; Automotive cybersecurity specialist</b> |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
|                                                                                               |                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | automobile sector                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                             |                                                                          |
| Skills Shortage                                                                               | Yes                                                                                                                                                                                                                                                                             | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yes                                                                                                                                                                                                                                                                                                                                                                                                 | Yes                                                                                         | Yes                                                                      |
| Skills Gap                                                                                    | Yes                                                                                                                                                                                                                                                                             | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yes                                                                                                                                                                                                                                                                                                                                                                                                 | Yes                                                                                         | Yes                                                                      |
| Relevance of TVET system                                                                      | No training for wiring/harness industry; Lack of practical experience                                                                                                                                                                                                           | ITI graduates do not have practical experience—do not have knowledge of manufacturing process (casting, welding, machining, painting and Japanese guiding principles of productivity); handling and usage of tools, working on conveyor lines, knowledge of process related defects<br>Lack of training on communication and socio-emotional skills, i.e., they are part of the curriculum but not being taught well<br>ITIs have poor maintenance and upkeep, tools & machines are old/outdated/not working<br>Shortage of Master trainers<br>Little interest from ITIs to allow industry players to set up practical training facility<br>Lack of automotive trades at ITI in particular regions close to auto clusters (e.g., Uttarakhand) | Specialists in the auto sector are needed                                                                                                                                                                                                                                                                                                                                                           | Low availability of specialised training in software development for automotive application | Limited cybersecurity expertise with application in automotive sector.   |
| Gender (Challenges)**                                                                         | Not perceived as a female job both from demand and supply sides                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Entry level challenge is not there but it is harder to retain women in higher positions as other industries offer higher returns and flexibility                                                                                                                                                                                                                                                    |                                                                                             |                                                                          |
| Challenges faced by industries in meeting skill requirements                                  | Incur costs in making the hired workforce industry ready, resulting in longer lead-times; high attrition as workforce does not want to 'work with hands' and demands high salary                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Need demand-supply matching, so that what is needed at industry can be provided by our education system (E.g., Students taking up electrical engineering has seen a drop in the last 5 years, resulting in their shortage. Seeing this fall in demand from students, even the universities have stopped BTech/MTech programs in electrical stream.)                                                 |                                                                                             |                                                                          |
| Industry-specific interventions that facilitate skill & capacity development (best practices) | L&D divisions; Training on the job; Graduate Engineer Trainees; industry-academia collaborations (model ITI)                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Firms are developing engineers for all these roles internally                                                                                                                                                                                                                                                                                                                                       |                                                                                             |                                                                          |
| Policy Recommendations                                                                        | <b>Skill Training Programme:</b> Needs to be expanded; Practical experience with latest machines and technologies, aligned with industry requirements; Model ITI programmes or Dual Vocational Training programmes need to be encouraged; Overcome spatial mismatch in terms of |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Skill Training Programme:</b> Need to be expanded, i.e., more programmes need to be introduced to train people in these fields<br><b>Curriculum Development:</b> Curriculum development needs to take place at all levels of education. curriculum should be updated with industry guidelines<br>Specialised/advanced courses, combining traditional engineering fields (mechanical/ electrical/ |                                                                                             |                                                                          |

| <b>Job roles</b> | <b>1) Machine/CNC operator; Turner; Grinder; Tool and die maker</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>2) Technician / mechanic; Motor mechanic</b> | <b>3) Power / Microelectronics engineers; AI/ML expert</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>4) Embedded software engineers; Vehicle software developer</b> | <b>5) AI Data science engineers; Automotive cybersecurity specialist</b> |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------------|
|                  | where the jobs are and where the skilled workers are (and even training centres)<br><b>Curriculum Development:</b> Curriculum needs to be encouraged with industry guidelines; ITIs equipped with latest technologies, teachers from industry; field visits; improve pedagogy<br><b>Gender:</b> More women at ITI and engineering colleges in relevant trades (hostel facilities; foresee automatic growth with EVs and automation (fewer physical tasks)<br><b>Skill Initiatives:</b> Compulsory OJT components during education/training; involvement of industry trainers for teaching and mentoring (aligning students interests and expectations for better matching and lowering attrition); encouraging women candidates in automotive trades (by awareness on POSH, creche, equal opportunity, etc.); openness to new culture, language, and food may also be included to help people transition to new places and language training |                                                 | electronics/comp. science) with latest cross-cutting technologies such as mechatronics (mechanical+ electronics), power electronics (electrical+ electronics), automotive software & AI/ML (engineering specialised courses in AI/data science with automotive industry in mind); development of soft skills should be integral to the curriculum<br><b>Gender:</b> Creche and flexible working hours<br><b>Skill Initiatives:</b> Academia-industry collaboration where traditional field develop specialisations in the auto sector |                                                                   |                                                                          |

Source: NCAER stakeholder interviews

Notes:

@ Advanced measurement based cutting jobs (Maecotei) (NCO: 3122.4200), painter (NCO: 7132.0201), plastic processing operator (NCO: 8142.1301=ASC/Q4402: Automotive Plastic Moulding Assistant and ASC/Q4401: Automotive Plastic Moulding Technician), operator level in press shop (NCO: 7211.0101= ASC/Q3402: Automotive Press Shop Technician): The findings relating to these male-dominated blue-collar occupations match those reported for Job role no. 1 in the above table (i.e. Machine/CNC operator; Turner; Grinder; Tool and die maker). It is difficult for firms to find trained workers (poor ITI training, no practical experience, and high salary expectations result in both skill gap and skill shortage), and the firms provide on-the job training for each of these roles.

\* This refers to the job roles which are expected to find maximum employment in next three years according to the input-output analysis (see Chapter 3). Pink shade indicates no match between I-O quantitative top 5 occupation projections and survey-based top 5 occupation projections. Green shade indicates a match.

\*\* Current practices to encourage female participation include implementing POSH in establishments; crèche; active look-out for female candidates in manufacturing roles; treat all applications at par; adopt female specific ITI.

## 7.7 Recommended Methodology

Based on the above, the recommended methodology to assess skills shortages and skill gaps for this sector is the following:

1. Map the sub-segments of the sector to the NIC code. Moving forward, it would be a good idea to expand the definition of the automotive sector, to also include the stages of design and R&D, as well as sale of motor vehicles through dealerships, where skill shortages are present. In this report, while the focus was on motor vehicles, the automotive sector is further divided into other sub-sectors namely two-wheelers & three-wheelers.<sup>32</sup>
2. Update mapping of NCO 2015 job roles with job roles identified by the Sector Skill Councils. This should be an annual exercise. For example, the automotive cyber security specialist has a SSC code but no corresponding NCO-2015 code. The NCO needs a more dynamic and regular update of job roles and

<sup>32</sup> Bhandari, B., Pratap, D. and Sahu, A.K. 2022. Contribution to Overall Employment by the Auto Industry: Jobs and Skills Contribution to Overall Employment by the Auto Industry: Jobs and Skills. <https://ncaer.org/publication/contribution-to-overall-employment-by-the-auto-industry-jobs-and-skills/>. NCAER, New Delhi, India. March.



descriptions of jobs. For example, the all the newer job roles in the automotive industry do not find any mention partly because they have evolved in the last one or two years.

3. In coordination with the Ministry of Skill Development and Entrepreneurship, the Sector Skill Council needs to implement surveys on a regular (at least annual) basis, which captures vacancies of firms. The job roles should be mapped/matched with job roles previously identified. Ideally the Economic Census forms the frame for any survey. Given the lack of data, the Ministry of Corporate Affairs' database or Goods and Services Tax Network are the other sources of universal data, from where data may be used to derive the universe. That universe needs to be divided into the sub-sectors as defined previously. Then proper sampling strategy needs to be adopted to understand the validity of the results. Biases needs to be addressed. Response rates should also be estimated.
4. Big Data analysis is highly recommended for SSCs using various job sites.<sup>33</sup> They should also use/assess data from National Career Services and various employment exchanges around the country. The job roles should be mapped/matched with previously identified job roles.

The questionnaires asked respondents of the mediums used for hiring employees. While direct recruitment through job fairs at ITI and campus recruitments from engineering colleges were common, several firms also advertised positions on websites such as LinkedIn, Naukri.com, and Workindia.in and National Career Services. The job details from advertised positions on these portals can help create a good database to understand the kind of job roles which are in demand by the industry along with the corresponding educational qualifications, skill-sets, and salaries. Constant tracking of such data can also help keep the job-roles and skills database dynamic.

5. Stakeholder interactions needs to be carried out as an annual exercise based on templates designed by the MSDE. It will capture jobs which are difficult to fill but also get a holistic view of the sector in terms of emerging technological trends, emerging jobs, detailed qualitative needs for qualifications and skills, hiring practices, best practices of firms, migration trends, practices to encourage female labour force participation, etc.
6. Last but not the least, the MSDE, Ministry of Labour and Employment and Ministry of Statistics and Programme Implementation should design an occupation-wage-employment survey. It is absolutely important to identify the occupation codes mentioned in Step 2. Ideally the Economic Census forms the frame for any survey.

This chapter puts forth the methodology and the instrument which can be useful to gather insights on skill shortages in the automotive sector, and how it may be captured on a dynamic basis. Through the challenges faced in testing out the methodology, the chapter also attempts to present practical solutions to the same. Given the novel nature of the exercise, in-person interviews are recommended at the start. Though, MSDE may consider moving to direct submission of details by the firms

---

<sup>33</sup> Big data should only be used as a 'supplement': As many job roles, especially the core manufacturing job roles which tend to be filled through campus placements from engineering colleges and ITI, may not to be advertised online. They will hence be missed in the big data analysis, despite being in-demand and faced with a skill shortage.

once the Labour Market Information System (LMIS) goes online, and the process of data collection has been regularised and popularised. This direct submission could involve uploading an electronic version of the questionnaire on the MSDE website, which can be accessed by the firms to submit their answers.

Though the usefulness of a labour market information system was acknowledged by the respondents, the workforce will be able to fulfil the skill demands only when the education and skilling ecosystem can keep up with designing their curriculums in the desired manner as well. Having realised this, the sector skill council and industry associations are working towards enhancing industry-academia collaboration. A stakeholder also highlighted the need to ‘empower companies’ and provide the necessary assistance to them to enable them to train their workforce. ITI and engineering colleges must look up to such collaboration possibilities to prepare an industry-ready workforce.

## 8. Electricity: Electric Power Generation using Solar Energy and Other Non-conventional sources

### 8.1 Definition of the Sector

Electricity generation is chosen among the secondary sectors in this study. As defined by the National Industrial Classification (NIC-4 digit), NIC 3510: Electric power generation, transmission and distribution, this sector includes the sub-sectors focussed on the ‘sunrise’ aspects of this sector:

- NIC 35105: Electric power generation using solar energy
- NIC 35106: Electric power generation using other non-conventional sources

### 8.2 Value Chain

Electricity generation using renewable sources has gained importance amid the growing concerns of climate change. In line with the Paris Agreement of 2015, India’s updated Nationally Determined Contribution (NDC) includes achieving 50 per cent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030.<sup>1</sup>

In India, solar and wind energy offer potential for renewable electricity generation. Other non-conventional sources, initially considered for this study, included small-hydro power (SHP) and biogas. It was found through the initial stakeholder meetings that there is limited potential for expansion of SHP, and demand for workforce is low/limited and easily met with the existing supply—resulting in absence of skill shortages for SHP. On the other hand, biogas is neither being used nor is being viewed as a potential source of electricity generation, due to economic unviability. Also, unlike SHP and biogas, India’s installed capacity for solar and wind energy has seen a rising trend over the years (MNRE<sup>2</sup>). Between April 2024 and January 2025, cumulative installed capacity for solar power increased by 18,516.2 MW (i.e., from 81.8 GW to 100.3 GW) and that for wind power increased by 2,478.8 MW (i.e., from 45.9 GW to 48.4 GW).<sup>3</sup>

It must be noted that the target was to reach 175 GW of renewable energy capacity by the year 2022, comprising 100 GW of solar and 60 GW of wind. This target is said to have been missed due to low-installation of solar roof-top and wind energy projects.<sup>4</sup> Now, by 2030, India aims to reach 500GW of installed capacity from non-fossil fuel sources. Attainment of these targets is possible if there is a corresponding

---

<sup>1</sup> India’s updated NDCs: <https://unfccc.int/sites/default/files/NDC/2022-08/India%20Updated%20First%20Nationally%20Determined%20Contrib.pdf>; accessed on 25 July 2024. India achieved 43.8 per cent of electric power installed capacity from non-fossil fuel-based energy by October 2023: <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1987752>

<sup>2</sup> Year wise achievements: <https://mnre.gov.in/year-wise-achievement/>; accessed on 30 July 2024

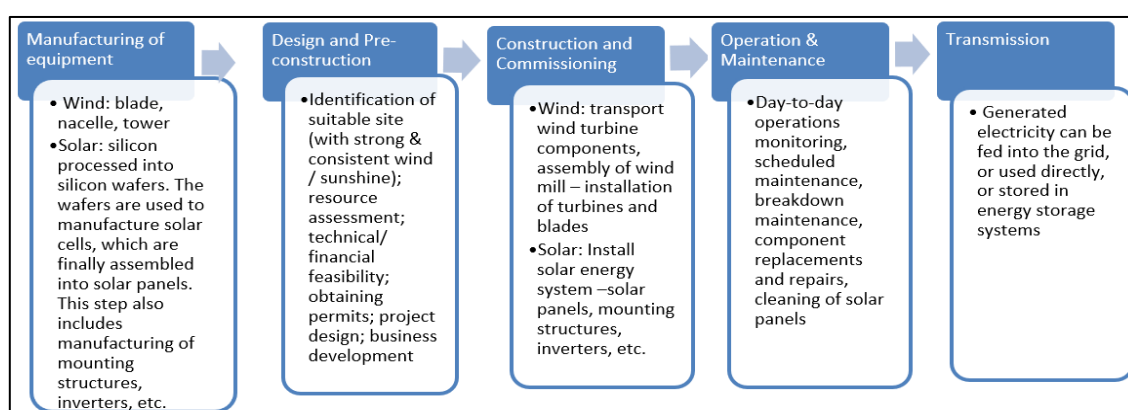
<sup>3</sup> Monthly physical progress: <https://mnre.gov.in/physical-progress/>; accessed on 6 March 2025

<sup>4</sup> <https://www.thehindu.com/sci-tech/energy-and-environment/india-misses-re-capacity-target-due-to-low-solar-rooftop-wind-energy-project-installations-parliamentary-panel/article66646350.ece>; accessed on 6 Sept 2024. Solar rooftop is now being promoted through the PM Surya Ghar Yojana (<https://pmsuryaghar.org.in/>), which is expected to increase the need for solar installers and O&M personnel.

growth of skilled personnel to fulfil the various job roles in the industry. According to an estimate by a recent study<sup>5</sup>, over 3 million new jobs can be created in the solar and wind energy sectors by 2030. Therefore, to capture the in-demand job roles, and the skill shortage thereof, only the sectors of solar and wind electricity have been focused upon.

While limiting the scope to solar and wind electricity generation, the values chains of electric power generated through solar and wind energy are presented below. Manufacturing of solar panels and wind turbines ‘precede’ generation of electricity, and transmission ‘follows’—both of which are outside the scope of the present study. Though technological changes are occurring within the manufacturing and transmission stages of the value chain, with regard to higher efficiency solar modules and wind turbines, and use of the electricity generated to produce green hydrogen.<sup>6</sup>

**Figure 8.1: Electric power generation using solar and wind energy**



Source: NCAER compilation, adapted from Ghosh et al. 2016<sup>7</sup> and SCGJ 2016.<sup>8</sup>

<sup>5</sup> CEEW, NRDC and SCGJ (2022). India’s Expanding Clean Energy Workforce: Opportunities in the Solar and Wind Energy Sectors. Available at: <https://www.ceew.in/publications/indias-expanding-clean-energy-workforce>; accessed on 8 July 2024

<sup>6</sup> Given the Governments’ Green Hydrogen Mission and the associated need for skills in the sector, Skill Council for Green Jobs has introduced several qualification packs for green Hydrogen, including Green Hydrogen Plant Entrepreneur, Green Hydrogen Plant Technician, Green Hydrogen Plant Junior Technician—Desalination, Green Hydrogen Plant Junior Technician- Electrolyser, Green Hydrogen Plant Junior Technician—Power Sources, and Green Hydrogen Plant Junior Technician—Storage.

<sup>7</sup> Design and pre-construction: design of the project. Direct employment includes jobs for designers, planners, architects, engineers (non-installers), resource analysts, and legal personnel. Construction and commissioning: actual installation of the project and setting up a connection to the national power grid. Direct jobs created for construction workers, electricians, technicians, engineers, meteorologists, and technicians working for equipment vendors (such as inverter suppliers). Both skilled and unskilled workers are required during this phase. Operations and maintenance create direct jobs for technicians, electricians, maintenance and security staff, and operations managers. Both skilled and unskilled workers are required to carry out O&M in the plant. Business development involves steps taken to develop a specific project, as well as ongoing efforts to promote business. Direct employment generated includes jobs in sales, marketing, legal, financial, and government/regulatory affairs (Ghosh et al. 2016. *Filling the Skill Gap in India’s Clean Energy Market-Solar Energy Focus*. New Delhi; New York: Council on Energy, Environment and Water and Natural Resources Defense Council).

<sup>8</sup> SCGJ 2016. Skill Gap Report for Solar, Wind and Small Hydro Sector. Skill Council for Green Jobs, September 2016.

With electricity generation being the focus of this study, it covers activities involving engineering–procurement–construction, i.e., EPC (involving design and pre-construction, construction and commissioning), operation and maintenance, and business development (Figure 8.1). With technological changes, personnel involved in EPC and O&M will be required to install, and operate and maintain higher efficiency solar modules and wind turbines, but also keep up with automated O&M and cleaning of solar panels (instead of manual cleaning), data analytics for interpreting and predicting wind turbine performance, software to read and forecast solar and wind data, and setting up off-shore wind power plants in India.<sup>9</sup>

### 8.3 Workforce Characteristics

- a. **Females:** 17 per cent of the workforce are females in the sector ‘electric power generation using solar energy’. This 17 per cent belongs to two States—Karnataka and Maharashtra. In the former, 40.4 per cent of the workers are females and in Maharashtra the corresponding number is 30.4 per cent. Female Labour Force Participation (LFP) is zero in case of electric power generation using other non-conventional sources.<sup>10</sup>
- b. **States:** Figure 8.2 shows employment generated in renewable electricity generation, across the different States of India. According to the PLFS data (2022–23):
  - Maximum share of workers employed in Electric power generation using solar energy are located in Maharashtra, Tamil Nadu, and Karnataka. 73.4 per cent of workers in this sector are only from these three States.
  - Maximum share of workers in electric power generation using other non-conventional sources, are located in Maharashtra, Tamil Nadu, and Chhattisgarh. 73.6 per cent of workers in this sector are concentrated in Maharashtra and Tamil Nadu.

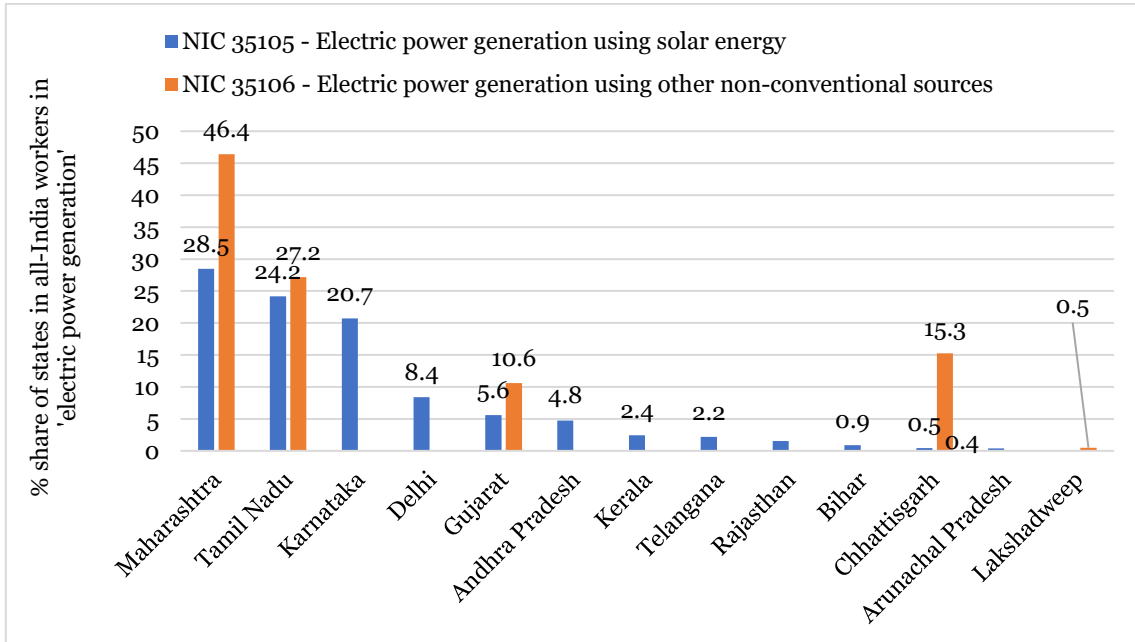
---

<sup>9</sup> Goswami, S. 2023. “India only has on-shore wind projects. Off-shore wind energy is currently being explored”. Moneycontrol.com <https://www.moneycontrol.com/news/business/indias-first-offshore-wind-projects-to-come-up-across-tamil-nadu-coast-11446851.html>. September 28.

National Institute of Wind Energy website.  
[https://niwe.res.in/department\\_wra%260\\_offshore\\_fowind.php](https://niwe.res.in/department_wra%260_offshore_fowind.php) ; accessed on 6 July 2024

<sup>10</sup> The finding of no women workers is based on PLFS data for 2022–23 (which was the latest available data at the time the secondary analysis was being conducted). Now with the release of PLFS data for 2023–24, it is noticed that there are some women employed in the sector ‘electric power generation using other non-conventional sources’, comprising 10 per cent of the sector’s workforce, in the state of Himachal Pradesh.

**Figure 8.2: Green energy workers (aged 15+) are concentrated in 13 States, 2022–23(%)**

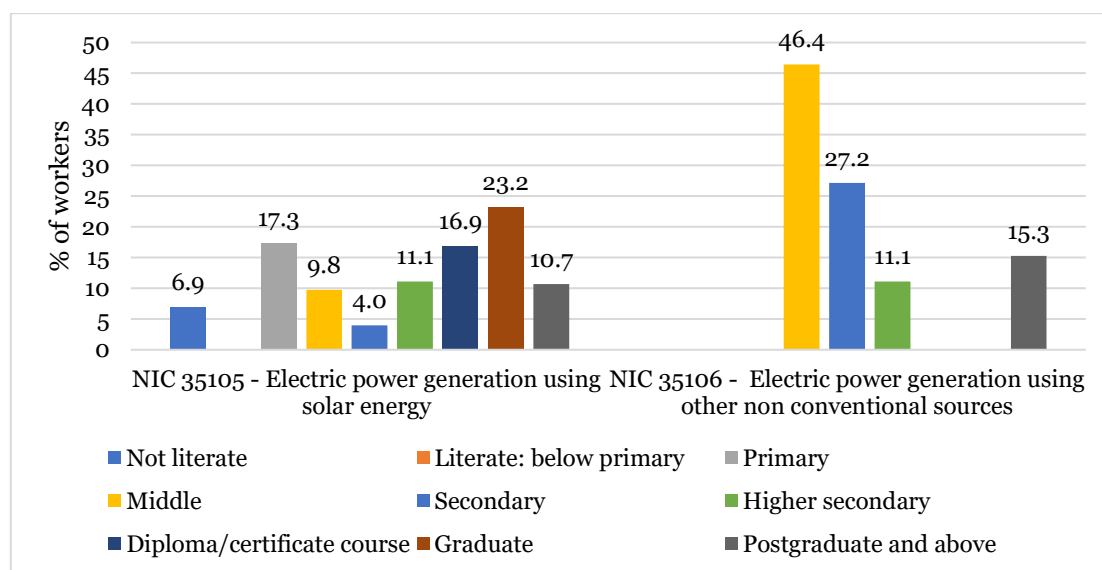


Source: NCAER analysis using PLFS data 2022–23.

c. **Education:** When analysed across levels of education (Figure 8.3), majority of workers involved in:

- Electric power generation using solar energy are graduates
- Electric power generation using other non-conventional sources are educated until middle school. But 27 per cent of workers have also attained secondary school education and 15 per cent of workers are post-graduates.
- Technical Education
  - 75 per cent of workers in electric power generation using solar energy do not have technical education. 8.1 per cent of workers have technical degree in: engineering/ technology, 6.7 per cent of workers have diploma or certificate (below graduate level): engineering/technology and 10.2 per cent of workers have diploma or certificate (below graduate level): other subjects.
  - 100 per cent of workers do not have technical education in the sub-sector, 'electric power generation using other non-conventional sources'.
- Vocational Education
  - 3.6 per cent of workers in electric power generation using solar energy have received formal vocational education and 20.5 per cent non-formal vocational education.
  - 100 per cent of workers have not received any formal vocational education in the sub-sector, 'electric power generation using other non-conventional sources' but 72.3 per cent of workers have received non-formal vocational education.

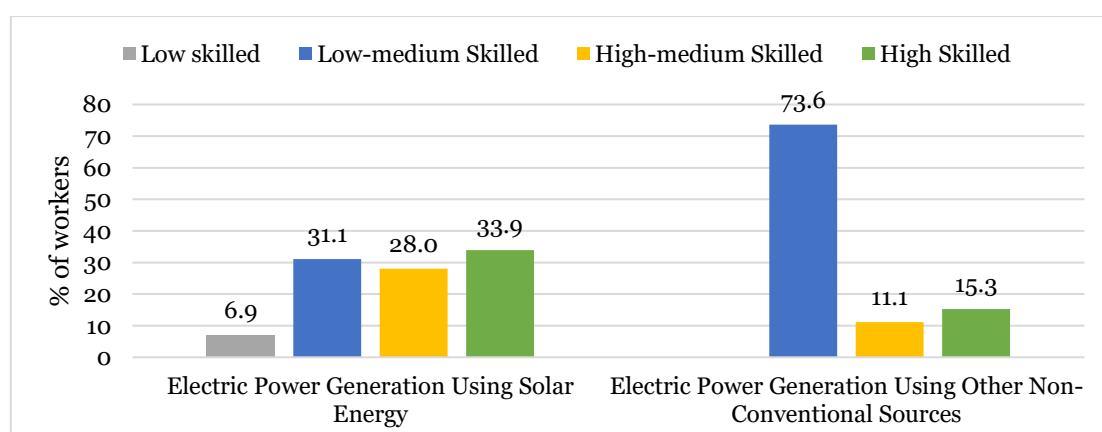
**Figure 8.3: General education of workers (aged 15+) engaged in electric power generation using solar energy, and electric power generation using other non-conventional sources, 2022–23 (%)**



Source: NCAER analysis using PLFS data 2022–23.

- d. **Skills:** Aligned with the levels of education, majority of workers involved in (Figure 8.4).
- Electric power generation using solar energy are high skilled.
  - Electric power generation using other non-conventional sources are low-medium skilled.

**Figure 8.4: Skill-level of workers (aged 15+) engaged in electric power generation using solar energy, and electric power generation using other non-conventional sources, 2022–23 (%)**



Source: NCAER analysis using PLFS data 2022–23 (see Annexure 4.2 for definition of skills).

- e. **Across Occupations:** In renewable electricity generation, workers are involved in several occupations. Certain occupations however stand-out, give the relatively large number of workers engaged in them (Table 8.1). For instance:

- Majority of workers in Electric power generation using solar energy (NIC 35105) are Protective Service Workers (30 per cent) and Electrical Equipment Installers and Repairers and keyboard Operators (both 12 per cent).
- Majority of workers in Electric power generation using other non-conventional sources (NIC 35106) are Manufacturing Labourers (46 per cent).

**Table 8.1: Green energy workers by their occupations, 2022–23 (%)**

| <i>Occupation Description</i>                            | <i>Number of Workers<br/>(Males + Females)</i> |              | <i>% Share of each job role<br/>in the industry</i> |              |
|----------------------------------------------------------|------------------------------------------------|--------------|-----------------------------------------------------|--------------|
|                                                          | <i>35105</i>                                   | <i>35106</i> | <i>35105</i>                                        | <i>35106</i> |
| Business Services and Administration Managers            | 6,203                                          | 0            | 8                                                   | 0            |
| Engineering Professionals (excluding Electro-technology) | 3,263                                          | 0            | 4                                                   | 0            |
| Finance Professionals                                    | 2,951                                          | 0            | 4                                                   | 0            |
| Sales, Marketing and Public Relations Professionals      | 4,179                                          | 0            | 6                                                   | 0            |
| Mining, Manufacturing and Construction Supervisors       | 1,651                                          | 2245         | 2                                                   | 15           |
| Administrative and Specialised Secretaries               | 1,792                                          | 0            | 2                                                   | 0            |
| General Office Clerks                                    | 2,948                                          | 3995         | 4                                                   | 27           |
| Keyboard Operators                                       | 8,934                                          | 0            | 12                                                  | 0            |
| Numerical Clerks                                         | 50                                             | 0            | 0                                                   | 0            |
| Other Clerical Support Workers                           | 3,154                                          | 0            | 4                                                   | 0            |
| Other Sales Workers                                      | 6,200                                          | 0            | 8                                                   | 0            |
| Protective Service Workers                               | 22,588                                         | 0            | 30                                                  | 0            |
| Electrical Equipment Installers and Repairers            | 8,611                                          | 0            | 12                                                  | 0            |
| Car, Van and Motorcycle Drivers                          | 0                                              | 1561         | 0                                                   | 11           |
| Manufacturing Labourers                                  | 1,618                                          | 6824         | 2                                                   | 46           |
| Other Elementary Workers                                 | 0                                              | 74           | 0                                                   | 1            |
| Grand Total                                              | 74,143                                         | 14,698       | 100                                                 | 100          |

Source: NCAER analysis using PLFS data 2022–23.

- f. **Engagement Status:** In the sector electrical power generation using solar energy, 99 per cent of workers are regular-wage employees. In the sector electric power generation using other non-conventional sources, 100 per cent of the workers are regular wage employees (Table 8.2).



**Table 8.2: Engagement status of workers (%)**

| <b>All Workers (aged 15+)</b>                                  |                                   |                      |                                                                                       |                                                    |                                   |              |
|----------------------------------------------------------------|-----------------------------------|----------------------|---------------------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------|--------------|
| <b>Self-employed</b>                                           |                                   |                      |                                                                                       |                                                    |                                   |              |
|                                                                | <b>Own<br/>account<br/>worker</b> | <b>Employ<br/>er</b> | <b>Worked as<br/>helper in h.h.<br/>enterprise<br/>(unpaid<br/>family<br/>worker)</b> | <b>Regular<br/>salaried/<br/>wage<br/>employee</b> | <b>Casual<br/>Wage<br/>Labour</b> | <b>Total</b> |
| Electric power generation using solar energy                   | 0.9                               | 0.0                  | 0.0                                                                                   | 99.1                                               | 0.0                               | 100.0        |
| Electric power generation using other non-conventional sources | 0.0                               | 0.0                  | 0.0                                                                                   | 100.0                                              | 0.0                               | 100.0        |
| <b>All Male Workers (aged 15+)</b>                             |                                   |                      |                                                                                       |                                                    |                                   |              |
| Electric power generation using solar energy                   | 1.1                               | 0.0                  | 0.0                                                                                   | 98.9                                               | 0.0                               | 100.0        |
| Electric power generation using other non-conventional sources | 0.0                               | 0.0                  | 0.0                                                                                   | 100.0                                              | 0.0                               | 100.0        |
| <b>All Female Workers (aged 15+)</b>                           |                                   |                      |                                                                                       |                                                    |                                   |              |
| Electric power generation using solar energy                   | 0.0                               | 0.0                  | 0.0                                                                                   | 100.0                                              | 0.0                               | 100.0        |
| Electric power generation using other non-conventional sources | 0.0                               | 0.0                  | 0.0                                                                                   | 0.0                                                | 0.0                               | 0.0          |

Source: NCAER analysis from PLFS 2022–23.

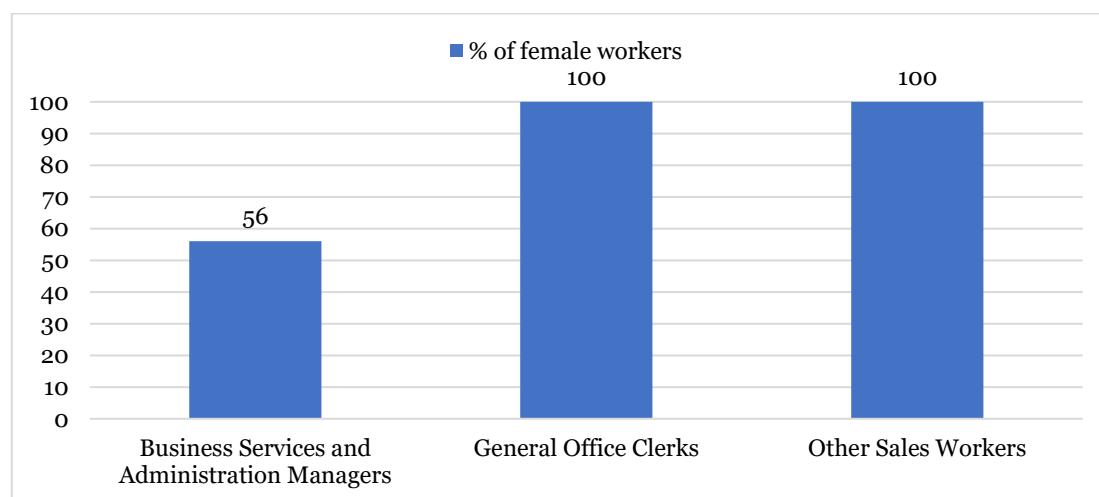
- g. ***Concentration of Females in Specific Job Roles:*** There are no women workers captured in the PLFS data who are employed in Electric power generation using other non-conventional sources. Therefore, all occupations within this sector only employ men. This finding of no women workers is based on PLFS data for 2022–23 (which was the latest available data at the time the secondary analysis was being conducted). Now with the release of PLFS data for 2023–24, it is noticed that there are some women employed in the sector ‘electric power generation using other non-conventional sources’, comprising 10 per cent of the sector’s workforce. Although these women are found to be engaged in only one occupation within this sector, that of ‘General Office Clerks’. Rather all general office clerks are women.

While there are very few women employed in the solar electricity generation, these too are concentrated in specific job roles, in particular occupations such as General Office Clerks and Other Sales Workers only have women. Among all Business Services and Administration Managers, more than 56 per cent are women (Figure 8.5).

According to the PLFS data, there are no women employed in any other occupation in this sector. It is therefore evident that women are employed in

job roles which ‘support’ the core activities of solar electricity generation, considering that the ‘core’ occupations, which have the largest share of workers, i.e., Protective Service Workers and Electrical Equipment Installers and Repairers, only have men engaged in them. Keyboard Operators—a support occupation which too employs a large share of workers — has no women worked engaged in it.

**Figure 8.5: Percentage of female workers (aged 15+) across job roles in green energy (%), 2022–23**



Source: NCAER analysis using PLFS 2022–23 data.

## 8.4 Geographical Clusters

In the electricity sector, the study’s focus is on electricity generation using solar and wind energy. Clusters of plants dedicated to generating electricity using either of the renewable sources is governed by the renewable energy potential of the geographic region. For instance, potential for solar and wind electricity will be higher in regions with greater duration and intensity of sunlight and wind. Solar and wind plants will be set up only in places where there is ample sunshine and wind to generate energy.

Firms will bid for tenders for setting plants of a particular installed capacity. Size of firms cannot be linked with size of plant.

Stakeholders (industry associations, SSC, training partners) connect geographical clusters, i.e., no. of projects, with State-level installed capacity (SCGJ 2016).<sup>11</sup> Therefore, departing from the standard Porter model, data on both on number of plants and installed capacity is used to assess rankings, and thereby clusters. The Central Electricity Authority (CEA) and Ministry of New and Renewable Energy (MNRE)<sup>12</sup> provide State-level data on installed capacity and generation of renewable electricity, helping identify the relevant States where there is focus on renewable electricity generation. Plant level information, though available with CEA,<sup>13</sup> is

<sup>11</sup> SCGJ 2016. Skill Gap Report for Solar, Wind and Small Hydro Sector. Skill Council for Green Jobs, September 2016

<sup>12</sup> MNRE Annual Reports: <https://mnre.gov.in/annual-report/>; accessed on 15 May 2024.

<sup>13</sup> Available at: <https://cea.nic.in/renewable-generation-report/?lang=en>; accessed on 15 May 2024.

incomplete as it includes only inter-state generating stations (ISGS) and central public sector units (CPSU).

An interactive portal, India Climate and Energy Dashboard,<sup>14</sup> developed by the NITI Aayog is a useful source to gather State and district-level information on all existing and proposed renewable and non-conventional energy plants (i.e., units), as well as their operational capacity. It may be noted that the data available from the NITI Aayog dashboard has been used after due cross-verification with other official government sources, particularly the Ministry of New and Renewable Energy (MNRE). In particular, state-level installed capacity of all renewable energy sources (which was arrived at by summing the installed capacity of NITI Aayog's plant-level data, as on 31<sup>st</sup> March 2024), matches the State-wise installed capacity data released by MNRE.

District-level data is useful to identify the exact location of the energy plant, but it has not been useful in determining the concentration of plants by district, since most districts only have one or two plants. State-level data has therefore been used for identification of clusters of solar and wind energy plants (Table 8.3).

**Table 8.3: Geographical concentration of solar and wind energy generation, as on 31 March 2024**

| <i>Solar Electricity Generation</i> |                                               |                                             |                     | <i>Wind Electricity Generation</i> |                                               |                                             |                     |
|-------------------------------------|-----------------------------------------------|---------------------------------------------|---------------------|------------------------------------|-----------------------------------------------|---------------------------------------------|---------------------|
| <i>State</i>                        | <i>Rank using Operational units (Numbers)</i> | <i>Rank using Operational Capacity (MW)</i> | <i>Average Rank</i> | <i>State</i>                       | <i>Rank using Operational units (Numbers)</i> | <i>Rank using Operational Capacity (MW)</i> | <i>Average Rank</i> |
| Gujarat                             | 2                                             | 2                                           | 2                   | Gujarat                            | 2                                             | 1                                           | 1.5                 |
| Karnataka                           | 1                                             | 3                                           | 2                   | Tamil Nadu                         | 1                                             | 2                                           | 1.5                 |
| Rajasthan                           | 4                                             | 1                                           | 2.5                 | Karnataka                          | 2                                             | 3                                           | 2.5                 |
| Tamil Nadu                          | 2                                             | 4                                           | 3                   | Maharashtra                        | 4                                             | 4                                           | 4                   |
| Andhra Pradesh                      | 5                                             | 7                                           | 6                   | Rajasthan                          | 5                                             | 5                                           | 5                   |
| Maharashtra                         | 8                                             | 5                                           | 6.5                 | Madhya Pradesh                     | 5                                             | 7                                           | 6                   |
| Madhya Pradesh                      | 5                                             | 8                                           | 6.5                 | Andhra Pradesh                     | 7                                             | 6                                           | 6.5                 |
| Uttar Pradesh                       | 5                                             | 9                                           | 7                   | Kerala                             | 8                                             | 9                                           | 8.5                 |
| Telangana                           | 12                                            | 6                                           | 9                   | Telangana                          | 9                                             | 8                                           | 8.5                 |
| Punjab                              | 10                                            | 11                                          | 10.5                | Others                             | 10                                            | 10                                          | 10                  |
| Haryana                             | 14                                            | 10                                          | 12                  |                                    |                                               |                                             |                     |
| Odisha                              | 11                                            | 15                                          | 13                  |                                    |                                               |                                             |                     |
| Chhattisgarh                        | 15                                            | 12                                          | 13.5                |                                    |                                               |                                             |                     |
| Delhi                               | 13                                            | 16                                          | 14.5                |                                    |                                               |                                             |                     |
| Uttarakhand                         | 17                                            | 14                                          | 15.5                |                                    |                                               |                                             |                     |
| Kerala                              | 19                                            | 13                                          | 16                  |                                    |                                               |                                             |                     |
| West Bengal                         | 15                                            | 18                                          | 16.5                |                                    |                                               |                                             |                     |
| Bihar                               | 17                                            | 17                                          | 17                  |                                    |                                               |                                             |                     |
| Jharkhand                           | 19                                            | 19                                          | 19                  |                                    |                                               |                                             |                     |
| Assam                               | 21                                            | 20                                          | 20.5                |                                    |                                               |                                             |                     |
| Arunachal Pradesh                   | 9                                             | 32                                          | 20.5                |                                    |                                               |                                             |                     |
| Himachal Pradesh                    | 23                                            | 21                                          | 22                  |                                    |                                               |                                             |                     |
| Chandigarh                          | 23                                            | 22                                          | 22.5                |                                    |                                               |                                             |                     |
| Jammu and Kashmir                   | 23                                            | 23                                          | 23                  |                                    |                                               |                                             |                     |
| Puducherry                          | 23                                            | 24                                          | 23.5                |                                    |                                               |                                             |                     |
| Goa                                 | 23                                            | 26                                          | 24.5                |                                    |                                               |                                             |                     |
| Daman and Diu                       | 23                                            | 27                                          | 25                  |                                    |                                               |                                             |                     |
| Mizoram                             | 23                                            | 28                                          | 25.5                |                                    |                                               |                                             |                     |

<sup>14</sup> Data can be viewed and downloaded from: <https://iced.niti.gov.in/energy/electricity/generation>; accessed on 15 May 2024.

| <b>Solar Electricity Generation</b> |                                                           |                                                             |                         | <b>Wind Electricity Generation</b> |                                                           |                                                         |                         |
|-------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------|-------------------------|------------------------------------|-----------------------------------------------------------|---------------------------------------------------------|-------------------------|
| <b>State</b>                        | <b>Rank using<br/>Operational<br/>units<br/>(Numbers)</b> | <b>Rank<br/>using<br/>Operational<br/>Capacity<br/>(MW)</b> | <b>Average<br/>Rank</b> | <b>State</b>                       | <b>Rank using<br/>Operational<br/>units<br/>(Numbers)</b> | <b>Rank using<br/>Operational<br/>Capacity<br/>(MW)</b> | <b>Average<br/>Rank</b> |
| Andaman and Nicobar Islands         | 22                                                        | 29                                                          | 25.5                    |                                    |                                                           |                                                         |                         |
| Tripura                             | 23                                                        | 30                                                          | 26.5                    |                                    |                                                           |                                                         |                         |
| Manipur                             | 23                                                        | 31                                                          | 27                      |                                    |                                                           |                                                         |                         |
| Across India                        | 38                                                        | 25                                                          | 31.5                    |                                    |                                                           |                                                         |                         |
| Ladakh                              | 32                                                        | 33                                                          | 32.5                    |                                    |                                                           |                                                         |                         |
| Sikkim                              | 32                                                        | 34                                                          | 33                      |                                    |                                                           |                                                         |                         |
| Dadra and Nagar Haveli              | 32                                                        | 35                                                          | 33.5                    |                                    |                                                           |                                                         |                         |
| Lakshadweep                         | 32                                                        | 36                                                          | 34                      |                                    |                                                           |                                                         |                         |
| Meghalaya                           | 32                                                        | 37                                                          | 34.5                    |                                    |                                                           |                                                         |                         |
| Nagaland                            | 32                                                        | 38                                                          | 35                      |                                    |                                                           |                                                         |                         |

Sources: Ministry of New and Renewable energy (MNRE); India Climate and Energy Dashboard, NITI Aayog.

Note: 'Operational capacity' refers to installed capacity.

Gujarat, Karnataka, Rajasthan, and Tamil Nadu are the key clusters at the State-level. The mapping between shares of labour force and concentration of generation units is not reported here to due to mismatch. While generation of solar energy is taking place in almost all States to some extent, the PLFS data shows that the workers are concentrated in barely 12 States. Box 8.1 elaborates on the reasons behind the data mismatch.

### **Box 8.1: Note on data mismatch between solar and wind clusters and associated presence of workers**

Renewable electricity generation is a sunrise sector, which is expanding at a fast pace. Within the last decade (March 2014 – March 2024), the installed capacity of wind power increased by 24 GW, and that of solar power by 80 GW (MNRE).

The geographic clusters of solar and wind power have been identified using State-wise data on number of plants and installed capacity. However, the data with regard to availability State-level renewable power plants and installed capacity, i.e., the identified clusters, does not match with the PLFS data on State-wise number of workers employed in renewable electricity generation. There can be several reasons to explain this discrepancy.

#### **1. Relocation or Migration of Workers in the Industry**

Renewable energy projects are located in remote areas, where the early stages of plant development—including design, pre-construction, construction, installation, commissioning—involve short term relocation / migration of workers and employees of a developer firm or a contractor to the site location. Once the plant has been set up, workers are employed in operation and maintenance (O&M), which provides long-term employment at plant location. Through our stakeholder interactions it has been learned that local people are hired for O&M related jobs, but involvement of migrant workers is also likely.

PLFS is a household survey and it selects the households randomly within the sample areas. If in an industry located in the same sample area hires migrant workers from other areas, and they are accommodated within the plant, they will not be captured in the survey. Therefore, the presence of renewable power units and capacity in a State, but evidence of no workers involved in renewable power industry, becomes a possibility.

Another factor is ‘daily migrants’ working in an industry in a sample area. In the industries present in inter-state border areas, workers may be residing in one State, but working in another State. Data for such workers will be captured in states in which they are residing rather than in the States where they are working.

#### **2. Time Period of Data Availability**

The identification of clusters using plant and installed capacity data is as of 31 March 2024. However, the PLFS data is for 2022–23. It is important to note that just between 2022–23 and 2023–24, operational capacity of solar power increased by 2249.44 MW and of wind power by 977.83 MW (MNRE).

#### **3. Definition of Industry**

Given the scope of renewable electricity generation for this study, PLFS captures data for workers involved in ‘electric power generation using solar energy’ and ‘electric power generation using other non-conventional sources’. While keeping in view the sources of discrepancy highlighted earlier, another discrepancy for wind power also emerges from the fact that PLFS data does not specifically capture the number of workers associated with electric power generation using wind energy. Rather, it is clubbed along with data for other non-conventional sources, and can hence be misleading.

#### **Alternative methods**

An alternative way of analysing workers in a particular industry is studying the plant level data captured by the Annual Survey of Industries (ASI) and the Enterprise Survey (ES), for organised and unorganised industries respectively. In this case, workers will be included in the sample area where the plant is located and not where they are residing. Here presence of workers in an industry should be commensurate with where ‘clusters’ for that industry are located. This may hold for the established sectors where frequent changes/revolutions are not taking place. However, in the sectors which is seeing frequent and fast transitions, just as the renewable power sector, even ASI and ES may not be able to capture presence of clusters and related workers in a sample area—primarily because the data is dated.

While this data could be valid for some amount of time (like 5 years) in normal circumstances, but in the fast changing sunrise sectors this may not be the case. In the case of green energy (solar and wind), latest years’ generation/installed capacity figures for a sample area may not match with information on workers in that sample area—because ASI/ES data will be for a period that is already two to three years in the past.

This makes the need of adopting multiple approaches for studying the presence of clusters and associated workers for an industry, be it at the State or district level. To have the latest view of the industry at the State/ district level, expert consultations and primary scoping surveys should also be considered to supplement the industrial data available through secondary sources.

## 8.5 Occupational Maps

The National Classification of Occupations (NCO) are occupations in which workers are employed within the respective green electricity generation sector, according to the periodic labour force survey (PLFS) data. There are no stand-alone NCOs for wind electricity generation, and hence these are covered under the NCOs for electricity generation using ‘other non-conventional’ sources. NCAER has mapped and supplemented these occupations with the job roles from Skill Council for Green Jobs (SCGJ) for a complete occupational mapping of the sector (Annexures 8.1 and 8.2). The latter has been useful for incorporation of new job roles which have emerged over the years, since NCO occupations (2015) are dated.

## 8.6 Stakeholders’ Survey

The scope of the electricity generation sector included the generation of electricity using solar power and other non-conventional sources. To assess skill shortages in the sector, a variety of stakeholders were contacted, including the sector skill council, industry associations, skilling institutions, firms, and experts and other stakeholders.<sup>15</sup> This section provides the methodology adopted to assess skill shortage in the sector, determine specific job roles in which firms are faced with a shortage at present and are likely to face a shortage in next three years, and the reasons thereof. Based on the findings, suggestions to carry forward the exercise have been provided.

### 8.6.1 Sampling

Data from the Ministry of New and Renewable Energy (MNRE) and NITI Aayog helped identify solar and wind energy clusters, i.e., States where there are a large number of plants and high installed capacity, and where both are fewer. Given that the present stage of the study only involved reaching out to a small sample of firms, it was considered useful to have a spatial spread of renewable energy plants in the choice of firms (a firm can have several solar and wind plants)—to capture any regional variation in skill shortage.

In the solar electricity sector, it was attempted to interview firms with solar plants in Rajasthan and Gujarat (given the high installed capacity and number of solar plants), and Madhya Pradesh and Chhattisgarh (given the potential solar capacity and plants). In the wind electricity sector, it was decided to target firms with wind farms in Tamil Nadu and Gujarat (given the high installed capacity and number of wind plants), and Karnataka and Maharashtra (given the potential wind capacity and plants). To understand if skill shortage varied by firm size, it was also attempted that firms operating across the selected regions are of different sizes.

---

<sup>15</sup> In line with the study’s agenda, interviews involve meetings with 25 stakeholders, including the sector skill council (1 no.), industry association (1), training centres (2), firms (20), and a recruitment agency. Depending on the scope of the sector and stakeholder availability, these numbers have varied in practice. For instance, instead of one industry association, NCAER has met with two industry associations, to cover solar and wind electricity generation. Meeting industry experts, belonging to other national/regional associations and firms, has also been insightful to understand the issues of skill shortages. As of 8 Nov. 2024, NCAER has met with sector skill council (1), industry associations (2), training centres (2), firms and industry experts (20), recruitment agency (1) – taking the total stakeholder meetings to 26.

To achieve an ideal sample, it is necessary to have a comprehensive list of all the firms in solar and wind electricity generation in India<sup>16</sup> (independent power producers (IPP), developers, and firms offering design, installation and operations & maintenance (O&M) services such as original equipment manufacturers (OEM) and independent service providers), along with: details of their size, renewable energy focus, project types (e.g., solar rooftop/residential, utility scale, commercial and industrial), work phases they are engaged in, where their plants are located, as well as a guarantee that personnel at the chosen firms are willing to meet to discuss the issue of skill shortages. Amidst a glaring lack of such data, NCAER tried to seek help from the stakeholders (in particular the sector skill council and the industry associations), and also tried to reach out to any contacts available on the internet and known prior contacts.

A total of 63 firms were contacted over email and telephone, of which personnel from only 14 firms have met to discuss skill shortages, resulting in a response rate of 22.2 per cent. Response rate tends to be low in business surveys. Yet, NCAER has been successful in ascertaining a spatial spread in firms' plant locations for solar and wind projects, as well as in conducting interviews with firms of different sizes. In addition to the firms who have provided their insights to the questionnaire, expert consultations with personnel from some other firms and industry members have also been useful in supplementing the findings (Table 8.4).

---

<sup>16</sup> As was learnt during the stakeholder interactions, there are three types of players: IPP, OEM, and Developer. i) IPP is on the commercial and fundraising side (primarily finance and business development); ii) OEM is technology-oriented and manufactures the equipment (E.g., Vesta, GE, Suzlon); O&M too is usually by the OEM; iii) The developer facilitates the IPP and OEM: It finds potential land to build solar and wind plant, ensuring nearest grid connectivity, involving stages of design and pre-construction and construction. While the above may be broadly applicable, the distinctions on the extent to which each type of firm is involved in a project is not as clear-cut. For instance, IPPs will tend to have O&M Supervisors / Managers on plant location and have increased their capabilities over the years to also develop and maintain their plants. An OEM may only be manufacturing and not engaging with O&M at all. Smaller IPPs (for which developing and maintaining is costly) may bring in an OEM to do everything.



**Table 8.4: Stakeholder consultations**

| Stakeholders (No.)                       |              |             | Location of Firms (No.) |   | Ownership Type (No. of Firms)    |    | Designation of Interviewees (No. of Interviewees *)                |   |
|------------------------------------------|--------------|-------------|-------------------------|---|----------------------------------|----|--------------------------------------------------------------------|---|
| Ministry                                 |              | No response | Delhi                   | 2 | Public Sector                    | 0  | Human Resource/Learning & Development Managers/Director (Training) | 6 |
| Sector Skill Council                     |              | 1           | Karnataka               | 3 | Public Limited                   | 3  | Managing Director/CEO                                              | 4 |
| National-level Industry Association      |              | 2           | Madhya Pradesh          | 1 | Private Limited                  | 10 | General Manager/Senior Manager                                     | 9 |
| No. of Firms                             | Micro/ Small | 3           | Maharashtra             | 3 | Individual Ownership/Partnership | 0  | Vice-President                                                     | 1 |
|                                          | Medium       | 4           | Tamil Nadu              | 3 | MNC                              | 1  |                                                                    |   |
|                                          | Large        | 7           | Telangana               | 1 | Limited Liability Partnership    | 0  |                                                                    |   |
|                                          | Total        | 14          | Uttar Pradesh           | 1 | Cooperatives                     | 0  |                                                                    |   |
| No. of Placement Cells/TVET Institutions |              | 2           |                         |   | Others                           | 0  |                                                                    |   |
| Recruitment Agencies                     |              | 1           |                         |   |                                  |    |                                                                    |   |
| Other Stakeholders                       |              | 6           |                         |   |                                  |    |                                                                    |   |
| Firms plus Other Stakeholders            |              | 20          |                         |   |                                  |    |                                                                    |   |
| Total                                    |              | 26          |                         |   |                                  |    |                                                                    |   |

Source: NCAER Survey

Note: \* NCAER team attempted to speak with multiple personnel at the firms.

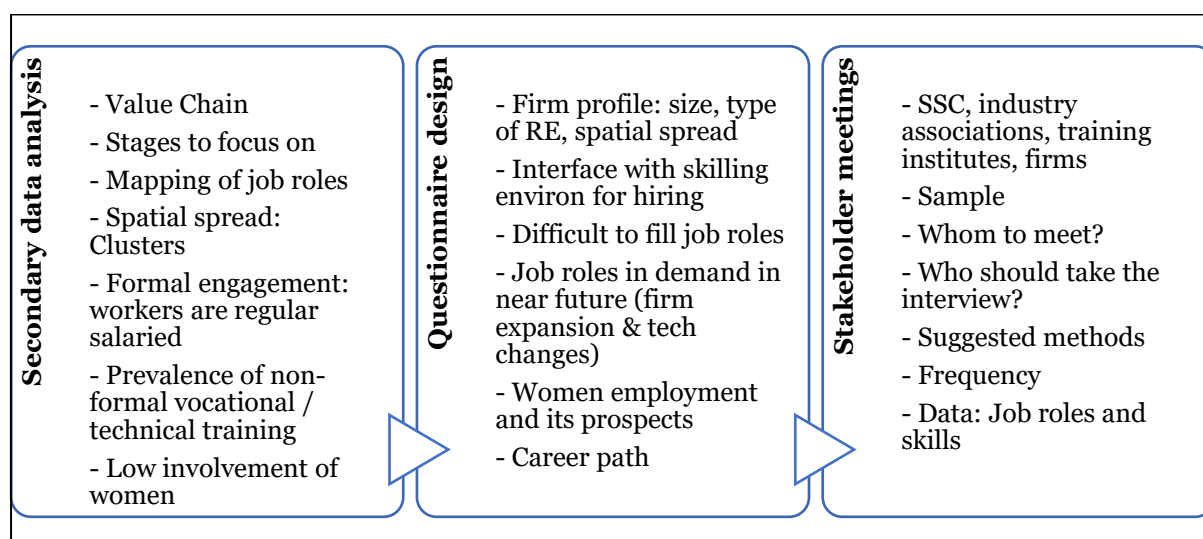
### 8.6.2 Methodology

NCAER recommends to approach the assessment of skill shortages from the lens of ‘data triangulation’ by utilising different sources of data (secondary and primary), accessing multiple personnel at firms to speak with, and collating data through a team of investigators.

NCAER undertook detailed secondary analysis to understand the sector, developed the key instrument for data collection (i.e., the questionnaire), and undertook stakeholders’ meetings to gather detailed insights on the sector and test the questionnaire and methodology of data collection on skill shortages. This process is summarised in Figure 8.6.



**Figure 8.6: Methodology**



Source: NCAER's Conceptualisation

### 8.6.3 How to Assess Skill Gaps?

A firm is faced with a skill shortage when they find difficulty in, or are unable to fill an advertised job role.

To get the stakeholders familiar with the various job roles, NCAER put together a list of occupations where personnel in the sector are employed (from the PLFS data) and mapped it onto the different job roles for which qualification packs have been designed by the sector skill council.

To collate specific job roles in which there is a skill shortage, questionnaires were structured to profile the firm on its size (small/medium/large), types of renewable electricity generation projects, spatial spread of projects, and the interface with the skilling environment for hiring purposes. They were designed particularly to help the respondents think through:

- Given the firm profile, what are the different job roles at the company
- For which job roles has there been a difficulty in finding the 'right' candidates
- For such 'difficult to fill job roles', what are the qualifications and skills that the company is looking out for in the 'right' candidate
- In near future, given the firm-level/technological changes, which job roles (and corresponding skills) will be required at the company, and how easy or difficult would it possibly be to find the appropriately skilled people
- Also, if difficulty in finding the appropriate skill sets are across India, or only in particular States/geographic regions
- Women employment at the firm—overall, specific job roles where there are more / no women, and prospects of increasing women employment in particular job roles
- Availability of factors supporting employee retention and gender diversity at workplace—career path, crèche facility, policies to hire female employees, and

policy and procedures for prevention of sexual harassment at workplace (POSH).

The questionnaire is an important instrument facilitating the collation of detailed information on job roles, and it has worked well on-field. The questionnaire and supporting documents have been designed for firms involved in generation of green electricity. Questionnaire for surveying firms engaged in generation of green electricity is attached at the end of the report (Questionnaire No. 8).

The questionnaire has been designed keeping in mind that the occupational map and in-demand job roles can vary between firms involved with different types and scales of renewable electricity generation projects, as well as depending on the project phases that the firms may be involved in. These intricacies and distinctions—particularly the in-demand job roles and skill requirements of different sets of firms, as per their project engagement—can be captured through analysing the data collected from a comprehensive industry survey.

- Based on the job roles identified during stakeholder meetings, Questionnaire has been updated to segregate the job roles, where: i) workers are employed according to PLFS (at NCO-3 digit), ii) those which do not show workers employed in PLFS but the NCOs are aligned with a qualification pack of Skill Council for Green Jobs (SCGJ), and iii) those which neither show PLFS worker data nor are aligned with any SCGJ QP. This has been useful to highlight the job roles which do not get captured in the PLFS survey, but are in-demand in the sector—with the skill council running training programs for some of these.<sup>17</sup>
- Salary is an important component, and appears to be a key deciding factor, whether an individual takes up a job in the sector. Therefore, it is recommended to collect information on the 'salary offered' by the firm for the in-demand job roles, within the supporting document of the questionnaires.

#### **8.6.4 Who to Talk to?**

The first task is to find the right person to speak with at the firm. A firm is a black box, where individual contact details are difficult to find.

Tasks related to preparing job descriptions, advertising job roles and facilitating interviews and onboarding, fall under the purview of the firms' human resource (HR) departments. Given the present aim to find details of 'difficult to fill' job roles, it is quite natural to consider the HR personnel as the key points of contact. However, the HR personnel are usually at the corporate/head office and responding to the demands of the operation managers, learning and development divisions, and senior directors while advertising job roles. While the HR may be able to check the data concerning number of jobs advertised and those which took longer or were not filled, further details on the skills of the applicants and how well they meet/do not meet the requirement of the company can be better gauged by the individuals overseeing the operations and on-the-job training (OJT). Also, in large firms, the HR personnel are a group of people, managing different departments, and therefore one person is unlikely

---

<sup>17</sup>Some of the other job roles mentioned by stakeholders included asset managers, resource assessors and site surveyors (for solar), site/construction manager, engineers (for wind energy), and even legal professionals, business development executives (for wind), and health, safety and environment officers. Incidentally, these are found to be missing among the job roles covered by PLFS 2022–23 and the sector skill council QPs.

to have all the information. In addition, before sharing any information with an outside party, consent from the corporate bosses is likely to be needed.

In NCAER's experience of talking to or trying to reach out to senior HR personnel, many were only able to give a broad overview with no specific details. Typically, they needed to consult their teams and operation heads for providing any information relating to skill shortages. At several firms, the contacted personnel directed NCAER's email request straight to the HR, none of whom have been responsive.

It may be noted that instead of bypassing the HR, the above pointers highlight the need to keep the individuals in the position of Managing Directors, CEOs, Manager-Plant and Operations, and those heading the learning and skill development divisions, among the key points of contact. Reaching out to these personnel at the firm should be ideal to get a full understanding of skill shortages. Unlike the usual manufacturing sector, the renewable electricity generation plants, once set up, are only employing personnel for O&M and site supervision. Since all activities are being managed from the corporate office, the senior corporate personnel are in a position to share the necessary details on difficult to fill job roles. The Managing Directors, CEOs, and General Managers have been rather resourceful and knowledgeable in providing specific details on all the questions.

Therefore, if the task is to carry out a large-scale survey of all firms in solar and wind electricity generation, the following steps may be followed:

- **Organise an awareness creation workshop/webinar**
  - At the outset, an awareness creation workshop or webinar must be organised, in partnership with the national and regional / State-level industry associations, with invitations going to the CEOs and all senior personnel at the corporate office of the firms.
  - Once all senior members of the corporate office have been explained the agenda and they find the usefulness of the labour market information system, they should be able to help connect with the HR heads, plant managers, and learning and skill development personnel at the firm. After all, the firms' organisational chart is known best by those at the top.
- **Compile a database of firm-level contacts, which should be periodically updated**
  - A comprehensive database should be created from the above exercise, which should also be updated on at least a semi-annual basis if the aim is to have a dynamic labour market information system, since:
    - Firms may be starting new plants, or even closing some
    - Individuals may be shifting between companies, and those who are the key points of contact at one point in time, may have shifted to another company when the survey is repeated.
- **Frequency of conducting the survey**
  - While the exercise is extensive, data on skill shortages should be collated from the firms on an annual basis—keeping in mind that the industry is growing at a rather fast pace and requires skilled personnel to help keep up the momentum.

#### ***8.6.5 Who Should Take the Interview?***

Given the novel nature of this exercise, it is important that the interviews are conducted in-person—either online or offline. On average, each interview takes about

one hour and hence the respondents should be requested to spare at least an hour to ensure completeness of information.

Taking the interviews requires a team of interviewers who should be talking to the firms' key points of contact (discussed in the previous section), to gather holistic data on skill shortages.

Considering the seriousness of this exercise and the benefit it promises, even the individuals who should be communicating with the key points of contact (i.e., the respondents)—either through written or verbal means—should be 'skilled interviewers', with the following traits:

- *Clarity of thought*: The interviewer should be able to impart the importance and essence of the exercise to the respondents in a clear and concise manner, and have a keen understanding of all components of the questionnaire to be able to explain it well to the respondents.
- *Focused, polite and persistent*: It must be remembered that the senior personnel being contacted for the survey are busy, and a single email or tele-call cannot guarantee an interview. One has to remain focused on the task and be polite and persistent with regular follow-ups. Of course, if one proceeds with gathering contact details using the steps mentioned in the previous section (i.e., via the corporate headquarters), the chances of easily getting an interview, without much persistence, are higher.
- *Organised, detail-oriented and honest*: They should be able to keep a log of all data—who was contacted, when were they contacted, and what were the responses, to be able to undertake follow-ups and organise meetings in a professional manner. The task would also be useful in helping with constant updation of the firm level data and key points of contact. All of this should be done with full transparency and honesty, if the real benefit of the exercise has to be achieved. That is, the interviewers should neither fudge data, nor talk to just about 'anybody' and claim they have collated accurate data. Just fulfilling hollow 'numbers' (i.e., 'this' many firms and respondents were contacted), instead of striving for good quality information, will lead to a failure of this extensive exercise.
- *Confident, curious, transparent*: The interviewer should be able to engage in a discussion with confidence, keep the discussion on track, and ask questions as necessary to ensure completeness of information. It is also a good idea if the interviewer is transparent with sharing the questionnaire with the respondent, and noting the answers in consultation with respondents as it helps enhance trust and in turn allows the respondent to be confident in sharing data. It also helps ensure data accuracy and replicability of the method by overcoming the bias / inaccuracy that may arise in translating respondents' answers to the skills framework in the questionnaire. In an online meeting, screen-sharing while filling answers is a good idea, which has also worked well in practice.
- *Advanced communication skills and knowledge of language*: To confidently deliver on each of the above, the interviewer needs to have advanced communication skills, with a superior knowledge of grammar and sentence structure to be able to communicate with respect and clarity in written (e.g., emails, filling questionnaire) and verbal (e.g., tele-calls, in-person meetings) formats. In a diverse country like ours, in addition to knowledge of English and Hindi, having interviewers who are conversant (or even proficient) in the local

language will be extremely useful in helping the respondents be at ease in sharing the requisite details.

- *Teamwork and cultural sensitivity*: Considering that firms in the sector are spread across the country, with plants in diverse geographies, it would be useful to have a team of interviewers, who can take on conducting interviews for the same sector, while focusing on different geographies depending on their knowledge of language and culture. Given the vastness of India, and the renewable energy sector, a culturally diverse team will make the task at hand more efficient in terms of time and cost, and effective in assimilating the requisite information.
- *Computer skills*: Along with a knowledge of MS Office and email communication, the interviewers should also be skilled at conducting online interviews through software such as Zoom, MS Teams, Webex, etc. Online interviews tend to be more convenient and time and cost effective, from the side of the respondents and interviewers, and the screen-sharing feature helps maintain transparency—in what is being asked of the respondent, and the answers being noted by the interviewer.
- *Ability to reflect towards the bigger picture*: Firms are profit oriented, and in many instances, it is likely that the respondent will ask: “what benefit do I get?”, “will you train those people for me?”, “what if you take information from me on what the industry needs, but the skilled people join another firm?”. The interviewers should be ready for such questions, and be able to explain how the contribution of each firm helps build an information system to benefit the industry and each of its players.
- *Education and knowledge*: While the above traits are necessary, it is more likely that an advanced degree in economics or a related field, with an interest / work / research experience in the particular sector and the skilling literature, will be helpful. Not only would it allow the interviewer to always have the bigger picture at the back of their mind (as economists are taught how to connect the micro with the macro), but an interest in the sector will be a constant source of curiosity.

### **8.6.6 Key Findings from the Stakeholders’ Survey**

Skill shortage is found to be an issue in the solar and wind energy sectors, across the different stages of project development due to peculiar issues emanating from the side of the skilling ecosystem (supply-side). This is especially true of job roles involving on-site plant installation and O&M, where the bulk of the workforce is required.

1. There are no renewable energy specific courses in India. People lack in-depth knowledge of renewable energy: both theoretical and practical knowledge. The industry relies upon the general pool of ITI and engineering candidates (in mechanical, electrical, and electronics streams), who then have to be trained to the needs of the renewable energy industry. While the need for such industry-aligned courses is at the ITI and graduate level, it has been learnt from industry stakeholders that courses in renewable energy are being introduced at the master’s level—indicating a clear mismatch between the industry needs and the skilling ecosystem.
2. Practical training, to be familiar with solar and wind modules and site-work, is absent. It has been learnt from stakeholders that while practical training is still possible for job roles in the solar sector, practical training for the wind sector is

only possible on a wind farm. To ensure practical knowledge, the industry looks out for individuals with at least 1–2 years of experience.

3. Solar and wind farms are in remote locations, but there is a lack of locally trained workforce to work on-site and manage site operations, including O&M. It has been learnt that those on-site need to be familiar with the local language and culture to maintain friendly relations with neighbouring villages. It implies that people need to be mobilised from the villages in sunny and windy locales and provided hostel facilities at training centres (to overcome issues regarding daily commute).
  - Shortages may also be experienced at company head offices for desk-based job roles—such as design, scheduling and forecasting engineers, and finance—when people do not wish to re-locate to a non-capital city (as was evinced by firms in Tamil Nadu and Maharashtra).

The *Suryamitra* programme, a top-up course for ITI/diploma graduates (in Electrical, Electronics, Civil, Mechanical, Fitter, Instrumentation, Welder) to be employed for installation and O&M of solar panels, was taken up with much fanfare. The stakeholders have highlighted how the obsession with ‘numbers trained’ rather than the quality of training—particularly practical training—resulted in poor placement record.<sup>18</sup>

Additionally, despite the fact that a local workforce with knowledge of local language and culture is needed in regions where there is scope for development of solar farms, *Suryamitra* was conducted across all States of India. A stakeholder on the training side did not appear sensitive to the possibility of a spatial mismatch, and felt it was quite easy for those trained (in say Assam) to be able to take up jobs and adjust to life in another part of the country (say a remote village in Rajasthan). Another stakeholder felt that the rise in roof-top solar installations all across the Indian States should help overcome this spatial mismatch in training and jobs.

The *Vayumitra* programme, a top-up course for ITI/diploma graduates (in Electrical, Electronics, Civil, Mechanical, Fitter, Instrumentation, Welder) to be employed on the wind farm as O&M technician (electrical and instrumentation), O&M technician (mechanical) or Wind Resource Assessors and Site Surveyor, is faced with its own set of challenges—in finding the training institutions to impart the training, and mobilising candidates.<sup>19</sup>

To avoid repeating the mistakes of the *Suryamitra* Programme, the *Vayumitra* programme is directed towards rural-folk, with the aim to develop a local skilled workforce available to work where wind farms are already operating. To be eligible to impart training on the curriculum, the training partners: i) Need to have training centres in the windy areas, at a certain distance from the wind farm to enable practical training and experience for local youth; ii) Should have an MoU with the

---

<sup>18</sup> According to the numbers on National Institute of Solar Energy (NISE) website, which is the nodal agency for MNRE’s *Suryamitra* programme, the overall placement rate across all States and years is 47 per cent: <https://nise.res.in/wp-content/uploads/2024/07/2015-2024-Suryamitra-Programme.pdf>; accessed on 14 Aug 2024. A stakeholder also indicated how the obsession with numbers resulted in many training centres recording ‘bogus’ candidates, and that the training quality suffered despite the fact that the training curriculum was developed by the sector skill council in all sincerity.

<sup>19</sup> National Institute of Wind Energy (NIWE), is the nodal agency implementing MNRE’s *Vayumitra* programme. Interestingly, the on-the-job training components in the qualification packs for the *Vayumitra* job roles are ‘optional’: <https://vsdp.niwe.res.in/VSDP/TP/Participant/>; accessed on 27 Aug 2024.

industry for on-the-job training and employability; iii) Need to have all training facilities, including trained faculty and infrastructure such as classrooms, labs, and hostels. It, however, has been difficult to find training partners and centres which meet the criteria, particularly in Telangana and Kerala.

At the same time, mobilising candidates for training has been difficult due to the remote job location and low salaries for O&M (which are in the range of INR 15,000 – 20,000 per month, though salaries are slightly higher for the relatively more skilled role of Wind Resource Assessor). As pointed out by a stakeholder, other work avenues, such as the job of a delivery worker in a major city (which requires no educational qualifications) may appear more lucrative to the youth, than working as an O&M professional at remote plant locations (see Box 8.2). Additionally, instrumentation engineers are in demand in other technical industries too, and wind industry has to compete with such other industries to attract this workforce.

### Box 8.2: Which job is more attractive?

Availability of alternative, better-paying, work avenues has made it difficult to mobilize youth for on-site job roles at solar and wind power plants. Salaries may lie in the range of INR 10,000-20,000 for junior level positions, and INR 20,000 – 25,000 for senior level positions for wind-site O&M. A comparison of recent job offerings in Tamil Nadu, from companies in the Wind energy and Food Delivery sectors, indicates why the former may potentially be faced with a shortage of its much-needed workforce.

| <b>Comparator</b>  | <b>Technician / Trainee Engineer<br/>(Tiruppur, Tamil Nadu)</b>                                                                                                                                                                                | <b>Delivery Boy<br/>(Chennai, Tamil Nadu)</b>                                                                                                                                                                                                                                                           |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Education required | Diploma / B.E.                                                                                                                                                                                                                                 | 12 <sup>th</sup> pass                                                                                                                                                                                                                                                                                   |
| Skills required    | <ul style="list-style-type: none"> <li>• Good communication skills</li> <li>• Technical knowledge</li> <li>• Team work</li> </ul>                                                                                                              | <ul style="list-style-type: none"> <li>• Deliver packages from one place to another safely and on time</li> <li>• Collect payments where needed</li> <li>• Good communication with customers (English and local language)</li> <li>• Physical fitness for riding and lifting</li> </ul>                 |
| Entry conditions   | <ul style="list-style-type: none"> <li>• Diploma or B.E. in Mechanical and Electrical and Electronics</li> <li>• Ability to commute/relocate</li> </ul>                                                                                        | <ul style="list-style-type: none"> <li>• Driving license and 2-wheeler (can join as cyclist if don't have bike and license)</li> <li>• Smartphone</li> <li>• Age: 18+ years</li> <li>• Bag and uniform kit for Rs.2</li> </ul>                                                                          |
| Work Experience    | 1 year                                                                                                                                                                                                                                         | Freshers (0 - 6 months)                                                                                                                                                                                                                                                                                 |
| Type of contract   | Not specified                                                                                                                                                                                                                                  | Not specified                                                                                                                                                                                                                                                                                           |
| Benefits           | <ul style="list-style-type: none"> <li>• Day shift (full time)</li> <li>• Food, accommodation, travel, training</li> <li>• health insurance, provident fund</li> <li>• Yearly bonus</li> <li>• Employer-provided relocation package</li> </ul> | <ul style="list-style-type: none"> <li>• Health insurance</li> <li>• Flexible hours, including evening and weekend shifts (part time or full time)</li> <li>• Life insurance</li> <li>• Joining bonus up to Rs. 10,000</li> <li>• Performance bonus</li> <li>• Opportunity for career growth</li> </ul> |
| Place of work      | Tiruppur, Tamil Nadu                                                                                                                                                                                                                           | Chennai, Tamil Nadu                                                                                                                                                                                                                                                                                     |
| Gender             | Not specified (though it is learnt that women do not usually apply for site-jobs)                                                                                                                                                              | Not specified (though job title says 'boy')                                                                                                                                                                                                                                                             |
| No. of vacancies   | Not specified                                                                                                                                                                                                                                  | Not specified                                                                                                                                                                                                                                                                                           |
| Salary per month   | Rs. 10,000 – Rs. 15,000                                                                                                                                                                                                                        | Rs. 35,000 – Rs. 40,000                                                                                                                                                                                                                                                                                 |

Source: NCAER analysis, using information from advertised positions on online job-portals.

**Note:** The Technician / Trainee Engineer details are taken from a Wind company's advertisement for their plant in Tiruppur, Tamil Nadu, available at: [https://www.glassdoor.co.in/job-listing/technician-trainee-engineer-wind-care-india-pvt-ltd-JV\\_IC2836484\\_KO0,26\\_KE27,50.htm?jl=1009440390077&utm\\_campaign=google\\_jobs\\_apply&utm\\_source=google\\_jobs\\_apply&utm\\_medium=organic](https://www.glassdoor.co.in/job-listing/technician-trainee-engineer-wind-care-india-pvt-ltd-JV_IC2836484_KO0,26_KE27,50.htm?jl=1009440390077&utm_campaign=google_jobs_apply&utm_source=google_jobs_apply&utm_medium=organic)

The Delivery Boy details are taken from Swiggy advertisement, for work in Chennai, available at: <https://www.simplyhired.co.in/job/zZPEKAHuwnKEcjDEswDEFkohnq2UWjn-wvGz55Q9HbQbyet5Fy5vgw>

The above reasons have rendered a shortage in the availability of a trained workforce on wind farms, which has also been evinced by the stakeholders from the side of the industry and those on the side of skilling.

4. Questions have also arisen on 'who is training'. Renewable energy industry is new, and personnel knowledgeable enough to train are few. Those with industry experience are the ideal individuals in a position to train. However, lack of industry-academia collaborations / tie-ups / partnerships are hampering the creation of an industry-ready workforce.
5. Increasing the generation of solar and wind power through development of solar and wind plants requires an increase in equipment manufacturing, i.e., solar panels and wind turbines and towers. Certain stakeholders highlighted how the original equipment manufacturers (OEMs) are themselves faced with a shortage of technicians for manufacturing and assembly operations, which hampers the OEMs' expansion plans and in turn, the renewable project developers are unable to find adequate equipment for their sites.
6. There are specialised personnel required at the wind farm during construction, such as the erection specialists and crane operators, which too are in short supply. After all, it makes sense to have more trained personnel for such short-term contractual construction jobs only when the industry offers a consistent demand, which has not quite been the case in the recent past.<sup>20</sup>

The fluctuating growth of the renewable energy industry over the past several years, and the wavering importance attributed to it from the side of policy, is blamed for the present state of lagging-affairs on the side of skilling. Better industry-academia alignment, with involvement of industry trainers, is therefore the need of the hour – such that skilling can take place to the desired requirement of the industry, with a focus on 'local' skill development. It will help: i) the industry reduce its cost of training a workforce that is unfamiliar with renewable energy (as is found to be a common practice across all firms), ii) the training centres to have an industry partner for imparting practical experience,<sup>21</sup> and iii) Have a locally skilled workforce which can communicate in the local language at the remote site location. Through such an arrangement, the quality and quantity of an industry-ready skilled workforce is bound to increase. A stakeholder talked about their firm having MoUs with engineering and non-engineering colleges to offer internships to students, who can then potentially be hired at the firm, or even at other firms, with minimal on-the-job training. Another industry stakeholder also pointed out that for Wind industry in particular, a skill gap in Andhra Pradesh, Madhya Pradesh and Rajasthan exists because of poor interaction between industry and skilling institutions, and that supply of skills is better where such interaction is present.

Job roles on-site are considered non-aspirational, such that despite undergoing training, students may choose another work avenue that offers a better salary. Women employment on-site is next to nil (see Box 8.3). An involved engagement of the

---

<sup>20</sup> Several stakeholders, both from the side of the industry and skilling, pointed out that the wind industry has not done well in the last few years and grown rather slowly in comparison to solar. While it peaked in the early 2000s, it slowed afterwards and picked up again in 2017-18 after which COVID-19 struck. Now the momentum is slowly getting back. Such fluctuation directly impacts employment, and the slow growth in the last few years automatically led to the lack of a pre-trained workforce in the present day.

<sup>21</sup> Setting up labs and equipment to provide practical training at academic institutions is considered difficult and costly.



industry may help in mentoring and counselling students, help setting expectations, better matching of interest and skills with job roles, and prevent attrition. That a career path and other incentives exist at the firm, where a technician can rise to higher level managerial positions, must also be highlighted during the training.

### **Box 8.3: Prospect for women employment in the green electricity sector**

There are few women in the solar and wind industry, and those in the sector are concentrated in job roles based at the corporate offices. These include:

- Administration related roles, including accounts, project finance, secretaries, human resource
- Engineers (across domains), Engineering Pre-Design (EPD)
- Project Coordination, Management Information System
- Resource assessment, Forecasting, Monitoring and Scheduling
- Policy and Regulatory

All stakeholders unanimously mentioned an absence of women for on-site work, particularly where long periods of stay on-site are required – such as O&M. While the firms have expressed their willingness to have gender diversity in the core on-site job roles, most are unable to fulfil the same due to:

- Lack of women at ITI, which offer training in trades preferable to the renewable industry (Electrical, Electronics, Civil, Mechanical, Fitter, Instrumentation, Welder).
- Lack of women applicants for O&M jobs due to remote site locations.
- Pre-conception among stakeholders about women being unable to perform physically taxing tasks. This has been particularly true of O&M roles in the wind sector, given the need for climbing wind mills.

While pre-conceptions, and ensuring women security in India, may take time to change, a positive finding has been the emphasis placed by several firms on treating applications from male and female candidates at par, enacting POSH policies and committees, and providing crèche facilities at corporate office premises (firms have not felt a need to have crèche facilities at plant locations, as there are no women involved there). A firm even talked about policies that provide incentives to their employment agencies if a woman candidate is hired and there being a 'technical committee' to encourage women participation in technical job roles.

In times to come, prospects of increasing women employment are perceived to be higher in:

- Resource assessment, forecasting
- Design: power system design, plant engineering and design, project management
- O&M: for solar (Wind O&M is a possibility once there are lifts provided for climbing), and for both solar and wind as and when O&M gets automated (i.e., remote diagnostics is possible)

Source: NCAER stakeholders' survey

The existence of skill shortage in the green energy industry is not new. In a study<sup>22</sup> undertaken in 2016, the Skill Council for Green Jobs (SCGJ) has conducted an occupational mapping and estimated the expected jobs which will be created by the renewable energy industry. It was on the basis of this study that different qualification packs were introduced for imparting training. It was learnt during the meetings that qualification packs / curriculum for different job roles are finalised after consultation with 30 industry players. Yet, persistence of skill shortage to this date requires digging deeper into the reasons for the same, as came out during NCAER's stakeholder meetings. More importantly, it highlights the need to conduct thorough industry surveys on a frequent basis, as the findings from 2016 and a small sub-set of players are unlikely to be applicable in 2024 and beyond for the entire industry, in such a fast-evolving sector. Additionally, more than just the projected numbers, the focus must be

<sup>22</sup> SCGJ 2016. Skill Gap Report for Solar, Wind and Small Hydro Sectors. Available at: <https://sscjj.in/wp-content/uploads/2016/06/SCGJ-skill-gap-report.pdf>; accessed on 1 July 2024

to qualitatively understand the detailed skill needs of the sector (i.e., detailed job descriptors for each in-demand job role) and how the industry views the demand for certain difficult to fill job roles evolving. The present study by NCAER is an attempt to help bridge this gap in skill shortage assessment.

Based on NCAER's limited stakeholder interactions, details on the job roles where there is a skill shortage are discussed in the following section.

### Job Roles in Demand

Having had detailed discussions with the firms, training institutes, and sector skill council, several job roles came into view, where:

- There is a skill shortage at present (i.e., there are not enough people, but the skills are high in demand by industry).
- There is likely to be a skill shortage in near future, three years from now (i.e., which will be in demand in future, but finding skilled personnel for the same may be difficult too).

Although the study's aim has been to develop a methodology and results from a small sample of firms cannot determine all possible job roles in shortage; yet there is an overlap between the views of the different stakeholders. Job roles mentioned by the stakeholders are detailed in Table 8.5.

Incidentally, from the firms' perspective, all job roles in shortage at present are also perceived to remain in shortage in near future. This is because of the expected growth of the solar and wind energy sectors.

All stakeholders agreed that along with technical training, soft-skills are equally important and are in-demand for the stated job roles. Interviews with stakeholders have been successful at collating details on job descriptors, including the different cognitive, socio-emotional, and physical skills needs for the job role, at different levels of proficiency. Considering that cognitive and socio-emotional skills start developing at the school level, the importance of good quality school education has also been reiterated in stakeholder meetings.

Along with a list of qualifications and skills, the questionnaire has also helped capture the number of personnel required by firms in the stated job roles – both at present and in near future to help anticipate demand, along with the geographic regions where the skilled personnel are required.

Additionally, any attempt to project the number of people required in the sector in the future using the existing PLFS database (as performed using the input-out analysis) is likely to be misleading. There are several job roles in-demand now and in the near future, but there are no individuals employed in their corresponding NCOs according to the PLFS database. It implies that while people may be working in those job roles now and increasingly in near future, any labour demand projections using PLFS will exclude such workers. This includes job roles relating to installers, technicians, resource assessors, engineers, site surveyors, site / project / asset managers– which were mentioned by the stakeholders, and the sector skill council (SCGJ) has even developed some QPs for training personnel in these in-demand roles – particularly for the *Suryamitras* and *Vayumitras*<sup>23</sup> (Table 8.5).

---

<sup>23</sup> The issue is detailed in an article Dayal, I. and Bhandari, B. 2025. "Expansion in renewable energy implies an employment growth in the sector too – are we undercounting green jobs?" *Down To*

Therefore, an annual national survey of solar and wind firms is recommended to ascertain the demand for job roles and associated skills in times to time, while working alongside to improve the skilling ecosystem and industry-academia collaborations in line with the sector's evolution.

Based on stakeholder interactions, the list of key job roles and their brief descriptions are de-lineated here.

1. Solar Project Manager; Solar Installer; Solar PV Installer and O&M Technician<sup>24</sup>: Solar Panel Installation Technician is also known as 'Panel Installer', the Solar Panel Installation Technician is responsible for installing solar panels at the customers' premises. The individual at work checks the installation site, understands the layout requirement as per design, assesses precautionary measures to be taken, installs the solar panel as per customer's requirement and ensures effective functioning of the system post installation.
2. O&M Technicians (Wind)—Mechanical and Electrical
  - O&M Mechanical Technician-Wind Power Plant<sup>25</sup>: Carry out operation of mechanical components of wind power plant, carry out maintenance of mechanical components of wind power plant, perform basic health and safety practices at project site (Ground and Height), work effectively with others.
  - O&M Electrical & Instrumentation Technician- Wind Power Plant<sup>26</sup>: carry out operation of electrical & instrumentation systems of wind power plant, carry out maintenance of electrical & instrumentation systems of wind power plant, perform basic health and safety practices at project site (Ground and Height), work effectively with others
3. Engineers; Electrical engineers—Power Systems Design; Civil and Electrical Engineers; Project Engineers
  - Engineers (Design engineers/Site Engineers/Forecasting and Scheduling engineers (O&M)): Perform efficient plant design for optimal electricity generation; oversee proper installation and material use, aligned with plant design; planning, forecasting, and scheduling the production and delivery of products and services; coordinate with different teams and stakeholders to ensure timely and efficient execution of projects and tasks; Knowledge of renewable energy systems and practical operations, and safety parameters
  - Electrical engineers- Power Systems Design: Optimising power transmission while reducing losses; knowledge of RE power transmission systems
  - Civil and Electrical Engineers: Perform RE project execution and O&M.

---

*Earth*. <https://www.downtoearth.org.in/renewable-energy/expansion-in-renewable-energy-implies-an-employment-expansion-in-the-sector-too-are-we-undercounting-green-jobs>. March 18.

<sup>24</sup> National Career Services. 2016. National Classification of Occupations 2015. [https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20\\_Vol%20I-%202015.pdf](https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20_Vol%20I-%202015.pdf). Directorate General of Employment, Ministry of Labour and Employment, Government of India, New Delhi.

<sup>25</sup> Skill Council for Green Jobs and National Skills Development Corporation. Undated. "O&M Mechanical Technician – Wind Power Plant". [https://sscgi.in/wp-content/uploads/2019/03/SGJ\\_Q1502-O\\_M-Mechanical-Technician-Wind-Power-Plant.pdf](https://sscgi.in/wp-content/uploads/2019/03/SGJ_Q1502-O_M-Mechanical-Technician-Wind-Power-Plant.pdf).

<sup>26</sup> Skill Council for Green Jobs and National Skills Development Corporation. Undated. "O&M Electrical & Instrumentation Technician – Wind Power Plant". [https://sscgi.in/wp-content/uploads/2019/03/SGJ\\_Q1503-O\\_M-Electrical-Technician-Wind-Power-Plant.pdf](https://sscgi.in/wp-content/uploads/2019/03/SGJ_Q1503-O_M-Electrical-Technician-Wind-Power-Plant.pdf).

- Project engineers: Implement the project as per the designs and specifications, within the stipulated timelines.
4. Resource Assessment; Site Surveyor; Resource Analysis:<sup>27</sup> Conduct site survey at power plant, perform basic health and safety practices at project site (Ground and Height) and work effectively with others
  5. Site Managers / in-charge /supervisor; Construction / Project Managers: Keeping projects up and running, without technical fault or challenge from locals; Manage and supervise site/construction functions and staff on site, including the installation and O&M vendors; regularly reporting on plant performance; practical experience in wind and solar projects along with the theoretical RE knowledge; Knowledge of machine and managing O&M at wind plant site; awareness of safety considerations. Project manager/Manager project design also needs to perform project design and optimisation of project cost with respect to RE (solar/wind).
  6. Asset Management; Quality and Vendor Management Engineers: Optimally and sustainably manage assets relating to their performance, risks and expenditures over their lifetime; efficient asset management for better machine availability and more output; basic managerial skill for asset management along with good communication—ensure quality of the outsourced activities, developing vendors, and managing the vendors.

---

<sup>27</sup> Skill Council for Green Jobs and National Skills Development Corporation. Undated. “Wind Resource Assessor and Site Surveyor – Wind Power Plant”. [https://sscgj.in/wp-content/uploads/2019/03/SGJ\\_Q1202-Site-Surveyor-Wind-Power-Plant.pdf](https://sscgj.in/wp-content/uploads/2019/03/SGJ_Q1202-Site-Surveyor-Wind-Power-Plant.pdf); <https://vsdp.niwe.res.in/static/img/Wind%20Resource%20Assessor%20and%20Site%20-%20WPP.pdf>.

**Table 8.5: Details of in-demand job roles**

| <b>Job roles</b>                                                       | <b>1) Solar Project Manager; Solar Installer; Solar PV Installer and O&amp;M Technician (Surya Mitra)</b> | <b>2) O&amp;M Technicians (Wind)—Mechanical and Electrical</b>                                                                   | <b>3) Engineers; Electrical engineers—Power Systems Design; Civil and Electrical Engineers; Project Engineers</b>                                                                                                                               | <b>4) Resource Assessment ; Site Surveyor; Resource Analysis</b>                                                                                           | <b>5) Site Managers / in-charge /supervisor; Construction / Project Managers</b>                                                                                                                                                                                        | <b>6) Asset Management; Quality &amp; Vendor Management Engineers</b>                                                                                      |
|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NCO 3/8–digit code                                                     | 7421.1401: Solar Panel Installation Technician                                                            | 3113.0102: Maintenance Technician Electrical<br>3115.0102: Maintenance Technician – Mechanical                                   | 214: Engineering Professionals (Excluding Electrotechnology)<br>215: Electrotechnology Engineers                                                                                                                                                | 2165.9900: Cartographers and Surveyors, Other                                                                                                              | 1323.0100: Manager, Construction/Manager Construction Projects                                                                                                                                                                                                          | 1324.0100: Manager, Material Control/Manager Materials                                                                                                     |
| NCO 8-digit (QP code)                                                  | SGJ/Q0102: Solar PV Installer – Electrical; SGJ/Q0101: Solar PV Installer (Suryamitra)                    | SGJ/Q1503: O&M Electrical & Instrumentation Technician—Wind Power Plant<br>SGJ/Q1502: O&M Mechanical Technician—Wind Power Plant | SGJ/Q0110: Solar PV Designer<br>SGJ/Q0109: Solar PV Structural Assistant Design Engineer<br>SGJ/Q0106: Rooftop Solar Grid Engineer                                                                                                              | SGJ/Q1202: Wind Resource Assessor and Site Surveyor-Wind Power Plant                                                                                       | SGJ/Q0114: Solar PV Project Manager (E&C)                                                                                                                                                                                                                               |                                                                                                                                                            |
| No. of stakeholders which mentioned this                               | 6                                                                                                         | 5                                                                                                                                | 4                                                                                                                                                                                                                                               | 4                                                                                                                                                          | 7                                                                                                                                                                                                                                                                       | 3                                                                                                                                                          |
| Match from Job Projections (541, 413, 741, 932, 411) @                 | No                                                                                                        | No                                                                                                                               | No                                                                                                                                                                                                                                              | No                                                                                                                                                         | No                                                                                                                                                                                                                                                                      | No                                                                                                                                                         |
| Extent of the need (sum of the numbers from stakeholder consultations) | 50,000 (NISE), additional 20,000 (till March 2025)                                                        | 3,660 (NIWE target until March 2025)                                                                                             | 40+ (now) and 80+ (three-five years from now)                                                                                                                                                                                                   | ~ 25 (now) and ~50 (three-five years from now)                                                                                                             | ~ 35 (now) and 50+ (three years from now)                                                                                                                                                                                                                               | ~ 21 (now) and ~45 (three-five years from now)                                                                                                             |
| Geography (where?)                                                     | MP; Across India (with solar rooftop)                                                                     | Windy States, such as: KL; TL; TN (Tirunelveli, Nagercoil, Udumalpet, Thenkasi); AP (Tadipatri); GJ (Kutch); KA (Shimoga)        | Corporate office: MH (Pune)<br>Solar now: KA (Pavagada); TL (Mahabubnagar, Gadwal, Veltoor, Jodhpur, Tandur, Nirmal); RJ (Jaisalmer, Jodhpur, Barmer, Jaisalmer, Dedasari), MH (Dhule)<br>Wind now: TN (Tirupur, Theni); GJ (Jamnagar, Mahidad, | Corp ofc: MH (Mumbai)<br>Solar now: RJ (Barmer, Jodhpur, Jaisalmer)<br>Wind now: AP (Anantpur, Kurnool)<br>Hybrid future: AP<br>Prospective future: TL, MP | Corp ofc: TN (Coimbatore)<br>Solar: TN, MH, GJ; KA (Pavagada); TL (Mahabubnagar, Gadwal); RJ (Jaisalmer, Jodhpur)<br>Wind: AP, TN (Tirupur); GJ (Jamnagar, Bhuj); KA (Chitradurga, Harapanahalli, Harihar), MH (Satara, Nandurbar), RJ (Jaisalmer, Jodhpur); MP (Devas) | Corp ofc: MH (Mumbai)<br>Solar: TN, MH, GJ<br>Wind: GJ, TN; RJ (Jaisalmer, Jodhpur); MP (Devas)<br>Solar Future: AP, MH, GJ, TN, RJ<br>Wind future: TN, GJ |

| <b>Job roles</b>                            | <b>1) Solar Project Manager; Solar Installer; Solar PV Installer and O&amp;M Technician (Surya Mitra)</b>                                                                                                             | <b>2) O&amp;M Technicians (Wind)—Mechanical and Electrical</b>                                                                                                                                 | <b>3) Engineers; Electrical engineers—Power Systems Design; Civil and Electrical Engineers; Project Engineers</b>                                                                                                                                                                                                        | <b>4) Resource Assessment ; Site Surveyor; Resource Analysis</b>                                                                                                                                  | <b>5) Site Managers / in-charge /supervisor; Construction / Project Managers</b>                                                                                                                                                                      | <b>6) Asset Management; Quality &amp; Vendor Management Engineers</b>                                                                                                                             |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                             |                                                                                                                                                                                                                       |                                                                                                                                                                                                | Samana, Sidhpur), AP (Anantpur, Kurnool), RJ (Bhakrani, Sipla, Tejuva); MP (Chandgarh); MH (Andhra Lake, Jath, Khandke); KA (Hara, Saundatti) Solar future: RJ (Barmer); GJ (Banaskantha) Wind future: MP Hybrid future: RJ+MP (Jaisalmer + Dhar); GJ+MP (Bansakantha + Dhar); RJ+MP+TN (Jaisalmer+ Dhar + Dindigul); AP |                                                                                                                                                                                                   | Hybrid: KA (Kopal) Solar future: AP, MH, TN, RJ (Barmer); GJ (Banaskantha) Wind future: TN, GJ, MP Hybrid future: KA (Gudadur); RJ+MP (Jaisalmer + Dhar); GJ+MP (Bansakantha + Dhar); RJ+MP+TN (Jaisalmer+ Dhar + Dindigul)                           |                                                                                                                                                                                                   |
| Monthly income (₹)                          | 12,000 – 15,000                                                                                                                                                                                                       | 15,000 – 20,000                                                                                                                                                                                | Varies by experience: ~ 40,000 – 60,000                                                                                                                                                                                                                                                                                  | Entry-mid level: ~ 35,000 – 45,000                                                                                                                                                                | Mid-Senior level positions: 1,30,000 – 1,90,000                                                                                                                                                                                                       | Managerial position: ~ 80,000 – 1,00,000                                                                                                                                                          |
| Educational Qualifications                  | ITI/Diploma/B Tech (Electrical/Mechanical/Electronics/Civil/ Fitter/ Instrumentation / Welder)                                                                                                                        | ITI / diploma (Mechanical / electrical/ electronics/ Civil/ Fitter/ Instrumentation/ Welder)                                                                                                   | B.E. / Diploma / B.Tech / M.E. (Electrical / Mechanical / Electronics/ Civil)                                                                                                                                                                                                                                            | B.E. / B. Tech / Diploma / M.Tech (Environmental sciences/ electrical/ computers/ Mechanical/ Civil/ Electronics and Communication / Control & Instrumentation)                                   | ITI / diploma / B.E./B Tech / M Tech (electrical/mechanical/electronics)                                                                                                                                                                              | Diploma / B.E. (Electrical/mechanical/civil)                                                                                                                                                      |
| Skills required at the competency level (3) | <b>Cognitive skills:</b> Speaking; communication; digital skills; active listening; problem solving; time management;<br><b>Socio-emotional skills:</b> Conscientiousness; agreeable (teamwork); emotional stability; | <b>Cognitive skills:</b> Reading; writing; speaking; communication; language (local plus local languages); numeracy/math; digital skills; active listening; science; problem solving; critical | <b>Cognitive skills:</b> Reading; writing; speaking; communication; language (local, English); numeracy/math; ICT skills; active listening/learning; science; problem solving; critical thinking; creativity; judgement; systems                                                                                         | <b>Cognitive skills:</b> Reading; writing; speaking; communication; language (local, English); numeracy/math; ICT skills; active listening/learning; science; problem solving; critical thinking; | <b>Cognitive skills:</b> Reading; writing; speaking; communication; language (local, English); numeracy/math; ICT skills; active listening/learning; science; problem solving; critical thinking; creativity; judgement; systems analysis/evaluation; | <b>Cognitive skills:</b> Reading; writing; speaking; communication; language (local, English); numeracy/math; ICT skills; active listening/learning; science; problem solving; critical thinking; |

| <b>Job roles</b> | <b>1) Solar Project Manager; Solar Installer; Solar PV Installer and O&amp;M Technician (Surya Mitra)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>2) O&amp;M Technicians (Wind)—Mechanical and Electrical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>3) Engineers; Electrical engineers—Power Systems Design; Civil and Electrical Engineers; Project Engineers</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>4) Resource Assessment ; Site Surveyor; Resource Analysis</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>5) Site Managers / in-charge /supervisor; Construction / Project Managers</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>6) Asset Management; Quality &amp; Vendor Management Engineers</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | <p><b>Physical skills:</b> ability to work at heights, e.g., solar rooftop; or in confined spaces</p> <p>Global competence</p> <p><b>TVET:</b> Fundamentals of electricity, electric components, necessary tools, measuring instruments and Solar PV; how to install, test, commission Solar PV systems efficiently, and operate, maintain, and troubleshoot solar PV systems; industrial safety; Solar field experience; knowledge of software (Sketchup, PVSyst), SCADA; working on computer (Word, excel, outlook etc.); need to work with drones in future for O&amp;M/security (<i>overlap with drone operators in agriculture sector</i>)</p> <p><b>Entrepreneurial skills</b> (Managing projects, installations, and manage technicians)</p> | <p>thinking; creativity; systems analysis; resource/time management; diversity</p> <p><b>Socio-emotional skills:</b> Open to experience; conscientiousness; agreeable; emotional stability;</p> <p><b>Physical skills:</b> climb windmills; ability to work at height and in confined spaces; actively access interspersed windmills; physically adjusting to different work shifts</p> <p><b>TVET:</b> Wind energy knowledge and its electrical and mechanical aspects; O&amp;M of the electrical and mechanical equipment—monitoring parameters and attending to breakdowns due to faults in machine parts; knowledge of working at height and in confined spaces with high voltages, and of working with wirings, gearboxes, bearings,</p> | <p>analysis/evaluation; resource/time management; diversity;</p> <p><b>Socio-emotional skills:</b> Open to experience; conscientiousness; agreeable; emotional stability; instructing; negotiation; persuasion; Physical skills ,particularly for on-site work;</p> <p>Global competence</p> <p><b>TVET:</b> <i>Engineers (Design engineers/Site Engineers/Forecasting and Scheduling engineers (O&amp;M)):</i> efficient plant design for optimal generation; oversee proper installation and material use, aligned with plant design; planning, forecasting, and scheduling the production and delivery of products and services; coordinate with different teams and stakeholders to ensure timely and efficient execution of projects and tasks; Knowledge of RE systems and practical operations, and safety parameters; knowledge of MS Office; CAD/CAM; SCADA; PVSyst.</p> | <p>creativity; judgement; systems analysis/evaluation; resource/time management; diversity;</p> <p><b>Socio-emotional skills:</b> Open to experience; conscientiousness; agreeable; emotional stability; instructing; negotiation; persuasion; Physical skills (need to climb towers, work at heights); Global competence</p> <p><b>TVET:</b> <i>Site surveyor:</i> Identifying the right land parcels and activities regarding survey of land- to acquire land systematically ; knowledge of survey tactics and required equipment, operate equipment like Total Station / GPS / AutoCAD; MS office</p> <p><b>Resource Assessment / analysis:</b> Layout design (wind / solar) along with energy assessment for individual sites, knowledge of RE energy assessment (study and analysis of wind and solar resources, in</p> | <p>resource/time management; cultural diversity;</p> <p><b>Socio-emotional skills:</b> Open to experience; conscientiousness; agreeable; emotional stability; instructing; negotiation; persuasion; Physical skills (Actively access large wind sites, where each plant may be a km apart; climbing the tower for inspection); Global competence (especially concerning communication; can have people working for other global operations too; due to competition from global firms)</p> <p><b>TVET:</b> Keeping projects up and running, without technical fault or challenge from locals; manage and supervise site / construction functions and staff on site including the installation and O&amp;M vendors; regularly reporting on plant performance; practical experience in wind and solar projects along with the theoretical RE knowledge; knowledge of machine and managing O&amp;M at wind plant</p> | <p>creativity; judgement; systems analysis/evaluation; resource/time management; diversity;</p> <p><b>Socio-emotional Skills:</b> Open to experience; conscientiousness; agreeable; emotional stability; instructing; negotiation; persuasion; Physical skills (site-work, climbing wind-mills); Global competence (especially concerning communication; competition from global firms)</p> <p><b>TVET:</b> Optimally and sustainably manage assets relating to their performance, risks and expenditures over their lifetime; Efficient asset management for better machine availability and more output; basic managerial skill for asset management along with good communication—Ensure quality of the outsourced activities, developing vendors and managing the vendors; practical</p> |



| <b>Job roles</b>         | <b>1) Solar Project Manager; Solar Installer; Solar PV Installer and O&amp;M Technician (Surya Mitra)</b>                                                                                                                                                                                                                                                                          | <b>2) O&amp;M Technicians (Wind)—Mechanical and Electrical</b>                                                                                                                                                                                                                            | <b>3) Engineers; Electrical engineers—Power Systems Design; Civil and Electrical Engineers; Project Engineers</b>                                                                                                                                                                                                                                                                                                                 | <b>4) Resource Assessment ; Site Surveyor; Resource Analysis</b>                                                                                                                                                                                                                                       | <b>5) Site Managers / in-charge /supervisor; Construction / Project Managers</b>                                                                                                                                                                                                                                                                                                                                               | <b>6) Asset Management; Quality &amp; Vendor Management Engineers</b>                                                                                                                                                                                                                                               |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          |                                                                                                                                                                                                                                                                                                                                                                                    | and hydraulic systems; understand health & safety practices in wind industry, SCADA                                                                                                                                                                                                       | <i>Electrical engineers—Power Systems Design:</i> Optimising power transmission while reducing losses; knowledge of RE power transmission systems, Conversant with MATLAB / ETAP; <i>Civil and Electrical Engineers:</i> knowledge of RE project execution and O&M. <i>Project engineers:</i> Implement the project as per the designs and specifications within the stipulated timelines. Future training for BESS and Green H2. | terms of geographical locations, historical trends, and quality); trained on software for resource assessment (e.g., WindPro); MS Office. Understand and perform health and safety practices at project site-- Ground and Height                                                                       | site; awareness of safety considerations; proficient in MS Office (Emails, Excel, PowerPoint). <i>Project manager/Manager project design:</i> Good communication, knowledge of CAD and other specific software (e.g., for solar: PVSyst software—to estimate generation from solar plant); project design and optimisation of project cost with respect to RE (solar/wind) Future skills relating to BESS; Green H2; bio-fuels | experience in wind and solar projects along with the theoretical RE knowledge; knowledge of MS Office and software for remote monitoring of solar and wind plants; safety awareness is important as work with electricity; future skills relating to Battery Energy Storage Systems; Green Hydrogen; bio-fuels      |
| Skills Shortage          | Yes                                                                                                                                                                                                                                                                                                                                                                                | Yes                                                                                                                                                                                                                                                                                       | Yes                                                                                                                                                                                                                                                                                                                                                                                                                               | Yes                                                                                                                                                                                                                                                                                                    | Yes                                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                                                                                                                                                                                                                                                                                                                 |
| Skills Gap               | Yes                                                                                                                                                                                                                                                                                                                                                                                | Yes                                                                                                                                                                                                                                                                                       | Yes                                                                                                                                                                                                                                                                                                                                                                                                                               | Yes                                                                                                                                                                                                                                                                                                    | Yes                                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                                                                                                                                                                                                                                                                                                                 |
| Relevance of TVET System | - Field / site experience is necessary, but practical experience and training is lacking; communication skills are also lacking- how to talk to customers.<br>- Programs are not imparting requisite knowledge (Trainees do not even know the difference between AC/DC, or between current and voltage).<br>- People tend to learn from online videos on YouTube or social media-- | - Those coming from colleges are not familiar with wind sites, and only have theoretical knowledge. Have to be imparted safety related training as well as practical (i.e. skill requirement on the field).<br>- Need to train people who can attend to mechanical and electronic aspects | - <i>Electrical engineers—Power Systems Design:</i> no one training people in this field<br>- <i>Ground Execution- Civil and Electrical Engineers:</i> people are not industry ready<br>- People lack in-depth renewable energy (RE) knowledge: both theoretical and practical knowledge. A curriculum needs to be designed for RE sector.                                                                                        | - Lack of institutes training people in these fields<br>- No structured training method<br>- People lack RE knowledge: both theoretical and practical knowledge<br>- For wind sector, resource assessor and site surveyor, the programme is being implemented by NIWE, but there is a lack of training | - Need to have engineering courses/B.E. in renewable energy (RE) (No RE courses for entry/mid management level). NTPC / NPTI / IIT /UPES have engineering courses related to power, but it is not enough to meet industry demand in terms of the numbers required. Courses should be run across States to overcome this spatial shortage.<br>- Engineers: have theoretical knowledge, but application of                       | - Need to have B.E./diploma in renewable energy (RE) (No RE courses for entry/mid management level). A curriculum needs to be designed for RE sector. When electrical/mechanical engineers join, they do not have RE knowledge<br>- Engineers: have theoretical knowledge, but application of knowledge is missing; |



| <i>Job roles</i>                                                                              | <b>1) Solar Project Manager; Solar Installer; Solar PV Installer and O&amp;M Technician (Surya Mitra)</b>                                                                                                                                                                                                                                                            | <b>2) O&amp;M Technicians (Wind)—Mechanical and Electrical</b>                                                                                                                                                                                                                                    | <b>3) Engineers; Electrical engineers—Power Systems Design; Civil and Electrical Engineers; Project Engineers</b>                                                                                                                                                               | <b>4) Resource Assessment ; Site Surveyor; Resource Analysis</b>                                                                                                                                                                                             | <b>5) Site Managers / in-charge /supervisor; Construction / Project Managers</b>                                                                                                                                                                                                                                                                                                                                                                                                 | <b>6) Asset Management; Quality &amp; Vendor Management Engineers</b>                                                      |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
|                                                                                               | These are not the right places, and impart wrong knowledge.<br>- They also should have knowledge of drill machines and grinder and other tools – but it is lacking.<br>- Trainers do not have field experience, and only have bookish knowledge. It is important that training is being provided by good quality, experienced trainers, who have industry knowledge. | (mechatronics).<br>- Lack of training centres with requisite facilities to impart training and those meeting NIWE's selection criteria (i.e. training centre in proximity to wind farm, MoU with industry for OJT and employability, trained faculty and infrastructure—classroom, labs, hostels) |                                                                                                                                                                                                                                                                                 | centres with requisite facilities to impart training, and those meeting NIWE's selection criteria (i.e. training centre in proximity to wind farm, MoU with industry for OJT and employability, trained faculty and infrastructure—classroom, labs, hostels) | knowledge is missing;<br>- For site roles: practical knowledge needs to be imparted. People need to be exposed to firm's green electricity systems<br>- Entire skill set is needed—managerial & technical skills. Difficult to find people with both (particularly local people with managerial bent of mind)<br>- Education and skilling system should at least impart overall awareness of safety considerations and provide a complete understanding of the core area of work | - For site roles: practical knowledge needs to be imparted. People need to be exposed to firm's green electricity systems. |
| Gender (Challenges) *                                                                         | Security and required physical skills to work at sites make these occupations non-aspirational both from demand and supply sides; Lack of women in relevant trades at ITI                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                   | There are some women in these job roles, and companies foresee an increase in women employment in these roles in next three years. Yet challenge comes from the fact that a ready-talent pool is not available (who have experience in renewable energy on the technical side). |                                                                                                                                                                                                                                                              | Security and required physical skills work at sites make these occupations non-aspirational both from demand and supply sides; absence of crèche/childcare facilities on-site                                                                                                                                                                                                                                                                                                    |                                                                                                                            |
| Challenges Faced by Industries in Meeting Skill Requirements                                  | ITI graduates have little practical skills, which means that firms incur costs and time in training them                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                   | Incur costs in making the hired workforce (from general engineering pool) industry ready and trained to RE needs                                                                                                                                                                |                                                                                                                                                                                                                                                              | Shortage of locally available capable people who can supervise construction and O&M on-site. These are senior/managerial level positions and it is difficult to shift with family to the remote site location, resulting in shortage as well as attrition.                                                                                                                                                                                                                       |                                                                                                                            |
| Industry-specific interventions that facilitate skill & capacity development (best practices) | Learning & Development (L&D) divisions; training on the job                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                   | L&D divisions; training on the job; Graduate Engineer Trainees                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                              | L&D divisions; training on the job (particularly practical knowledge for site roles)                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                            |
| Policy Recommendations                                                                        | <b>Skill Training Programmes:</b> Training programmes need to be expanded especially for training in the wind sector; Remote location adds to spatial mismatch and hence one needs locally skilled workforce—Local coordination                                                                                                                                      |                                                                                                                                                                                                                                                                                                   | <b>Skill Training Programmes:</b> Training programmes need to be expanded to fulfil specific needs of the RE sector; Remote location adds to spatial mismatch and hence one needs locally skilled workforce— Local coordination                                                 |                                                                                                                                                                                                                                                              | <b>Skill Training Programmes:</b> Need for upskilling/reskilling programmes, to enable those with experience in other managerial / supervisory site roles (E.g., in conventional power) to take up such senior roles in RE.                                                                                                                                                                                                                                                      |                                                                                                                            |

| <i>Job roles</i> | <b>1) Solar Project Manager; Solar Installer; Solar PV Installer and O&amp;M Technician (Surya Mitra)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>2) O&amp;M Technicians (Wind)—Mechanical and Electrical</b> | <b>3) Engineers; Electrical engineers—Power Systems Design; Civil and Electrical Engineers; Project Engineers</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>4) Resource Assessment ; Site Surveyor; Resource Analysis</b> | <b>5) Site Managers / in-charge /supervisor; Construction / Project Managers</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>6) Asset Management; Quality &amp; Vendor Management Engineers</b> |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
|                  | <p>between industry and ITIs is critical.</p> <p><b>Curriculum Development:</b> Practical experience at solar and wind sites, knowledge of latest equipment, data and analytical skills aligned with industry requirements; emphasis on development of local skilled workforce; engage more master trainers from the industry</p> <p><b>Gender:</b> Security and reduced physical work at sites (lifts for climbing windmill; automated O&amp;M); hostel facilities at ITI to encourage women in relevant trades; counselling and mentoring at high school level and encouraging women candidates by awareness on POSH, equal opportunity, etc.</p> <p><b>Skill Initiatives:</b> Dual vocational skilling programmes; apprenticeships should be made mandatory; Compulsory OJT components during education/training; involvement of industry trainers for teaching and mentoring (aligning students' interests and expectations for better matching and lowering attrition)</p> |                                                                | <p>between industry and engineering colleges is critical.</p> <p><b>Curriculum Development:</b> Develop specialised courses on RE technology (at present industry hires from general pool of engineering graduates, and trains them to RE needs); development of soft skills should be integral to the curriculum.</p> <p><b>Gender:</b> Counselling and mentoring from high school level, encouraging women candidates in RE engineering trades, and generating awareness on renewable energy company practices (on POSH, equal opportunity, etc.)</p> <p><b>Skill Initiatives:</b> Compulsory OJT components during education/training; involvement of industry trainers for teaching and mentoring (aligning students' interests and expectations for better matching and lowering attrition)</p> |                                                                  | <p><b>Curriculum Development:</b> Curriculum should impart engineering (specific to RE) and managerial skills, along with practical experience at solar and wind sites; Emphasis on development of local skilled workforce; development of soft skills (especially excellent communication skills) and knowledge of safety considerations on-site should be integral to the curriculum</p> <p><b>Gender:</b> Counselling and mentoring from high school level, encouraging women candidates in RE engineering trades, and generating awareness on renewable energy company practices (on POSH, equal opportunity, etc.)</p> <p><b>Skill Initiatives:</b> Compulsory OJT components during education/training; involvement of industry trainers for teaching and mentoring (aligning students' interests and expectations for better matching and lowering attrition); skill development at local level</p> |                                                                       |

Source: NCAER survey.

Notes: © Pink shade indicates no match between I-O quantitative top 5 occupation projections (Chapter 3) and survey-based top 6 occupation projections

## 8.7 Recommended Methodology

Based on the above, the recommended methodology to assess skills shortages and skill gaps for this sector is the following:

1. Map the sub-segments of the sector to the NIC code and specify them clearly. For example, the wind sub-sector is not clearly specified in the NIC.
2. Update mapping of NCO 2015 job roles with job roles identified by the Sector Skill Councils. This should be an annual exercise.
3. In coordination with the Ministry of Skill Development and Entrepreneurship, the Sector Skill Council needs to implement surveys on a regular (at least annual) basis, which captures vacancies of firms. The job roles should be mapped/matched with the ones previously identified. Ideally the Economic Census forms the frame for any survey. Given the lack of data, the Ministry of Corporate Affairs' database or Goods and Services Tax Network are the other sources of universal data, from where data may be used to derive the universe. That universe needs to be divided into the sub-sectors as previously identified. Then proper sampling strategy needs to be adopted to understand the validity of the results. Biases needs to be addressed. Response rates should also be collected.
4. Big Data analysis is highly recommended for SSCs using various job sites<sup>28</sup> They should also use/assess data from National Career Services and various employment exchanges around the country. The job roles should be mapped/matched with previously identified job roles.
5. The questionnaires asked respondents of the mediums used for hiring employees. While direct recruitment through job fairs at ITI and campus recruitments from engineering colleges were common, several firms also advertised positions on websites such as LinkedIn, Naukri.com, and Workindia.in and National Career Services. The job details from advertised positions on these portals can help create a good database to understand the kind of job roles which are in demand by the industry along with the corresponding educational qualifications, skill-sets, and salaries. Constant tracking of such data can also help keep the job-roles and skills database dynamic.
6. Stakeholder interactions needs to be carried out as an annual exercise based on templates designed by the MSDE. It will capture jobs which are difficult to fill but also get a holistic view of the sector in terms of emerging technological trends, emerging jobs, detailed qualitative needs for qualifications and skills, hiring practices, best practices of firms, migration trends, practices to encourage female labour force participation, etc.
7. Last but not the least, the MSDE, Ministry of Labour and Employment and Ministry of Statistics and Programme Implementation should design an occupation-wage-employment survey. It is absolutely important to identify the occupation codes mentioned in Step 2. Ideally the Economic Census forms the frame for any survey.

This chapter puts forth the methodology and the instrument which can be useful to gather insights on skill shortages in the green electricity sector, and how it may be captured on a dynamic basis. Through the challenges faced in testing out the methodology, the chapter also attempts to present practical solutions to the same.

---

<sup>28</sup> Big data should only be used as a 'supplement': As many job roles, especially the core manufacturing job roles which tend to be filled through campus placements from engineering colleges and ITI, may not to be advertised online. They will hence be missed in the big data analysis, despite being in-demand and faced with a skill shortage.

Given the novel nature of the exercise, in-person interviews are recommended at the start. Though, MSDE may consider moving to direct submission of details by the firms once the Labour Market Information System (LMIS) goes online, and the process of data collection has been regularised and popularised. This direct submission could involve uploading an electronic version of the questionnaire on the MSDE website, which can be accessed by the firms to submit their answers.

Moving forward, it would be a good idea to also consider the sector of manufacturing of solar panels and wind turbines and towers, as all technological advancements in the renewable energy industry – to manufacture more efficient solar and wind equipment – are happening in this stage. While this was outside the scope of the present study, several stakeholders highlighted the issue of shortage of workers for manufacturing, which stands to hold back the expansion of solar and wind electricity generation in India and the achievement of 2030 targets. It should not be a difficult task to do so, since the OEMs (i.e., original equipment manufacturers) are already mentioned among the stakeholders who should be contacted for the study (as they also tend to be involved in O&M activities).

Though the usefulness of a labour market information system was acknowledged by the respondents, the workforce will be able to fulfil the skill demands only when the education and skilling ecosystem can keep up with designing their curriculums in the desired manner as well. ITI and engineering colleges must look up to collaboration possibilities with the industry to prepare an industry ready workforce, particularly at the local village-level where renewable energy plants are located / are in the pipeline.

## 9. Trade: Retail Trade in Food, Clothing, Footwear and Leather Articles in Specialised Stores

### 9.1 Definition

The sub-sectors in the sector that are used for analysis in this report include retail sale of food in specialised stores and retail sale of clothing, footwear and leather articles in specialised stores. The composition of these sectors is given below in Table 9.1.

**Table 9.1: NIC codes in the retail sector**

| <i>NIC 4-digit</i> | <i>NIC 5-digit</i> | <i>Description</i>                                                                                                                       |
|--------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4721</b>        |                    | Retail sale of food in specialised stores                                                                                                |
|                    | 47211              | Retail sale of cereals and pulses, tea, coffee, spices, and flour                                                                        |
|                    | 47212              | Retail sale of fresh or preserved fruit and vegetables                                                                                   |
|                    | 47213              | Retail sale of meat, meat products, poultry products, fish, other seafood, and products thereof                                          |
|                    | 47214              | Retail sale of bakery products, dairy products, and eggs                                                                                 |
|                    | 47215              | Retail sale of sugar confectionery and sweetmeat                                                                                         |
|                    | 47219              | Retail sale of other food products n.e.c.                                                                                                |
| <b>4771</b>        |                    | Retail sale of clothing, footwear, and leather articles in specialised stores                                                            |
|                    | 47711              | Retail sale of readymade garments, hosiery goods, other articles of clothing and clothing accessories such as gloves, ties, braces, etc. |
|                    | 47712              | Retail sale of articles of fur and artificial fur                                                                                        |
|                    | 47713              | Retail sale of footwear                                                                                                                  |
|                    | 47714              | Retail sale of leather goods and travel accessories of leather and leather substitutes                                                   |

Source: Central Statistical Organisation, Ministry of Statistics and Programme Implementation. 2008. [National Industrial Classification \(All Economic Activities\)](https://www.ncs.gov.in/Documents/NIC_Sector.pdf). 2008. [https://www.ncs.gov.in/Documents/NIC\\_Sector.pdf](https://www.ncs.gov.in/Documents/NIC_Sector.pdf).

### 9.2 Background

The Retailers' Association Skill Council of India (RASCI) 2024 report says that India is the fourth largest retail market in the world and ranks second in the Global Retail Development Index.<sup>1</sup> The size of the Indian retail market was valued at USD835.9 billion in FY' 2022 and was forecasted to growth at a Compound Annual Growth Rate of 10 per cent to reach ~USD 1.2 trillion by financial year (FY) 26. In FY'22, it was estimated that the unorganised segment was 81.5 per cent of the retail sector which is estimated to go down to 72.3 per cent in the FY' 26. The Indian retail has three main channels—Traditional Retail (Kirana shops, mom & pop shops, etc.), Modern Retail (regional stores & national chain of stores) and Online channels (direct to consumer platforms and aggregators). There are several factors that are driving the growth in the sector—increased urbanisation, growing incomes, changing consumer preferences, government initiatives to attract foreign direct investment, e-Commerce and

<sup>1</sup> Wazir Advisors and RASCI. 2022. [Mapping of Employment Scope & Skill Gaps in Retail till FY26](#). Sourced from RASCI.

technological changes.<sup>2</sup> The RBI Report on Currency and Finance projects that the e-Commerce market size will grow to USD300 billion by 2030 and the share of online retail will go up to 14 per cent by 2028.<sup>3</sup> Both online users and digitally influenced users are projected to increase exponentially.

### 9.3 Value Chain in the Retail Sector

The value chain for the two sub-sectors, retail sale of food in specialised stores and retail sale of clothing, footwear and leather articles in specialised stores is described below. The value chains for both the sub-sectors are broadly same. The retail sector value chain starts with selection of locations for establishment of shops /e-Commerce platforms through market surveys and it goes up to customers' satisfaction to ensure sustainability of business. The various stages of value chain and the associated job roles in each stage are given below (Figures 9.1 and 9.2):<sup>4</sup>

- a. Selection of locations for establishment of shops /e-Commerce platforms through market surveys: This involves R&D activities to ascertain the feasibility of the business in a particular area and future scope of expansion of business.
- b. Selecting type of shops based on needs complete shops versus 'grab and go' shops versus e-Commerce platforms: This stage of the value chain is the extension of the first stage. This involves finding out the type of shops/ scope of online platforms in the areas under consideration.
- c. Product finalisation through consumers' surveys, adhering to government norms: This stage of value chain involves finalisation of products keeping in mind the taste and preferences, type of consumer base and financial capacity of the consumers.
- d. Procurement (ensuring timely supply of products at the store): The next stage involves procurement of products for the establishments to ensure timely supply at the store and also to see that procurements are commensurate with anticipated demand which ensures minimum wastages in case of perishables and minimum storage expenses in case of other goods.
- e. Storage and warehousing: This involves cold storage (for perishables)/ storage of goods which would be ensuring minimum wastage, quick supply to stores, minimising delivery times in case of e-commerce operations.
- f. Store management: This involves assigning space to various sections, promotion of new products, store security, ICT infrastructure, customer support at store and delivery at doors (for e-commerce operations).
- g. Customers' satisfaction: This involves customer support, customer grievances, customer feedback.

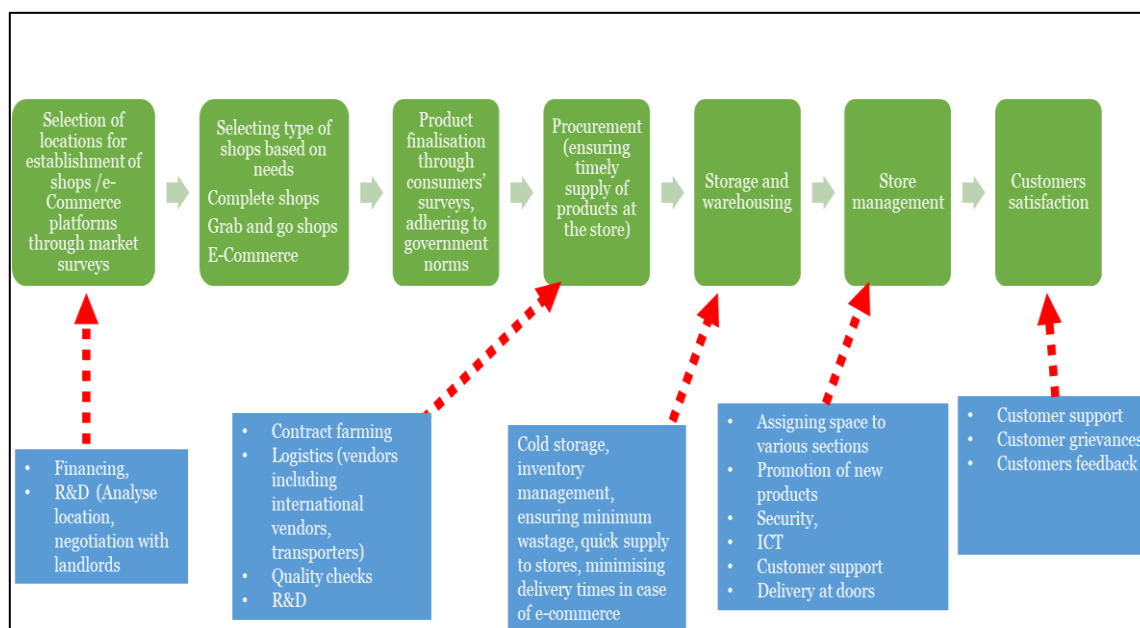
---

<sup>2</sup> Sharma, S. 2024. "Retail Industry in India: Trends and Insights". <https://www.indianretailer.com/article/retail-business/retail/retail-industry-india-overview-retail-sector-market-size-growth>. May 20.

<sup>3</sup> Reserve Bank of India. 2024. Report on Currency and Finance. <https://rbi.org.in/Scripts/AnnualPublications.aspx?head=Report%20on%20Currency%20and%20Finance>. July 29.

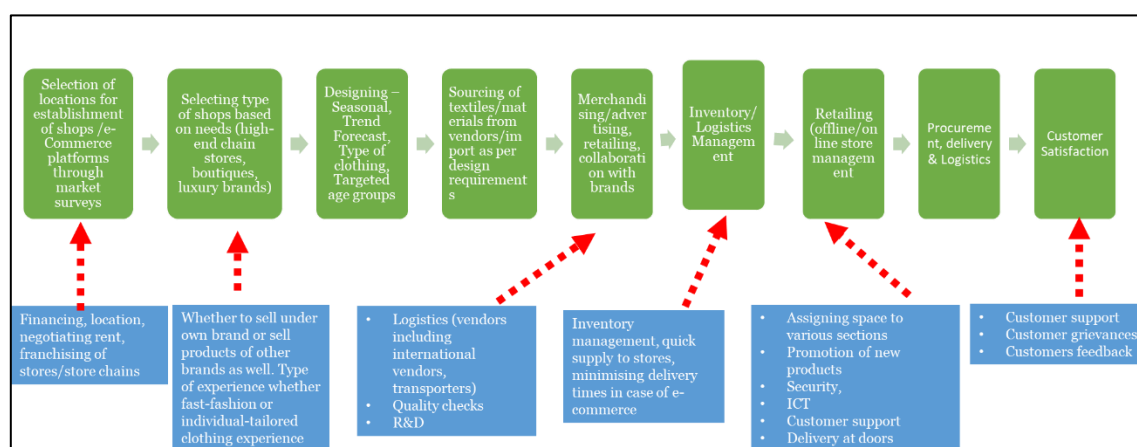
<sup>4</sup> This has been paraphrased from Wazir Advisors and RASCI. 2022. Mapping of Employment Scope & Skill Gaps in Retail till FY26. Sourced from RASCI and consultation with retail sector experts.

**Figure 9.1: Defining value chain for retail sale of food in specialised stores**



Source: NCAER conceptualisation from literature review and expert consultation.

**Figure 9.2: Defining value chain for retail sale of clothing and footwear in specialised stores**



Source: NCAER Conceptualisation from Literature Review and Expert Consultation.

## Digital transformation of the retail sector

The rapidly changing technology has (creatively) disrupted business model and value chain in retail trade. Consequently, both the organised and traditional retail have had to adapt themselves to changing needs. Further, the share of organised retail is also increasing. The combination of these changes is making the sector more structured and organised unlike the largely informal nature of retail trade that had existed so far. The increased share of organised retail segments, is creating more opportunities for good quality jobs with social security.

The requirements for digital skills due to the transformation from traditional retail to modern retail and the e-Commerce is discussed below. Table 9.2 shows an Artificial



Intelligence-enabled value chain. Specific examples are given below to illustrate the increased demand for digital skills in each job role due to the deployment of technology in this sector.

- Traditional retail shops cater to a small area as compared to modern retail and e-Commerce. Due to broadening of areas of operations, this involves research and development (R&D) activities to ascertain the feasibility of the business in a particular area and future scope of expansion of business. Data analytics is the key job role required which involves analysis of diversified large-scale data on consumer base, change in taste and preferences of customers.
- With the growth of modern retail and e-Commerce and entry of large corporate players into retail, competition in the retail segment has increased and there is a need to study the moves of the competitors. Demand for Artificial Intelligence has increased.
- With importance of modern retail and e-Commerce rising, the value chain in retail has become structured. With increase in coverage area, products base, and type of customers, all the levels of the value chain, from location finalisation to products finalisation to procurement of products to storage and warehousing to store management, have to be integrated and automated. Deep learning may help in inventory management.<sup>5</sup> This requires digitisation of databases, and thus computer literacy in job roles at every level of the value chain. One multi-brand retail manager told that decision about products selection, supply of products to stores, manpower requirements are taken at the headquarters level. This requires highest levels of digitisation. Advanced degree in Information Technology and Artificial Intelligence is required.
- In-person store managers are replaced by virtual store managers, thus requiring digital skills among the workers. Augmented intelligence help in store operation and sales and customer use and support.<sup>6</sup>
- Transactions in retail stores are done through bar code reading. Preparing bar codes for all the products requires to be created and computer operator becomes a key job role required.
- GPS (Global Positioning System) and RFID (Radio-Frequency Identification) technology, cloud/hybrid storage, blockchain technology are extensively used in modern retail. Digital skills are required in every job role associated with these operations.
- Quick commerce is a very specialised form of e-Commerce. “E-commerce’ refers to the online purchase, or sale, of a good or service, which can take 3–4 or longer days to deliver, whereas Q-commerce aims to deliver in a 30–60 minutes span.”<sup>7</sup> Q-commerce has digitised the whole business model.<sup>8</sup> There

---

<sup>5</sup> Oosthuizen, K., Botha, E., Robertson, J., & Montecchi, M. 2020. “Artificial intelligence in retail: The AI-enabled value chain”. *Australasian Marketing Journal*. 29(3): 264–273. <https://doi.org/10.1016/j.ausmj.2020.07.007> (Original work published 2021).

M Naik, D., Dokku, S., Nagamalleswara, V., Srinivas, K., Challa, S. and Narayana, M. 2023. “Impact of Artificial Intelligence on the Indian Retail Industry”. *Financial Engineering*. 1. 316–325. 10.37394/232032.2023.1.30.

<sup>6</sup> Oosthuizen, K., Botha, E., Robertson, J., & Montecchi, M. 2020. “Artificial intelligence in retail: The AI-enabled value chain”. *Australasian Marketing Journal*. 29(3): 264–273.

<sup>7</sup> Business Standard website. <https://www.business-standard.com/about/what-is-quick-commerce>.

<sup>8</sup> Ranjekar, G. and Roy, D. 2023. “Rise of Quick Commerce in India: Business Models and Infrastructure Requirements”. Centre for Transportation and Logistics, IIM Ahmedabad.



are three key aspects of Q-commerce-technology, dark stores,<sup>9</sup> and delivery partners.<sup>10</sup> Warehousing plays a significant role in making supply chains in Q-commerce efficient. *“The coordination between upstream dark stores, distribution centres, and downstream delivery partners is crucial for the quick fulfilment of orders (for example, within 15 minutes). Data-driven demand estimation models improve warehouse management efficiency when the order fulfilment process gets delayed and becomes costly. Through historical customer data analysis and real-time data capturing, various parameters such as high-demand parts, order volumes, and order seasonality can be predicted in advance. Also, strategic locations for distribution centres can be planned by leveraging advanced data management technology. Various parameters such as population density, road networks, and busy zones are considered while selecting the locations to ensure that delivery times are minimised”* (Ranjekar and Roy 2023; pp 15).<sup>11</sup>

**Table 9.2: Artificial intelligence-enabled value chain in retail**

| <b>Stage of value chain</b>      | <b>Technologies</b>                                                                                                                                                                                     | <b>Outcome</b>                                       |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Inventory Management             | Chatbot, insight engines, intelligent applications, machine learning, virtual assistant                                                                                                                 | Predict demand close to supply                       |
| Operations Optimisation          | AI-related Consulting System Integration Services (AI-related C&SI), Computer vision, Deep Learning, Edge AI, Intelligent applications, Machine Learning, Robotic process automation, virtual assistant | Operating efficiently and effectively                |
| Customer Engagement              | AI-related C&SI, Augmented Intelligence, Chatbox, Computer Vision, Deep Learning, Edge AI, Insight engines, Intelligent applications, Machine Learning, Speech recognition, Virtual assistants          | To build customer trust                              |
| Knowledge and insight management | AI-related C&SI, Deep Learning, Edge AI, GPU Accelerators, Insight Agents, Intelligent Applications                                                                                                     | Provide insights by managing, processing information |

Source: Adapted from Oosthuizen, K., Botha, E., Robertson, J., & Montecchi, M. 2020. “Artificial intelligence in retail: The AI-enabled value chain”. *Australasian Marketing Journal*. 29(3), 264–273. <https://doi.org/10.1016/j.ausmj.2020.07.007> (Original work published 2021).

[https://www.iima.ac.in/sites/default/files/2023-06/Q-com%20-%20Ranjekar%20%26%20Roy\\_o.pdf](https://www.iima.ac.in/sites/default/files/2023-06/Q-com%20-%20Ranjekar%20%26%20Roy_o.pdf). March.

<sup>9</sup> “Dark stores are micro warehouses scattered in dense neighbourhoods that aid the efficient delivery of products.”Ranjekar, G. and Roy, D. 2023. “Rise of Quick Commerce in India: Business Models and Infrastructure Requirements”. Centre for Transportation and Logistics, IIM Ahmedabad. [https://www.iima.ac.in/sites/default/files/2023-06/Q-com%20-%20Ranjekar%20%26%20Roy\\_o.pdf](https://www.iima.ac.in/sites/default/files/2023-06/Q-com%20-%20Ranjekar%20%26%20Roy_o.pdf). March.

<sup>10</sup> Ranjekar, G. and Roy, D (2023), cited above. Potdukhe, S., Dixit, S., & Kumar, A. 2022. Quick Commerce: The Business of Instant Gratification. JM Financial Institutional Securities Limited. India Internet Sector Report. <https://www.jmflresearch.com/JMnew/JMCRM/analystreports/pdf/%5BJMFL%5D%20India%20Internet%20Quick%20Commerce%2010June22.pdf>. JM Financial Institutional Securities Ltd. June 10.

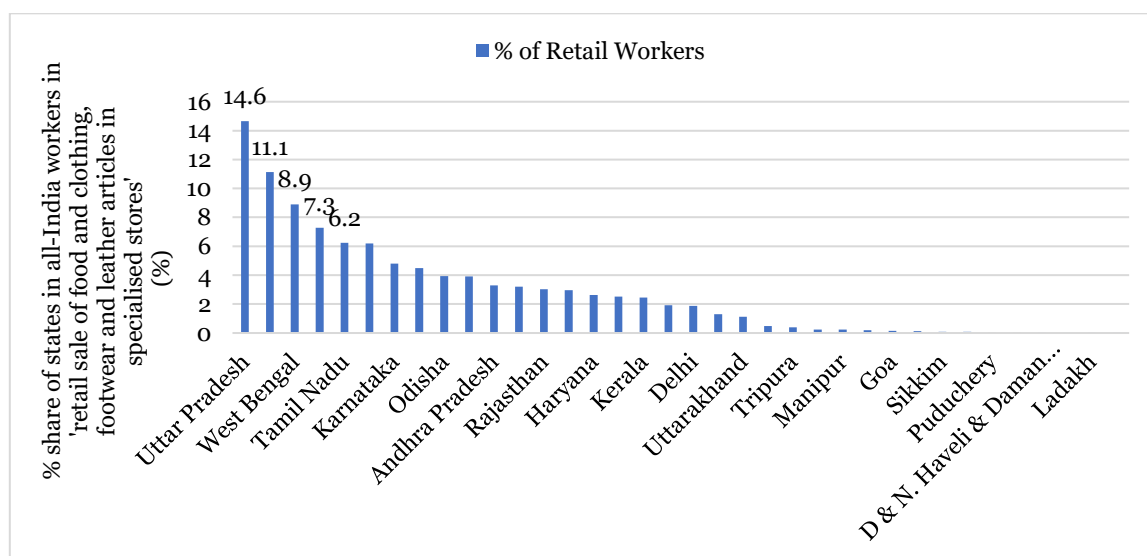
<sup>11</sup> Ranjekar, G. and Roy, D (2023), cited above.

## 9.4 Workforce Characteristics

- a. **Female:** The share of female workers in 'retail sale of food in specialised stores' is 21.4 per cent and 'retail sale of clothing, footwear and leather articles in specialised stores' is 15.8 per cent. When the total workers in both the sub-sectors are clubbed together, the percentage share of female workers in these two sub-sectors is 20 per cent.
- b. **State:** Uttar Pradesh, Bihar, West Bengal and Maharashtra are the top four States in terms of concentration of workers in the retail trade sector of retail sale of food and clothing, footwear and leather articles in specialised stores' (Figure 9.3). In the sub-sector retail sale of food in specialised stores, maximum number of workers are in Uttar Pradesh followed by Bihar, West Bengal and Maharashtra. In the sub-sector Retail sale of clothing, footwear and leather articles in specialised stores, maximum number of workers are in Uttar Pradesh followed by West Bengal, Maharashtra and Bihar.

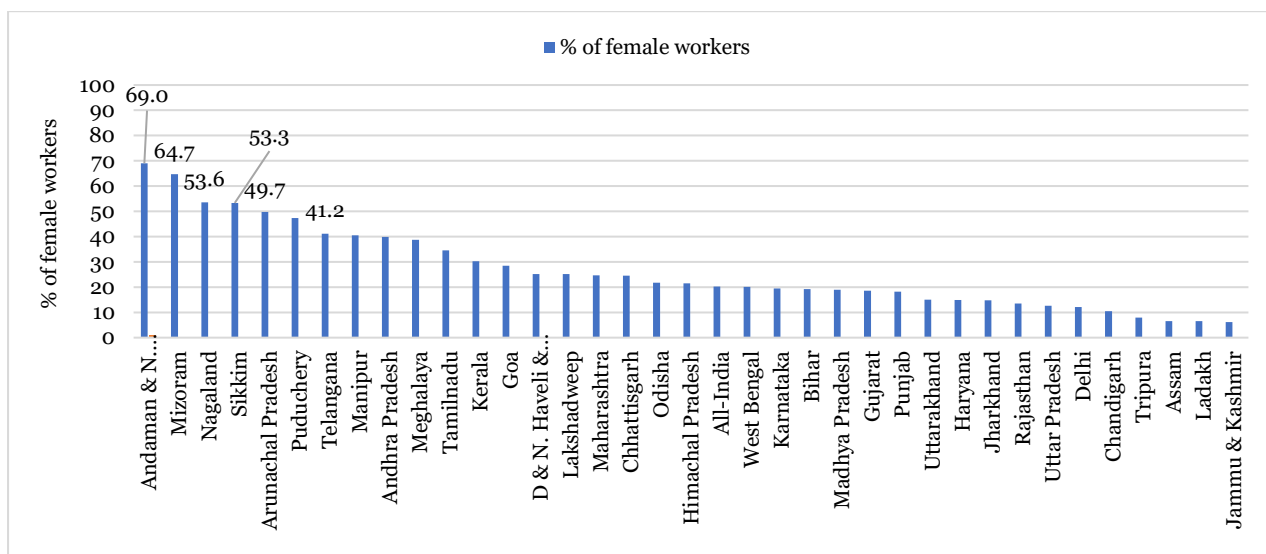
The presence of female workers in these two sub-sectors together is relatively higher in the North-eastern States and UTs like Andaman & Nicobar Islands & Puducherry (Figure 9.4). Among the bigger States the presence of female workers is higher in Southern States like Telangana (41 per cent), Andhra Pradesh (40 per cent), and Tamil Nadu (35 per cent).

**Figure 9.3: State-wise share of workers (aged 15+) in retail sale of food and clothing, footwear and leather articles in specialised stores'**



Source: NCAER Analysis from PLFS 2022–23.

**Figure 9.4: State-wise percentage of female workers (aged 15+) in retail sale of food and clothing, footwear and leather articles in specialised stores', 2022–23**



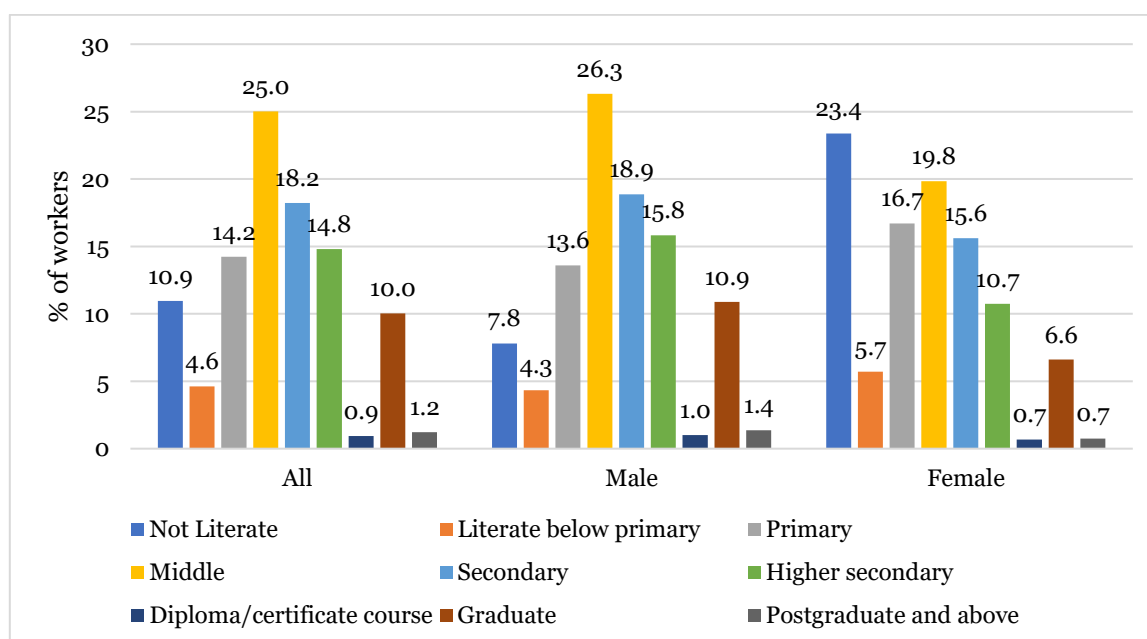
Source: NCAER analysis from PLFS 2022–23.

### c. **Retail sector workers across education levels**

- **General Educational Attainment**: Combining both the sub-sectors' data, one finds that 11 per cent of workers are not literate, 25 per cent of workers have attained middle school and 18.2 per cent have secondary school attainment (Figure 9.5). Larger percentage of workers are having educational level of Middle and Secondary (43 per cent). The corresponding figures for male and female were 45 per cent and 35 per cent respectively. The male workers were relatively better educated than female workers. Notably, while, only 7.8 per cent of male workers are 'not literate', 23.4 per cent of female workers belong to this category.

In the sub-sector retail sale of food in specialised stores, larger share of workers had education level between middle and secondary (42 per cent), followed by 34 per cent with education level up to primary. Only 24 per cent of workers were higher secondary and above. In the sub-sector retail sale of clothing, footwear and leather articles in specialised stores, 47 per cent of workers had education level between middle and secondary. 39 per cent were higher secondary and above educated and 14 per cent were up to primary level of education.

**Figure 9.5: General educational attainment of retail sector workers (aged 15+), 2022–23**

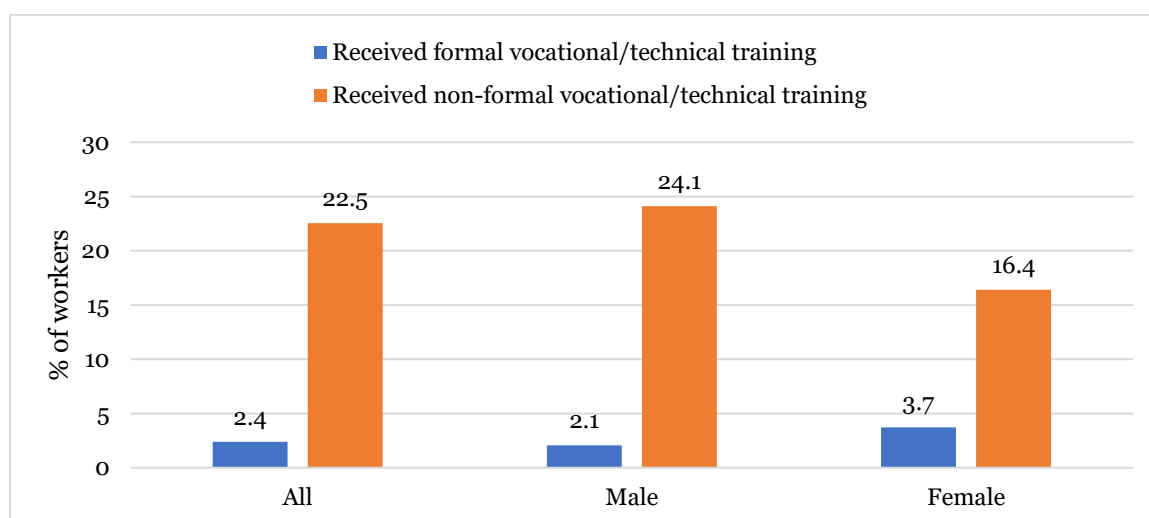


Source: NCAER Analysis from PLFS 2022–23.

- **Technical Educational Attainment:** 98 per cent of workers do not have any technical education. Only around 2 per cent of workers in the sub-sector ‘retail sale of food in specialised stores’ had some technical education. The corresponding figure for the sub-sector retail sale of clothing, footwear and leather articles in specialised stores, was around 3 per cent. 1.3 per cent of workers have either a technical degree in engineering/technology or diploma or certificate (below graduate level and above graduate level) in engineering/technology. The rising importance of e-Commerce would give a rise to needs for workers with a technological background, although currently the share of workers is relatively low.
- **Vocational Education:** 2.4 per cent of workers had received formal vocational education and 22.5 per cent non-formal vocational education (Figure 9.6). Only 2 per cent of workers had received formal vocational/technical training in the ‘retail sale of food in specialised stores’ sub-sector. The corresponding figure for the sub-sector ‘retail sale of clothing, footwear and leather articles in specialised stores’, was around 4 per cent.

Interestingly, more males had received non-formal vocational training and more females had received formal vocational training.

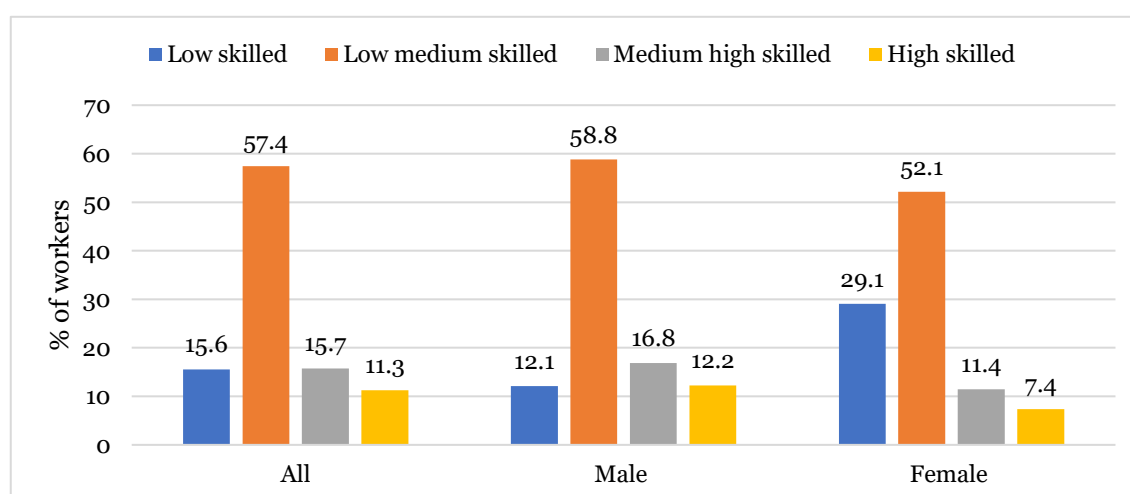
**Figure 9.6: Vocational/technical training attainment of retail sector workers (aged 15+), 2022–23**



Source: NCAER Analysis from PLFS 2022–23.

- d. **Retail sector workers across skills levels:** The retail sector is characterised by low-medium skill workers. About a third of the female workers are low-skilled (Figure 9.7).

**Figure 9.7: Skill levels of retail sector workers (aged 15+), 2022–23**

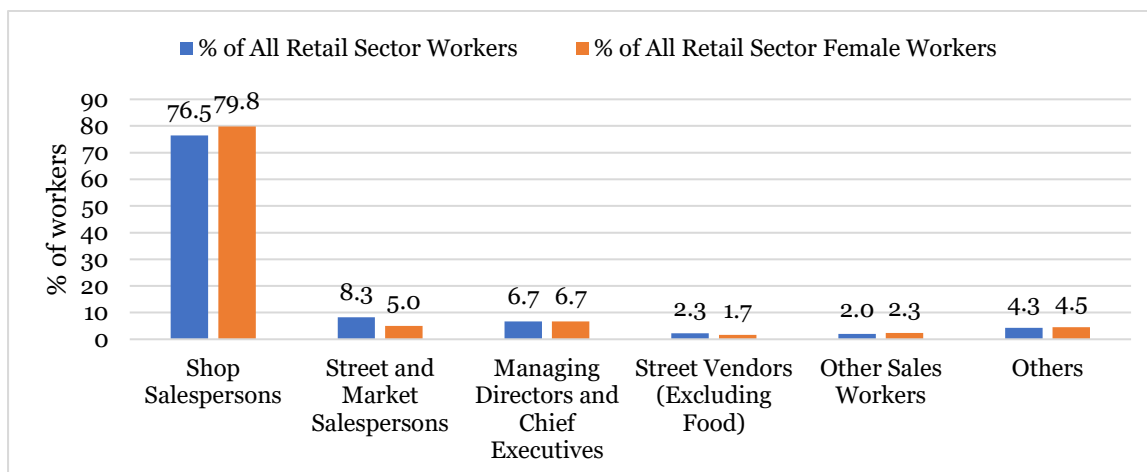


Source: NCAER Analysis from PLFS 2022–23.

- e. **Retail sector workers across occupations:** The PLFS gives the occupations of workers engaged in various sectors as per National Classification of Occupations (NCO) 2015 at 3-digit level. In the retail sector, 76.5 per cent of workers were working as ‘shop salespersons’ and this number for female workers was 80 per cent (Figure 9.8). Other prominent occupations in these two sub-sectors were Street and Market Salespersons (around 8 per cent in both the sub-sectors), and Managing Directors and Chief Executives (7 per cent in

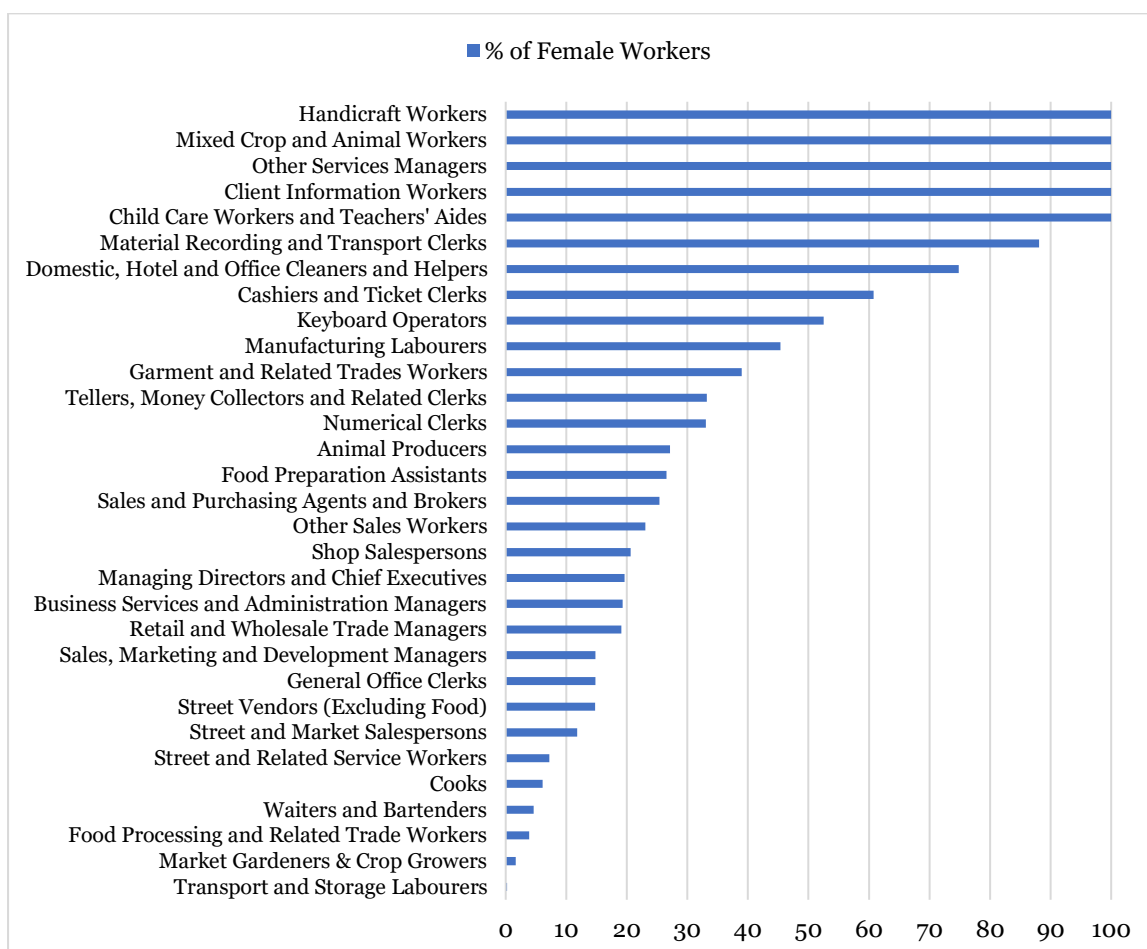
the sub-sector Retail sale of food in specialised stores and around 5 per cent in Retail sale of clothing, footwear and leather articles in specialised stores).

**Figure 9.8: Percentage share of workers (aged 15+) across occupations (NCO 3-digit)**



Source: NCAER Analysis from PLFS 2022–23.

**Figure 9.9: Job roles-wise percentage of female workers, 2022–23**



Source: NCAER Analysis from PLFS 2022–23.

However, Figure 9.9 shows that the share of females in certain job roles is more than 50 per cent and rest below that. The ones that are below 50 per cent are the ones that are more leadership roles—Managing Directors, CEOs, Managers, etc. Females are more engaged in supportive roles.

- f. ***Engagement Status of Retail Sector workers (Table 9.3):*** PLFS divides the engagement status of workers as two broad groups, self-employed and hired workers (employees). Again, self-employed workers are classified under own account workers, employers and unpaid family labour. Hired workers are further classified as regular wage/ salaried workers and casual wage workers. In the retail sub-sector, ‘retail sale of food in specialised stores’, 65.9 per cent of workers are own-account workers, 2.8 per cent are employers, 20.8 per cent are unpaid family workers, 9.0 per cent are regular-wage workers and 1.5 per cent of workers are casual wage workers. The corresponding numbers for male workers were 73.3 per cent, 3.4 per cent, 11.5 per cent, 10.1 per cent and 1.8 per cent, respectively. The corresponding numbers for female workers were 38.8 per cent, 0.4 per cent, 55.2 per cent, 5.2 per cent and 0.3 per cent, respectively. In the sub-sector, ‘retail sale of clothing, footwear and leather articles in specialised stores’, the share of own-account workers was 42.5 per cent, 5.9 per cent were self-employed, 10.7 per cent were unpaid family workers, 40.0 per cent were regular-wage workers and 1.0 per cent of workers were casual wage workers. In this sector, 37.7 per cent of male workers were working as regular wage employees but the corresponding number for female workers was 52 per cent.

**Table 9.3: Engagement status of retail workers (%)**

|                                                                              | <i>Self-employed</i>              |                 |                                                                               | <i>Regular<br/>salaried/ wage<br/>employee</i> | <i>Casual<br/>Wage<br/>Labour</i> | <i>Total</i> |
|------------------------------------------------------------------------------|-----------------------------------|-----------------|-------------------------------------------------------------------------------|------------------------------------------------|-----------------------------------|--------------|
|                                                                              | <i>Own<br/>account<br/>worker</i> | <i>Employer</i> | <i>Worked as helper<br/>in h.h. enterprise<br/>(unpaid family<br/>worker)</i> |                                                |                                   |              |
| <b>All Workers (aged 15+)</b>                                                |                                   |                 |                                                                               |                                                |                                   |              |
| Retail sale of food in specialised stores                                    | 65.9                              | 2.8             | 20.8                                                                          | 9.0                                            | 1.5                               | 100.0        |
| Retail sale of clothing, footwear and leather articles in specialised stores | 42.5                              | 5.9             | 10.7                                                                          | 40.0                                           | 1.0                               | 100.0        |
| All workers 15+                                                              | 35.6                              | 3.2             | 18.6                                                                          | 21.4                                           | 21.2                              | 100.0        |
| <b>All Male Workers (aged 15+)</b>                                           |                                   |                 |                                                                               |                                                |                                   |              |
| Retail sale of food in specialised stores                                    | 73.3                              | 3.4             | 11.5                                                                          | 10.1                                           | 1.8                               | 100.0        |
| Retail sale of clothing, footwear and leather articles in specialised stores | 45.7                              | 6.5             | 9.0                                                                           | 37.7                                           | 1.1                               | 100.0        |
| All workers 15+                                                              | 39.6                              | 4.5             | 9.5                                                                           | 24.0                                           | 22.3                              | 100.0        |
| <b>All Female Workers (aged 15+)</b>                                         |                                   |                 |                                                                               |                                                |                                   |              |
| Retail sale of food in specialised stores                                    | 38.8                              | 0.4             | 55.2                                                                          | 5.2                                            | 0.3                               | 100.0        |
| Retail sale of clothing, footwear and leather articles in specialised stores | 25.3                              | 2.7             | 19.8                                                                          | 52.0                                           | 0.1                               | 100.0        |
| All workers 15+                                                              | 27.3                              | 0.6             | 37.4                                                                          | 15.9                                           | 18.8                              | 100.0        |

Source: NCAER analysis from PLFS 2022–23.

## 9.5 Geographical Clusters in the Retail Sector

As mentioned previously, the majority of the retail sector is unorganised. There is no unified data source which will provide data on the sector for both organised and unorganised sectors. While there are various methodologies available which have been used for other sectors, constraints of data inhibit using any specific methodology.

Therefore, to overcome this challenge, data on the number of units were used. This is available only for the unorganised sector. The data source for the unorganised sector is the Enterprise Survey provided by the MoSPI for unincorporated enterprises. Then for the organised sector, memberships by State are taken from the Retailers Association of India. Lastly to measure innovation, one takes the data on number of start-ups from the DPIIT. At the State level, the geographical clusters' top eight States are Maharashtra, Karnataka, West Bengal, Tamil Nadu, Uttar Pradesh, Gujarat, Delhi, and Telangana (Table 9.4). Intuitively these results make senses since all the Tier 1 cities are located in these States.

The correlation between rankings based on share of workers and geographical clusters is 0.9 (Figure 9.10).

**Table 9.4: Geographical clusters in the retail sector**

|                  | <i>Rank using ASUSE survey, 2021-22</i> | <i>Rank using Retailers Association of India members</i> | <i>Rank using no. of start-ups</i> | <i>Average rank</i> |
|------------------|-----------------------------------------|----------------------------------------------------------|------------------------------------|---------------------|
| Maharashtra      | 3                                       | 1                                                        | 1                                  | 1.7                 |
| Karnataka        | 5                                       | 4                                                        | 3                                  | 4.0                 |
| Uttar Pradesh    | 1                                       | 9                                                        | 4                                  | 4.7                 |
| West Bengal      | 2                                       | 3                                                        | 9                                  | 4.7                 |
| Tamil Nadu       | 6                                       | 2                                                        | 7                                  | 5.0                 |
| Gujarat          | 8                                       | 10                                                       | 5                                  | 7.7                 |
| Delhi            | 19                                      | 5                                                        | 2                                  | 8.7                 |
| Haryana          | 15                                      | 7                                                        | 6                                  | 9.3                 |
| Telangana        | 14                                      | 6                                                        | 8                                  | 9.3                 |
| Madhya Pradesh   | 7                                       | 11                                                       | 12                                 | 10.0                |
| Kerala           | 17                                      | 7                                                        | 11                                 | 11.7                |
| Bihar            | 4                                       | 19                                                       | 13                                 | 12.0                |
| Andhra Pradesh   | 9                                       | 12                                                       | 16                                 | 12.3                |
| Odisha           | 10                                      | 13                                                       | 14                                 | 12.3                |
| Rajasthan        | 12                                      | 15                                                       | 10                                 | 12.3                |
| Punjab           | 13                                      | 17                                                       | 15                                 | 15.0                |
| Assam            | 16                                      | 14                                                       | 17                                 | 15.7                |
| Jharkhand        | 11                                      | 25                                                       | 17                                 | 17.7                |
| Chhattisgarh     | 20                                      | 18                                                       | 17                                 | 18.3                |
| Jammu & Kashmir  | 18                                      | 20                                                       | 21                                 | 19.7                |
| Uttarakhand      | 21                                      | 23                                                       | 20                                 | 21.3                |
| Meghalaya        | 24                                      | 16                                                       | 25                                 | 21.7                |
| Chandigarh       | 27                                      | 23                                                       | 22                                 | 24.0                |
| Himachal Pradesh | 22                                      | 29                                                       | 22                                 | 24.3                |
| Puducherry       | 28                                      | 20                                                       | 27                                 | 25.0                |
| Goa              | 29                                      | 20                                                       | 28                                 | 25.7                |
| Tripura          | 25                                      | 29                                                       | 24                                 | 26.0                |



|                             | <b>Rank using ASUSE survey, 2021-22</b> | <b>Rank using Retailers Association of India members</b> | <b>Rank using no. of start-ups</b> | <b>Average rank</b> |
|-----------------------------|-----------------------------------------|----------------------------------------------------------|------------------------------------|---------------------|
| Manipur                     | 26                                      | 25                                                       | 28                                 | 26.3                |
| Arunachal Pradesh           | 23                                      | 29                                                       | 28                                 | 26.7                |
| Andaman & N. Island         | 32                                      | 25                                                       | 27                                 | 28.0                |
| Nagaland                    | 30                                      | 29                                                       | 25                                 | 28.0                |
| Mizoram                     | 34                                      | 25                                                       | 28                                 | 29.0                |
| Sikkim                      | 31                                      | 29                                                       | 28                                 | 29.3                |
| D & N. Haveli & Daman & Diu | 33                                      | 29                                                       | 27                                 | 29.7                |
| Lakshadweep                 | 35                                      | 29                                                       | 28                                 | 30.7                |

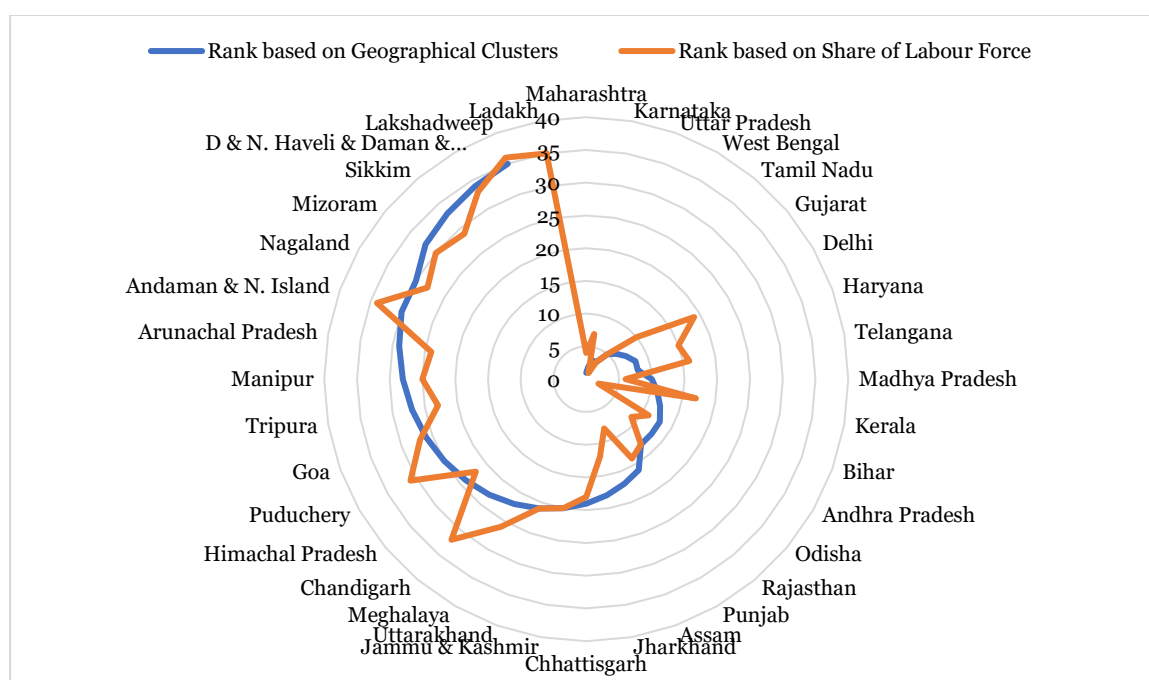
Sources:

1. Ministry of Statistics and Programme Implementation. 2024. Annual Survey of Unincorporated Sector Enterprises (ASUSE) of 2021-2022. DDI-IND-MOSPI-NSSO-ASUSE2122. <https://microdata.gov.in/nada43/index.php/catalog/196>.
2. DPIIT website. <https://www.startupindia.gov.in/digital-map/maps>

Retailers Association of India website.

Note: The industries that were filtered were retail and other speciality retailers.

**Figure 9.10: State-wise rankings based on geographical clusters and share of labour force**



Sources: NCAER computations from Figure 9.3 and Table 9.3.

Note: Lower ranking means higher concentrations.

## 9.6 Occupational Mapping

Occupational mapping of job roles in the retail sector from PLFS and corresponding job roles as detailed by the RASCI (both from their website and report) are given in Annexure 9.1. Essentially, the PLFS helps identify job roles at the NCO 3-digit level. Then based on expert knowledge and literature review, one identifies the exact job role at the 8-digit level. Then they were mapped to job roles available at the RASCI website and their latest report.

## 9.7 Stakeholders' Survey

This section deals with primary survey of the stakeholders associated with the retail trade sector.

### 9.7.1 Survey Methodology

Companies across traditional retail, modern retail and online channels were selected to understand the nuances across clusters. Firms were spread across Delhi and Uttar Pradesh (North), Maharashtra (West), Bihar/ Jharkhand (East) and Chhattisgarh (Central). Also, firms were chosen across size (small, medium, and large). The questionnaire for firms in the retail sector is attached at the end of the report (Questionnaire no. 9). Further, to understand the skill gaps in the retail sector, other stakeholders were also interviewed. They were Government ministry/department, sector skill council, industry association, and training agencies. The number of interviews conducted across various groups is given below (Table 9.5).

**Table 9.5: Survey of stakeholders**

| <b>Sector</b>                            |        | <b>Retail sale of food, clothing and shoes</b> |
|------------------------------------------|--------|------------------------------------------------|
| Ministry                                 |        | 1                                              |
| Sector Skill Council                     |        | 1                                              |
| National-level Industry Association      |        |                                                |
| No of Firms                              | Micro/ | 7                                              |
|                                          | Small  |                                                |
|                                          | Medium | 4                                              |
|                                          | Large  | 4                                              |
|                                          | Total  | 19                                             |
| No. of Placement Cells/TVET Institutions |        | 2                                              |
| Recruitment Agencies                     |        | 1                                              |
| Other Stakeholders                       |        | 2                                              |
| Total                                    |        | 26                                             |

Source: NCAER.

Note: Response rate was 38 per cent.

Among the 19 retail firms surveyed, 3 were public limited firms, 6 were private limited firms, and 10 were individual owned/ partnership firms. The response rate was 38 per cent. Across designations of respondents in firms' survey, 7 were proprietors, one was HR person, one was MD/CEO, and 10 were GMs/senior managers. State-wise distribution of firms surveyed, 8 were from Delhi, 6 were from Uttar Pradesh, 3 were from Maharashtra, and 2 were from Chhattisgarh.

### 9.7.2 Survey Findings

There are both supply-side and demand-side challenges.

#### *Supply-side challenges*

The survey yielded some key supply-side challenges:

- There is a gap between what is taught (mainly for government sponsored training programmes—Pradhan Mantri Kaushal Vikas Yojana and Deen Dayal Upadhyaya Grameen Kaushalya Yojana.) and what is actually happening at work. Hands-on-training is not there in these programmes.

- The retail employers, particularly the traditional retailers, prefer hiring through their own networks over hiring from government sponsored training institutes. They give more weightage to experience over formal degrees. This discourages students to enroll in training courses. This was also found in the study by RASCI.
- Industry is largely dominated by Micro, Small, and Medium Enterprises (MSMEs) who have little incentive to train as attrition rates are high. Further, MSMEs do not offer internships or summer jobs.
- In contrast, large firms are running their own training programmes providing both technical and non-technical skills.
- One major challenge was that people did not want to relocate to other places for jobs.<sup>12</sup> For this the training centres would train people keeping in mind local job needs. However, one firm interviewed viewed that people would be happy to migrate if jobs offered would be of permanent nature and would have other benefits like medical benefits, paid leave, etc.

### *In-demand Job Roles*

The survey findings with regard to assessment of current and future skills shortage in the retail sector, skills required at the competency level, challenges faced by industries in meeting skill requirements, and policy recommendations based on stake-holders' consultations are elucidated in Tables 9.6. The four job roles which are and will be in demand includes Customer service representative/Sales Associate/Sales person/e-Commerce Marketing Assistant/Manager; Merchandising Manager/ Associate; Logistics manager/ Associate, and ICT Personnel/ Computer operator.

1. *Customer service representative/Sales Associate/Sales person/e-Commerce Marketing Assistant:* In traditional retail, their job is to manage counter, show products to customers and listen to customers and give descriptions about various products. In modern retail, they have to manage certain display sections (like particular apparel, food items, etc.). They have to manage those sections and explain to customers about the products. An e-commerce marketing assistant supports the e-commerce team by managing the online store, they also assist with marketing campaign
2. *Merchandising Manager/ Associate:* A Merchandising Manager/Associate has to do planning, selecting, and optimising product inventory, analysing sales trends, managing stock levels, negotiating with suppliers, and ensuring the right products are available to meet changing customer preferences and expectations.
3. *Logistics Manager/ Associate:* Their job is to act as a link between various layers of the value chain. They perform the coordination role in the value chain. They ensure inventory management, meeting orders, and coordinating with transportation of products so that there will be minimum wastages and timely delivery of products.
4. *ICT Personnel/ Computer operator:* Their job is to manage and maintain the computer systems and networks, ensure data security, and efficient processing of transactions, inventory, and customer database. They also prepare bar codes for products to enable computerised billing.

---

<sup>12</sup> In the states study also, it was highlighted among the surveyed youth that many did not want to migrate.

**Table 9.6: Assessment of current and future skills shortage (findings from stakeholder consultations): retail sale of food, clothing, and shoes in specialised stores: demand shortage is there in four job roles**

| Items                                                                                             | Customer service representative/Sales Associate/Sales person/e-Commerce Marketing Assistant/Manager                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Merchandising Manager/Associate                                    | Logistics Manager/Associate                                                                                                                                                                                                                                                                                                                                                                                                                          | ICT Personnel/Computer Operator                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NCO 3/8-digit code                                                                                | 522                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 332                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 413                                                                                                                                                                                                                                                                                                                                            |
| NCO 8-digit /QP code                                                                              | 5223.0100 (RAS/Q0103),<br>5223.0102 (G&J/Q8302),<br>5223.0103 (G&J/Q8303),<br>5223.0105 (RAS/Q0103),<br>(RAS/Q0606)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3323.0102 (AMH/Q0901)                                              | Not available                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4132.0402 (SSC/Q2212)                                                                                                                                                                                                                                                                                                                          |
| Match from Job Projections (723,932,112,821,312,311)                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                |
| No. of stakeholders which mentioned this                                                          | 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3                                                                  | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 5                                                                                                                                                                                                                                                                                                                                              |
| Extent of the need based on firms interviewed (sum of the numbers from stakeholder consultations) | 500~                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 50~                                                                | 10~                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 5~                                                                                                                                                                                                                                                                                                                                             |
| Location of firms/farms                                                                           | Raipur, Chhattisgarh; Mumbai, Maharashtra; Delhi and Ghaziabad, UP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Raipur, Chhattisgarh; Mumbai, Maharashtra; Delhi and Ghaziabad, UP | Mumbai, Maharashtra and Delhi                                                                                                                                                                                                                                                                                                                                                                                                                        | Raipur, Chhattisgarh; Mumbai, Maharashtra; Delhi and Ghaziabad, UP                                                                                                                                                                                                                                                                             |
| Average monthly income (₹)                                                                        | 10,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 25,000+                                                            | 25,000                                                                                                                                                                                                                                                                                                                                                                                                                                               | 30,000                                                                                                                                                                                                                                                                                                                                         |
| Educational qualifications                                                                        | 10 <sup>th</sup> to Graduate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Graduate/ MBA                                                      | Graduate/ MBA                                                                                                                                                                                                                                                                                                                                                                                                                                        | Bachelor of Computer Applications/Master of Computer Applications                                                                                                                                                                                                                                                                              |
| Skills required at the competency level (3)                                                       | <b>Cognitive Skills:</b> Digital literacy, reading, writing, numeracy, communication skills, ability to speak well, active listening, active learning, problem solving, creativity, learning strategies (new products, new marketing techniques, technology at job), gender diversity, resource management (entrepreneurial skills)<br><b>Socio-emotional Skills:</b> Conscientiousness (good attitude, efficient, speed, agility), openness to experiences (flexibility), behavioural skills for dealing with customers-agreeable (working in a team), emotional stability, extraversion, negotiation and persuasion<br><b>TVET:</b> Occupation specific skills (information about products) |                                                                    | <b>Cognitive Skills:</b> Digital literacy, numeracy, communication skills, ability to speak well, language skills (business language & local language), problem solving, critical thinking, creativity and judgement & decision-making skills<br><b>Socio-emotional Skills:</b> Conscientiousness, agreeable and emotional stability<br><b>TVET:</b> Occupation specific skills = knowledge about value chain, transport, warehousing, finance, etc. | <b>Cognitive Skills:</b> Advanced digital skills, mathematical skills, mathematics reasoning, critical thinking, communication skills (use non-technical language to understand and communicate)<br><b>Socio-emotional Skills:</b> Conscientiousness and agreeable<br><b>TVET:</b> Data analytics, Machine learning, AI based work, statistics |
| Skills Shortage                                                                                   | No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | No                                                                 | Yes; competition from other sectors                                                                                                                                                                                                                                                                                                                                                                                                                  | Yes                                                                                                                                                                                                                                                                                                                                            |
| Skills Gap                                                                                        | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yes                                                                | No                                                                                                                                                                                                                                                                                                                                                                                                                                                   | No                                                                                                                                                                                                                                                                                                                                             |
| Gender (Challenges)                                                                               | <ul style="list-style-type: none"><li>Women participation is limited to certain sub-sectors like clothing and apparel (30%-50%)</li><li>Working hours, locations pose challenges to female participation</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                |

| <i>Items</i>                                                                                  | <i>Customer service representative/Sales Associate/Sales person/e-Commerce Marketing Assistant/Manager</i>                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>Merchandising Manager/Manager/Associate</i>                                                                                                                                                                                                                                                                                                                                   | <i>Logistics Manager/Manager/Associate</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>ICT Personnel/Computer Operator</i>                                                        |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Challenges Faced by Industries in Meeting Skill Requirements                                  | <ul style="list-style-type: none"> <li>Gap between what is taught (mainly for govt. sponsored training programmes-PMKVY and DDU-GKY) and what is actually happening at work</li> <li>Hands-on-training not there</li> <li>Industry is largely MSMEs; have little incentive to train as attrition rates are high;</li> <li>MSMEs do not offer internships; summer jobs</li> </ul>                                                                                                                                                          | <ul style="list-style-type: none"> <li>Gap between what is taught (mainly for govt. sponsored training programmes-PMKVY and DDU-GKY) and what is actually happening at work</li> <li>Hands-on-training not there</li> <li>Industry is largely MSMEs; have little incentive to train as attrition rates are high;</li> <li>MSMEs do not offer internships; summer jobs</li> </ul> | No challenge from the TVET system                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | No challenge from the TVET system                                                             |
| Industry-specific interventions that facilitate skill & capacity development (best practices) | <ul style="list-style-type: none"> <li>Large company are running their own training programme providing both technical and non-technical skills;</li> <li>Willing to pay more for slightly more educated candidates (XIITH pass)</li> <li>Gender sensitisation, public transport, flexible timings</li> <li>Association with sector-skill council (RASCI), labournet, internal job posting (IJP) has helped companies find qualified candidates internally.</li> <li>Traditional firms unaware about govt. skilling programmes</li> </ul> | Industry-specific interventions that facilitate skill & capacity development (best practices)                                                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Large company are running their own training programme providing both technical and non-technical skills;</li> <li>Willing to pay more for slightly more educated candidates (XIITH pass)</li> <li>Gender sensitisation, public transport, flexible timings</li> <li>Association with sector-skill council (RASCI), labournet, internal job posting (IJP) has helped companies find qualified candidates internally.</li> <li>Traditional firms unaware about govt. skilling programmes</li> </ul> | Industry-specific interventions that facilitate skill & capacity development (best practices) |
| Policy Recommendations                                                                        | <ul style="list-style-type: none"> <li><b>Skill Training Programme:</b> RPL and refresher courses</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                               |

| <i>Items</i> | <i>Customer service representative/Sales Associate/Sales person/e-Commerce Marketing Assistant/Manager</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <i>Merchandising Manager/Manager/Associate</i> | <i>Logistics Manager/Manager/Associate</i> | <i>ICT Personnel/Computer Operator</i> |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------|----------------------------------------|
|              | <ul style="list-style-type: none"> <li>• <b>Curriculum Development:</b> Curriculum needs to be expanded to meet the market needs and frequently updated, say every three years;</li> <li>• Sustainable textiles, advanced materials, supply chain invocations, artificial intelligence and machine learning, entrepreneurial training</li> <li>• <b>Gender:</b> Gender sensitization app (recognition that gender diversity is important should be included in training)</li> <li>• <b>Skill Initiatives:</b> Internships should be made mandatory at all levels</li> <li>• <b>Others:</b> <ul style="list-style-type: none"> <li>▪ Demand for jobs directly related to share of e-Commerce; Some jobs will get obsolete over time-cash collector, team supervisor and store supervisor and some jobs are evolving like remote operating executive;</li> <li>▪ Firms' sensitization about skilling, providing apprenticeships/internships, hiring skilled workers needs to be carried out</li> </ul> </li> </ul> |                                                |                                            |                                        |

Source: NCAER Conceptualisation.

Notes: @ Pink shade indicates no match between I-O quantitative top 5 occupation projections and survey-based top 4 occupation projections. Green shade indicates a match.

## 9.8 Recommended Methodology

Based on the above, the recommended methodology to assess skills shortages and skill gaps for this sector is the following:

1. Map the sub-segments of the sector to the NIC code and specify them clearly.
2. Update mapping of NCO 2015 job roles with job roles identified by the Sector Skill Councils. This should be an annual exercise.
3. In coordination with the Ministry of Skill Development and Entrepreneurship, the Sector Skill Council needs to implement surveys on a regular (at least annual) basis, which captures vacancies of firms. The job roles should be mapped/matched with the ones previously identified. Ideally the Economic Census forms the frame for any survey. Given the lack of data, the Ministry of Corporate Affairs' database or Goods and Services Tax Network are the other sources of universal data, from where data may be used to derive the universe. That universe needs to be divided into the sub-sectors as previously identified. Then proper sampling strategy needs to be adopted to understand the validity of the results. Biases needs to be addressed. Response rates should also be collected.
4. Big data analysis is highly recommended for SSCs using various job sites. They should also use/assess data from National Career Services and various employment exchanges around the country. The job roles should be mapped/matched with previously identified job roles.
5. The questionnaires asked respondents of the mediums used for hiring employees. While direct recruitment through job fairs at ITI and campus recruitments from engineering colleges were common, several firms also advertised positions on websites such as LinkedIn, Naukri.com, and Workindia.in and National Career Services. The job details from advertised positions on these portals can help create a good database to understand the kind of job roles which are in demand by the industry along with the corresponding educational qualifications, skill-sets, and salaries. Constant tracking of such data can also help keep the job-roles and skills database dynamic.
6. Stakeholder interactions needs to be carried out as an annual exercise based on templates designed by the MSDE. It will capture jobs which are difficult to fill but also get a holistic view of the sector in terms of emerging technological trends, emerging jobs, detailed qualitative needs for qualifications and skills, hiring

practices, best practices of firms, migration trends, practices to encourage female labour force participation, etc.

7. Last but not the least, the MSDE, Ministry of Labour and Employment and Ministry of Statistics and Programme Implementation should design an occupation-wage-employment survey. It is absolutely important to identify the occupation codes as identified previously. Ideally the Economic Census should form the frame for any survey.

In sum, the Indian retail has three main channels- traditional retail (Kirana shops, mom & pop shops, etc.), modern retail (regional stores & national chain of stores) and online channels (direct to consumer platforms and aggregators). The three forms of retail have different marketing approach, marketing strategy, operation type and have different customer base. With the increased share of organised retail segments, the job roles are more structured/ well-defined, recognised (enhanced opportunity) and secured (employment with statutory benefits) with career progression path ahead. With increased share of organised retail and traditional retail adapting themselves to cope up with changing times, retail value chain has become structured, well-defined. Data analytics, AI personnel are highly in demand. Firms prefer multi-skilled graduates who can perform at various levels of value chain. Multi-skilling in the job is highly in demand. Apart from the job roles highly in demand and firms facing difficulties in filling them, other job roles which some firms described as hard to fill are visual merchandising and digital cataloguing, E-com merchant relationship, virtual store managers, frontline retail sales executives/ associates, e-commerce marketing, etc. There is a gap between what is taught and what is actually happening at work. Curriculum needs to be expanded to meet the market needs and frequently updated every three years.

## 10. Computer Programming Activities

### 10.1 Definition of the Sector

The generally accepted definition of IT services, which NASSCOM articulates, and Gartner refers to “the application of business and technical expertise to enable organisations in the creation, management, and optimisation of or access to information and business processes.”<sup>1</sup>

The NIC code 6201, “Computer programming activities”, was selected based on the selection exercise of choosing sectors. It consists of the following sub-sectors (Table 10.1):<sup>2</sup>

**Table 10.1: Definition of the technology sub-sector used in the analysis**

| <i>NIC Code</i> | <i>Description</i>                                                                                                            |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------|
| 62011           | Writing, modifying, and testing the computer programme to meet the needs of a particular client, excluding web page designing |
| 62012           | Webpage designing                                                                                                             |
| 62013           | Providing software support and maintenance to the clients                                                                     |

*Source:* Central Statistical Organisation, Ministry of Statistics and Programme Implementation. 2008. National Industrial Classification (All Economic Activities). 2008. [https://www.ncs.gov.in/Documents/NIC\\_Sector.pdf](https://www.ncs.gov.in/Documents/NIC_Sector.pdf).

### 10.2 Background

India's technology sector is rapidly transforming through spatial computing, merging the physical and digital worlds to enhance efficiency. Augmented Reality and Virtual Reality technologies are revolutionising various industries, from virtual banking services to immersive medical training, shaping the future of the industrial landscape. The technology is utilised by significant sectors such as banking, retail, healthcare, manufacturing, automotive, and education. The adoption of spatial computing is rising due to a strong tech ecosystem, widespread smartphone usage, and government backing, with the added boost of increased remote collaboration during the pandemic.

Indian enterprises are fostering innovation and growth by modernising their legacy systems through Information Technology (IT) upgrades and Enterprise Resource Planning (ERP) enhancements in response to a swiftly evolving digital environment. Companies are shifting towards a data-centric strategy, increasing computational requirements. The conventional dependence on hardware progress, like Computer Processing Units (CPUs) and Graphics processing units (GPUs), is approaching its maximum capacity. The next era of computing involves enhancing codes rather than simply upgrading hardware through sheer force. The rise of GenAI introduces complexity, necessitating creative solutions beyond mere processing capabilities. With

<sup>1</sup> Gartner website. <https://www.gartner.com/en/information-technology/glossary/it-services>.

<sup>2</sup> Alternatively, NASSCOM has divided the IT sectors in the following sub-sectors—IT enabled Services (ITeS), Business Process Management (BPM), Engineering and Research & Development (ER&D), Software Products Development (SPD), Future Skills, etc.<sup>2</sup>



70 per cent of organisations grappling with outdated IT infrastructures, new insights into technical debt and user experience are essential for maximising the advantages of adaptable organisations. Globally, advancements such as GenAI, 5G/6G, Web 3, blockchain, and IT modernisation propel this movement. Key areas for investment include cloud computing, DevOps, data analytics, artificial intelligence, the Internet of Things, and cybersecurity.

Besides Indian technology firms contributing to growth, global capacity centres drive the IT sector. More than 55 per cent of the world's Global Capacity Centres (GCCs) are based in India, with significant centres in Bengaluru, Hyderabad, Mumbai, and Pune. The number of GCCs in India is predicted to expand rapidly, with over 1,900 centres by 2025, contributing to a market size of \$60 billion by then.<sup>3</sup>

According to NASSCOM, the Indian IT sector is expected to generate \$282.6 billion in revenue in FY25, a 5.1 per cent increase over the previous year. The industry is predicted to exceed \$300 billion by FY26, owing to advances in AI, cloud computing, and digital transformation. Export sales are expected to be \$224.4 billion, while domestic revenues are projected to increase to \$58.2 billion.<sup>4</sup>

### 10.3 Value Chain

The IT sector can be sub-classified into five different subsectors:

- Industry 4.0, also known as intelligent manufacturing, represents the digital evolution of the sector, providing instant decision-making, increased efficiency, adaptability, and responsiveness to transform the manufacturing, enhancement, and distribution processes of businesses.
- Cloud Infrastructure: A cloud infrastructure consists of the software and hardware components of servers housed in data centres, which are set up to deliver cloud computing services to clients. This infrastructure allows companies to lease computing resources as needed via the Internet, utilising a pay-as-you-go model instead of investing in and maintaining their own on-premises data centres, servers, and software.
- Software Products: They can be two types. One is generic software, and the others are bespoke software. While both types of software can be loaded on the user's premises, they are also used through a shared infrastructure on the cloud and are termed Software as a Service.
- IT Integration/System Integration: The integration process involves consolidating various smaller components or data from separate subsystems into one cohesive unit. Integration in IT involves merging different subsystems, even if they are dissimilar, to create a more extensive system that can efficiently share data as required. This typically necessitates organisations to develop a

---

<sup>3</sup> Times of India. 2024. "India to have 1.9k GCCs with \$60billion in market size by 2025". Times of India. <https://timesofindia.indiatimes.com/city/bengaluru/india-to-have-19k-gccs-with-60bn-in-market-size-by-2025/articleshow/110576787.cms#:~:text=Bengaluru%3A%20As%20the%20global%20capability,to%20a%20Nasscom%20DKPMG%20report>. May 31.

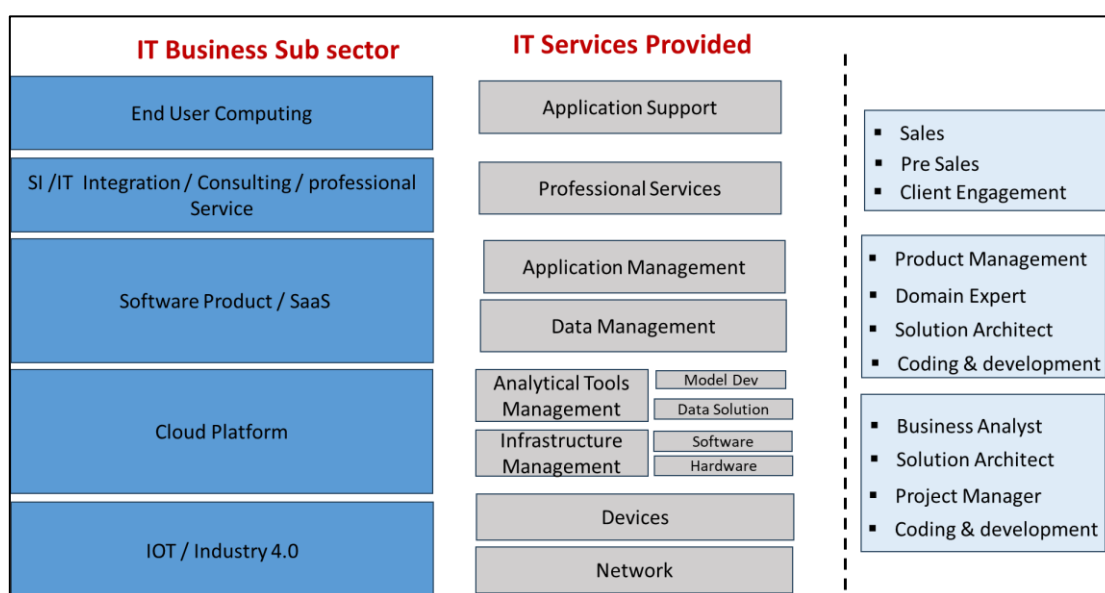
<sup>4</sup> NASSCOM website. <https://nasscom.in/knowledge-center/publications/technology-sector-india-strategic-review-2025#>.

tailored framework of applications to integrate new or existing hardware, software, and other elements.

- **End User Computing:** End-user computing (EUC) combines technologies, policies, and processes that give your workforce secure, remote access to applications, desktops, and data they need to get their work done. Modern enterprises use EUC so that their employees can work from wherever they are, across multiple devices, in a safe and scalable way. A well-designed EUC programme gives users immediate access to the digital technologies they need for productivity, both on-premises and remotely in the cloud.
- Each IT sub-sector provides many IT services and requires different skills, as articulated in Figure 10.1.

For each sub-sector, relevant IT services are required, as articulated in Figure 10.1, and the functional roles within each IT service are as follows:

**Figure 10.1: Software value chain and role**



Source: NCAER conceptualisation from literature.

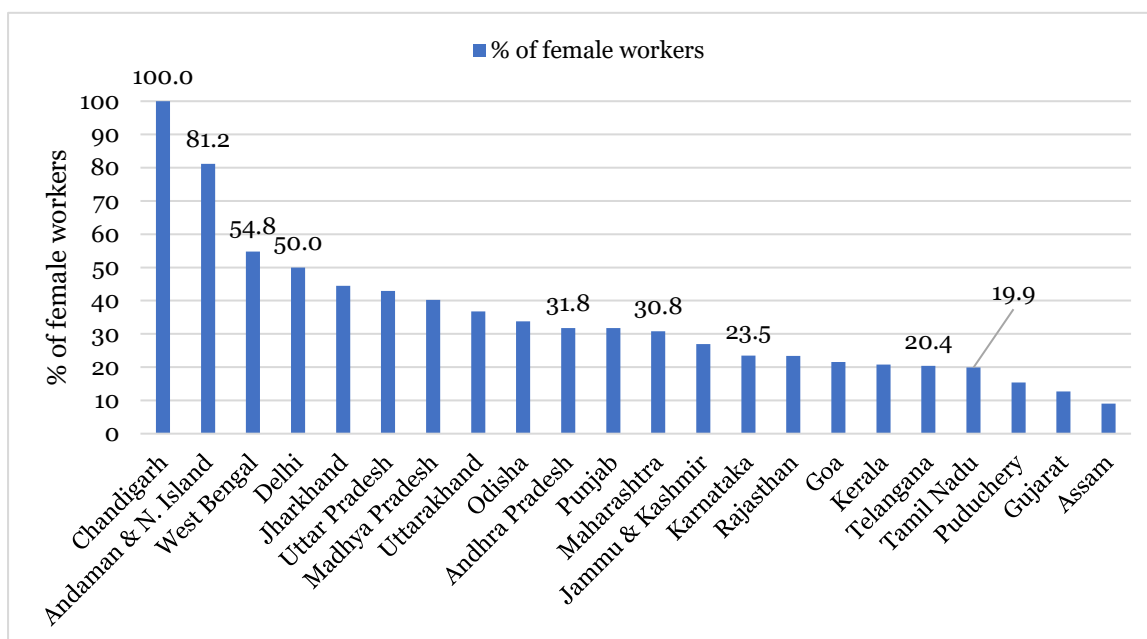
From a domain perspective, the value chain intersects with the following existing domains: finance, health care, commerce, mobility, and aggrotech. Also important are new key emerging domains such as clean tech, climate, ocean–blue water economy, remote sensing, and precision medicine/pharmaceuticals.

#### 10.4. Workforce Characteristics

This section of the chapter gives the macro trends for the IT industry regarding labour participation in the IT industry, female workforce, educational attainment, types of skills, etc., based on various renowned secondary data sources.

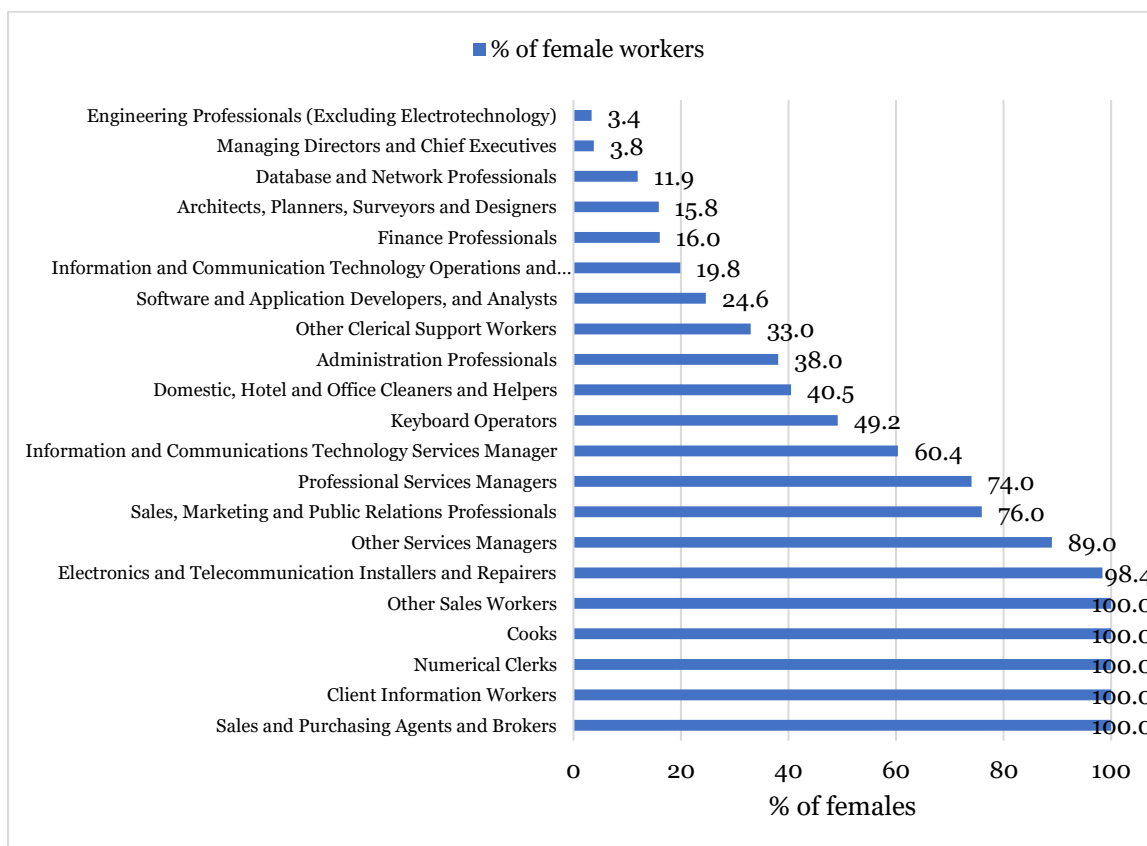
- Share of female workers:** 26.2 per cent of workers in the IT sector are females. Figure 10.2 shows the share of female IT workers across States/UTs. Figure 10.3 shows the share of female workers across NCO 3-digit job roles.

**Figure 10.2: Percentage of female workers (aged 15+) across States/UTs, 2022–23**



Source: NCAER Analysis from PLFS 2022–23.

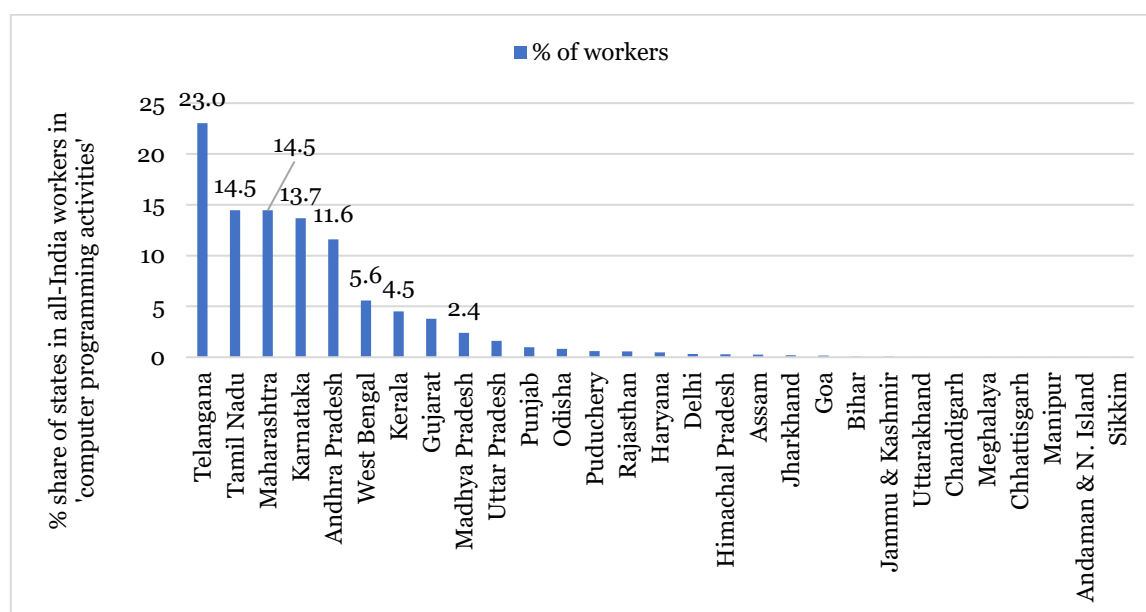
**Figure 10.3: Share of female IT workers in job role, 2022–23**



Source: NCAER analysis from PLFS 2022–23.

- b. **State:** 77 per cent of workers are located in five States in the IT sector, namely Telangana, Tamil Nadu, Maharashtra, Karnataka, and Andhra Pradesh (Figure 10.4). However, the share of the female workforce in these States is relatively low (Figure 10.2) compared to States like West Bengal and Delhi, where females form either 50 per cent or more of the workforce.

**Figure 10.4: State-wise distribution of workers (aged 15+) in the IT sector (%), 2022–23**

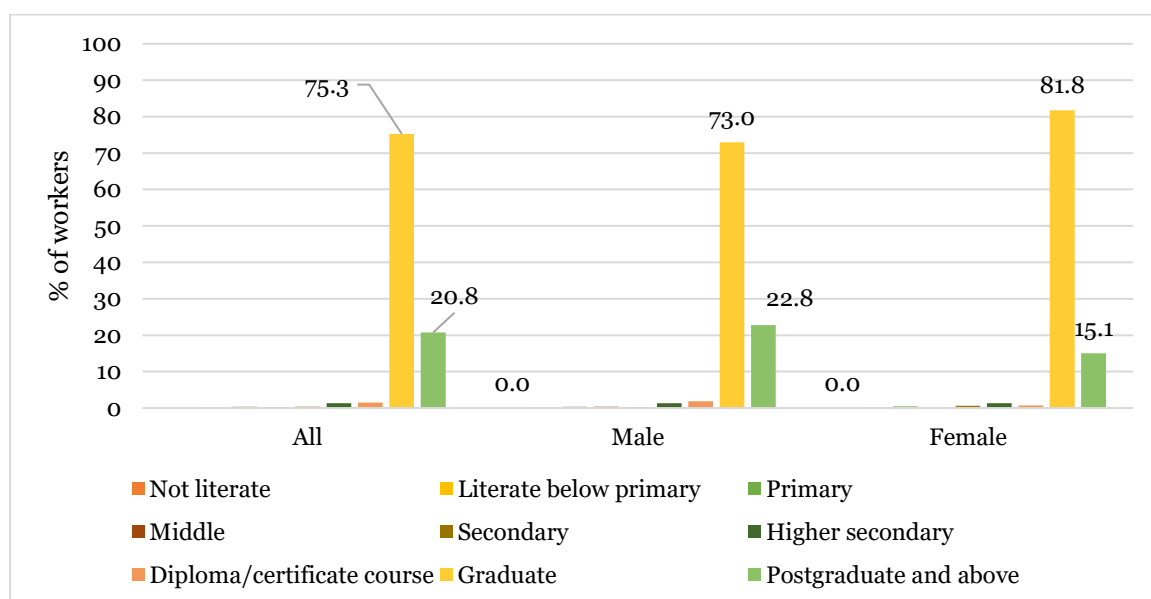


Source: NCAER analysis from PLFS 2022–23.

- c. **Education:** In ‘general educational attainment’, 96 per cent of the workers are graduates and above in the IT sector (Figure 10.5). Marginally, the female educational attainment is higher than males. The majority of the workers in this sector have a technical education. 57.5 per cent of IT workers have a technical degree (Figure 10.6). A higher share of IT female workers (65.9 per cent) have a technical degree. 5.4 per cent of IT have a diploma or certificate (graduate and above level) in engineering/technology. About 27.7 per cent of IT workers do not have technical education.

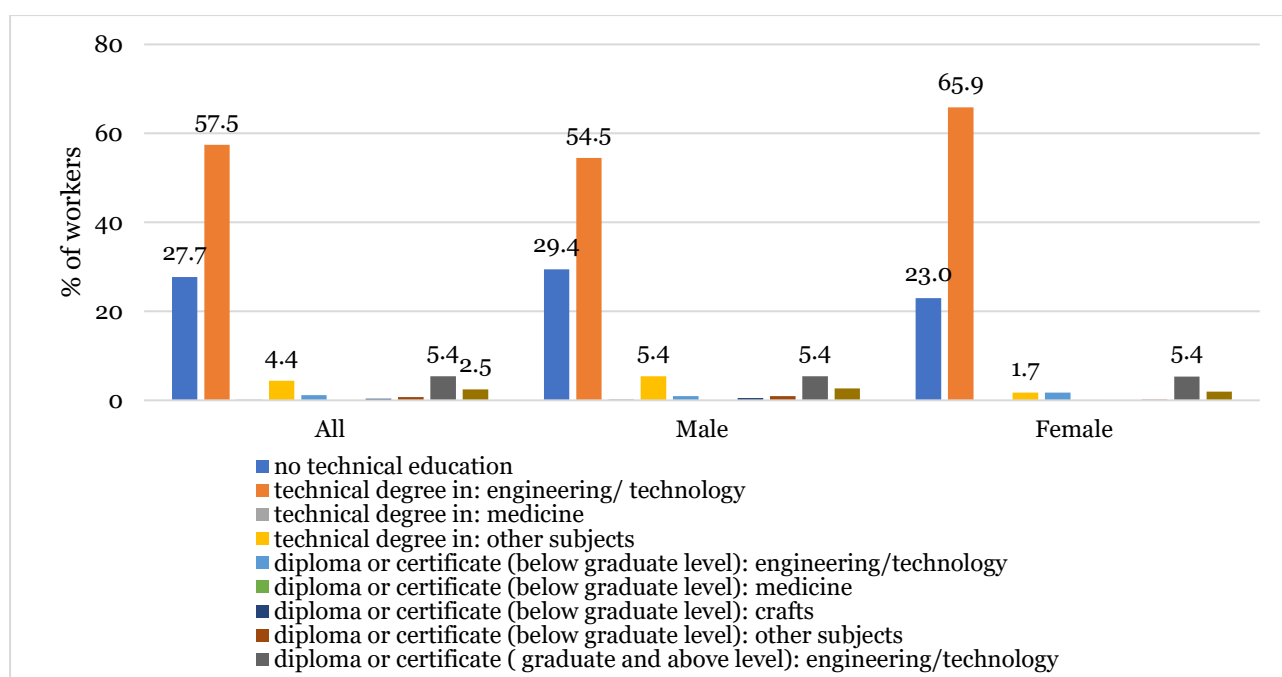
Forty-two per cent of workers have received vocational training (Figure 10.7); 12.9 per cent have received it through formal means and 29 per cent through non-formal means. Twenty per cent of all workers and 25 per cent of all female workers received non-formal vocational training or on-the-job training.

**Figure 10.5: General educational attainment of IT workers, 2022–23**



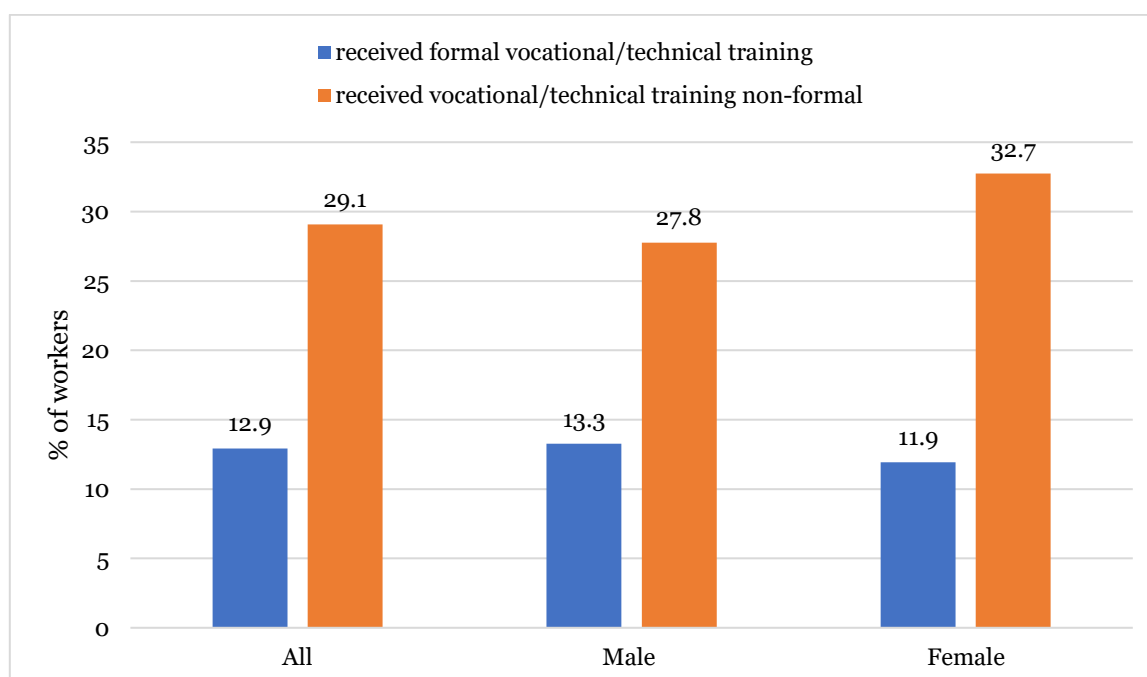
Source: NCAER Analysis from PLFS 2022–23.

**Figure 10.6: Attainment of technical education of IT workers (aged 15+), 2022–23**



Source: NCAER Analysis from PLFS 2022–23.

**Figure 10.7: Share of workers (aged 15+) who have received vocational training, 2022–23 (%)**



Source: NCAER Analysis from PLFS 2022–23.

- d. **Skill**: 96 per cent of the workers are high-skilled, and 96.8 per cent of the female IT workers are high-skilled.
- e. **Occupations**: 77.4 per cent of workers are ‘Software and Application Developers and Analysts’, 5 per cent are ‘Information and Communications Technology Services Managers’ and 2.1 per cent are ‘Managing Directors and Chief Executives’. The corresponding numbers for female workers are 72.3 per cent, 11.4 per cent and 0.3 per cent respectively. Figure 10.3 shows that women are concentrated in a few job roles. Their share is particularly low in leadership positions and mainly focused on support jobs. Significantly, in the most prevalent job role, ‘software and application developers’, the percentage share of females is 26 per cent.
- f. **Engagement Status**: 95.6 per cent of workers are regular salaried/wage workers. 3.7 per cent are own-account workers, and 0.7 per cent are employers (Table 10.2). The corresponding numbers for male workers are 94.1 per cent, 5 per cent and 0.8 per cent. The corresponding numbers for female workers are 99.5 per cent, 0.1 per cent and 0.2 per cent.

**Table 10.2: Engagement status of workers (%)**

|                                 | <i>All Workers (aged 15+)</i>               |                      |                                                                                       | <i>Regular<br/>salaried/<br/>wage<br/>employee</i> | <i>Casual<br/>Wage<br/>Labour</i> | <i>Total</i> |
|---------------------------------|---------------------------------------------|----------------------|---------------------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------|--------------|
|                                 | <i>Self-employed</i>                        |                      |                                                                                       |                                                    |                                   |              |
|                                 | <i>Own<br/>accou<br/>nt<br/>worke<br/>r</i> | <i>Employ<br/>er</i> | <i>Worked as<br/>helper in h.h.<br/>enterprise<br/>(unpaid<br/>family<br/>worker)</i> |                                                    |                                   |              |
| Computer programming activities | 3.7                                         | 0.7                  | 0.0                                                                                   | 95.6                                               | 0.0                               | 100.0        |
| All workers 15+                 | 35.6                                        | 3.2                  | 18.6                                                                                  | 21.4                                               | 21.2                              | 100.0        |
|                                 | <i>All Male Workers (aged 15+)</i>          |                      |                                                                                       |                                                    |                                   |              |
| Computer programming activities | 5.0                                         | 0.8                  | 0.0                                                                                   | 94.1                                               | 0.0                               | 100.0        |
| All workers 15+                 | 39.6                                        | 4.5                  | 9.5                                                                                   | 24.0                                               | 22.3                              | 100.0        |
|                                 | <i>All Female Workers (aged 15+)</i>        |                      |                                                                                       |                                                    |                                   |              |
| Computer programming activities | 0.1                                         | 0.2                  | 0.2                                                                                   | 99.5                                               | 0.0                               | 100.0        |
| All workers 15+                 | 27.3                                        | 0.6                  | 37.4                                                                                  | 15.9                                               | 18.8                              | 100.0        |

Source: NCAER analysis from PLFS 2022–23.

## 10.5 Identification of Geographical Clusters

There are many ways of identifying geographical clusters. Rao and Balsubramanya (2017) examined the rise of IT Service Clusters in India and its industrial impact.<sup>5</sup> The authors identified seven clusters—Bengaluru, Chennai, Hyderabad, Mumbai, Pune, the National Capital Region of Delhi, and Kolkata. This report aims to develop a methodology to identify clusters to help government officials within their region or sectors identify them. As in the earlier sections, we discussed various ways of defining them. Porter (1990) described an industry cluster as a geographically proximate group of firms and associated institutions in related industries linked by economic and social interdependencies.<sup>6</sup> However, in the IT sector, as recommended by Rao and Balsubramanya (2017), it is more sensible to use the Delgado et al. (2014) definition of clusters for the IT sector, which defined clusters as “geographic concentrations of industries related by knowledge, skills, inputs, demand, and/or other linkages”.<sup>7</sup> Using the same framework as agriculture and livestock, there are four pillars—infrastructure, innovation, business environment, and human resources (skills) (Table 10.3). Similar to other sectors, a simple rank was computed for each indicator. Then, a step-wise average was calculated, resulting in a final average of all the rankings from each pillar. The results are shown in Table 10.4. The topmost clusters at State level are Maharashtra, Tamil Nadu, Karnataka, Uttar Pradesh, Gujarat, Telangana, Andhra Pradesh, and West Bengal. The State-level STPI exports are also ranked, and then a

<sup>5</sup> Rao, P. M. and Balasubrahmanya, M.H. 2017. "The Rise of IT Services Clusters in India: A case of growth by replication". *Faculty of Marketing & International Business Publications*. 2. [http://digitalcommons.liu.edu/post\\_mrkibfpub/2](http://digitalcommons.liu.edu/post_mrkibfpub/2)

<sup>6</sup> Porter, M. E. 1990. *Competitive advantage of nations*. New York: Free Press.

<sup>7</sup> Delgado, M., Porter, M. E., & Stern, S. 2014. "Defining clusters of related industries". *NBER Working Paper No. w20375*. [https://www.nber.org/system/files/working\\_papers/w20375/w20375.pdf](https://www.nber.org/system/files/working_papers/w20375/w20375.pdf). Boston: MA: National Bureau of Economic Research.

correlation between the geographical cluster rankings and the rankings of the States based on STPI exports is computed. The correlation coefficient is 0.83. By no means is the cluster methodology perfect, but it is a reasonably decent indicator to compute clusters.

**Table 10.3: Geographical clusters framework for the IT sector**

| <i>Pillar</i>              | <i>Indicator</i>                                         | <i>Source</i>                                                              | <i>Link</i>                                                                                                     | <i>State</i> | <i>District</i> |
|----------------------------|----------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------------|-----------------|
| Infrastructure             | Electricity Energy Sale for Commercial Purposes          | Central Electricity Authority                                              | <a href="https://cea.nic.in/dashbord/?lang=en">https://cea.nic.in/dashbord/?lang=en</a>                         | ✓            | X               |
|                            | Teledensity                                              | Telecom Regulatory Authority of India Performance Indicators/Annual Report | (https://www.trai.gov.in/release-publication/reports/performance-indicators-reports)                            | ✓            | X               |
|                            | Internet Density                                         |                                                                            |                                                                                                                 | ✓            | X               |
| Innovation                 | No. of start-ups                                         | DPIIT                                                                      | <a href="https://www.startupindia.gov.in/digital-map/maps">https://www.startupindia.gov.in/digital-map/maps</a> | ✓            | ✓               |
| Business Environment       | Number of STPs                                           | STPI Annual Report                                                         | <a href="https://stpi.in/en/stpi-annual-reports">https://stpi.in/en/stpi-annual-reports</a>                     | ✓            | ✓               |
| Human Resources/<br>Skills | No. of colleges specialising in engineering & technology | ASHIE                                                                      | <a href="https://aishe.gov.in/aishe-final-report/">https://aishe.gov.in/aishe-final-report/</a>                 | ✓            | ✓               |

Source: NCAER conceptualisation from literature.

**Table 10.4: Geographical cluster of the IT sector<sup>8</sup>**

| <i>State</i>   | <i>Infrastructure</i> | <i>Innovation</i> | <i>Human Resources</i> | <i>Business</i> | <i>Average</i> |
|----------------|-----------------------|-------------------|------------------------|-----------------|----------------|
| Maharashtra    | 6.7                   | 1.0               | 2.0                    | 1.0             | 2.7            |
| Tamil Nadu     | 6.7                   | 5.0               | 1.0                    | 3.0             | 3.9            |
| Karnataka      | 8.0                   | 2.0               | 5.0                    | 1.0             | 4.0            |
| Uttar Pradesh  | 12.0                  | 4.0               | 6.0                    | 5.0             | 6.8            |
| Gujarat        | 10.3                  | 7.0               | 4.0                    | 9.0             | 7.6            |
| Telangana      | 9.7                   | 6.0               | 7.0                    | 9.0             | 7.9            |
| Andhra Pradesh | 15.0                  | 13.0              | 3.0                    | 5.0             | 9.0            |
| West Bengal    | 10.0                  | 11.0              | 14.0                   | 3.0             | 9.5            |
| Delhi          | 6.7                   | 3.0               | 19.0                   |                 | 9.6            |
| Kerala         | 9.0                   | 8.0               | 9.0                    | 14.0            | 10.0           |
| Rajasthan      | 13.0                  | 10.0              | 10.0                   | 9.0             | 10.5           |

<sup>8</sup> The NASSCOM report used a proprietary database of Draup to compute clusters. However, that database may be compared to PLFS where one is using workers. However, even that cannot be strictly compared because one does not know the sampling strategy behind collecting data of this database. Has this been independently validated or the database compared? It is necessary to undertake research to compare the two databases to have a more complete set of information versus choosing one or the other. Nonetheless, the conceptual idea behind clusters is to see the agglomeration of firms and not just workers. Purely looking at a workers' database whether Draup or PLFS will give an incomplete picture. Therefore, it is recommended to look at both agglomerations in terms of workers and units to get a holistic picture.



| <b>State</b>                             | <b>Infrastructure</b> | <b>Innovation</b> | <b>Human Resources</b> | <b>Business</b> | <b>Average</b> |
|------------------------------------------|-----------------------|-------------------|------------------------|-----------------|----------------|
| Madhya Pradesh                           | 18.7                  | 12.0              | 8.0                    | 7.0             | 11.4           |
| Haryana                                  | 11.0                  | 9.0               | 12.0                   | 14.0            | 11.5           |
| Odisha                                   | 19.3                  | 14.0              | 11.0                   | 7.0             | 12.8           |
| Punjab                                   | 12.7                  | 16.0              | 12.0                   | 14.0            | 13.7           |
| Bihar                                    | 19.3                  | 15.0              | 16.0                   | 14.0            | 16.1           |
| Uttarakhand                              | 17.3                  | 19.0              | 17.0                   | 14.0            | 16.8           |
| Jharkhand                                | 24.7                  | 18.0              | 17.0                   | 9.0             | 17.2           |
| Chhattisgarh                             | 23.0                  | 17.0              | 15.0                   | 14.0            | 17.3           |
| Jammu & Kashmir                          | 19.0                  | 22.0              | 22.0                   | 9.0             | 18.0           |
| Himachal Pradesh                         | 17.0                  | 23.0              | 19.0                   | 14.0            | 18.3           |
| Ladakh                                   | 18.5                  |                   |                        |                 | 18.5           |
| Goa                                      | 16.7                  |                   | 26.0                   | 14.0            | 18.9           |
| Assam                                    | 22.0                  | 20.0              | 22.0                   | 14.0            | 19.5           |
| Puducherry                               | 28.3                  | 24.0              | 21.0                   | 14.0            | 21.8           |
| Manipur                                  | 26.7                  | 25.0              | 24.0                   | 14.0            | 22.4           |
| Tripura                                  | 26.7                  | 26.0              | 24.0                   | 14.0            | 22.7           |
| Chandigarh                               | 18.3                  | 21.0              | 29.0                   |                 | 22.8           |
| Nagaland                                 | 26.7                  | 29.0              |                        | 14.0            | 23.2           |
| Meghalaya                                | 25.7                  | 27.0              | 30.0                   | 14.0            | 24.2           |
| Mizoram                                  | 23.7                  | 31.0              | 30.0                   | 14.0            | 24.7           |
| Sikkim                                   | 25.3                  | 33.0              | 28.0                   | 14.0            | 25.1           |
| A & N Islands                            | 24.0                  | 28.0              | 30.0                   |                 | 27.3           |
| Dadar & Nagar Haveli (incl. Daman & Diu) | 31.3                  | 30.0              | 27.0                   |                 | 29.4           |
| Arunachal Pradesh                        | 28.3                  | 31.0              |                        |                 | 29.7           |
| Lakshadweep                              | 29.0                  | 34.0              |                        |                 | 31.5           |

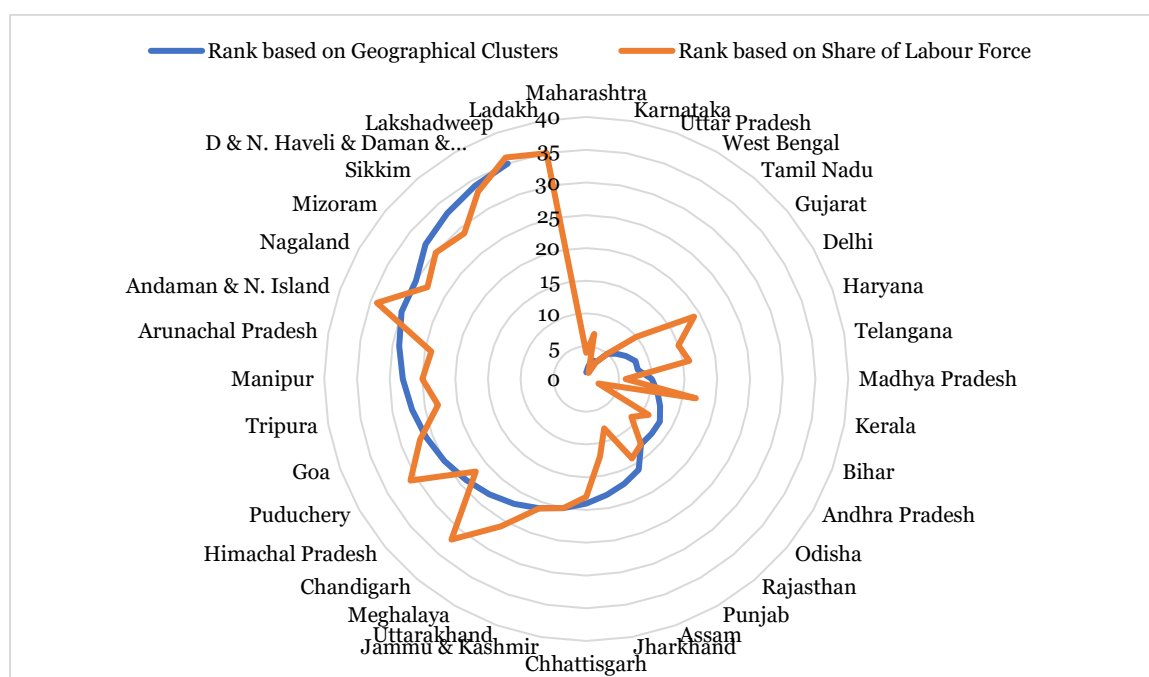
Sources: NCAER computations from the following:

1. Telecom Regulatory Authority of India. 2024. *The Indian Telecom Services Performance Indicators January–March 2024*. [https://traai.gov.in/sites/default/files/QPIR\\_04072024\\_0.pdf](https://traai.gov.in/sites/default/files/QPIR_04072024_0.pdf); 2. Central Electricity Authority. Dashboard - Central Electricity Authority (CEA.nic.in); 3. Department of Higher Education, Ministry of Education, Government of India. *All India Survey on Higher Education 2021-22*. <https://aishe.gov.in/aishe-final-report/>; 4. DPIIT website. <https://www.startupindia.gov.in/digital-map/maps>; 5. Software Technology Parks of India. 2023. *Annual Report 2022–23*. <https://stpi.in/en/stpi-annual-reports>.

Notes: 1. For downloading data from the DPIIT website, these terms were used to filter the data: Analytics, AR VR, Computer Vision, Enterprise Software, Finance Technology, Internet of Things, IT Services, Robotics, Telecommunications, and Networking.

The correlation between rankings based on share of labour force and geographical clusters is 0.9 (Figure 10.8).

**Figure 10.8: State-wise rankings based on geographical clusters and share of labour force**



Sources: NCAER computations from Figure 10.4 and Table 10.4.

Note: Lower ranking means higher concentrations.

## 10.6 Occupational Map

Annexure 10.1 shows the occupational mapping. The key point is that there are new and emerging codes developed by the Sector Skill Council which cannot be mapped to the NCO 2015. Therefore, it is important to update NCO 2015 and NCS database/portal on a regular basis.

## 10.7 Sectoral Findings

### 10.7.1 Stakeholder Interactions

To get detailed industry insight, various stakeholders were reached in the IT industry, including Industry Associations, Academic Institutions, Global Capacity centres, and Indian software companies, both outsourcing and product. Interviews with these stakeholders were more of a conversation rather than just asking questions from the respondents in the questionnaire. Separate questionnaires were developed for each stakeholder. It helped us understand their perspective more clearly. Questionnaires are available upon request. Successful interactions were held with the 21 stakeholders in the sector, as given in Table 10.5.

**Table 10.5: Distribution of stakeholder interactions in the IT sector**

| <b>Sector</b>                            | <b>Computer programming activities</b> |
|------------------------------------------|----------------------------------------|
| Ministry                                 | 1                                      |
| Sector Skill Council                     | 1                                      |
| National-level Industry Association      | 1                                      |
| No of Firms                              |                                        |
| Micro/Small                              |                                        |
| Medium                                   |                                        |
| Large                                    |                                        |
| Total                                    | 17                                     |
| No. of Placement Cells/TVET Institutions | 3                                      |
| Recruitment Agencies                     | 1                                      |
| Other Stakeholders                       | 3                                      |
| Firms plus Other Stakeholders            | 20                                     |
| Total                                    | 27                                     |

Source: NCAER.

### 10.7.2. Sectoral Findings

This section discusses the key findings of the technology sector-based on stakeholder interactions and the literature review. It sheds light on various aspects of technological changes in the industry. It assesses key job roles currently facing a maximum shortage in this sector or scarcity over the next 3 years. The questionnaire for firms in the IT industry (Questionnaire 10) is located at the end of the report.

Skill shortage is an issue in the technology sector and is intensified due to the technologically dynamic nature of the industry. There are specific technologies that drive skills demand, and some of these technologies are sector specific (Table 10.6).

**Table 10.6: Technology changes**

| <b>Digital Technologies – Across sector</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Sector-Specific technology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Python – AI/ML</li> <li>• Full stack developer</li> <li>• Image and signal processing</li> <li>• Natural Language Processing</li> <li>• Large Language Model Building</li> <li>• Small Language Model Building</li> <li>• Deep Neural Networks</li> <li>• Cyber Cloud Security</li> <li>• Cybersecurity:</li> <li>• Cloud Computing</li> <li>• Data Protection</li> <li>• Econometric Modeling</li> <li>• Blockchain and 5G Technology</li> </ul> | <p>For Agritech, commerce and EV</p> <ul style="list-style-type: none"> <li>• Remote Sensing</li> <li>• Drip Technology</li> </ul> <p>For Manufacturing -</p> <ul style="list-style-type: none"> <li>• Robotics</li> <li>• Embedded Computing</li> <li>• Digital Twin</li> </ul> <p>Pharmaceutical and Medical</p> <ul style="list-style-type: none"> <li>• 3D Modeling</li> <li>• 3D Printing:</li> <li>Robotics: Virtual and Augmented Reality (VR/AR)</li> <li>• Nanotechnology</li> <li>• Digital Twin</li> <li>• CRISPR</li> <li>• Bio printing</li> </ul> |

Source: NCAER stakeholders' survey

The drivers of changing job roles in the technology sector in India are shaped by rapid advancements in technology, evolving business needs, and global trends. Here are the key factors:

- **Emerging Technologies:** The rise of AI, machine learning, blockchain, and cloud computing has created a demand for specialised roles like AI engineers, data scientists, and cloud architects.
- **Digital Transformation:** Businesses are adopting digital tools and platforms, leading to roles in DevOps, cybersecurity, and digital marketing.
- **Globalisation and Outsourcing (Establishment of GCC):** India remains a hub for IT outsourcing, requiring professionals skilled in project management, software development, and client relations.
- **5G and IoT:** The rollout of 5G and the growth of Internet of Things (IoT) have spurred demand for roles in network engineering and IoT development.
- **Remote Work and Gig Economy:** The shift to remote work has increased the need for roles in IT support, collaboration tools development, and freelance tech consulting.
- **Focus on Sustainability:** Green technologies and sustainable practices are driving roles in energy-efficient IT solutions and environmental data analysis.

We can see the impact of Moore's law in action. **Moore's Law** is the observation made by Gordon Moore, co-founder of Intel, in 1965, which states that the number of transistors on a microchip doubles approximately every two years while the cost of computing power decreases. This trend has driven exponential growth in computing capabilities and has been a guiding principle for advancements in the semiconductor industry.

Typically, job roles are clustered by various titles, depending on the company's domain and whether it is a global multinational corporation versus Indian corporate versus start-up. For instance, the exact role can be Data Engineer, Data Consultant, or Developer. It may have full stack or front-end developers, depending on the technology and area the individual works in. For the report, the titles have been clustered in the following functional areas (each will have multiple areas):

- Developer / Engineer / Data Engineer
- Technical Consultant / Analyst
- Functional Consultant / Analyst
- Security Engineers – which includes various types of security

The point is that finding people is perceived to be somewhat 'difficult' for each job role. There were several reasons behind this, both from the side of the skilling ecosystem (supply-side) and the industry (demand-side).

### *Key Challenges identified*

- The PLFS data on occupational characteristics indicates that the technology industry has a relatively high demand for formal education and training. Lack of topic expertise, people management abilities, and keeping up with the most recent technological advancements are some of the leading causes of the hiring gap.
- A key reason for 'difficulty' in filling job roles was that the candidates lacked the "skills to do the job". While they may have theoretical understanding, a lack of practical knowledge of working with the latest machines renders them unemployable, and even if employed, they cannot do the job at hand.
- **Technology Skills:** The demand for specialised tech skills (AI, blockchain, cloud computing) often exceeds the supply, making it challenging to find the right talent. Engineering colleges provide theoretical knowledge but not necessarily proper domain knowledge to complement the technology skills. For example,

knowledge of heat power engineering or EV engines and information technology experience is essential for manufacturing companies. Information technology and data science can only provide analytical results but not necessarily interpretation of results.

- Absence of non-cognitive skills: Soft skills are also necessary for successful performance in the workplace. Teamwork, conscientiousness, self-control, emotional stability, psychomotor skills, safety awareness, cultural and gender sensitivity, and practical communication are a few of these. The emergence of global capacity centres makes these criteria much more crucial.
- It was also mentioned that recruiters look for coding skills, logical ability, and reasoning skills. Technology skills are missing from coding, application and theoretical framework knowledge. Similarly, it is not just statistical skills but also mathematical skills. We try to map the cognitive and socio-emotional/non-cognitive in Table 10.7.

**Table 10.7: Cognitive and non-cognitive skills**

| <b><i>Cognitive</i></b>                                                                                                                                                                                                                                              | <b><i>Socio-emotional/ Non Cognitive</i></b>                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Critical thinking</li> <li>• Problem-solving</li> <li>• Resource/time management</li> <li>• Design Thinking</li> <li>• Man-management and Leadership</li> <li>• Entrepreneurship</li> <li>• Algorithmic Thinking</li> </ul> | <ul style="list-style-type: none"> <li>• Open to experience</li> <li>• Patience</li> <li>• Emotional stability</li> <li>• Cross-country cultural sensitivity, especially for global capacity centres</li> <li>• Communication and articulation</li> <li>• English language articulation/ regional biases</li> <li>• Cultural conscientiousness</li> <li>• Empathy and sensitivity</li> <li>• Non-transactional attitude</li> <li>• Risk-taking ability</li> </ul> |

Source: NCAER stakeholders' survey.

Due to a lack of domain expertise and a skilling environment, technology companies must provide on-the-job practical and soft-skill training to all new employees, which they believe should have been provided through the education and training system. All engineering and diploma graduates are frequently hired as Graduate Engineer Trainees, which adds to the firm's costs. The impact is significant if there is a hiring to be done with 5–7 years of experience. It is challenging to identify the right hire who has technical skills, domain skills, and non-cognitive abilities.

Table 10.8 shows the key in-demand job roles. A short description of the four roles are given below:

- **Data Engineering:**<sup>9</sup> It is the practice of designing and building systems for the aggregation, storage and analysis of data at scale. Data engineers empower organisations to get insights in real time from large datasets.
- **Technical Business Analyst:**<sup>10</sup> Technical Business Analysts analyse science, engineering, business, and other data processing problems to develop and implement solutions to complex applications problems, system administration

<sup>9</sup> IBM website. <https://www.ibm.com/think/topics/data-engineering>

<sup>10</sup> Franklin University website. <https://www.franklin.edu/career-guide/computer-systems-analysts/what-do-technical-business-analysts-do>.

issues, or network concerns. Perform systems management and integration functions, improve existing computer systems, and review computer system capabilities, workflow, and schedule limitations. May analyse or recommend commercially available software.

- Data Security:<sup>11</sup> Data security is the practice of protecting digital information from unauthorised access, corruption or theft throughout its entire lifecycle.
- Functional/Domain Analyst:<sup>12</sup> A Functional/Domain Analyst bridges the gap between business needs and technical solutions, focusing on understanding specific business processes and ensuring that software and technology solutions effectively address those needs.

**Table 10.1: Assessment of current and future skills shortage (findings from stakeholder consultations) in computer programming activities Demand shortage is there in four job roles**

|                                                                                                                   | Data Engineering*                                                                                                                            | Business Analyst—Technical | Data Security | Functional/Domain Analyst |
|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------|---------------------------|
| NCO 3/8–digit code                                                                                                | 252                                                                                                                                          | 251                        | 252           | Not available             |
| NCO 8-digit /QP code                                                                                              | HCLT/N0003/IT/2024 v1: Data Engineering with Analytics and Visualization<br>IT-ITeS SSC<br>NASSCOM/N0002/I<br>T/2024: Data Engineering – IBM |                            |               |                           |
| Match from Job Projections (251, 133, 112, 216, 413) @                                                            |                                                                                                                                              |                            |               |                           |
| No. of stakeholders which mentioned this                                                                          | 15                                                                                                                                           | 10                         | 17            | 17                        |
| Indicative computation of the extent of current needs & vacancy rate (NCAER computations from Big Data Analysis)* | 200,000–225,000                                                                                                                              | 50,000–60,000              | 40,000–50,000 | 70,000–80,000             |

<sup>11</sup> IBM website. <https://www.ibm.com/think/topics/data-security>.

<sup>12</sup> Generative AI from Indeed website. <https://www.indeed.com/career-advice/resumes-cover-letters/functional-analyst-skills#:~:text=What%20is%20a%20functional%20analyst,productivity%20of%20a%20business%20domain.>

|                                                     | <b>Data Engineering*</b>                                                                                                                                                                                                                                                                                                                                                                                 | <b>Business Analyst—Technical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Data Security</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Functional/Domain Analyst</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Location of firms                                   | Bangalore, NCR, Kochi, Hyderabad, Mumbai                                                                                                                                                                                                                                                                                                                                                                 | Bangalore, NCR, Kochi, Hyderabad, Mumbai                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Bangalore, NCR, Kochi, Hyderabad, Mumbai                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Bangalore, NCR, Kochi, Hyderabad, Mumbai                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Average monthly income (₹) for 3– 5 Years           | 1,25,000–1,70,000                                                                                                                                                                                                                                                                                                                                                                                        | 1,25,000–1,70,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3,00,000–4,00,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ~ 1,50,000–3,50,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Note                                                | Senior-level experience varies widely depending on experience, domain, location.                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Educational Qualifications                          | B. Tech /M. Tech Engineering, M. Tech/PhD. Engineering + AI/ML programs                                                                                                                                                                                                                                                                                                                                  | B. Tech /M. Tech Engineering+ AI/ML programs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | B. Tech /M. Tech Engineering (AI and Data Science; or Computer Science/IT + Cybersecurity Certificate)                                                                                                                                                                                                                                                                                                                                                                                                                                          | Domain Experience with any Graduation. Preference is Post Graduation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Skills required at the competency level (3 or more) | <b>Cognitive Skills:</b> <ul style="list-style-type: none"> <li>• Critical thinking,</li> <li>• Problem-solving,</li> <li>• Resource/time mgmt.</li> <li>• Algorithmic Thinking</li> </ul> <b>Socio-emotional skills:</b> <ul style="list-style-type: none"> <li>• Active Listening,</li> <li>• Patience</li> <li>• Cross-country cultural sensitivity-especially for Global capacity centres</li> </ul> | <b>Cognitive Skills:</b> <ul style="list-style-type: none"> <li>• Critical thinking,</li> <li>• Problem-solving,</li> <li>• Communication skills</li> <li>• Resource/time mgmt.</li> <li>• Design Thinking</li> <li>• Algorithmic Thinking</li> </ul> <b>Socio-emotional skills:</b> <ul style="list-style-type: none"> <li>• Active Listening,</li> <li>• Man management and Leadership</li> <li>• Entrepreneurship</li> <li>• Open to experience,</li> <li>• Patience</li> <li>• Emotional stability</li> <li>• Cross-country cultural sensitivity-especially for Global capacity centres</li> <li>• Cultural conscientiousness,</li> <li>• Empathy and sensitivity</li> </ul> | <b>Cognitive Skills:</b> <ul style="list-style-type: none"> <li>• Critical thinking,</li> <li>• Problem-solving,</li> <li>• Algorithmic Thinking</li> </ul> <b>Socio-emotional skills:</b> <ul style="list-style-type: none"> <li>• Active Listening,</li> <li>• Patience</li> <li>• Emotional stability</li> <li>• Cross-country cultural sensitivity-especially for Global capacity centres</li> </ul> <b>TVET:</b> <ul style="list-style-type: none"> <li>• Specialised skills in security in terms of – Data security, infrastru</li> </ul> | <b>Cognitive Skills:</b> <ul style="list-style-type: none"> <li>• Critical thinking,</li> <li>• Problem-solving,</li> <li>• Communication skills</li> <li>• Resource/time mgmt.</li> <li>• Design Thinking</li> <li>• Algorithmic Thinking</li> </ul> <b>Socio-emotional skills:</b> <ul style="list-style-type: none"> <li>• Active Listening,</li> <li>• Man management and Leadership</li> <li>• Entrepreneurship</li> <li>• Open to experience,</li> <li>• Patience</li> <li>• Emotional stability</li> <li>• Cross-country cultural sensitivity-especially for Global capacity centres</li> <li>• Cultural conscientiousness,</li> </ul> |
|                                                     | <b>TVET:</b> <ul style="list-style-type: none"> <li>• Python – AI/ML</li> <li>• Full stack developer</li> <li>• image and signal processing</li> <li>• Natural Language Processing</li> <li>• Large Language Model Building</li> <li>• Small Language Model Building</li> <li>• Deep Neural Networks</li> </ul>                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|                                                                                                 | <b>Data Engineering*</b>                                                                                                                                                                                                                                                                                                               | <b>Business Analyst—Technical</b>                                                                                                                                                                                                                                       | <b>Data Security</b>                                                                                                                | <b>Functional/Domain Analyst</b>                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                 |                                                                                                                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Non-transactional attitude</li> </ul> <b>TVET:</b> <ul style="list-style-type: none"> <li>Technical coding skills as well as technical design skills. Typically has worked as Data engineer or a full stack developer</li> </ul> | <ul style="list-style-type: none"> <li>Secure security and access security.</li> <li>Specialised certification preferred</li> </ul> | <ul style="list-style-type: none"> <li>Empathy and sensitivity</li> <li>Non-transactional attitude</li> </ul> <b>TVET:</b> <ul style="list-style-type: none"> <li>In-depth domain knowledge – e.g. Health care, BFSI, engineering. Experience preferred</li> </ul> |
| Skills Shortage                                                                                 | No                                                                                                                                                                                                                                                                                                                                     | Yes                                                                                                                                                                                                                                                                     | Yes                                                                                                                                 | No                                                                                                                                                                                                                                                                 |
| Skills Gap                                                                                      | Yes                                                                                                                                                                                                                                                                                                                                    | Yes                                                                                                                                                                                                                                                                     | Yes                                                                                                                                 | Yes                                                                                                                                                                                                                                                                |
| Relevance of TVET System                                                                        | Yes                                                                                                                                                                                                                                                                                                                                    | Yes                                                                                                                                                                                                                                                                     | NA                                                                                                                                  | No                                                                                                                                                                                                                                                                 |
| Gender (Challenges)                                                                             | No challenge in 1-3 years however as years of experience increases, female candidature reduces                                                                                                                                                                                                                                         | No challenge: Women preferred                                                                                                                                                                                                                                           | Rare skill and gender-based hiring is even rare                                                                                     | Functional domain in financial services and core engineering such as Heat power or High voltage                                                                                                                                                                    |
|                                                                                                 | <ul style="list-style-type: none"> <li>Remote working enabled the return to labour force participation (LFP)</li> <li>Focused program to enrol women back in the workforce</li> <li>Diversity norms by level and function have helped increase LFP</li> </ul>                                                                          |                                                                                                                                                                                                                                                                         |                                                                                                                                     |                                                                                                                                                                                                                                                                    |
| Challenges Faced by Industries in Meeting Skill Requirements *                                  | <ul style="list-style-type: none"> <li>Tier II town - Job options and opportunities are limited, thereby hampering talent identification by corporates</li> <li>Talent gap at mid- and senior- level higher</li> </ul>                                                                                                                 | <ul style="list-style-type: none"> <li>Tier II town - Job options and opportunities are limited, thereby hampering talent identification</li> <li>Talent gap at mid and senior level higher</li> </ul>                                                                  | <ul style="list-style-type: none"> <li>No formal course in engineering for data security</li> </ul>                                 | <ul style="list-style-type: none"> <li>Talent focused on coding rather than domain experience resulting in gap</li> <li>Tier II town - Job options and opportunities are limited, thereby hampering talent identification.</li> </ul>                              |
| Industry-specific interventions that facilitate skill and capacity development (best practices) | <ul style="list-style-type: none"> <li>Capacity-building sessions on non-cognitive skills</li> <li>Partnership with institutes for skills</li> <li>Hackathon</li> <li>Cultural sensitivity initiative</li> <li>Structured diversity and women in tech program</li> </ul>                                                               |                                                                                                                                                                                                                                                                         |                                                                                                                                     |                                                                                                                                                                                                                                                                    |
| Policy Recommendations:                                                                         | <b>Skill Training Programme:</b> <ul style="list-style-type: none"> <li>Partner with Industries to structure course curriculum</li> <li>Establish Centres of Excellence with Industry specific leaders</li> <li>Encourage collaboration between educational institutions and research bodies to promote practical learning.</li> </ul> |                                                                                                                                                                                                                                                                         |                                                                                                                                     |                                                                                                                                                                                                                                                                    |



| <b>Data Engineering*</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Business Analyst—Technical</b> | <b>Data Security</b> | <b>Functional/Domain Analyst</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|----------------------|----------------------------------|
| <b>Curriculum Development:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |                      |                                  |
| <ul style="list-style-type: none"> <li>• Focus on domain building and not just data analytics</li> <li>• Engage industry experts to co-develop training content and modules</li> <li>• Focus on non-cognitive skills</li> <li>• Communication Skills development focus</li> </ul>                                                                                                                                                                                                                                                                                                                                                                               |                                   |                      |                                  |
| <b>Gender:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |                      |                                  |
| <ul style="list-style-type: none"> <li>• Focused program to enrol women back in the workforce</li> <li>• Diversity norms by level as well as function have helped increase LFP.</li> <li>• Ensure no pay gap is observed for women in tech</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |                      |                                  |
| <b>Skill Initiatives:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   |                      |                                  |
| <ul style="list-style-type: none"> <li>• Make internship compulsory, as in medical science</li> <li>• Collaborate with the industry for internship</li> <li>• Establish mentorship programs with experienced industry as a part of final-year project coursework</li> <li>• Organise intensive boot camps and hackathons</li> </ul>                                                                                                                                                                                                                                                                                                                             |                                   |                      |                                  |
| <b>Others/Macro Policy:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                   |                      |                                  |
| <ul style="list-style-type: none"> <li>• Emerging centres are driving demand, such as Indore, Bhubaneswar, Kochi, Chandigarh, Kolkata, Goa, Ahmednagar, Vadodara, Jaipur, Thiruvananthapuram, and Pune—primarily non-metros and emerging metros.</li> <li>• Digital communication has reduced ‘Virtual Distance’ in information but not necessarily ‘connectivity distance’ impacting talent availability</li> <li>• Ensure appropriate <ul style="list-style-type: none"> <li>– Air connectivity</li> <li>– Health care</li> <li>– State government ‘perceived openness and ease of doing business’</li> <li>– Education infrastructure</li> </ul> </li> </ul> |                                   |                      |                                  |

It should be noted that core technical, non-cognitive, and cognitive skills differ for different experience levels. Based on our interview table, 10.9 attempts to summarise the findings.

**Table 10.9: Skills gap summary: based on years of experience and type of skills**

|                                | <i>Years of Experience</i> |                |                 |
|--------------------------------|----------------------------|----------------|-----------------|
|                                | <i>&lt; 3 yrs</i>          | <i>3-7 Yrs</i> | <i>7-10 Yrs</i> |
| <b>Core Skills</b>             |                            |                |                 |
| Technical Acumen               | High                       | High           | Medium          |
| Problem Solving—               | Medium                     | high           | Low             |
| Analytical                     | Medium                     | High           | High            |
| Project / Program Management   | Low                        | Medium         | High            |
| <b>Non-Cognitive Skills</b>    |                            |                |                 |
| Business Acumen                | Low                        | Low            | High            |
| Leadership                     | Low                        | Medium         | High            |
| Continuous Learning            | High                       | High           | High            |
| Design thinking                | Medium                     | High           | High            |
| Strategic Thinking             | Low                        | Low            | High            |
| <b>Soft Skills</b>             |                            |                |                 |
| Cross-Functional Collaboration | Low                        | Medium         | High            |
| Interpersonal Communication    | Medium                     | High           | High            |
| Ethics and Legal Awareness     | Medium                     | High           | High            |
| Cultural Sensitivity           | Medium                     | High           | High            |

Source: NCAER stakeholders’ survey.

### *Location*

It is not just skills but the availability of skills at the location where the opportunity lies. Apart from Mumbai, NCR, Bangalore, Chennai, and Hyderabad, the new emerging centres are driving demand, such as Indore, Bhubaneswar, Kochi, Chandigarh, Kolkata, Goa, Ahmednagar, Vadodara, Jaipur, Thiruvananthapuram, and Pune. While the key driving factor is the availability of talent, including the presence of good universities and technology institutes, companies also prefer locations with lower rental costs, air connectivity, health care, and perceived openness and ease of doing business.

However, relatively fewer people want to join the workforce in those cities as the perception is that jobs in tier II towns are ‘not cool enough’ and working in tier II towns may hamper job mobility and exposure. Only people who want to move back to their home town are attracted by these new technology centres in tier II cities. While digital communication has reduced ‘virtual distance’ in information, not necessarily ‘connectivity distance’ plays a key role in impacting mobility to tier II towns.

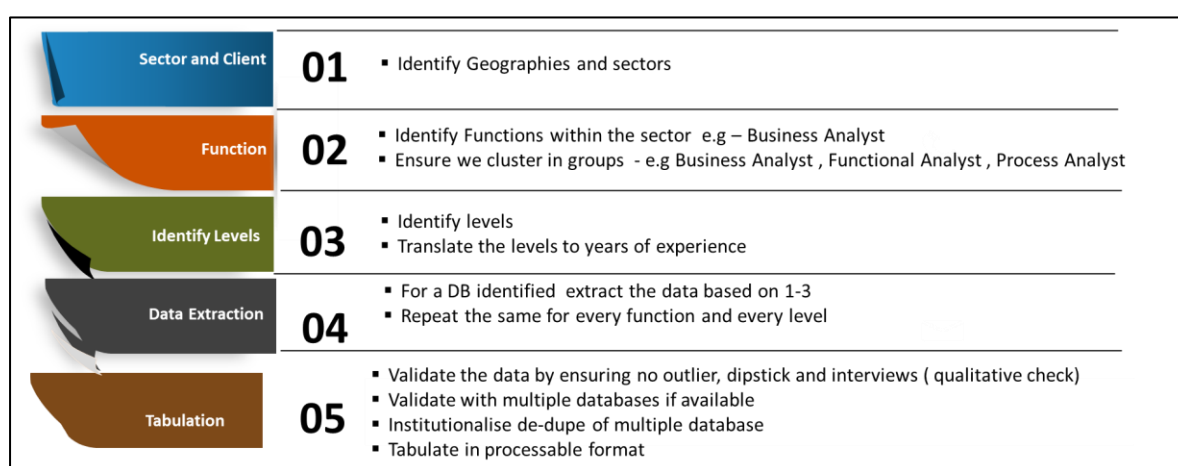
### *Women in Workforce in Technology*

While there were no apparent biases for or against any gender, the preferred functions for women in technology were—Business analyst, quality control, and program management. The qualitative interviews revealed that the above roles require patience, perseverance, flexibility, and communication skills, which are key to the above roles. The socio-emotional skills of women employees make them preferred candidates for project execution and delivery, including quality control. However, there were gaps at the senior level, and a pay gap was observed. Women in tech are often paid less than their male counterparts. Additionally, work-life balance was an issue. The tech industry usually demands long hours and high levels of commitment, which can be challenging for women balancing work with family responsibilities. Another issue highlighted was mobility, as women could not relocate for growth. Lastly, fewer leadership roles resulted in a lack of role models, collectively subduing aspirations for women in technology.

## **10.8 Web Scraping / Big Data Methodology**

Data scraping helps evaluate job demand by extracting information from job listings. The approach starts with defining specific goals, such as identifying crucial information like job titles, skills, locations, or sectors. Using technologies like Python libraries (e.g., BeautifulSoup, Scrapy, Selenium) or no-code solutions (e.g., Octoparse, ParseHub), scripts can be configured to navigate job boards and retrieve pertinent data (Figure 10.9). Following scraping, the raw data is cleaned to assure accuracy by removing duplicates and extraneous information. The organised data is then saved in forms such as CSV or databases for analysis. Analysing trends with tools like Pandas or Tableau can provide insights, allowing for the depiction of employment demand patterns. It is crucial to follow ethical procedures throughout the process, including honouring website terms of service and avoiding anti-scraping methods such as CAPTCHAs. It is also essential to determine if multiple databases are used, and if yes, they need to be deduped. This approach can deliver actionable insights into changing job demands in specific industries.

**Figure 10.9: Analytics using web data**



Source: Author's conceptualisation.

## 10.9 Policy Recommendations

Based on the industry insights as discussed in the above section, the following policy recommendations are suggested for the IT sector for addressing skills shortages:

- Curriculum Development:** To structure the course curriculum, Curricula must be developed in partnership with partners from industries. It entails engaging with industry experts to co-develop training content and modules and establishing centres of excellence with industry-specific leaders. The curriculum needs to focus on domain building and not just data analytics
- Skill Initiatives:** Encourage academia-industry collaboration, guest faculties from industries, make internship compulsory, such as in medical science, and collaborate with the industry for internship. Encourage collaboration between educational institutions and research bodies to promote practical learning. There have to be structured mentorship programs with the experienced sector as a part of final-year project coursework, including intensive boot camps and hackathons
- Non-Technical Skills:** Attention to be paid to non-cognitive skills, especially cultural sensitivity and communication skills.
- Job Sites:** Require to improve spatial matching of industry and workers.
- Diversity and Inclusion:** To encourage women in technology, it is necessary to have remote working, which enables women to return to the labour force. There needs to be a focused program to enrol women back in the workforce. Diversity norms by level and function have helped increase Labour Force Participation(LFP).

## 10.10 Recommended Methodology

Based on the above, the recommended methodology to assess skills shortages and skill gaps for this sector is the following:

- Map the sub-segments of the sector to the NIC codes and specify them clearly. The sectoral sub-sectors have to be mapped to the NIC codes to ensure a multi-disciplinary approach and ensure that all experts can talk to each other in a holistic fashion. Further, this enables the policymaker to track the data at any desired terminology or aggregation.

2. Update mapping of NCO 2015 job roles with job roles identified by the Sector Skill Councils. This should be an annual exercise. Considering the rapid pace of technology in this sector, the job codes have to be regularly updated. It has to be ensured that Skill Digital Hub of MSDE and National Career Services portal are linked to each other and changes in one reflect changes in both.
3. In coordination with the Ministry of Skill Development and Entrepreneurship, the Sector Skill Council needs to implement surveys on a regular (at least annual) basis, which captures vacancies of firms. The job roles should be mapped/matched with the ones previously identified. Ideally the Economic Census forms the frame for any survey. Given the lack of data, the Ministry of Corporate Affairs' database or Goods and Services Tax Network are the other sources of universal data, from where data may be used to derive the universe. That universe needs to be divided into the sub-sectors as previously identified. Then proper sampling strategy needs to be adopted to understand the validity of the results. Biases need to be addressed. Response rates should also be collected.
4. Big Data analysis is highly recommended for SSCs using various job sites. They should also use/assess data from National Career Services and various employment exchanges around the country. The job roles should be mapped/matched with previously identified job roles.
5. Other databases as desired also may be used to complement existing databases. Any gaps in two different databases need to be recognised and reconciled to understand sectoral trends in the market.
6. The questionnaires asked respondents of the mediums used for hiring employees. While direct recruitment through job fairs at ITI and campus recruitments from engineering colleges were common, several firms also advertised positions on websites such as LinkedIn, Naukri.com, and Workindia.in and National Career Services. The job details from advertised positions on these portals can help create a good database to understand the kind of job roles which are in demand by the industry along with the corresponding educational qualifications, skill-sets, and salaries. Constant tracking of such data can also help keep the job-roles and skills database dynamic.
7. Stakeholder interactions need to be carried out as an annual exercise based on templates designed by the MSDE. It will capture jobs which are difficult to fill but also get a holistic view of the sector in terms of emerging technological trends, emerging jobs, detailed qualitative needs for qualifications and skills, hiring practices, best practices of firms, migration trends, practices to encourage female labour force participation, etc. This can be complemented by market intelligence reports, etc. that is available.
8. Last but not the least, the MSDE, Ministry of Labour and Employment and Ministry of Statistics and Programme Implementation should design an occupation-wage-employment survey. It is absolutely important to identify the occupation codes as identified previously. Ideally the Economic Census should form the frame for any survey.

This chapter describes the approach and instrument that can be used to collect insights about skill shortages in the technology sector. The chapter seeks to give actual solutions to the issues encountered while testing the technique. Given the unique nature of the practice, in-person interviews are encouraged from the outset. However, once the Labour Market Information System (LMIS) is operational and the data-gathering method has been standardised, MSDE may consider allowing firms to submit details directly. This direct submission could include sending an electronic questionnaire to the MSDE website, where enterprises can submit their responses.

Furthermore, it is critical to investigate leveraging big data/web data to analyse abilities and requirements. The job specifics from posted opportunities on these portals can assist in building a substantial database to understand the types of job roles in demand in the business and the matching educational qualifications, skill sets, and remuneration. Constantly tracking such data can also assist in maintaining the job roles and skills database current. Separating the definition by domain inside the technology sector would be a good idea—a junction of abilities and domains.

Big data is also a possible source to investigate and use to support qualitative firm-level interviews. Respondents were questioned about the recruiting processes in the questionnaires. In addition to hiring directly through ITI job fairs and engineering college campuses, several companies also posted job openings on websites like LinkedIn, Naukri.com, and Workindia.

Even though the respondents agreed that a labour market information system is helpful, the workforce won't meet skill demands unless the education and skilling ecosystem can keep up with curriculum design. In light of this, industrial associations and the sector skill council should attempt to improve industry-academia cooperation. Another stakeholder emphasised the necessity of "empowering companies" and giving them the support they need to train their employees. Engineering institutions must consider these collaborative opportunities to prepare a workforce for the industry.

## 11. Policy Recommendations and Way Forward

### 11.1 Introduction

This last chapter is divided in three sub-parts. The first presents a table which compares the different methodologies of assessing skills shortages and skill gaps. The second section presents the assessment methodology and the last section presents policy recommendations for improving the skilling eco-system.

### 11.2 Comparison of Methodologies

Table 11.1 presents the comparisons of methodologies between States, sectors and districts. While sectors have used vacancy data and surveys to assess skill shortages and gap, States have focused on assessing skill shortages for youth, most at the entry level jobs. They have done a survey of the youth and stakeholder surveys or firms' surveys at the State/district. Some States have gone on to identify occupations also at the beginning of their work which they then have tracked at State/district levels. A World Bank study has also assessed skills gap assessing skills demand and supply of training seats at the district level. Each study has its own advantages and disadvantages. The challenge is that the policymaker at the central level is not able to compile and compare the numbers together because they are derived from various methodologies.

**Table 11.1: Comparison of methodologies**

|                     | <i>NCAER</i>                                                                                                                                                        | <i>NASSCOM</i>                                                                                                                                                                                                                                                                                                    | <i>RASCI</i>                                                                                                                 | <i>World Bank</i>                                                                                    | <i>States</i>                                              |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Key Objective       | Assess skill shortage of 7 high growth sectors                                                                                                                      | Mapping of employment scope and skills gap in retail                                                                                                                                                                                                                                                              | Mapping of employment scope and skills gap in retail                                                                         | Local skill gaps at the district level for the youth                                                 | Assess skill shortages in States/Districts                 |
| Multiple objectives | Jobs forecasting both using macro methods and sectorally; Skills gap—medium or hard to fill both now and in the future; skills gap—extensive or intensive in nature | Estimate talent skills gap<br>Talent Supply refers to the installed tech talent for the given year. Talent Demand is defined as “Fulfilled Demand (Installed Talent) + Unmet Demand (Open Job Postings)”; only includes unfilled jobs at present and excludes met job postings over the previous 12-month period. | Jobs forecasting; incremental job requirements, identification of growing job roles & spatially too and Intensive skills gap | Assessed skills gaps in terms of differences between local opportunities and local skilling capacity | Jobs forecasting                                           |
| Methodology Used    | Input-output analysis; Primary Assessment, estimate demand at sectoral level                                                                                        | Used proprietary database; AI/ML data used and CAGR technique for forecasting                                                                                                                                                                                                                                     | Survey-based method but sampling size not statistically significant                                                          | Economic mapping and stakeholder consultations-Survey                                                | Secondary data analysis, survey and stakeholders' analysis |
| Sectors covered     | 7 sectors                                                                                                                                                           | IT                                                                                                                                                                                                                                                                                                                | Retail and Allied sectors                                                                                                    | Not applicable                                                                                       | All districts                                              |

|                   | <b>NCAER</b>                                                                                       | <b>NASSCOM</b>                                                                                                                      | <b>RASCI</b>                                                                                                                                             | <b>World Bank</b>                                                                                                                                                                                                         | <b>States</b>                                                                                          |
|-------------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Locations covered | All-India                                                                                          | All-India                                                                                                                           | All-India                                                                                                                                                | 1 district per state across 6 States                                                                                                                                                                                      | Districts                                                                                              |
| Job Projections   | Yes (I-O analysis) gives quantitative forecasts about jobs and occupations                         | No; gives projections about workers across broad categories                                                                         | No; gives projections about workers across broad categories                                                                                              | No                                                                                                                                                                                                                        | Gives projections for NSQF job roles                                                                   |
| Skill Shortage    | Yes; Stakeholder consultations (feasible to be scaled up if national survey done)                  | Yes                                                                                                                                 | No                                                                                                                                                       | No                                                                                                                                                                                                                        | Yes, but only for youth and the definition of youth differs across States                              |
| Skill Gap         | Yes                                                                                                | Yes                                                                                                                                 | No                                                                                                                                                       | No                                                                                                                                                                                                                        | No                                                                                                     |
| Advantages        | Simultaneous forecast of jobs for all sectors using IO; direct plus indirect job creation using IO | Closest to identifying gaps                                                                                                         | De-compose retail sector and identify growing jobs; identify high growth cities                                                                          | Good bottom-up approach; can be scaled up at the State-level                                                                                                                                                              | Good bottom-up approach; compute shortage                                                              |
| Disadvantages     | Mismatch in wages not estimated                                                                    | Cannot be applied to other sectors especially the traditional ones; only captures technical skills; mismatch in wages not estimated | Not statistically significant; should have had a sample size of at least 1,600; extensive skills gap assessment missing; mismatch in wages not estimated | Does not assess skills gaps in terms of jobs in demand and number in supply; Skilling capacity does not translate to number of people available because aspirations change; mismatch in wages not estimated; labour stock | Hard to compare across the country<br>Focussed on one demography may result in missing systemic issues |

**Sources:**

1. Ministry of Education and Strengthening Teaching-Learning and Results for States. 2024. *Jobs at Your Doorstep: A Jobs Diagnostics for Young People in Six States*. <https://documents1.worldbank.org/curated/en/099611211222442291/pdf/IDU-38279e6c-c3f8-4b1a-8b80-5e93677bc046.pdf>. November 22.
2. NASSCOM, Indeed.com and Draup. 2023. *India Tech Industry Demand and Supply Analysis 2023*. <https://nasscom.in/knowledge-center/publications/india-tech-industry-digital-talent-demand-and-supply-2023>. March 2.
3. Wazir Advisors and Retailers Association's Skill Council of India(RASCI). 2024. *Mapping of Employment Scope & Skill Gaps in Retail till FY26*. <https://www.rasci.in/pdf/RASCI%20Skill%20Gap%20Report%20upto%202026.pdf>. Mumbai, India.
4. Various States PPT Presentations made at the MSDE-NCAER Regional Workshops, March 11 and March 13, 2025.

### 11.3 Methodology

The objectives for the Central (State) Government are to give the overarching design to assess skill shortages and gap. The Central (State) Government has to carry out five key objectives:

1. Macro Analysis of sectoral shares of GVA workforce at the All-India level and State-level.
  - a. The State governments should carry out this analysis at the district level.
2. Macro Analysis- simulations to forecast jobs. This is a strongly recommended approach to be implemented by the policy planner to assess the direction of the economy.
  - a. The Central Government should do this for all sectors at the disaggregated level. The State governments should do this exercise using State-level data.

3. Demand projections of jobs of non-agricultural sectors using occupational–wage–employment survey of non-agricultural enterprises
  - a. The Ministry of Skill Development and Entrepreneurship (MSDE), Ministry of Labour and Employment (MoLE) and Ministry of Statistics and Programme Implementation (MoSPI) should design questionnaires, sampling strategy based on universal company data sourced from Ministry of Corporate Affairs/Goods & Services Tax Network to assess skill shortages and gaps.
  - b. The State governments should assess by collecting data representative at the district level.
4. Assess skill shortages and gaps of non-agricultural sectors using survey of non-agricultural firms for data on vacancies and skills
  - a. The Central Government should develop the template for questionnaires and sampling strategy.
  - b. The State governments may implement this too in their States.
5. Design of district-level analysis of jobs in the agriculture and allied sectors
  - a. A bottom-up approach should be adopted here.
  - b. The Central Government may develop a template for district analysis.
  - c. The State governments should analyse the available secondary data from situation analysis of farmers, agriculture census, soil and water statistics, production and exports data of agricultural and allied products and States' own publications. This is to be combined with surveys, Focus Group Discussions with farmers, cooperatives, other stakeholders in the value chain, etc.
6. Design of stakeholder interactions
  - a. The Central Government should design the stakeholder interactions.
  - b. The Sector Skills Council should implement this and share the results with the States too via the MSDE.

The focus of all the exercises is providing occupation. Therefore, the macro analysis exercise has to start from that point.

### **11.3.1 Mapping Occupations**

#### **Step 1**

- a. Map the occupational skills of National Classification of Occupations (2015) with the occupations identified in the Sector Skill Councils and appropriately classify them at the 8–digit level.
- b. Work backwards and identify the occupations at the 3-digit level too.

**Step 2:** Ensure that all the databases, the Periodic Labour Force Survey (PLFS), the Annual Survey of Industries (ASI) and the Annual Survey of Unincorporated Sector Enterprises (ASUSE) are all using, capturing and using the same NCO codes. The ASI and ASUSE may capture occupations at the 8–digit level (as mentioned earlier both the surveys are not capturing NCO codes at all).

**Step 2:** Identify the occupations that will be tracked at the 3-digit and 8-digit levels.

- a. The 3-digit level occupations will be used in macro analysis and simulations as the Periodic Labour Force Survey, the national household survey data tracks data at the 3-digit NCO level.



- b. The 8-digit level occupations will be used in demand projections using the occupational–wage–employment survey (OWES).

### 11.3.2 Map the Industries

“The National Industrial Classification (NIC) is an essential Statistical Standard for developing and maintaining comparable data base according to economic activities. Such classifications are frequently used in classifying the economically active population, statistics of industrial production and distribution, the different fields of labour statistics and other economic data such as national income. Comparability of statistics available from various sources, on different aspects of the economy, and usability of such data for economic analysis, are prerequisite for standardisation of a system of classification.” They go from 2-digit to 5-digit depending on the level of disaggregation. However, the NIC classifications itself may not match the more modern sub-sectors like renewable energy and information technology.

- c. Mapping of NIC industrial classification codes with the sub-sectors, especially of the new sectors.
  - i. For example, the wind energy sector is a new and upcoming sector in India. But it is not captured separately. The NIC code, 35106 captures, Electric power generation using other non-conventional sources and therefore the wind energy sector is subsumed within this.
  - ii. Similarly, the IT sector has one key NIC code, 6201 named as ‘computer programming activities’. But it has several other sub-sectors- ITeS, BPM, Er&D, SPD, Future Skills, which are subsumed under the NIC code 6201. The IT sector can also be divided across broad skill sets of data and cloud, software development and IT and product management.

### 11.3.3 Macroeconomic Analysis

- a. Annual macroeconomic analysis of sectors computing the sectoral shares of Gross Value Added (GVA).<sup>1</sup> This is to be done from Chapter 8 of the National Accounts Statistics (NAS) that are published annually by industry. The latest National Accounts 2024 are published here: <https://www.mospi.gov.in/publication/national-accounts-statistics-2024>. Share of GDP is computed by the following formulae.

$$\text{Sectoral Share (\%)} = 100 \times \frac{\text{Nominal Gross Value Added of Sector in a particular year at All – India (State/District)}}{\text{Nominal All – India (State/District) Gross Value Added in a particular year}}$$

- a. Compute sectoral share of labour force using the annual Periodic Labour Force Survey data.

---

<sup>1</sup> Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India. [National Industrial Classification 2008](https://www.ncs.gov.in/Documents/NIC_Sector.pdf).  
[https://www.ncs.gov.in/Documents/NIC\\_Sector.pdf](https://www.ncs.gov.in/Documents/NIC_Sector.pdf).

*Sectoral Share (%)*

$$= 100 \times \frac{\text{No. of workers employed in a sector in All – India (State/District) in a particular year}}{\text{All – India (State/District) workers employed in a particular year}}$$

- b. Using I-O analysis, compute the output, income and employment multipliers at the All-India (State) level.<sup>2</sup> For the same years and same 64 sectors, compute the sectoral shares of GDP and employment using the above-mentioned formulae. The national I-O tables are derived from the Supply-use Table (SUTs) produced by the MoSPI at that level of aggregation. Input-output analysis is a technique invented by Professor Wassily W. Leontief in 1951. It is used to analyse inter-industry relationship in order to understand the inter-dependencies and complexities of the economy and thus the conditions for maintaining equilibrium between supply and demand. The advantage of this methodology is that it captures the interlinkages and the indirect jobs created across the economy due to output change in a particular sector.
  - An income multiplier is defined as total income generated in the economy due to one unit of output generated in the said sector. Income is measured by the Gross Value Added (GVA).
  - An output multiplier is defined as total output generated in the economy due to one unit of output generated in the said sector. Output in an economy is measured by the Gross Value of Output (GVO).
  - An employment multiplier is defined as total direct and indirect employment generated in the economy due to change in one unit of final demand in that sector.
- c. Selection of Sectors: Ideally one should carry out the remaining analysis for all the sectors. However, if the choice is to carry out the analysis for selected sectors, the selection process is mentioned below step-wise.
  - i. As mentioned above, the income and employment multipliers are estimated and then ranked. If I-O analysis cannot be implemented, then this step can be skipped and one can directly go to step (iv) using disaggregated data from Chapter 8 of NAS.<sup>3</sup>
  - ii. Other variables examined, which can support the above analysis and give a holistic perspective, are:
    - GVA
      - Ten-year average share of Gross Value Added (GVA)
      - Ten-year average growth rate of GVA
      - Ten-year average ratio of GVA to Gross Value of Output (GVO)
    - Gross Capital Formation
      - Ten-year average growth of Gross Capital Formation (GCF)
      - Ten-year average share of GCF to GVA

<sup>2</sup> Munjal, P., Siddiqui, K.A., Pratap, D., Baruah, P. and Alam, A. 2022. Input-Output Transactions Table 2017-18 Himachal Pradesh. <https://ncaer.org/publication/input-output-transactions-table-2017-18-himachal-pradesh/>. NCAER, New Delhi, India. July 1.

<sup>3</sup> “The National Industrial Classification (NIC) is an essential Statistical Standard for developing and maintaining comparable data base according to economic activities. Such classifications are frequently used in classifying the economically active population, statistics of industrial production and distribution, the different fields of labour statistics and other economic data such as national income. Comparability of statistics available from various sources, on different aspects of the economy, and usability of such data for economic analysis, are prerequisite for standardization of a system of classification.” Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India. National Industrial Classification 2008. [https://www.ncs.gov.in/Documents/NIC\\_Sector.pdf](https://www.ncs.gov.in/Documents/NIC_Sector.pdf).

- Ten-year average share of GCF to GVO
- Labour
  - Five-year average share of workers (Periodic Labour Force Survey is available from 2017–18 onwards on an annual basis)
  - Five-year average share of labour inputs to GVO
  - Percentage share of female workers
  - Average intensity of work (average hours worked in a week)
- Forecasting
  - Auto-regressive integrated moving forecasting model.
- One could additionally look at trade (exports & imports data–DGCIS) and FDI (DPIIT & RBI). However, there are many challenges with the above variables. They are:
  5. While data on merchandise trade are available from the DGCIS, data on service exports by region, either State or district are not available. The methodology would not be consistent across sectors and therefore these variables were dropped.
  6. FDI data are not mapped to the National Industrial Classification (NIC) code and therefore hard to classify and map with the data provided by the National Accounting System. The available data are mapped at the State-level but not district level.
  7. Data on GCF are not available at the regional level, either State or district.
  8. ARIMA forecasting can give erroneous results given the rapid technological changes and various transitions involved like transition to a green economy.
- iii. Therefore, two variables are chosen—the percentage share of GVA and percentage share of workers in the economy and that also for the latest year for which both sets of numbers are available (and it should correspond to the years used in the I-O analysis, in case that is being used too). Then sectors are ranked separately based on the above two indicators. The top 25 sectors are chosen that appear in both the separate lists.
- iv. The top 25 sectors which have the highest share of GVA are ranked first. The rankings of these sectors regarding share of jobs, GVA, and employment multiplier are mapped.
- v. Sunrise/key future sectors from policy documents are identified and mapped to the sectors being used for analysis.
- vi. Then steps iv and v are integrated. Ideally the broad sectors of primary, secondary and tertiary should contain at least one sector from the above-mentioned process and one sunrise sector.
- vii. The last step involves taking in the policymakers' inputs on the selected sectors in order to finalise the sectors.
- viii. The identified sector may be very broad. Therefore, it was recommended to narrow them down further into sub-sectors. Data on GVA are not available at a disaggregated basis. Therefore, share of labour force was used to select the largest sub-sector (using NIC codes) within each of the above seven sectors.

- d. Identify the value chain, stakeholders of the identified sector/s at that particular NIC level and the job roles.
- e. Identify usage of technologies at various stages of the value chain in that sector/sub-sectors.
- f. Sector-wise time series (5–10 years) analysis of workforce characteristics for either all or selected sectors across
  - i. Categories
    1. State
      - This will also help in identification of geographical clusters based on workers' data.
    2. Educational qualifications (general, technical and vocational education)
    3. Engagement
    4. Occupation (NCO 3-digit or whatever level of disaggregation is available) and
    5. Gender of workers
  - ii. Data Sources are various publications of the MoSPI including PLFS, Annual Survey of Industries (ASI) and Annual Survey of Unincorporated Sector Enterprises (ASUSE). All the surveys to the extent feasible should capture occupations data at the 8-digit level.
  - iii. This may also be supplemented by sectoral reports or reports from that Ministry wherever available/applicable. For example,
    1. In the 'weaving of textiles' sector, handloom census may supplement MoSPI publications.
    2. There are various other publications by MoSPI in the agricultural sector like 'Agriculture Census', 'Situation Assessment of Farmers' that also gives insights.
    3. For 'raising cattle and buffaloes', Animal Husbandry Statistics and Livestock Census are also useful.
    4. The important thing is to use publicly available, verifiable, and credible data sources.
    5. In some sectors, where detailed statistics are not available, this analysis may be supplemented by market intelligence reports, etc.
  - iv. Big Data analysis across sub-sectors within NIC codes also may shed light on the location of workers across States. Multiple websites may be used.
  - v. There would be differences across data sources, which needs to be reconciled to get policy insights.
- g. Identification of sector-wise geographic clusters: Given sectoral variations, paucity in data, a sectoral methodology has to be adopted. Simple and replicable approaches are suggested with sources of data from publicly available, verifiable, credible sources following a standard methodology. Ideally either the Porter (1990) or the Delgado (2014) definitions should be used to define clusters. The definition should be clear and stated right in the beginning.

- i. Primary Sector: The framework to identify geographical clusters was adapted from Sutawi et al. (2022)<sup>4</sup>. Look at Chapters 4 and 5 for methodology. A step-wise ranking method is used to compute clusters.
- ii. Secondary Sector: Chapters 6, 7, and 8 show how the Porter definition of agglomeration of production units are used to compute clusters.
  1. Number of plants across States are counted to estimate clusters across NIC codes. Data are sourced from both ASI and ASUSE.
  2. For the energy sector: Clusters of plants dedicated to generating electricity using either of the renewable sources is governed by the renewable energy potential of the geographic region. For instance, potential for solar and wind electricity will be higher in regions with greater duration and intensity of sunlight and wind.  
 With solar and wind, plants will be set up only in places where there is ample sunshine and wind to generate energy. Firms will bid for tenders for setting plants of a particular installed capacity. Size of firms cannot be linked with size of plant. Stakeholders (industry associations, SSC) connect geographical clusters, i.e., no. of projects, with State-level installed capacity.
- iii. Tertiary Sector: Chapters 9 and 10 show the different methodologies used in each sector depending on the data availability.
  1. Specialised retail in food and clothing: Data on the number of units were used. This is available only for the unorganised sector in the ASUSE database. Then for the organised sector, memberships by State are taken from the Retailers Association of India. Lastly to measure innovation, one takes the data on number of start-ups from the DPIIT.
  2. Computer Programming Activities: Using the same framework as in agriculture and livestock (Figure 4.9), there are four pillars—infrastructure, innovation, business environment, human resources (skills) (Table 10.3). Similar to other sectors, a simple rank was computed for each indicator and then a step-wise average was computed resulting in a final averaging of all the rankings from each pillar.
- iv. Geographical clusters of workers may also be computed using the PLFS. However, this may be supplemented by other databases like the NASSCOM has used the Draup database.
- v. Comparison between geographical clusters and workforce clusters: This helps in identifying spatial mismatches, if any. Looking at one or the other gives an incomplete picture.

#### **11.3.4 Simulations: Forecasting of Jobs and Occupations**

- i. Using input-output methodology this can be implemented. It is deemed to be an optional step.

---

<sup>4</sup> Sutawi, Prihartini I., Zalizar L., Wahyudi A., Hendraningsih L. 2022. “The Success Indicators of a Dairy Farming Cluster in Indonesia: A Case in Malang Regency of East Java Province”. *Asian Journal of Dairy and Food Research*, 41(1): 22-27. doi: 10.18805/ajdfr.DR-242.

- ii. The advantage is that it is a simultaneous process across sectors. It captures the interlinkages across sectors and can show the direction a country is going towards. However, a linear forecasting methodology may give biased results. For example,
- iii. The I-O analysis is used to project the total number of jobs in 2026–27 and the top five occupations that will find maximum employment.
- iv. Base year numbers are derived from the PLFS.
- v. Steps for projecting employment
  1. National Accounts data (gives GVO data) are available till 2022–23
  2. Gross value of output (GVO): Value of the total sales of goods and services + Value of changes in the inventories.
  3. 2018–19 Input-Output (I-O) analysis is used.
  4. GVO/Output multiplier
    - Output generated in the entire economy due to one unit of output generated in the said sector.
    - 2018–19 I-O was used to estimate the output multiplier.
  5. Employment multiplier
    - Number of (direct & indirect) jobs created in the entire economy due to one unit of output generated in the said sector.
    - 2018–19 output multiplier was multiplied with 2022–23 labour-output ratio to estimate the employment multiplier for 2022–23.
  6. Number of jobs are projected over the next 3 years (2026–27) for the seven high-growth sectors.
  7. Make sectoral GVO assumptions
  8. Use average annual growth rates to make forecasts.
    - Alternative growth scenarios may be developed.
      - a. Alternative growth assumptions may be made
      - b. Another way is how Chaudhary, Pratap and Pohit (2024) use the alternative NITI Aayog assumptions to simulate the impact of net zero transition on employment.<sup>5</sup> Similarly, if assumptions, policy priorities, goals and targets have to be modelled for either all 64 or selected sectors, one can tentatively estimate both the overall and sectoral impact on jobs and occupations.
  9. Estimate number of (direct and indirect) jobs.
  10. Estimate jobs for the sub-sectors by taking the job shares of the sub-sectors in the main sectors.
  11. The same shares are used to estimate jobs for 2026–27.
  12. Distribution across occupations of ***ONLY direct jobs*** based on share of occupations for the year base year.
  13. Using the same shares, projections for occupations may be done.

---

<sup>5</sup> Chaudhuri, C., Pratap, D. & Pohit, S. 2024. “Effect of Energy Transition Under Net-Zero Target on Employment.” *Ind. J. Labour Econ.* <https://doi.org/10.1007/s41027-024-00528-y>. November 30.

### **11.3.5 Demand Forecasts using Occupational-wage-employment Survey for Non-agricultural Firms**

The MSDE, MoLE along with MoSPI should carry out occupation–wage–employment survey. They should do the following (Table 11.2):

1. Occupations and sectors need to be identified which will be followed over time.
  - a. As a starting point, one can start with the occupations already identified by the MSDE and Sector Skills Council.
2. The sampling strategy has to be designed. Firms should be sampled across size, ownership and region and sub-sectors.
3. The designations of respondents are also critical and quality checks need to be maintained.
4. The Ministry of Corporate Affairs/Goods & Services Tax Network/Economic Census data has to be the universe because no other data are available.
5. The sectoral data and the estimates have to be representative across all-India, States, districts, urban, rural and Tier 1 cities.
6. It should capture the following details on the identified occupations
  - a. Job Roles
  - b. Number of people employed
  - c. Wage rates across different geographies
  - d. Qualifications
  - e. Skills required
  - f. Technical skills
  - g. Anticipated demand for number of jobs at a particular job role

**Table 11.2: Representative questions for OWES**

| Job Role | NCO/NSQF Code | Stage of Value Chain | Tasks | Educational Qualifications sought by the firm | Knowledge (technical and theoretical knowledge relating to the job role) | Technical Skills (Computer applications and software) | Years of Experience | Skills (Full list of Skills-Annexure 2.3) | Geographic identifier |
|----------|---------------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|-------------------------------------------|-----------------------|
|----------|---------------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|-------------------------------------------|-----------------------|

Source: NCAER conceptualisation.

### **11.3.6 Assess Skill Shortages and Gaps of Non-agricultural Sectors Using Survey of Non-agricultural Firms for Data on Vacancies and Skills**

The Centre should design sampling strategy and questionnaires for Sector Skill Councils to assess skill shortages and gaps. This is for non-agricultural sectors which can collect the data on vacancies and skills. Firms should be sampled across size, ownership and region and sub-sectors.

The Economic Census/Ministry of Corporate Affairs database/Goods & Services Tax data may be used as the universe. Proper replacement strategy should be used because otherwise the responses suffer from selection bias.

The Centre should define as to what is a skill shortage? If vacancies last for more than three months, then it should be defined as a skill shortage. Using this definition, the SSCs can use a common assessment framework to feed into MSDE policymaking.

The following questions may be asked.

- How many employees do you have currently? \_\_\_\_\_
- How many job roles are currently vacant that you are actively looking to fill? \_\_\_\_\_
- Please fill in the details about the current vacant position/s (shown in Table 11.3)

**Table 11.3: Details about vacancies**

| Job Role | Name | No. of positions that are vacant | Years of Experience<br>1. 0 years<br>2. 1 to 5 years<br>3. 5 to 10 years<br>4. 10 to 15 years<br>5. More than 15 years | How long have these job roles being vacant?<br>1. ≤3 months;<br>2. >3 months & ≤ 6 months<br>3. >6 months & ≤9 months-3<br>4. 9 months & ≤12 month;<br>5. > 12 months-5 | Qualifications required | Skills Required | Please give us the reasons for vacancy.<br>1. We advertised only recently.<br>2. We(firm) didn't try much; if we get someone that is fine but otherwise it is okay<br>3. We wanted to try out the market<br>4. Wages did not match-expectations of wages were higher by prospective employees<br>5. Didn't find people with the required qualification<br>6. Find people but they do not have the skill set that we require for the job<br>7. Others |
|----------|------|----------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |      |                                  |                                                                                                                        |                                                                                                                                                                         |                         |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

Source: NCAER conceptualisation.

Note: You can add more rows if required.

### **11.3.7 District-level Analysis of Jobs in the Agriculture and Allied Sectors**

The States can use the secondary data analysis using Agriculture Census, Livestock Census, Situation Assessment Survey, Animal Husbandry Statistics, soil health, land use statistics, rainfall & groundwater statistics and their own statistics, etc. to undertake a district level analysis to assess the labour market situation in their district. Using this information, the labour market clusters for each agriculture & allied sector in the district can be identified. The Centre may use the secondary analysis from the States.

The States should design a survey and focus group discussions of farms, cooperatives, other stakeholders in the value chain, etc. Since value chains for each product will be identified, the stakeholders can also be identified. All of them should be interviewed in a structured manner to assess and anticipate the evolving jobs.



### 11.3.8 Design of Stakeholder Interactions

The MSDE should design for detailed stakeholder interactions including FGDs and structured questionnaires. This will inform not just about jobs but also about economic, technological changes that the sector is undergoing, the firms' own practices in hiring, skilling, etc. and perceptions about the sector.

Table 11. 4 presents a summary of all the approaches.

**Table 11.4: Objectives and methodology**

| S.No. | Type of Analysis                                            | Study Lead in Design                                                                                                     | Objectives and Methods                                                                                                                                                          | Implementing Agency                     |                                    | Frequency of Analysis |
|-------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------|-----------------------|
| 1.    | Macro Analysis of sectoral shares and labour force          | MSDE                                                                                                                     | <ul style="list-style-type: none"> <li>Descriptive data analysis from secondary data</li> <li>Identification of geographical clusters</li> <li>Input-output analysis</li> </ul> | MSDE                                    | All-India and State-level analysis | Annual Basis          |
|       |                                                             |                                                                                                                          |                                                                                                                                                                                 | State                                   | District-level analysis            |                       |
| 2.    | Macro Analysis (optional)                                   | MSDE                                                                                                                     | (3 to 5 year) forecasts of occupations accounting for stated policy goals, technological changes (and simulations for scenario building)                                        | MSDE                                    | All-India                          | 3 to 5 years          |
|       |                                                             |                                                                                                                          |                                                                                                                                                                                 | State                                   | State-level analysis               |                       |
| 3.    | Demand projections of jobs of non-agricultural sectors      | MSDE & MoLE (design of questionnaires, sampling strategy based on universal company data sourced from MCA)               | Occupational-wage-employment survey of non-agricultural enterprises (panel data)                                                                                                | MoSPI with district-level participation |                                    | 3 to 5 years          |
| 4.    | Assess skill shortages and gaps of non-agricultural sectors | MSDE (design of questionnaires, sampling strategy based on universal company data sourced from MCA/GSTN/Economic Census) | Survey of non-agricultural firms for data on vacancies and skills                                                                                                               | Sector Skill Councils                   |                                    | Annual                |
| 5.    | Analysis of jobs in sub-sectors of non-agricultural sectors | Sector Skill Councils                                                                                                    | Big Data Analysis                                                                                                                                                               | Sector Skill Councils                   |                                    | Annual                |
| 6.    | Analysis of agriculture & allied sectors                    | State Government                                                                                                         | District-level secondary data analysis                                                                                                                                          | State Skill Missions                    |                                    | Annual                |
|       |                                                             | MSDE (design of questionnaires, identification of stakeholders, etc.)                                                    | Survey, FGDs of farms, cooperatives, other stakeholders in the value chain, etc.                                                                                                | State and District Skill Missions       |                                    | Annual                |
| 7.    | Stakeholder Interactions                                    | MSDE                                                                                                                     | FGDs and structured interviews for anticipating economic & technological changes                                                                                                | Sector Skill Councils                   |                                    | Annual                |

Source: NCAER Conceptualisation.

## 11.4 Policy Recommendations

### 11.4.1 Stakeholders

In the skilling eco-system, there are four stakeholders—prospective workers and current workers, firms who demand workers, training providers, and statistical systems. Training providers may belong to the public sector. Statistical systems also belong to the government sector. All of them have to work hand-in-hand to address the skills shortage and gaps.

### 11.4.2 Limitations of Current Statistics

From the perspective of assessing skills, the Periodic Labour Force Survey suffers from some key limitations. It only captures job roles at the 3-digit NCO code. Specific examples are:

- Some job roles like the solar panel technician are not consistently captured.<sup>6</sup>
- 731 is the NCO code for handicraft workers. Code for a power loom weaver is 7318.5500 and that for a handloom weaver is 7318.5800. Since PLFS gives data at the 3-digit level, it is impossible to decipher which specific occupation is going to increase or decrease. Further, the power loom weaver code captures four different types of technologies (plain loom, semi-automatic loom, automatic loom and shuttle-less loom)

The Annual Survey of Industries and Annual Survey of Unincorporated Sector Enterprises does not capture NCO codes at all. Further, databases do not always match in terms of numbers. Chapter 6 especially discusses the issues of the differences between PLFS, Enterprise Survey and Handloom Census data. The National Classification of Occupations also has major challenges that have repeatedly come up in the sectoral chapters.

- Existing job roles are also not intuitive because the data are published at the 3-digit NCO code whereas occupations are identified at the 8-digit NCO code.
- Difficult to match new and emerging job roles
- Job roles not capturing different skill sets
- The Skill India Digital Hub and National Career Services need to ramp up their integration and communication with each other to improve the effectiveness of both.

The methodology above outlines a step-by-step process to reconcile these issues of industries and occupations, and discusses the urgent need for an updated survey, which will have a unified methodology—the Occupations Wage Employment Survey (OWES). Vacancy data analysis may be implemented using the existing National Career Services database and asking the Sector Skill Councils to conduct regular surveys with the MSDE appropriately designing the template. Big Data Analysis by Sector Skill Councils is another suggested approach.

### 11.4.3 Mismatch between Employers and Employees

The mismatch between employers and employees arise because of both supply and demand-side issues, which are specified here. The source for all these are the

---

<sup>6</sup> Dayal and Bhandari, 2025; <https://www.downtoearth.org.in/renewable-energy/expansion-in-renewable-energy-implies-an-employment-expansion-in-the-sector-too-are-we-undercounting-green-jobs>)

stakeholder surveys, which were done across the seven sectors and there were some common issues. They are:

1. Poor foundational skills that cannot be improved by skill training programmes (ITIs or other short-term training programmes): Improve the quality of schools to improve digital and financial literacy, active listening, active learning, reading, writing, speaking, math, attitude, flexibility, adaptability, working in a cooperative manner, conflict resolution, empathy, openness, gender diversity, patience and calmness. Digital courses which address these specific skill gaps could also be introduced with the cooperation of the Ministry of Education.
2. Poor quality of Higher Education Systems: Above the skills, upgrade curriculums, improve pedagogy, appoint quality teachers; industry-academia partnerships at all levels of education; encourage apprenticeships and internships; applied fields like agricultural machinery, dairy, engineering need to have mandatory on-field experience in every course they take; practical classes need to be taught by professors; introduce new courses; offer courses in the evening so that working professionals can update themselves.
3. Improve the Quality of the Training Providers especially the ITIs: Update curriculum to match latest industry needs (this needs to happen every three years), make practical training an important part of the curriculum, internships and apprenticeships to be made mandatory, improve pedagogy, periodically upskill teachers and master trainers. Industry partnerships with ITIs need to happen—every ITI should be partnered with an industry partner. Placement agencies need to be strengthened. Counselling and mentoring offered to students.
4. Local Skilling mismatch: District Magistrates need to facilitate cooperation such that local skilling eco-system works in close coordination with local market needs.
5. Traditional sectors' firms/farms need:
  - Awareness: MSMEs made aware about government skilling initiatives in Tier 2 & 3 cities
  - Re-orientation: Adopt digitisation, adopt technology, gains from hiring skilled workers; pay more; aim retention, teach what are perceived traditional taught in families to others; teach traditional employees new skills in the same sector like textiles; provide on-the-job training
  - Re-skilling and up-skilling: Existing employees need to be trained
  - Attitude changes: Firms need to pay more at the prevailing local minimum wages; at the minimum, use government welfare to provide social welfare benefits; recognition that old style of working needs to change
  - Other interventions—outreach to market: Need help with marketing, forecasting, basically reaching the market, etc.—either teach traditional firms those skills or provide them with help; Government extension programmes of departments have key roles to play; teach entrepreneurship skills—financial, personnel, materials management
6. Youth Aspirations: There is mismatch between what firms are offering and what the youth wants. Counselling and placement right from school level becomes important.
7. Retention problem: Offer mentoring, guidance, information about career path, better wage, and better social welfare nets.
8. Wage mismatch: Wages information needs to be captured; firms need to be willing to pay for skilled workers and that recognition is missing. Youth need to be mentored too. Chapters 7 and 8 compare the wage gaps between a fresh entry job for a motor mechanic and food delivery platform worker.

9. Identify the level of gap and fill that—Fresh or intermediate: Policy interventions will differ—auto has need for both fresh and intermediate but literature and Big Data analysis shows there is a shortage at the intermediate level. This is the problem that plagues the states too. They are focussed on the youth but the challenge may not exist there.
10. Jobs that are demanded across sectors—IT, Sales, Accounts/Finance: Recognise that certain jobs are demanded across skills; demand and, therefore, wages are more.
11. Technological Changes: New job roles are emerging and old ones are becoming obsolete. These need to be captured by stakeholders' survey and regularly updated in the National Career Services portal.
12. Recognise that MSMEs need multi-skilled workers. They need to be mapped and people need to be trained accordingly.
13. Digital Skills: Start from school onwards to including it in every phase of training.
14. Socio-emotional Skills: Start from school onwards to including it in every phase of training.
15. Advanced Cognitive Skills needs to be taught.
16. Firms need to offer avenues for re-skilling and upskilling. Like the employment linked incentive, skilling-linked incentive could make firms more invested in skilling. The apprenticeship/internship schemes could be made more popular.

#### **11.4.4 Low Female Labour Force Participation**

Across sectors, the common policy recommendations to increase female labour force participation are:

1. Establish Role Models: It is important to have positive role models both in the education and the Technical & Vocational Education and Training Systems especially from the local community.
2. Counselling and mentoring are important at all levels of education starting from secondary education and even at firms.
3. Construct female hostels near ITIs and industrial clusters.
4. Provide transport to female students and workers: Security at education and work and while travelling to schools/ITIs and work.
5. Change in gender attitudes at schools/ITIs: Both men and women need to be taught about gender diversity; set aspirations that women can do all kinds of job roles including seemingly those roles which require physical skills. Dhar, Jain and Jayachandran (2022) evaluated the 'Taaron ki Toli' programme implemented in Haryana.<sup>7</sup> The programme was centred around classroom discussions about gender equality in secondary schools. The authors found that that improved gender attitudes persisted even after two years of the programme. Other States like Odisha and Punjab are also introducing gender equity programmes in schools.<sup>8</sup>
6. Change the conditions of work: Create flexible jobs, offer them better pay or 'permanent' jobs; lifts for climbing windmill. The Code on Social Security Bill 2020, when implemented would recognise gig work and this should help in

---

<sup>7</sup> Dhar, D., Jain, T. and Jayachandran, S. 2022. "Reshaping Adolescents' Gender Attitudes: Evidence from a School-Based Experiment in India." *American Economic Review*. 112 (3): 899–927.

<sup>8</sup> Abdul Latif Jameel Poverty Action Lab website.  
<https://www.povertyactionlab.org/evaluation/impact-school-based-gender-attitude-change-program-india>.

formalising part-time job contracts thereby encouraging female labour force participation.<sup>9</sup>

7. Providing digital, financial, and entrepreneurship skills to women will help them attain better labour market outcomes.
8. Social Security Schemes: Generate awareness and leverage current government schemes to provide benefits to traditional workers.

## 11.5 Summary

A combination of methodological changes is proposed in this report along with demand-supply interventions to overhaul the system.

---

<sup>9</sup> Dev and Sahay (2025) pointed to the need of formalising part-time job contracts to increase female labour force participation rate.

Dev, A. and Sahay, R. 2025. “Unlocking Women’s Workforce Potential in India:

Quantifying the Labour Market Impact of Formalising Part-Time Employment and Gender Equality in Unpaid Care Work. *NCAER Working Paper No. 178*. <https://ncaer.org/wp-content/uploads/2025/01/NCAER-WP-178-Aakash-Ratna.pdf>. January.

# **Annexures**



## Annexure 2.1: Periodic Labour Force Survey Data

The unit-level data from the Periodic Labour Force Survey (PLFS) was used for explaining the employment contribution of the selected sectors and sub-sectors. The PLFS is a representative survey of households (representative at the NSS region level) undertaken by the National Statistical Office (NSO) of the Ministry of Statistics & Programme Implementation, Government of India.<sup>1</sup> It captures the activity status of all the members of the households surveyed and enlists the industry that each member of the household is engaged in (as per the National Industrial Classification (NIC) 5-digit level). Thus, the number of workers in each industry is estimated from the survey by using the weight of each surveyed individual. Apart from the industry of engagement, other details about the workers like their education level (general, technical, and vocational), the quality of jobs like written job contracts, and access to social security benefits, are also captured in the survey. The PLFS is carried out between July of one year and June of next year. This is carried out on an annual basis. There are quarterly reports available too but they are available only for urban areas and were not used here in this work.

For estimating the workers and jobs at the NIC 5-digit level, usual status workers (usual principal status (UPS) and usual subsidiary status (USS)) provided by the PLFS are used.<sup>2</sup> Adding the estimated workers using the UPS numbers and the exclusively subsidiary workers (individuals who have no worker status in their UPS and worker status in their USS) gives the number of workers at NIC 5-digit levels.

Jobs, as opposed to workers, entails adding multiple workers into the National Sample Survey (NSS) definition of Usual Status workers (Usual Principal Status (UPS) and Usual Subsidiary Status (USS)). Multiple workers are those workers who have worker status in both UPS and USS. Adding the multiple workers to 'workers' gives the labour inputs or jobs in various NICs. The methodology for estimating the number of jobs/labour inputs is explained in Kolli, Sharma and Sinharay (2008).<sup>3</sup>

---

<sup>1</sup> Ministry of Statistics and Programme Implementation (MoSPI): Periodic Labour Force Survey. <https://www.mospi.gov.in/Periodic-Labour-Surveys>.

<sup>2</sup> The concept of usual activity status refers to the activity status of a person during the last 365 days preceding the date of survey. The activity status on which a person spent a relatively longer time (183 days or more) in the year is called his/her UPS. Similarly, if a person has engaged in economic activity for a period of 30 days or more and less than 183 days during the last 365 days preceding the date of survey, it is called his/her usual subsidiary status (USS).

<sup>3</sup> Kolli, R., Sharma, S. and Sinharay, A. 2008. "Estimates of Workforce from the NSS-61st Round, 2004-05". *Journal of Income and Wealth*, 30(1): 34-58.



## Annexure 2.2: Input-Output Analysis

A sector, apart from creating jobs within itself, also creates jobs in other sectors of the economy through its linkages with other sectors. Each sector creates jobs in other sectors of the economy through both backward (the sector using the output of other sectors as inputs in its production process) and forward (the output of the sector is used by other sectors as their inputs) linkages.

Estimation of employment multiplier uses the Input-Output methods put forward by Prof. Wassily Leontief. The Leontief input-output model is a quantitative economic model that shows how different sectors of an economy are interdependent through the backward and forward linkages. Each column of the Input-Output Matrix shows how a particular sector uses the outputs of other sectors as its inputs. Each row of the Input-Output Matrix shows how the output of a particular sector is used as inputs by other sectors (thus intermediate use share of output) and as final use (like consumption, capital formation and net exports) referred to as final demand.

The Ministry of Statistics and Programme Implementation (MoSPI), provides Supply-Use Tables (SUTs). The input-output table is to be derived from the supply-use tables. Analysis in the report uses the Input-Output (I-O) table for 2018–19 as estimated by Chaudhary, Pratap and Pohit (2024).<sup>4</sup>

The Leontief Inverse is an exhibition of the interlinkages among all the sectors in the economy. This is computed using the 64-sectors I-O table for 2018–19. Using the Leontief inverse matrix for 2018–19, various multipliers for subsequent years could be estimated by using respective numbers (labour-output ratio) for that particular year. One thing may be noted here is that while we are estimating multipliers for a later year (say 2022–23), we are assuming the technology (and thus interlinkages among sectors) to remain fixed at 2018–19 level. This is a limitation of the I-O analysis.

### **Output Multiplier**

The Output multiplier for a sector is the output generated in the entire economy due to one unit of output generated in that particular sector. It is computed by adding the column of the Leontief Inverse matrix with regard to a sector.

### **Employment Multiplier**

The output generation in all the sectors of the economy due to interlinkages among the sectors will lead to creation of jobs in each sector. One unit of output generation in a sector will lead to  $L/Y$  unit of direct jobs, where  $L/Y$  is the labour-output ratio for a sector. In this way, employment multiplier matrix can be generated by multiplying the Leontief inverse matrix with the labour-output ( $L/Y$ ) matrix. For a 64-sector economy, the  $L/Y$  matrix will be a  $64 \times 64$  matrix. This will be a matrix with only non-zero diagonal elements and all non-diagonal elements being zero. The diagonal elements give respective sectoral  $L/Y$  ratios. Multiplying the  $L/Y$  matrix with the Leontief inverse matrix, we get a  $64 \times 64$  employment matrix, which gives the employment multiplier matrix for the 64 sectors. Column sum of the matrix gives the sectoral employment multiplier. Employment multiplier for a sector denotes the employment

---

<sup>4</sup> Chaudhary, C., Pratap, D. and Pohit, S. 2024. “Estimation of SAM for India: An Application for India’s Energy Transition Targets”. *Margin: The Journal of Applied Economic Research*. 18(1–2), 74–133. <https://doi.org/10.1177/00252921241284278>. NCAER, New Delhi, India.

generation in the entire economy due to one unit of output generated in the said sector. The diagonal elements in each column gives the direct share of the employment multiplier (sector's own contribution to jobs) and sum of all non-diagonal elements in each column gives the indirect share of the employment multiplier (sector's indirect contribution to jobs).

Thus, total employment generated (entire economy) due to economic activities in a sector could be estimated as

$$\text{Total employment generated in the economy due to economic activities in sector A} = \text{Employment Multiplier of sector A} * \text{production of sector A}$$

The direct jobs in a particular sector are estimated from the PLFS, as discussed in Annexure 2.1, and direct plus indirect jobs are estimated by using the I-O approach. From this, one can estimate number of jobs created in the economy by the economic activities in a particular sector per unit direct jobs in that sector.

### ***Income (GVA) Multiplier***

Output (Gross Value of Output or GVO) generation in a sector would lead to addition to Gross Value Added (GVA or Income) of the sector. If the total output of a sector is 'O' and total GVA of the sector is 'I', one unit of output increase will lead to increase in GVA by I/O, which is the GVA/GVO ratio. Thus, the GVA multiplier matrix is estimated by multiplying GVA/GVO ratio with the Leontief inverse matrix. Column sum of the GVA multiplier matrix gives the income or GVA multiplier for the sector. GVA multiplier for a sector can be denoted as total income generated in the entire economy due to one unit of output (or GVO) increase in the said sector.

### Annexure 2.3: Alternative Sectors

| <i>S.No.</i> | <i>Sector</i> | <i>Sub-sector</i>                                                                                      | <i>Appears in all 4 top 25 lists of Multipliers and Shares</i> | <i>Sunrise Sector (mentioned in Union Budget 2022–23)</i> | <i>Sector Skill Council</i>                    |
|--------------|---------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------|
| <b>1</b>     | Tertiary      | Community, Social and Personal Services                                                                | 4                                                              |                                                           |                                                |
| <b>2</b>     | Tertiary      | Education & Research                                                                                   | 3                                                              |                                                           |                                                |
|              | Tertiary      | Other Business Services                                                                                | 3                                                              |                                                           |                                                |
| <b>3</b>     | Tertiary      | Land Transport                                                                                         | 3                                                              |                                                           |                                                |
| <b>4</b>     | Secondary     | Manufacture of textiles + cotton ginning                                                               | 3                                                              |                                                           | Textile Sector Skill Council                   |
| <b>5</b>     | Tertiary      | Public Administration and Defence                                                                      | 2                                                              |                                                           |                                                |
| <b>6</b>     | Tertiary      | Ownership of dwellings                                                                                 | 2                                                              |                                                           |                                                |
| <b>7</b>     | Tertiary      | Financial Services                                                                                     | 2                                                              |                                                           | BFSI                                           |
| <b>8</b>     | Secondary     | Manufacture of Basic Iron and Steel + Casting of iron and steel                                        | 2                                                              |                                                           | Indian Iron and Steel Sector Skill Council     |
| <b>9</b>     | Tertiary      | Communication                                                                                          | 4                                                              |                                                           | Telecom Sector Skill Council                   |
| <b>10</b>    | Tertiary      | Medical and Health                                                                                     | 3                                                              |                                                           | Healthcare Sector Skill Council                |
| <b>11</b>    | Secondary     | Manufacture of chemical and chemical products except pharmaceuticals, medicinal and botanical products | 3                                                              |                                                           |                                                |
| <b>12</b>    | Primary       | Forestry and Logging                                                                                   | 3                                                              |                                                           |                                                |
| <b>13</b>    | Secondary     | Manufacture of other non-metallic mineral products                                                     | 2                                                              |                                                           |                                                |
| <b>14</b>    | Secondary     | Manufacture of coke and refined petroleum products                                                     | 2                                                              |                                                           |                                                |
| <b>15</b>    | Primary       | Fishing & Aquaculture                                                                                  | 2                                                              |                                                           | ASCI                                           |
| <b>16</b>    | Secondary     | Manufacture of Transport                                                                               | 1                                                              | Clean Mobility Systems                                    | Automotive Skills Development Council (ASDC)   |
| <b>17</b>    | Secondary     | Manufacture of machinery and equipments n.e.c.                                                         | 1                                                              |                                                           |                                                |
| <b>18</b>    | Secondary     | Manufacture of pharmaceutical; medicinal chemicals and botanical products                              | 1                                                              | Genomics and Pharmaceuticals, pharma                      | Life Sciences Sector Skill Development Council |
| <b>19</b>    | Secondary     | Manufacture of computer, electronic and optical products                                               |                                                                | Geospatial Systems and Drones                             | Electronics Sector Skill Council of India      |
| <b>20</b>    | Secondary     | Manufacture of communication equipment                                                                 |                                                                | Semiconductor and its eco-system                          | Telecom Sector Skill Council                   |
| <b>21</b>    | Tertiary      | Air Transport                                                                                          |                                                                | Space Economy                                             | Aerospace and Aviation Sector Skill Council    |

Sources: NCAER Computations from Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2021-June 2022. Document No.: DDI-IND-CSO-PLFS-2021-22. <https://microdata.gov.in/nada43/index.php/catalog/165/study-description> and Ministry of Statistics and Programme Implementation, Government of India. 2024. National Accounts. <https://mospi.gov.in/data>.

## Annexure 2.4: Summary Tables of Sectors & Sub-sectors

| Sector                                                                                      | Share<br>(2017-18 to 2022-23)    |                                  | Multiplier<br>(2021-22) |            | Rate of Growth over the<br>last five years |                                       |
|---------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|-------------------------|------------|--------------------------------------------|---------------------------------------|
|                                                                                             | GVA<br>(Average Share<br>in GDP) | Employment<br>(as % of<br>total) | GV<br>A                 | Employment | GVA<br>(2017-18 to<br>2022-23)             | Employment<br>(2018-19 to<br>2022-23) |
| Primary                                                                                     | 17                               | 45                               | N.A.                    | N.A.       | 4.7                                        | 8.8                                   |
| Agriculture<br>(Crops)                                                                      | 9.5                              | 40.3                             | 1.0                     | 95.0       | 3.2                                        | 6.1                                   |
| Growing of<br>cereals                                                                       | N.A.                             | 30.5                             | N.A.                    | N.A.       | N.A.                                       | 4.7                                   |
| Livestock                                                                                   | 5                                | 5.6                              | 1                       | 43.3       | 6.9                                        | 29                                    |
| Raising of<br>cattle and<br>buffaloes                                                       | N.A.                             | 2.7                              | N.A.                    | N.A.       | N.A.                                       | 28.2                                  |
| Secondary/Industry                                                                          | 25.7                             | 26                               | N.A.                    | N.A.       | 4                                          | 6.8                                   |
| Manufacturing                                                                               | 14.2                             | 11.3                             | N.A.                    | N.A.       | 3.5                                        | 4.7                                   |
| Manufacturing<br>of Textiles<br>plus cotton<br>ginning                                      | 1.3                              | 1.1                              | 1                       | 28.4       | 7.1                                        | (-)2.0                                |
| Weaving of<br>textiles                                                                      | N.A.                             | 0.3                              | N.A.                    | N.A.       | N.A.                                       | 4.5                                   |
| Manufacturing<br>of Transport                                                               | 1.5                              | 0.3                              | 0.9                     | 13.2       | 2                                          | 7.2                                   |
| Manufactu<br>re of motor<br>vehicles                                                        | N.A.                             | 0.05                             | N.A.                    | N.A.       | N.A.                                       | (-)3.9                                |
| Manufactu<br>re of parts<br>and<br>accessories<br>for motor<br>vehicle                      | N.A.                             | 0.1                              | N.A.                    | N.A.       | N.A.                                       | 16.4                                  |
| Electricity Gas &<br>Water Supply                                                           | 2.4                              | 0.5                              | N.A.                    | N.A.       | 6.1                                        | 4.2                                   |
| Electricity                                                                                 | 1.8                              | 0.3                              | 1                       | 10.6       | 4.7                                        | 1.4                                   |
| Electric<br>power<br>generation<br>using solar<br>energy                                    | N.A.                             | 0.01                             | N.A.                    | N.A.       | N.A.                                       | 50.1                                  |
| Electric<br>power<br>generation<br>using other<br>non-<br>convention<br>al sources          | N.A.                             | 0.01                             | N.A.                    | N.A.       | N.A.                                       | 82.3                                  |
| Tertiary/Services                                                                           | 48.6                             | 27.6                             | NA                      | NA         | 5.1                                        | 4.6                                   |
| Trade, hotels,<br>transport,<br>communication<br>and services<br>related to<br>broadcasting | 16.3                             | 15.8                             | NA                      | NA         | 5.1                                        | 5.1                                   |
| Trade                                                                                       | 9.8                              | 9.8                              | 1.1                     | 27.5       | 3.7                                        | 6.5                                   |

| Sector                                                                                         | Share<br>(2017-18 to 2022-23)    |                                  | Multiplier<br>(2021-22) |            | Rate of Growth over the<br>last five years |                                       |
|------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|-------------------------|------------|--------------------------------------------|---------------------------------------|
|                                                                                                | GVA<br>(Average Share<br>in GDP) | Employment<br>(as % of<br>total) | GV<br>A                 | Employment | GVA<br>(2017-18 to<br>2022-23)             | Employment<br>(2018-19 to<br>2022-23) |
| Retail sale<br>of food in<br>specialised<br>stores                                             | NA                               | 3.4                              | NA                      | NA         | NA                                         | 9.4                                   |
| Retail sale<br>of clothing,<br>footwear<br>and leather<br>articles in<br>specialised<br>stores | NA                               | 0.8                              | NA                      | NA         | NA                                         | 7.5                                   |
| Maintenance<br>and repair of<br>motor<br>vehicles                                              | NA                               | 0.4                              | NA                      | NA         | NA                                         | 7.2                                   |
| Computer<br>related<br>services                                                                | 4.4                              | 0.7                              | 1                       | 8.3        | 8.8                                        | 17.9                                  |
| Computer<br>programming<br>activities                                                          | NA                               | 0.3                              | NA                      | NA         | NA                                         | 18.9                                  |

Sources: NCAER Computations from

1. Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2021-June 2022. Document No.: DDI-IND-CSO-PLFS-2021-22.  
<https://microdata.gov.in/nada43/index.php/catalog/165/study-description>.
2. Ministry of Statistics and Programme Implementation, Government of India. 2024. National Accounts.  
<https://mospi.gov.in/data>.

## Annexure 4.1: Yield of Cereals, Pulses and Oilseeds

### Labour and Land Yield of Cereals, Oilseeds and Pulses, 2021–22

| State                     | Yield of Cereals, Oilseeds and Pulses (kg/hectare), 2021–22 |          |        | Labour Productivity of Cereals, Oilseeds and Pulses (kg/worker), 2021–22* |          |        |
|---------------------------|-------------------------------------------------------------|----------|--------|---------------------------------------------------------------------------|----------|--------|
|                           | Cereals                                                     | Oilseeds | Pulses | Cereals                                                                   | Oilseeds | Pulses |
| Andaman & Nicobar Islands | 2,518                                                       |          | 393    | 1,555                                                                     |          | 75     |
| Andhra Pradesh            | 3,778                                                       | 899      | 817    | 1,881                                                                     | 576      | 2,406  |
| Arunachal Pradesh         | 1,659                                                       | 1,046    | 1,025  | 1,930                                                                     | 79,754   | 1,931  |
| Assam                     | 2,129                                                       | 638      | 754    | 1,409                                                                     | 37,868   | 0      |
| Bihar                     | 2,595                                                       | 1,131    | 874    | 1,414                                                                     | 1,119    | 2,701  |
| Chandigarh                | 4,883                                                       |          |        | 4,819                                                                     |          |        |
| Chhattisgarh              | 1,782                                                       | 593      | 602    | 1,044                                                                     |          |        |
| Dadra & Nagar Haveli      | 2,089                                                       | 539      | 1,044  | 1,378                                                                     |          |        |
| Daman and Diu             | 1,585                                                       |          | 1,019  |                                                                           |          |        |
| Delhi                     | 3,645                                                       | 1,269    | 1,000  | 5,442                                                                     | 11,398   |        |
| Goa                       | 2,691                                                       | 2,285    | 916    | 10,409                                                                    |          |        |
| Gujarat                   | 2,490                                                       | 1,973    | 1,273  | 2,549                                                                     | 4,728    | 11,292 |
| Haryana                   | 3,929                                                       | 1,940    | 925    | 21,632                                                                    | 5,122    | 60,044 |
| Himachal Pradesh          | 2,140                                                       | 649      | 1,901  | 1,239                                                                     | 1,140    | 2,410  |
| Jammu & Kashmir           | 1,956                                                       | 824      | 973    | 3,679                                                                     |          | 10,253 |
| Jharkhand                 | 2,082                                                       | 760      | 1,040  | 937                                                                       |          |        |
| Karnataka                 | 2,300                                                       | 944      | 628    | 2,449                                                                     | 2,161    | 2,893  |
| Kerala                    | 2,861                                                       | 604      | 975    | 3,030                                                                     |          | 889    |
| Ladakh                    | 1,604                                                       |          | 902    | 4,330                                                                     |          |        |
| Madhya Pradesh            | 2,812                                                       | 986      | 1,007  | 2,475                                                                     | 6,004    | 50,187 |
| Maharashtra               | 1,530                                                       | 1,178    | 868    | 1,478                                                                     | 1,851    | 16,183 |
| Manipur                   | 2,385                                                       | 820      | 944    | 5,462                                                                     |          | 3,669  |
| Meghalaya                 | 2,482                                                       | 1,061    | 1,433  | 3,207                                                                     |          |        |
| Mizoram                   | 1,712                                                       | 1,126    | 1,448  | 1,386                                                                     |          | 2,298  |
| Nagaland                  | 1,668                                                       | 1,050    | 1,176  | 4,069                                                                     |          | 4,369  |
| Odisha                    | 2,065                                                       | 766      | 563    | 1,925                                                                     | 9,451    | 66,047 |
| Puducherry                | 2,997                                                       | 2,048    | 566    | 10,445                                                                    |          |        |
| Punjab                    | 4,568                                                       | 1,505    | 1,014  | 18,304                                                                    | 29,170   | 62,524 |
| Rajasthan                 | 2,011                                                       | 1,466    | 662    | 2,435                                                                     | 9,983    | 10,883 |
| Sikkim                    | 1,746                                                       | 925      | 962    |                                                                           |          |        |
| Tamil Nadu                | 3,642                                                       | 2,493    | 654    | 2,962                                                                     | 4,912    | 2,005  |
| Telangana                 | 3,542                                                       | 1,808    | 958    | 2,489                                                                     | 2,967    | 14,858 |
| Tripura                   | 2,936                                                       | 825      | 748    | 8,859                                                                     |          |        |
| Uttar Pradesh             | 3,039                                                       | 1,025    | 1,036  | 2,528                                                                     | 2,955    | 28,547 |
| Uttarakhand               | 2,458                                                       | 947      | 961    | 6,427                                                                     |          | 664    |
| West Bengal               | 3,120                                                       | 1,191    | 876    | 2,043                                                                     | 17,192   | 91,843 |
| All India                 | 2,782                                                       | 1,267    | 842    | 2,397                                                                     | 3,919    | 9,576  |

#### Sources:

Ministry of Agriculture and Farmers' Welfare. <https://desagri.gov.in/statistics-type/five-year-estimates/>.

PLFS 2021–22. Ministry of Statistics and Programme Implementation, Government of India. 2023. *Periodic Labour Force Survey (PLFS), July 2021-June 2022*. Document No.: DDI-IND-CSO-PLFS-2021-22.

<https://microdata.gov.in/nada43/index.php/catalog/165/study-description>.

**Note:** The PLFS captures two activities for the surveyed individuals. One is the principal activity where the person devotes majority of his/her time in a given year (183 days and more). The subsidiary activity captures the second activity of individuals who are engaged in more than one activity. The person devotes lesser amount of time (at least 30 days and less than 183 days) to this activity. For calculating labour productivity, we are taking only the principal activity of the person as this is the activity the person devotes majority of time in a year. The PLFS estimated population is lower than the projected population for a year. As a matter of practice, the ratio between the projected census population and the PLFS estimated population is taken as an

adjustment factor and PLFS estimated figures are multiplied by the adjustment factor to arrive at the adjusted figures which are closer to the actual population.

## Annexure 4.2: Definition of Skills Using PLFS

| <b>Type of Skill</b> | <b>Description</b>                                                                         |
|----------------------|--------------------------------------------------------------------------------------------|
| Low skilled          | General education below primary, no technical and no vocational education                  |
|                      | General education below primary, no technical and some vocational education                |
| Low medium skilled   | General education primary to secondary, no technical and no vocational education           |
|                      | General education primary to secondary, no technical and some vocational education         |
| Medium high skilled  | General education higher secondary, no technical and no vocational education               |
|                      | General education higher secondary, no technical and some vocational education             |
|                      | General education higher secondary, some technical and no vocational education             |
|                      | General education diploma/certificate course, no technical and no vocational education     |
|                      | General education diploma/certificate course, no technical and some vocational education   |
|                      | General education diploma/certificate course, some technical and no vocational education   |
|                      | General education diploma/certificate course, some technical and some vocational education |
| High skilled         | General education graduate & above, no technical and no vocational education               |
|                      | General education graduate & above, no technical and some vocational education             |
|                      | General education graduate & above, some technical and no vocational education             |
|                      | General education graduate & above, some technical and some vocational education           |

Source: NCAER 2022. Contribution to Overall Employment by the Auto Industry: Jobs and Skills. <https://www.ncaer.org/wp-content/uploads/2022/03/NCAER-Report-Impact-of-Auto-on-Jobs-and-Skills-March-2022-1.pdf>. March.

## Annexure 4.3: Agricultural Clusters

### Clusters in Agriculture in India

Agricultural clusters represent geographically proximate networks of interconnected farms, markets, research institutions, and support organisations within the agricultural sector. These clusters are characterised by shared resources, knowledge, and collaborative opportunities, embodying the concept of the "Economy of Agglomeration" (Silvis et al., 2002)<sup>5</sup>.

### Determinants of National Competitive Advantage:

In the context of India, several factors contribute to the nation's competitive advantage in agriculture, shaping the landscape of agricultural clusters across the country:

- 1. Factor Conditions:** India's competitive advantage in agriculture is influenced by various factor conditions such as technological advancements, availability of skilled labour, and infrastructure development. For instance, the adoption of modern agricultural practices and the availability of skilled labour contribute to increased productivity in States like Punjab and Haryana, known for their advanced farming techniques and irrigation infrastructure (Kumar et al., 2018)<sup>6</sup>.
- 2. Demand Conditions:** The demand conditions within India's diverse and populous market significantly impact the growth and innovation in the agricultural sector. For example, the demand for rice and wheat in States like Uttar Pradesh and West Bengal, with large populations and high consumption rates, drives the production and innovation of these crops to meet local dietary preferences (Joshi et al., 2017)<sup>7</sup>.
- 3. Related and Supporting Industries:** India's agricultural sector benefits from the presence of related and supporting industries such as agri-input suppliers, food processing units, and agricultural machinery manufacturers. For instance, the establishment of food processing industries in States like Maharashtra and Gujarat enhances value addition to agricultural products, fostering the development of integrated agricultural clusters (Sharma et al., 2020)<sup>8</sup>.
- 4. Firm Strategy, Structure, and Rivalry:** The competitive dynamics among agricultural firms in India influence the strategies, structures, and overall performance of the sector. For example, the presence of numerous agricultural cooperatives in States like Gujarat and Maharashtra fosters collaboration among farmers and

---

<sup>5</sup> Silvis, H., Slangen, L. H. G., Bremmers, H., Heijman, W., & Jongeneel, R. 2002. Handboek agrarische economie en beleid: bedrijven, ketens en groene ruimte (Handbook of agricultural economics and policy: companies, chains and green space). Groningen: Wolters-Noordhoff. ISBN 90-207-3175-0.

<sup>6</sup> Kumar, P., Dhillon, R. S., & Kaur, G. 2018. "Agricultural Development in India: A District Level Analysis". *International Journal of Agricultural and Statistical Sciences*, 14(1). 169–180.

<sup>7</sup> Joshi, P. K., BIRTHAL, P. S., & Minot, N. 2017. "Sources of agricultural productivity growth in India: The role of globalization". *Agricultural Economics*, 48(1), 51–65.

<sup>8</sup> Sharma, S., Anand, P., & Pandey, A. 2020. "Impact of food processing industry on Indian Agriculture". *Journal of Public Affairs*, 20(2), e2122.



enhances bargaining power, leading to better market access and improved profitability (Srivastava et al., 2019)<sup>9</sup>.

## **Role of Clusters in the context of India**

- 1. Increasing Static Productivity:** Agricultural clusters in India contribute to enhancing static productivity through several mechanisms. Firstly, they provide access to specialised inputs and skilled labour, which is essential for efficient agricultural production. For example, clusters focusing on horticulture in regions like Maharashtra and Karnataka benefit from access to specialised seeds, fertilisers, and agri-technologies, leading to higher yields and improved productivity (Gupta et al., 2019)<sup>10</sup>. Additionally, clusters facilitate the flow of information and knowledge among participants, enabling farmers to adopt best practices, innovative techniques, and technological advancements. This exchange of knowledge often occurs through farmer cooperatives, agricultural extension services, and research institutions linked to the clusters. Furthermore, clusters foster complementarities between different agricultural activities, such as crop cultivation, livestock rearing, and agro-processing, thereby optimising resource utilisation and enhancing overall productivity. Lastly, clusters provide access to essential institutions and public goods, including agricultural research centres, irrigation facilities, and market infrastructure, which further support productivity enhancement efforts (Saxena et al., 2020)<sup>11</sup>.
- 2. Increasing Capacity for Innovation:** Agricultural clusters serve as hubs for innovation by facilitating collaboration, knowledge sharing, and joint marketing initiatives among stakeholders. These clusters often bring together farmers, agri-businesses, research institutions, and government agencies, creating fertile ground for innovation diffusion and adoption. For instance, clusters specialising in organic farming in States like Sikkim and Uttarakhand promote innovation in sustainable agricultural practices, soil conservation techniques, and organic certification standards through collaborative research and knowledge exchange platforms (Sharma & Singh, 2018)<sup>12</sup>. Moreover, the presence of agri-start-ups and entrepreneurial ventures within clusters encourages experimentation with novel technologies, value-added products, and market-driven solutions, thereby fostering a culture of innovation and entrepreneurship in the agricultural sector.
- 3. Stimulation of New Business Formations:** Agricultural clusters in India stimulate the entry of new firms by providing various incentives and reducing barriers to entry. Firstly, they serve as information hubs, signalling market demand, emerging trends, and business opportunities to potential entrants. For example, clusters focusing on high-value crops like spices in Kerala or floriculture in Tamil Nadu attract new entrepreneurs by highlighting the demand for these

---

<sup>9</sup> Srivastava, A. K., Singh, R., & Bhagat, R. B. 2019. "Impact of agricultural credit on agriculture and allied sector in India: A spatial analysis". *International Journal of Agricultural and Statistical Sciences*. 15(2): 557–566.

<sup>10</sup> Gupta, R. K., Kumar, A., & Gaurav, K. 2019. "Role of Agricultural Clusters in Sustainable Agriculture Development: Evidence from India". *Indian Journal of Agricultural Economics*. 74(4): 549–562.

<sup>11</sup> Saxena, A., Singh, M., & Tiwari, S. 2020. "Agricultural clusters in India: Current status, opportunities and challenges". *Agriculture and Food Security*, 9(1): 11.

<sup>12</sup> Sharma, V., & Singh, S. 2018. "Organic Farming Clusters: A Sustainable Pathway for Agricultural Development in India". *Indian Journal of Agricultural Economics*, 73(3): 312–325.

products in domestic and international markets (Saravanan et al., 2019)<sup>13</sup>. Additionally, the collaborative ecosystem within clusters lowers entry barriers by providing access to shared infrastructure, technical expertise, and financial resources. This collaborative environment fosters mentorship, peer learning, and risk-sharing among existing and new businesses, thereby encouraging entrepreneurship and fostering the growth of Small and Medium Enterprises (SMEs) in the agricultural value chain.

## Types of Clusters in Indian Agriculture

### 1. Types of Clusters by Knowledge:

- **Factor Endowment Clusters:** In India, factor endowment clusters emerge in regions with abundant natural resources, fertile land, and favourable agro-climatic conditions. For instance, the Punjab-Haryana belt is renowned for its wheat and rice cultivation, benefitting from rich alluvial soil and well-irrigated fields (Singh et al., 2017)<sup>14</sup>. Similarly, regions like Andhra Pradesh and Telangana exhibit factor endowment clusters for horticultural crops like mangoes and bananas due to favourable soil and climatic conditions.
- **Techno Clusters:** India boasts techno clusters in agricultural biotechnology, precision farming, and agri-informatics, often cantered around premier research institutions and technology parks. For instance, the Biotech Park in Hyderabad serves as a hub for biotechnology start-ups and research organisations, driving innovation in crop genetics, bioinformatics, and agri-biopharmaceuticals (Sujatha & Reddy, 2018)<sup>15</sup>.
- **Historic Knowhow-Based Clusters:** Historic knowhow-based clusters in India are exemplified by traditional agricultural practices passed down through generations. Regions like Kerala's Kuttanad and Tamil Nadu's Cauvery delta have thriving rice cultivation clusters, benefiting from centuries-old knowledge of paddy farming techniques, water management, and crop rotation (Kumar et al., 2019)<sup>16</sup>.

### 2. Types of Clusters by Form of Development:

- **Geographical Clusters:** Geographical clusters in India arise due to specific agro-ecological conditions and resource availability. For instance, the Western Ghats region hosts geographical clusters of spice cultivation, including pepper, cardamom, and cinnamon, owing to its tropical climate and hilly terrain (Balasubramanian et al., 2019)<sup>17</sup>.

<sup>13</sup> Saravanan, S., Sharma, P., & Bhagat, R. B. 2019. "Growth Dynamics of Agricultural Clusters in Tamil Nadu, India: An Economic Analysis". *Asian Journal of Agricultural Extension, Economics & Sociology*, 35(1): 1–10.

<sup>14</sup> Singh, S., Singh, B., & Kumar, A. 2017. "Wheat Crop Production and Its Future Prospects in India". *International Journal of Current Microbiology and Applied Sciences*, 6(6): 3925–3933.

<sup>15</sup> Sujatha, P., & Reddy, S. 2018. "Technological Clusters in India: A Case Study of Agricultural Biotechnology Industry in Hyderabad". *Economic Affairs*, 63(2): 315–326.

<sup>16</sup> Kumar, P., Jain, P. K., & Prasad, R. K. 2019. "Traditional Rice Cultivation in Kuttanad Region: A Sustainable Farming Practice in Kerala, India". *International Journal of Current Microbiology and Applied Sciences*, 8(6): 1092–1098.

<sup>17</sup> Balasubramanian, S., Murali, K. S., & Ramakrishnan, B. 2019. "Clusters and Spices Sector: A Study in Western Ghats Region". *Journal of Agribusiness in Developing and Emerging Economies*, 9(2): 188–203.

- **Sectoral Clusters:** Sectorial clusters in India are prevalent across diverse agricultural domains, such as dairy farming, floriculture, and sericulture. For example, the dairy clusters in Gujarat's Anand district, home to the Amul dairy cooperative, represent a sectorial cluster renowned for its milk production and dairy processing capabilities (Patel & Prajapati, 2020)<sup>18</sup>.
- **Horizontal and Vertical Clusters:** Horizontal clusters in India foster collaboration and resource-sharing among agri-businesses operating at the same level of the value chain. An example is the collaboration between multiple small-scale organic farms in Uttarakhand, collectively marketing their produce under a unified brand, thereby leveraging economies of scale and enhancing market access. Vertical clusters, on the other hand, involve integration along the agricultural supply chain, such as the linkage between contract farming companies, agro-processing units, and retail chains in the fresh fruit and vegetable sector (Gupta et al., 2020)<sup>19</sup>.

### Methods for Identifying Agricultural Clusters:

1. **Shift Share Analysis:** This method evaluates regional competitiveness by examining changes in employment and associated competitiveness over time. In India, it can provide insights into the dynamic nature of agricultural clusters across different States and regions.

a. Actual Total Shift:

$$\text{Actual Total Shift} = \sum \Delta E_{ij} - \Delta E_{ti}$$

$\Delta E_{ij}$ : Change in employment per sector  $i$  in region  $j$  from year  $o$  to year  $t$

$\Delta E_{ti}$ : Change in employment per sector  $i$  in the total economic area from year  $o$  to year  $t$

- b. Relative Actual Shift (RAS):

$$\text{Relative actual shift} = \sum \left( \frac{E_{ij}}{E_{ti}} \right)$$

$E_{ij}$ : Employment per sector  $i$  in region  $j$  from year  $o$  to year  $t$

$E_{ti}$ : Employment per sector  $i$  in the total economic area from year  $o$  to year  $t$

2. **Location Quotient Analysis:** Location quotient analysis helps assess the relative economic strength of specific agricultural industries within regions compared to the national average. By comparing employment data, it highlights areas where certain agricultural sectors are particularly concentrated, indicating potential cluster formations.

---

<sup>18</sup> Patel, D., & Prajapati, J. (2020). Dairy Clusters: A Boon for Rural Development in Gujarat. *Indian Journal of Dairy Science*, 73(3): 301–305.

<sup>19</sup> Gupta, R. K., Yadav, R. K., & Sharma, A. 2020. "Contract Farming: A Case Study of Fruit and Vegetable Growers in Jharkhand, India". *International Journal of Agriculture, Environment and Biotechnology*, 13(5): 637–644.

$$Location\ Quotient = \frac{\frac{E_i^j}{E_i^N}}{\frac{E^j}{E^N}}$$

$E_i^j$ : Employment in activity  $i$  in region  $j$

$E_i^N$ : Employment in activity  $i$  in the nation

$E^j$ : Total employment in region  $j$

$E^N$ : Total employment in the nation

3. **Clustering Based on Number of Farms:** Analysing the distribution of farms across regions offers another perspective on agricultural clustering. By comparing the prevalence of specific agricultural sectors in different areas, researchers can identify clusters based on the concentration of farming activities.

$$Percentage\ of\ farms\ in\ the\ sector = \left( \frac{C_j}{C} \right) \times 100$$

$C_j$ : Number of farms of a sector in region  $j$

$C$ : Number of farms of a sector in nation

4. **Clusters based on machinery usage per capita:** Clusters based on machinery usage per capita refer to geographically concentrated areas where agricultural machinery is extensively utilised relative to the population engaged in agricultural activities. These clusters often indicate regions where mechanisation plays a significant role in agricultural production and where there is a high density of machinery use per agricultural worker or per capita. This concept is important in understanding the spatial distribution of agricultural mechanisation and its impact on agricultural productivity, labour efficiency, and overall economic development within specific regions or countries.

$$Machinery\ usage\ per\ capita = \frac{Total\ Agricultural\ Machinery\ Usage}{Population\ engaged\ in\ Agricultural\ activities}$$

## Annexure 4.4: Indicators of Cereals (including Rice), Leguminous Crops and Oilseeds Producing Clusters

| <i>Pillars</i>                 | <i>Sub-Pillars</i>           | <i>Indicators</i>                                                                                      | <i>Source of data</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <i>State-wise data available (Yes/No)</i> | <i>District-wise data available (Yes/No)</i> |
|--------------------------------|------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----------------------------------------------|
| <b>Institutional</b>           | Social Capital               | Primary Agricultural Societies                                                                         | National Cooperative Database, Ministry of Cooperation, Government of India, 2023<br><a href="https://cooperatives.gov.in/en/home/cooperative-sector-wise-list-reports/sector/77">https://cooperatives.gov.in/en/home/cooperative-sector-wise-list-reports/sector/77</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Yes                                       | Yes                                          |
|                                |                              | % of farm households where any of the household member is a member of registered farmer's organisation | MoSPI: Situation Assessment Survey Agricultural Households                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                           |                                              |
|                                | Network & Partnership        | FPOs                                                                                                   | Directory of Farmer Producer Organisations of India ( <a href="https://ccsniam.gov.in/images/pdfs/Directory_of_Farmer_Book_NIAM.pdf">https://ccsniam.gov.in/images/pdfs/Directory_of_Farmer_Book_NIAM.pdf</a> )<br>Or<br><a href="https://fpo.tci.cornell.edu/dashboard">https://fpo.tci.cornell.edu/dashboard</a><br><br><a href="http://www.sfacindia.com/PDFs/Tenders/State%20wise%20list%20of%20registered%20FPOs%20details%20under%20Central%20Sector%20Scheme%20for%20Formation%20and%20Promotion%20of%2010,000%20FPOs%20by%20SFAC%20as%20on%2031-12-2023.pdf">http://www.sfacindia.com/PDFs/Tenders/State%20wise%20list%20of%20registered%20FPOs%20details%20under%20Central%20Sector%20Scheme%20for%20Formation%20and%20Promotion%20of%2010,000%20FPOs%20by%20SFAC%20as%20on%2031-12-2023.pdf</a> | Yes                                       | Yes                                          |
|                                | Leadership and Vision        | State Agricultural Marketing Boards/Directorates                                                       | <a href="https://enam.gov.in/NAMV2/home/usefullinks.html#">https://enam.gov.in/NAMV2/home/usefullinks.html#</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yes                                       | Not Applicable                               |
|                                |                              | National Agricultural Federation                                                                       | National Cooperative Database, Ministry of Cooperation, Government of India, 2023<br><a href="https://cooperatives.gov.in/en/home/federation-reports">https://cooperatives.gov.in/en/home/federation-reports</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Yes                                       | Not Applicable                               |
|                                | Entrepreneurship and Culture | No. of agri tech-start-ups                                                                             | <a href="https://www.startupindia.gov.in/digital-map/maps">https://www.startupindia.gov.in/digital-map/maps</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yes                                       | Not Available                                |
|                                | Competition                  | Not relevant in Indian Agricultural Scenario                                                           | Not Applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Not Applicable                            | Not Applicable                               |
| <b>Business Infrastructure</b> | Information Access           | % of crop growers who are accessing technical advise                                                   | MoSPI: Situation Assessment Survey of Agricultural Households                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Yes                                       | Yes                                          |
|                                | Market Access                | Access to market sources for selling their produce                                                     | MoSPI: Situation Assessment Survey of Agricultural Households                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Yes                                       | Yes                                          |
|                                |                              | Market information System: Number of APMC Market registered in eNAM portal/ooo farmers                 | <a href="https://enam.gov.in/NAMV2/home/mandis.html#">https://enam.gov.in/NAMV2/home/mandis.html#</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Yes                                       | Yes                                          |
|                                | Specialist Service           | Soil Testing Laboratories                                                                              | <a href="https://soilhealth.dac.gov.in/soil-lab">https://soilhealth.dac.gov.in/soil-lab</a><br><br><a href="https://pib.gov.in/PressReleaseDetail.aspx?PRID=1988294">https://pib.gov.in/PressReleaseDetail.aspx?PRID=1988294</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Yes                                       | Yes                                          |

| <i>Pillars</i>         | <i>Sub-Pillars</i>     | <i>Indicators</i>                                                                                                                             | <i>Source of data</i>                                                                                                                                                                                                                                                                                                                                                 | <i>State-wise data available (Yes/No)</i> | <i>District-wise data available (Yes/No)</i> |
|------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----------------------------------------------|
|                        |                        | Custom Hiring Centres Established                                                                                                             | <a href="https://agrimachinery.nic.in/">https://agrimachinery.nic.in/</a><br><a href="https://agrimachinery.nic.in/GraphReport/SMAMFmtti/SMAMFmtti.aspx">https://agrimachinery.nic.in/GraphReport/SMAMFmtti/SMAMFmtti.aspx</a><br><a href="https://sansad.in/getFile/annex/263/AU835.pdf?source=pqars">https://sansad.in/getFile/annex/263/AU835.pdf?source=pqars</a> | Yes                                       | Yes                                          |
|                        |                        | State-wise Storage capacity:<br>State-wise list of the Warehouses Registered with the Warehousing Development and Regulatory Authority (WDRA) | <a href="https://wdra.gov.in/web/wdra/registered-warehouses">https://wdra.gov.in/web/wdra/registered-warehouses</a>                                                                                                                                                                                                                                                   | Yes                                       | Yes                                          |
|                        |                        | State -wise seed Testing Laboratories                                                                                                         | <a href="https://seednet.gov.in/Material/SeedTestingLabs.aspx">https://seednet.gov.in/Material/SeedTestingLabs.aspx</a>                                                                                                                                                                                                                                               | Yes                                       |                                              |
|                        |                        | State Seed Corporations                                                                                                                       | <a href="https://seednet.gov.in/Material/StateSeedCorporation.aspx">https://seednet.gov.in/Material/StateSeedCorporation.aspx</a>                                                                                                                                                                                                                                     | Yes                                       |                                              |
|                        |                        | Seed Certification Agencies                                                                                                                   | <a href="https://seednet.gov.in/Material/SSCA.aspx">https://seednet.gov.in/Material/SSCA.aspx</a>                                                                                                                                                                                                                                                                     | Yes                                       |                                              |
|                        |                        | State-wise number of Fertiliser sale points                                                                                                   | Page I-66 Table 5.02<br><a href="https://fertiliserindia.com/wp-content/uploads/2023/05/Fertiliser-Stat-Book-2021-22.pdf">https://fertiliserindia.com/wp-content/uploads/2023/05/Fertiliser-Stat-Book-2021-22.pdf</a>                                                                                                                                                 | Yes                                       |                                              |
|                        | Specialist Service     | State-wise number of fertiliser quality control Laboratories                                                                                  | Pages I-191 Table 9.03 (b) and I-192<br><a href="https://fertiliserindia.com/wp-content/uploads/2023/05/Fertiliser-Stat-Book-2021-22.pdf">https://fertiliserindia.com/wp-content/uploads/2023/05/Fertiliser-Stat-Book-2021-22.pdf</a>                                                                                                                                 | Yes                                       | No                                           |
|                        | Financial Access       | State wise number of operative KCC                                                                                                            | Page II-98 Table 9.04<br><a href="https://fertiliserindia.com/wp-content/uploads/2023/05/Fertiliser-Stat-Book-2021-22.pdf">https://fertiliserindia.com/wp-content/uploads/2023/05/Fertiliser-Stat-Book-2021-22.pdf</a>                                                                                                                                                | Yes                                       |                                              |
| <b>Human Resources</b> | Competence & Expertise | % of workers who are employed in growing of cereals, pulses and oilseeds industry                                                             | PLFS                                                                                                                                                                                                                                                                                                                                                                  | Yes                                       | Yes, but not reliable                        |
|                        | Innovation             | Training Institutes                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                       | Yes                                       | Could be adapted to district level           |
|                        |                        | <b>Seeds:</b> National Seed Research and Training Centre, Varanasi                                                                            | <a href="http://nsrtc.nic.in/seed_testing.html">http://nsrtc.nic.in/seed_testing.html</a><br><a href="https://agrimachinery.nic.in/">https://agrimachinery.nic.in/</a>                                                                                                                                                                                                |                                           |                                              |
|                        |                        | No. of Farm Machinery training institutes                                                                                                     | <a href="https://agrimachinery.nic.in/GraphReport/SMAMFmtti/SMAMFmtti.aspx">https://agrimachinery.nic.in/GraphReport/SMAMFmtti/SMAMFmtti.aspx</a>                                                                                                                                                                                                                     |                                           |                                              |
|                        |                        | National Centre for Organic and Natural Farming (Regional Training Stations)                                                                  | <a href="https://nconf.dac.gov.in/">https://nconf.dac.gov.in/</a>                                                                                                                                                                                                                                                                                                     |                                           |                                              |
|                        |                        | R &D Investment in Agriculture (Crops)                                                                                                        | <a href="https://niap.icar.gov.in/pdf/PP44.pdf">https://niap.icar.gov.in/pdf/PP44.pdf</a><br>Table 5.3. Per cent share of sub-sectors in agricultural R&D in States, 2011-2020                                                                                                                                                                                        | Yes                                       |                                              |
|                        |                        | % of ICAR institutes and State Agricultural Universities devoted to crop sciences                                                             | <a href="https://icar.org.in/state-agricultural-universities">https://icar.org.in/state-agricultural-universities</a> ,<br><a href="https://icar.org.in/institutes#">https://icar.org.in/institutes#</a><br>and <a href="https://icar.org.in/state-agricultural-universities">https://icar.org.in/state-agricultural-universities</a>                                 | Yes                                       | Could be adapted to district-level           |

| <b>Pillars</b>            | <b>Sub-Pillars</b> | <b>Indicators</b>                                                      | <b>Source of data</b>                                                                                                                                                                                                                      | <b>State-wise data available (Yes/No)</b> | <b>District-wise data available (Yes/No)</b> |
|---------------------------|--------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----------------------------------------------|
|                           |                    | Agri-clinics And Agri-business Centers                                 | <a href="https://acabcmis.gov.in/ACABC_dashboard_Chart.aspx">https://acabcmis.gov.in/ACABC_dashboard_Chart.aspx</a><br><a href="https://acabcmis.gov.in/ACABC_dashboard_Chart.aspx">https://acabcmis.gov.in/ACABC_dashboard_Chart.aspx</a> | Yes                                       |                                              |
| <b>Government Support</b> | Infrastructure     | No. of Primary Agricultural Credit Society(PACS) by State              | PACS<br><a href="https://pib.gov.in/PressReleasePage.aspx?PRID=1946740">https://pib.gov.in/PressReleasePage.aspx?PRID=1946740</a>                                                                                                          | Available                                 | Available                                    |
|                           |                    | % of (Agriculture) capital expenditure to total government expenditure | RBI<br><a href="https://rbi.org.in/Scripts/PublicationsView.aspx?id=22323">https://rbi.org.in/Scripts/PublicationsView.aspx?id=22323</a>                                                                                                   | Yes                                       | Not Applicable                               |
|                           | Policies           | Agri-tech                                                              | <a href="https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2003181">https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2003181</a>                                                                                                      |                                           |                                              |
|                           |                    | State Agriculture Infrastructure Development Plan (SAIDP)              | <a href="https://rkvy.nic.in/">https://rkvy.nic.in/</a>                                                                                                                                                                                    | Yes                                       |                                              |
|                           |                    | State Agriculture Plan (SAP)                                           |                                                                                                                                                                                                                                            |                                           |                                              |
|                           |                    | District Agriculture Plan (DAP)                                        |                                                                                                                                                                                                                                            |                                           |                                              |
|                           |                    | National Agriculture Infra Financing Facility                          | <a href="https://agriinfra.dac.gov.in/Home/FundAllocation">https://agriinfra.dac.gov.in/Home/FundAllocation</a><br><a href="https://agridashboard.dac.gov.in/">https://agridashboard.dac.gov.in/</a>                                       |                                           |                                              |
|                           |                    | State Extension Programmes for Extension Reforms (ATMA)                | <a href="https://extensionreforms.da.gov.in/DashBoard_Statusatma.aspx">https://extensionreforms.da.gov.in/DashBoard_Statusatma.aspx</a>                                                                                                    |                                           |                                              |

Source: NCAER Compilation of Indicators and framework adapted from the Paper by Sutawi, I. Prihartini, L. Zalizar, A. Wahyudi, L. Hendraningsih (The Success Indicators of a Dairy Farming Cluster in Indonesia) in Asian Journal of Dairy and Food Research,

## Annexure 4.5: Occupational Mapping of Job Roles Listed in PLFS and Agriculture Skill Council of India in the Agriculture Sector

March, 2022).

| <i>NCO Code</i> | <i>NCO Description</i>                                                                | <i>Agriculture Skill Council of India Job Roles</i>                                                         |
|-----------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| 112             | Managing Directors and Chief Executives                                               |                                                                                                             |
| 1120.2800       | Director, Storage and Warehousing                                                     |                                                                                                             |
| 121             | Business Services and Administration Manager                                          |                                                                                                             |
| 1211.0100       | General Manager, Bank                                                                 |                                                                                                             |
| 1211.0200       | General Manager, Insurance                                                            |                                                                                                             |
| 122             | Sales, Marketing and Development Managers                                             |                                                                                                             |
| 1223            | Research and Development Managers                                                     |                                                                                                             |
| 131             | Production Managers in Agriculture, Forestry and Fisheries                            | Climate Change & Risk Mitigation Manager, Risk Analyst.<br>Manager-Agri Commodity, Produce Mapping Surveyor |
| 1311            | Agricultural and Forestry Production Managers                                         |                                                                                                             |
| 1311.0300       | General Manager, Agricultural Farm                                                    | Farm Supervisor                                                                                             |
| 1311.0700       | Manager, Agricultural Farm                                                            | Farm Manager                                                                                                |
| 1311.1000       | Manager, Aerial Planting and Cultivation                                              | Plant Tissue Culture Technician                                                                             |
| 1311.9900       | Agricultural and Forestry Production Managers, Others                                 |                                                                                                             |
| 132             | Manufacturing, Mining, Construction and Distribution Managers                         |                                                                                                             |
| 1321.0500       | Manager, Food Processing Plant                                                        |                                                                                                             |
| 1324            | Supply, Distribution and Related Managers                                             |                                                                                                             |
| 1324.1200       | Manager, Storage and Warehousing                                                      | Agri Warehouse Supervisor                                                                                   |
| 1324.2200       | General Manager, Storage and Warehousing                                              |                                                                                                             |
| 1324.9900       | Supply, Distribution and Related Managers and General Managers, Other                 |                                                                                                             |
| 214             | Engineering Professionals (Excluding Electrotechnology)                               |                                                                                                             |
| 2141.0900       | Agricultural Engineer                                                                 |                                                                                                             |
| 221             | Medical Doctors                                                                       |                                                                                                             |
| 235             | Other Teaching Professionals                                                          |                                                                                                             |
| 241             | Finance Professionals                                                                 |                                                                                                             |
| 2412.0501       | Agriculture Field Officer                                                             | Farm Worker                                                                                                 |
| 261             | Legal Professionals                                                                   |                                                                                                             |
| 311             | Physical and Engineering Science Technicians                                          |                                                                                                             |
| 3111.0200       | Laboratory Assistant, Soil                                                            | Soil & Water Testing Lab Analyst, Soil & Water Testing<br>Lab Technician, Soil Sampler/Collector            |
| 3116.0200       | Laboratory Assistant, Food & Beverages/ Chemist/ Analytical<br>Supervisor/Lab Chemist |                                                                                                             |
| 3119.0600       | Weather Observer                                                                      |                                                                                                             |
| 312             | Mining, Manufacturing and Construction Supervisors                                    |                                                                                                             |
| 3122.6900       | Supervisor and Foreman, Food Processing/Production Supervisor                         |                                                                                                             |
| 314             | Life Science Technicians and Related Associate Professionals                          |                                                                                                             |
| 3142            | Agricultural Technicians                                                              | Service Technician-Watershed                                                                                |
| 3142.0101       | Micro Irrigation Technician                                                           | Irrigation Service Technician, Micro Irrigation Technician                                                  |
| 3142.0201       | Bare Foot Technician (BFT)                                                            |                                                                                                             |
| 3142.99         | Agricultural Technicians, Others                                                      | Solar Pump Technician                                                                                       |
| 332             | Sales and Purchasing Agents and Brokers                                               |                                                                                                             |
| 3323.0601       | Associate – Supply Chain Management                                                   | Electronic Trading Supervisor-Agri Commodity, Agri<br>Commodity Procurement Manager                         |
| 3323.0602       | Supply Chain Field Assistant                                                          | Supply Chain Field Executive                                                                                |
| 333             | Business Service Agents                                                               |                                                                                                             |
| 3339.0300       | Auctioneer                                                                            |                                                                                                             |
| 411             | General Office Clerks                                                                 |                                                                                                             |
| 413             | Keyboard Operators                                                                    |                                                                                                             |
| 4132.1300       | Bookkeeping Machine Operator                                                          |                                                                                                             |
| 4132.0401       | Data Entry Machine Operator                                                           |                                                                                                             |



| <b>NCO Code</b> | <b>NCO Description</b>                             | <b>Agriculture Skill Council of India Job Roles</b>                                                                 |
|-----------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| 432             | Material Recording and Transport Clerks            |                                                                                                                     |
| 4321            | Stock Clerks                                       | Commodity Account manager                                                                                           |
| 4321.01         | Store Keeper                                       |                                                                                                                     |
| 4321.0200       | Store Distributor                                  |                                                                                                                     |
| 4321.0401       | Manager Stores Operation                           | Packhouse Worker                                                                                                    |
| 441             | Other Clerical Support Workers                     |                                                                                                                     |
| 4419.0200       | Patwari                                            |                                                                                                                     |
| 4419.0300       | Patrol, Irrigation                                 |                                                                                                                     |
| 511             | Travel Attendants, Conductors and Guides           |                                                                                                                     |
| 512             | Cooks                                              |                                                                                                                     |
| 515             | Building and Housekeeping Supervisors              |                                                                                                                     |
| 521             | Street and Market Salespersons                     |                                                                                                                     |
| 522             | Shop Salespersons                                  |                                                                                                                     |
| 524             | Other Sales Workers                                |                                                                                                                     |
| 5244            | Contact Centre Salespersons                        |                                                                                                                     |
| 5245            | Service Station Attendants                         |                                                                                                                     |
| 5249.0600       | Selling Agent                                      |                                                                                                                     |
| 5249.0700       | Stockist                                           |                                                                                                                     |
| 531             | Child Care Workers and Teachers' Aides             |                                                                                                                     |
| 541             | Protective Service Workers                         |                                                                                                                     |
| 6               | Skilled Agricultural, Forestry and Fishery Workers |                                                                                                                     |
| 61              | Market-Oriented Skilled Agricultural Workers       |                                                                                                                     |
| 611             | Market Gardeners & Crop Growers                    |                                                                                                                     |
| 6111            | Field Crop and Vegetable Growers                   | Green House Operator, Group Farming Practitioner                                                                    |
| 6111.01         | Cultivator, General                                |                                                                                                                     |
| 6111.0101       | Paddy Farmer                                       |                                                                                                                     |
| 6111.0200       | Cultivator, Crop                                   | Cereal Crop Grower                                                                                                  |
| 6111.0201       | Wheat Cultivator                                   | Wheat Cultivator                                                                                                    |
| 6111.0301       | Maize Cultivator                                   | Maize Cultivator                                                                                                    |
| 6111.0401       | Pulses Cultivator                                  | Pulses Cultivator                                                                                                   |
| 6111.0501       | Soybean Cultivator                                 | Soyabean Cultivator                                                                                                 |
| 6111.9900       | Field Crop and Vegetable Growers, Other            |                                                                                                                     |
| 6111.2000       | Fieldman, Agriculture                              |                                                                                                                     |
| 6114.9900       | Mixed Crop Growers, Other                          |                                                                                                                     |
| 6116            | Agriculture Information Management                 |                                                                                                                     |
| 6116.0101       | Agriculture Extension Executive                    |                                                                                                                     |
| 6116.0102       | Agriculture Extension Service Provider             | Agri Service Input Dealer                                                                                           |
| 6116.0112       | Community Service Provider                         |                                                                                                                     |
| 612             | Animal Producers                                   |                                                                                                                     |
| 6121.0100       | Farmer                                             |                                                                                                                     |
| 6121.0201       | Farmer, Dairy/Dairy Farmer/Entrepreneur            |                                                                                                                     |
| 6122.0101       | Farmer, Poultry/Broiler Farm Supervisor            |                                                                                                                     |
| 6122.0200       | Farmer, Poultry Breeding                           |                                                                                                                     |
| 6129.0100       | Farmer, Fur-Bearing Animals                        |                                                                                                                     |
| 613             | Mixed Crop and Animal Workers                      |                                                                                                                     |
| 6130.0201       | Seed Grower/Quality Seed Grower                    | Quality Seed Grower                                                                                                 |
| 6130.0202       | Seed Processing Worker                             | Seed Analysis In-charge, Seed Plant Production Supervisor, Seed Processing Plant Technician, Seed Processing Worker |
| 6130.99         | Mixed Crop and Animal Workers, Other               |                                                                                                                     |
| 621             | Forestry and Related Workers                       |                                                                                                                     |

| <b>NCO Code</b> | <b>NCO Description</b>                                        | <b>Agriculture Skill Council of India Job Roles</b>  |
|-----------------|---------------------------------------------------------------|------------------------------------------------------|
| 622             | Fishery Workers, Hunters and Trappers                         |                                                      |
| 631             | Subsistence Crop Farmers                                      |                                                      |
| 6310.9900       | Subsistence Crop Farmers, Others                              |                                                      |
| 6330            | Subsistence Mixed Crop and Livestock Farmers                  |                                                      |
| 723             | Machinery Mechanics and Repairers                             | Farm Workshop/Service Manager                        |
| 7231.0300       | Tractor Mechanic                                              | Tractor Service Mechanic                             |
| 7233            | Agricultural and Industrial Machinery Mechanics and Repairers | Service & Maintenance Technician- Farm Machinery     |
| 7233.2800       | Agriculture Engineering Technician                            | Agriculture Machinery Demonstrator                   |
| 7233.9900       | Machinery Mechanics and Fitters, Other                        | Farm Workshop Foreman/ Supervisor                    |
| 752             | Wood Treathers, Cabinet Makers and Related Trades Workers     |                                                      |
| 753             | Garment and Related Trades Workers                            |                                                      |
| 754             | Other Craft and Related Workers                               |                                                      |
| 7543            | Product Graders and Testers (Excluding Food and Beverages)    |                                                      |
| 7543.0202       | Quality Assessor                                              | Agri Commodity Quality Assayer                       |
| 7544            | Fumigators and Other Pest and Weed Controllers                | Agri Commodity Fumigation Operator                   |
| 814             | Rubber, Plastic and Paper Products Machine Operators          |                                                      |
| 816             | Food and Related Products Machine Operators                   |                                                      |
| 8160.0700       | Miller, Food Grains                                           |                                                      |
| 8160.0800       | Husker, Machine (Food Grains)                                 |                                                      |
| 8160.0900       | Rollerman, (Food Grains)                                      |                                                      |
| 8160.1000       | Flour Mill Operator                                           |                                                      |
| 8160.1100       | Siever, Machine                                               |                                                      |
| 8160.1200       | Oil Crusher Operator, Power                                   |                                                      |
| 8160.1300       | Filter Press Operator (Oil)                                   |                                                      |
| 8160.1900       | Flake Miller, Wheat and Oats (Grain-Feed Mills)               |                                                      |
| 8160.2700       | Processing Man (Food Canning and Preserving)                  |                                                      |
| 8160.3100       | Peanut Blancher                                               |                                                      |
| 831             | Locomotive Engine Drivers and Related Workers                 |                                                      |
| 832             | Car, Van and Motorcycle Drivers                               |                                                      |
| 833             | Heavy Truck and Bus Drivers                                   |                                                      |
| 834             | Mobile Plant Operators                                        |                                                      |
| 8341            | Mobile Farm and Forestry Plant Operators                      |                                                      |
| 8341.0101       | Tractor Operator, Farm                                        | Tractor Operator                                     |
| 8341.0200       | Operator, Farm Machines                                       | Kisan Drone Operator                                 |
| 8341.0201       | Harvesting Machine Operator                                   | Operator-Reaper, Thresher and Crop Residue Machinery |
| 8341.9900       | Farm Machinery Operators, Other                               | Custom Hiring Service Provider                       |
| 911             | Domestic, Hotel and Office Cleaners and Helpers               |                                                      |
| 912             | Vehicle, Window, Laundry and Other Hand Cleaners              |                                                      |
| 921             | Agricultural, Forestry and Fishery Labourers                  |                                                      |
| 9211            | Crop Farm Labourers                                           |                                                      |
| 9211.0100       | Ploughman                                                     |                                                      |
| 9211.0200       | Labourer, Agriculture                                         |                                                      |

| <b>NCO Code</b> | <b>NCO Description</b>                                             | <b>Agriculture Skill Council of India Job Roles</b> |
|-----------------|--------------------------------------------------------------------|-----------------------------------------------------|
| 9211.9900       | Farm Hands and Labourers, Other                                    |                                                     |
| 9213            | Mixed Crop and Livestock Farm Labourers                            |                                                     |
| 9215.0100       | Labourer, Plantation                                               |                                                     |
| 931             | Mining and Construction Labourers                                  |                                                     |
| 932             | Manufacturing Labourers                                            |                                                     |
| 933             | Transport and Storage Labourers                                    |                                                     |
| 9332            | Drivers of Animal-Drawn Vehicles and Machinery                     |                                                     |
| 9332.0500       | Supervisor, Animal-Drawn and Manually Operated Transport Equipment |                                                     |
| 9332.9900       | Animal and Animal Drawn Vehicle Drivers, Other                     |                                                     |
| 9333.01         | Loader and Unloader                                                |                                                     |
| 9333.0101       | Loader/Loading and Unloading Operator                              |                                                     |
| 9333.0201       | Warehouse Worker                                                   | Agriculture Warehouse Worker                        |
| 9333.0202       | Loader, Transport Associate/Loader/Unloader                        |                                                     |
| 951             | Street and Related Service Workers                                 |                                                     |
| 961             | Refuse Workers                                                     |                                                     |
| 962             | Other Elementary Workers                                           |                                                     |

*Sources:*

9. Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022-June 2023. Document No.: DDI-IND-CSO-PLFS-2022-23. <https://microdata.gov.in/nada43/index.php/catalog/179>.
10. National Career Service. Directorate General of Employment, Ministry of Labour and Employment, Government of India. National Classification Of Occupations-2015 (Code Structure). <https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20 Vol%20I-%20202015.pdf>.
11. Agriculture Skill Council of India website. <https://asci-india.com/>.

## Annexure 4.6: Indicative Computation of the Extent of the Need & Vacancy Rate (NCAER computations for 2026–27)

| <b>Drone Operator</b>                                                                                                              |                                           |
|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Area to be covered (hectares (hac))                                                                                                | 13,93,00,000                              |
| Drone coverage (hac/flight)                                                                                                        | 20 hac/day (8 hours) (means four flights) |
| Flight time (hour/flight)                                                                                                          | 0.5 hour/flight                           |
| Daily operational hour                                                                                                             | 8 hours                                   |
| No of flights required to cover 3497000 hac (Number)                                                                               | 27,8,60,000                               |
| Total flight time required (hour)                                                                                                  | 1,39,30,000                               |
| Total operator required to cover the entire area                                                                                   | 17,41,250                                 |
| If 100 % Net Sown Area (NSA) is to be covered                                                                                      | 17,41,250                                 |
| If 50 % NSA is to be covered                                                                                                       | 8,70,625                                  |
| if 25% NSA is to be covered                                                                                                        | 4,35,313                                  |
| <b>Farm -Machinery Service Technician</b>                                                                                          |                                           |
| Total Operational Holdings                                                                                                         | 14,64,50,000                              |
| Total number of farmers using farm Machinery (70% of total Operational Holdings)                                                   | 10,25,15,000                              |
| Average Number of Equipment per Farmer                                                                                             | 2                                         |
| Utilisation rate (Each piece of equipment is used 20 hours per season) Total                                                       | 4,10,06,00,000                            |
| Usage Hours per Equipment                                                                                                          |                                           |
| Maintenance Frequency: Each equipment requires maintenance every 50 hours of use. (maintenance sessions)                           | 8,20,12,000                               |
| Time Per maintenance session (Average 2 hour)                                                                                      | 16,40,24,000                              |
| Average Repair Incidents: 1 incident per piece of equipment per season, with an average repair time of 3 hours. Total Repair Hours | 61,50,90,000                              |
| Total Work Hours Required (Total Maintenance Hours + Total Repair Hours)                                                           | 77,91,14,000                              |
| Available Work Hours per Technician (8 hours/day*250 days)                                                                         | 2,000                                     |
| Technician Requirement ((Total Work Hours Required/Available Work Hours per Technician)                                            | 3,89,557.00                               |
| Total technician requirement                                                                                                       | 3,89,557                                  |

### Sources:

1. Terra Drone Agri. (n.d.). How much area can an agriculture drone cover? Factors influencing coverage. August 16, 2024. <https://terra-droneagri.com/how-much-area-can-an-agriculture-drone-cover-factors-influencing-coverage/>
2. Jouav. (n.d.). How agriculture drones are revolutionising farming. March 19, 2025. <https://www.jouav.com/blog/agriculture-drone.html>
3. Department of Agriculture & Farmers' Welfare, Government of Haryana. (n.d.). Vital statistics of agriculture. August 20, 2024. [https://agriharyana.gov.in/data/AYP\\_MSP\\_VitalOfAgriDoc/Vital\\_of\\_Agriculture.pdf](https://agriharyana.gov.in/data/AYP_MSP_VitalOfAgriDoc/Vital_of_Agriculture.pdf)
4. Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India. (2019). Agriculture Census 2015–16 (Phase-I): All India Report on Number and Area of Operational Holdings. [https://www.fao.org/fileadmin/templates/ess/ess\\_test\\_folder/World\\_Census\\_Agriculture/WCA\\_2020/WCA\\_2020\\_new\\_doc/IND\\_REP\\_ENG\\_2015\\_2016.pdf](https://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/WCA_2020/WCA_2020_new_doc/IND_REP_ENG_2015_2016.pdf)
5. Ministry of Agriculture and Farmers' Welfare, Government of India. (n.d.). Farm Mechanisation guide. <https://farmech.dac.gov.in/FarmerGuide/HR/index1.html>
6. Kumar, N., Mukesh, S., & Bhardwaj, S. (2017). Farm mechanisation level in different operations of major crops in Haryana State. International Journal of Agricultural Science and Research, 7(1), 305–312. Retrieved from [https://www.researchgate.net/publication/354313117\\_farm\\_mechanisation\\_level\\_in\\_different\\_operations\\_of\\_major\\_crops\\_in\\_haryana\\_state](https://www.researchgate.net/publication/354313117_farm_mechanisation_level_in_different_operations_of_major_crops_in_haryana_state)

## Annexure 5.1: State-wise Productivity Indicators in Milk Production in India, 2022–23

| States/UTs                 | Average Milk per Animal (tonnes per animal) | Average Milk (tonnes) per worker |
|----------------------------|---------------------------------------------|----------------------------------|
| A&N Islands                | 1.7                                         | 6.2                              |
| Andhra Pradesh             | 2.8                                         | 24.4                             |
| Arunachal Pradesh          | 0.6                                         | 38.7                             |
| Assam                      | 0.6                                         | 4.6                              |
| Bihar                      | 1.6                                         | 5.4                              |
| Chandigarh                 | 4.2                                         | N.A.                             |
| Chhattisgarh               | 1.1                                         | 21.8                             |
| Daman & Diu and D&N Haveli | 1.9                                         | N.A.                             |
| Delhi                      | 3.2                                         | 115.1                            |
| Goa                        | 2.4                                         | 29.2                             |
| Gujarat                    | 2.2                                         | 5.6                              |
| Haryana                    | 3.7                                         | 27.5                             |
| Himachal Pradesh           | 1.6                                         | 3.9                              |
| Jammu & Kashmir            | 2.3                                         | 3.1                              |
| Jharkhand                  | 1.0                                         | 13.3                             |
| Karnataka                  | 2.3                                         | 20.0                             |
| Kerala                     | 3.8                                         | 5.3                              |
| Ladakh                     | N.A.                                        | N.A.                             |
| Lakshadweep                | 1.2                                         | N.A.                             |
| Madhya Pradesh             | 1.6                                         | 13.3                             |
| Maharashtra                | 2.3                                         | 11.5                             |
| Manipur                    | 1.0                                         | 29.0                             |
| Meghalaya                  | 0.6                                         | 7.3                              |
| Mizoram                    | 2.2                                         | 20.2                             |
| Nagaland                   | 1.7                                         | 31.5                             |
| Odisha                     | 1.1                                         | 4.7                              |
| Puducherry                 | 2.1                                         | 1.6                              |
| Punjab                     | 3.9                                         | 19.1                             |
| Rajasthan                  | 2.4                                         | 22.3                             |
| Sikkim                     | 1.9                                         | 16.0                             |
| Tamil Nadu                 | 2.4                                         | 6.0                              |
| Telangana                  | 2.0                                         | 71.9                             |
| Tripura                    | 1.0                                         | 22.2                             |
| Uttar Pradesh              | 1.9                                         | 5.0                              |
| Uttarakhand                | 1.8                                         | 22.7                             |
| West Bengal                | 1.4                                         | 6.1                              |
| All India                  | 2.1                                         | 9.1                              |

Sources: Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying. 2023. Basic Animal Husbandry Statistics-2023. <https://dahd.nic.in/sites/default/files/BAHS2023.pdf>. Krishi Bhawan, New Delhi and NCAER Analysis from PLFS 2022–23.

## Annexure 5.2: Indicators of Dairy Producing Clusters

| Pillars                 | Sub-Pillars                  | Indicators                                                                                        | Source of data                                                                                         | State-wise data available (Yes/No)  | District-wise data available (Yes/No)                                 |
|-------------------------|------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------|
| Institutional           | Social Capital               | Affiliated Dairy Cooperative Societies (DCS)                                                      | National Cooperative Database, Ministry of Cooperation, Government of India, 2023 <a href="#">Link</a> | Yes                                 | Yes                                                                   |
|                         |                              | FPOs                                                                                              | MCA data but not publicly available                                                                    | MCA data but not publicly available | MCA data but not publicly available                                   |
|                         | Network & Partnership        | Membership of Dairy Cooperatives                                                                  | National Cooperative Database, Ministry of Cooperation, Government of India, 2023 <a href="#">Link</a> | Yes                                 | Yes                                                                   |
|                         |                              | No. of private dairy farms                                                                        | Secondary data not available                                                                           | No                                  | No                                                                    |
|                         | Leadership and Vision        | Dairy Federations                                                                                 | National Cooperative Database, Ministry of Cooperation, Government of India, 2023 <a href="#">Link</a> | Yes                                 | Not Applicable                                                        |
|                         | Entrepreneurship and Culture | Dairy Cooperative Brands                                                                          | National Dairy Development Board (NDDB) database                                                       | Yes                                 | Not Applicable                                                        |
|                         |                              | Percentage of employers in the specific NIC code                                                  | PLFS                                                                                                   | Yes                                 | Yes, but not reliable                                                 |
|                         | Competition                  | No. of private dairy farms                                                                        | No secondary data available                                                                            | Not Available                       | Not Available                                                         |
| Business Infrastructure | Information Access           | % of dairy farmers who are accessing technical advice                                             | MoSPI: Situation Assessment Survey of Agricultural Households                                          | Yes                                 | Yes                                                                   |
|                         | Market Access                | Procurement volume of milk across India -% of dairy farm households who are selling to the market |                                                                                                        |                                     |                                                                       |
|                         | Specialist Service           | Artificial insemination centres                                                                   | DHAD Annual Report 2019-20                                                                             | Yes                                 | No.                                                                   |
|                         |                              | No. of Artificial inseminations done                                                              | Basic Animal Husbandry Statistics                                                                      | Yes                                 | Infrequently available about the no. of artificial inseminations done |
|                         |                              | Fodder farms                                                                                      | Basic Animal Husbandry Statistics                                                                      | Yes                                 | No                                                                    |
|                         |                              | Bulk cooling units                                                                                | Bimonthly Report on State Dairy Profile                                                                | Yes                                 | No                                                                    |
|                         | Bulk Cooling Units           | Liquid Milk Plants                                                                                |                                                                                                        |                                     |                                                                       |
|                         | Milk Processing Centre (No.) | Capacity of milk processed (Thousand Litres Per Day (TLPD))                                       | Basic Animal Husbandry Statistics                                                                      | Yes                                 | No                                                                    |
|                         | Financial Access             | % of dairy farm households who have a bank account                                                | MoSPI: Situation Assessment Survey Agricultural Households                                             | Yes                                 | Yes                                                                   |
|                         |                              | % of dairy farm households who have accessed institutional credit                                 |                                                                                                        |                                     |                                                                       |

| <i>Pillars</i>     | <i>Sub-Pillars</i>     | <i>Indicators</i>                                                                                                       | <i>Source of data</i>                                                                                                                                                                                                                                                                                                           | <i>State-wise data available (Yes/No)</i> | <i>District-wise data available (Yes/No)</i> |
|--------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----------------------------------------------|
| Human Resources    | Competence & Expertise | % of dairy farm households who accessed credit for capital expenditure in farm business                                 |                                                                                                                                                                                                                                                                                                                                 |                                           |                                              |
|                    |                        | % of workers who are employed in dairy industry and who have technical/vocational education                             | PLFS                                                                                                                                                                                                                                                                                                                            | Yes                                       | Yes, but not reliable                        |
|                    |                        | No. of training institutes                                                                                              | NDDDB Training Institutes<br><a href="https://www.nddb.coop/services/hrd/training">https://www.nddb.coop/services/hrd/training</a>                                                                                                                                                                                              | Yes                                       | Could be adapted to district level           |
|                    | Innovation             | State-wise no. of patents in dairy industry                                                                             | Not Available                                                                                                                                                                                                                                                                                                                   | Not Available                             | Not Available                                |
|                    |                        | % of ICAR institutes and State Agricultural Universities devoted to dairy or veterinary                                 | <a href="https://icar.org.in/state-agricultural-universities">https://icar.org.in/state-agricultural-universities</a> , <a href="https://icar.org.in/institutes#">https://icar.org.in/institutes#</a> and <a href="https://icar.org.in/state-agricultural-universities">https://icar.org.in/state-agricultural-universities</a> | Yes                                       | Could be adapted to district-level           |
| Government Support | Infrastructure         | No. of PACS by State                                                                                                    | PACS                                                                                                                                                                                                                                                                                                                            | Available                                 | Available                                    |
|                    |                        | No. of Gram Panchayats covered by Dairy Cooperatives                                                                    | National Cooperative Database, Ministry of Cooperation, Government of India, 2023<br><a href="#">Link</a>                                                                                                                                                                                                                       | Yes                                       | Not Applicable                               |
|                    | Policies               | % of (dairy development plus animal husbandry) capital expenditure to total government expenditure or total agriculture | RBI                                                                                                                                                                                                                                                                                                                             | Yes                                       | Not Applicable                               |
|                    |                        | Dairy Progeny Programme                                                                                                 | Not Available                                                                                                                                                                                                                                                                                                                   | Not Available                             | Not Available                                |

Source: NCAER Compilation of Indicators and framework adapted from Sutawi, I. Prihartini, L. Zalizar, A. Wahyudi, L. Hendraningsih. 2022. "The Success Indicators of a Dairy Farming Cluster in Indonesia". *Asian Journal of Dairy and Food Research*. 41(1): 22–27. March.

## Annexure 5.3: Occupational Mapping in the Livestock Sector

| <i>NCO-Code</i> | <i>NCO-2015</i>                                                  | <i>Agriculture Skill Council of India</i>                    |
|-----------------|------------------------------------------------------------------|--------------------------------------------------------------|
| 1120.9900       | Managing Directors and Chief Executives, Others                  |                                                              |
| 1211.9900       | Finance Managers, Others                                         |                                                              |
| 1212.0100       | Personnel Managers                                               |                                                              |
| 1213.9900       | Managers, Other Services                                         |                                                              |
| 1219.0100       | Manager, Import and Export                                       |                                                              |
| 1311.0400       | General Manager, Livestock Farm                                  |                                                              |
| 1311.0500       | General Manager, Dairy Farm                                      |                                                              |
| 1311.1300       | Manager, Livestock Farm                                          |                                                              |
| 1311.1400       | Manager, Dairy Farm                                              |                                                              |
| 1420.0100       | Manager, Wholesale Trade                                         |                                                              |
| 1420.0200       | Manager, Retail Trade                                            |                                                              |
| 1420.0300       | Manager Export                                                   |                                                              |
| 1420.0400       | General Manager, Wholesale Trade/Senior Manager, Wholesale Trade |                                                              |
| 1420.0500       | General Manager, Retail Trade, Senior Manager, Retail Trade      |                                                              |
| 1420.9900       | Retail and Wholesale Trade Managers, Other                       |                                                              |
| 1439            | Services Manager Not Elsewhere Classified                        |                                                              |
| 2141.1900       | Dairy Technologist                                               |                                                              |
| 2250.0100       | Animal Pathologist                                               |                                                              |
| 2250.0200       | Veterinarian, General                                            |                                                              |
| 2250.0300       | Veterinarian, Surgeon                                            |                                                              |
| 2250.0400       | Animal Genetics                                                  |                                                              |
| 2250.9900       | Veterinarians, Other                                             |                                                              |
| 3240.0100       | Vaccinator, Veterinary                                           |                                                              |
| 3240.0200       | Stockman                                                         | Dairy Farm Supervisor (NSQF 5)                               |
| 3240.0300       | Animal Keeper                                                    |                                                              |
| 3240.0400       | Laboratory Technician, Artificial Breeding                       | Veterinary Clinical Assistant                                |
| 3240.9900       | Veterinary Technicians and Assistants, Other                     | Veterinary Field Assistant                                   |
| 3321.0100       | Insurance Agent                                                  |                                                              |
| 3321.9900       | Insurance Representatives, Other                                 |                                                              |
| 3322.0500       | Sales Supervisor, Wholesale Trade                                |                                                              |
| 3322.0900       | Sales Supervisor, Retail Trade                                   |                                                              |
| 3322.9900       | Commercial Sales Representatives, Other                          |                                                              |
| 4110.0100       | Clerk, General                                                   |                                                              |
| 4110.0200       | Clerk, Enquiry                                                   |                                                              |
| 4131.0100       | Secretary/Back Office Support                                    |                                                              |
| 4131.0600       | Computer Operator                                                |                                                              |
| 4131.9900       | Typists and Word Processing Operators, Other                     |                                                              |
| 4132.1400       | Bill Processing Clerk                                            |                                                              |
| 4132.9900       | Data Entry Clerk, Others                                         |                                                              |
| 4321.0100       | Store Keeper                                                     |                                                              |
| 4321.0200       | Store Distributor                                                |                                                              |
| 4321.9900       | Stock Clerks, Other                                              |                                                              |
| 4415            | Filing and Copying Clerks                                        |                                                              |
| 4416.0101       | Associate – HRO                                                  |                                                              |
| 4419.9900       | Clerical Support Workers, Other                                  |                                                              |
| 5164            | Pet Groomers and Animal Care Workers                             |                                                              |
| 5212.0100       | Milkman                                                          |                                                              |
| 5222.0100       | Sales Supervisor, Wholesale Trade                                |                                                              |
| 5243.0300       | Home Deliveryman                                                 |                                                              |
| 6121.0100       | Farmer, Livestock                                                |                                                              |
| 6121.0201       | Farmer, Dairy/Dairy Farmer/Entrepreneur                          | Dairy Farmer (Small Holding) NSQF2/Dairy Farmer Entrepreneur |
| 6121.0300       | Livestock Worker, General                                        |                                                              |
| 6121.0400       | Herdsman                                                         |                                                              |
| 6121.0500       | Livestock Workers/Other Livestock Workers                        |                                                              |
| 6121.0601       | Dairy Farm Worker, General/Dairy Worker                          | Dairy Worker                                                 |
| 6121.0700       | Milker                                                           |                                                              |
| 6121.0800       | Milker, Machine                                                  |                                                              |
| 6121.1400       | Grass Cutter                                                     |                                                              |
| 6121.9900       | Dairy and Livestock Producers, Other                             |                                                              |
| 6129.9900       | Animal Producers and Related Workers, Other                      |                                                              |
| 6130.0100       | Artificial Breeding Technician                                   | Artificial Insemination Technician                           |
| 6130.0201       | Seed Grower/Quality Seed Grower                                  |                                                              |
| 6130.0202       | Seed Processing Worker                                           |                                                              |
| 6130.9900       | Mixed Crop and Animal Workers, Other                             |                                                              |
| 6224.0800       | Yard Officer                                                     |                                                              |
| 6310.9900       | Subsistence Crop Farmers, Others                                 |                                                              |
| 6320            | Subsistence Livestock Farmers                                    |                                                              |
| 6330            | Subsistence Mixed Crop and Livestock Farmers                     |                                                              |



| <b>NCO-Code</b> | <b>NCO-2015</b>                                                         | <b>Agriculture Skill Council of India</b>                              |
|-----------------|-------------------------------------------------------------------------|------------------------------------------------------------------------|
| 6340            | Subsistence Fishers, Hunters, Trappers and Gatherers                    |                                                                        |
| 7127.0100       | Mechanic, Refrigeration and Air-Conditioning                            | Bulk Milk Cooler (BMC) Operator and Chilling Plant Technician (NSQF 4) |
| 7513.0100       | Dairy Worker, General                                                   |                                                                        |
| 7513.0200       | Separator Man                                                           |                                                                        |
| 7513.9900       | Dairy Products Makers, Others                                           |                                                                        |
| 753             | Garment and Related Trades Workers                                      |                                                                        |
| 9111.0100       | Domestic Servant                                                        |                                                                        |
| 9112.9900       | Helpers and Cleaners in Offices, Hotels and Other Establishments, Other |                                                                        |
| 9212            | Livestock Farm Labourers                                                | Helper                                                                 |
| 9213            | Mixed Crop and Livestock Farm Labourers                                 |                                                                        |
| 9321            | Hand Packers                                                            |                                                                        |
|                 |                                                                         | Livestock Service Provider (NSQF 4)                                    |
|                 |                                                                         | Milk Procurement and Input Supervisor (NSQF 5)                         |
|                 |                                                                         | Milk Tester (NSQF3)                                                    |
|                 |                                                                         | Village-level Milk Collection Centre in-charge (NSQF 4)                |

Sources: Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022-June 2023. Document No.: DDI-IND-CSO-PLFS-2022-23. <https://microdata.gov.in/nada43/index.php/catalog/179>; National Career Service. Directorate General of Employment, Ministry of Labour and Employment, Government of India. [National Classification Of Occupations-2015 \(Code Structure\)](https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20Vol%20I-%202015.pdf). [https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20 Vol%20I-%202015.pdf](https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20Vol%20I-%202015.pdf) and; Agriculture Skill Council of India website. <https://asci-india.com/>.

## Annexure 6.1: Defining Textile Clusters

For both handloom and power loom sectors, the Ministry of Textile provides set definitions for identifying clusters in the following ways:

**Handloom Clusters:** The handloom cluster may be defined as a place where there is a large concentration of handlooms, producing handloom fabrics that would be in tune with the market demands. These handlooms could be located in close proximity in two adjoining revenue sub-divisions/villages within an administrative district or across two (mostly adjoining) districts. In smaller & hilly States, where the villages/ sub-divisions are of smaller size, the number of villages/sub-divisions may be increased to ensure the minimum critical size of the cluster. In many clusters across the country, the number of handlooms are much higher but for the purpose of the scheme, the size of cluster will be restricted to the part of cluster having handlooms in the range of 200 - 500 and 2000-5000, as per the MoT guidelines<sup>20</sup>. As on date, 715 handloom clusters have been taken up for financial assistance of Rs. 533.2 crore<sup>21</sup>. As per the guidelines, Comprehensive Handloom Cluster Development Scheme (CHCDS) is implemented for development of mega handloom clusters, having at least 15,000 looms per cluster with Government of India share up to Rs 40 crore in a period of 5 years<sup>22</sup>. The idea behind forming clusters is to focus on formation of weavers' groups as a visible entity so that the groups become self-sustainable. Under this, ten mega handloom clusters have been identified in 8 States under Comprehensive Handloom Cluster Development Scheme (CHCDS)<sup>23</sup> scheme given as follows: Assam (Sivasagar), Uttar Pradesh (Varanasi), Tamil Nadu (Virudhunagar and Trichy), West Bengal (Murshidabad), Jharkhand (Godda & neighbouring district.), Andhra Pradesh (Prakasam & Guntur district), Bihar (Bhagalpur) and Manipur (East Imphal) according to the Ministry of Textiles.

**Power loom Clusters:** According to the guidelines for the various components of PowerTex India, under Comprehensive Scheme for Power loom Sector Development, Office of Textile Commissioner, MoT, GoI, the power loom cluster may be defined as a place where there is at least 200 power loom units or at least 2,000 power looms located within the 50 km periphery and are producing fabrics<sup>24</sup>. Under Textile Cluster Development Scheme (TCDS), the list of 5 power loom mega clusters is given as follows: Erode (Tamil Nadu), Ichalkaranji (Maharashtra), Surat (Gujarat), Bengaluru (Karnataka), and Karanj (Gujarat).

---

<sup>20</sup> Guidelines for Implementation of Comprehensive Handlooms Development Scheme (CHDS), A Component of "National Handloom Development Programme", Dec 2013, Office of the Development Commissioner for Handlooms, Ministry of Textiles. Link: [https://industries.delhi.gov.in/sites/default/files/generic\\_multiple\\_files/chds.pdf](https://industries.delhi.gov.in/sites/default/files/generic_multiple_files/chds.pdf); Also mentioned in PIB article published by MoT dated April 29, 2013. Link: <https://pib.gov.in/newsite/PrintRelease.aspx?relid=95221>

<sup>21</sup> Key-initiatives/achievements for promotion of handloom sector from 2014-15 to 2024-25 (as on 30.06.2024), Document by Office of DC handlooms, MoT, GoI, Link: [https://handlooms.nic.in/assets/img/Statistics/Key%20Achivements%20in%20India%20\(1\).pdf](https://handlooms.nic.in/assets/img/Statistics/Key%20Achivements%20in%20India%20(1).pdf)

<sup>22</sup> Comprehensive Handloom Cluster Development Scheme, Press Information Bureau, Government of India, Ministry of Textiles, published on Jan 3, 2019. Link:

<sup>23</sup> As per Annual Report 2022-23, Ministry of Textiles, GoI. Link: [https://pib.gov.in/Pressreleaseshare.aspx?PRID=1558446#:~:text=Comprehensive%20Handloom%20Cluster%20Development%20Scheme&text=As%20per%20the%20guidelines%2C%20Comprehensiv,e,a%20period%20of%205%20years.https://texmin.nic.in/sites/default/files/English%20Final%20MOT%20Annual%20Report%202022-23%20%28English%29\\_o.pdf](https://pib.gov.in/Pressreleaseshare.aspx?PRID=1558446#:~:text=Comprehensive%20Handloom%20Cluster%20Development%20Scheme&text=As%20per%20the%20guidelines%2C%20Comprehensiv,e,a%20period%20of%205%20years.https://texmin.nic.in/sites/default/files/English%20Final%20MOT%20Annual%20Report%202022-23%20%28English%29_o.pdf)

<sup>24</sup> Ministry of Textiles, Government of India. 2013. Office Memorandum: "Minutes of the Standing Finance Committee held on 8.10. 2013. For approval the proposal for continuation and modification of Integrated Scheme for Power loom Sector Development". [http://txcindia.gov.in/html/INTEGRATED\\_SCHEME\\_FOR\\_POWER\\_LOOM.pdf](http://txcindia.gov.in/html/INTEGRATED_SCHEME_FOR_POWER_LOOM.pdf), October 24. and <https://texmin.nic.in/sites/default/files/Guidelines%20of%20PowerTex%20India%20Scheme.pdf>

## Annexure 6.2: List of Data Sources

| <i>S.No.</i> | <i>Dimension/<br/>Pillar</i> | <i>Indicator</i>                                         | <i>Source of data</i>                                                                               | <i>State-wise data<br/>available<br/>(Yes/No)</i> | <i>District-<br/>wise data<br/>available<br/>(Yes/No)</i> |
|--------------|------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------|-----------------------------------------------------------|
| 1            | Institutional/<br>Government | Number of<br>Factories                                   | Annual Survey of<br>Industries 2021-22,<br>MoSPI, Govt. of India                                    | Yes                                               | No                                                        |
| 2            | Institutional/<br>Government | Number of<br>Weaving Units                               | Enterprise Survey of<br>Unincorporated<br>Enterprises, 2021-22,<br>MoSPI, (GoI)                     | Yes                                               | No                                                        |
| 3            | Institutional/<br>Government | No of units of<br>handloom /<br>Power loom               | Ministry of Textiles,<br>GoI                                                                        | Yes                                               | No                                                        |
| 4            | Gender/<br>Government        | No of women<br>workers for<br>handloom                   | Ministry of Textile, GoI                                                                            | Yes                                               | No                                                        |
| 5            | Government                   | List of mega<br>clusters-<br>handloom /<br>Power loom    | Ministry of Textiles,<br>GoI                                                                        | Yes                                               | District names<br>given                                   |
| 6            | Government                   | State wise list of<br>clusters 2015-<br>23 <sup>25</sup> | Ministry of Textiles,<br>GoI                                                                        | Yes                                               | District /<br>cluster given                               |
| 7            | Institutional/<br>Government | State-wise list of<br>products for<br>Handlooms          | 4 <sup>th</sup> Handloom Census<br>2019-20, office of DC<br>Handlooms, Ministry of<br>Textiles, GoI | Yes                                               | No                                                        |

Source: NCAER Compilation.

<sup>25</sup> State-wise number of Clusters sanctioned under National Handloom Development Programme (NHDP) & Comprehensive Handloom Cluster Development Scheme (CHCDS) during 2015-16 to 2021-22 (till date)

<https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fhandlooms.nic.in%2Fassets%2Fimg%2FHandloom%2520Clusters%2F2500.xlsx&wdOrigin=BROWSELINK>.

### Annexure 6.3: Occupation Mapping from Periodic Labour Force, NCO-2015 and Textile Sector Skill Council Job Roles

| <i>NCO 3-Digit</i> | <i>NCO 8-Digit</i> | <i>NCO Job roles</i>                                                   | <i>TSC Job Role Code</i> | <i>TSC Job Role Detail</i> |
|--------------------|--------------------|------------------------------------------------------------------------|--------------------------|----------------------------|
| 112                |                    | Managing Directors and Chief Executives                                |                          |                            |
|                    | 1120.1700          | Working Proprietor, Manufacturing/Proprietor, Manufacturing            |                          |                            |
|                    | 1120.1800          | Director Manufacturing                                                 |                          |                            |
|                    | 1120.2800          | Director, Storage and Warehousing                                      |                          |                            |
| 121                |                    | Business Services and Administration Managers                          |                          |                            |
|                    | 1211.9900          | Finance Managers, Others                                               |                          |                            |
|                    | 1212               | Human Resource Managers                                                |                          |                            |
|                    | 1212.0100          | Personnel Manager                                                      |                          |                            |
|                    | 1212.9900          | Personnel and Industrial Relations Managers, Other                     |                          |                            |
|                    | 1213               | Policy and Planning Managers                                           |                          |                            |
|                    | 1213.0101          | Quality Assurance Standards In-Charge                                  |                          |                            |
|                    | 1213.0102          | Manager – Customer Quality                                             |                          |                            |
|                    | 1213.0201          | Area Service Manager                                                   |                          |                            |
|                    | 1219               | Business Services and Administration Managers Not Elsewhere Classified |                          |                            |
|                    | 1219.0100          | Manager, Import and Export                                             |                          |                            |
|                    |                    | Sales, Marketing and Development Managers                              |                          |                            |
|                    | 1221               | Sales and Marketing Managers                                           |                          |                            |
|                    | 1221.0100          | Sales Manager (Wholesale Trade)                                        |                          |                            |
|                    | 1221.0200          | Sales Manager (Retail Trade)                                           |                          |                            |
|                    | 1221.9900          | Sales and Marketing Managers, Other                                    |                          |                            |
| 122                | 1222               | Advertising and Public Relation Managers                               |                          |                            |
|                    | 1222.0100          | Manager, Advertising and Promotion                                     |                          |                            |
|                    | 1222.0200          | Manager, Fashion/Fashion Manager                                       |                          |                            |
|                    | 1222.9900          | Advertising and Public Relations Department Managers, Others           |                          |                            |
|                    | 1223               | Research and Development Managers                                      |                          |                            |
| 132                |                    | Manufacturing, Mining, Construction and Distribution Managers          |                          |                            |
|                    | 1321               | Manufacturing Managers                                                 |                          |                            |
|                    | 1321.0100          | Manager, Electricity                                                   |                          |                            |
|                    | 1321.0300          | Manager, Gas                                                           |                          |                            |
|                    | 1321.0400          | Manager, Water Supply                                                  |                          |                            |
|                    | 1321.0600          | Manager, Manufacturing                                                 |                          |                            |
|                    | 1321.0700          | General Manager, Electricity                                           |                          |                            |
|                    | 1321.0800          | General Manager, Gas                                                   |                          |                            |
|                    | 1321.0900          | General Manager, Water Supply                                          |                          |                            |
|                    | 1321.1000          | General Manager, Manufacturing                                         |                          |                            |
|                    | 1321.9900          | Manufacturing Managers, Other                                          |                          |                            |
|                    | 1324               | Supply, Distribution and Related Managers                              |                          |                            |
|                    | 1324.0100          | Manager, Material Control/Manager Materials                            |                          |                            |
|                    | 1324.0200          | Manager, Transport                                                     |                          |                            |
|                    | 1324.0800          | Manager, Flight Operation                                              |                          |                            |
|                    | 1324.1200          | Manager, Storage and Warehousing                                       |                          |                            |
|                    | 1324.1300          | Goods Supervisor, Railway                                              |                          |                            |

| <b>NCO 3-Digit</b> | <b>NCO 8-Digit</b> | <b>NCO Job roles</b>                                                  | <b>TSC Job Role Code</b> | <b>TSC Job Role Detail</b> |
|--------------------|--------------------|-----------------------------------------------------------------------|--------------------------|----------------------------|
|                    | 1324.1400          | Goods Supervisor, Road Transport                                      |                          |                            |
|                    | 1324.2100          | General Manager, Transport                                            |                          |                            |
|                    | 1324.2200          | General Manager, Storage and Warehousing                              |                          |                            |
|                    | 1324.9900          | Supply, Distribution and Related Managers and General Managers, Other |                          |                            |
| 134                |                    | Professional Services Managers                                        |                          |                            |
|                    | 1346               | Financial and Insurance Service Branch Managers                       |                          |                            |
|                    | 1346.0100          | Manager, Bank                                                         |                          |                            |
|                    | 1346.0200          | Manager, Insurance                                                    |                          |                            |
|                    | 1346.9900          | Financial and Insurance Service Branch Managers, Other                |                          |                            |
| 142                |                    | Retail and Wholesale Trade Managers                                   |                          |                            |
|                    | 1420               | Retail and Wholesale Trade Managers                                   |                          |                            |
|                    | 1420.0100          | Manager, Wholesale Trade                                              |                          |                            |
|                    | 1420.0200          | Manager, Retail Trade                                                 |                          |                            |
|                    | 1420.0300          | Manager, Export                                                       |                          |                            |
|                    | 1420.0400          | General Manager, Wholesale Trade/Senior Manager, Wholesale Trade      |                          |                            |
|                    | 1420.0500          | General Manager, Retail Trade, Senior Manager, Retail Trade           |                          |                            |
|                    | 1420.9900          | Retail and Wholesale Trade Managers, Other                            |                          |                            |
| 214                |                    | Engineering Professionals (Excluding Electrotechnology)               |                          |                            |
|                    | 2141.1000          | Textile Technologist                                                  |                          |                            |
|                    | 2141.1200          | Jute Technologist                                                     |                          |                            |
|                    | 2141.1300          | Fibre Technologist                                                    |                          |                            |
|                    | 2141.1400          | Spinning Master                                                       |                          |                            |
|                    | 2141.1500          | Weaving Master                                                        |                          |                            |
|                    | 2141.1600          | Dyeing and Bleaching Master (Textiles)                                |                          |                            |
|                    | 2141.1700          | Printing Master (Textile)                                             |                          |                            |
|                    | 2141.2400          | Printing Technologist                                                 |                          |                            |
|                    | 2141.2500          | Safety Engineer                                                       |                          |                            |
|                    | 2141.2600          | Occupational Health and Safety Specialist                             |                          |                            |
| 216                |                    | Architects, Planners, Surveyors and Designers                         |                          |                            |
|                    | 2163               | Product and Garment Designers                                         |                          |                            |
|                    | 2163.0100          | Package Designer/Packaging Designer                                   |                          |                            |
|                    | 2163.0500          | Fashion Designer                                                      |                          |                            |
|                    | 2163.0600          | Textile Designer                                                      |                          |                            |
|                    | 2166               | Graphic and Multimedia Designers                                      |                          |                            |
|                    | 2166.0300          | Web Designer                                                          |                          |                            |
| 241                |                    | Finance Professionals                                                 |                          |                            |
|                    | 2411               | Accountants                                                           |                          |                            |
|                    | 2411.0100          | Accountant                                                            |                          |                            |
|                    | 2411.0101          | Associate – Transactional Finance & Accounting                        |                          |                            |
|                    | 2411.0200          | Auditor                                                               |                          |                            |
|                    | 2411.0300          | Cost Accountant                                                       |                          |                            |
|                    | 2412               | Financial and Investment Advisors                                     |                          |                            |
|                    | 2412.0100          | Financial Examiner                                                    |                          |                            |

| <b>NCO 3-Digit</b> | <b>NCO 8-Digit</b> | <b>NCO Job roles</b>                                                      | <b>TSC Job Role Code</b> | <b>TSC Job Role Detail</b> |
|--------------------|--------------------|---------------------------------------------------------------------------|--------------------------|----------------------------|
|                    | 2412.0200          | Financial Analyst                                                         |                          |                            |
|                    | 2412.0300          | Budget Analyst                                                            |                          |                            |
|                    | 2412.0400          | Risk Management Analyst                                                   |                          |                            |
|                    | 2412.0600          | Commission Agent                                                          |                          |                            |
|                    | 2412.9900          | Financial and Investment Advisors, Other                                  |                          |                            |
|                    | 2413               | Financial Analysts                                                        |                          |                            |
| 242                |                    | Administration Professionals                                              |                          |                            |
|                    | 2424               | Training and Staff Development Professionals                              |                          |                            |
|                    | 2424.0100          | Manpower Officer/Area Manager, Human Resource                             |                          |                            |
|                    | 2424.0200          | Employment Officer/Operation Head, Employment                             |                          |                            |
|                    | 2424.0300          | Human Resource Manager                                                    |                          |                            |
|                    | 2424.9900          | Training and Staff Development Professionals, Other                       |                          |                            |
| 251                |                    | Software and Application Developers, and Analysts                         |                          |                            |
|                    | 2511               | System Analysts                                                           |                          |                            |
|                    | 2511.0103          | Engineer – Packaging                                                      |                          |                            |
|                    | 2511.0104          | Engineer – Product Lifecycle Management (PLM)                             |                          |                            |
|                    | 2512               | Software Developers                                                       |                          |                            |
|                    | 2512.0100          | Computer Programmer/Software Engineer                                     |                          |                            |
|                    | 2513               | Web and Multimedia Developers                                             |                          |                            |
| 311                |                    | Physical and Engineering Science Technicians                              |                          |                            |
|                    | 3113               | Electrical Engineering Technicians                                        |                          |                            |
|                    | 3113.0200          | Electrical Technician (High Voltage)                                      |                          |                            |
|                    | 3113.0401          | Machine Maintenance Technician                                            |                          |                            |
|                    | 3118               | Draught persons                                                           |                          |                            |
|                    | 3118.0800          | Tracer                                                                    |                          |                            |
|                    | 3118.0900          | Blue Printer                                                              |                          |                            |
|                    | 3118.9900          | Draught persons, Other                                                    |                          |                            |
|                    | 3119               | Physical and Engineering Science Technicians Not Elsewhere Classified     |                          |                            |
|                    | 3119.0800          | Fire Prevention Officer                                                   |                          |                            |
|                    | 3119.0900          | Fire Officer                                                              |                          |                            |
| 312                |                    | Mining, Manufacturing and Construction Supervisors                        |                          |                            |
|                    | 3122               | Manufacturing Supervisors                                                 |                          |                            |
|                    | 3122.2800          | Jobber (Textile)                                                          |                          |                            |
|                    | 3122.3400          | Supervisors and Foremen, Textile-Related Products                         |                          |                            |
|                    | 3122.3450          | Scouring Supervisor, Wool                                                 |                          |                            |
|                    | 3122.3500          | Supervisors and Foremen, Tailoring and Dress Making                       |                          |                            |
|                    | 3122.4100          | Supervisor and Foreman, Checking, Sorting, Packing and Related Activities |                          |                            |
| 332                |                    | Sales and Purchasing Agents and Brokers                                   |                          |                            |
|                    | 3321               | Insurance Representatives                                                 |                          |                            |
|                    | 3321.9900          | Insurance Representatives, Other                                          |                          |                            |
|                    | 3322               | Commercial Sales Representatives                                          |                          |                            |
|                    | 3322.0900          | Sales Supervisor, Retail Trade                                            |                          |                            |
|                    | 3322.9900          | Commercial Sales Representatives, Other                                   |                          |                            |

| <b>NCO 3-Digit</b> | <b>NCO 8-Digit</b> | <b>NCO Job roles</b>                                                                   | <b>TSC Job Role Code</b> | <b>TSC Job Role Detail</b> |
|--------------------|--------------------|----------------------------------------------------------------------------------------|--------------------------|----------------------------|
|                    | 3323               | Buyers                                                                                 |                          |                            |
|                    | 3323.0100          | Buyer                                                                                  |                          |                            |
|                    | 3323.0401          | Purchase Executive                                                                     |                          |                            |
|                    | 3323.9900          | Buyers, Other                                                                          |                          |                            |
| 333                |                    | Business Service Agents                                                                |                          |                            |
|                    | 3339               | Business Service Agents Not Elsewhere Classified                                       |                          |                            |
|                    | 3339.0200          | Brand Manager                                                                          |                          |                            |
|                    | 3339.0600          | Call Centre Executive                                                                  |                          |                            |
| 351                |                    | Information and Communication Technology (ICT) Operations and User Support Technicians |                          |                            |
|                    | 3512               | Information and Communication Technology (ICT) User Support Technicians                |                          |                            |
|                    | 3512.0801          | Engineer – Technical Support                                                           |                          |                            |
|                    | 3512.9900          | Information and Communication Technology User Support Technicians, Other               |                          |                            |
| 411                |                    | General Office Clerks                                                                  |                          |                            |
|                    | 4110               | General Office Clerks                                                                  |                          |                            |
|                    | 4110.0100          | Clerk, General                                                                         |                          |                            |
| 413                |                    | Keyboard Operators                                                                     |                          |                            |
|                    | 4132               | Data Entry Clerks                                                                      |                          |                            |
|                    | 4132.1000          | Addressing Machine Operator                                                            |                          |                            |
|                    | 4132.1300          | Bookkeeping Machine Operator                                                           |                          |                            |
|                    | 4132.1400          | Bill Processing Clerk                                                                  |                          |                            |
|                    | 4132.9900          | Data Entry Clerks, Other                                                               |                          |                            |
| 431                |                    | Numerical Clerks                                                                       |                          |                            |
|                    | 4311               | Accounting and Bookkeeping Clerks                                                      |                          |                            |
|                    | 4311.0300          | Ledger Clerk                                                                           |                          |                            |
|                    | 4311.0500          | Audit, Clerk                                                                           |                          |                            |
|                    | 4311.0600          | Clerk, Cost Accounting                                                                 |                          |                            |
|                    | 4311.0700          | Bill and Accounts Collector                                                            |                          |                            |
|                    | 4313               | Payroll Clerks                                                                         |                          |                            |
| 432                |                    | Material Recording and Transport Clerks                                                |                          |                            |
|                    | 4321               | Stock Clerks                                                                           |                          |                            |
|                    | 4321.0100          | Store Keeper                                                                           |                          |                            |
|                    | 4321.0200          | Store Distributor                                                                      |                          |                            |
|                    | 4322               | Production Clerks                                                                      |                          |                            |
| 441                |                    | Other Clerical Support Workers                                                         |                          |                            |
|                    | 4419               | Clerical Support Workers Not Elsewhere Classified                                      |                          |                            |
|                    | 4419.0102          | Business Correspondent                                                                 |                          |                            |
| 515                |                    | Building and Housekeeping Supervisors                                                  |                          |                            |
|                    | 5151               | Cleaning and Housekeeping Supervisors in Offices, Hotels and Other Establishments      |                          |                            |
|                    | 5151.0500          | Linen Keeper                                                                           |                          |                            |
| 521                |                    | Street and Market Salespersons                                                         |                          |                            |
|                    | 5211               | Stall and Market Salespersons                                                          |                          |                            |
|                    | 5211.0301          | Sales Executive – Dealership                                                           |                          |                            |
| 522                |                    | Shop Salespersons                                                                      |                          |                            |

| <b>NCO 3-Digit</b> | <b>NCO 8-Digit</b> | <b>NCO Job roles</b>                                                 | <b>TSC Job Role Code</b> | <b>TSC Job Role Detail</b>                                               |
|--------------------|--------------------|----------------------------------------------------------------------|--------------------------|--------------------------------------------------------------------------|
|                    | 5222               | Shop Supervisors                                                     |                          |                                                                          |
|                    | 5222.0100          | Sales Supervisor, Wholesale Trade                                    |                          |                                                                          |
|                    | 5223               | Shop Sales Assistants                                                |                          |                                                                          |
| 524                |                    | Other Sales Workers                                                  |                          |                                                                          |
|                    | 5249               | Sales Workers Not Elsewhere Classified                               |                          |                                                                          |
|                    | 5249.0200          | Salesman, Wholesale Trade                                            |                          |                                                                          |
|                    | 5249.0400          | Wholesale Dealer                                                     |                          |                                                                          |
|                    | 5249.0500          | Retail Dealer                                                        |                          |                                                                          |
|                    | 5249.0600          | Selling Agent                                                        |                          |                                                                          |
|                    | 5249.0700          | Stockist                                                             |                          |                                                                          |
| 723                |                    | Machinery Mechanics and Repairers                                    |                          |                                                                          |
|                    | 7233               | Agricultural and Industrial Machinery Mechanics and Repairers        |                          |                                                                          |
|                    | 7233.1600          | Mechanic, Textile Machinery                                          |                          |                                                                          |
|                    | 7233.1700          | Mechanic, Printing Machinery                                         |                          |                                                                          |
|                    | 7233.1800          | Mechanic, Sewing Machine                                             |                          |                                                                          |
| 731                |                    | Handicraft Workers                                                   |                          |                                                                          |
|                    | 7318               | Handicraft Workers in Textiles, Leather and Related Materials        |                          |                                                                          |
|                    | 7318.0300          | Carpet Weaver (Carpet & Rug)                                         |                          |                                                                          |
|                    | 7318.0500          | Hand Printer, Textile/Hand Block Printer                             | TSC/Q7402                | Kalamkari Artisan                                                        |
|                    | 7318.0600          | Hand Dyer                                                            | TSC/Q7201                | Hank Dyer                                                                |
|                    |                    |                                                                      | TSC/Q2301                | Fabric Checker – Textiles                                                |
|                    | 7318.0800          | Repairer, Fabrics/Fabric Mender                                      | TSC/Q2302                | Fabric Mender – Textiles                                                 |
|                    |                    |                                                                      | TSC/Q2101                | Warper – Direct Warping Machine or Handloom                              |
|                    | 7318.0900          | Bale Breaker Tenter, Cotton/Blow Room Operator                       | TSC/Q0101                | Blowroom Operator                                                        |
|                    | 7318.0900          | Bale Breaker Tenter, Cotton/Blow Room Operator                       | TSC/Q5404                | Textile Post Processing Machine Operator Elective 1 – Washing Range      |
|                    | 7318.1000          | Batching Worker, Wool                                                |                          |                                                                          |
|                    | 7318.1100          | Wool Sorter                                                          |                          |                                                                          |
|                    | 7318.1200          | Selector, Jute                                                       | TSC/Q0107                | Jute Selector cum Assorter                                               |
|                    | 7318.1300          | Grader, Coir                                                         |                          |                                                                          |
|                    | 7318.1500          | Waste Machine Man (Cotton Textile)/Waste Collection Machine Operator |                          |                                                                          |
|                    | 7318.1800          | Scouring Man, Wool/Wool Washing and Scouring Operator                |                          |                                                                          |
|                    | 7318.1900          | Cooker (Silkworm)                                                    |                          |                                                                          |
|                    | 7318.2             | Softener Feeder and Receiver, Jute                                   |                          |                                                                          |
|                    | 7318.2100          | Root Cutter, Jute                                                    |                          |                                                                          |
|                    | 7318.2200          | Teaser (Feeder and Receiver) Jute                                    |                          |                                                                          |
|                    | 7318.2300          | Fibre Preparer, Coir                                                 |                          |                                                                          |
|                    |                    |                                                                      | TSC/Q0102                | Carding Operator                                                         |
|                    | 7318.2700          | Cardtenter, Cotton/Carding Tenter                                    | TSC/Q5404                | Textile Post Processing Machine Operator Elective 3 – Balloon Squeezing  |
|                    | 7318.2800          | Set Framer, Silk                                                     |                          |                                                                          |
|                    | 7318.2900          | Sliver Lap Man/Combing Preparatory Operator                          | TSC/Q0103                | Combing Preparatory Operator                                             |
|                    | 7318.2900          | Sliver Lap Man/Combing Preparatory Operator                          | TSC/Q5103                | Textile Processing Preparatory Operator Elective 1 – Singeing & Desizing |
|                    | 7318.3500          | Gill Box Man                                                         |                          |                                                                          |



| <b>NCO 3-Digit</b> | <b>NCO 8-Digit</b> | <b>NCO Job roles</b>                                                  | <b>TSC Job Role Code</b> | <b>TSC Job Role Detail</b>                                                                                                               |
|--------------------|--------------------|-----------------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
|                    | 7318.3600          | Spreader Feeder, Jute                                                 |                          |                                                                                                                                          |
|                    | 7318.3700          | Spreader, Receiver, Jute                                              |                          |                                                                                                                                          |
|                    | 7318.3800          | Breaker Feeder, Jute                                                  |                          |                                                                                                                                          |
|                    | 7318.4             | Finisher Feeder, Jute                                                 |                          |                                                                                                                                          |
|                    | 7318.4200          | Hand Spinner (Cotton and Woollen Textile)                             | TSC/Q7901                | Hand Spinning Operator, Elective 1 – Traditional Charkha, Elective 2 – New Model Charkhas, Elective 3 – Solar Operated New Model Charkha |
|                    | 7318.4300          | Piecer                                                                |                          |                                                                                                                                          |
|                    | 7318.4500          | Spinner, Jute                                                         | TSC/Q0204                | Jute spinning Sardar (Jobber) cum Jr. Supervisor                                                                                         |
|                    | 7318.4600          | Spinner, Coir                                                         |                          |                                                                                                                                          |
|                    | 7318.4700          | Twister                                                               |                          |                                                                                                                                          |
|                    | 7318.4800          | Doffer, Spinning/Ring Spinning Doffer                                 | TSC/Q0202                | Ring Frame Doffer                                                                                                                        |
|                    | 7318.4900          | Knottter, Silk                                                        |                          |                                                                                                                                          |
|                    | 7318.5000          | Beam Gaiter                                                           |                          |                                                                                                                                          |
|                    | 7318.5100          | Lacer, Hand                                                           |                          |                                                                                                                                          |
|                    | 7318.5200          | Lattice Pegger                                                        |                          |                                                                                                                                          |
|                    | 7318.5300          | Reacher, Hand (Textile)                                               |                          |                                                                                                                                          |
|                    | 7318.5500          | Weaver Power Loom                                                     | TSC/Q2210                | Shuttle loom operator cum pirn winder (Power loom, Automatic loom)                                                                       |
|                    |                    |                                                                       | TSC/Q7404                | Ikkat Artisan                                                                                                                            |
|                    | 7318.5800          | Weaver, Handloom                                                      | TSC/Q7306                | Jacquard Weaver – Handloom                                                                                                               |
|                    |                    |                                                                       | TSC/Q7307                | Loin Loom Weaver                                                                                                                         |
|                    | 7318.5900          | Carpet Weaver, Hand Knitting                                          | TSC/Q7304                | Hand Knitting Machine Operator                                                                                                           |
|                    | 7318.6000          | Carpet Clipper, Hand                                                  |                          |                                                                                                                                          |
|                    | 7318.6100          | Carpet Embosser                                                       |                          |                                                                                                                                          |
|                    | 7318.6200          | Carpet Repairer                                                       |                          |                                                                                                                                          |
|                    | 7318.6300          | Coir Weaver (Matting)                                                 |                          |                                                                                                                                          |
|                    | 7318.6400          | Net Maker, Hand                                                       |                          |                                                                                                                                          |
|                    | 7318.6500          | Crochet Worker, Hand                                                  |                          |                                                                                                                                          |
|                    | 7318.6600          | Knitter, Hand                                                         |                          |                                                                                                                                          |
|                    | 7318.6700          | Braid Maker, Hand                                                     |                          |                                                                                                                                          |
|                    |                    |                                                                       | TSC/Q7403                | Assistant Design Maker – Textiles                                                                                                        |
|                    |                    |                                                                       | TSC/Q7101                | Cocoon tester cum purchaser, Elective 1 – Textile MSME, Elective 2 – Textile Mill                                                        |
|                    |                    |                                                                       | TSC/Q7301                | Cone Winder-cum-Pirn Winder                                                                                                              |
|                    |                    |                                                                       | TSC/Q7801                | Handloom Entrepreneur                                                                                                                    |
|                    |                    |                                                                       | TSC/Q7502                | Jacquard Harness Builder                                                                                                                 |
|                    |                    |                                                                       | TSC/Q7102                | Mulberry cocoon sorter, drier cum grader                                                                                                 |
|                    | 7318.9900          | Handicraft Workers in Textiles, Leather and Related Materials, Others | TSC/Q5405                | Textile Finishing Machine Operator Elective 1 – -Stenter                                                                                 |
|                    |                    |                                                                       | TSC/Q5404                | Textile Post Processing Machine Operator Elective 5 – Calendar                                                                           |
|                    |                    |                                                                       | TSC/Q5208                | Textile Printing Machine operator                                                                                                        |
|                    |                    |                                                                       | TSC/Q5208                | Textile Printing Machine operator – Printing Screen Making                                                                               |
|                    |                    |                                                                       | TSC/Q5103                | Textile Printing Machine operator – Continuous Bleaching Range                                                                           |
| 754                |                    | Other Craft and Related Workers                                       |                          |                                                                                                                                          |
|                    | 7543               | Product Graders and Testers (Excluding Food and Beverages)            |                          |                                                                                                                                          |

| <b>NCO 3-Digit</b> | <b>NCO 8-Digit</b> | <b>NCO Job roles</b>                                                         | <b>TSC Job Role Code</b> | <b>TSC Job Role Detail</b>                                        |
|--------------------|--------------------|------------------------------------------------------------------------------|--------------------------|-------------------------------------------------------------------|
| 815                | 7543.0400          | Examiner, Dry Cleaning/Fabric Inspection Operator                            |                          |                                                                   |
|                    |                    | Textile, Fur and Leather Products Machine Operators                          |                          |                                                                   |
|                    | 8151               | Fibre Preparing, Spinning and Winding Machine Operators                      |                          |                                                                   |
|                    | 8152               | Weaving and Knitting Machine Operators                                       |                          |                                                                   |
|                    | 8153               | Sewing Machine Operators                                                     |                          |                                                                   |
|                    | 8154               | Bleaching, Dyeing and Cleaning Machine Operators                             |                          |                                                                   |
|                    | 8159               | Textile, Fur and Leather Products Machine Operators Not Elsewhere Classified |                          |                                                                   |
|                    | 8151.0100          | Garnett Machineman, Woollen                                                  |                          |                                                                   |
|                    | 8151.0300          | Rag Machineman (Woollen Textile)                                             |                          |                                                                   |
|                    | 8151.0400          | Doubling Machine Operator (Textile)                                          |                          |                                                                   |
|                    | 8151.0500          | Combing Tenter                                                               | TSC/Q0104                | Combing Operator                                                  |
|                    | 8151.0500          | Combing Tenter                                                               | TSC/Q5103                | Textile Processing Preparatory Operator                           |
|                    | 8151.0600          | Spinner, Frame (Textile)/Ring Frame Tenter                                   | TSC/Q0205                | Ring Frame Operator, Manual doffing,Auto doffing                  |
|                    |                    |                                                                              | TSC/Q0201                | Ring Frame Tenter                                                 |
|                    | 8151.0700          | Drawing Tenter                                                               | TSC/Q0105                | Draw Frame Operator                                               |
|                    |                    |                                                                              | TSC/Q7902                | Twister cum Doubler – Handloom                                    |
|                    | 8151.1000          | Reeler Textile                                                               |                          |                                                                   |
|                    | 8151.1100          | Reed Man                                                                     |                          |                                                                   |
|                    | 8151.1200          | Healdman (Textile)                                                           |                          |                                                                   |
|                    | 8151.1300          | Reeler, Silk                                                                 |                          |                                                                   |
|                    | 8151.1400          | Yarn Tester                                                                  |                          |                                                                   |
|                    | 8151.1500          | Warping Boy (Textile)/Wrapper                                                |                          |                                                                   |
|                    | 8151.1600          | Pin Setter (Textile)                                                         |                          |                                                                   |
|                    | 8151.1700          | Roller Coverer                                                               |                          |                                                                   |
|                    | 8151.1800          | Winder Textile/Winding Operator                                              | TSC/Q0301                | Autoconer Tenter                                                  |
|                    |                    |                                                                              | TSC/Q0302                | Cone Winding Operator-Manual & Assembly Winding                   |
|                    |                    |                                                                              | TSC/Q0304                | Jute Weft Winding Operator                                        |
|                    |                    |                                                                              | TSC/Q5405                | Textile Finishing Machine Operator Elective 3 – Relax Dryer       |
|                    |                    |                                                                              | TSC/Q0303                | TFO Tenter                                                        |
|                    | 8151.1900          | Size Mixer (Textile)                                                         | TSC/Q2102                | Size Mixer                                                        |
|                    | 8151.2000          | Waterproofer, Textile                                                        |                          |                                                                   |
|                    | 8151.2100          | Weighter, Silk                                                               |                          |                                                                   |
|                    | 8151.2200          | Fetler (Woollen Textile)                                                     |                          |                                                                   |
|                    | 8151.9900          | Fibre Preparing, Spinning and Winding Machine Operators, Other               | TSC/Q0902                | Assistant Cotton Grader (Ginning)                                 |
|                    |                    |                                                                              | TSC/Q0903                | Assistant Ginning Fitter                                          |
|                    |                    |                                                                              | TSC/Q0306                | Finished Package Checker-cum-Packer – Spinning, Yarn Conditioning |
|                    |                    |                                                                              | TSC/Q0403                | Fitter – Post Spinning                                            |
|                    |                    |                                                                              | TSC/Q0402                | Fitter – Ring Spinning                                            |
|                    |                    |                                                                              | TSC/Q0401                | Fitter Spinning Preparatory                                       |
|                    |                    |                                                                              | TSC/Q0901                | Ginning Helper                                                    |
|                    |                    |                                                                              | TSC/Q0108                | Jute Carding Operator                                             |
|                    |                    |                                                                              | TSC/Q0203                | Open-End Spinning Tenter                                          |
|                    |                    |                                                                              | TSC/Q8201                | Tape Plant Operator                                               |
|                    |                    |                                                                              | TSC/Q8301                | Tape Winder                                                       |

| <b>NCO 3-Digit</b> | <b>NCO 8-Digit</b> | <b>NCO Job roles</b>                                            | <b>TSC Job Role Code</b> | <b>TSC Job Role Detail</b>                                           |
|--------------------|--------------------|-----------------------------------------------------------------|--------------------------|----------------------------------------------------------------------|
|                    |                    |                                                                 | TSC/Q5405                | Textile Finishing Machine Operator                                   |
|                    |                    |                                                                 | TSC/Q5405                | Textile Finishing Machine Operator Elective 2 – Sanforiser           |
|                    |                    |                                                                 | TSC/Q0305                | Winding Tenter (Autoconer, Manual Cone Winding, Doubler Winding)     |
|                    | 8152.0100          | Drawing Man                                                     |                          |                                                                      |
|                    | 8152.0200          | Doffer, Fly Frame/Speed Frame Operator                          | TSC/Q0106                | Speed Frame Operator – Tenter and Doffer                             |
|                    | 8152.0300          | Knitting Jobber                                                 |                          |                                                                      |
|                    |                    |                                                                 | TSC/Q7401                | Card Puncher (Automatic Machine)                                     |
|                    |                    |                                                                 | TSC/Q8401                | Circular loom operator (Shuttle type)                                |
|                    | 8152.0400          | Card Cutter                                                     | TSC/Q5404                | Textile Post Processing Machine Operator Elective 2 – Drying Range   |
|                    |                    |                                                                 | TSC/Q5404                | Textile Post Processing Machine Operator Elective 4 – Fabric Folding |
|                    | 8152.0500          | Mat Shearing Operator                                           |                          |                                                                      |
|                    | 8152.0600          | Flat Knitter, Machine/Knitting Machine Operator – Flat Knitting | TSC/Q4102                | Knitting Machine Operator Flat Bed Knitting                          |
|                    | 8152.0700          | Sock Knitter/Knitting Machine Operator –                        |                          |                                                                      |
|                    | 8152.0800          | Sock Knitter, Automatic Machine                                 |                          |                                                                      |
|                    | 8152.0900          | Knitter, Machine/Knitting Machine Operator                      | TSC/Q4101                | Knitting Machine Operator Circular Knitting                          |
|                    | 8152.1             | Looperman, Hosiery                                              |                          |                                                                      |
|                    | 8152.1100          | Warp Knitter/Knitting Machine Operator –                        | TSC/Q4103                | Knitting Machine Operator Warp Knitting                              |
|                    | 8152.1200          | Weaver, Lace (Machine)                                          |                          |                                                                      |
|                    | 8152.1300          | Braid Maker, Machine/Braiding Machine Operator                  |                          |                                                                      |
|                    | 8152.1400          | Lace Maker (Machine)                                            |                          |                                                                      |
|                    | 8152.1600          | Warp Tying Machineman                                           | TSC/Q2205                | Knotting Machine Operator                                            |
|                    | 8152.1700          | Warper                                                          | TSC/Q2104                | Jute Beaming Operator                                                |
|                    | 8152.2000          | Front Sizer (Cotton Textile)                                    |                          |                                                                      |
|                    | 8152.2100          | Back Sizer                                                      |                          |                                                                      |
|                    |                    |                                                                 | TSC/Q2601                | Beam Carrier – Loader                                                |
|                    |                    |                                                                 | TSC/Q2405                | Fitter – Shuttleless Weaving Machine: Air-Jet                        |
|                    |                    |                                                                 | TSC/Q2404                | Fitter – Shuttleless Weaving Machine: Projectile                     |
|                    |                    |                                                                 | TSC/Q2406                | Fitter Helper – Weaving                                              |
|                    | 8152.9900          | Weaving and Knitting Machine Operators, Other                   | TSC/Q2401                | Fitter Weaving Preparatory                                           |
|                    |                    |                                                                 | TSC/Q2206                | Pirn Winding Machine Operator                                        |
|                    |                    |                                                                 | TSC/Q2211                | Shuttleless Loom Operator (Airjet, Rapier, Projectile, Waterjet)     |
|                    |                    |                                                                 | TSC/Q2103                | Sizing Machine Operator                                              |
|                    |                    |                                                                 | TSC/Q5404                | Textile Post Processing Machine Operator                             |
|                    | 8153.0200          | Button Hole Maker, Machine                                      |                          |                                                                      |
|                    | 8153.0300          | Eyelet Holing Machine Operator                                  |                          |                                                                      |
|                    | 8153.0400          | Button Stitching Machine Operator                               |                          |                                                                      |
|                    | 8153.0500          | Embroider, Machine                                              |                          |                                                                      |
|                    | 8153.0600          | Embroidery Machine Operator (Semi-Automatic)                    |                          |                                                                      |
|                    | 8153.9900          | Sewers and Embroiders, Other                                    |                          |                                                                      |
|                    | 8154.0200          | Kierman (Textile)/Package Dyeing Machine Operator               | TSC/Q5207                | Textile Dyeing machine operator (Package Dyeing)                     |

| <b>NCO 3-Digit</b> | <b>NCO 8-Digit</b> | <b>NCO Job roles</b>                                      | <b>TSC Job Role Code</b> | <b>TSC Job Role Detail</b>                                |
|--------------------|--------------------|-----------------------------------------------------------|--------------------------|-----------------------------------------------------------|
|                    | 8154.0300          | Scouringman, Woollen Yarn                                 |                          |                                                           |
|                    | 8154.0500          | Washing Machineman                                        |                          |                                                           |
|                    | 8154.0600          | De-Gummer, Silk                                           |                          |                                                           |
|                    | 8154.0700          | Carbonizer, Textile                                       |                          |                                                           |
|                    | 8154.0800          | Scutcherman, Bleaching                                    |                          |                                                           |
|                    | 8154.0900          | Dyed- Yarn Operator (Textile)                             |                          |                                                           |
|                    | 8154.1000          | Jiggerman (Cotton Textile)/Jigger Machine Operator        | TSC/Q5207                | Textile Dyeing machine operator (Jigger)                  |
|                    | 8154.1100          | Dye Automation Operator (Textile)/Dyeing Machine Operator |                          |                                                           |
|                    | 8154.1200          | Wool Dyer                                                 |                          |                                                           |
|                    | 8154.1500          | Dyer Garment                                              |                          |                                                           |
|                    | 8154.1700          | Damping Machine Attendant                                 |                          |                                                           |
|                    | 8154.1800          | Calenderman (Cotton Textile)                              |                          |                                                           |
|                    | 8154.1900          | Miller                                                    |                          |                                                           |
|                    | 8154.2000          | Raising Machineman (Textile)                              |                          |                                                           |
|                    | 8154.2100          | Stentering Machineman/Stentering Operator                 |                          |                                                           |
|                    | 8154.2200          | Cropper                                                   |                          |                                                           |
|                    | 8154.2300          | Padding Machineman/Padding Mangle Operator                |                          |                                                           |
|                    | 8154.2400          | Brushing Machineman (Textile)                             |                          |                                                           |
|                    | 8154.2500          | Crabbing Machineman (Woollen Textile)                     |                          |                                                           |
|                    | 8154.2700          | Singeing Machineman/Singeing Machine Operator             |                          |                                                           |
|                    |                    |                                                           | TSC/Q5205                | Dyestuff & Chemical Preparation Operator                  |
|                    | 8154.9900          | Bleaching, Dyeing and Cleaning Machine Operators, Other   | TSC/Q5701                | Fitter – Chemical Processing (Textiles)                   |
|                    |                    |                                                           | TSC/Q5207                | Textile Dyeing machine operator (Soft flow)               |
|                    |                    |                                                           | TSC/Q7303                | Two Shaft Handloom Weaver                                 |
|                    | 8159.0200          | Splicing – Machine Operator, Automatic (Textile)          |                          |                                                           |
|                    |                    |                                                           | TSC/Q0904                | Bale Press Operator                                       |
|                    | 8159.0300          | Balling – Machine Operator (Textile)                      | TSC/Q5405                | Textile Finishing Machine Operator Elective 4 – Compactor |
| <b>821</b>         |                    | Assemblers                                                |                          |                                                           |
|                    | 8211               | Mechanical Machinery Assemblers                           |                          |                                                           |
|                    | 8211.0300          | Assembler, Textile Machinery                              |                          |                                                           |

*Sources:* Mapping exercise done at NCAER in consultation with TSC for the job roles as given by Textile Skill Council (TSC) and National Classification of Occupations (NCO) 2015, Ministry of Labour & Employment, Directorate General of Employment, Government of India and Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022-June 2023. Document No.: DDI-IND-CSO-PLFS-2022-23. <https://microdata.gov.in/nada43/index.php/catalog/179>

## Annexure 7.1: Occupations and Job Roles in the Automotive Sector

| 3-Digit NCO                                                         | 4/8 Digit NCO | NCO Description                                             | ASDC Job Role                                                                                                                  |
|---------------------------------------------------------------------|---------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| 112 - Managing Directors and Chief Executives                       | 1120.1700     | Working Proprietor, Manufacturing/Proprietor, Manufacturing |                                                                                                                                |
|                                                                     | 1120.1800     | Director Manufacturing                                      | Automotive Smart Manufacturing Head                                                                                            |
|                                                                     | 1120.3500     | Working Proprietor, Other Services                          |                                                                                                                                |
|                                                                     | 1120.3600     | Director, Other Services                                    |                                                                                                                                |
|                                                                     | 1120.9900     | Managing Directors and Chief Executives, Others             |                                                                                                                                |
| 121 - Business Services and Administration Managers                 | 1211.9900     | Finance Managers, Others                                    |                                                                                                                                |
|                                                                     | 1212.0100     | Personnel Manager                                           |                                                                                                                                |
|                                                                     | 1212.9900     | Personnel and Industrial Relations Managers, others         |                                                                                                                                |
|                                                                     | 1213.0100     | Manager, Automotive Service                                 |                                                                                                                                |
|                                                                     | 1213.0101     | Quality Assurance Standards In-Charge                       | Automotive Quality Control Lead Inspector                                                                                      |
|                                                                     | 1213.0200     | Manager, Automotive Service Station                         |                                                                                                                                |
|                                                                     | 1213.0201     | Area Service Manager                                        |                                                                                                                                |
|                                                                     | 1213.0202     | Territory Service Manager                                   |                                                                                                                                |
|                                                                     | 1219.0100     | Manager, Import and Export                                  |                                                                                                                                |
| 122 - Sales, Marketing and Development Managers                     | 1223.0102     | Manager Material Testing                                    | Automotive Robotics System Integrator/Planner                                                                                  |
|                                                                     | 1223.0101     | Manager Testing Facility                                    | Automotive Robotics and Automation Manager<br>Automotive Robotics and Automation Simulation Engineer                           |
| 132 - Manufacturing, Mining, Construction and Distribution Managers | 1321.0600     | Manager, Manufacturing                                      |                                                                                                                                |
| 134 - Professional Services Managers                                | 1349          | Professional Services Managers Not Elsewhere Classified     |                                                                                                                                |
| 142 - Retail and Wholesale Trade Managers                           | 1420.0100     | Manager, Wholesale Trade                                    |                                                                                                                                |
|                                                                     | 1420.0200     | Manager, Retail Trade                                       |                                                                                                                                |
| 143 - Other Services Manager                                        | 1439          | Services Manager Not Elsewhere Classified                   |                                                                                                                                |
| 212-Mathematicians, Actuaries and Statisticians                     | 2120.0300     | Statistician                                                | Automotive Manufacturing Data Science Specialist                                                                               |
| 214 - Engineering Professionals (Excluding Electrotechnology)       | 2141.0100     | Works Inspector, Engineering/Inspection Engineer            |                                                                                                                                |
|                                                                     | 2144.0301     | Equipment Designer                                          | Automotive Production Equipment Design Engineer                                                                                |
|                                                                     | 2144.0700     | Mechanical Engineer, Automobile                             |                                                                                                                                |
|                                                                     | 2144.0800     | Automobile Designer                                         |                                                                                                                                |
|                                                                     | 2144.0803     | Product Design Engineer                                     | Electric Vehicle Product Design Engineer;<br>Automotive Product Design Lead Engineer                                           |
|                                                                     | 2141.2500     | Safety Engineer                                             | Automotive Design Safety Specialist                                                                                            |
|                                                                     | 2144.0801     | Product Design Manager                                      | Automotive Additive Manufacturing Technician<br>Automotive IIOT Application Engineer<br>Automotive IIOT Application Technician |
|                                                                     | 2144.0804     | Prototyping Manager                                         | Automotive Automation and Robotics Engineer<br>Advanced Driver Assistance System (ADAS) Engineer                               |
|                                                                     | 2145.0900     | Technologist, Fuel                                          | Automotive Flex Fuel Engine Designer                                                                                           |
|                                                                     |               |                                                             |                                                                                                                                |
| 215 - Electrotechnology Engineers                                   | 2151.9900     | Electrical Engineers, Other                                 |                                                                                                                                |
|                                                                     | 2151.0602     | Systems Designer (PCB Design)                               | Automotive IIOT Application Specialist<br>Automotive Manufacturing Data Analyst                                                |
|                                                                     | 2152.0902     | Testing and Validation Engineer                             | Automotive Material Testing Incharge                                                                                           |

|                                                           |           |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------|-----------|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 232 - Vocational Education Teachers                       | 2320      | Vocational Education Teachers                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 241 - Finance Professionals                               | 2411      | Accountants                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 2412.9900 | Financial and Investment Advisors, Other               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 2413      | Financial Analysts                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 242 - Administration Professionals                        | 2421.0101 | Analyst-Research                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 2424.0401 | Sales Training Manager                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 2424.0402 | Sales/Service Trainer (Dealer)                         | Automotive Sales Trainer                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 243 - Sales, Marketing and Public Relations Professionals | 2431.0100 | Market Research Analyst                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 2431.0201 | Product Brand Manager (Automotive)                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 252 – Database and Network Professionals                  | 2521.0100 | Database Design Analyst                                | Automotive Data Science Head<br>Automotive Dealership Data Analyst<br>Automotive Dealership Data Science Specialist                                                                                                                                                                                                                                                                                                                                                                    |
|                                                           | 2523.9900 | Computer Network Professionals, Other                  | Automotive Cyber security Engineer<br>Automotive Cyber security Specialist                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                           |           |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           |           |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 264 - Authors, Journalists and Linguists                  | 2642      | Journalists                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 311 - Physical and Engineering Science Technicians        | 3113.0102 | Maintenance Technician Electrical                      | Automotive Maintenance Technician-Electrical<br>Electric Vehicle Maintenance Technician                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                           | 3113.0401 | Machine Maintenance Technician                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 3115.0102 | Maintenance Technician – Mechanical                    | Automotive Maintenance Technician-Mechanical                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                                           | 3115.0103 | Maintenance Technician Assistant – Mechanical          | Automotive Prototype Manufacturing Lead Technician                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                           | 3115.0104 | Body Shop In-Charge                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 3115.0105 | Workshop Manager                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 3115.0201 | Automotive Engineering Technician/Testing Manager      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 3115.0202 | Test Engineer Product/Vehicle                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 3115.0301 | Executive, Proto Manufacturing                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 3115.0501 | Manager Maintenance Mechanical and Electrical          | Automotive Maintenance Lead Technician-Electrical<br>Automotive Maintenance Lead Technician-Mechanical                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                           | 3115.0601 | Master Auto Service Technician/Auto Service Technician |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | 3115.0602 | Auto Service Technical Manager/Auto Service Technician | Heavy Commercial Vehicle Service Technician<br>Automotive Detailer Assistant<br>Automotive Detailer Technician<br>Bicycle Mechanic<br>CNG Kit Fitment Technician<br>Electric Vehicle Service Assistant<br>Electric Vehicle Service Lead Technician<br>Electric Vehicle Service technician<br>Fabrication and Service Technician<br>Four Wheeler Service Assistant<br>Four wheeler Service Lead Technician<br>Four Wheeler Service Master Technician<br>Four Wheeler Service Technician |
|                                                           | 3115.1302 | Tool Room Supervisor                                   | Automotive Tool Room Lead Technician                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                           | 3118.0301 | Draftsman                                              | Automotive CAD Technician<br>Computer Aided Product Design<br>Product Reverse Engineering                                                                                                                                                                                                                                                                                                                                                                                              |
| 312 - Mining, Manufacturing and                           | 3122.0601 | Assembly Line Supervisor                               | Automotive Assembly Lead Technician;                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

|                                               |                                   |                                                                                                                                       |                                                |
|-----------------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Construction Supervisors                      | 3122.2200                         | Plastic Moulding Shop Supervisor                                                                                                      |                                                |
|                                               | 3122.4200                         | Supervisor and Foreman, Welding and Flame Cutting                                                                                     |                                                |
|                                               | 3122.4401                         | Casting Line In-Charge                                                                                                                |                                                |
|                                               | 3122.4501                         | Forging Shop Shift In-Charge                                                                                                          |                                                |
|                                               | 3122.4502                         | Forging Shop Supervisor                                                                                                               |                                                |
|                                               | 3122.4601                         | Press Shop Shift In-Charge                                                                                                            |                                                |
|                                               | 3122.4602                         | Press Shop Supervisor                                                                                                                 |                                                |
|                                               | 3122.4701                         | Welding Machine Setter                                                                                                                | Automotive Welding Machine Master Technician   |
|                                               | 3122.4702                         | Welding Supervisor                                                                                                                    | Automotive Welding Machine Lead Technician     |
|                                               |                                   |                                                                                                                                       | Automotive Welding Machine Trainer             |
|                                               |                                   |                                                                                                                                       | Manufacturing and Mechatronics Lead Technician |
|                                               |                                   |                                                                                                                                       | Fleet Telematic Executive                      |
|                                               | 3122.5300                         | Supervisor and Foreman, Motor Vehicle Repairing                                                                                       |                                                |
| 3122.6502                                     | Product Development Manager       | Automotive Smart Manufacturing Engineer                                                                                               |                                                |
|                                               |                                   | Automotive Smart Manufacturing Specialist                                                                                             |                                                |
|                                               |                                   | Automotive Sustainability Engineer                                                                                                    |                                                |
|                                               |                                   |                                                                                                                                       |                                                |
| 313 - Process Control Technicians             | 3139.1400                         | Robotic Machine Operator                                                                                                              | Industrial Robotic System Integration          |
|                                               |                                   |                                                                                                                                       | Industrial Robotic System Planning             |
|                                               | 3139.1501                         | Auto component Assembly Fitter                                                                                                        |                                                |
|                                               | 3139.2001                         | Assembly Supervisor                                                                                                                   |                                                |
|                                               | 3139.5001                         | Quality Control Inspector                                                                                                             | Automotive Quality Control Assistant           |
|                                               |                                   |                                                                                                                                       | Automotive Quality Control Inspector           |
|                                               |                                   |                                                                                                                                       | Electric Vehicle Quality Control Inspector     |
|                                               | 3139.5002                         | Quality Controller                                                                                                                    | Automotive Service Quality Controller          |
| 3139.9900                                     | Industrial Robot Operators, Other |                                                                                                                                       |                                                |
| 332 - Sales and Purchasing Agents and Brokers | 3321.0101                         | Sales Officer (Auto Insurance)                                                                                                        |                                                |
|                                               | 3321.0102                         | Sales Consultant (Auto Finance)                                                                                                       |                                                |
|                                               | 3322.0801                         | Area Manager (Auto Components)                                                                                                        |                                                |
|                                               | 3322.0802                         | Sales Officer (Auto Components)                                                                                                       |                                                |
|                                               | 3322.1001                         | Territory Sales Manager                                                                                                               |                                                |
|                                               | 3322.1002                         | Territory Sales Manager (Used Vehicles)                                                                                               |                                                |
|                                               | 3322.1101                         | Customer Relationship Manager                                                                                                         | Automotive Customer Relationship Manager       |
|                                               | 3322.1201                         | Regional Sales Manager (Pre-Owned Vehicles)                                                                                           |                                                |
|                                               |                                   |                                                                                                                                       |                                                |
|                                               |                                   |                                                                                                                                       |                                                |
|                                               | 3322.1202                         | Sales Lead (Pre-Owned Vehicles)                                                                                                       |                                                |
|                                               | 3322.1203                         | Sales Consultant (Pre-Owned Vehicles)                                                                                                 |                                                |
|                                               | 3322.1301                         | Sales Manager                                                                                                                         |                                                |
|                                               | 3322.1303                         | Sales Consultant (Retail)                                                                                                             | Automotive Sales Consultant                    |
|                                               |                                   |                                                                                                                                       | Automotive Sales Leader                        |
|                                               | 3322.1304                         | Sales Consultant                                                                                                                      | Automotive Sales Executive                     |
|                                               | 3322.1501                         | Regional Sales Manager (RSM)                                                                                                          |                                                |
| 3322.2501                                     | Service Supervisor                | Automotive Service Supervisor                                                                                                         |                                                |
| 3322.2502                                     | Service Advisor                   | Automotive Service Advisor                                                                                                            |                                                |
| 411 - General Office Clerks                   | 4110.0100                         | Clerk, General                                                                                                                        |                                                |
|                                               | 4110.0200                         | Clerk, Enquiry                                                                                                                        |                                                |
|                                               | 4110.0500                         | Time Keeper                                                                                                                           |                                                |
| 413 - Keyboard Operators                      | 4131                              | Typists and Word Processing Operators                                                                                                 |                                                |
|                                               | 4132                              | Data Entry Clerks                                                                                                                     |                                                |
| 422 - Client Information Workers              | 4226.0201                         | Showroom Hostess/Host<br>(This NCO appears only in NIC 45200 - maintenance & repair of vehicles - occupation does not match industry) | Automotive Showroom Host                       |
| 431 - Numerical Clerks                        | 4311                              | Accounting and Bookkeeping Clerks                                                                                                     |                                                |
|                                               | 4312                              | Statistical Finance and Insurance Clerks                                                                                              |                                                |
|                                               | 4313                              | Payroll Clerks                                                                                                                        |                                                |
| 432 - Material Recording and Transport Clerks | 4321.0101                         | Spare Parts Operations Executive                                                                                                      | Automotive Spare Parts Operations Assistant    |
|                                               | 4321.0501                         | Store Ops Assistant                                                                                                                   |                                                |
|                                               | 4321.0601                         | Warehouse Picker                                                                                                                      |                                                |



|                                                                                     |           |                                                                                           |                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------|-----------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                     | 4321.0701 | Warranty Processor                                                                        | Automotive Warranty Processor                                                                                                                                                                                                                    |
| 441 - Other Clerical Support Workers                                                | 4413      | Coding, Proofreading and Related Clerks                                                   |                                                                                                                                                                                                                                                  |
|                                                                                     | 4415      | Filing and Copying Clerks                                                                 |                                                                                                                                                                                                                                                  |
|                                                                                     | 4416      | Personnel Clerks                                                                          |                                                                                                                                                                                                                                                  |
|                                                                                     | 4419      | Clerical Support Workers Not Elsewhere Classified                                         |                                                                                                                                                                                                                                                  |
| 512 – Cooks                                                                         | 5120.0200 | Cook, Institutional                                                                       |                                                                                                                                                                                                                                                  |
| 515 - Building and Housekeeping Supervisors                                         | 5151.0201 | Janitor/Housekeeping Attendant                                                            |                                                                                                                                                                                                                                                  |
| 516 - Other Personal Service Workers                                                | 5165      | Driving Instructors                                                                       | Driver Trainer-LMV (NCO-2015/5165.0101)                                                                                                                                                                                                          |
| 521 - Street and Market Salespersons                                                | 5211.0300 | Telemarketing Sales Person/Telemarketing Sales Operator                                   |                                                                                                                                                                                                                                                  |
|                                                                                     | 5211.0301 | Sales Executive – Dealership                                                              | Automotive Sales Assistant                                                                                                                                                                                                                       |
|                                                                                     | 5211.0302 | Telecaller                                                                                | Automotive Telecaller                                                                                                                                                                                                                            |
| 522 - Shop Salespersons                                                             | 5223.0105 | Trainee Associate                                                                         |                                                                                                                                                                                                                                                  |
| 524 - Other Sales Workers                                                           | 5242.0102 | Sales Associate                                                                           |                                                                                                                                                                                                                                                  |
|                                                                                     | 5242.0201 | Customer Care Executive (Relationship Centre)                                             |                                                                                                                                                                                                                                                  |
|                                                                                     | 5242.0301 | Customer Care Executive (Repair Centre)                                                   |                                                                                                                                                                                                                                                  |
|                                                                                     | 5242.0401 | In-Store Promoter                                                                         |                                                                                                                                                                                                                                                  |
|                                                                                     | 5244.0103 | Customer Relation Executive                                                               |                                                                                                                                                                                                                                                  |
|                                                                                     | 5249.0101 | Key Account Service Manager                                                               |                                                                                                                                                                                                                                                  |
|                                                                                     | 5249.0201 | Commercial Manager (Zonal/Regional)                                                       |                                                                                                                                                                                                                                                  |
|                                                                                     | 5249.0202 | Commercial Executive/Officer                                                              |                                                                                                                                                                                                                                                  |
|                                                                                     | 5249.0301 | Salesman, Retail Trade                                                                    |                                                                                                                                                                                                                                                  |
| 541 - Protective Service Workers                                                    | 5411      | Fire Fighters                                                                             |                                                                                                                                                                                                                                                  |
|                                                                                     | 5414      | Security Guards                                                                           |                                                                                                                                                                                                                                                  |
|                                                                                     | 5419      | Protective Services Workers Not Elsewhere Classified                                      |                                                                                                                                                                                                                                                  |
| 713 - Painters, Builders, Structure Cleaners and Related Trades Workers             | 7132.0202 | Auto Spray Painter/Painter                                                                |                                                                                                                                                                                                                                                  |
|                                                                                     | 7132.0203 | Auto Body Painting Technician – Surface Treatment                                         | Automotive Body Painting Technician<br>Automotive Body Painting Operator                                                                                                                                                                         |
|                                                                                     | 7132.0204 | Automotive Body Painting Technician                                                       |                                                                                                                                                                                                                                                  |
|                                                                                     | 7132.0205 | Auto Spray Painter Assistant/Painter                                                      |                                                                                                                                                                                                                                                  |
|                                                                                     | 7132.0300 | Metal Sprayer                                                                             | Automotive Paint Repair Assistant<br>Automotive Paint Repair Technician                                                                                                                                                                          |
|                                                                                     | 7132.0901 | Automotive Paint Shop Assistant                                                           | Automotive Paint Shop Assistant                                                                                                                                                                                                                  |
|                                                                                     | 7211.0101 | Press Shop Operator                                                                       | Automotive Press Shop Technician                                                                                                                                                                                                                 |
|                                                                                     | 7211.0102 | Press Shop Assistant/Helper                                                               | Automotive Press Shop Assistant                                                                                                                                                                                                                  |
| 721 - Sheet and Structural Metal Workers, Moulders and Welders, and Related Workers | 7211.0201 | Casting Technician – Sand Moulding                                                        | Automotive Casting Technician                                                                                                                                                                                                                    |
|                                                                                     | 7212.0301 | Welder                                                                                    |                                                                                                                                                                                                                                                  |
|                                                                                     | 7212.0302 | Welding Technician                                                                        | Automotive Welding Machine Technician                                                                                                                                                                                                            |
|                                                                                     | 7212.0303 | Gas Metal Arc Welder/Metal Inert Gas/Metal Active Gas/Gas Metal Arc Welder (MIG/MAG/GMAW) | Automotive Welding Machine Operator (Manual and Robotics)                                                                                                                                                                                        |
|                                                                                     | 7212.0801 | Welding Assistant                                                                         | Automotive Welding Machine Assistant                                                                                                                                                                                                             |
|                                                                                     | 7213.0201 | Auto Engine Repair Technician                                                             | Automotive Engine Repair Technician<br>Automobile Lead Technician (Diagnostics)<br>Automobile Technician (Diagnostics)<br>Automotive Open System (AUTOSAR) Engineer<br>Automotive Unified Diagnostics Engineer<br>End of Life Vehicle Dismantler |
|                                                                                     | 7213.0301 | Dent Remover/Auto Body Repair Technician/ Denter                                          | Automotive Body Repair Assistant                                                                                                                                                                                                                 |
|                                                                                     | 7213.0302 | Auto Body Technician/Denter                                                               | Automotive Body Repair Technician                                                                                                                                                                                                                |
|                                                                                     | 7221.0301 | Forging Operator                                                                          | Automotive Forging Technician                                                                                                                                                                                                                    |



|                                                                      |           |                                                                |                                                     |
|----------------------------------------------------------------------|-----------|----------------------------------------------------------------|-----------------------------------------------------|
| 722 - Blacksmiths, Tool Makers and Related Trades Workers            | 7222.0200 | Tool Maker                                                     | Automotive Tool Room Technician                     |
|                                                                      | 7223.0401 | Assembly Line Machine Setter                                   | Automotive Assembly Master Technician               |
|                                                                      | 7222.0500 | Die Maker                                                      |                                                     |
|                                                                      | 7223.0501 | Machine Shop Master Technician/Setter                          | Automotive Machining Master Technician              |
|                                                                      |           |                                                                | Automotive Machining Trainer                        |
|                                                                      | 7223.0502 | Machine Shop Supervisor                                        | Automotive Machining Lead Technician                |
|                                                                      | 7223.0601 | Turner/Conventional Turning                                    | Automotive Conventional Machining Technician        |
|                                                                      | 7223.5001 | Machining Technician/CNC Operator                              | Automotive Machining Operator                       |
|                                                                      | 7223.5002 | CNC Operator – Machining Technician                            | Automotive CNC Machining Technician                 |
| 723 - Machinery Mechanics and Repairers                              | 7223.5003 | CNC Operator-Machinist                                         |                                                     |
|                                                                      | 7231.01   | Mechanic, Automobile                                           |                                                     |
|                                                                      | 7231.0101 | Maintenance Technician – Service Workshop                      | Automobile Jr. Technician (Service and Maintenance) |
|                                                                      |           |                                                                | Automotive AC Technician                            |
|                                                                      | 7231.0102 | AC Specialist                                                  |                                                     |
|                                                                      | 7231.0103 | Automotive Body Technician Level 3                             |                                                     |
|                                                                      | 7231.0104 | Automotive Body Technician Level 4                             |                                                     |
|                                                                      | 7231.0105 | Brake Specialist                                               |                                                     |
|                                                                      | 7231.0106 | Clutch Specialist                                              |                                                     |
|                                                                      | 7231.0107 | Auto Service Technician – Mechanic                             |                                                     |
|                                                                      | 7231.0108 | Auto Service Technician – Helper                               |                                                     |
|                                                                      | 7231.0200 | Engine Tester                                                  |                                                     |
|                                                                      | 7231.0201 | Test Technician                                                | Automotive Product Testing Technician               |
|                                                                      |           |                                                                | Electric Vehicle Test Engineer                      |
|                                                                      | 7231.0400 | Fitter Automobile                                              |                                                     |
|                                                                      | 7231.0900 | Cleaner Motor Vehicle                                          |                                                     |
|                                                                      | 7231.9900 | Motor Vehicle Mechanics, Other                                 |                                                     |
| 731 - Handicraft Workers                                             | 7233.1200 | Millwright                                                     |                                                     |
|                                                                      | 7233.2901 | Fitter: Hydraulic and Pneumatic System                         |                                                     |
| 741 - Electrical Equipment Installers and Repairers                  | 7316.1200 | Sign Writer, Decorative Painters, Engravers and Etchers, Other |                                                     |
|                                                                      | 7412.0101 | Automation Specialist                                          | Automotive Automation Specialist                    |
|                                                                      |           |                                                                | Automotive Additive Manufacturing Operator          |
|                                                                      | 7412.0701 | Electrician, Automobile                                        | Automotive Electrician                              |
|                                                                      | 7412.0801 | Maintenance Assistant/Helper                                   | Automotive Maintenance Assistant                    |
| 742 - Electronics and Telecommunication Installers and Repairers     | 7419.0500 | Battery Servicing Man                                          |                                                     |
|                                                                      | 7421.0101 | Iron and Steel Fitter: Electronic Assembly                     |                                                     |
| 752 - Wood Treathers, Cabinet Makers and Related Trades Workers      | 7522.0600 | Body Builder, Automobile                                       |                                                     |
| 753 - Garment and Related Trades Workers                             | 7534.0300 | Upholsterer, Vehicle                                           |                                                     |
| 754 - Other Craft and Related Workers                                | 7543.0701 | Incoming QC Technician                                         |                                                     |
|                                                                      | 7543.2001 | Quality Inspector-forged, casted or machined components        |                                                     |
| 811 - Mining and Mineral Processing Plant Operators                  | 8111.0200 | Driller, Machine                                               |                                                     |
| 812 - Metal Processing and Finishing Plant Operators                 | 8121.3701 | Heat Treating Furnace Operator                                 | Automotive Heat Treatment Technician                |
|                                                                      | 8121.3801 | Assistant Casting Technician                                   | Automotive Casting Operator                         |
|                                                                      | 8121.4200 | Die Casting Machine Operator                                   |                                                     |
|                                                                      | 8121.4201 | Pressure Die Casting (PDC) Operator                            |                                                     |
|                                                                      | 8121.4300 | Casting Machine Operator (Non-Ferrous Metal)                   |                                                     |
| 813 - Chemical and Photographic Products Plant and Machine Operators | 8131.2200 | Heat Treater                                                   |                                                     |
| 814 - Rubber, Plastic and Paper Products Machine Operators           | 8141.1703 | Tyre Building Operator – Passenger Vehicles                    |                                                     |
|                                                                      | 8141.1801 | Tyre Moulding Operator                                         |                                                     |
|                                                                      | 8141.2100 | Tyre Repairer                                                  |                                                     |

|                                                                |           |                                                                         |                                                                               |
|----------------------------------------------------------------|-----------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------|
|                                                                | 8142.1100 | Printing Machine Operator                                               | Automotive Additive Manufacturing Engineer                                    |
|                                                                | 8142.1301 | Plastic Moulding Technician or Operator                                 | Automotive Plastic Moulding Assistant; Automotive Plastic Moulding Technician |
| 815 - Textile, Fur and Leather Products Machine                | 8153.0101 | Sewing Machine Operator, General                                        |                                                                               |
| 817 - Wood Processing and Papermaking Plant Operators          | 8172.9900 | Wood Processing Plant Operators and Related Workers, Other              |                                                                               |
| 818 - Other Stationary Plant and Machine Operators             | 8183.0100 | Building Insulator, Machine                                             |                                                                               |
| 821 – Assemblers                                               | 8211.1000 | Mechanist, General/Machinist                                            | Front line Production Resource                                                |
|                                                                | 8211.1200 | Assembler, Automobile                                                   | Automotive Assembly Assistant                                                 |
|                                                                |           |                                                                         | Machining and Assembly Technician                                             |
|                                                                |           |                                                                         | Electric Vehicle Assembly Operator                                            |
|                                                                |           |                                                                         | Electric Vehicle Assembly Technician                                          |
|                                                                |           |                                                                         | Automotive Assembly Operator                                                  |
|                                                                |           |                                                                         | Automotive Assembly Technician                                                |
|                                                                | 8211.1201 | Vehicle Assembly Fitter                                                 |                                                                               |
|                                                                | 8212.0100 | Battery Assembler                                                       | Automotive Battery Management System (BMS) Engineer                           |
|                                                                |           |                                                                         | Automotive Electric Vehicle BSS (Battery Swapping System) Planning Engineer   |
| 832 - Car, Van and Motorcycle Drivers                          | 8322.0102 | Chauffer, Cab Driver                                                    | Chauffeur                                                                     |
|                                                                |           |                                                                         | Commercial Vehicle Driver                                                     |
| 833 - Heavy Truck and Bus Drivers                              | 8331.0500 | Driver Road Test                                                        |                                                                               |
|                                                                | 8331.0501 | Test Driver                                                             |                                                                               |
|                                                                | 8332      | Heavy Truck and Lorry Drivers                                           |                                                                               |
| 834 - Mobile Plant Operators                                   | 8344.0201 | Fork Lift Truck Operator                                                | Forklift Operator/Driver                                                      |
|                                                                | 8344.9900 | Lift Truck Operator, Other                                              |                                                                               |
| 835 - Ships' Deck Crews and Related Workers                    | 8350.0500 | Driver, Launch/Tug Master                                               |                                                                               |
| 911 - Domestic, Hotel and Office Cleaners and Helpers          | 9112.0100 | Dusting Man, Office; Farash, Office/Housekeeping Attendant              |                                                                               |
|                                                                | 9112.9900 | Helpers and Cleaners in Offices, Hotels and Other Establishments, Other |                                                                               |
| 912 - Vehicle, Window, Laundry and Other Hand Cleaning Workers | 9122.0201 | Washer                                                                  | Automotive Washer                                                             |
|                                                                | 9122.0301 | Driving Assistant                                                       | Driving Assistant                                                             |
|                                                                | 9122.9900 | Vehicle, Window and Related Cleaners, Other                             |                                                                               |
| 932 - Manufacturing Labourers                                  | 9321.0101 | Packer, Hand                                                            | Automotive Packing Assistant                                                  |
|                                                                | 9321.1401 | Machining Assistant or Helper                                           | Automotive Machining Assistant                                                |
|                                                                | 9321.9900 | Hand Packers, Others                                                    |                                                                               |
|                                                                | 9329.0701 | Accessory Fitter                                                        | Automotive Accessory Fitter                                                   |
|                                                                | 9329.0801 | Parts Picker                                                            | Automotive Material Handling Operator                                         |
| 933 – Transport & Storage Labourers                            | 9331.0300 | Hand Cartman                                                            |                                                                               |
|                                                                | 9333.0101 | Loader/Loading and Unloading Operator                                   | Automotive Material Handling Assistant                                        |
| 951 - Street and Related Service Workers                       |           |                                                                         |                                                                               |
| 961 - Refuse Workers                                           | 9611.9900 | Garbage Collectors, Other                                               |                                                                               |
|                                                                |           |                                                                         |                                                                               |
|                                                                | 9613      | Sweepers and Related Labourers                                          |                                                                               |
| 962 – Other Elementary Workers                                 | 9623.0401 | PUC Attendant                                                           |                                                                               |
|                                                                | 9623.0501 | Tyre Inflation Attendant                                                |                                                                               |
|                                                                | 9623.0601 | Quick Care Point Attendant                                              |                                                                               |

*Sources:*

1. Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022-June 2023. Document No.: DDI-IND-CSO-PLFS-2022-23. <https://microdata.gov.in/nada43/index.php/catalog/179>.
2. National Career Service. Directorate General of Employment, Ministry of Labour and Employment, Government of India. [https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20\\_Vol%20I-%202015.pdf](https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20_Vol%20I-%202015.pdf).
3. Automotive Skills Development Council. <https://www.asdc.org.in/>

## Annexure 8.1: Occupations and Job Roles in Solar Electricity Generation

| <b>3 Digit NCO</b>                                                  | <b>Four/Eight Digit NCO</b> | <b>NCO Description</b>                                               | <b>SCGJ Job Role</b>                                      |
|---------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------|-----------------------------------------------------------|
| 121-Business Services and Administration Managers                   | 1211.9900                   | Finance Managers, Others                                             |                                                           |
|                                                                     | 1212                        | Human Resource Managers                                              |                                                           |
|                                                                     | 1219.0100                   | Manager, Import and Export                                           |                                                           |
| 132 - Manufacturing, Mining, Construction and Distribution Managers | 1323.0100                   | Manager, Construction/Manager Construction Projects                  | Solar PV Project Manager (E&C)                            |
| 214 - Engineering Professionals (Excluding Electrotechnology)       | 2141.0200                   | Instrument Engineer/Instrumentation Engineer                         |                                                           |
|                                                                     | 2141.0300                   | Industrial Engineer                                                  |                                                           |
|                                                                     | 2142.0100                   | Civil Engineer, General                                              |                                                           |
|                                                                     | 2142.0300                   | Civil Engineer, Structural                                           |                                                           |
|                                                                     | 2143.0100                   | Solar Energy System Designer                                         | Solar PV Designer                                         |
|                                                                     | 2144.0100                   | Mechanical Engineer, General                                         |                                                           |
|                                                                     | 2144.0300                   | Tool Engineer                                                        | Solar PV Structural Assistant Design Engineer             |
|                                                                     | 2144.0500                   | Mechanical Engineer, Structural                                      |                                                           |
|                                                                     | 2144.0600                   | Mechanical Engineer, Maintenance                                     |                                                           |
|                                                                     | 2144.1401                   | Service Engineer - Installation                                      |                                                           |
|                                                                     | 2144.1402                   | Service Engineer - Installation and Commissioning                    |                                                           |
| 215 - Electrotechnology Engineers                                   | 2151.0100                   | Electrical Engineer, General                                         | Rooftop Solar Grid Engineer                               |
| 241 - Finance Professionals                                         | 2411                        | Accountants                                                          |                                                           |
|                                                                     | 2412.0200                   | Financial Analyst                                                    | Solar Proposal Evaluation Specialist                      |
|                                                                     | 2412.0300                   | Budget Analyst                                                       |                                                           |
| 243 - Sales, Marketing and Public Relations Professionals           | 2431.0501                   | Market Research Associate – Sales & Marketing/Business Development   | Solar Photovoltaic Entrepreneur                           |
|                                                                     | 2433.0501                   | Sales Executive - Solar Electronics                                  |                                                           |
|                                                                     | 2433.0601                   | Business Development Executive                                       | Solar PV Business Development Executive                   |
| 311 - Physical and Engineering Science Technicians                  | 3112.9900                   | Civil Engineering Technicians, Other                                 | Solar PV Installer - Civil                                |
|                                                                     | 3113.0101                   | Electrical Engineering, Technician/Maintenance Technician Electrical | Junior Technician- Solar EV Charging Station              |
|                                                                     | 3113.0901                   | Cluster In-Charge                                                    | Solar EV Charging Entrepreneur                            |
| 312 - Mining, Manufacturing and Construction Supervisors            | 3122                        | Manufacturing Supervisors                                            |                                                           |
|                                                                     | 3123.0400                   | Electrical Supervisor, Wiring                                        |                                                           |
| 334 - Administrative and Specialised Secretaries                    |                             |                                                                      |                                                           |
| 411 - General Office Clerks                                         |                             |                                                                      |                                                           |
| 413 - Keyboard Operators                                            | 4131.0600                   | Computer Operator                                                    |                                                           |
|                                                                     | 4132                        | Data Entry Clerks                                                    |                                                           |
| 431 - Numerical Clerks                                              |                             |                                                                      |                                                           |
| 441 - Other Clerical Support Workers                                |                             |                                                                      |                                                           |
| 524 - Other Sales Workers                                           | 5242.0101                   | Technical Demonstrator (Sale)/Area Technical Lead                    |                                                           |
|                                                                     | 5249                        | Sales Workers Not Elsewhere Classified                               |                                                           |
| 541 - Protective Service Workers                                    | 5411                        | Fire Fighters                                                        |                                                           |
|                                                                     | 5414.0101                   | Security Officer                                                     |                                                           |
|                                                                     | 5414.0102                   | Assignment Manager                                                   |                                                           |
|                                                                     | 5414.0111                   | Security Supervisor                                                  |                                                           |
|                                                                     | 5414.0121                   | CCTV Supervisor                                                      |                                                           |
|                                                                     | 5414.0151                   | Armed Security Guard                                                 |                                                           |
|                                                                     | 5414.0400                   | Watchman                                                             |                                                           |
|                                                                     | 5414.0501                   | Gateman/Unarmed Security Guard                                       |                                                           |
| 611 - Market Gardeners & Crop Growers                               | 6111.1300                   | Cultivator, Vegetables                                               | Solar Cold Storage Entrepreneur                           |
| 712 - Building Finishers and Related Trades Workers                 | 7127.0100                   | Mechanic, Refrigeration and Air-Conditioning                         | Junior Technician- Solar Cold Storage                     |
| 731 - Handicraft Workers                                            | 7311.0101                   | Technician Instrumentation                                           | Solar PV Maintenance Technician-Electrical (Ground Mount) |
|                                                                     | 7411.0100                   | Electrician, General                                                 | Solar Lighting Assembler                                  |

| <b>3 Digit NCO</b>                                               | <b>Four/Eight Digit NCO</b> | <b>NCO Description</b>                                          | <b>SCGJ Job Role</b>                                    |
|------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------|---------------------------------------------------------|
| 741 - Electrical Equipment Installers and Repairers              | 7412.0200                   | Electrical Fitter                                               |                                                         |
|                                                                  | 7413.0100                   | Lineman, Light and Power                                        |                                                         |
|                                                                  | 7413.9900                   | Electrical Line Installers, Repairers and Cable Jointers, Other |                                                         |
| 742 - Electronics and Telecommunication Installers and Repairers | 7421.1401                   | Solar Panel Installation Technician                             | Solar PV Installer (Suryamitra)                         |
|                                                                  |                             |                                                                 | Solar PV Installer – Electrical                         |
|                                                                  |                             |                                                                 | Agrivoltaics Installer Electrical                       |
|                                                                  | 7421.1402                   | Solar Photo Voltaic System Installation Technician              | Solar Photovoltaic Technician                           |
|                                                                  | 7421.1403                   | PV System Installation Engineer                                 | Solar PV Engineer (Solar Water Pumping Junior Engineer) |
|                                                                  | 7422.1801                   | Site Surveyor/R F Site Surveyor                                 | Solar PV Site Survey Assistant                          |
|                                                                  | 7422.1901                   | Assembly Line Operator                                          | Solar PV Cell Manufacturing Technician                  |
| 821 - Assemblers                                                 | 8212.0400                   | Assembler, Electrical Accessories                               | Solar PV Module Manufacturing Technician                |
|                                                                  | 8212.9900                   | Electrical and Electronic Equipment Assemblers, Other           | Solar Manufacturing - Junior Technician                 |
| 931 - Mining and Construction Labourers                          | 9313.0501                   | Helper Electrician                                              | Solar Domestic Product Assembler                        |
|                                                                  |                             |                                                                 | Solar PV Installation Helper / Solar PV Project Helper  |

Sources: NCAER analysis using information.

1. Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022-June 2023. Document No.: DDI-IND-CSO-PLFS-2022-23. <https://microdata.gov.in/nada43/index.php/catalog/179>.
2. National Career Service. Directorate General of Employment, Ministry of Labour and Employment, Government of India. National Classification Of Occupations-2015 (Code Structure).
3. Skill Council for Green Jobs website. <https://sscgj.in/>

## Annexure 8.2: Occupations and Job Roles in Electricity Generation using Other non-Conventional Sources (for Wind)

| <b>3 Digit NCO</b>                                       | <b>Four/Eight Digit NCO</b> | <b>NCO Description</b>                                                                                                                                          | <b>SCGJ Job Role</b>                                          |
|----------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| 216 - Architects, Planners, Surveyors and Designers      | 2165.9900                   | Cartographers and Surveyors, Other                                                                                                                              | Wind Resource Assessor and Site Surveyor-Wind Power Plant     |
| 311 - Physical and Engineering Science Technicians       | 3113.0102                   | Maintenance Technician Electrical                                                                                                                               | O&M Electrical & Instrumentation Technician –Wind Power Plant |
|                                                          | 3115.0101                   | Mechanical Engineering Technician/Supervisor R&D Testing                                                                                                        | Construction Technician- Wind Power Plant                     |
|                                                          | 3115.0102                   | Maintenance Technician – Mechanical                                                                                                                             | O&M Mechanical Technician - Wind Power Plant                  |
|                                                          | 3115.0501                   | Manager Maintenance Mechanical & Electrical                                                                                                                     | CMS Engineer - Wind Power Plant                               |
| 312 - Mining, Manufacturing and Construction Supervisors | 3122.1400                   | Supervisor and Foreman, Petroleum Refining and Related Activities/ Operator/ Engineering Assistant (Mechanical/ Electrical/ Civil/ Chemical) Related Activities | Project Assistant Planner - Wind Power Plant                  |
|                                                          | 3122.4300                   | Supervisor and Foreman, Sheet and Structural Metal Working                                                                                                      |                                                               |
|                                                          | 3122.9900                   | Manufacturing Supervisors, Other                                                                                                                                |                                                               |
|                                                          | 3123.0100                   | Work Supervisor, Construction                                                                                                                                   |                                                               |
| 411 - General Office Clerks                              | 4110.0100                   | Clerk, General                                                                                                                                                  |                                                               |
| 832 - Car, Van and Motorcycle Drivers                    | 8321                        | Motorcycle Drivers                                                                                                                                              |                                                               |
|                                                          | 8322                        | Car, Taxi and Van Drivers                                                                                                                                       |                                                               |
| 932 - Manufacturing Labourers                            | -                           | -                                                                                                                                                               |                                                               |
| 962 - Other Elementary Workers                           | -                           | -                                                                                                                                                               |                                                               |

Sources: NCAER analysis using information from:

1. Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022-June 2023. Document No.: DDI-IND-CSO-PLFS-2022-23. <https://microdata.gov.in/nada43/index.php/catalog/179>.
2. National Career Service. Directorate General of Employment, Ministry of Labour and Employment, Government of India. National Classification of Occupations-2015 (Code Structure).
3. Skill Council for Green Jobs website. <https://sscgi.in/>

## Annexure 9.1: Occupations in the Retail Sector

| <b>NCO 2015 code</b> | <b>Job description NCO 2015</b>                                            | <b>Mapped RASCI Occupations</b>                             | <b>RASCI QP Code &amp; Model Curriculum developed (Y/N)</b> |
|----------------------|----------------------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| 522                  | Shop Salespersons (76% jobs in this NCO group)                             |                                                             |                                                             |
| 5221                 | Shopkeepers                                                                | Direct Seller                                               | Yes                                                         |
| 5222                 | Shop Supervisors                                                           | Retail Team Leader                                          | Yes                                                         |
| 5222.0100            | Sales Supervisor,                                                          |                                                             |                                                             |
| 5222.0101            | Area Parts Manager (APM)                                                   |                                                             |                                                             |
| 5222.0201            | Sales Supervisor, Retail Trade/CRM Manager                                 | Retail Store Manager/Assistant Store Manager                | Yes                                                         |
| 5223                 | Shop Sales Assistants                                                      | Retail Store Ops Assistant                                  | Yes                                                         |
| 5223.0100            | Shop Assistant                                                             | Retail Sales Associate                                      | Yes                                                         |
| 5223.0101            | Order Processor                                                            | Digital Cataloguer                                          | Yes                                                         |
| 5223.0102            | Jewellery Retail Sales Associate (Basic)                                   | Retail Merchandising Executive                              | Yes                                                         |
| 5223.0103            | Jewellery Retail Sales Associate (Advanced)                                |                                                             |                                                             |
| 5223.0104            | Plumbing Products Sales Assistant                                          |                                                             |                                                             |
| 5223.0105            | Trainee Associate                                                          | Retail Trainee Associate                                    | Yes                                                         |
| 521                  | Street and Market Salespersons (8% jobs)                                   |                                                             |                                                             |
| 5211                 | Stall and Market Salespersons                                              |                                                             |                                                             |
| 5211.0100            | Advertising Sales Agent/Advertising Executive                              |                                                             |                                                             |
| 5211.0200            | Shop Attendant/Sales Assistant                                             |                                                             |                                                             |
| 5211.0300            | Telemarketing Sales Person/Telemarketing Sales Operator                    |                                                             |                                                             |
| 5211.0301            | Sales Executive- Dealership                                                |                                                             |                                                             |
| 5211.0302            | Tele caller                                                                | Merchant Relationship Executive                             | Yes                                                         |
| 5211.9900            | Stall and Market Salespersons, Other                                       |                                                             |                                                             |
| 5212                 | Street Food Salespersons                                                   |                                                             |                                                             |
| 5212.0100            | Milkman                                                                    |                                                             |                                                             |
| 5212.9900            | Street Food Vendors, Other/Khomchawala, Dhabawala, Chat Thelawala          |                                                             |                                                             |
| 112                  | Managing Directors and Chief Executives (6% jobs)                          |                                                             |                                                             |
| 1120.2200            | Director, Retail Trade                                                     | Business Leader/Multi-outlet Retailer/Director retail trade | Yes                                                         |
| 1120.2700            | Working Proprietor, Storage and Warehousing                                |                                                             |                                                             |
| 1120.2800            | Director, Storage and Warehousing                                          |                                                             |                                                             |
| 1120.3000            | Director, Lodging and Catering Services/Director Food and Beverage Service |                                                             |                                                             |
| 952                  | Street Vendors (Excluding Food)                                            |                                                             |                                                             |
| 9520                 | Street Vendors (Excluding Food)                                            |                                                             |                                                             |
| 9520.0100            | Hawker                                                                     |                                                             |                                                             |
| 9520.9900            | Street Vendors, Non-Food Products, Other                                   |                                                             |                                                             |
| 524                  | Other Sales Workers                                                        |                                                             |                                                             |
| 5242                 | Sales Demonstrators                                                        |                                                             |                                                             |
| 5242.0101            | Technical Demonstrator (Sale)/Area Technical Lead                          |                                                             |                                                             |
| 5242.0102            | Sales Associate                                                            |                                                             |                                                             |

| <b>NCO 2015 code</b> | <b>Job description NCO 2015</b>                                | <b>Mapped RASCI Occupations</b>                | <b>RASCI QP Code &amp; Model Curriculum developed (Y/N)</b> |
|----------------------|----------------------------------------------------------------|------------------------------------------------|-------------------------------------------------------------|
| 5242.0201            | Customer Care Executive (Relationship Centre)                  | Customer Service Representative                | Yes                                                         |
| 5242.0401            | In-Store Promoter                                              |                                                |                                                             |
| 5242.9900            | Sales Demonstrators, Other                                     |                                                |                                                             |
| 5243                 | Door-to-Door Salespersons                                      |                                                |                                                             |
| 5243.0300            | Home Deliveryman                                               |                                                |                                                             |
| 5243.0401            | Distributor Sales Representative                               | Distributor Salesman                           | Yes                                                         |
| 5243.0501            | Field Sales Executive (FSE)                                    |                                                |                                                             |
| 5244                 | Contact Centre Salespersons                                    |                                                |                                                             |
| 5244.0101            | CRM Domestic Voice                                             |                                                |                                                             |
| 5244.0102            | Associate CRM                                                  |                                                |                                                             |
| 5244.0103            | Customer Relation Executive                                    | Customer Service Associate                     | Yes                                                         |
| 5244.0201            | CRM Domestic Non-Voice                                         |                                                |                                                             |
| 5244.0202            | Associate Customer Care (Non-Voice)                            |                                                |                                                             |
| 5244.0301            | Customer Care Executive                                        |                                                |                                                             |
| 5244.0302            | Remote Helpdesk Technician                                     |                                                |                                                             |
| 5245                 | Service Station Attendants                                     |                                                |                                                             |
| 5245.0101            | Petrol Pump Salesman/Fuel Serviceman/Fuel Dispensing Attendant |                                                |                                                             |
| 5246                 | Food Service Counter Attendants                                |                                                |                                                             |
| 5249                 | Sales Workers Not Elsewhere Classified                         |                                                |                                                             |
| 5249.0101            | Key Account Service Manager                                    | Retail Cashier/Store Accountant                | Yes                                                         |
| 5249.0301            | Salesman, Retail Trade                                         |                                                |                                                             |
| 5249.0400            | Wholesale Dealer                                               |                                                |                                                             |
| 5249.0500            | Retail Dealer                                                  | Retail Departmental Manager                    | Yes                                                         |
| 5249.0600            | Selling Agent                                                  |                                                |                                                             |
| 5249.0700            | Stockist                                                       |                                                |                                                             |
| 121                  | Business Services and Administration Managers                  |                                                |                                                             |
| 1211                 | Finance Managers                                               |                                                |                                                             |
| 1212                 | Human Resource Managers                                        |                                                |                                                             |
| 1213.0101            | Quality Assurance Standards In-Charge                          |                                                |                                                             |
| 1213.0102            | Manager Customer Quality                                       |                                                |                                                             |
| 1213.0201            | Area Service Manager                                           |                                                |                                                             |
| 1213.0202            | Territory Service Manager                                      |                                                |                                                             |
| 1213.9900            | Managers, Other Services                                       |                                                |                                                             |
| 122                  | Sales, Marketing and Development Managers                      | Digital Marketing Manager/Marketing Specialist | Yes                                                         |
| 1221                 | Sales and Marketing Managers                                   |                                                |                                                             |
| 1221.0200            | Sales Manager (Retail Trade)                                   |                                                |                                                             |
| 1221.0301            | Home Delivery Manager                                          |                                                |                                                             |
| 1222                 | Advertising and Public Relation Managers                       |                                                |                                                             |
| 1222.0100            | Manager, Advertising and Promotion                             |                                                |                                                             |
| 1222.0102            | Advertising Operations Coordinator (Digital)                   |                                                |                                                             |

| <b>NCO 2015 code</b>                                                                                      | <b>Job description NCO 2015</b>                             | <b>Mapped RASCI Occupations</b>                                                   | <b>RASCI QP Code &amp; Model Curriculum developed (Y/N)</b> |
|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------|
| 1223                                                                                                      | Research and Development Managers                           |                                                                                   |                                                             |
| 1223.0101                                                                                                 | Manager Testing Facility                                    |                                                                                   |                                                             |
| 1223.0102                                                                                                 | Manager Material Testing                                    |                                                                                   |                                                             |
| 1223.0201                                                                                                 | Research Associate                                          |                                                                                   |                                                             |
| 142                                                                                                       | Retail and Wholesale Trade Managers                         |                                                                                   |                                                             |
| 1420.0200                                                                                                 | Manager, Retail Trade                                       |                                                                                   |                                                             |
| 1420.0500                                                                                                 | General Manager, Retail Trade, Senior Manager, Retail Trade |                                                                                   |                                                             |
| 523                                                                                                       | Cashiers and Ticket Clerks                                  |                                                                                   |                                                             |
| 5230                                                                                                      | Cashiers and Ticket Clerks                                  |                                                                                   |                                                             |
| 751                                                                                                       | Food Processing and Related Trade Workers                   |                                                                                   |                                                             |
| 7515                                                                                                      | Food and Beverage Tasters and Graders                       |                                                                                   |                                                             |
| 753                                                                                                       | Garment and Related Trades Workers                          |                                                                                   |                                                             |
| 7531                                                                                                      | Tailors, Dressmakers, Furriers and Hatters                  |                                                                                   |                                                             |
| 7532                                                                                                      | Garment and Related Pattern Makers and Cutters              |                                                                                   |                                                             |
| 2513                                                                                                      | Web and Multimedia Developers                               | Web Developer/Online or Web Analytics Manager/ Business Analyst/Virtual Assistant | No                                                          |
| 432                                                                                                       | Material Recording and Transport Clerks                     |                                                                                   |                                                             |
| 4321.0102                                                                                                 | Inventory Clerk                                             | Inventory Management Executive                                                    | Yes                                                         |
| 4321.0103                                                                                                 | Inventory Manager                                           | Inventory Control Specialist                                                      | Yes                                                         |
| 1324                                                                                                      | Supply, Distribution and Related Managers                   | Distribution Manager /Warehouse Manager                                           | Yes                                                         |
| 332                                                                                                       | Sales and Purchasing Agents and Brokers                     |                                                                                   |                                                             |
| 3323.0601                                                                                                 | Associate Supply Chain Management                           |                                                                                   |                                                             |
| 3323.0602                                                                                                 | Supply Chain Field Assistant                                |                                                                                   |                                                             |
| 2431.0601                                                                                                 | Product Executive                                           | Product Manager                                                                   |                                                             |
| <b>Job Roles mentioned by RASCI which were not assigned QP code and could not be mapped with NCO 2015</b> |                                                             |                                                                                   |                                                             |
|                                                                                                           | Content Writer                                              |                                                                                   | No                                                          |
|                                                                                                           | Logistics Executive                                         |                                                                                   | No                                                          |
|                                                                                                           | Merchant On-boarding Executive                              |                                                                                   | No                                                          |
|                                                                                                           | Pay-Per-Click (PPC) Manager                                 |                                                                                   | No                                                          |
|                                                                                                           | Visual Merchandising Executive                              |                                                                                   | No                                                          |
|                                                                                                           | Cluster Hub Manager                                         |                                                                                   | No                                                          |
|                                                                                                           | Logistics Advisor                                           |                                                                                   | No                                                          |
|                                                                                                           | Online Merchandiser                                         |                                                                                   | No                                                          |

Sources: NCAER analysis from

1. Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022-June 2023. Document No.: DDI-IND-CSO-PLFS-2022-23. <https://microdata.gov.in/nada43/index.php/catalog/179>.
2. National Career Service. Directorate General of Employment, Ministry of Labour and Employment, Government of India. National Classification of Occupations-2015 (Code Structure).
3. Retailers Association Skill Council of India. <https://www.rasci.in/>.



## Annexure 10.1: Mapping of the Occupations of the IT Sector

| S.No. | NCO (3-Digit) | Group                                                      | NCO 2015 (8-digit) | Job Roles                                                  | Nasscom | Nasscom name                            | Comment             |
|-------|---------------|------------------------------------------------------------|--------------------|------------------------------------------------------------|---------|-----------------------------------------|---------------------|
| 1     | 122           | Sales, Marketing and Development Managers                  | 1223.0101          | Manager- testing facility                                  |         |                                         |                     |
| 2     |               |                                                            | 3223.0102          | Manager- material testing                                  |         |                                         |                     |
| 3     |               |                                                            | 1223.0201          | Research Associate                                         |         |                                         |                     |
| 4     | 133           | Information and Communications technology services manager | 1330.9900          | Information and communications technology services manager |         |                                         |                     |
| 5     | 214           | Engineering Professionals (Excluding Electrotechnology)    | 2149.01            | Engineers and Related Technologists, Other                 | Yes     | Associate Machine Learning Engineer     | No 8-digit NCO Code |
| 6     |               |                                                            |                    |                                                            |         | Machine Learning Engineer               | No 8-digit NCO Code |
| 7     |               |                                                            |                    |                                                            |         | Principal Machine Learning Engineer     | No 8-digit NCO Code |
| 8     |               |                                                            |                    |                                                            |         | DevOps Engineer                         | No 8-digit NCO Code |
| 9     |               |                                                            |                    |                                                            |         | Senior DevOps Engineer                  | No 8-digit NCO Code |
| 10    |               |                                                            |                    |                                                            |         | Lead DevOps Engineer                    | No 8-digit NCO Code |
| 11    |               |                                                            |                    |                                                            |         | Associate Data Engineer                 | No 8-digit NCO Code |
| 12    |               |                                                            |                    |                                                            |         | Data Engineer                           | No 8-digit NCO Code |
| 13    |               |                                                            |                    |                                                            |         | Senior Blockchain Test Engineer         | No 8-digit NCO Code |
| 14    |               |                                                            |                    |                                                            |         | Senior Blockchain Security Engineer     | No 8-digit NCO Code |
| 15    |               |                                                            |                    |                                                            |         | Blockchain Security Engineer            | No 8-digit NCO Code |
| 16    |               |                                                            |                    |                                                            |         | Blockchain Test Engineer                | No 8-digit NCO Code |
| 17    |               |                                                            |                    |                                                            |         | Associate Blockchain Security Engineer  | No 8-digit NCO Code |
| 18    |               |                                                            |                    |                                                            |         | Lead AR/VR Infrastructure Engineer      | No 8-digit NCO Code |
| 19    |               |                                                            |                    |                                                            |         | Lead AR/VR Test Engineer                | No 8-digit NCO Code |
| 20    |               |                                                            |                    |                                                            |         | Senior AR/VR Infrastructure Engineer    | No 8-digit NCO Code |
| 21    |               |                                                            |                    |                                                            |         | Senior AR/VR Test Engineer              | No 8-digit NCO Code |
| 22    |               |                                                            |                    |                                                            |         | AR/VR Test Engineer                     | No 8-digit NCO Code |
| 23    |               |                                                            |                    |                                                            |         | AR/VR Infrastructure Engineer           | No 8-digit NCO Code |
| 24    |               |                                                            |                    |                                                            |         | Associate AR/VR Infrastructure Engineer | No 8-digit NCO Code |
| 25    |               |                                                            |                    |                                                            |         | RPA*Test Engineer                       | No 8-digit NCO Code |
| 26    |               |                                                            |                    |                                                            |         | Senior RPA*Test Engineer                | No 8-digit NCO Code |

| S.No. | NCO (3-Digit) | Group                                             | NCO 2015 (8-digit) | Job Roles                                                   | Nasscom | Nasscom name                  | Comment             |
|-------|---------------|---------------------------------------------------|--------------------|-------------------------------------------------------------|---------|-------------------------------|---------------------|
| 27    | 251           | Software and Application Developers, and Analysts | 2512.01            | Computer Programmer/Software Engineer                       |         |                               |                     |
| 28    |               |                                                   | 2512.0201          | Software Engineer                                           |         |                               |                     |
| 29    |               |                                                   | 2512.0203          | Design Engineer(Product Engineer)                           |         |                               |                     |
| 30    |               |                                                   | 2512.0204          | Software Developer – Application Development                | YES     | Software Developer            |                     |
| 31    |               |                                                   | 2512.0205          | Junior Software Developer                                   | YES     | Software Developer            |                     |
| 32    |               |                                                   | 2512.0301          | Software Developer – Product Development and Delivery       |         |                               |                     |
| 33    |               |                                                   | 2512.0401          | FPGA Design Engineer                                        |         |                               |                     |
| 34    |               |                                                   | 2512.08            | Programmer, Engineering and Scientific/System Programmer    |         |                               |                     |
| 35    |               |                                                   | 2513.0101          | Web Developer                                               | YES     |                               |                     |
| 36    |               |                                                   | 2513.0201          | User Interface Developer                                    |         |                               |                     |
| 37    |               |                                                   | 2513.0302          | Media Developer – Application Development                   | YES     | Media developer               |                     |
| 38    |               |                                                   | 2514.99            | Computer Programmers, Other                                 |         |                               |                     |
| 39    |               |                                                   | 2519.01            | System Programmer                                           |         |                               |                     |
| 40    | 252           | Database and Network Professionals                | 2521.01            | Database Design Analyst                                     |         |                               |                     |
| 41    |               |                                                   | 2521.0202          | Junior Data Associate                                       |         |                               |                     |
| 42    |               |                                                   | 2522.01            | Database Administrator                                      | YES     | Database Administrator        | No 8-digit NCO Code |
| 43    |               |                                                   | 2522.01            | Database Administrator                                      | YES     | Senior Database Administrator | No 8-digit NCO Code |
| 44    |               |                                                   | 2522.01            | Database Administrator                                      | YES     | Lead Database Administrator   | No 8-digit NCO Code |
| 45    |               |                                                   | 2522.0201          | Security Analyst                                            | YES     | Security Analyst              | No 8-digit NCO Code |
| 46    |               |                                                   |                    |                                                             |         | Senior Security Analyst       | No 8-digit NCO Code |
| 47    |               |                                                   |                    |                                                             |         | Principal Security Analyst    | No 8-digit NCO Code |
| 48    |               |                                                   | 2523.01            | Data Communication Analyst/Network Administrator            |         |                               |                     |
| 49    |               |                                                   | 2523.0401          | Design Engineer                                             |         |                               |                     |
| 50    |               |                                                   | 2523.99            | Computer Network Professionals, Other                       |         |                               |                     |
| 51    |               |                                                   | 2529               | Database and Network Professionals Not Elsewhere Classified | Yes     | Associate data engineer       | No 8-digit NCO Code |
| 52    |               |                                                   |                    |                                                             |         | data engineer                 | No 8-digit NCO Code |
| 53    |               |                                                   |                    |                                                             |         | data architect                | No 8-digit NCO Code |

| S.No. | NCO (3-Digit) | Group                                                                            | NCO 2015 (8-digit) | Job Roles                                      | Nasscom | Nasscom name                      | Comment             |
|-------|---------------|----------------------------------------------------------------------------------|--------------------|------------------------------------------------|---------|-----------------------------------|---------------------|
| 54    |               |                                                                                  |                    |                                                |         | senior database administrator     | No 8-digit NCO Code |
| 55    |               |                                                                                  |                    |                                                |         | lead database administrator       | No 8-digit NCO Code |
| 56    |               |                                                                                  |                    |                                                |         | data quality analyst              | No 8-digit NCO Code |
| 57    |               |                                                                                  |                    |                                                |         | senior data quality analyst       | No 8-digit NCO Code |
| 58    |               |                                                                                  |                    |                                                |         | associate data scientist          | No 8-digit NCO Code |
| 59    |               |                                                                                  |                    |                                                |         | data scientist                    | No 8-digit NCO Code |
| 60    |               |                                                                                  |                    |                                                |         | Data Sciences Consultant          | No 8-digit NCO Code |
| 61    |               |                                                                                  |                    |                                                |         | Chief Data Officer                | No 8-digit NCO Code |
| 62    | 313           | Process Control Technicians                                                      | 3139.99            | Industrial Robot Operators, Other              | YES     | RPA*Support Analyst               | No 8-digit NCO Code |
| 63    |               |                                                                                  |                    |                                                |         | RPA*Developer                     | No 8-digit NCO Code |
| 64    |               |                                                                                  |                    |                                                |         | RPA*Implementation Specialist     | No 8-digit NCO Code |
| 65    |               |                                                                                  |                    |                                                |         | Associate RPA*Consultant          | No 8-digit NCO Code |
| 66    |               |                                                                                  |                    |                                                |         | Senior RPA*Support Analyst        | No 8-digit NCO Code |
| 67    |               |                                                                                  |                    |                                                |         | RPA*Technical Lead                | No 8-digit NCO Code |
| 68    |               |                                                                                  |                    |                                                |         | RPA*Implementation Manager        | No 8-digit NCO Code |
| 69    |               |                                                                                  |                    |                                                |         | RPA*Solutions Architect           | No 8-digit NCO Code |
| 70    |               |                                                                                  |                    |                                                |         | RPA*Consultant                    | No 8-digit NCO Code |
| 71    |               |                                                                                  |                    |                                                |         | RPA*Support Manager               | No 8-digit NCO Code |
| 72    |               |                                                                                  |                    |                                                |         | RPA*QA Manager                    | No 8-digit NCO Code |
| 73    |               |                                                                                  |                    |                                                |         | Senior RPA*Technical Lead         | No 8-digit NCO Code |
| 74    |               |                                                                                  |                    |                                                |         | Senior RPA*Implementation Manager | No 8-digit NCO Code |
| 75    |               |                                                                                  |                    |                                                |         | Senior RPA*Solutions Architect    | No 8-digit NCO Code |
| 76    |               |                                                                                  |                    |                                                |         | Senior RPA*Consultant             | No 8-digit NCO Code |
| 77    |               |                                                                                  |                    |                                                |         | Head, RPA*                        | No 8-digit NCO Code |
| 78    | 351           | Information and Communication Technology Operations and User Support Technicians | 3514.03            | Programming Assistant/Junior Software Engineer |         |                                   |                     |

*Sources:*

1. Ministry of Statistics and Programme Implementation, Government of India. 2023. Periodic Labour Force Survey (PLFS), July 2022-June 2023. Document No.: DDI-IND-CSO-PLFS-2022-23. <https://microdata.gov.in/nada43/index.php/catalog/179>.
2. National Career Service. Directorate General of Employment, Ministry of Labour and Employment, Government of India. National Classification of Occupations-2015 (Code Structure).
3. IT-ITeS Sector Skill Council. <https://www.sscnasscom.com/>.

# Questionnaires



## National Skill Gap Study for High Growth

### Questionnaire 1: Agri-tech Firms

#### National Council of Applied Economic Research

Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE) is undertaking the 'National Skill Gap Study for High Growth Sectors', and NCAER is the implementing agency for the study. The overall objective of this work is to develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for job roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship.

Your identity would be held confidential while discussing your suggestions and views on the subject.

1. Respondent's Name.....
2. Respondent's Firm Name.....
3. Respondent's Designation.....
4. Respondent's Phone .....
5. Respondent's Email .....
6. Website of your firm.....

#### FIRM PROFILE

7. What is the firm's ownership type? *(Please select one)*

|                                                           |                                                        |                                                        |
|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| <input type="checkbox"/> Public Sector                    | <input type="checkbox"/> Public Limited                | <input type="checkbox"/> Private Limited               |
| <input type="checkbox"/> Partnership/Individual Ownership | <input type="checkbox"/> Multinational Company         | <input type="checkbox"/> Limited Liability Partnership |
| <input type="checkbox"/> Cooperative                      | <input type="checkbox"/> Others, please specify: _____ |                                                        |
8. What was the annual turnover range in FY 2023-24? *(Please select one)*

|                                                                  |                                                               |
|------------------------------------------------------------------|---------------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 5 crore (Micro)                    | <input type="checkbox"/> > Rs 5 crore & ≤ Rs 50 crore (Small) |
| <input type="checkbox"/> > Rs 50 crore & ≤ Rs 250 crore (Medium) | <input type="checkbox"/> > Rs 250 crore (Large)               |
9. What was the investment in plant and machinery in FY 2023-24? *(Please select one)*

|                                                        |                                                       |
|--------------------------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 1 crore                  | <input type="checkbox"/> > Rs 1 crore & ≤ Rs 10 crore |
| <input type="checkbox"/> > Rs 10 crore & ≤ Rs 50 crore | <input type="checkbox"/> > Rs 50 crore                |
| <input type="checkbox"/> No investment                 |                                                       |
10. What are the main activities carried out by the firm? *(Multiple selection is possible)*

|                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Technical guidance and accessibility to a wide range of high-quality inputs to farmers          |
| <input type="checkbox"/> Access to financial services, and market linkages                                               |
| <input type="checkbox"/> Provides a network of agri retailers                                                            |
| <input type="checkbox"/> Providing real-time data and insights.                                                          |
| <input type="checkbox"/> Predict weather patterns and build early warning systems                                        |
| <input type="checkbox"/> Storage services and facilitates affordable financial solutions                                 |
| <input type="checkbox"/> AI and image recognition tools to perform grading and quality checks of agri products.          |
| <input type="checkbox"/> Directly purchases from farmers and sells through online platform                               |
| <input type="checkbox"/> Range of tech solutions such as crop advisory, grading, packaging, logistics and sales support. |
| <input type="checkbox"/> Sourcing raw materials to warehousing.                                                          |
| <input type="checkbox"/> Any other, please specify_____                                                                  |

11. Agri tech encompasses a wide range of technologies to improve efficiency, increase yields, reduce costs, and boost sustainability. Which technologies does the firm use? (*multiple selections possible*)
- |                                                                                              |                                                                 |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| <input type="checkbox"/> Precision Monitoring                                                | <input type="checkbox"/> Block Chain Technology                 |
| <input type="checkbox"/> Monitoring and Data Analysis                                        | <input type="checkbox"/> Big data analysis and Machine Learning |
| <input type="checkbox"/> Automated irrigation systems, automated Tractors, Combine harvester | <input type="checkbox"/> KissanGPT, ChatGPT                     |
| <input type="checkbox"/> Satellite and drone imagery                                         | <input type="checkbox"/> Internet of Things (IoT) sensors       |
| <input type="checkbox"/> Robotics                                                            | <input type="checkbox"/> Smart greenhouses (Vertical farming)   |
| <input type="checkbox"/> Any other, Please Specify _____                                     |                                                                 |
12. Overall, what is the percentage of female employees in the firm? (*Please select one*)
- |                                      |                                      |                                      |
|--------------------------------------|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> 0%          | <input type="checkbox"/> ≤20%        | <input type="checkbox"/> >20% & ≤40% |
| <input type="checkbox"/> >40% & ≤60% | <input type="checkbox"/> >60% & ≤80% | <input type="checkbox"/> >80%        |

#### UNDERSTANDING HIRING, SKILLING, GENDER-BASED ROLES, AND SKILL SHORTAGES

13. What are the mediums used for hiring employees? (*multiple selections possible*)
- |                                                         |                                                                                          |
|---------------------------------------------------------|------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Employment agency              | <input type="checkbox"/> Online job sites/advertisements; Please specify: _____          |
| <input type="checkbox"/> Own website advertisements     | <input type="checkbox"/> Campus recruitment; Please mention institutions: _____          |
| <input type="checkbox"/> Vocational training institutes | <input type="checkbox"/> Sector Skill Council/Sector Skill Council affiliated institutes |
| <input type="checkbox"/> Newspaper advertisements       | <input type="checkbox"/> Internships/apprenticeships                                     |
| <input type="checkbox"/> Networks and referrals         | <input type="checkbox"/> Others, specify: _____                                          |
14. Do you provide on-the-job training within the firm, either before or after deployment?  
Yes / No: \_\_\_\_\_  
If 'Yes', what is your policy? \_\_\_\_\_  
Should this training rather be provided by India's education and skilling system? \_\_\_\_\_
15. Does the firm run its own skilling institution, or have any tie-up / informal association with another institution / ASCI for skilling purposes?  
Yes / No: \_\_\_\_\_; Is it owned by the firm? Yes / No: \_\_\_\_\_  
If 'Yes', please mention which institutions: \_\_\_\_\_
16. What kind of association(s) does the firm have with the skilling institution(s) identified in Q.15? (*multiple selections possible*)
- |                                                                                            |                                                                                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <input type="checkbox"/> We offer apprenticeships/internships for trainee students         | <input type="checkbox"/> We send our staff to take visiting classes or other classes  |
| <input type="checkbox"/> We offer inputs to the course curriculum                          | <input type="checkbox"/> We sponsor lab facilities in TVET or other institutions      |
| <input type="checkbox"/> We sponsor fresh skilling programmes to absorb the students later | <input type="checkbox"/> We sponsor re-skilling/upskilling programs for our employees |
| <input type="checkbox"/> No associations                                                   | <input type="checkbox"/> Other; please specify: _____                                 |
- We have collated a list of occupations from the National Classification of Occupations (NCOs) and job roles from the Agriculture Skills Council of India (ASCI), associated with the agriculture value chain in Annexure 4.5 for the list of job roles; this was attached to the questionnaire).
17. For all types of activities that the firm is involved in (Q.10), do the job roles (*Annexure 4.5*) cover the relevant activities undertaken by the firm?  
Yes / No: \_\_\_\_\_  
What other occupations/job roles should be included? Please specify: \_\_\_\_\_
18. As regards gender ratio, which job roles:  
Employ majority women (>50% of all workers in the job role): \_\_\_\_\_  
Employ some women (20% to 50% of all workers in the job role): \_\_\_\_\_  
Employ no women (0% of all workers in the job role): \_\_\_\_\_

19. How easy or difficult was it to fill the job roles (including the number of positions) advertised by the firm in the last three years (FY 2021-22 onwards)? (Add rows if necessary. If the firm advertised many job roles, you can specify job roles at two extremes: those which were easiest to fill, and those very difficult/un-filled).

| S. No. | Job Roles advertised | Please Specify the Level:<br>Entry level/intermediate or mid-level/senior level/ managerial level/director level /executive level | Difficulty of filling jobs (rank)<br>1. Very easy; 2. Easy; 3. Average; 4. Difficult; 5. Very difficult; 6. Not filled at all |
|--------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1      |                      |                                                                                                                                   |                                                                                                                               |
| 2      |                      |                                                                                                                                   |                                                                                                                               |
| 3      |                      |                                                                                                                                   |                                                                                                                               |
| 4      |                      |                                                                                                                                   |                                                                                                                               |
| 5      |                      |                                                                                                                                   |                                                                                                                               |

20. In Q.19, for the job roles with rank 3-6 on 'difficulty of filling jobs', can you please detail the skills, knowledge and education sought by the firm, in the form of a detailed job description? (Please refer to *Table Q1.1*. Request you to provide the details for each of the relevant job roles within the format of *Table Q1.1*).

We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Educational Qualifications sought by the firm | Knowledge (technical and theoretical knowledge relating to the job role) | Technical Skills (Computer applications and software) | Years of Experience | Skills (refer to Table Q1.2) | Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role (mention States and Districts) |
|----------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |                                               |                                                                          |                                                       |                     |                              |                                                                                                                                       |

21. Who is presently providing education and skilling for these 'hard to fill' job roles in Q.20, if any? Nobody / formal education system / vocational education system? Please specify: \_\_\_\_\_  
Is the formal/vocational education system run by the government / private parties / NGOs? Please specify: \_\_\_\_\_

Please list the formal and vocational training institutions for these job-roles: \_\_\_\_\_

22. For the Agritech firm involved in (Q.10 and Q.11), what are the upcoming technological developments? Please specify: \_\_\_\_\_

23. Does the firm have its own R&D and design division, or plan to develop one?  
Have R&D unit/Plan to set up R&D unit / no R&D and no plan: \_\_\_\_\_

24. In view of the developments (Q.22 and Q.23), which job roles will be in-demand in the next three years by the firm? (Please refer to *Table Q1.1*. Request you to provide the details, for each of the relevant job roles, within the format of *Table Q1.1*). We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Education | Knowledge | Technical Skills | Years of Experience | Skills (refer to Table Q1.2) | Geographical areas/spatial clusters where needs are highest (mention States and Districts) | Difficulty of finding workers<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |
|----------|----------------------|-------|-----------|-----------|------------------|---------------------|------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |           |           |                  |                     |                              |                                                                                            |                                                                                                                                                  |



## GENDER DIVERSITY AND CARRER PATH AT WORKPLACE

25. In the next three years, do you perceive a demand for women in particular job roles, either among the existing job-roles or those which will be in-demand in future?

Yes / No: \_\_\_\_\_

If 'Yes', please specify which ones: \_\_\_\_\_

26. Does the firm have hiring policies to encourage female employment, especially in non-traditional job roles?

Yes / No: \_\_\_\_\_

If 'Yes', please explain the policy in detail: \_\_\_\_\_

Does the firm have a creche on its premises? Yes / No: \_\_\_\_\_

27. Has the firm defined sexual harassment policies, prevention systems, procedures and service rules for its employees (Prevention of Sexual Harassment at Workplace Act 2013)?

Yes / No: \_\_\_\_\_

28. Does the firm offer a career-path to all its employees? (for instance, has anyone at the firm risen from being at a 'technician level position' to a 'managerial level position')?

Yes / No: \_\_\_\_\_

Does the firm fund the employee's education/upskilling/re-skilling, as may be required for higher-level job roles? Yes / No: \_\_\_\_\_

## EMPLOYMENT BACKGROUND

29. How many people are employed at the firm?

| S. No. | Particulars                  | Number of people employed |               |
|--------|------------------------------|---------------------------|---------------|
|        |                              | Managerial Staff (No.)    | Workers (No.) |
|        | Total Employees (in numbers) |                           |               |

30. With reference to the total employees identified in Q.29, what is the educational background of the employees (as percentage (%) of total employees)?

| Below Class X (%) | Above Class X and Below Class XII (%) | Class XII pass (%) | Vocationally Educated (ITI, PMKVY, RPL etc.) (%) | Bachelor's degree and above (%) |
|-------------------|---------------------------------------|--------------------|--------------------------------------------------|---------------------------------|
|                   |                                       |                    |                                                  |                                 |

**Table Q1.1: Details of Identified Job Roles in Q.20 and Q.24 of the Questionnaire**  
(Request you to provide the details, for each of the relevant job roles, in the format as given below)

S. No.: \_\_\_\_\_

Job Role: \_\_\_\_\_

**Table 1: Job Descriptors**

| Descriptors                                                                                                                                                                                                                     |                                               | Firm's Answer |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------|
| Alternative job titles in the industry                                                                                                                                                                                          |                                               |               |
| Stage of the value chain:<br>1. Pre-production<br>2. Production<br>3. Post Production                                                                                                                                           |                                               |               |
| Is this job role:<br>1. 'Difficult to fill' at present (Q.20), or<br>2. Will be in-demand in next 3 years by the firm (Q.24)                                                                                                    |                                               |               |
| How many do you need to hire at the 'present moment'/now, or you will need to hire 3 years from now?                                                                                                                            |                                               |               |
| Tasks to be performed in the job role<br>(please include specific systems / components / technologies / personnel required to be dealt or interacted with, if any)                                                              |                                               |               |
| Education:<br>School (up to what level?) / ITI/ Short-term vocational training programme/ Bachelors/ Masters)                                                                                                                   |                                               |               |
| Knowledge                                                                                                                                                                                                                       | General? What knowledge?                      |               |
|                                                                                                                                                                                                                                 | Specialised (Sector, Occupational, and Trade) |               |
| Technical Skills:<br>Software languages required, or maybe required in the near future                                                                                                                                          |                                               |               |
| Years of Experience, if any                                                                                                                                                                                                     |                                               |               |
| Skills required and level of competence<br>(refer to framework of skills in <b>Table Q1.2</b> below)                                                                                                                            |                                               |               |
| Difficulty of finding workers in the job role, with the above requirements and the skills as detailed below:<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |                                               |               |
| Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role**<br>(mention States and Districts)                                                                                      |                                               |               |

\*\* Please explain the reasons behind skill shortage in the specified states and districts: Are there demand side factors (such as low salary, demanding work conditions, absence of platforms to advertise jobs, non-acceptability of workers from conventional labour markets, competition from other sectors to hire the same candidate, etc) and/or supply side factors (such as course not offered by Indian institutions, specialised skilled people not available, absence of and/or proximity to training centres, poor quality of skilling and training programs, lack of programs for re-skilling/upskilling workers from traditional sectors, high salary expectations, non-aspirational job role, availability of other work avenues, etc)?

**Table Q1.2: List of Skills**

| <i>Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)</i>                                                                                                                                 |                                                                                                                                                            |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                                                                                     | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| <i>Reading Literacy:</i> Would they need to read and understanding written sentences and paragraphs in work related documents?                                                                                                                                                                                                                      |                                                                                                                                                            |          |
| <i>Writing:</i> Would they need to communicate effectively in writing as per their audience for their job?                                                                                                                                                                                                                                          |                                                                                                                                                            |          |
| <i>Speaking:</i> Do they need to talk to others to convey information effectively?                                                                                                                                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Communication:</i> Would they need to provide information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person?                                                                                                                                                                                      |                                                                                                                                                            |          |
| <i>Language Skills 1:</i> Is knowledge of the structure and content of the language including the meaning and spelling of words, rules of composition, and grammar required for the job?                                                                                                                                                            |                                                                                                                                                            |          |
| <i>Language Skills 2:</i> Any specific language requirement for the job? If Yes, which one?                                                                                                                                                                                                                                                         |                                                                                                                                                            |          |
| <i>Numeracy/Mathematics:</i> Would they need to work with numbers for their job?                                                                                                                                                                                                                                                                    |                                                                                                                                                            |          |
| <i>ICT Literacy to Skills:</i> Would they need to use mobile phones/tabs/computers etc. to do their job?<br><br>For example, Arts & Graphics, Desktop Publishing, Presentation, Spreadsheet, Word Processing, Programming, Client Server/Networking/Hardware, Operating Systems, Database/Statistics, Engineering Software and Web Page Design etc. |                                                                                                                                                            |          |
| <i>Self-learning to Active (Independent) Learning:</i> Would they need to understand new information for both current and future problem-solving and decision-making at their job? Are they expected to do on their own for the job or self-learn, if the material is provided to them?                                                             |                                                                                                                                                            |          |
| <i>Active Listening:</i> Do they need to listen for their job, like taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times?                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Science:</i> Do they need to use scientific rules and methods to solve problems at work?                                                                                                                                                                                                                                                         |                                                                                                                                                            |          |
| <i>Problem Solving:</i> Do they need to identify problems and review related information to develop and evaluate options and implement solutions?                                                                                                                                                                                                   |                                                                                                                                                            |          |
| <i>Learning Strategies:</i> Do they need to select and use training/instructional methods and procedures appropriate for the situation when learning or teaching new things?                                                                                                                                                                        |                                                                                                                                                            |          |

| Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)                                                                                 |                                                                                                                                                            |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                              | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| <i>Critical Thinking:</i> Would the worker need to use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems?                                                                                                         |                                                                                                                                                            |          |
| <i>Creativity:</i> Do the workers need to develop, design, or create new applications, ideas, relationships, systems, or products, including artistic contributions?                                                                                                                         |                                                                                                                                                            |          |
| <i>Independent research:</i> Would the worker need to conduct literature review, undertake data collection, cleaning etc., develop research plan?                                                                                                                                            |                                                                                                                                                            |          |
| <i>Judgement and Decision-making:</i> Would the worker need to consider the relative costs and benefits of potential actions to choose the most appropriate one?                                                                                                                             |                                                                                                                                                            |          |
| <i>Systems Analysis:</i> Would the worker need to determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes?                                                                                                                  |                                                                                                                                                            |          |
| <i>Systems Evaluation:</i> Would workers need to identify measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system?                                                                                        |                                                                                                                                                            |          |
| <i>Financial Resources:</i> Would the worker need to determine how money will be spent to get the work done, and accounting for these expenditures?                                                                                                                                          |                                                                                                                                                            |          |
| <i>Material Resources:</i> Would the worker need to obtain and see to the appropriate use of equipment, facilities, and materials needed to do certain work?                                                                                                                                 |                                                                                                                                                            |          |
| <i>Personnel Resources:</i> Would the worker need to motivate, develop, and direct people as they work, identifying the best people for the job?                                                                                                                                             |                                                                                                                                                            |          |
| <i>Time Management:</i> Managing one's own time and the time of others                                                                                                                                                                                                                       |                                                                                                                                                            |          |
| <i>Seek and Value Diversity:</i> Do workers need to work with people (as colleagues/clients etc.) from other cultures/States/socio-economic backgrounds etc? Is it important for their job performance? Is it likely to be important for their job performance?                              |                                                                                                                                                            |          |
| <i>Gender Diversity:</i> Do workers need to work with female colleagues/clients etc.? Is it important for their job performance? Is it likely to be important for their job performance?                                                                                                     |                                                                                                                                                            |          |
| <i>Conscientiousness (including attitude towards work):</i> Will the worker need to be organised, responsible, and hardworking or have any one of the following traits- Competence (efficient), organised, dutiful (not careless), ambitious, self-discipline (not lazy), and not impulsive? |                                                                                                                                                            |          |

| Please think whether the person in the above job profile would need the following skills to do their job.<br>(Please choose the relevant skills and indicate the level of competence required for those skills)                                |                                                                                                                                                            |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| <i>Openness to Experiences:</i> Will the worker need to be open to new aesthetic, cultural, or intellectual experiences or have any one of the following traits- Imaginative, artistic, excitable, wide interests, curious and unconventional? |                                                                                                                                                            |          |
| <i>Extraversion:</i> Will the worker need to show the following traits- warmth (friendly), sociable, self-confident, energetic, excitement seeking (adventurous), and enthusiastic?                                                            |                                                                                                                                                            |          |
| <i>Agreeableness:</i> Will the worker need to work in a team in a cooperative, unselfish manner?                                                                                                                                               |                                                                                                                                                            |          |
| <i>Neuroticism/Emotional stability:</i> Will the worker need to show emotional stability i.e. predictability and consistency in emotional reactions, with absence of rapid mood changes?                                                       |                                                                                                                                                            |          |
| <i>Does the worker need social skills at work?</i>                                                                                                                                                                                             |                                                                                                                                                            |          |
| <i>Instructing:</i> Does the worker need to teach others how to do something?                                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Negotiation:</i> Does the worker need to bring others together and try to reconcile differences?                                                                                                                                            |                                                                                                                                                            |          |
| <i>Persuasion:</i> Do workers need to persuade others to change their minds or behaviour?                                                                                                                                                      |                                                                                                                                                            |          |
| <i>Occupation-specific skills</i>                                                                                                                                                                                                              |                                                                                                                                                            |          |
| <i>Physical skills</i> , including job-specific complex psychomotor skills                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Global Competence:</i> Globally competent workers                                                                                                                                                                                           |                                                                                                                                                            |          |
| <i>Any other?</i> Please specify:                                                                                                                                                                                                              |                                                                                                                                                            |          |

## National Skill Gap Study for High Growth

### Questionnaire 2: Questionnaire for Farmer Producer Organisations (FPOs)

#### National Council of Applied Economic Research

Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE) is undertaking the 'National Skill Gap Study for High Growth Sectors' and NCAER is the implementing agency for the study. The overall objective of in this work is develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for jobs roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship.

Your identity would be held confidential while discussing your suggestions and views on the subject.

- 1 Name of the FPO.....
- 2 Date of Registration of FPO.....
- 3 Respondent's Name.....
- 4 Respondent's Designation.....
- 5 Respondent's Phone .....
- 6 Respondent's Email: .....
- 7 Is there any website for the FPO? If yes, please provide the address.....

#### FPO PROFILE

- 1 Membership restricted to?  
Number of villages  
Number of GPs  
Number of Blocks
- 2 Board of Directors Constitution  
Number of Male Directors  
Number of Female Directors
- 3 Shareholders Constitutions  
Number of Male Shareholders  
Number of Female Shareholders
- 4 Engagement of members with FPO  
Active Member (%)  
Number of non-members taken support from FPO Number)
- 5 What Services provided by FPO to its members

|                           |                       |  |
|---------------------------|-----------------------|--|
| Inputs                    | Seeds                 |  |
|                           | Pesticides            |  |
|                           | Fertiliser            |  |
|                           | Other                 |  |
| Trading License           | Seeds                 |  |
|                           | Pesticides            |  |
|                           | Fertiliser            |  |
|                           | Other                 |  |
| Market Linkages           | Through e-Nam         |  |
|                           | Through Local Vendors |  |
|                           | Other                 |  |
| Aggregation               | Commodity Name        |  |
| Storage                   | Commodity Name        |  |
| Sorting/Grading/ Cleaning | Commodity Name        |  |
| Processing                | Commodity Name        |  |
| Branding                  | Commodity Name        |  |

## 6 Staff Composition of FPO

|                                            |            |            |                    |            |
|--------------------------------------------|------------|------------|--------------------|------------|
| Number of Full-time staff                  |            |            |                    |            |
| Number of Part-time staff                  |            |            |                    |            |
| Number of Female Staff                     |            |            |                    |            |
| Education qualification of Full-time staff | Illiterate | Under 10th | Matriculation Pass | Graduation |
|                                            |            |            |                    |            |
| Education qualification of Part-time staff | Illiterate | Under 10th | Matriculation Pass | Graduation |
|                                            |            |            |                    |            |
| Education qualification of female staff    | Illiterate | Under 10th | Matriculation Pass | Graduation |
|                                            |            |            |                    |            |

## 7 What type of Job roles are at FPO?

| S.No | Job Roles | Full-time/<br>Part-time | Education<br>Qualification | Specific<br>Skills<br>required | Difficulty in finding persons (rank)<br>1. Very easy; 2. Easy; 3. Average;<br>4. Difficult; 5. Very difficult;<br>6. Not find at all |
|------|-----------|-------------------------|----------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
|      |           |                         |                            |                                |                                                                                                                                      |
|      |           |                         |                            |                                |                                                                                                                                      |
|      |           |                         |                            |                                |                                                                                                                                      |
|      |           |                         |                            |                                |                                                                                                                                      |
|      |           |                         |                            |                                |                                                                                                                                      |

## 8 Are you using any mediums for hiring employees? (multiple selections possible)

|                                |                                                                   |
|--------------------------------|-------------------------------------------------------------------|
| Employment agency              | Online job sites/advertisements; Please specify:                  |
| Own website advertisements     | Sector Skill Council / Sector Skill Council affiliated institutes |
| Vocational training institutes | Internships/apprenticeships                                       |
| Newspaper advertisements       | Others, specify_____                                              |
| Networks and referrals         |                                                                   |

## 9 Do you provide any training to your employees?

Yes / No: \_\_\_\_\_

If 'Yes', what is your policy? \_\_\_\_\_

## 10 Does the FPO run its skilling centre, or have any tie-up / informal association with another institution / ASCI for skilling purposes?

Yes / No: \_\_\_\_\_; Is it owned by the firm? Yes / No: \_\_\_\_\_

If 'Yes', please mention which institutions: \_\_\_\_\_

## 11 As regards gender ratio, which job roles:

Employ majority women (>50% of all workers in the job role): \_\_\_\_\_

Employ some women (20% to 50% of all workers in the job role): \_\_\_\_\_

Employ no women (0% of all workers in the job role): \_\_\_\_\_

## 12 Are you using any technologies to improve efficiency, increase yields, reduce costs, and boost sustainability? If Yes, Which technologies does the FPO use? (multiple selections possible)

|                                                                     |                                        |
|---------------------------------------------------------------------|----------------------------------------|
| Precision Monitoring                                                | Chain Technology                       |
| Monitoring and Data Analysis                                        | Big Data Analysis and Machine Learning |
| Automated irrigation systems, automated Tractors, Combine harvester | KissanGPT, ChatGPT                     |
| Satellite and drone imagery                                         | Internet of Things (IoT) sensors       |
| Robotics                                                            | Smart greenhouses (Vertical farming)   |
| Any other, Please Specify                                           |                                        |

13 In view of the new technologies, which job roles will be in-demand in the next three years by the FPO?

| Job Role | Stage of Value Chain | Tasks | Education | Knowledge | Technical Skills | Years of Experience | Non-technical Skills | Geographical areas/spatial clusters where needs are highest (mention States and Districts) | Difficulty of finding workers<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |
|----------|----------------------|-------|-----------|-----------|------------------|---------------------|----------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |           |           |                  |                     |                      |                                                                                            |                                                                                                                                                  |

*Note:* For list of job roles, questionnaires about job roles facing shortage and skills required to do those jobs are the same as in previous questionnaire.





**National Skill Gap Study for High Growth**  
**Questionnaire 3: Raising Cattle and Buffaloes in Dairy Farms/Bulk Chilling**  
**Centres/Milk Collection Centres**

**National Council of Applied Economic Research**

Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE) is undertaking the 'National Skill Gap Study for High Growth Sectors' and NCAER is the implementing agency for the study. The overall objective of in this work is develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for jobs roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship.

Your identity would be held confidential while discussing your suggestions and views on the subject.

1. Date of Interview.....
2. Respondent's Name.....
3. Respondent's Designation.....
4. Respondent's Company/Federation Name: .....
5. Respondent's Phone .....
6. Respondent's Email: .....
7. Major line of activity of your organisation: .....
8. *Ownership: (Please select one)*

|                                                           |                                                        |                                                        |
|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| <input type="checkbox"/> Public Sector                    | <input type="checkbox"/> Public Limited                | <input type="checkbox"/> Private Limited               |
| <input type="checkbox"/> Partnership/Individual Ownership | <input type="checkbox"/> Multinational Company         | <input type="checkbox"/> Limited Liability Partnership |
| <input type="checkbox"/> Cooperatives                     | <input type="checkbox"/> Others, please specify: _____ |                                                        |
9. *Annual Turnover in sales in FY 2023-24: (Please select one)*

|                                                                  |                                                               |
|------------------------------------------------------------------|---------------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 5 crore (Micro)                    | <input type="checkbox"/> > Rs 250 crore (Large)               |
| <input type="checkbox"/> > Rs 50 crore & ≤ Rs 250 crore (Medium) | <input type="checkbox"/> > Rs 5 crore & ≤ Rs 50 crore (Small) |
| <input type="checkbox"/> Others, please specify: _____           |                                                               |
10. *Annual Investment in Plant and Machinery in FY 2023-24: (Please select one)*

|                                                        |                                                       |
|--------------------------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 1 crore                  | <input type="checkbox"/> > Rs 1 crore & ≤ Rs 10 crore |
| <input type="checkbox"/> > Rs 10 crore & ≤ Rs 50 crore | <input type="checkbox"/> > Rs 50 crore                |
| <input type="checkbox"/> No investment                 |                                                       |
11. How many manufacturing units does the firm have in India? Information on plant locations (States, Districts, Clusters) will help in understanding the spatial spread of the industry.  
Number of units: \_\_\_\_\_  
States and Districts: \_\_\_\_\_  
Are the plants located in a dairy cluster? Yes / No: \_\_\_\_\_;  
If 'Yes', which cluster: \_\_\_\_\_
12. Which machineries are used in the dairy manufacturing? Please specify
  - i)
  - ii)

13. What is the medium used for recruitment? (*multiple selections possible*)

- ☐ Employment agency
 ☐ Online job sites/advertisements; Please specify: \_\_\_\_\_  
☐ Own website advertisements
 ☐ Campus recruitment; Please mention institutions: \_\_\_\_\_  
☐ Vocational training institutes
 ☐ Sector Skill Council  
☐ Newspaper advertisements
 ☐ Internships/apprenticeships  
☐ Networks and referrals
 ☐ Others, specify: \_\_\_\_\_

14. Please provide in details:

| S. No. | Particulars                  | Number of people employed |         |
|--------|------------------------------|---------------------------|---------|
|        |                              | Managerial Staff          | Workers |
| 1.     | Permanent Employees/workers* |                           |         |
| 2.     | Temporary Employees/workers  |                           |         |
| 3.     | Total Employees              |                           |         |

\*Permanent workers/employees should satisfy all three conditions- have more than one 1-year written contract, employer-provided social security benefits and paid leave

15. What is the educational and skill background of all your employees (% of employees)?

| Below Class X | Above Class X and Below Class XII | Class XII pass | Vocationally Educated (ITI, PMKVY, RPL etc.) | Bachelors and above |
|---------------|-----------------------------------|----------------|----------------------------------------------|---------------------|
|               |                                   |                |                                              |                     |

16. What is the percentage share of females that you are employing? (*Please select one*)

- ☐ 0%
 ☐ ≤20%
 ☐ >20% & ≤40%  
☐ >40% & ≤60%
 ☐ >60% & ≤80%
 ☐ >80%

17. What is the distribution of female workers across job roles (% of all employees)?

| S. No. | Job Roles | % of all employees |
|--------|-----------|--------------------|
| 1.     |           |                    |
| 2.     |           |                    |
| 3.     |           |                    |
| 4.     |           |                    |
| 5.     |           |                    |

18. Does the firm run its own skilling institution, or have any tie-up / informal-association with another institution / ASCI for skilling purposes?

Yes / No: \_\_\_\_\_; Is it owned by the firm? Yes / No: \_\_\_\_\_

If 'Yes', please mention which institutions: \_\_\_\_\_

19. At the workers' entry-level positions, do you hire people with or without work experience? (*Multiple ticks possible*)

- ☐ Without work experience
 ☐ Apprenticeship/internship  
☐ With work experience
 ☐ Others, specify \_\_\_\_\_

20. Do you provide on-the-job training around (either before or after) deployment? (Yes/No)? If 'Yes', what is your policy?

21. Have you advertised for particular jobs in the last three years? If 'Yes', can you share the list of jobs that you advertised?

22. How easy or difficult was it to fill the job roles (including the number of positions) advertised by the firm in the last three years (FY 2021-22 onwards)? (Add rows if necessary. If the firm advertised many job roles, you can specify job roles at two extremes: those which were easiest to fill, and those very difficult / un-filled)

| S.No. | Job Roles advertised | Please Specify the Level:<br>Entry level / intermediate or<br>mid-level / senior level /<br>managerial level / director<br>level / executive level | Difficulty of filling jobs (rank)<br>1. Very easy; 2. Easy; 3. Average; 4.<br>Difficult; 5. Very difficult; 6. Not<br>filled at all |
|-------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
|       |                      |                                                                                                                                                    |                                                                                                                                     |

*\*Use Annexure 5.3*

23. In Q.22, for the job roles with rank 3-6 on 'difficulty of filling jobs', can you please detail the skills, knowledge and education sought by the firm– in the form of a detailed job description? (Please refer to Table Q3.1. Request you to provide the details, for each of the relevant job roles, within the format of Table Q3.1). We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Educational Qualifications sought by the firm | Knowledge (technical and theoretical knowledge relating to the job role) | Technical Skills (Computer applications and software) | Years of Experience | Skills (refer to Table Q3.2) | Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role (mention States and Districts) |
|----------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |                                               |                                                                          |                                                       |                     |                              |                                                                                                                                       |

*\*Use Annexure 5.3*

24. What is the primary reason for the hard-to-fill vacancies in your organisation? (Multiple ticks possible)

- ☐ Lack of technical skills
 ☐ Inadequate educational qualifications  
☐ Lack of experience
 ☐ Others specify

25. Does the firm have hiring policies to encourage female employment, especially in non-traditional job roles?

Yes / No: \_\_\_\_\_

If 'Yes', please explain the policy in detail: \_\_\_\_\_

Does the firm have a creche on its premises? Yes / No: \_\_\_\_\_

26. Has the firm defined sexual harassment policies, prevention systems, procedures and service rules for its employees (Prevention of Sexual Harassment at Workplace Act 2013)?

Yes / No: \_\_\_\_\_

27. Does the firm offer a career path to all its employees? (for instance, has anyone at the firm risen from being a 'Milkmaid' to a 'Dairy Clerk')?

Yes / No: \_\_\_\_\_

28. Does the firm fund the employee's education / upskilling / re-skilling, as may be required for higher level job roles?

Yes / No: \_\_\_\_\_

29. In your opinion, what will be the changes in employment, and job roles given the structural, technological and other changes?

30. In the next three years, do you perceive that there will be demand for women in particular (either existing or new) job roles? Which ones are they? And what are you doing to address these future needs?

31. Which job roles are currently facing skill gap issues? Mention reasons.  
Also specify the stage of value chain for which this skill gap exists.

32. Which job roles you think will be in-demand in the next three years? You can write NA wherever 'Not Applicable'. (You can refer to Table Q3.1)

| Job role | Stage of Value Chain* | No of jobs | Tasks | Education | Knowledge / Years of experience | Skill Requirement (Refer Table Q3.2) | Geo areas/ Spatial clusters where needs are highest | Availability of workers<br>i) Easy<br>ii) Moderate<br>iii) Difficult |
|----------|-----------------------|------------|-------|-----------|---------------------------------|--------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------|
|          |                       |            |       |           |                                 |                                      |                                                     |                                                                      |

*\*Stage of Value Chain includes Input, Production, Processing, Manufacturing, Transportation, Marketing & Distribution*

*(Request you to provide the details, for each of the relevant job roles, in the format as given below)*

S. No.: \_\_\_\_\_  
Job Role: \_\_\_\_\_

**Table Q3.1: Job Descriptors**

| Descriptors                                                                                                                                                                                                                     |                                               | Firm's Answer |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------|
| Alternative job titles in the industry                                                                                                                                                                                          |                                               |               |
| Stage of value chain:<br>1. Input<br>2. Production<br>3. Processing<br>4. Manufacturing<br>5. Transportation<br>6. Marketing & Distribution                                                                                     |                                               |               |
| Is this job role:<br>1. 'Difficult to fill' at present ( <b>Q.23</b> ), or<br>2. Will be in-demand in next 3 years by the firm ( <b>Q.32</b> )                                                                                  |                                               |               |
| How many do you need to hire at the 'present moment'/now, or you will need to hire 3 years from now?                                                                                                                            |                                               |               |
| Tasks to be performed in the job role<br>(please include specific systems / components / technologies / personnel required to be dealt or interacted with, if any)                                                              |                                               |               |
| Education:<br>School (up to what level?) / ITI/ Short-term vocational training programme/ Bachelors/ Masters)                                                                                                                   |                                               |               |
| Knowledge                                                                                                                                                                                                                       | General? What knowledge?                      |               |
|                                                                                                                                                                                                                                 | Specialised (Sector, Occupational, and Trade) |               |
| Technical Skills:<br>Software languages required, or maybe required in the near future                                                                                                                                          |                                               |               |
| Years of Experience, if any                                                                                                                                                                                                     |                                               |               |
| Skills required and level of competence<br>(refer to framework of skills in <b>Table Q3.2</b> below)                                                                                                                            |                                               |               |
| Difficulty of finding workers in the job role, with the above requirements and the skills as detailed below:<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |                                               |               |
| Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role**<br>(mention States and Districts)                                                                                      |                                               |               |

\*\* Please explain the reasons behind skill shortage in the specified states and districts: Are there demand side factors (such as low salary, demanding work conditions, absence of platforms to advertise jobs, non-acceptability of workers from conventional labour markets, competition from other sectors to hire the same candidate, etc) and/or supply side factors (such as course not offered by Indian institutions, specialised skilled people not available, absence of and/or proximity to training centres, poor quality of skilling and training programs, lack of programs for re-skilling/upskilling workers from traditional sectors, high salary expectations, non-aspirational job role, availability of other work avenues, etc)?

**Table Q3.2: List of Skills**

| <i>Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)</i>                                                                                                                               |                                                                                                                                                       |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                                                                                   | If required, what is the degree of competence needed in the employee?<br>1.Beginner; 2. Intermediate<br>3. Competent; 4. Advanced<br>5. Very Advanced | Comments |
| <i>Reading Literacy:</i> Would they need to read and understanding written sentences and paragraphs in work related documents?                                                                                                                                                                                                                    |                                                                                                                                                       |          |
| <i>Writing:</i> Would they need to communicate effectively in writing as per their audience for their job?                                                                                                                                                                                                                                        |                                                                                                                                                       |          |
| <i>Speaking:</i> Do they need to talk to others to convey information effectively?                                                                                                                                                                                                                                                                |                                                                                                                                                       |          |
| <i>Communication:</i> Would they need to provide information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person?                                                                                                                                                                                    |                                                                                                                                                       |          |
| <i>Language Skills 1:</i> Is knowledge of the structure and content of the language including the meaning and spelling of words, rules of composition, and grammar required for the job?                                                                                                                                                          |                                                                                                                                                       |          |
| <i>Language Skills 2:</i> Any specific language requirement for the job? If Yes, which one?                                                                                                                                                                                                                                                       |                                                                                                                                                       |          |
| <i>Numeracy/Mathematics:</i> Would they need to work with numbers for their job?                                                                                                                                                                                                                                                                  |                                                                                                                                                       |          |
| <i>ICT Literacy to Skills:</i> Would they need to use mobile phones/tabs/computers etc. to do their job?<br>For example, Arts & Graphics, Desktop Publishing, Presentation, Spreadsheet, Word Processing, Programming, Client Server/ Networking/ Hardware, Operating Systems, Database/Statistics, Engineering Software and Web Page Design etc. |                                                                                                                                                       |          |
| <i>Self-learning to Active (Independent) Learning:</i> Would they need to understand new information for both current and future problem-solving and decision-making at their job? Are they expected to do on their own for the job or self-learn, if the material is provided to them?                                                           |                                                                                                                                                       |          |
| <i>Active Listening:</i> Do they need to listen for their job, like taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times?                                                                                                                                                |                                                                                                                                                       |          |
| <i>Science:</i> Do they need to use scientific rules and methods to solve problems at work?                                                                                                                                                                                                                                                       |                                                                                                                                                       |          |
| <i>Problem Solving:</i> Do they need to identify problems and review related information to develop and evaluate options and implement solutions?                                                                                                                                                                                                 |                                                                                                                                                       |          |
| <i>Learning Strategies:</i> Do they need to select and use training/instructional methods and procedures appropriate for the situation when learning or teaching new things?                                                                                                                                                                      |                                                                                                                                                       |          |
| <i>Critical Thinking:</i> Would the worker need to use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems?                                                                                                                                                             |                                                                                                                                                       |          |

| <i>Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)</i>                                                                           |                                                                                                                                                        |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                               | If required, what is the degree of competence needed in the employee?<br>1. Beginner; 2. Intermediate<br>3. Competent; 4. Advanced<br>5. Very Advanced | Comments |
| <i>Creativity:</i> Do the workers need to develop, design, or create new applications, ideas, relationships, systems, or products, including artistic contributions?                                                                                                                          |                                                                                                                                                        |          |
| <i>Independent research:</i> Would the worker need to conduct literature review, undertake data collection, cleaning, etc., and develop research plan?                                                                                                                                        |                                                                                                                                                        |          |
| <i>Judgement and Decision-making:</i> Would the worker need to consider the relative costs and benefits of potential actions to choose the most appropriate one?                                                                                                                              |                                                                                                                                                        |          |
| <i>Systems Analysis:</i> Would the worker need to determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes?                                                                                                                   |                                                                                                                                                        |          |
| <i>Systems Evaluation:</i> Would workers need to identify measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system?                                                                                         |                                                                                                                                                        |          |
| <i>Financial Resources:</i> Would the worker need to determine how money will be spent to get the work done, and accounting for these expenditures?                                                                                                                                           |                                                                                                                                                        |          |
| <i>Material Resources:</i> Would the worker need to obtain and see to the appropriate use of equipment, facilities, and materials needed to do certain work?                                                                                                                                  |                                                                                                                                                        |          |
| <i>Personnel Resources:</i> Would the worker need to motivate, develop, and direct people as they work, identifying the best people for the job?                                                                                                                                              |                                                                                                                                                        |          |
| <i>Time Management:</i> Managing one's own time and the time of others                                                                                                                                                                                                                        |                                                                                                                                                        |          |
| <i>Seek and Value Diversity:</i> Do workers need to work with people (as colleagues/clients etc.) from other cultures/States/socio-economic backgrounds etc? Is it important for their job performance? Is it likely to be important for their job performance?                               |                                                                                                                                                        |          |
| <i>Gender Diversity:</i> Do workers need to work with female colleagues/clients, etc.? Is it important for their job performance? Is it likely to important for their job performance?                                                                                                        |                                                                                                                                                        |          |
| <i>Conscientiousness (including attitude towards work):</i> Will the worker need to be organised, responsible, and hardworking, or have any one of the following traits- Competence (efficient), organised, dutiful (not careless), ambitious, self-discipline (not lazy), and not impulsive? |                                                                                                                                                        |          |
| <i>Openness to Experiences:</i> Will the worker need to be open to new aesthetic, cultural, or intellectual experiences or have any one of the following traits- Imaginative, artistic, excitable, wide interests, curious and unconventional?                                                |                                                                                                                                                        |          |
| <i>Extraversion-</i> Will the worker need to show the following traits- warmth (friendly), sociable, self-confident, energetic, excitement seeking (adventurous), and enthusiastic?                                                                                                           |                                                                                                                                                        |          |



Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)

| Skills Required                                                                                                                                                                           | If required, what is the degree of competence needed in the employee?<br>1. Beginner; 2. Intermediate<br>3. Competent; 4. Advanced<br>5. Very Advanced | Comments |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <i>Agreeableness</i> - Will the worker need to work in a team in a cooperative, unselfish manner?                                                                                         |                                                                                                                                                        |          |
| <i>Neuroticism/Emotional stability</i> – Will the worker need to show emotional stability i.e. predictability and consistency in emotional reactions, with absence of rapid mood changes? |                                                                                                                                                        |          |
| Does the worker need social skills at work?                                                                                                                                               |                                                                                                                                                        |          |
| <i>Instructing</i> - Does the worker need to teach others how to do something?                                                                                                            |                                                                                                                                                        |          |
| <i>Negotiation</i> - Does the worker need to bring others together and try to reconcile differences?                                                                                      |                                                                                                                                                        |          |
| <i>Persuasion</i> - Do workers need to persuade others to change their minds or behaviour?                                                                                                |                                                                                                                                                        |          |
| <i>Occupation-specific skills</i>                                                                                                                                                         |                                                                                                                                                        |          |
| <i>Physical skills</i> , including job-specific complex psychomotor skills                                                                                                                |                                                                                                                                                        |          |
| <i>Global Competence</i> – Globally competent workers                                                                                                                                     |                                                                                                                                                        |          |
| <i>Any other?</i> Please specify:                                                                                                                                                         |                                                                                                                                                        |          |

\*Animal Husbandry skills: Understanding the breeding & genetics of dairy breeds; Nutrition Management: Knowledge of balanced diets to ensure optimal milk production and animal health; Health Management: Skills in identifying and treating common diseases like mastitis, which can affect milk quality.

## National Skill Gap Study for High Growth

### Questionnaire 4: Questionnaire for Textile Weaving Industry

#### National Council of Applied Economic Research

Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE) is undertaking the 'National Skill Gap Study for High Growth Sectors' and NCAER is the implementing agency for the said study. The overall objective of in this work is develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for jobs roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship. Your identity would be held confidential while discussing your suggestions and views on the subject.

1. Date of Interview: .....
2. Respondent's Name: .....
3. Respondent's Designation & Company: .....
4. Respondent's Phone: .....
5. Respondent's Email: .....
6. Major line of activity of your organisation: .....
7. Industry ownership type (Tick most applicable): Public Sector-1; Private Limited-2; Public Limited-3; Partnership/ Individual Ownership-4; Multinational Company-5; Limited Liability Partnership (LLP)-6; Co-operatives -7, Others-99, specify.....
8. Annual Turnover in sales in FY 2023-24 (Tick most applicable): ≤ Rs 5 crore (Micro)-1; > Rs 5 crore & ≤ Rs 50 crore (Small) - 2; > Rs 50 crore & ≤ Rs 250 crore (Medium)-3; > Rs 250 crore (Large) - 4. If case of cooperatives, specify.....
9. Annual Investment in Plant and Machinery in FY 2023-24 (Tick most applicable): ≤ Rs 1 crore-1; > Rs 1 crore & ≤ Rs 10 crore-2; > Rs 10 crore & ≤ Rs 50 crore-3; > Rs 50 crore-4; No investment-5. If case of cooperatives, Specify.....

10. Please provide the following details about the workers employed in your industry.

| S. No.             | Particulars                  | Number of people employed |         |
|--------------------|------------------------------|---------------------------|---------|
|                    |                              | Managerial Staff          | Workers |
| 1.                 | Permanent Employees/workers* |                           |         |
| 2.                 | Temporary Employees/workers  |                           |         |
| Total Employees    |                              |                           |         |
| % Female employees |                              |                           |         |

\*permanent workers/employees should satisfy all three conditions- have more than one 1-year written contract, employer-provided social security benefits and paid leave.

11. In which sector your company operates? (Tick)  
Handloom-1, Powerloom-2, Spinning mills-3, Composite mills-4, Recycle textiles-5, Green textile-6, Technical textile-7, Other specify-8.....
12. What are your company's core products or services?
13. What are the key stages in supply chain network where your company operates? (Tick)  
Ginning-1, Spinning-2, Weaving-3, Finishing-4, Marketing-5, Other specify-6.....
14. Has your company has adopted technological advancements in last three years?  
a. Yes-1, No-2  
14.2 If yes, what kind of recent technological advancements have you adopted?

15. Were you able to get the sufficient employees for operating new technologies?
16. What are the major challenges your company faces in the textile weaving industry related to human resources requirements and skilling (including female workers)?
17. How do you ensure that your workforce is skilled and up-to-date with industry standards?
18. What types of training and development programs do you offer your employees?
19. How do you see the textile industry evolving in the future? What major changes or developments do you anticipate?
20. At the entry-level positions, what is the level of experience you take (Multiple ticks)?
  - a. Fresher's =1
  - b. Candidates with some Apprenticeship/internship program=2
  - c. Experienced= 3
  - d. Others=99, specify\_\_\_\_\_
21. Do you provide on-the-job training around (before or after) deployment? (Yes=1/No=2)
22. If 'Yes', what is your policy for providing on-the-job training?
23. What is the medium used for advertising/ recruitment for the workers (multiple ticks possible)?
  - a. Online job sites/advertisements=1
  - b. Own website advertisements =2
  - c. Newspaper advertisements =3
  - d. Campus recruitments =4
  - e. Local Network in nearby locations/villages =5
  - f. Others =99, specify\_\_\_\_\_
24. Have you advertised for particular jobs in the last three years (Yes=1/No=2)?
25. If 'Yes', can you share the list of jobs that you have advertised in last 3 years? How easy or difficult were they to fill? Please rate it on a Likert scale of 1 to 5.

| S. No. | Job Roles Advertised | Level of Position (Entry=1/<br>Intermediate=2/ Senior=3) | Ease of filling jobs<br>(Very hard=1; Hard=2;<br>Average=3; Easy=4; Very<br>easy=5; Not filled at all=99) |
|--------|----------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 1.     |                      |                                                          |                                                                                                           |
| 2.     |                      |                                                          |                                                                                                           |
| 3.     |                      |                                                          |                                                                                                           |
| 4.     |                      |                                                          |                                                                                                           |
| 5.     |                      |                                                          |                                                                                                           |

26. What are the primary reasons for the vacancies that were either not filled or difficult to be filled in your organisation? (Multiple ticks possible)
  - a) Lack of technical skills=1
  - b) Lack of non-technical skills (communication skill, soft skill, etc.) =2
  - c) Lack of experience=3
  - d) Inadequate educational qualifications=4
  - e) Others=99 specify\_\_\_\_\_
27. In your opinion, what will be the changes in the pattern of the employment/ job roles in your sector given the structural, technological and other changes in the next three years?
  - a. In which types of skills or job roles, you feel industry is facing shortage since last 3 years and what remedies you have taken to resolve this shortage? Refer *Annexure 6.3* for job roles.

28. Which job roles you think will be in-demand in the next three years? (You can refer to the List of job roles (either existing as given in the Annexure 6.3 or may add new job roles)  
(Alternatively, Table Q4.1 and Q4.2 may be filled)

|                                                                                                                                                                             |  |  |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
| Job Role                                                                                                                                                                    |  |  |  |  |  |
| Stage of Value Chain                                                                                                                                                        |  |  |  |  |  |
| Tasks                                                                                                                                                                       |  |  |  |  |  |
| Education: up to primary-1, middle-2, secondary-3, senior secondary-4, Graduate/ equivalent diploma-5, PG/ equivalent diploma-6, Vocational/ technical-7, others-8, specify |  |  |  |  |  |
| Knowledge                                                                                                                                                                   |  |  |  |  |  |
| Technical Skills                                                                                                                                                            |  |  |  |  |  |
| Years of Experience                                                                                                                                                         |  |  |  |  |  |
| Skills                                                                                                                                                                      |  |  |  |  |  |
| Geographical areas/spatial clusters where needs are highest (mention States and Districts)                                                                                  |  |  |  |  |  |
| Difficulty of finding workers (1. Not at all difficult; 2. Somewhat difficult; 3. Difficult; 4. Very Difficult; 5. Extremely difficult)                                     |  |  |  |  |  |

29. What is your role in designing the required skill curriculum/providing trainings for particular skills in various research institutes or textile training centres?
30. In the case of MSME firm, is there multiskilling? (Yes-1, No-2), If yes, explain how?
31. Do you sponsor upskilling/ reskilling programs for your own employees?
32. Do you offer career paths or lifelong learning to workers?
33. Does your company collaborate in skill initiatives programmes of the government? If yes, in what ways?

#### **GENDER DIVERSITY AND CARRER PATH AT WORKPLACE**

34. What are the prominent job roles for female workers in your organisation and what is their percentage (as % of total employees)?

| S.No. | Job Roles | % Female employees out of total |
|-------|-----------|---------------------------------|
|       |           |                                 |

35. In the next three years, do you perceive that there will be demand for women workers in your organisation for the above-mentioned job roles? Are there any new upcoming job roles where women would be required most? What are you doing to address these future needs? Does your industry have women friendly policies?
36. Has the firm defined sexual harassment policies, prevention systems, procedures and service rules for employees (Prevention of Sexual Harassment at Workplace or POSH)?  
Yes-1 / No-2

Table Q4.1: Details of Identified Job Roles  
Job Descriptors

|                                                                                                                                                                                                                                 |                                               |  |  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--|--|--|--|
| Descriptors                                                                                                                                                                                                                     |                                               |  |  |  |  |
| Alternative job titles in the industry                                                                                                                                                                                          |                                               |  |  |  |  |
| Stage of textile value chain:<br>1. Ginning<br>2. Spinning<br>3. Weaving<br>4. Post weaving activities<br>5. Marketing                                                                                                          |                                               |  |  |  |  |
| Is this job role:<br>1. 'Difficult to fill' at present, or<br>2. Will be in-demand in next 3 years by the firm.                                                                                                                 |                                               |  |  |  |  |
| How many do you need to hire at the 'present moment'/now, or you will need to hire 3 years from now?                                                                                                                            |                                               |  |  |  |  |
| Tasks to be performed in the job role (please include specific systems / components / technologies / personnel required to be dealt or interacted with, if any)                                                                 |                                               |  |  |  |  |
| Education:<br>School (up to what level?) / ITI/ Short-term vocational training programme/ Bachelors/ Masters)                                                                                                                   |                                               |  |  |  |  |
| Knowledge                                                                                                                                                                                                                       | General? What knowledge?                      |  |  |  |  |
|                                                                                                                                                                                                                                 | Specialised (Sector, Occupational, and Trade) |  |  |  |  |
| Technical Skills:<br>Software languages required, or maybe required in the near future                                                                                                                                          |                                               |  |  |  |  |
| Years of Experience, if any                                                                                                                                                                                                     |                                               |  |  |  |  |
| Skills required and level of competence (refer to framework of skills in Table 2 below)                                                                                                                                         |                                               |  |  |  |  |
| Difficulty of finding workers in the job role, with the above requirements and the skills as detailed below:<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |                                               |  |  |  |  |
| Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role** (mention States and Districts)                                                                                         |                                               |  |  |  |  |

\*\* Please explain the reasons behind skill shortage in the specified states and districts: Are there demand side factors (such as low salary, demanding work conditions, absence of platforms to advertise jobs, non-acceptability of workers from conventional labour markets, competition from other sectors to hire the same candidate, etc) and/or supply side factors (such as course not offered by Indian institutions, specialised skilled people not available, absence of and/or proximity to training centres, poor quality of skilling and training programs, lack of programs for re-skilling/upskilling workers from traditional sectors, high salary expectations, non-aspirational job role, availability of other work avenues, etc.)?

Table Q4.2: List of Skills

| <p>Please think whether the person in the above job profile would need the following skills to do their job.<br/>Please choose the relevant skills and indicate the level of competence required for those skills<br/>1. Beginner; 2. Intermediate; 3. Competent; 4. Advanced; 5. Very Advanced</p>                                             |  |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| Skills Required/Job Role                                                                                                                                                                                                                                                                                                                        |  |  |  |  |
| <i>Reading Literacy:</i> Would they need to read and understanding written sentences and paragraphs in work related documents?                                                                                                                                                                                                                  |  |  |  |  |
| <i>Writing:</i> Would they need to communicate effectively in writing as per their audience for their job?                                                                                                                                                                                                                                      |  |  |  |  |
| <i>Speaking:</i> Do they need to talk to others to convey information effectively?                                                                                                                                                                                                                                                              |  |  |  |  |
| <i>Communication:</i> Would they need to provide information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person?                                                                                                                                                                                  |  |  |  |  |
| <i>Language Skills 1:</i> Is knowledge of the structure and content of the language including the meaning and spelling of words, rules of composition, and grammar required for the job?                                                                                                                                                        |  |  |  |  |
| <i>Language Skills 2:</i> Any specific language requirement for the job? If Yes, which one?                                                                                                                                                                                                                                                     |  |  |  |  |
| <i>Numeracy/Mathematics:</i> Would they need to work with numbers for their job?                                                                                                                                                                                                                                                                |  |  |  |  |
| <i>ICT Literacy to Skills:</i> Would they need to use mobile phones/tabs/computers etc. to do their job?<br>For example, Arts & Graphics, Desktop Publishing, Presentation, Spreadsheet, Word Processing, Programming, Client Server/Networking/Hardware, Operating Systems, Database/Statistics, Engineering Software and Web Page Design etc. |  |  |  |  |
| <i>Self-learning to Active (Independent) Learning:</i> Would they need to understand new information for both current and future problem-solving and decision-making at their job? Are they expected to do on their own for the job or self-learn, if the material is provided to them?                                                         |  |  |  |  |
| <i>Active Listening:</i> Do they need to listen for their job, like taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times?                                                                                                                                              |  |  |  |  |
| <i>Science:</i> Do they need to use scientific rules and methods to solve problems at work?                                                                                                                                                                                                                                                     |  |  |  |  |
| <i>Problem Solving:</i> Do they need to identify problems and review related information to develop and evaluate options and implement solutions?                                                                                                                                                                                               |  |  |  |  |
| <i>Learning Strategies:</i> Do they need to select and use training/instructional methods and procedures appropriate for the situation when learning or teaching new things?                                                                                                                                                                    |  |  |  |  |
| <i>Critical Thinking:</i> Would the worker need to use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems?                                                                                                                                                            |  |  |  |  |

| <p>Please think whether the person in the above job profile would need the following skills to do their job.</p> <p>Please choose the relevant skills and indicate the level of competence required for those skills</p> <p>1. Beginner; 2. Intermediate; 3. Competent; 4. Advanced; 5. Very Advanced</p> |  |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| Skills Required/Job Role                                                                                                                                                                                                                                                                                  |  |  |  |  |
| <i>Creativity:</i> Do the workers need to develop, design, or create new applications, ideas, relationships, systems, or products, including artistic contributions?                                                                                                                                      |  |  |  |  |
| <i>Independent research:</i> Would the worker need to conduct literature review, undertake data collection, cleaning etc., develop research plan?                                                                                                                                                         |  |  |  |  |
| <i>Judgement and Decision-making:</i> Would the worker need to consider the relative costs and benefits of potential actions to choose the most appropriate one?                                                                                                                                          |  |  |  |  |
| <i>Systems Analysis:</i> Would the worker need to determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes?                                                                                                                               |  |  |  |  |
| <i>Systems Evaluation:</i> Would workers need to identify measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system?                                                                                                     |  |  |  |  |
| <i>Financial Resources:</i> Would the worker need to determine how money will be spent to get the work done, and accounting for these expenditures?                                                                                                                                                       |  |  |  |  |
| <i>Material Resources:</i> Would the worker need to obtain and see to the appropriate use of equipment, facilities, and materials needed to do certain work?                                                                                                                                              |  |  |  |  |
| <i>Personnel Resources:</i> Would the worker need to motivate, develop, and direct people as they work, identifying the best people for the job?                                                                                                                                                          |  |  |  |  |
| <i>Time Management:</i> Managing one's own time and the time of others                                                                                                                                                                                                                                    |  |  |  |  |
| <i>Seek and Value Diversity:</i> Do workers need to work with people (as colleagues/clients etc.) from other cultures/States/socio-economic backgrounds etc? Is it important for their job performance? Is it likely to be important for their job performance?                                           |  |  |  |  |
| <i>Gender Diversity:</i> Do workers need to work with female colleagues/clients etc.? Is it important for their job performance? Is it likely to be important for their job performance?                                                                                                                  |  |  |  |  |
| <i>Conscientiousness (including attitude towards work):</i> Will the worker need to be organised, responsible, and hardworking or have any one of the following traits- Competence (efficient), organised, dutiful (not careless), ambitious, self-discipline (not lazy), and not impulsive?              |  |  |  |  |
| <i>Openness to Experiences:</i> Will the worker need to be open to new aesthetic, cultural, or intellectual experiences or have any one of the following traits- Imaginative, artistic, excitable, wide interests, curious and unconventional?                                                            |  |  |  |  |
| <i>Extraversion:</i> Will the worker need to show the following traits- warmth (friendly), sociable, self-confident, energetic, excitement seeking                                                                                                                                                        |  |  |  |  |

|                                                                                                                                                                                                                                                                                                                                |  |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| <p><i>Please think whether the person in the above job profile would need the following skills to do their job.</i></p> <p><i>Please choose the relevant skills and indicate the level of competence required for those skills</i></p> <p><i>1. Beginner; 2. Intermediate; 3. Competent; 4. Advanced; 5. Very Advanced</i></p> |  |  |  |  |
| <i>Skills Required/Job Role</i>                                                                                                                                                                                                                                                                                                |  |  |  |  |
| (adventurous), and enthusiastic?                                                                                                                                                                                                                                                                                               |  |  |  |  |
| <i>Agreeableness:</i> Will the worker need to work in a team in a cooperative, unselfish manner?                                                                                                                                                                                                                               |  |  |  |  |
| <i>Neuroticism/Emotional stability:</i> Will the worker need to show emotional stability i.e. predictability and consistency in emotional reactions, with absence of rapid mood changes?                                                                                                                                       |  |  |  |  |
| <i>Does the worker need social skills at work?</i>                                                                                                                                                                                                                                                                             |  |  |  |  |
| <i>Instructing:</i> Does the worker need to teach others how to do something?                                                                                                                                                                                                                                                  |  |  |  |  |
| <i>Negotiation:</i> Does the worker need to bring others together and try to reconcile differences?                                                                                                                                                                                                                            |  |  |  |  |
| <i>Persuasion:</i> Do workers need to persuade others to change their minds or behaviour?                                                                                                                                                                                                                                      |  |  |  |  |
| <i>Occupation-specific skills</i>                                                                                                                                                                                                                                                                                              |  |  |  |  |
| <i>Physical skills</i> , including job-specific complex psychomotor skills                                                                                                                                                                                                                                                     |  |  |  |  |
| <i>Global Competence:</i> Globally competent workers                                                                                                                                                                                                                                                                           |  |  |  |  |
| <i>Any other?</i> Please specify:                                                                                                                                                                                                                                                                                              |  |  |  |  |





**National Skill Gap Study for High Growth**  
**Questionnaire 5: Questionnaire for Manufacturing of Motor Vehicles**

**National Council of Applied Economic Research**

Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE), Government of India, is undertaking the 'National Skill Gap Study for High Growth Sectors' and NCAER is the implementing agency for the said study. The overall objective of this work is to develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for jobs roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship. Your identity would be held confidential while discussing your suggestions and views on the subject.

Respondent's Name: .....

Respondent's Company Name and Address: .....

Respondent's Designation: .....

Respondent's Phone: .....

Respondent's Email: .....

**FIRM PROFILE**

1. What is the firm's ownership type? *(Please select one)*

- |                                                           |                                                        |                                                        |
|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| <input type="checkbox"/> Public Sector                    | <input type="checkbox"/> Public Limited                | <input type="checkbox"/> Private Limited               |
| <input type="checkbox"/> Partnership/Individual Ownership | <input type="checkbox"/> Multinational Company         | <input type="checkbox"/> Limited Liability Partnership |
| <input type="checkbox"/> Cooperative                      | <input type="checkbox"/> Others, please specify: _____ |                                                        |

2. What was the annual turnover range in FY 2023-24? *(Please select one)*

- |                                                                  |                                                               |
|------------------------------------------------------------------|---------------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 5 crore (Micro)                    | <input type="checkbox"/> > Rs 5 crore & ≤ Rs 50 crore (Small) |
| <input type="checkbox"/> > Rs 50 crore & ≤ Rs 250 crore (Medium) | <input type="checkbox"/> > Rs 250 crore (Large)               |

3. How many manufacturing plants does the firm have in India? Information on plant locations (States, Districts, Clusters) will help in understanding the spatial spread of the industry.

Number of plants: \_\_\_\_\_

States and Districts: \_\_\_\_\_

Are the plants located in an auto cluster? Yes / No: \_\_\_\_\_; If 'Yes', which cluster: \_\_\_\_\_

4. What was the investment in plant and machinery in FY 2023-24? *(Please select one)*

- |                                                        |                                                       |
|--------------------------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 1 crore                  | <input type="checkbox"/> > Rs 1 crore & ≤ Rs 10 crore |
| <input type="checkbox"/> > Rs 10 crore & ≤ Rs 50 crore | <input type="checkbox"/> > Rs 50 crore                |
| <input type="checkbox"/> No investment                 |                                                       |

5. What type of motor vehicles does the firm manufacture? *(multiple selections possible)*

- ☐ Passenger vehicles; what type (SUV/hatchback/etc): \_\_\_\_\_
- ☐ Commercial vehicles; what type (trucks/buses/etc): \_\_\_\_\_
- ☐ Trailers / semi-trailers; what type (flatbed/refrigerated/etc): \_\_\_\_\_
- ☐ Other, please specify: \_\_\_\_\_; what kind: \_\_\_\_\_

6. Which technologies do the motor vehicles adhere to? *(multiple selections possible)*

- |                                                                            |                                                          |
|----------------------------------------------------------------------------|----------------------------------------------------------|
| <input type="checkbox"/> Internal combustion engine (ICE: Petrol / Diesel) | <input type="checkbox"/> Electric vehicles (EV)          |
| <input type="checkbox"/> Compressed Natural Gas (CNG)                      | <input type="checkbox"/> Bio-fuel, please specify: _____ |
| <input type="checkbox"/> Hydrogen fuel                                     | <input type="checkbox"/> All technologies                |
| <input type="checkbox"/> Other, please specify: _____                      |                                                          |

7. Which markets do you sell to?  
Domestic / Foreign / Both: \_\_\_\_\_
8. Overall, what is the percentage of female employees in the firm? (*Please select one*)
- |                                      |                                      |                                      |
|--------------------------------------|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> 0%          | <input type="checkbox"/> ≤20%        | <input type="checkbox"/> >20% & ≤40% |
| <input type="checkbox"/> >40% & ≤60% | <input type="checkbox"/> >60% & ≤80% | <input type="checkbox"/> >80%        |

#### UNDERSTANDING HIRING, SKILLING, GENDER-BASED ROLES, AND SKILL SHORTAGES

9. What are the mediums used for hiring employees? (*multiple selections possible*)
- |                                                         |                                                                                            |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Employment agency              | <input type="checkbox"/> Online job sites/advertisements; Please specify: _____            |
| <input type="checkbox"/> Own website advertisements     | <input type="checkbox"/> Campus recruitment; Please mention institutions: _____            |
| <input type="checkbox"/> Vocational training institutes | <input type="checkbox"/> Sector Skill Council / Sector Skill Council affiliated institutes |
| <input type="checkbox"/> Newspaper advertisements       | <input type="checkbox"/> Internships/apprenticeships                                       |
| <input type="checkbox"/> Networks and referrals         | <input type="checkbox"/> Others, specify: _____                                            |
10. Do you provide on-the-job training within the firm, either before or after deployment?  
Yes / No: \_\_\_\_\_  
If 'Yes', what is your policy? \_\_\_\_\_  
Should this training rather be provided by India's education and skilling system? \_\_\_\_
11. Does the firm run its own skilling institution, or have any tie-up/informal-association with another institution / Automotive Skill Development Council (ASDC) for skilling purposes?  
11.1 Yes / No: \_\_\_\_\_; Is it owned by the firm? Yes / No: \_\_\_\_\_  
11.2 If 'Yes', please mention which institutions: \_\_\_\_\_
12. What kind of association(s) does the firm have with the skilling institution(s) identified in Q.11? (*multiple selections possible*)
- |                                                                                            |                                                                                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <input type="checkbox"/> We offer apprenticeships/internships for trainee students         | <input type="checkbox"/> We send our staff to take visiting classes or other classes  |
| <input type="checkbox"/> We offer inputs to the course curriculum                          | <input type="checkbox"/> We sponsor lab facilities in TVET or other institutions      |
| <input type="checkbox"/> We sponsor fresh skilling programmes to absorb the students later | <input type="checkbox"/> We sponsor re-skilling/upskilling programs for our employees |
| <input type="checkbox"/> No associations                                                   | <input type="checkbox"/> Other; please specify: _____                                 |

We have collated a list of occupations from the National Classification of Occupations (NCOs) and job roles from Automotive Skills Development Council (ASDC), associated with the full automotive value chain (white and blue collar), including manufacturing, and repair and maintenance, in Annexure 7.1.

13. For all types of motor vehicle manufacturing that the firm is involved in (Q.5), do the job roles (Annexure 7.1) cover the relevant activities undertaken by the firm?  
Yes / No: \_\_\_\_\_  
What other occupations/job roles should be included? Please specify: \_\_\_\_\_
14. As regards gender ratio, which job roles:  
Employ majority women (>50% of all workers in the job role): \_\_\_\_\_  
Employ some women (20% to 50% of all workers in the job role): \_\_\_\_\_  
Employ no women (0% of all workers in the job role): \_\_\_\_\_

15. How easy or difficult was it to fill the job roles (including the number of positions) advertised by the firm in the last three years (FY 2021-22 onwards)? (Add rows if necessary. If the firm advertised many job roles, you can specify job roles at two extremes: those which were easiest to fill, and those very difficult/un-filled)

| S.No. | Job Roles advertised | Please Specify the Level:<br>Entry level / intermediate or<br>mid-level / senior level /<br>managerial level / director level<br>/ executive level | Difficulty of filling jobs (rank)<br>1. Very easy; 2. Easy; 3. Average; 4.<br>Difficult; 5. Very difficult; 6. Not filled<br>at all |
|-------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1     |                      |                                                                                                                                                    |                                                                                                                                     |
| 2     |                      |                                                                                                                                                    |                                                                                                                                     |
| 3     |                      |                                                                                                                                                    |                                                                                                                                     |
| 4     |                      |                                                                                                                                                    |                                                                                                                                     |
| 5     |                      |                                                                                                                                                    |                                                                                                                                     |

16. In Q.15, for the job roles with rank 3-6 on 'difficulty of filling jobs', can you please detail the skills, knowledge and education sought by the firm – in the form of a detailed job description? (Please refer to Table Q5.1. Request you to provide the details, for each of the relevant job roles, within the format of Table Q5.1).

We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Educational Qualifications sought by the firm | Knowledge (technical and theoretical knowledge relating to the job role) | Technical Skills (Computer applications and software) | Years of Experience | Skills (refer to Table Q5.2) | Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role (mention States and Districts) |
|----------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |                                               |                                                                          |                                                       |                     |                              |                                                                                                                                       |

17. Who is presently providing education and skilling for these 'hard to fill' job roles in Q.16, if any? Nobody / formal education system / vocational education system? Please specify: \_\_\_\_\_  
Is the formal/vocational education system run by the government/ private parties /NGOs?  
Please specify: \_\_\_\_\_  
Please list the formal and vocational training institutions for these job-roles: \_\_\_\_\_
18. For the motor vehicle manufacturing the firm is involved in (Q.5 and Q.6), what are the upcoming technological developments?  
Please specify: \_\_\_\_\_
19. Does the firm have its own R&D and design division, or plan to develop one?  
Have R&D unit/ Plan to set up R&D unit / no R&D and no plan: \_\_\_\_\_

20. In view of the developments (Q.18 and Q.19), which job roles will be in-demand in the next three years by the firm? (Please refer to *Table Q5.1* Request you to provide the details, for each of the relevant job roles, within the format of *Table Q5.1*).

We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Education | Knowledge | Technical Skills | Years of Experience | Skills (refer to Table Q5.2) | Geographical areas/spatial clusters where needs are highest (mention States and Districts) | Difficulty of finding workers<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |
|----------|----------------------|-------|-----------|-----------|------------------|---------------------|------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |           |           |                  |                     |                              |                                                                                            |                                                                                                                                                  |

### GENDER DIVERSITY AND CARRER PATH AT WORKPLACE

21. In the next three years, do you perceive a demand for women in particular job roles, either among the existing job-roles or those which will be in-demand in future?

Yes / No: \_\_\_\_\_

If 'Yes', please specify which ones: \_\_\_\_\_

22. Does the firm have hiring policies to encourage female employment, especially in non-traditional job roles?

Yes / No: \_\_\_\_\_

If 'Yes', please explain the policy in detail: \_\_\_\_\_

Does the firm provide creche on plant/office premises: Yes / No: \_\_\_\_\_

23. Has the firm defined sexual harassment policies, prevention systems, procedures and service rules for employees (prevention of Sexual Harassment at Workplace or POSH)?

Yes / No: \_\_\_\_\_

24. Does the firm offer a career-path to all its employees? (for instance, has anyone at the firm risen from being at a 'technician level position' to a 'managerial level position')?

Yes / No: \_\_\_\_\_

Does the firm fund the employee's education / upskilling / re-skilling, as may be required for higher level job roles? Yes / No: \_\_\_\_\_

### EMPLOYMENT BACKGROUND

25. How many people are employed at the firm?

| 25. How many people are employed at the firm: |             |                           |               |
|-----------------------------------------------|-------------|---------------------------|---------------|
| S.No.                                         | Particulars | Number of people employed |               |
|                                               |             | Managerial Staff (No.)    | Workers (No.) |
| Total Employees (in numbers)                  |             |                           |               |

26. With reference to the total employees identified in Q.25, what is the educational background of the employees (as percentage (%) of total employees)?

| Below Class X (%) | Above Class X and Below Class XII (%) | Class XII pass (%) | Vocationally Educated (ITI, PMKVY, RPL etc.) (%) | Bachelor's degree and above (%) |
|-------------------|---------------------------------------|--------------------|--------------------------------------------------|---------------------------------|
|                   |                                       |                    |                                                  |                                 |

\*\*\*

**National Skill Gap Study for High Growth**  
**Questionnaire 6: Questionnaire for Manufacturing of Parts and Accessories of Motor Vehicles**

**National Council of Applied Economic Research**  
Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE), Government of India, is undertaking the 'National Skill Gap Study for High Growth Sectors' and NCAER is the implementing agency for the said study. The overall objective of this work is to develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for jobs roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship.

Your identity would be held confidential while discussing your suggestions and views on the subject.

Respondent's Name: .....

Respondent's Company Name and Address: .....

Respondent's Designation: .....

Respondent's Phone: .....

Respondent's Email: .....

**FIRM PROFILE**

1. What is the firm's ownership type? *(Please select one)*

|                                                           |                                                        |                                                        |
|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| <input type="checkbox"/> Public Sector                    | <input type="checkbox"/> Public Limited                | <input type="checkbox"/> Private Limited               |
| <input type="checkbox"/> Partnership/Individual Ownership | <input type="checkbox"/> Multinational Company         | <input type="checkbox"/> Limited Liability Partnership |
| <input type="checkbox"/> Cooperative                      | <input type="checkbox"/> Others, please specify: _____ |                                                        |
2. What was the annual turnover range in FY 2023-24? *(Please select one)*

|                                                                  |                                                               |
|------------------------------------------------------------------|---------------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 5 crore (Micro)                    | <input type="checkbox"/> > Rs 5 crore & ≤ Rs 50 crore (Small) |
| <input type="checkbox"/> > Rs 50 crore & ≤ Rs 250 crore (Medium) | <input type="checkbox"/> > Rs 250 crore (Large)               |
3. How many manufacturing plants does the firm have in India? Information on plant locations (States, Districts, Clusters) will help in understanding the spatial spread of the industry.  
Number of plants: \_\_\_\_\_  
States and Districts: \_\_\_\_\_  
Are the plants located in an auto cluster? Yes / No: \_\_\_\_\_; If 'Yes', which cluster: \_\_\_\_\_
4. What was the investment in plant and machinery in FY 2023-24? *(Please select one)*

|                                                        |                                                       |
|--------------------------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 1 crore                  | <input type="checkbox"/> > Rs 1 crore & ≤ Rs 10 crore |
| <input type="checkbox"/> > Rs 10 crore & ≤ Rs 50 crore | <input type="checkbox"/> > Rs 50 crore                |
| <input type="checkbox"/> No investment                 |                                                       |
5. Which tier(s) of auto component manufacturing is the firm involved in? *(multiple selections possible)*

|                                                                                  |
|----------------------------------------------------------------------------------|
| <input type="checkbox"/> Tier 1 supplier; Components include: _____              |
| <input type="checkbox"/> Tier 2 supplier; Components include: _____              |
| <input type="checkbox"/> Tier 3 supplier; Components include: _____              |
| <input type="checkbox"/> Other, please specify: _____; Components include: _____ |
6. Which motor vehicle technologies do the component(s) adhere to? *(multiple selections possible)*

|                                                                          |                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------|
| <input type="checkbox"/> Internal combustion engine (ICE: Petrol/Diesel) | <input type="checkbox"/> Electric vehicles (EV)          |
| <input type="checkbox"/> Compressed Natural Gas (CNG)                    | <input type="checkbox"/> Bio-fuel, please specify: _____ |
| <input type="checkbox"/> Hydrogen fuel                                   | <input type="checkbox"/> All technologies                |
| <input type="checkbox"/> Other, please specify: _____                    |                                                          |

7. Which markets do you sell to?  
Domestic / Foreign / Both: \_\_\_\_\_
8. Overall, what is the percentage of female employees in the firm? (*Please select one*)
- |                                      |                                      |                                      |
|--------------------------------------|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> 0%          | <input type="checkbox"/> ≤20%        | <input type="checkbox"/> >20% & ≤40% |
| <input type="checkbox"/> >40% & ≤60% | <input type="checkbox"/> >60% & ≤80% | <input type="checkbox"/> >80%        |

#### UNDERSTANDING HIRING, SKILLING, GENDER-BASED ROLES, AND SKILL SHORTAGES

9. What are the mediums used for hiring employees? (*multiple selections possible*)
- |                                                         |                                                                                            |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Employment agency              | <input type="checkbox"/> Online job sites/advertisements; Please specify: _____            |
| <input type="checkbox"/> Own website advertisements     | <input type="checkbox"/> Campus recruitment; Please mention institutions: _____            |
| <input type="checkbox"/> Vocational training institutes | <input type="checkbox"/> Sector Skill Council / Sector Skill Council affiliated institutes |
| <input type="checkbox"/> Newspaper advertisements       | <input type="checkbox"/> Internships/apprenticeships                                       |
| <input type="checkbox"/> Networks and referrals         | <input type="checkbox"/> Others, specify: _____                                            |
10. Do you provide on-the-job training within the firm, either before or after deployment?  
Yes / No: \_\_\_\_\_  
If 'Yes', what is your policy? \_\_\_\_\_  
Should this training rather be provided by India's education and skilling system? \_\_\_\_
11. Does the firm run its own skilling institution, or have any tie-up / partnership with another institution / ASDC for skilling purposes?  
Yes / No: \_\_\_\_\_; Is it owned by the firm? Yes / No: \_\_\_\_\_  
If 'Yes', please mention which institutions: \_\_\_\_\_
12. What kind of association(s) does the firm have with the skilling institution(s) identified in Q.11? (*multiple selections possible*)
- |                                                                                            |                                                                                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <input type="checkbox"/> We offer apprenticeships/internships for trainee students         | <input type="checkbox"/> We send our staff to take visiting classes or other classes  |
| <input type="checkbox"/> We offer inputs to the course curriculum                          | <input type="checkbox"/> We sponsor lab facilities in TVET or other institutions      |
| <input type="checkbox"/> We sponsor fresh skilling programmes to absorb the students later | <input type="checkbox"/> We sponsor re-skilling/upskilling programs for our employees |
| <input type="checkbox"/> No associations                                                   | <input type="checkbox"/> Other; please specify: _____                                 |
- We have collated a list of occupations from the National Classification of Occupations (NCOs) and job roles from Automotive Skills Development Council (ASDC), associated with the full automotive value chain (white and blue collar), including manufacturing, and repair and maintenance, in Annexure 7.1.
13. For all types of component manufacturing that the firm is involved in (Q.5), do the job roles (Annexure 7.1) cover the relevant activities undertaken by the firm?  
Yes / No: \_\_\_\_\_  
What other occupations/job roles should be included? Please specify: \_\_\_\_\_
14. As regards gender ratio, which job roles:  
Employ majority women (>50% of all workers in the job role): \_\_\_\_\_  
Employ some women (20% to 50% of all workers in the job role): \_\_\_\_\_  
Employ no women (0% of all workers in the job role): \_\_\_\_\_

15. How easy or difficult was it to fill the job roles (including the number of positions) advertised by the firm in the last three years (FY 2021-22 onwards)? (Add rows if necessary. If the firm advertised many job roles, you can specify job roles at two extremes: those which were easiest to fill, and those very difficult / un-filled)

| S. No. | Job Roles advertised | Please Specify the Level:<br>Entry level / intermediate or mid-level / senior level / managerial level / director level / executive level | Difficulty of filling jobs (rank)<br>1. Very easy; 2. Easy; 3. Average; 4. Difficult; 5. Very difficult; 6. Not filled at all |
|--------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1      |                      |                                                                                                                                           |                                                                                                                               |
| 2      |                      |                                                                                                                                           |                                                                                                                               |
| 3      |                      |                                                                                                                                           |                                                                                                                               |
| 4      |                      |                                                                                                                                           |                                                                                                                               |
| 5      |                      |                                                                                                                                           |                                                                                                                               |

16. In Q.15, for the job roles with rank 3-6 on 'difficulty of filling jobs', can you please detail the skills, knowledge and education sought by the firm– in the form of a detailed job description? (Please refer to Table Q5.1. Request you to provide the details, for each of the relevant job roles, within the format of Table Q5.1).

We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Educational Qualifications sought by the firm | Knowledge (technical and theoretical knowledge relating to the job role) | Technical Skills (Computer applications and software) | Years of Experience | Skills (refer to Table Q5.2) | Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role (mention States and Districts) |
|----------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |                                               |                                                                          |                                                       |                     |                              |                                                                                                                                       |

17. Who is presently providing education and skilling for these 'hard to fill' job roles in Q.16, if any?  
 Nobody / formal education system / vocational education system? Please specify: \_\_\_\_  
 Is the formal/vocational education system run by the government / private parties / NGOs?  
 Please specify: \_\_\_\_  
 Please list the formal and vocational training institutions for these job-roles: \_\_\_\_
18. For the component manufacturing the firm is involved in (Q.5 and Q.6), what are the upcoming technological developments?  
 Please specify: \_\_\_\_
19. Does the firm have its own R&D and design division, or plan to develop one?  
 Have R&D unit / Plan to set up R&D unit / no R&D and no plan: \_\_\_\_



20. In view of the developments (Q.18 and Q.19), which job roles will be in-demand in the next three years by the firm? (Please refer to *Table Q5.1*. Request you to provide the details, for each of the relevant job roles, within the format of *Table Q5.1*).

We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Education | Knowledge | Technical Skills | Years of Experience | Skills (refer to Table Q5.2) | Geographical areas/spatial clusters where needs are highest (mention States and Districts) | Difficulty of finding workers<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |
|----------|----------------------|-------|-----------|-----------|------------------|---------------------|------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |           |           |                  |                     |                              |                                                                                            |                                                                                                                                                  |

#### GENDER DIVERSITY AND CARRER PATH AT WORKPLACE

21. In the next three years, do you perceive a demand for women in particular job roles, either among the existing job-roles or those which will be in-demand in future?

Yes / No: \_\_\_\_\_

If 'Yes', please specify which ones: \_\_\_\_\_

22. Does the firm have hiring policies to encourage female employment, especially in non-traditional job roles?

Yes / No: \_\_\_\_\_

If 'Yes', please explain the policy in detail: \_\_\_\_\_

Does the firm provide creche on plant/office premises: Yes / No: \_\_\_\_\_

23. Has the firm defined sexual harassment policies, prevention systems, procedures and service rules for employees (Prevention of Sexual Harassment at Workplace or POSH)?

Yes / No: \_\_\_\_\_

24. Do the firm offer a career-path to all its employees? (for instance, has anyone at the firm risen from being at a 'technician level position' to a 'managerial level position')?

Yes / No: \_\_\_\_\_

Does the firm fund the employee's education / upskilling / re-skilling, as may be required for higher level job roles? Yes / No: \_\_\_\_\_

#### EMPLOYMENT BACKGROUND

25. How many people are employed at the firm?

| How many people are employed at the firm: |             |                           |               |
|-------------------------------------------|-------------|---------------------------|---------------|
| S.No.                                     | Particulars | Number of people employed |               |
|                                           |             | Managerial Staff (No.)    | Workers (No.) |
| Total Employees (in numbers)              |             |                           |               |

26. With reference to the total employees identified in Q.25, what is the educational background of the employees (as percentage (%) of total employees)?

| Below Class X (%) | Above Class X and Below Class XII (%) | Class XII pass (%) | Vocationally Educated (ITI, PMKVY, RPL etc.) (%) | Bachelor's degree and above (%) |
|-------------------|---------------------------------------|--------------------|--------------------------------------------------|---------------------------------|
|                   |                                       |                    |                                                  |                                 |

.....

**National Skill Gap Study for High Growth**  
**Questionnaire 7: Questionnaire for Maintenance and Repair of Motor Vehicles**

**National Council of Applied Economic Research**

Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE), Government of India, is undertaking the 'National Skill Gap Study for High Growth Sectors' and NCAER is the implementing agency for the said study. The overall objective of this work is to develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for jobs roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship.

Your identity would be held confidential while discussing your suggestions and views on the subject.

Respondent's Name: .....

Respondent's Firm Name and Address: .....

Respondent's Designation: .....

Respondent's Phone: .....

Respondent's Email: .....

**FIRM PROFILE**

1. What is the firm's ownership type? *(Please select one)*

- |                                                           |                                                        |                                                        |
|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| <input type="checkbox"/> Public Sector                    | <input type="checkbox"/> Public Limited                | <input type="checkbox"/> Private Limited               |
| <input type="checkbox"/> Partnership/Individual Ownership | <input type="checkbox"/> Multinational Company         | <input type="checkbox"/> Limited Liability Partnership |
| <input type="checkbox"/> Cooperative                      | <input type="checkbox"/> Others, please specify: _____ |                                                        |

2. What was the annual turnover range in FY 2023-24? *(Please select one)*

- |                                                                  |                                                               |
|------------------------------------------------------------------|---------------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 5 crore (Micro)                    | <input type="checkbox"/> > Rs 5 crore & ≤ Rs 50 crore (Small) |
| <input type="checkbox"/> > Rs 50 crore & ≤ Rs 250 crore (Medium) | <input type="checkbox"/> > Rs 250 crore (Large)               |

3. How many workshops/branches does the firm have in India? Information on locations (States, Districts, Clusters) will help in understanding the spatial spread of the industry.

Number of workshops: \_\_\_\_\_

States and Districts: \_\_\_\_\_

Are the workshops in an auto cluster? Yes / No: \_\_\_\_; If 'Yes', which cluster: \_\_\_\_\_

4. What was the investment in plant and machinery in FY 2023-24? *(Please select one)*

- |                                                        |                                                       |
|--------------------------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 1 crore                  | <input type="checkbox"/> > Rs 1 crore & ≤ Rs 10 crore |
| <input type="checkbox"/> > Rs 10 crore & ≤ Rs 50 crore | <input type="checkbox"/> > Rs 50 crore                |
| <input type="checkbox"/> No investment                 |                                                       |

5. What type of motor vehicles does the workshop repair / maintain? *(multiple selections possible)*

- |                                                                                                               |
|---------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Passenger vehicles; specific brand & product (SUV/hatchback/etc)? _____              |
| <input type="checkbox"/> Commercial vehicles; specific brand & product (truck/bus)? _____                     |
| <input type="checkbox"/> Trailers / semi-trailers; specific brand & product (flatbed/refrigerated/etc)? _____ |
| <input type="checkbox"/> Other, please specify: _____; specific brand & product? _____                        |

6. Which technologies do the motor vehicles, which you service, adhere to? (*multiple selections possible*)
- ☐ Internal combustion engine (ICE: Petrol / Diesel) ☐ Electric vehicles (EV)
- ☐ Compressed Natural Gas (CNG) ☐ Bio-fuel, please specify: \_\_\_\_\_
- ☐ Hydrogen fuel ☐ All technologies
- ☐ Other, please specify: \_\_\_\_\_
7. Do you specialize in servicing particular components of motors vehicles?  
Yes / No: \_\_\_\_\_; If 'Yes', which ones: \_\_\_\_\_
8. Overall, what is the percentage of female employees in the firm? (*Please select one*)
- ☐ 0% ☐ ≤20% ☐ >20% & ≤40%
- ☐ >40% & ≤60% ☐ >60% & ≤80% ☐ >80%

#### UNDERSTANDING HIRING, SKILLING, GENDER-BASED ROLES, AND SKILL SHORTAGES

9. What are the mediums used for hiring employees? (*multiple selections possible*)
- ☐ Employment agency ☐ Online job sites/advertisements; Please specify: \_\_\_\_\_
- ☐ Own website advertisements ☐ Campus recruitment; Please mention institutions: \_\_\_\_\_
- ☐ Vocational training institutes ☐ Sector Skill Council / Sector Skill Council affiliated institutes
- ☐ Newspaper advertisements ☐ Internships/apprenticeships
- ☐ Networks and referrals ☐ Others, specify: \_\_\_\_\_
10. Do you provide on-the-job training within the firm, either before or after deployment?  
Yes / No: \_\_\_\_\_  
If 'Yes', what is your policy?  
Should this training rather be provided by India's education and skilling system? \_\_\_\_
11. Does the firm run its own skilling institution, or have any tie-up / partnership with another institution / ASDC for skilling purposes?  
Yes / No: \_\_\_\_\_ Is it owned by the firm? Yes / No: \_\_\_\_\_  
If 'Yes', please mention which institutions: \_\_\_\_\_
12. What kind of association(s) does the firm have with the skilling institution(s) identified in Q.11? (*multiple selections possible*)
- ☐ We offer apprenticeships/internships for trainee students ☐ We send our staff to take visiting classes or other classes
- ☐ We offer inputs to the course curriculum ☐ We sponsor lab facilities in TVET or other institutions
- ☐ We sponsor fresh skilling programmes to absorb the students later ☐ We sponsor re-skilling/upskilling programs for our employees
- ☐ No associations ☐ Other; please specify: \_\_\_\_\_

We have collated a list of occupations from the National Classification of Occupations (NCOs) and job roles from Automotive Skills Development Council (ASDC), associated with the full automotive value chain (white and blue collar), including manufacturing, and repair and maintenance, in Annexure 7.1.

13. For all types of motor vehicle servicing that the firm is involved in (Q.5), do the job roles (Annexure 7.1) cover the relevant activities undertaken by the firm?  
Yes / No: \_\_\_\_\_  
What other occupations/job roles should be included? Please specify: \_\_\_\_\_
14. As regards gender ratio, which job roles:  
Employ majority women (>50% of all workers in the job role): \_\_\_\_\_  
Employ some women (20% to 50% of all workers in the job role): \_\_\_\_\_  
Employ no women (0% of all workers in the job role): \_\_\_\_\_

15. How easy or difficult was it to fill the job roles (including the number of positions) advertised by the firm in the last three years (FY 2021-22 onwards)? (Add rows if necessary. If the firm advertised many job roles, you can specify job roles at two extremes: those which were easiest to fill, and those very difficult / un-filled)

| S.No. | Job Roles advertised | Please Specify the Level:<br>Entry level / intermediate or<br>mid-level / senior level /<br>managerial level/ director level /<br>executive level | Difficulty of filling jobs (rank)<br>1. Very easy; 2. Easy; 3. Average; 4.<br>Difficult; 5. Very difficult; 6. Not filled<br>at all |
|-------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1     |                      |                                                                                                                                                   |                                                                                                                                     |
| 2     |                      |                                                                                                                                                   |                                                                                                                                     |
| 3     |                      |                                                                                                                                                   |                                                                                                                                     |
| 4     |                      |                                                                                                                                                   |                                                                                                                                     |
| 5     |                      |                                                                                                                                                   |                                                                                                                                     |

16. In Q.15, for the job roles with rank 3-6 on 'difficulty of filling jobs', can you please detail the skills, knowledge and education sought by the firm – in the form of a detailed job description? (Please refer to Table Q5.1. Request you to provide the details, for each of the relevant job roles, within the format of Table Q5.1). We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Educational Qualifications sought by the firm | Knowledge (technical and theoretical knowledge relating to the job role) | Technical Skills (Computer applications and software) | Years of Experience | Skills (Refer to Table Q5.2) | Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role (mention States and Districts) |
|----------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |                                               |                                                                          |                                                       |                     |                              |                                                                                                                                       |

17. Who is presently providing education and skilling for these 'hard to fill' job roles in Q.16, if any? Nobody / formal education system / vocational education system? Please specify: \_\_\_\_\_  
Is the formal/vocational education system run by the government / private parties / NGOs? Please specify: \_\_\_\_\_  
Please list the formal and vocational training institutions for these job-roles: \_\_\_\_\_

18. For the motor vehicle servicing the firm is involved in (Q.5, Q.6, Q.7), what are the upcoming technological developments?  
Please specify: \_\_\_\_\_

19. Is the firm an authorized service partner/franchisee for a motor vehicle company, or plan to become one?  
Already an authorized partner/Plan to become an authorized partner/ not an authorized partner and no plan: \_\_\_\_\_

20. In view of the developments (Q.18 and Q.19), which job roles will be in-demand in the next three years by the firm? (Please refer to Table Q5.1. Request you to provide the details, for each of the relevant job roles, within the format of Table Q5.1).  
We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Education | Knowledge | Technical Skills | Years of Experience | Skills (refer to Table Q5.2) | Geographical areas/spatial clusters where needs are highest (mention States and Districts) | Difficulty of finding workers<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |
|----------|----------------------|-------|-----------|-----------|------------------|---------------------|------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |           |           |                  |                     |                              |                                                                                            |                                                                                                                                                  |

### GENDER DIVERSITY AND CARRER PATH AT WORKPLACE

21. In the next three years, do you perceive a demand for women in particular job roles, either among the existing job-roles or those which will be in-demand in future?  
 Yes / No: \_\_\_\_\_  
 If 'Yes', please specify which ones: \_\_\_\_\_
22. Does the firm have hiring policies to encourage female employment, especially in non-traditional job roles?  
 Yes / No: \_\_\_\_\_  
 If 'Yes', please explain the policy in detail: \_\_\_\_\_  
 Does the firm provide creche on plant/office premises: Yes / No: \_\_\_\_\_
23. Has the firm defined sexual harassment policies, prevention systems, procedures and service rules for employees (prevention of Sexual Harassment at Workplace or POSH)?  
 Yes / No: \_\_\_\_\_
24. Does the firm offer a career-path to all its employees? (for instance, has anyone at the firm risen from being at a 'technician level position' to a 'managerial level position')?  
 Yes / No: \_\_\_\_\_  
 Does the firm fund the employee's education / upskilling / re-skilling, as may be required for higher level job roles? Yes / No: \_\_\_\_\_

### EMPLOYMENT BACKGROUND

25. How many people are employed at the firm?

| S.No.                        | Particulars | Number of people employed |               |
|------------------------------|-------------|---------------------------|---------------|
|                              |             | Managerial Staff (No.)    | Workers (No.) |
| Total Employees (in numbers) |             |                           |               |

26. With reference to the total employees identified in Q.25, what is the educational background of the employees (as percentage (%) of total employees)?

| Below Class X (%) | Above Class X and Below Class XII (%) | Class XII pass (%) | Vocationally Educated (ITI, PMKVY, RPL etc.) (%) | Bachelor's degree and above (%) |
|-------------------|---------------------------------------|--------------------|--------------------------------------------------|---------------------------------|
|                   |                                       |                    |                                                  |                                 |

**Table Q5.1: Details of Identified Job Roles  
in Q.16 and Q.20 of the Questionnaires**

*(Request you to provide the details, for each of the relevant job roles, in the format as given below)*

S. No.: \_\_\_\_\_

Job Role: \_\_\_\_\_

**Table 1: Job Descriptors**

| Descriptors                                                                                                                                                                                                                     |                                               | Firm's Answer |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------|
| Alternative job titles in the industry                                                                                                                                                                                          |                                               |               |
| Stage of the automobile value chain:<br>1. Design and R&D<br>2. Manufacturing<br>3. Sales<br>4. After sales service: Repair and Maintenance<br>5. Support services (Procurement, Finance, HR, etc; please specify)              |                                               |               |
| Is this job role:<br>1. 'Difficult to fill' at present ( <b>Q.16</b> ), or<br>2. Will be in-demand in next 3 years by the firm ( <b>Q.20</b> )                                                                                  |                                               |               |
| How many do you need to hire at the 'present moment'/now, or you will need to hire 3 years from now?                                                                                                                            |                                               |               |
| Tasks to be performed in the job role<br>(please include specific systems / components / technologies / personnel required to be dealt or interacted with, if any)                                                              |                                               |               |
| Education:<br>School (up to what level?) / ITI/ Short-term vocational training programme/ Bachelors/ Masters)                                                                                                                   |                                               |               |
| Knowledge                                                                                                                                                                                                                       | General? What knowledge?                      |               |
|                                                                                                                                                                                                                                 | Specialised (Sector, Occupational, and Trade) |               |
| Technical Skills:<br>Software languages required, or maybe required in the near future                                                                                                                                          |                                               |               |
| Years of Experience, if any                                                                                                                                                                                                     |                                               |               |
| Skills required and level of competence<br>(refer to framework of skills in <b>Table Q5.2</b> below)                                                                                                                            |                                               |               |
| Difficulty of finding workers in the job role, with the above requirements and the skills as detailed below:<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |                                               |               |
| Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role**<br>(mention States and Districts)                                                                                      |                                               |               |
| Salary Offered                                                                                                                                                                                                                  |                                               |               |

\*\* Please explain the reasons behind skill shortage in the specified states and districts: Are there demand side factors (such as low salary, demanding work conditions, absence of platforms to advertise jobs, non-acceptability of workers from conventional labour markets, competition from other sectors to hire the same candidate, etc.) and/or supply side factors (such as course not offered by Indian institutions, specialised skilled people not available, absence of and/or proximity to training centres, poor quality of skilling and training programs, lack of programs for re-skilling/upskilling workers from traditional sectors, high salary expectations, non-aspirational job role, availability of other work avenues, etc.)?

**Table Q5.2: List of Skills**

| <i>Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)</i>                                                                                                                             |                                                                                                                                                            |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                                                                                 | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| <i>Reading Literacy:</i> Would they need to read and understand written sentences and paragraphs in work related documents?                                                                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Writing:</i> Would they need to communicate effectively in writing as per their audience for their job?                                                                                                                                                                                                                                      |                                                                                                                                                            |          |
| <i>Speaking:</i> Do they need to talk to others to convey information effectively?                                                                                                                                                                                                                                                              |                                                                                                                                                            |          |
| <i>Communication:</i> Would they need to provide information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person?                                                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Language Skills 1:</i> Is knowledge of the structure and content of the language including the meaning and spelling of words, rules of composition, and grammar required for the job?                                                                                                                                                        |                                                                                                                                                            |          |
| <i>Language Skills 2:</i> Any specific language requirement for the job? If Yes, which one?                                                                                                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Numeracy/Mathematics:</i> Would they need to work with numbers for their job?                                                                                                                                                                                                                                                                |                                                                                                                                                            |          |
| <i>ICT Literacy to Skills:</i> Would they need to use mobile phones/tabs/computers etc. to do their job?<br>For example, Arts & Graphics, Desktop Publishing, Presentation, Spreadsheet, Word Processing, Programming, Client Server/Networking/Hardware, Operating Systems, Database/Statistics, Engineering Software and Web Page Design etc. |                                                                                                                                                            |          |
| <i>Self-learning to Active (Independent) Learning:</i> Would they need to understand new information for both current and future problem-solving and decision-making at their job? Are they expected to do on their own for the job or self-learn, if the material is provided to them?                                                         |                                                                                                                                                            |          |
| <i>Active Listening:</i> Do they need to listen for their job, like taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times?                                                                                                                                              |                                                                                                                                                            |          |
| <i>Science:</i> Do they need to use scientific rules and methods to solve problems at work?                                                                                                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Problem Solving:</i> Do they need to identify problems and review related information to develop and evaluate options and implement solutions?                                                                                                                                                                                               |                                                                                                                                                            |          |
| <i>Learning Strategies:</i> Do they need to select and use training/instructional methods and procedures appropriate for the situation when learning or teaching new things?                                                                                                                                                                    |                                                                                                                                                            |          |
| <i>Critical Thinking:</i> Would the worker need to use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems?                                                                                                                                                            |                                                                                                                                                            |          |
| <i>Creativity:</i> Do the workers need to develop, design, or create new applications, ideas, relationships, systems, or products, including artistic contributions?                                                                                                                                                                            |                                                                                                                                                            |          |

| Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)                                                                                 |                                                                                                                                                            |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                              | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| <i>Independent research:</i> Would the worker need to conduct literature review, undertake data collection, cleaning etc., develop research plan?                                                                                                                                            |                                                                                                                                                            |          |
| <i>Judgement and Decision-making:</i> Would the worker need to consider the relative costs and benefits of potential actions to choose the most appropriate one?                                                                                                                             |                                                                                                                                                            |          |
| <i>Systems Analysis:</i> Would the worker need to determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes?                                                                                                                  |                                                                                                                                                            |          |
| <i>Systems Evaluation:</i> Would workers need to identify measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system?                                                                                        |                                                                                                                                                            |          |
| <i>Financial Resources:</i> Would the worker need to determine how money will be spent to get the work done, and accounting for these expenditures?                                                                                                                                          |                                                                                                                                                            |          |
| <i>Material Resources:</i> Would the worker need to obtain and see to the appropriate use of equipment, facilities, and materials needed to do certain work?                                                                                                                                 |                                                                                                                                                            |          |
| <i>Personnel Resources:</i> Would the worker need to motivate, develop, and direct people as they work, identifying the best people for the job?                                                                                                                                             |                                                                                                                                                            |          |
| <i>Time Management:</i> Managing one's own time and the time of others                                                                                                                                                                                                                       |                                                                                                                                                            |          |
| <i>Seek and Value Diversity:</i> Do workers need to work with people (as colleagues/clients etc.) from other cultures/States/socio-economic backgrounds etc? Is it important for their job performance? Is it likely to be important for their job performance?                              |                                                                                                                                                            |          |
| <i>Gender Diversity:</i> Do workers need to work with female colleagues/clients etc.? Is it important for their job performance? Is it likely to be important for their job performance?                                                                                                     |                                                                                                                                                            |          |
| <i>Conscientiousness (including attitude towards work):</i> Will the worker need to be organised, responsible, and hardworking or have any one of the following traits- Competence (efficient), organised, dutiful (not careless), ambitious, self-discipline (not lazy), and not impulsive? |                                                                                                                                                            |          |
| <i>Openness to Experiences:</i> Will the worker need to be open to new aesthetic, cultural, or intellectual experiences or have any one of the following traits- Imaginative, artistic, excitable, wide interests, curious and unconventional?                                               |                                                                                                                                                            |          |
| <i>Extraversion:</i> Will the worker need to show the following traits- warmth (friendly), sociable, self-confident, energetic, excitement seeking (adventurous), and enthusiastic?                                                                                                          |                                                                                                                                                            |          |
| <i>Agreeableness:</i> Will the worker need to work in a team in a cooperative, unselfish manner?                                                                                                                                                                                             |                                                                                                                                                            |          |



| Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills) |                                                                                                                                                            |          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                              | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| <i>Neuroticism/Emotional stability:</i> Will the worker need to show emotional stability i.e. predictability and consistency in emotional reactions, with absence of rapid mood changes?                     |                                                                                                                                                            |          |
| <i>Does the worker need social skills at work?</i>                                                                                                                                                           |                                                                                                                                                            |          |
| <i>Instructing:</i> Does the worker need to teach others how to do something?                                                                                                                                |                                                                                                                                                            |          |
| <i>Negotiation:</i> Does the worker need to bring others together and try to reconcile differences?                                                                                                          |                                                                                                                                                            |          |
| <i>Persuasion:</i> Do workers need to persuade others to change their minds or behaviour?                                                                                                                    |                                                                                                                                                            |          |
| <i>Occupation-specific skills</i>                                                                                                                                                                            |                                                                                                                                                            |          |
| <i>Physical skills,</i> including job-specific complex psychomotor skills                                                                                                                                    |                                                                                                                                                            |          |
| <i>Global Competence:</i> Globally competent workers                                                                                                                                                         |                                                                                                                                                            |          |
| <i>Any other?</i> Please specify:                                                                                                                                                                            |                                                                                                                                                            |          |

## National Skill Gap Study for High Growth

### Questionnaire 8: Questionnaire for Generation of Green Electricity

**National Council of Applied Economic Research**  
Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE), Government of India, is undertaking the 'National Skill Gap Study for High Growth Sectors' and NCAER is the implementing agency for the said study. The overall objective of this work is to develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for jobs roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship.

Your identity would be held confidential while discussing your suggestions and views on the subject.

Respondent's Name: .....  
Respondent's Company Name and Address: .....  
Respondent's Designation: .....  
Respondent's Phone: .....  
Respondent's Email: .....

#### FIRM PROFILE

1. *What is the firm's ownership type? (Please select one)*  
☐ Public Sector                      ☐ Public Limited                      ☐ Private Limited  
☐ Partnership/Individual Ownership                      ☐ Multinational Company                      ☐ Limited Liability Partnership  
☐ Cooperative                      ☐ Others, please specify: \_\_\_\_\_
2. *What was the annual turnover range in FY 2023-24? (Please select one)*  
☐ ≤ Rs 5 crore (Micro)                      ☐ > Rs 5 crore & ≤ Rs 50 crore (Small)  
☐ > Rs 50 crore & ≤ Rs 250 crore (Medium)                      ☐ > Rs 250 crore (Large)
3. *Which green electricity generation sector is the firm involved in? (multiple selections possible)*

| Green Electricity       | Type of Production and Use:<br>1. Open Access<br>2. For selling to DISCOMs<br>3. Captive generation<br>4. Other, please specify | Scale of Generation:<br>1. Utility scale<br>2. Commercial and industrial<br>3. Residential<br>4. Other, please specify | Phase of Project Firm is involved with:<br>1. Design<br>2. Construction<br>3. O&M<br>4. Other, please specify* |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Solar                   |                                                                                                                                 |                                                                                                                        |                                                                                                                |
| Wind                    |                                                                                                                                 |                                                                                                                        |                                                                                                                |
| Small Hydro             |                                                                                                                                 |                                                                                                                        |                                                                                                                |
| Green Hydrogen          |                                                                                                                                 |                                                                                                                        |                                                                                                                |
| Hybrid; please specify: |                                                                                                                                 |                                                                                                                        |                                                                                                                |
| Other; please specify   |                                                                                                                                 |                                                                                                                        |                                                                                                                |

\*If the firm is involved in manufacturing specific components / systems of a green electricity generation plant, please mention the same under 'other', along with the type of components / systems manufactured.

- 3.1 If in Solar: What type of solar electricity generation projects is the firm involved in and what is the installed capacity? Information on project locations (States and Districts) will help in understanding the spatial spread of the industry. *(multiple selections possible)*
- ☐ Ground mounted; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- ☐ Rooftop- grid connected; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- ☐ Off-grid; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- ☐ Other, please specify: \_\_\_\_\_; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- 3.2 If in Wind: What type of wind electricity generation projects is the firm involved in and what is the installed capacity? Information on project locations (States and Districts) will help in understanding the spatial spread of the industry. *(multiple selections possible)*
- ☐ On-shore; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- ☐ Off-shore; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- ☐ Other, please specify: \_\_\_\_\_; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- 3.3 If in Small Hydro: What type of small-hydro electricity generation projects is the firm involved in and what is the installed capacity? Information on project locations (States and Districts) will help in understanding the spatial spread of the industry. *(multiple selections possible)*
- ☐ Run-of-river based; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- ☐ Dam-toe based; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- ☐ Canal based; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- ☐ Other, please specify: \_\_\_\_\_; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- 3.4 If in Green Hydrogen, Hybrid or Other: Please mention the type(s) of green electricity generation projects the firm is involved in and the installed capacity? Information on project locations (States and Districts) will help in understanding the spatial spread of the industry.
- ☐ \_\_\_\_\_; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
- ☐ \_\_\_\_\_; Installed capacity: \_\_\_\_\_; States and Districts: \_\_\_\_\_
4. Overall, what is the percentage of female employees in the firm? *(Please select one)*
- ☐ 0% ☐ ≤20% ☐ >20% & ≤40%
- ☐ >40% & ≤60% ☐ >60% & ≤80% ☐ >80%

#### UNDERSTANDING HIRING, SKILLING, GENDER-BASED ROLES, AND SKILL SHORTAGES

5. What are the mediums used for hiring employees? *(multiple selections possible)*
- ☐ Employment agency ☐ Online job sites/advertisements; Please specify: \_\_\_\_\_
- ☐ Own website advertisements ☐ Campus recruitment; Please mention institutions: \_\_\_\_\_
- ☐ Vocational training institutes ☐ Sector Skill Council / Sector Skill Council affiliated institutes
- ☐ Newspaper advertisements ☐ Internships/apprenticeships
- ☐ Networks and referrals ☐ Others, specify: \_\_\_\_\_
6. Do you provide on-the-job training within the firm, either before or after deployment?  
Yes / No: \_\_\_\_\_  
If 'Yes', what is your policy? \_\_\_\_\_  
Should this training rather be provided by India's education and skilling system? \_\_\_\_\_
7. Does the firm run its own skilling institution, or have any tie-up / partnership with another institution / Skill Council for Green Jobs (SCGJ) for skilling purposes?  
Yes / No: \_\_\_\_\_  
If 'Yes', please mention which institutions: \_\_\_\_\_

8. What kind of association(s) does the firm have with the skilling institution(s) identified in Q.7? *(multiple selections possible)*

- ☐ We offer apprenticeships/ internships for trainee students
- ☐ We offer inputs to the course curriculum
- ☐ We sponsor fresh skilling programmes to absorb the students later
- ☐ No associations
- ☐ We send our staff to take visiting classes or other classes
- ☐ We sponsor lab facilities in TVET or other institutions
- ☐ We sponsor re-skilling/upskilling programs for our employees
- ☐ Other; please specify: \_\_\_\_\_

We have collated a list of occupations from the National Classification of Occupations (NCOs) and job roles from Skill Council for Green Jobs (SCGJ) associated with green electricity generation industry (solar, wind, small-hydro, green hydrogen, biogas) in Annexures 8.1 and 8.2

9. For all forms of green electricity generation that the firm is involved in (Q.3), do the job roles (Annexure 8.1 and 8.2) cover the activities involving EPC (design and pre-construction, construction and commissioning), O&M, business development<sup>1</sup>?

Yes / No: \_\_\_\_\_

What other occupations/job roles should be included, for any of the green electricity generation projects the firm is involved in? Please specify: \_\_\_\_\_

10. As regards gender ratio, which job roles:

Employ majority women (>50% of all workers in the job role): \_\_\_\_\_

Employ some women (20% to 50% of all workers in the job role): \_\_\_\_\_

Employ no women (0% of all workers in the job role): \_\_\_\_\_

11. How easy or difficult was it to fill the job roles (including the number of positions) advertised by the firm in the last three years (FY 2021-22 onwards)? (Add rows if necessary. If the firm advertised many job roles, you can specify job roles at two extremes: those which were easiest to fill, and those very difficult / un-filled)

| S.No. | Green Electricity Sector (solar / wind / small hydro / hybrid / etc) | Job Roles advertised | Please Specify the Level: Entry level / intermediate or mid-level / senior level / managerial level / director level / executive level | Difficulty of filling jobs (rank) 1. Very easy; 2. Easy; 3. Average; 4. Difficult; 5. Very difficult; 6. Not filled at all |
|-------|----------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
|-------|----------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|

12. In Q.11, for the job roles with rank 3-6 on 'difficulty of filling jobs', can you please detail the skills, knowledge and education sought by the firm – in the form of a detailed job description? (Please refer to Table Q8.1. Request you to provide the details, for each of the relevant job roles, within the format of Table Q8.1). We are seeking the following information:

| Green Electricity Sector (solar / wind / small hydro / hybrid / etc) | Job Role | Stage of Value Chain | Tasks | Educational Qualifications sought by the firm | Knowledge (technical and theoretical knowledge relating to the job role) | Technical Skills (Computer applications and software) | Years of Experience | Skills (refer to Table Q8.2) | Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role (mention States and Districts) |
|----------------------------------------------------------------------|----------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
|----------------------------------------------------------------------|----------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|

<sup>1</sup> Design and pre-construction: design of the project once a bid has been won. Direct employment created includes jobs for designers, planners, architects, engineers (non-installers), resource analysts and legal personnel. Construction and commissioning: actual installation of the project and setting up a connection to the national power grid. Direct jobs are created for construction workers, electricians, technicians, engineers, meteorologists, and technicians working for equipment vendors (such as inverter suppliers). Both skilled and unskilled workers are required during this phase of execution. Operations and maintenance create direct jobs for technicians, electricians, maintenance and security staff, and operations managers. Both skilled and unskilled workers are required to carry out O&M in the plant. Business development includes all actions taken to develop a specific project prior to submission of a possible bid (if the project is selected through a government policy scheme), as well as ongoing efforts to promote business. Direct employment generated includes jobs in sales, marketing, legal, financial, and government/regulatory affairs (CEEW & NRDC 2016).

13. Who is presently providing education and skilling for these 'hard to fill' job roles in Q.12, if any? Nobody / formal education system / vocational education system? Please specify: \_\_\_\_\_  
Is the formal/vocational education system run by the government / private parties / NGOs?  
Please specify: \_\_\_\_\_  
Please list the formal and vocational training centres for these job-roles? \_\_\_\_\_
14. For the green electricity generation sectors the firm is involved (Q.3), what are the upcoming technological developments?  
Please specify: \_\_\_\_\_
15. Is the firm planning to expand to other forms green electricity sectors / project phases / project types / locations – Over and above those identified in (Q.3, and Q 3.1 / 3.2 / 3.3 / 3.4)?  
Yes / No: \_\_\_\_\_  
If 'Yes', please detail which sector(s)/phase(s)/project type(s), and where (states and districts): \_\_\_\_\_
16. In view of the developments (Q.14 and Q.15), which job roles will be in-demand in the next three years by the firm? (Please refer to Table Q8.1. Request you to provide the details, for each of the relevant job roles, within the format of Table Q8.1).  
We are seeking the following information:

| Green Electricity Sector (solar / wind / small hydro / hybrid / etc) | Job Role | Stage of Value Chain | Tasks | Education | Knowledge | Technical Skills | Years of Experience | Skills (refer to Table Q8.2) | Geographical areas/spatial clusters where needs are highest (mention States and Districts) | Difficulty of finding workers<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |
|----------------------------------------------------------------------|----------|----------------------|-------|-----------|-----------|------------------|---------------------|------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|----------------------------------------------------------------------|----------|----------------------|-------|-----------|-----------|------------------|---------------------|------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|

#### GENDER DIVERSITY AND CARRER PATH AT WORKPLACE

17. In the next three years, do you perceive a demand for women in particular job roles, either among the existing job-roles or those which will be in-demand in future?  
Yes / No: \_\_\_\_\_  
If 'Yes', please specify which ones: \_\_\_\_\_
18. Does the firm have hiring policies to encourage female employment, especially in non-traditional job roles?  
Yes / No: \_\_\_\_\_  
If 'Yes', please explain the policy in detail: \_\_\_\_\_  
Does the firm provide creche on plant/office premises: Yes / No: \_\_\_\_\_
19. Has the firm defined sexual harassment policies, prevention systems, procedures and service rules for employees (prevention of Sexual Harassment at Workplace or POSH)?  
Yes / No: \_\_\_\_\_
20. Does the firm offer a career-path to all its employees? (for instance, has anyone at the firm risen from being at a 'technician level position' to a 'managerial level position')?  
Yes / No: \_\_\_\_\_  
Does the firm fund the employee's education / upskilling / re-skilling, as may be required for higher level job roles? Yes / No: \_\_\_\_\_

#### EMPLOYMENT BACKGROUND

21. How many people are employed at the firm?

| S.No. | Particulars | Number of people employed |               |
|-------|-------------|---------------------------|---------------|
|       |             | Managerial Staff (No.)    | Workers (No.) |

22. With reference to the total employees identified in Q.21, what is the educational background of the employees (as percentage (%) of total employees)?

| Below Class X (%) | Above Class X and Below Class XII (%) | Class XII pass (%) | Vocationally Educated (ITI, PMKVY, RPL etc.) (%) | Bachelor's degree and above (%) |
|-------------------|---------------------------------------|--------------------|--------------------------------------------------|---------------------------------|
|-------------------|---------------------------------------|--------------------|--------------------------------------------------|---------------------------------|

\*\*\*

**Table Q8.1: Details of Identified Job Roles**  
in Q.12 and Q.16 of the Questionnaire

*(Request you to provide the details, for each of the relevant job roles, in the format as given below)*

S. No.: \_\_\_\_\_

Job Role: \_\_\_\_\_

**Table 1: Job Descriptors**

| Descriptors                                                                                                                                                                                                                     |                                               | Firm's Answer |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------|
| Alternative job titles in the industry                                                                                                                                                                                          |                                               |               |
| Green Electricity Sector (solar / wind / small hydro / green hydrogen / hybrid / etc)                                                                                                                                           |                                               |               |
| Stage of electricity generation value chain:<br>1. Design & pre-construction<br>2. Construction and commissioning<br>3. Operation and maintenance (O&M)<br>4. Business development<br>5. Other, please specify                  |                                               |               |
| Is this job role:<br>1. 'Difficult to fill' at present (Q.12), or<br>2. Will be in-demand in next 3 years by the firm (Q.16)                                                                                                    |                                               |               |
| How many do you need to hire at the 'present moment'/now, or you will need to hire 3 years from now?                                                                                                                            |                                               |               |
| Tasks to be performed in the job role<br>(please include specific systems / components / technologies / personnel required to be dealt or interacted with, if any)                                                              |                                               |               |
| Education:<br>School (up to what level?) / ITI/ Short-term vocational training programme/ Bachelors/ Masters)                                                                                                                   |                                               |               |
| Knowledge                                                                                                                                                                                                                       | General? What knowledge?                      |               |
|                                                                                                                                                                                                                                 | Specialised (Sector, Occupational, and Trade) |               |
| Technical Skills:<br>Software languages required, or maybe required in the near future                                                                                                                                          |                                               |               |
| Years of Experience, if any                                                                                                                                                                                                     |                                               |               |
| Skills required and level of competence<br>(refer to framework of skills in Table Q8.2 below)                                                                                                                                   |                                               |               |
| Difficulty of finding workers in the job role, with the above requirements and the skills as detailed below:<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |                                               |               |
| Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role**<br>(mention States and Districts)                                                                                      |                                               |               |
| Salary Offered                                                                                                                                                                                                                  |                                               |               |

\*\* Please explain the reasons behind skill shortage in the specified states and districts: Are there demand side factors (such as low salary, demanding work conditions, absence of platforms to advertise jobs, non-acceptability of workers from conventional labour markets, competition from other sectors to hire the same candidate, etc) and/or supply side factors (such as course not offered by Indian institutions, specialised skilled people not available, absence of and/or proximity to training centres, poor quality of skilling and training programs, lack of programs for re-skilling/upskilling workers from traditional sectors, high salary expectations, non-aspirational job role, availability of other work avenues, etc)?

**Table Q8.2: List of Skills**

| <i>Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)</i>                                                                                                                             |                                                                                                                                                            |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                                                                                 | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| <i>Reading Literacy:</i> Would they need to read and understanding written sentences and paragraphs in work related documents?                                                                                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Writing:</i> Would they need to communicate effectively in writing as per their audience for their job?                                                                                                                                                                                                                                      |                                                                                                                                                            |          |
| <i>Speaking:</i> Do they need to talk to others to convey information effectively?                                                                                                                                                                                                                                                              |                                                                                                                                                            |          |
| <i>Communication:</i> Would they need to provide information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person?                                                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Language Skills 1:</i> Is knowledge of the structure and content of the language including the meaning and spelling of words, rules of composition, and grammar required for the job?                                                                                                                                                        |                                                                                                                                                            |          |
| <i>Language Skills 2:</i> Any specific language requirement for the job? If Yes, which one?                                                                                                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Numeracy/Mathematics:</i> Would they need to work with numbers for their job?                                                                                                                                                                                                                                                                |                                                                                                                                                            |          |
| <i>ICT Literacy to Skills:</i> Would they need to use mobile phones/tabs/computers etc. to do their job?<br>For example, Arts & Graphics, Desktop Publishing, Presentation, Spreadsheet, Word Processing, Programming, Client Server/Networking/Hardware, Operating Systems, Database/Statistics, Engineering Software and Web Page Design etc. |                                                                                                                                                            |          |
| <i>Self-learning to Active (Independent) Learning:</i> Would they need to understand new information for both current and future problem-solving and decision-making at their job? Are they expected to do on their own for the job or self-learn, if the material is provided to them?                                                         |                                                                                                                                                            |          |
| <i>Active Listening-</i> Do they need to listen for their job, like taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times?                                                                                                                                              |                                                                                                                                                            |          |
| <i>Science-</i> Do they need to use scientific rules and methods to solve problems at work?                                                                                                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Problem Solving-</i> Do they need to identify problems and review related information to develop and evaluate options and implement solutions?                                                                                                                                                                                               |                                                                                                                                                            |          |
| <i>Learning Strategies-</i> Do they need to select and use training/instructional methods and procedures appropriate for the situation when learning or teaching new things?                                                                                                                                                                    |                                                                                                                                                            |          |
| <i>Critical Thinking-</i> Would the worker need to use logic                                                                                                                                                                                                                                                                                    |                                                                                                                                                            |          |

| Please think whether the person in the above job profile would need the following skills to do their job.<br>(Please choose the relevant skills and indicate the level of competence required for those skills)                                                                               |                                                                                                                                                            |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                               | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems?                                                                                                                                                                       |                                                                                                                                                            |          |
| <i>Creativity</i> -Do the workers need to develop, design, or create new applications, ideas, relationships, systems, or products, including artistic contributions?                                                                                                                          |                                                                                                                                                            |          |
| <i>Independent research</i> -Would the worker need to conduct literature review, undertake data collection, cleaning etc., develop research plan?                                                                                                                                             |                                                                                                                                                            |          |
| <i>Judgement and Decision-making</i> - Would the worker need to consider the relative costs and benefits of potential actions to choose the most appropriate one?                                                                                                                             |                                                                                                                                                            |          |
| <i>Systems Analysis</i> - Would the worker need to determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes?                                                                                                                  |                                                                                                                                                            |          |
| <i>Systems Evaluation</i> - Would workers need to identify measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system?                                                                                        |                                                                                                                                                            |          |
| <i>Financial Resources</i> - Would the worker need to determine how money will be spent to get the work done, and accounting for these expenditures?                                                                                                                                          |                                                                                                                                                            |          |
| <i>Material Resources</i> -Would the worker need to obtain and see to the appropriate use of equipment, facilities, and materials needed to do certain work?                                                                                                                                  |                                                                                                                                                            |          |
| <i>Personnel Resources</i> - Would the worker need to motivate, develop, and direct people as they work, identifying the best people for the job?                                                                                                                                             |                                                                                                                                                            |          |
| <i>Time Management</i> - Managing one's own time and the time of others                                                                                                                                                                                                                       |                                                                                                                                                            |          |
| <i>Seek and Value Diversity</i> -Do workers need to work with people (as colleagues/clients etc.) from other cultures/States/socio-economic backgrounds etc? Is it important for their job performance? Is it likely to be important for their job performance?                               |                                                                                                                                                            |          |
| <i>Gender Diversity</i> -Do workers need to work with female colleagues/clients etc.? Is it important for their job performance? Is it likely to be important for their job performance?                                                                                                      |                                                                                                                                                            |          |
| <i>Conscientiousness (including attitude towards work)</i> - Will the worker need to be organised, responsible, and hardworking or have any one of the following traits- Competence (efficient), organised, dutiful (not careless), ambitious, self-discipline (not lazy), and not impulsive? |                                                                                                                                                            |          |
| <i>Openness to Experiences</i> - Will the worker need to be open to new aesthetic, cultural, or intellectual                                                                                                                                                                                  |                                                                                                                                                            |          |



| Please think whether the person in the above job profile would need the following skills to do their job.<br>(Please choose the relevant skills and indicate the level of competence required for those skills) |                                                                                                                                                            |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                 | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| experiences or have any one of the following traits- Imaginative, artistic, excitable, wide interests, curious and unconventional?                                                                              |                                                                                                                                                            |          |
| <i>Extraversion</i> - Will the worker need to show the following traits- warmth (friendly), sociable, self-confident, energetic, excitement seeking (adventurous), and enthusiastic?                            |                                                                                                                                                            |          |
| <i>Agreeableness</i> - Will the worker need to work in a team in a cooperative, unselfish manner?                                                                                                               |                                                                                                                                                            |          |
| <i>Neuroticism/Emotional stability</i> – Will the worker need to show emotional stability i.e. predictability and consistency in emotional reactions, with absence of rapid mood changes?                       |                                                                                                                                                            |          |
| Does the worker need social skills at work?                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Instructing</i> - Does the worker need to teach others how to do something?                                                                                                                                  |                                                                                                                                                            |          |
| <i>Negotiation</i> - Does the worker need to bring others together and try to reconcile differences?                                                                                                            |                                                                                                                                                            |          |
| <i>Persuasion</i> - Do workers need to persuade others to change their minds or behaviour?                                                                                                                      |                                                                                                                                                            |          |
| <i>Occupation-specific skills</i>                                                                                                                                                                               |                                                                                                                                                            |          |
| <i>Physical skills</i> , including job-specific complex psychomotor skills                                                                                                                                      |                                                                                                                                                            |          |
| <i>Global Competence</i> – Globally competent workers                                                                                                                                                           |                                                                                                                                                            |          |
| <i>Any other?</i> Please specify:                                                                                                                                                                               |                                                                                                                                                            |          |

**National Skill Gap Study for High Growth**  
**Questionnaire 9: Questionnaire for Retail Trade**

**National Council of Applied Economic Research**  
Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE), Government of India, is undertaking the 'National Skill Gap Study for High Growth Sectors' and NCAER is the implementing agency for the said study. The overall objective of this work is to develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for jobs roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship.

Your identity would be held confidential while discussing your suggestions and views on the subject.

Respondent's Name: .....

Respondent's Company Name: .....

Respondent's Designation: .....

Respondent's Phone: .....

Respondent's Email: .....

**FIRM PROFILE**

1. What is the firm's ownership type? *(Please select one)*

- |                                                           |                                                        |                                                        |
|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| <input type="checkbox"/> Public Sector                    | <input type="checkbox"/> Public Limited                | <input type="checkbox"/> Private Limited               |
| <input type="checkbox"/> Partnership/Individual Ownership | <input type="checkbox"/> Multinational Company         | <input type="checkbox"/> Limited Liability Partnership |
| <input type="checkbox"/> Cooperative                      | <input type="checkbox"/> Others, please specify: _____ |                                                        |

2. What was the annual turnover range in FY 2023-24? *(Please select one)*

- |                                                                  |                                                               |
|------------------------------------------------------------------|---------------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 5 crore (Micro)                    | <input type="checkbox"/> > Rs 5 crore & ≤ Rs 50 crore (Small) |
| <input type="checkbox"/> > Rs 50 crore & ≤ Rs 250 crore (Medium) | <input type="checkbox"/> > Rs 250 crore (Large)               |

3. Which segment of Retail Trade the company/ firm falls in? (pre-filled) (multiple ticks)

- a. Traditional retail
- b. Modern retail
- c. E-Commerce company
- d. Allied Activities

4. Geographical spread of the firm: (States, Districts, Clusters)

- a. Number of Countries \_\_\_\_\_
- b. Number of States: \_\_\_\_\_
- c. Number of Cities \_\_\_\_\_

5. Presence across City-tiers (please tick according, multiple ticks possible)

- a. Tier1
- b. Tier 2
- c. Tier 3

6. What was the investment by your firm in FY 2023-24? *(Please select one)*

- |                                                        |                                                       |
|--------------------------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 1 crore                  | <input type="checkbox"/> > Rs 1 crore & ≤ Rs 10 crore |
| <input type="checkbox"/> > Rs 10 crore & ≤ Rs 50 crore | <input type="checkbox"/> > Rs 50 crore                |
| <input type="checkbox"/> No investment                 |                                                       |

7. Your presence in various stages of retail sector value chain: *(multiple selections possible)*
- Finance & R&D: Financing, location (coverage area in case of e-Commerce firms), negotiating rent, franchising of stores/store chains, Selecting type of shops based on needs, Product finalisation through consumers' surveys)
  - Logistics and Inventory management: (Vendors selection, including international vendors, sourcing of products (finished as well as intermediates) transporters, Quality checks)
  - Storage and warehousing
  - Store management
  - Customer satisfaction
  - Any other \_\_\_\_\_
8. Organisational progress/shift in the last three years
- From traditional retail to modern retail
  - Exploring new areas of business (increase in areas of operation)
  - Addition to type of operation (like earlier only retail and now retail+ e-Commerce)
  - Expanding presence in multiple stages of value chain
  - Outsourcing parts of business to business partners following retail revolution

9. How the relative importance of various job roles have changed following the organisational shift?

| <i>Job Roles that have become obsolete</i> | <i>Job Roles that will continue to be needed</i> | <i>Job Roles that have emerged during the last 3 years</i> |
|--------------------------------------------|--------------------------------------------------|------------------------------------------------------------|
|                                            |                                                  |                                                            |
|                                            |                                                  |                                                            |

#### UNDERSTANDING HIRING, SKILLING, GENDER-BASED ROLES, AND SKILL SHORTAGES

10. What are the mediums used for hiring employees? *(multiple selections possible)*
- |                                                         |                                                                                          |
|---------------------------------------------------------|------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Employment agency              | <input type="checkbox"/> Online job sites/advertisements; Please specify: _____          |
| <input type="checkbox"/> Own website advertisements     | <input type="checkbox"/> Campus recruitment; Please mention institutions: _____          |
| <input type="checkbox"/> Vocational training institutes | <input type="checkbox"/> Sector Skill Council/Sector Skill Council affiliated institutes |
| <input type="checkbox"/> Newspaper advertisements       | <input type="checkbox"/> Internships/apprenticeships                                     |
| <input type="checkbox"/> Networks and referrals         | <input type="checkbox"/> Others, specify: _____                                          |

11. Overall, what is the percentage of female employees in the firm? *(Please select one)*

- |                                      |                                      |                                      |
|--------------------------------------|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> 0%          | <input type="checkbox"/> ≤20%        | <input type="checkbox"/> >20% & ≤40% |
| <input type="checkbox"/> >40% & ≤60% | <input type="checkbox"/> >60% & ≤80% | <input type="checkbox"/> >80%        |

12. Do you provide on-the-job training within the firm, either before or after deployment?

- Yes / No: \_\_\_\_\_
- If 'Yes', what is your policy? \_\_\_\_\_
- Should this training rather be provided by India's education and skilling system? \_\_\_\_\_

13. Does the firm run its own skilling institution, or have any tie-up / informal-association with another institution / RASCI for skilling purposes?

- Yes / No: \_\_\_\_\_; is it owned by the firm? Yes / No: \_\_\_\_\_
- If 'Yes', please mention which institutions: \_\_\_\_\_

14. What kind of association(s) does the firm have with the skilling institution(s) identified in Q.13? *(multiple selections possible)*

- |                                                                                            |                                                                                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <input type="checkbox"/> We offer apprenticeships/internships for trainee students         | <input type="checkbox"/> We send our staff to take visiting classes or other classes  |
| <input type="checkbox"/> We offer inputs to the course curriculum                          |                                                                                       |
| <input type="checkbox"/> We sponsor fresh skilling programmes to absorb the students later | <input type="checkbox"/> We sponsor re-skilling/upskilling programs for our employees |
| <input type="checkbox"/> No associations                                                   | <input type="checkbox"/> Other; please specify: _____                                 |

We have collated a list of occupations from the National Classification of Occupations (NCOs) and job roles from RASCI, associated with the Retail sector value chain in Annexure 9.1.

15. For the types retail trade activities (like traditional retail, modern retail, e-Commerce and allied activities) that the firm is involved in (Q.3), do the job roles (Annexure 9.1) cover the relevant activities undertaken by the firm?

- Yes / No: \_\_\_\_\_
- What other occupations/job roles should be included? Please specify: \_\_\_\_\_

16. As regards gender ratio, which job roles:

- Employ majority women (>50% of all workers in the job role): \_\_\_\_\_
- Employ some women (20% to 50% of all workers in the job role): \_\_\_\_\_
- Employ no women (0% of all workers in the job role): \_\_\_\_\_

17. How easy or difficult was it to fill the job roles (including the number of positions) advertised by the firm in the last three years (FY 2021-22 onwards)? (Add rows if necessary. If the firm advertised many job roles, you can specify job roles at two extremes: those which were easiest to fill, and those very difficult / un-filled)

| S.No. | Job Roles advertised | Please Specify the Level:<br>Entry level / intermediate or<br>mid-level / senior level /<br>managerial level / director level<br>/ executive level | Difficulty of filling jobs (rank)<br>1. Very easy; 2. Easy; 3. Average; 4.<br>Difficult; 5. Very difficult; 6. Not filled<br>at all |
|-------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1     |                      |                                                                                                                                                    |                                                                                                                                     |
| 2     |                      |                                                                                                                                                    |                                                                                                                                     |
| 3     |                      |                                                                                                                                                    |                                                                                                                                     |
| 4     |                      |                                                                                                                                                    |                                                                                                                                     |
| 5     |                      |                                                                                                                                                    |                                                                                                                                     |

18. In Q.17, for the job roles with rank 3-6 on 'difficulty of filling jobs', can you please detail the skills, knowledge and education sought by the firm – in the form of a detailed job description? (Please refer to Table Q9.1. Request you to provide the details, for each of the relevant job roles, within the format of Table Q9.1).

We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Educational Qualifications sought by the firm | Knowledge (technical and theoretical knowledge relating to the job role) | Technical Skills (Computer applications and software) | Years of Experience | Skills (refer to Table Q9.2) | Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role (mention States and Districts) |
|----------|----------------------|-------|-----------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |                                               |                                                                          |                                                       |                     |                              |                                                                                                                                       |
|          |                      |       |                                               |                                                                          |                                                       |                     |                              |                                                                                                                                       |

19. Who is presently providing education and skilling for these 'hard to fill' job roles in Q.17, if any?
- Nobody / formal education system / vocational education system? Please specify: \_\_\_\_\_
  - Is the formal/vocational education system run by the government / private parties / NGOs? Please specify: \_\_\_\_\_
  - Please list the formal and vocational training institutions for these job-roles: \_\_\_\_\_

20. For the retail trade business the firm is involved in (Q.3), what are the upcoming technological developments?

Please specify: \_\_\_\_\_

21. Does the firm have its own R&D division, or plan to develop one?

22. In view of the recent developments, which job roles will be in-demand in the next three years by the firm? (Please refer to Table Q9.1. Request you to provide the details, for each of the relevant job roles, within the format of Table Q9.1).

We are seeking the following information:

| Job Role | Stage of Value Chain | Tasks | Education | Knowledge | Technical Skills | Years of Experience | Skills (refer to Table Q9.2) | Geographical areas/spatial clusters where needs are highest (mention States and Districts) | Difficulty of finding workers<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |
|----------|----------------------|-------|-----------|-----------|------------------|---------------------|------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                      |       |           |           |                  |                     |                              |                                                                                            |                                                                                                                                                  |

#### GENDER DIVERSITY AND CARRER PATH AT WORKPLACE

23. In the next three years, do you perceive a demand for women in particular job roles, either among the existing job-roles or those which will be in-demand in future?
- Yes / No: \_\_\_\_\_
  - If 'Yes', please specify which ones: \_\_\_\_\_
24. Does the firm have hiring policies to encourage female employment, especially in non-traditional job roles?
- Yes / No: \_\_\_\_\_
  - If 'Yes', please explain the policy in detail: \_\_\_\_\_
  - Does the firm have a creche on its premises? Yes / No: \_\_\_\_\_
25. Has the firm defined sexual harassment policies, prevention systems, procedures and service rules for its employees (Prevention of Sexual Harassment at Workplace Act 2013)?
- Yes / No: \_\_\_\_\_
26. Does the firm offer a career-path to all its employees? (for instance, has anyone at the firm risen from being at a 'technician level position' to a 'managerial level position')?
- Yes / No: \_\_\_\_\_
  - Does the firm fund the employee's education / upskilling / re-skilling, as may be required for higher level job roles? Yes / No: \_\_\_\_\_

#### EMPLOYMENT BACKGROUND

27. How many people are employed at the firm?

| 7. How many people are employed at the firm. |             |                           |               |
|----------------------------------------------|-------------|---------------------------|---------------|
| S.No.                                        | Particulars | Number of people employed |               |
|                                              |             | Managerial Staff (No.)    | Workers (No.) |
| Total Employees (in numbers)                 |             |                           |               |

28. With reference to the total employees identified in Q.27, what is the educational background of the employees (as percentage (%) of total employees)?

| Below Class X (%) | Above Class X and Below Class XII (%) | Class XII pass (%) | Vocationally Educated (ITI, PMKVY, RPL etc.) (%) | Bachelor's degree and above (%) |
|-------------------|---------------------------------------|--------------------|--------------------------------------------------|---------------------------------|
|                   |                                       |                    |                                                  |                                 |

**Table Q9.1: Details of Identified Job Roles**

**Table 1: Job Descriptors**

| Descriptors                                                                                                                                                                                                                     |                                               | Firm's Answer |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------|
| Alternative job titles in the industry                                                                                                                                                                                          |                                               |               |
| Stage of value chain:<br>1. Finance & R&D<br>2. Logistics and Inventory management<br>3. Storage and warehousing<br>4. Store management<br>5. Customer satisfaction<br>6. Others                                                |                                               |               |
| Is this job role:<br>1. 'Difficult to fill' at present, or<br>2. Will be in-demand in next 3 years by the firm                                                                                                                  |                                               |               |
| How many do you need to hire at the 'present moment'/now, or you will need to hire 3 years from now?                                                                                                                            |                                               |               |
| Tasks to be performed in the job role<br>(please include specific systems / components / technologies / personnel required to be dealt or interacted with, if any)                                                              |                                               |               |
| Education:<br>School (up to what level?) / ITI/ Short-term vocational training programme/ Bachelors/ Masters)                                                                                                                   |                                               |               |
| Knowledge                                                                                                                                                                                                                       | General? What knowledge?                      |               |
|                                                                                                                                                                                                                                 | Specialised (Sector, Occupational, and Trade) |               |
| Technical Skills:<br>Software languages required, or maybe required in the near future                                                                                                                                          |                                               |               |
| Years of Experience, if any                                                                                                                                                                                                     |                                               |               |
| Skills required and level of competence<br>(refer to framework of skills in Table Q9.2 below)                                                                                                                                   |                                               |               |
| Difficulty of finding workers in the job role, with the above requirements and the skills as detailed below:<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |                                               |               |
| Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role**<br>(mention States and Districts)                                                                                      |                                               |               |

\*\* Please explain the reasons behind skill shortage in the specified states and districts: Are there demand side factors (such as low salary, demanding work conditions, absence of platforms to advertise jobs, non-acceptability of workers from conventional labour markets, competition from other sectors to hire the same candidate, etc) and/or supply side factors (such as course not offered by Indian institutions, specialised skilled people not available, absence of and/or proximity to training centres, poor quality of skilling and training programs, lack of programs for re-skilling/upskilling workers from traditional sectors, high salary expectations, non-aspirational job role, availability of other work avenues, etc)?

**Table Q9.2: List of Skills**

| <i>Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)</i>                                                                                                                             |                                                                                                                                                            |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                                                                                 | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| <i>Reading Literacy:</i> Would they need to read and understanding written sentences and paragraphs in work related documents?                                                                                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Writing:</i> Would they need to communicate effectively in writing as per their audience for their job?                                                                                                                                                                                                                                      |                                                                                                                                                            |          |
| <i>Speaking:</i> Do they need to talk to others to convey information effectively?                                                                                                                                                                                                                                                              |                                                                                                                                                            |          |
| <i>Communication:</i> Would they need to provide information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person?                                                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Language Skills 1:</i> Is knowledge of the structure and content of the language including the meaning and spelling of words, rules of composition, and grammar required for the job?                                                                                                                                                        |                                                                                                                                                            |          |
| <i>Language Skills 2:</i> Any specific language requirement for the job? If Yes, which one?                                                                                                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Numeracy/Mathematics:</i> Would they need to work with numbers for their job?                                                                                                                                                                                                                                                                |                                                                                                                                                            |          |
| <i>ICT Literacy to Skills:</i> Would they need to use mobile phones/tabs/computers etc. to do their job?<br>For example, Arts & Graphics, Desktop Publishing, Presentation, Spreadsheet, Word Processing, Programming, Client Server/Networking/Hardware, Operating Systems, Database/Statistics, Engineering Software and Web Page Design etc. |                                                                                                                                                            |          |
| <i>Self-learning to Active (Independent) Learning:</i> Would they need to understand new information for both current and future problem-solving and decision-making at their job? Are they expected to do on their own for the job or self-learn, if the material is provided to them?                                                         |                                                                                                                                                            |          |
| <i>Active Listening:</i> Do they need to listen for their job, like taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times?                                                                                                                                              |                                                                                                                                                            |          |
| <i>Science:</i> Do they need to use scientific rules and methods to solve problems at work?                                                                                                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Problem Solving:</i> Do they need to identify problems and review related information to develop and evaluate options and implement solutions?                                                                                                                                                                                               |                                                                                                                                                            |          |
| <i>Learning Strategies:</i> Do they need to select and use training/instructional methods and procedures appropriate for the situation when learning or teaching new things?                                                                                                                                                                    |                                                                                                                                                            |          |
| <i>Critical Thinking:</i> Would the worker need to use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems?                                                                                                                                                            |                                                                                                                                                            |          |
| <i>Creativity:</i> Do the workers need to develop, design, or                                                                                                                                                                                                                                                                                   |                                                                                                                                                            |          |

| Please think whether the person in the above job profile would need the following skills to do their job.<br>(Please choose the relevant skills and indicate the level of competence required for those skills)                                                                              |                                                                                                                                                            |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                              | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| create new applications, ideas, relationships, systems, or products, including artistic contributions?                                                                                                                                                                                       |                                                                                                                                                            |          |
| <i>Independent research:</i> Would the worker need to conduct literature review, undertake data collection, cleaning etc., develop research plan?                                                                                                                                            |                                                                                                                                                            |          |
| <i>Judgement and Decision-making:</i> Would the worker need to consider the relative costs and benefits of potential actions to choose the most appropriate one?                                                                                                                             |                                                                                                                                                            |          |
| <i>Systems Analysis:</i> Would the worker need to determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes?                                                                                                                  |                                                                                                                                                            |          |
| <i>Systems Evaluation:</i> Would workers need to identify measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system?                                                                                        |                                                                                                                                                            |          |
| <i>Financial Resources:</i> Would the worker need to determine how money will be spent to get the work done, and accounting for these expenditures?                                                                                                                                          |                                                                                                                                                            |          |
| <i>Material Resources:</i> Would the worker need to obtain and see to the appropriate use of equipment, facilities, and materials needed to do certain work?                                                                                                                                 |                                                                                                                                                            |          |
| <i>Personnel Resources:</i> Would the worker need to motivate, develop, and direct people as they work, identifying the best people for the job?                                                                                                                                             |                                                                                                                                                            |          |
| <i>Time Management:</i> Managing one's own time and the time of others                                                                                                                                                                                                                       |                                                                                                                                                            |          |
| <i>Seek and Value Diversity:</i> Do workers need to work with people (as colleagues/clients etc.) from other cultures/States/socio-economic backgrounds etc? Is it important for their job performance? Is it likely to be important for their job performance?                              |                                                                                                                                                            |          |
| <i>Gender Diversity:</i> Do workers need to work with female colleagues/clients etc.? Is it important for their job performance? Is it likely to be important for their job performance?                                                                                                     |                                                                                                                                                            |          |
| <i>Conscientiousness (including attitude towards work):</i> Will the worker need to be organised, responsible, and hardworking or have any one of the following traits- Competence (efficient), organised, dutiful (not careless), ambitious, self-discipline (not lazy), and not impulsive? |                                                                                                                                                            |          |





## National Skill Gap Study for High Growth

### Questionnaire 10: Questionnaire for Computer Programming Activities (Information Technology Sector)

#### National Council of Applied Economic Research

Parisila Bhawan, 11, Indraprastha Estate,  
New Delhi -110002, India

The Ministry of Skill Development and Entrepreneurship (MSDE) is undertaking the 'National Skill Gap Study for High Growth Sectors' and NCAER is the implementing agency for the said study. The overall objective of in this work is develop a Labour Market Information System. The specific objective of this questionnaire is to understand the present and future demand for jobs roles/occupations and associated skills. This study is sponsored by the Ministry of Skill Development and Entrepreneurship.

Your identity would be held confidential while discussing your suggestions and views on the subject.

Respondent's Name: .....

Respondent's Company Name: .....

Respondent's Designation: .....

Respondent's Phone: .....

Respondent's Email: .....

#### FIRM PROFILE

1. What is the firm's ownership type? (Please select one)

- |                                                           |                                                        |                                                        |
|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| <input type="checkbox"/> Public Sector                    | <input type="checkbox"/> Public Limited                | <input type="checkbox"/> Private Limited               |
| <input type="checkbox"/> Partnership/Individual Ownership | <input type="checkbox"/> Multinational Company         | <input type="checkbox"/> Limited Liability Partnership |
| <input type="checkbox"/> Cooperative                      | <input type="checkbox"/> Others, please specify: _____ |                                                        |

2. What was the annual turnover range in FY 2023-24? (Please select one)

- |                                                                  |                                                               |
|------------------------------------------------------------------|---------------------------------------------------------------|
| <input type="checkbox"/> ≤ Rs 5 crore (Micro)                    | <input type="checkbox"/> > Rs 5 crore & ≤ Rs 50 crore (Small) |
| <input type="checkbox"/> > Rs 50 crore & ≤ Rs 250 crore (Medium) | <input type="checkbox"/> > Rs 250 crore (Large)               |

3. What is the key production/service activity of your firm? Tick one or multiple options

- Industry 4.0
- Cloud Infrastructure
- Software Product
- IT Integration / System Integration
- End User Computing

#### EMPLOYMENT BACKGROUND

4. How many people are employed at the firm?

| Q. How many people are employed at the firm? |             |                           |               |
|----------------------------------------------|-------------|---------------------------|---------------|
| S.No.                                        | Particulars | Number of people employed |               |
|                                              |             | Managerial Staff (No.)    | Workers (No.) |
| Total Employees (in numbers)                 |             |                           |               |

5. With reference to the total employees identified in Q.4, what is the educational background of the employees (as percentage (%) of total employees)?

| Below Class X (%) | Above Class X and Below Class XII (%) | Class XII pass (%) | Vocationally Educated (ITI, PMKVY, RPL etc.) (%) | Bachelor's degree and above (%) |
|-------------------|---------------------------------------|--------------------|--------------------------------------------------|---------------------------------|
|                   |                                       |                    |                                                  |                                 |

## II. UNDERSTANDING HIRING, SKILLING, GENDER-BASED ROLES, AND SKILL SHORTAGES

6. What is your experience of the IT/ITeS sector from the point of skilling? Is it mostly fresh skilling of workers or reskilling or upskilling or recognition of prior skills?
7. What is your outlook on skills availability?
8. Which domain do you hire?
  - a. Agri tech
  - b. Fintech
  - c. Edu technology
  - d. Health tech
  - e. Others
9. What are the mediums used for hiring employees? (*multiple selections possible*)
 

|                                                         |                                                                                            |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Employment agency              | <input type="checkbox"/> Online job sites/advertisements; Please specify: _____            |
| <input type="checkbox"/> Own website advertisements     | <input type="checkbox"/> Campus recruitment; Please mention institutions: _____            |
| <input type="checkbox"/> Vocational training institutes | <input type="checkbox"/> Sector Skill Council / Sector Skill Council affiliated institutes |
| <input type="checkbox"/> Newspaper advertisements       | <input type="checkbox"/> Internships/apprenticeships                                       |
| <input type="checkbox"/> Networks and referrals         | <input type="checkbox"/> Others, specify: _____                                            |
10. What percentage do you hire from Universities?
11. Do you provide on-the-job training within the firm, either before or after deployment?  
 Yes / No: \_\_\_\_\_  
 If 'Yes', what is your policy? \_\_\_\_\_
12. How many people have you skilled or hired to be skilled in the last one year?
  - a. For Lateral entrant – 2- 5 yrs / 5-10 Yrs / 5-15 Yrs / 15 yrs +
  - b. For fresh hire
13. Were they reskilled or fresh skilled or upskilled?
14. Do you have the capacity to train aspirants in those job roles?
15. How do you structure capacity training?
16. Does the firm run its own skilling institution, or have any tie-up / partnership with another institution / NASSCOM for skilling purposes?  
 Yes / No: \_\_\_\_\_  
 If 'Yes', please mention which institutions: \_\_\_\_\_
17. What kind of association(s) does the firm have with the skilling institution(s) identified in Q.16, if any? (*multiple selections possible*)
 

|                                                                                            |                                                                                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <input type="checkbox"/> We offer apprenticeships/internships for trainee students         | <input type="checkbox"/> We send our staff to take visiting classes or other classes  |
| <input type="checkbox"/> We offer inputs to the course curriculum                          | <input type="checkbox"/> We sponsor lab facilities in TVET or other institutions      |
| <input type="checkbox"/> We sponsor fresh skilling programmes to absorb the students later | <input type="checkbox"/> We sponsor re-skilling/upskilling programs for our employees |
| <input type="checkbox"/> No associations                                                   | <input type="checkbox"/> Other; please specify: _____                                 |
18. Do you offer career path to employees?
19. Do people prefer geographies? Are there particular geographies where jobs are more available?

### Gender

20. What was the gender ratio on average? Was it skewed towards one particular sector?
21. In the next three years, do you perceive a demand for women in particular job roles, either among the existing job-roles or those which will be in-demand in future?  
Yes / No: \_\_\_\_\_  
If 'Yes', please specify which ones: \_\_\_\_\_
22. Does the firm have hiring policies to encourage female employment, especially in non-traditional job roles?  
Yes / No: \_\_\_\_\_  
If 'Yes', please explain the policy in detail: \_\_\_\_\_
23. Has the firm defined sexual harassment policies, prevention systems, procedures and service rules for its employees (Prevention of Sexual Harassment at Workplace Act 2013)?  
Yes / No: \_\_\_\_\_

### Skill Gap

24. How easy or difficult was it to fill the job roles (including the number of positions) advertised by the firm in the last three years (FY 2021-22 onwards)? (Add rows if necessary. If the firm advertised many job roles, you can specify job roles at two extremes: those which were easiest to fill, and those very difficult / un-filled)

| S.No. | Value Chain | Job Roles advertised (Annexure 10.1) | Geographic Availability/needs | Please Specify the Level:<br>Entry level/<br>intermediate or mid-level/senior level /<br>managerial level/<br>director level/<br>executive level | Difficulty of filling jobs (rank)<br>1. Very easy; 2. Easy; 3. Average; 4. Difficult; 5. Very difficult; 6. Not filled at all |
|-------|-------------|--------------------------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1     |             |                                      |                               |                                                                                                                                                  |                                                                                                                               |
| 2     |             |                                      |                               |                                                                                                                                                  |                                                                                                                               |
| 3     |             |                                      |                               |                                                                                                                                                  |                                                                                                                               |
| 4     |             |                                      |                               |                                                                                                                                                  |                                                                                                                               |
| 5     |             |                                      |                               |                                                                                                                                                  |                                                                                                                               |

25. Please fill out table for job roles which were difficult or very difficult to fill or not filled at all due to skills shortage.

| S.No. | Job Role          | Skills Required / Important (Look at Table Q10.1 and Q10.2) |           |           |                        |
|-------|-------------------|-------------------------------------------------------------|-----------|-----------|------------------------|
|       |                   | Cognitive Skills                                            | Knowledge | Education | Socio-Emotional Skills |
| 1.    | Developer         |                                                             |           |           |                        |
| 2.    | Architect         |                                                             |           |           |                        |
| 3.    | Security Analyst  |                                                             |           |           |                        |
| 4.    | Program Manager   |                                                             |           |           |                        |
| 5.    | Domain Consultant |                                                             |           |           |                        |

### Anticipating Skills

26. How is Gen 3 technologies changing the skills landscape in India? Are the jobs getting redundant or do they need upskill and reskill? Are the skills rare?

27. Do you anticipate any new job roles that will come up in the next three years due to the technological changes or old existing job roles that will require updated skill sets?

| S. No. | Job Role          | Geography where they will be required | Skills Required / Important (Look at Table Q10.1 and Q10.2) |                       |           |                                      |
|--------|-------------------|---------------------------------------|-------------------------------------------------------------|-----------------------|-----------|--------------------------------------|
|        |                   |                                       | Cognitive Skills (Table Q10.2)                              | Knowledge (Technical) | Education | Socio-Emotional Skills (Table Q10.2) |
| 1.     | Developer         |                                       |                                                             |                       |           |                                      |
| 2.     | Architect         |                                       |                                                             |                       |           |                                      |
| 3.     | Security Analyst  |                                       |                                                             |                       |           |                                      |
| 4.     | Program Manager   |                                       |                                                             |                       |           |                                      |
| 5.     | Domain Consultant |                                       |                                                             |                       |           |                                      |
| 6.     | Others            |                                       |                                                             |                       |           |                                      |

**Table Q10.1**  
**Table Q10.1: Details of Identified Job Roles**  
**in Q.25 and Q.27 of the Questionnaire**

(Request you to provide the details, for each of the relevant job roles, in the format as given below)

S. No.: \_\_\_\_\_

Job Role: \_\_\_\_\_

**Job Descriptors**

| Descriptors                                                                                                                                                                                                                     | Firm's Answer |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Alternative job titles in the industry                                                                                                                                                                                          |               |
| Stage of IT value chain:<br>1. Industry 4.0<br>2. Cloud Infrastructure<br>3. Software Product<br>4. IT Integration / System Integration<br>5. End User Computing                                                                |               |
| Is this job role:<br>1. 'Difficult to fill' at present, or<br>2. Will be in-demand in next 3 years by the firm (Q.27)                                                                                                           |               |
| How many do you need to hire at the 'present moment'/now, or you will need to hire 3 years from now?                                                                                                                            |               |
| Tasks to be performed in the job role<br>(please include specific systems / components / technologies / personnel required to be dealt or interacted with, if any)                                                              |               |
| Education:<br>School (up to what level?) / ITI/ Short-term vocational training programme/<br>Bachelors/ Masters)                                                                                                                |               |
| Knowledge    General? What knowledge?                                                                                                                                                                                           |               |
| Specialised (Sector, Occupational, and Trade)                                                                                                                                                                                   |               |
| Technical Skills:<br>Software languages required, or maybe required in the near future                                                                                                                                          |               |
| Years of Experience, if any                                                                                                                                                                                                     |               |
| Skills required and level of competence<br>(refer to framework of skills in Table Q10.2 below)                                                                                                                                  |               |
| Difficulty of finding workers in the job role, with the above requirements and the skills as detailed below:<br>1. Not at all difficult<br>2. Somewhat difficult<br>3. Difficult<br>4. Very Difficult<br>5. Extremely difficult |               |
| Geographical areas/spatial clusters (existing or emerging) where it is most difficult to fill the role**(mention States and Districts)                                                                                          |               |

\*\* Please explain the reasons behind skill shortage in the specified states and districts: Are there demand side factors (such as low salary, demanding work conditions, absence of platforms to advertise jobs, non-acceptability of workers from conventional labour markets, competition from other sectors to hire the same candidate, etc) and/or supply side factors (such as course not offered by Indian institutions, specialised skilled people not available, absence of and/or proximity to training centres, poor quality of skilling and training programs, lack of programs for re-skilling/upskilling workers from traditional sectors, high salary expectations, non-aspirational job role, availability of other work avenues, etc)?

**Table Q10.2: List of Skills**

|                                                                                                                                                                                                                     |                                                                                                                                                            |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <i>Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)</i> |                                                                                                                                                            |          |
| Skills Required                                                                                                                                                                                                     | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| Reading Literacy: Would they need to read and                                                                                                                                                                       |                                                                                                                                                            |          |

| <i>Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)</i>                                                                                                                                 |                                                                                                                                                            |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                                                                                     | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| understanding written sentences and paragraphs in work related documents?                                                                                                                                                                                                                                                                           |                                                                                                                                                            |          |
| <i>Writing:</i> Would they need to communicate effectively in writing as per their audience for their job?                                                                                                                                                                                                                                          |                                                                                                                                                            |          |
| <i>Speaking:</i> Do they need to talk to others to convey information effectively?                                                                                                                                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Communication:</i> Would they need to provide information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person?                                                                                                                                                                                      |                                                                                                                                                            |          |
| <i>Language Skills 1:</i> Is knowledge of the structure and content of the language including the meaning and spelling of words, rules of composition, and grammar required for the job?                                                                                                                                                            |                                                                                                                                                            |          |
| <i>Language Skills 2:</i> Any specific language requirement for the job? If Yes, which one?                                                                                                                                                                                                                                                         |                                                                                                                                                            |          |
| <i>Numeracy/Mathematics:</i> Would they need to work with numbers for their job?                                                                                                                                                                                                                                                                    |                                                                                                                                                            |          |
| <i>ICT Literacy to Skills:</i> Would they need to use mobile phones/tabs/computers etc. to do their job?<br><br>For example, Arts & Graphics, Desktop Publishing, Presentation, Spreadsheet, Word Processing, Programming, Client Server/Networking/Hardware, Operating Systems, Database/Statistics, Engineering Software and Web Page Design etc. |                                                                                                                                                            |          |
| <i>Self-learning to Active (Independent) Learning:</i> Would they need to understand new information for both current and future problem-solving and decision-making at their job? Are they expected to do on their own for the job or self-learn, if the material is provided to them?                                                             |                                                                                                                                                            |          |
| <i>Active Listening-</i> Do they need to listen for their job, like taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times?                                                                                                                                                  |                                                                                                                                                            |          |
| <i>Science-</i> Do they need to use scientific rules and methods to solve problems at work?                                                                                                                                                                                                                                                         |                                                                                                                                                            |          |
| <i>Problem Solving-</i> Do they need to identify problems and review related information to develop and evaluate options and implement solutions?                                                                                                                                                                                                   |                                                                                                                                                            |          |
| <i>Learning Strategies-</i> Do they need to select and use training/instructional methods and procedures appropriate for the situation when learning or teaching new things?                                                                                                                                                                        |                                                                                                                                                            |          |
| <i>Critical Thinking-</i> Would the worker need to use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to                                                                                                                                                                          |                                                                                                                                                            |          |

| <i>Please think whether the person in the above job profile would need the following skills to do their job. (Please choose the relevant skills and indicate the level of competence required for those skills)</i>                                                                           |                                                                                                                                                            |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                                                                                               | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| problems?                                                                                                                                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Creativity</i> -Do the workers need to develop, design, or create new applications, ideas, relationships, systems, or products, including artistic contributions?                                                                                                                          |                                                                                                                                                            |          |
| <i>Independent research</i> -Would the worker need to conduct literature review, undertake data collection, cleaning etc., develop research plan?                                                                                                                                             |                                                                                                                                                            |          |
| <i>Judgement and Decision-making</i> - Would the worker need to consider the relative costs and benefits of potential actions to choose the most appropriate one?                                                                                                                             |                                                                                                                                                            |          |
| <i>Systems Analysis</i> - Would the worker need to determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes?                                                                                                                  |                                                                                                                                                            |          |
| <i>Systems Evaluation</i> - Would workers need to identify measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system?                                                                                        |                                                                                                                                                            |          |
| <i>Financial Resources</i> - Would the worker need to determine how money will be spent to get the work done, and accounting for these expenditures?                                                                                                                                          |                                                                                                                                                            |          |
| <i>Material Resources</i> -Would the worker need to obtain and see to the appropriate use of equipment, facilities, and materials needed to do certain work?                                                                                                                                  |                                                                                                                                                            |          |
| <i>Personnel Resources</i> - Would the worker need to motivate, develop, and direct people as they work, identifying the best people for the job?                                                                                                                                             |                                                                                                                                                            |          |
| <i>Time Management</i> - Managing one's own time and the time of others                                                                                                                                                                                                                       |                                                                                                                                                            |          |
| <i>Seek and Value Diversity</i> -Do workers need to work with people (as colleagues/clients etc.) from other cultures/States/socio-economic backgrounds etc? Is it important for their job performance? Is it likely to be important for their job performance?                               |                                                                                                                                                            |          |
| <i>Gender Diversity</i> -Do workers need to work with female colleagues/clients etc.? Is it important for their job performance? Is it likely to important for their job performance?                                                                                                         |                                                                                                                                                            |          |
| <i>Conscientiousness (including attitude towards work)</i> - Will the worker need to be organised, responsible, and hardworking or have any one of the following traits- Competence (efficient), organised, dutiful (not careless), ambitious, self-discipline (not lazy), and not impulsive? |                                                                                                                                                            |          |
| <i>Openness to Experiences</i> - Will the worker need to be open to new aesthetic, cultural, or intellectual experiences or have any one of the following traits- Imaginative,                                                                                                                |                                                                                                                                                            |          |



| Please think whether the person in the above job profile would need the following skills to do their job.<br>(Please choose the relevant skills and indicate the level of competence required for those skills) |                                                                                                                                                            |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Skills Required                                                                                                                                                                                                 | If required, what is the degree of competence needed in the employee?<br>1. Beginner<br>2. Intermediate<br>3. Competent<br>4. Advanced<br>5. Very Advanced | Comments |
| artistic, excitable, wide interests, curious and unconventional?                                                                                                                                                |                                                                                                                                                            |          |
| <i>Extraversion</i> - Will the worker need to show the following traits- warmth (friendly), sociable, self-confident, energetic, excitement seeking (adventurous), and enthusiastic?                            |                                                                                                                                                            |          |
| <i>Agreeableness</i> - Will the worker need to work in a team in a cooperative, unselfish manner?                                                                                                               |                                                                                                                                                            |          |
| <i>Neuroticism/Emotional stability</i> – Will the worker need to show emotional stability i.e. predictability and consistency in emotional reactions, with absence of rapid mood changes?                       |                                                                                                                                                            |          |
| Does the worker need social skills at work?                                                                                                                                                                     |                                                                                                                                                            |          |
| <i>Instructing</i> - Does the worker need to teach others how to do something?                                                                                                                                  |                                                                                                                                                            |          |
| <i>Negotiation</i> - Does the worker need to bring others together and try to reconcile differences?                                                                                                            |                                                                                                                                                            |          |
| <i>Persuasion</i> - Do workers need to persuade others to change their minds or behaviour?                                                                                                                      |                                                                                                                                                            |          |
| <i>Occupation-specific skills</i>                                                                                                                                                                               |                                                                                                                                                            |          |
| <i>Physical skills</i> , including job-specific complex psychomotor skills                                                                                                                                      |                                                                                                                                                            |          |
| <i>Global Competence</i> – Globally competent workers                                                                                                                                                           |                                                                                                                                                            |          |
| <i>Any other?</i> Please specify:                                                                                                                                                                               |                                                                                                                                                            |          |

\*\*\*





Tel: +91-11-2345-2698, 6120-2698 info@ncaer.org www.ncaer.org

