

# Identifying Emerging Green Jobs in Coal and Thermal Power Sector in the wake of Just Transition in the Eastern Part of India





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## Executive Summary

The prevailing discourses on the adverse impacts of climate change have induced an amplified consciousness regarding carbon footprints and social mobilisations, promoting a 'post-carbon society'. Within the Indian context, coal has played a pivotal role in the country's economic advancement, serving as the fundamental pillar of the industrial sector. However, its mining and combustion have been principal catalysts for anthropogenic carbon emissions.

Given India's commitment to addressing climate change, it can be inferred that achieving a 'net-zero' economy by 2070 will require a phased reduction and eventual elimination of coal and its related value chains in the upcoming decades. However, this transition raises important concerns regarding the well-being of individuals who depend on the coal industry for their livelihoods. As the shift to a 'post-coal' economy is likely to result in job losses, internal migration, and socio-economic disruptions, questions arise regarding the distribution of benefits and restorative justice associated with this transformation, as well as the economic restructuring required to achieve it. Therefore, India faces a dual challenge of gradually and progressively reducing coal mining while minimising the impact on those who rely on the coal value chain.


The present study is a step in that direction as it attempts to take stock of the impact of coal 'phase down' on revenue and employment generation alongside skill obsolescence in the eastern coal belt of India. As one of the oldest coal belts in the country, it spans the states of West Bengal, Jharkhand, and Odisha, spearheading their economic development over the decades.

This study utilises both primary and secondary data to analyse the coal value chain in the eastern region and establish a 'baseline' scenario for the current state of the coal sector in West Bengal, Jharkhand, and Odisha. Furthermore, the study identifies key sectors in these states that make a significant contribution to their respective economies. These sectors may provide an opportunity to absorb the surplus labour force that may become unemployed as a result of the forthcoming coal 'phase down.'

The final result of this research is a comprehensive skill matrix which delineates potential sectors for employment creation, and skill intervention, alongside identifying skills to be developed for the next several decades. The rationale for creating this matrix lies in the necessity to mitigate unemployment arising from the coal 'phase-out' by identifying opportunities in clean energy technologies and other labour-intensive industries. Hence, this matrix can serve as a tool to facilitate effective skill development and job creation strategies for affected communities.

We discovered in all three states that although there is a requirement for skill training workshops and modules for specific groups, the necessity for developing market connections is even greater to guarantee the long-term viability of such initiatives.

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We expect certain occupations to gain relevance shortly within the eastern coal belt region. These include agriculture and allied activities such as food processing, horticulture, and livestock rearing, as well as forest-based industry and traditional handicrafts like Dhokra casting and bamboo craft. Additionally, there is potential for skill intervention in the end-to-end solar PV manufacturing sector in the context of clean energy. The service sector, particularly in the fields of eco-tourism and hospitality, also presents opportunities for job creation.

Furthermore, the report examines the involvement of women in the coal value chains over the years and how the impending 'energy transition' could offer an occasion to rectify the gender disparity in workforce representation that currently exists in these coal mining regions. This could provide women, who are presently limited to engaging in illegal coal scavenging, with an equitable opportunity to pursue secure and satisfying livelihoods.

Considering the expected increase in the number of green jobs soon and the transition of current industries towards ecological sustainability, we earnestly aspire that this report will function as a guide for policymakers at both the central and state levels, non-governmental organisations, and other relevant stakeholders involved in skill development, aiding them in designing effective skill training programs and policies to build economic resilience among communities that stand to be the most affected by this transition.

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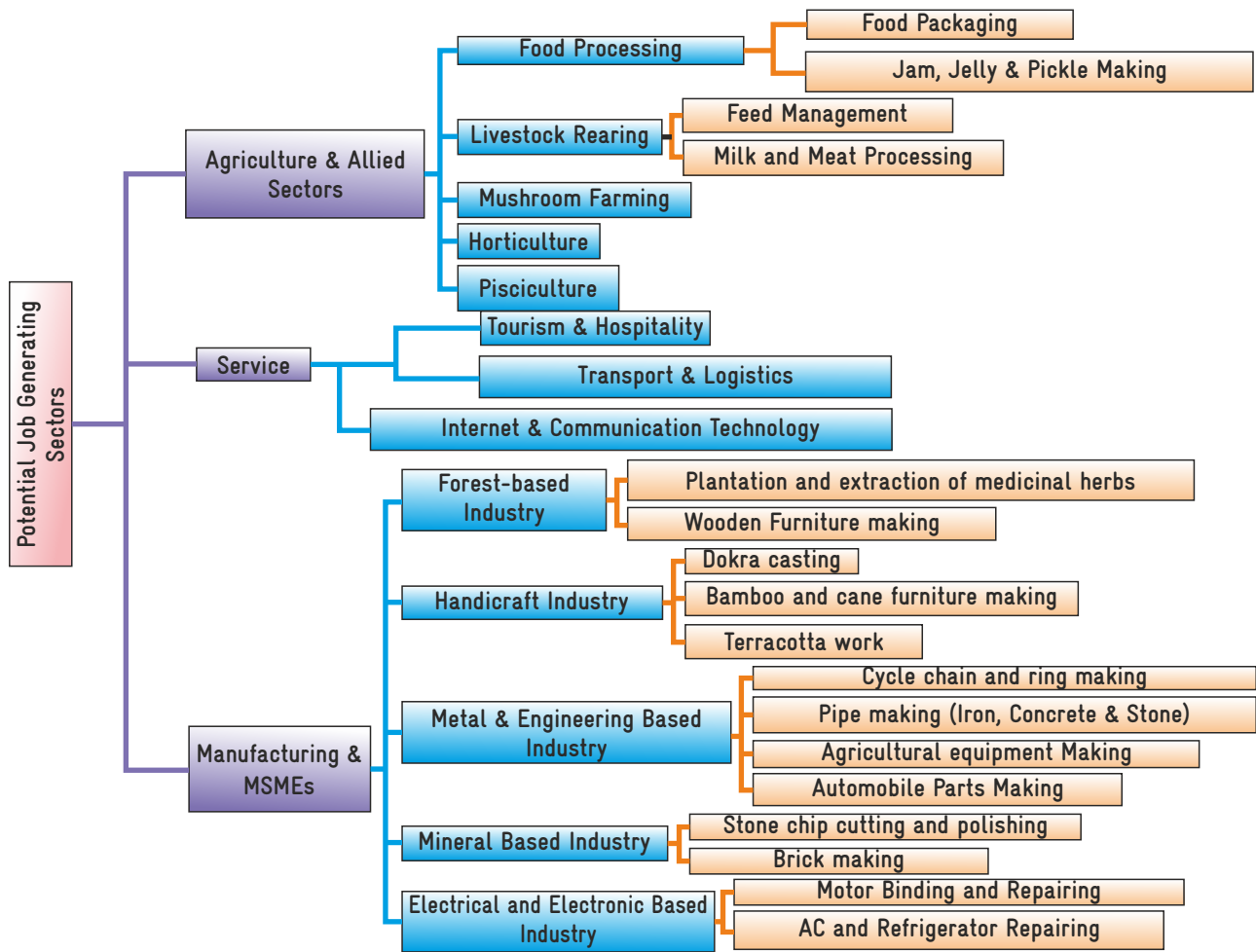
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# Abbreviations

BCCL	Bharat Coking Coal Limited
CIL	Coal India Limited
CCL	Central Coalfields Limited
CMPDI	Central Mine Planning & Design Institute
COP	Conference of the Parties
CSR	Corporate Social Responsibility
DPL	Durgapur Projects Limited
DVC	Damodar Valley Corporation
ECL	Eastern Coalfield Limited
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IISCO	Indian Iron & Steel Company
IDCO	Odisha Industrial Infrastructure Development Corporation
JCF	Jharia coalfield
MCL	Mahanadi Coalfields Limited
MSME	Micro, Small and Medium Enterprises
MT	Million Tonnes
NSSO	National Sample Survey Organisation
NTPC	National Thermal Power Corporation
OC	Open Cast
PSU	Public Sector Undertaking
PV	Photo Voltaic
SECL	South-Eastern Coalfields Limited
TISCO	Tata Iron and Steel Company
UG	Under Ground
VET	Vocational Education and Training
WBPDCL	West Bengal Power Development Corporation Limited



# Consolidated Skill Matrix for the Eastern Coal Belt





# Introduction

Assessing the availability of social and physical infrastructure, as well as individual income levels, is widely considered to be the primary means of evaluating the well-being of communities across developing countries. National and international development agencies also place significant emphasis on these indicators when analysing the level of socioeconomic progress in any geographic location or population group.

In the context of planning- a comprehensive, equitable transition strategy that focuses on reskilling and re-employment of mining industry workers, it is crucial to possess a deep understanding of the existing socio-economic infrastructure and amenities within a mining area. Furthermore, as the mining and power industries often make considerable investments in local area development and community welfare through corporate social responsibility (CSR) funds and other means, it is equally essential to quantify the degree of dependency that the local community has on such services, if possible. To this end, this study undertakes extensive primary surveys – interacting with the community representatives, government, private players, and domain experts as well as secondary literature reviews to understand and analyse the multifaceted transition process in these mineral-rich regions and eventually be able to frame a Skill Requirement Matrix for the select pockets.

The people living in the coal districts of India rely heavily on the coal industry for their livelihoods, both directly and indirectly through related industries such as transportation and power generation. Therefore, any plan to transition away from coal in these regions must take this complex dependence into account.

It is crucial to determine how the anticipated clean energy shift will impact the workforce in each region. It's also important to identify which industries can absorb the workers who may lose their jobs, pinpoint areas with skill gaps, and map out new job opportunities in environmentally friendly fields. This will help create a sustainable plan for skill-building, to facilitate a fair and equitable transition.

The proposed Skill Matrix will clarify the type and scale of skilling and re-skilling drives to be deployed in the identified coal corridors through collaborations between government and industries, as these regions prepare to embrace energy transition in a gender-inclusive, community-driven way. The requirement of vocational and technical education investments in these districts, the state, and the region shall be massive. However, to channel the investment, there should be a strategic document with proper need assessment, identification of scope for skill interventions for green jobs and ways to enhance access to such programmes by stakeholders. Also, there should be a sync between the Central and state agencies and their schemes.



## Background and Context

India has the 5th largest coal reserves in the world and is the second largest producer and consumer of coal after China. As a result, coal has taken the lion's share of the country's fuel mix over the decades. It is the backbone of the nation's thermal energy sector, accounting for approximately 50 percent of the total generation capacity. As a result, the energy generation industry is a major contributor to greenhouse gas (GHG) emissions, accounting for nearly 68.7 percent of emissions, with India's coal-fired power sector alone responsible for approximately one-third of the country's GHG emissions.

Hence, to meet the 1.5°C climate goals of the Paris Agreement and its net-zero commitments, the Indian government has already begun the process by discontinuing about 293 coal mines across Coal India Limited (CIL) and its various subsidiaries (refer to Table 1.0). However, it still has a long way to go in this regard. Presently the government is exploring the possibility of repurposing the abandoned quarries of CIL for the following:

- i. Dumping /Filling of fly ash into the worked-out area for suitable reclamation
- ii. Development of eco and mine tourism parks
- iii. Afforestation
- iv. Pisciculture
- v. Source to supply drinking water and other domestic use.
- vi. Generation of sand from overburden of open-cast mines at a few place
- vii. Ground-mounted solar power projects in its suitable de-coaled area

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1. <https://www.worldometers.info/coal/#coal-reserves>

2. <https://www.worldometers.info/coal/coal-consumption-by-country/>

3. Retrieved October 20, 2022 from <https://powermin.gov.in/en/content/power-sector-glance-all-india>

4. <https://www.climatelinks.org/sites/default/files/asset/document/India%20GHG%20Emissions%20Factsheet%20FINAL.pdf>

5. Retrieved November 28, 2022 from <http://164.100.24.220/loksabhaquestions/annex/178/AS389.pdf>

6. Overburden from a coal mine is the material that is excavated to access coal seams underground. It is typically stored in a designated disposal area or stockpile until it can be used for reclamation purposes.



**Table 1.0: Number of Closed/Abandoned/Discontinued Coal Mines in India (as of April 01, 2021)**

Name of Company	Number of closed/abandoned/discontinued mines
Eastern Coalfields Limited (ECL)	84
Bharat Coking Coal Limited (BCCL)	42
Central Coalfields Limited (CCL)	29
Northern Coalfields Limited (NCL)	1
Western Coal Limited (WCL)	56
South Eastern Coalfields Limited (SECL)	66
Mahanadi Coalfields Limited (MCL)	2
North Eastern Coalfields (NEC)	4
<b>Singareni Collieries Company Limited (SCCL)</b>	<b>9</b>

**Source:** Retrieved November 28, 2022 from <http://164.100.24.220/loksabhaquestions/annex/178/AS389.pdf>

Given that a “Just Transition” should be at the heart of all energy transition policies, welfare must be a crucial part of such plans. This includes minimising disruptions and ensuring inclusivity for indigenous people and local communities, as emphasised by COP-26 in Glasgow. Without proper legislation and institutions to address their concerns, a transition to renewable energy could potentially result in a climatechange-induced, socio-economic disaster.

One of the biggest hurdles to policy planning for “Just Transition” is the lack of consolidated data on formal and informal employment in the coal and thermal power sector. It is well-known that despite being entirely nationalised, the coal mining industry retains a significant informality. However, formal definitions and statistics for these informal employees and their contributions to the coal ecosystem are little to non-existent.

A study by iForest, which analysed employment data from the Annual Survey of Industries and the National Sample Survey Organisation's (NSSO) 68th round of survey on the employment and unemployment situation of India, revealed that almost 1.8 million people are employed formally and 6.9 million people informally in the various sectors of the coal value chain in the country (Table 1.1).

7. [http://microdata.gov.in/nada43/index.php/catalog/127/study-description#:~:text=The%20NSS%2068th,\(ii\)%20Employment%20and%20Unemployment](http://microdata.gov.in/nada43/index.php/catalog/127/study-description#:~:text=The%20NSS%2068th,(ii)%20Employment%20and%20Unemployment)

**Table 1.1: Estimated Workforce (in millions) in the Coal Value Chain<sup>8</sup>**

Sectors	Informal Employment	Formal Employment
Coal Mining	1.8	0.8
Coal-based thermal power (1)	0.05	0.13
Iron and Steel	2.6	0.3
Cement	1.2	0.2
Oil and Gas, excluding refineries(2)	NA	0.12
Refineries	0.08	0.04
Fuel Retail	0.96	0.14
LPG distribution	0.01	0.09
Fertilizer (3)	0.2	0.02
Automobile (4)	NA	NA
<b>Total</b>	<b>6.9</b>	<b>1.8</b>

Source: Chandra Bhushan and Srestha Banerjee. (2021). Five R's: A cross-sectoral landscape of Just Transition in India, International Forum for Environment, Sustainability & Technology (iFOREST), New Delhi.

In case of a coal “phase out,” this cumulative population of 8.7 million people shall be the biggest casualty of this climate change-induced move. Generating livelihood and ensuring re-absorption of this labour shall be the biggest challenge for any transition from coal to alternative renewable energy sources.

We are pleased to acknowledge that our study has been supported by the Indo-German Programme for Vocational Education and Training (IGVET) vertical of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The vertical, among many things, aims to promote sustainable economic development through vocational education and training (VET). IGVET does the following:

1. **Facilitate Public Private** Partnership
2. Introduce **Cluster Development approach** to Skill development
3. **Develop/support Pilot models** of Skill development
4. **Capacity Development** for key actors of Cooperative VET
5. **Strategic Advisory** for Systemic Change
6. **Replication and scale-up** of pilot models

In addition to their work on VET, IGVET is also working on green skills, green jobs, and just transition. They see skill training as a key component of this transition, as workers in coal-dependent industries will need to acquire new skills and knowledge to be able to participate in the emerging clean energy economy.

8. Explanatory notes: (1) Excluding fly ash handling and processing. (2) This is formal employment in oil and gas companies. The total employment is likely to be higher, due to the large-scale use of contract workers. (3) Only urea manufacturing plants, which are directly dependent on fossil fuels for feedstock. (4). Division of formal and informal workers not available. Includes employment in servicing and dealership.



## Location Mapping

The eastern coalfields of India span the states of West Bengal, Jharkhand, and Odisha. It is one of the oldest coal belts in the country, which has spearheaded the economic development of this region. However, in light of the increasing GHG emissions and the nation's climate change commitments, the central and state governments have been increasingly looking towards renewables, particularly bio-energy, solar, and wind energy, to decrease their dependence on thermal energy.

Hence, this project aims to create a skill matrix that will guide the development of industry-linked skill programmes to support the transition away from coal mining in the eastern coal belt region. The need for such programmes arises from the revenue and employment losses caused by the phasing out of coal mining. The idea is to analyse and identify the gap areas in skill training and capacity building at the community (both local and the workforce) level for creating diversified economies through alternate employment and revenue generation channels.

Such capacity-building programmes will have a three-pronged impact. It will help affected communities to:

1. address economic vulnerabilities rising from the gradual closure of the coal mines
2. to gain relevant skills and resources to diversify themselves out of the coal value chain.
3. to become active agents of the clean energy transition.

For this study, we intend to focus on the eastern coal belt of India, specifically concentrating on the states of Jharkhand, Odisha, and West Bengal, which account for 26, 24 and 11 percent of the country's total coal reserves, respectively.

Locations from Odisha, West Bengal and Jharkhand were selected based on the following criteria:

- i. Proximity to coal mines and thermal power plants, especially those to be exhausted or decommissioned soon
- ii. Industrial belt surrounding the mines and thermal power plants, such as the Jharia-Raniganj-Asansol-Durgapur industrial area
- iii. Industry clusters which are labour-intensive and appropriate for green interventions as well as environment-friendly employment creation
- iv. Departments/offices of representatives from the leading sectors of each state economy (both government and private)

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9. <https://www.nsenergybusiness.com/features/states-india-largest-coal-reserves/>

Given the above criteria, we shall focus on the following coal cum industrial belts in the three selected states:

State	Coal Belt
West Bengal	Durgapur-Asansol
Jharkhand	Jharia-Dhanbad
Odisha	Talcher

**Figure 1.1: Geological Resources of Coal in Eastern India in Million Tonnes (as of 1.4.2022)**



Source: <https://coal.gov.in/en/major-statistics/coal-reserves>

## State Profiles

### Odisha

The state of Odisha, previously known as Orissa, has an ample supply of minerals such as coal, bauxite, and iron ore, which has resulted in the establishment of several noteworthy mining and steel industries. Despite possessing a prosperous mineral profile, the state requires more foreign investment to enhance its economy, generate increased employment opportunities for its growing workforce, and aid in the transition towards renewable energy sources. To accomplish this, the state government is advocating for market liberalisation, decreasing regulatory obstacles, and creating skill training programs like 'Skilled in Odisha' and 'Make in Odisha' to transform the state into a prominent hub for skilled labour in the country.

As the country's second-largest producer of coal and lignite, Odisha will inevitably be affected by the energy transition from fossil fuels to renewables. Like many of the coal-rich regions of the country, it is not a renewable powerhouse. However, solar and wind energy are some of the up-and-coming renewable technologies in the state which can offset some of the economic shocks from the transition.

Further, there should be detailed plans regarding repurposing lands from discontinued coal mines and thermal power plants alongside re-skilling and training programmes which can potentially be crucial to the energy transition from the workers' point of view. In addition, another major component of a just energy transition would be providing pension benefits for eligible employees and developing social security plans for workers. There should also be a foolproof plan for transition support to the informal or contractual workers.

While a Just Transition for Odisha's coal mines will entail a restructuring and balanced diversification of the state's economy and industrial activities, the process necessitates adequate supplementation by detailed policy and plans outlining the transition in phases. It also needs to consider the coal mines' timeframe, thermal power plant closures, and corresponding growth in green industries. Hence early planning is imperative to allow sufficient time for labour adjustment. Considering the state government's efforts at skilling and training workers, it is clear that labour support and re-training shall be at the heart of all transition plans. This will minimise disruptions to the lives of communities involved in the fossil fuel industry and ensure their basic needs are adequately addressed.

Thus, companies must develop employee portfolios that consider the future demand for skills. As a significant portion of informal labourers is semi-skilled or unskilled, it is necessary to assist them through income-generating schemes and training programs to facilitate re-employment. Additionally, government initiatives focused on job creation through infrastructure investments and livelihood production will be crucial. Lastly, achieving economic diversification that balances the contribution of primary, secondary, and tertiary sectors to the state GDP will be vital.

## Case Study in Focus – Angul

Located at the heart of Odisha and between the rivers Brahmani and Mahanadi, the district of Angul is home to the Talcher coalfield, the largest repository of power-grade coal in India. In addition, the district takes pride in being a major source of revenue for the state as it is the third biggest coal-producing district in India, after Korba in Chhattisgarh and Singrauli in Madhya Pradesh.

**Figure 3.1: Coal-carrying Wagons at Angul Station**



Source : Captured by Authors during field study

**Table 3.1: Coal Reserves in Angul as a Percentage of the Coal Reserves in India and Odisha in Million Metric Tonnes (as of 01.04.2020)**

Coal Reserves	Proved	Indicated	Inferred	Total
India	163460.84	150391.96	30168.04	344020.84
Odisha	40871.77	36067.17	7713.12	84652.06
Angul	25515.86	22931.87	4102.59	52550.32
Angul's reserves as a percentage of Odisha's reserves	62	64	53	62
Angul's reserves as a percentage of India's reserves	16	15	14	15

Source: [https://ibm.gov.in/writereaddata/files/04272022135005Coal\\_Lignite%20\\_AR.pdf](https://ibm.gov.in/writereaddata/files/04272022135005Coal_Lignite%20_AR.pdf)

10. <https://angul.nic.in/about-district/#.text=Covering%20an%20area%20of%206232.1930%20villages%20having%201273821%20population.>

Coal mining has been a major way people earn a living in the district for over 100 years. The first mine, called Handidua colliery, was opened in 1921 by M/s Villiers. After that, other mines were opened like Talcher colliery, Deulbera, and Nandira. These mines were managed by railway companies and were run by the Government of India. In 1973, all the mines in the district were nationalised and put under Coal India Limited (CIL). South-Eastern Coalfields Ltd. (SECL) ran the mines in Angul until 1992 when Mahanadi Coalfields Limited (MCL) took over as the last subsidiary of CIL.

**Figure 3.2:Open Cast Mining at Bhubaneswari Coal Mine, Talcher**



**Source :** Captured by Authors during field study

Most of Odisha's coal mining is centred in the Angul district, with eight open casts and one underground mine operating in the Talcher coalfields. Moreover, 15 percent of Talcher's population is directly or indirectly engaged in the coal industry, including two thermal power plants controlled by the National Thermal Power Corporation (NTPC).<sup>11</sup>

11. Sharma, V., Greig, C., & Lant, P. (2021). What is stopping India's rapid decarbonisation? Examining social factors, speed, and institutions in Odisha. *Energy Research & Social Science*, 78, 102117. Doi:10.1016/j.erss.2021.102117



Moreover, the long-term requirements for coal resources are being met by enhancing the capacity of current coal mines and building new ones in Angul. The coal mining area in Angul, which includes both active and inactive mines, covers more than 13,662 acres or more than two percent of the district's land area.<sup>12</sup> When factoring in the allocation of blocks, new mines, and the expansion of existing mines, the coal mining area will increase to five percent of the entire area.

**Table 3.2: Operational Coal Mines in Angul (2021-22)**

Name of Mine	Block	Operation Type	Public/Private	Capacity (MMTPA)	Production (MMT)	Area (ha)
Nandira	Talcher	UG	Public	0.3	0.08	370
Jagannath	Talcher	OC	Public	7.5	7	553.9
Bharatpur	Talcher	OC	Public	20	9.2	927.4
Balaram	Talcher	OC	Public	8	6.5	1309
Ananta	Talcher	OC	Public	15	13.6	1419.8
Lingaraj	Talcher	OC	Public	16	14.5	1493.2
Hingula	Talcher	OC	Public	15	7.7	1870
Bhuvaneshwari	Talcher	OC	Public	28	28	638.3
Kaniha	Kaniha	OC	Public	14	10.1	718
<b>Total</b>				123.8	96.7	9299.6

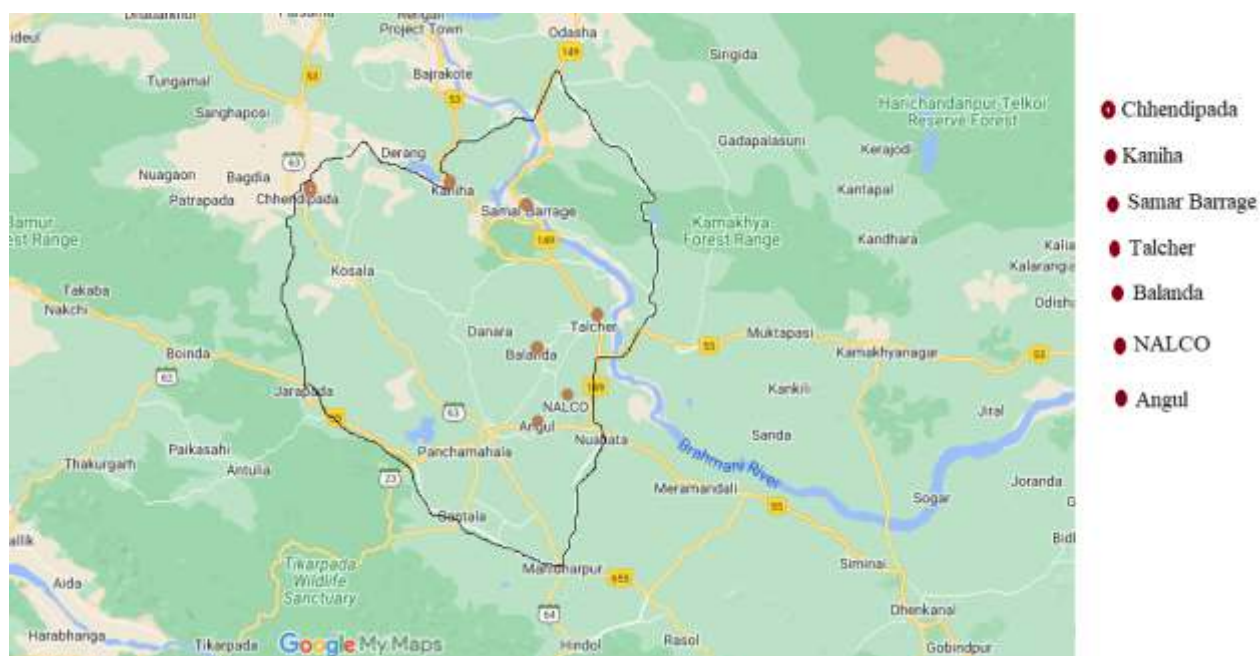
**Source:** Chandra Bhushan, Srestha Banerjee, Chinmayi Shalya and Deeksha Pande. (2022). Angul: Planning a just energy transition and a new green economy. International Forum for Environment, Sustainability and Technology (iFOREST). New Delhi, India.

Coal and coal-based industries, such as thermal power plants, coal washeries, transport, steel, and aluminium industries, are a primary source of income for Angul. The local economy heavily relies on coal; and phasing it out would result in unemployment and devastating economic damage, especially for coal-dependent districts like Angul. According to a study by iForest, around 30 percent of households in Angul rely on the coal ecosystem for income, and around 13 percent of households are employed informally in activities such as cleaning, overseeing conveyor belts, and moving small equipment.<sup>13</sup>

12. Chandra Bhushan, Srestha Banerjee, Chinmayi Shalya and Deeksha Pande. (2022). Angul: Planning a just energy transition and a new green economy. International Forum for Environment, Sustainability and Technology (iFOREST). New Delhi, India.

13. i.d

**Figure 3.3: Parts of the Talcher Coalfield covered under this study from Odisha**



## Baseline Scenario

**Primary Sector:** As per our interactions with local stakeholders, agriculture and coal mining were the two primary industries of the district, alongside non-timber forest-based industry –since 45 percent of the district is under forest cover and primarily centred around the collection of tendu leaves. Again, 53 percent of the labour force is engaged in the Agri-sector and commonly cultivated crops here are Paddy, maize and legumes.<sup>14</sup>

The district's farming largely relies on rainfall, making it sensitive to temperature changes. Besides that, there exists potential for agro-based industries like horticulture, livestock rearing, and dairy farming, but it hasn't been fully developed because of the small size of land holdings, depleted groundwater from mining and industry, poor irrigation, and ineffective implementation of agricultural schemes.

**Secondary Sector:** Manufacturing forms the bulk of the secondary sector in the district. According to a report by iForest, 21 hectares have been set aside for constructing an MSME park in Angul to encourage and boost the potential of MSMEs in the district.<sup>15</sup> Besides this, the State government will extend gross financial assistance of Rs 428.95 crore to Odisha Industrial Infrastructure Development Corporation (IDCO) develop a mega aluminium park in Angul.<sup>16</sup>

14. Data from field interactions

15. Chandra Bhushan, Srestha Banerjee, Chinmayi Shalya and Deeksha Pande. (2022). Angul: Planning a just energy transition and a new green economy. International Forum for Environment, Sustainability and Technology (iFOREST). New Delhi, India.

16. <https://sambadenglish.com/odisha-cabinet-okays-establishment-of-mega-aluminium-park-in-angul-at-cost-of-rs-428-95-cr/>

**Table 3.3: Existing MSME Clusters in Angul**

Sl No.	Name of Cluster/Product	Location	No. of MSMEs in the Cluster	Cluster is suitable for which Scheme	Nodal Agency (DIC/ Association /NGO etc.)
1	Artistic Textile Handloom	Athmallick, Angul	178	DC Handicrafts/ Handlooms Scheme	DC (Handicraft) / SADHAC
2	Terracotta (Earthen & plaster statues, Earthenware)	Chhendipada (Jaradapada, Malisahi, Jhampuli)	100	DIC, Angul/ Schemes of DC (Handicraft)Soft Interventions/ SFRUTI	DIC, Angul
3	Dhokra Casting/craft (Metal ware)	Talcher & Adjoining Area Chendipada (Tangiri)	90	DIC, Angul/ Schemes of DC (Handicraft)Soft Interventions/ SFRUTI	DIC, Angul
4	Cane & Bamboo (Basketry, Mat Weaving & Cane Articles)	Kishore Nagar & nearby areas (Gobindpur, Jhampuli)	90	DIC, Angul/ Schemes of DC (Handicraft)Soft Interventions/ SFRUTI	DIC, Angul
5	Cane & Bamboo (Basketry, Mat Weaving & Cane Articles)	Pallahada (Odasha, Mundribeda, Khamar)	100	DIC, Angul/ Schemes of DC (Handicraft) Soft Interventions/ SFRUTI	DIC, Angul
6	Engineering	Angul, Talcher	22	MSE-CDP Awareness Prgms IPR/Design/ ZED /Gem	DIC, Angul MSME-DI, Cuttack
7	Fly Ash Bricks	Angul & adjacent areas	40	MSE-CDP Awareness Prgms IPR/Design/ ZED /Gem	DIC, Angul MSME-DI, Cuttack
8	Brass & Bell Metal	Tubey, Banarpal	60	DIC, Angul/ Schemes of DC (Handicraft)Soft Interventions/ SFRUTI	DIC, Angul
9	Terracotta	Talcher (jambubahali, Kanjara)	60	DIC, Angul/ Schemes of DC (Handicraft)Soft Interventions/ SFRUTI	DIC, Angul
10	Cane & Bamboo Craft	Paktunga	150	DIC, Angul/ Schemes of DC (Handicraft)Soft Interventions/ SFRUTI	DIC, Angul

Source: <http://www.msmedicuttack.gov.in/press-release/CmZLrIW4BIPs%20Angul%202019-20%20Final.pdf>

**Table 3.4: Large-Scale Industries/Public Sector Undertakings in Angul**

Sl No.	Name of the unit	Location	Item of production
1	National Aluminum Company Ltd. (NALCO)	NALCO Nagar	Aluminium
2	National Thermal Power Corporation (NTPC)	Kanhia	Electricity, Thermal
3	Talcher Thermal Power Station	Talcher	Electricity, Thermal
4	Heavy Water Plant	Talcher	Heavy Water
5	Mahanadi Coal Field Ltd.(MCL)	Talcher	Coal
6	M/s. Shree Metaliks Ltd	Amlapada	Sponge Iron
7	M/s. Bindal Sponge Ltd.	Sunakhani, Talcher	Sponge Iron, MS Ingot & Bar
8	M/s. Ganesh Sponge Pvt. Ltd.	Krushnachandrapur, Parjang,	Sponge Iron
9	M/s. CPP Unit of Jindal Steel and Power Ltd.	Kerjar	Power

Source: <http://www.msmedicuttack.gov.in/press-release/CmZLrIW4BIPs%20Angul%202019-20%20Final.pdf>

To summarise, it is imperative to consider the employment and livelihood implications of transitioning from coal to renewable energy sources. As such, any skilling and re-training programmes implemented to facilitate this transition should prioritise the agriculture and manufacturing sectors. A just transition plan, which includes accompanying transition support, should also be put in place to ensure a smooth and fair shift towards greener energy sources. By doing so, we can ensure a sustainable future while also taking care of the needs and well-being of the workforce.

## Strategies for Diversification

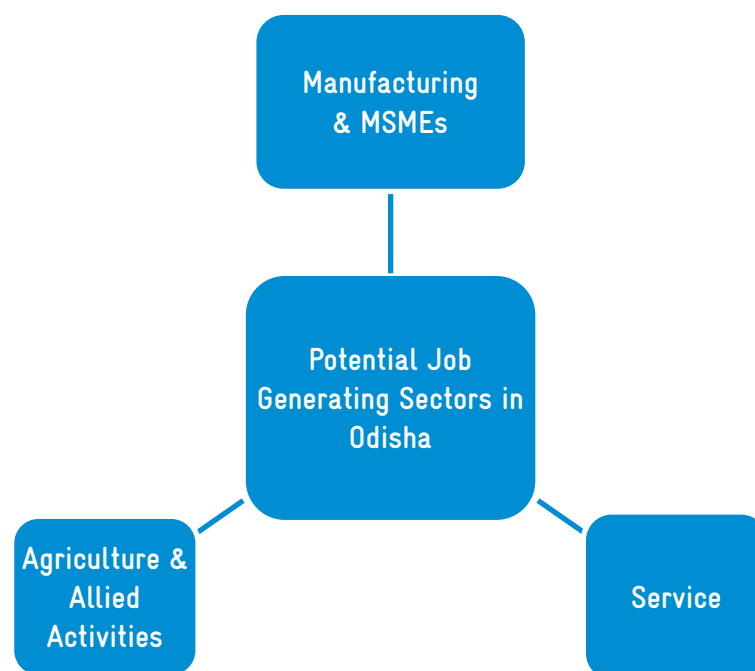
One important approach to smoothening the transition away from coal would be to improve the income-generating potential of the agrarian industry in Angul, to achieve a more balanced economy in the district. This is particularly important considering that a large portion of the land is currently used for agriculture, but this sector does not contribute significantly to the district's overall economic output. A few avenues that can be explored in this regard are:

1. Making agriculture and allied activities like livestock rearing, dairy farming, horticulture, pisciculture and food processing lucrative and profitable enough to match the earnings from the mining sector. This will help prevent farmers from selling their land since land prices in the district are quite high and comparable to those in some major cities.

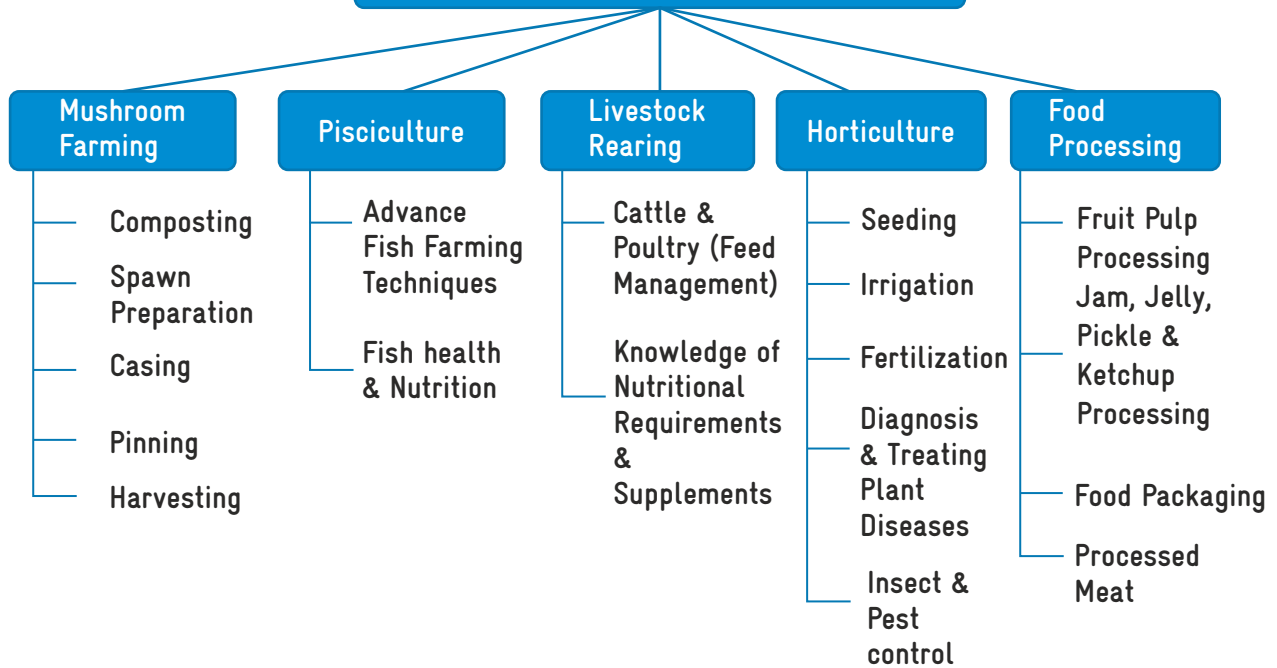
However, achieving this goal will require extensive training in modern technologies and equipment, as many farmer families have not been involved in agriculture for almost two generations.

2. In addition to agriculture, supporting the growth of MSMEs could be an effective approach to achieving a more balanced economic diversification. The district has a small handicraft and textile industry as well as a tobacco manufacturing industry, where workers from the coal industry could potentially find work after receiving appropriate training. However, the tobacco industry has serious health risks and is strongly opposed by advocates for a just transition. Another way to promote economic diversification is by supporting the development of MSMEs in industries related to steel and aluminium production, as well as plastic and polymer manufacturing.
3. Ecotourism & hospitality could be another potential industry that the state government could look into, given that the district has ample forest cover, heritage sites, hills and varied species of wild flora and fauna.
4. The robust transport and logistics sector, which has emerged as a result of the coal mines, is effectively connected to other expanding sectors such as tourism and exports, it has the potential to generate even more jobs and opportunities.
5. Finally, in terms of renewables – while solar PV plants do not generate adequate employment opportunities, there exists a possibility of setting up manufacturing facilities for solar panels, solar pumps and components of electric vehicles that will create green jobs.

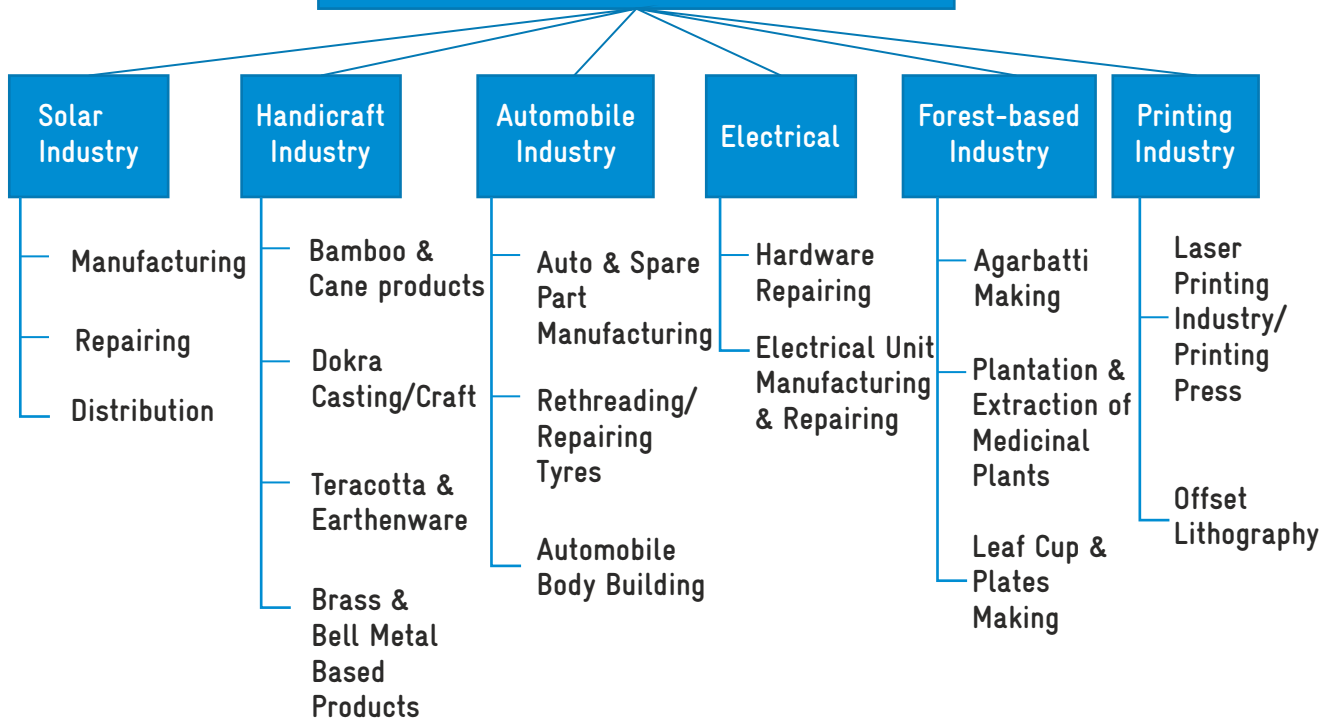
## Odisha Skill Matrix

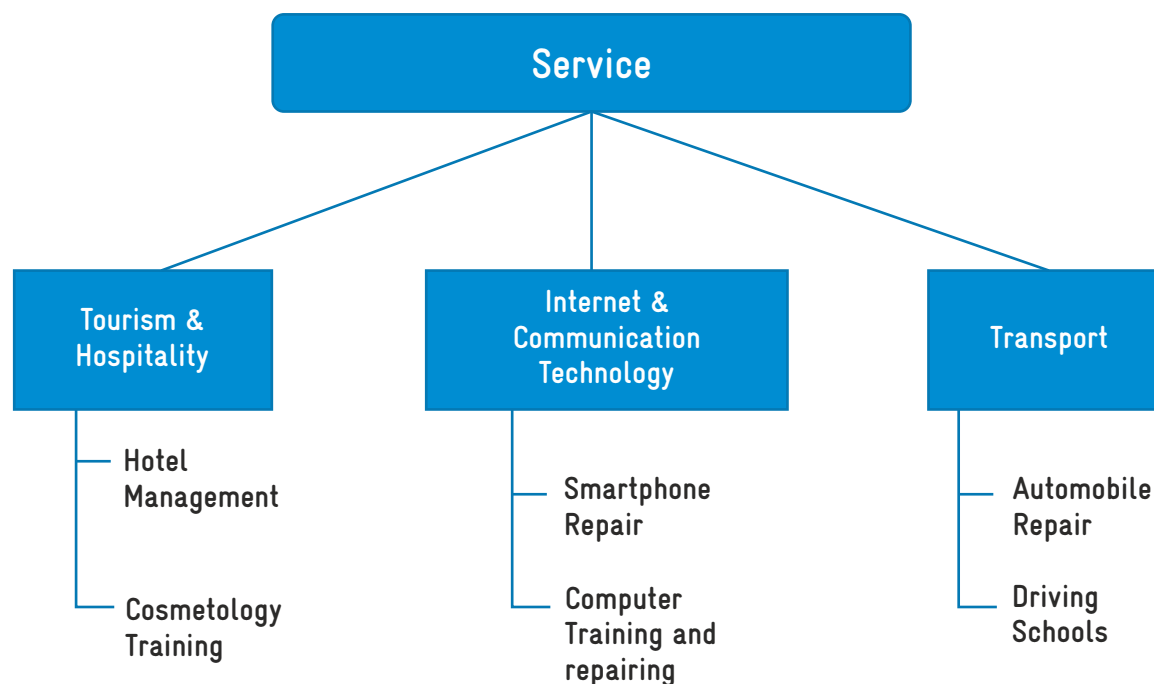


## Agriculture & Allied Activities



## Manufacturing & MSMEs





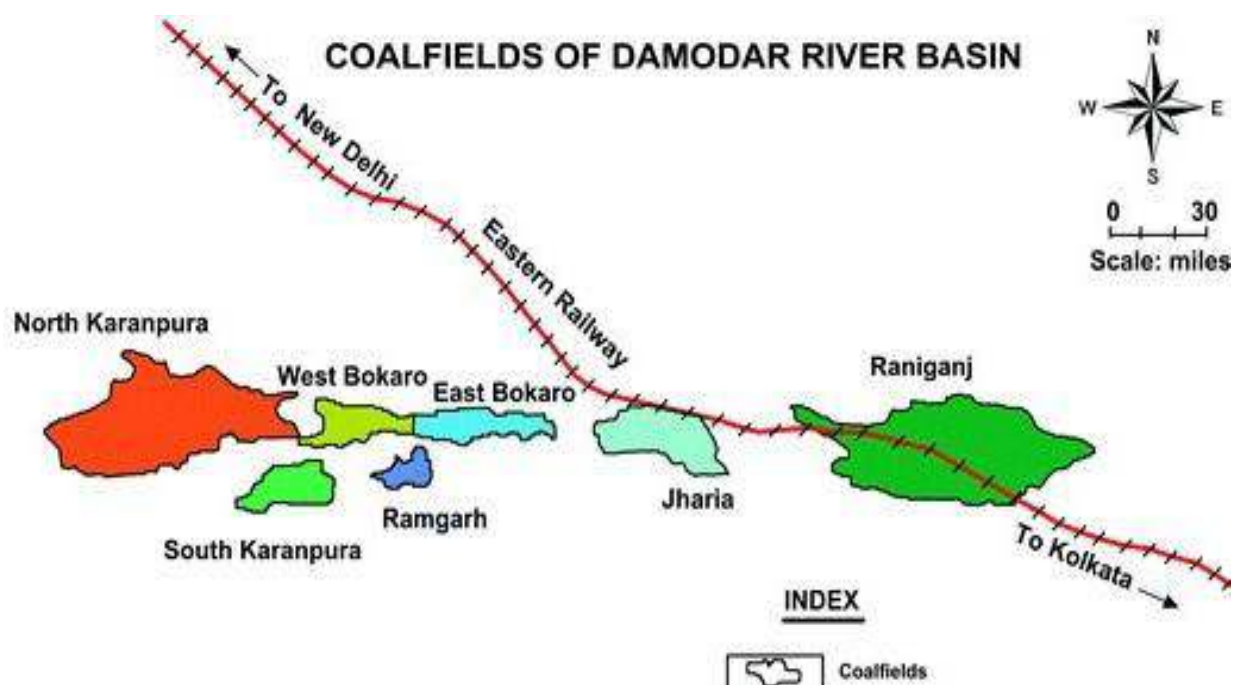
## Jharkhand

Located on the north-eastern part of the Chota Nagpur Plateau, Jharkhand became the twenty-eighth state of India in November 2000, when it was carved out of southern Bihar. One of the most mineral-rich states in the nation, it is naturally blessed with sizeable deposits of copper, chromite, asbestos, kyanite, china clay, fire clay, steatite, uranium, manganese, dolomite, tungsten, gold, and mica which typically have a localised distribution.

Furthermore, the Gondwana rocks found in the Damodar basin, form the nation's main coking coal production hub, which supports the coal requirement for power generation in Jharkhand and West Bengal. Raniganj, Jharia, East and West Bokaro, Ramgarh, South and North Karanpura, are some of the well-known coalfields located in this basin. As a result, the region also houses some notable collieries and industries like coke oven plants, and coal washeries, alongside coal-powered thermal power plants which are favoured by the easy availability of coal and water. About 48 percent of the nation's coal, 45 percent of its mica, 48 percent of its bauxite, 90 percent of its apatite, and almost all its kyanite are produced in Jharkhand.<sup>17</sup>

17. Mathew Areeparampil. (1996). Displacement Due to Mining in Jharkhand. *Economic and Political Weekly*, 31(24), 1524–1528. <http://www.jstor.org/stable/4404276>

**Figure 4.1: Coalfields of the Damodar River Basin**



**Source:** Mondal, G. C., Singh, A. K., & Singh, T. B. (2018). Damodar River basin: a storehouse of Indian coal. *The Indian Rivers: Scientific and Socio-economic Aspects*, 259-272.

Because of its highly mineralised zones, this state also has a prominent position on the global map. Besides that, its dense forests are home to a variety of forest products, notably herbal and medicinal plants, which are yet to be 'commercially exploited.'

Despite the abundance of natural resources in Jharkhand, the poverty of its residents is severe and persistent. The original inhabitants of the state were Adivasi (Santals, Mundas, Oraons, Hos, Gonds, Kharias, Bhuiyas, Bhumij, Birhors, Turi, Sadans, Kamar, Kumhars, and Kurmis) who relied heavily on the forests and land for their sustenance. As a result, their culture and identity were closely tied to the forest ecosystem. These communities, which currently make up about 26.3 percent of Jharkhand's population,<sup>18</sup> have been the biggest victims of the extensive exploitation of the state's natural resources, which includes mining activities, and rampant deforestation to make way for industries and extraction sites. This thriving population now lives in extreme poverty due to the loss of their traditional sources of livelihood. Jharkhand is the second poorest state in India, with 42.16% of its people facing multidimensional poverty. This means they lack access to basic needs such as healthcare, education, clean living conditions, and proper work conditions.<sup>19</sup>

Further, industrialization in Jharkhand led to a labour crisis, and immigrants from all over India migrated there for better opportunities. The increasing migrant population gradually displaced the indigenous tribes from their homelands and pushed them to the periphery.

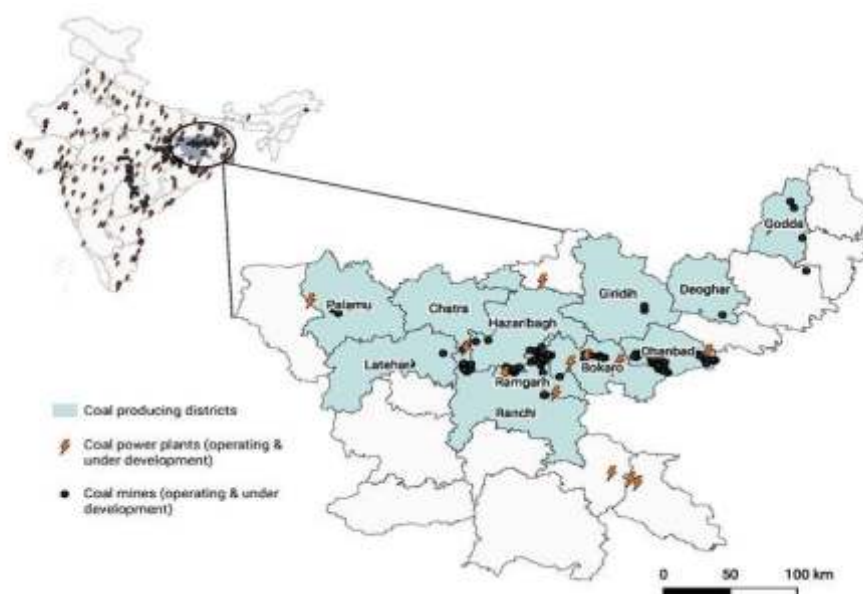
18. <https://nsdcindia.org/sites/default/files/files/jharkhand-sg-report.pdf>

19. Singhal K; Gupta P, Mohammad F; Coal transition- Jharkhand Working Paper, National Foundation For India, September 2022



Considering the nation's net-zero goals, Jharkhand will inevitably be affected by the energy transition from fossil fuels to renewables. Like many of the coal-rich regions of the country, it is not a renewable powerhouse. Besides that, coal is so deeply embedded into the state economy that coal mining taxes and royalties make up approximately 8 percent of the state government's exchequer.

**Figure 4.2: Distribution of Coal Mines and Power Plants in Jharkhand**



**Source:** Pai, Sandeep. (2021). Understanding just transitions in coal-dependent communities: Case Studies from Mpumalanga, South Africa, and Jharkhand, India.

At present, the state is home to three of eight subsidiaries of the apex coal-mining body in the country, CIL, they are –Central Coalfields Limited (CCL), Bharat Coking Coal Limited (BCCL), and Central Mine Planning & Design Institute (CMPDI), all of which are headquartered in the state itself. Another subsidiary, the Eastern Coalfields Limited (ECL) also operates several mines in the state but is headquartered in West Bengal. Amongst the private players, the Tata Group is the most prominent in the state, operating several captive mines which are used to power their steel plants. While Jharkhand produces approximately 130 million tonnes (MT) of coal every year (including 44 MT of prime coking coal),<sup>20</sup> most of it is used by the iron and steel industry and the rest is transported to thermal power plants in the neighbouring states for electricity generation.

Given the extent of the coal value chain in the state, it is worth noting that this sector is responsible for over 300,000 direct jobs in the state with relatively higher median wages compared to other sectors. Additionally, the coal sector in Jharkhand also indicates a high degree of informality which is further complicated by the fact that there exists little to no information on the workers, that can help concerned authorities map out their engagement and

20. Pai, Sandeep. (2021). Understanding just transitions in coal-dependent communities: Case Studies from Mpumalanga, South Africa, and Jharkhand, India.

participation in the coal value chain in various capacities. Even data related to their demographic details, education, wages, skill level, and employment terms are difficult to come by which further complicates planning for a 'just transition' away from the fossil fuel economy.

**Figure 4.3: An Open Cast Mining Pit in Kusunda Colliery in Dhanbad**



**Source :** Captured by Authors during field study

While coal mining in remote areas often leads to the creation of physical and social infrastructure such as industries, road and rail connectivity, healthcare, and education facilities – a shift away from coal could potentially result in job losses, reduced government revenue, and corporate social responsibility funds from the coal sector. To ensure a sustainable transition, the Jharkhand government needs to create stable employment opportunities in renewable or labour-intensive sectors, reduce poverty, and empower communities through targeted public welfare services. Thus, a just transition roadmap must prioritise alternative livelihoods and economic empowerment.

### **Case Study in Focus – Dhanbad-Jharia**

Known as the 'coal capital' of India, the Dhanbad district was carved out of the former Manbhum district in 1956, before which it used to be a part of West Bengal. At present, it is bounded by Giridih and Jamtara in the north, by Burdwan (West Bengal) in the east, by Purulia (West Bengal) in the south and by Bokaro in the west. The district is home to the erstwhile JCF, one of the oldest and largest sources of prime coking coal in the nation. Hence it is also one of the most industrialised regions of the state.

Given its prominence, JCF has been mined since 1894 and is now one of the most densely populated coalfields in India. Coal mining is the primary occupation in the district, with PSUs like BCCL and Eastern Coalfield Limited (ECL), and privately owned corporations like the Indian

Iron & Steel Company (IISCO) and Tata Iron and Steel Company (TISCO) engaged in coal mining activities. The district also has many other large and medium-sized businesses involved in coal mining, transportation, logistics, production of iron and steel, non-metallic mineral goods, and coal-related products like coke.

**Table 4.1: Coal Reserves in Jharia as a Percentage of Total Coal Reserves in India and Jharkhand in Million Metric Tonnes (as of 01.04.2020)**

Coal Reserves	Proved	Indicated	Inferred	Total
India	163460.84	150391.96	30168.04	344020.84
Jharkhand	49468.59	30283.80	5849.71	85602.10
Jharia	16282.19	3248.44	-	19530.63
Jharia's reserves as a percentage of Jharkhand's reserves	33	11	-	23
Jharia's reserves as a percentage of India's reserves	10	2	-	6

Source: [https://ibm.gov.in/writereaddata/files/04272022135005Coal\\_Lignite%20\\_AR.pdf](https://ibm.gov.in/writereaddata/files/04272022135005Coal_Lignite%20_AR.pdf)

Jharia is home to some of the world's longest-burning coal fires, with the first coal fire being discovered in the year 1916. While their cause is yet to be determined,<sup>21</sup> the severe safety risks and the resultant financial losses associated with coal fires make those a serious threat to society. These coal fires impact nearby communities by increasing land surface temperature and releasing toxic fumes containing mercury, methane, carbon monoxide, and carbon dioxide, leading to harmful health outcomes. Mine workers are at risk of fatal working conditions and respiratory diseases due to exposure to these fires.

**Figure 4.4: Capturing the Issues of Burning Coal in Bastacola Colliery, Jharia**



Source : Captured by Authors during field study

21. Biswal, S. S., & Gorai, A. K. (2021). Studying the coal fire dynamics in Jharia coalfield, India using time-series analysis of satellite data. *Remote Sensing Applications: Society and Environment*, 23, 100591.

Dhanbad district has 51 mines lying on the JCF -17 underground (UG), 24 opencast (OC) and 10 mixed (refer to Table 4.2). Consequently, its entire economy revolves around coal. Hence any effort towards transitioning away from coal would necessitate the formulation of detailed plans focusing solely on replacing the livelihoods of the coal-dependent communities living close to the mines. This is especially necessary because the upcoming generation of these communities have basic education and are willing to shift to alternative lines of work, having grown up watching the preceding generations toil hard on coalfields, risking their lives and inhaling toxic fumes.

**Table 4.2: Coal Mines in the Dhanbad District of Jharkhand**

Name of Mine	Operation Type (OC=Open cast mine UG=Underground mine)	Public/Private	Production (MT) 2019-20	Mine Owner Name
Amalgamated Sudamdih. Patherdih Colliery	OC	Public	0.18	BCCL
Basantimata-dahibari Colliery	OC	Public	0.78	BCCL
Amalgamated Gaslitand Katars Chaitudih	OC	Public	0.16	BCCL
Phularitand	Mixed	Public	2.68	BCCL
New Akash Kinaree Colly	Mixed	Public	1.2	BCCL
Amalgamated Keshalpur West Mudidih Colliery	Mixed	Public	4.22	BCCL
Tetulmari	Mixed	Public	0.67	BCCL
New Godhur. Kusunda Colliery	Mixed	Public	0.95	BCCL
Gondudih Khas Kusundu Colly	Mixed	Public	0.24	BCCL
Gopalichuck	Mixed	Public	0.01	BCCL
Kuya	Mixed	Public	1.922	BCCL
Bhowra(south) Colliery	Mixed	Public	0.32	BCCL
Jharia Division	OC	Public	1.243	TSL
Tasra (captive)	OC	Public	0.185	SAIL
Jitpur (captive)	OC	Public	0.092	IISCO

Name of Mine	Operation Type (OC=Open cast mine UG=Underground mine)	Public/Private	Production (MT) 2019-20	Mine Owner Name
Chasnala (captive)	OC	Public	0.35	IISCO
Badjna	UG	Public	0.07	ECL
Hariajam	UG	Public	0.06	ECL
Lakhimata	UG	Public	0.08	ECL
Shayampur-b	UG	Public	0.08	ECL
Kumardhubi	UG	Public	0.03	ECL
Khoodia	UG	Public	0.04	ECL
Rajpura	OC	Public	0.21	ECL
Barmuri	OC	Public	0.43	ECL
Kapasara	OC	Public	0.4	ECL
Nirsha	OC	Public	0.19	ECL
Chapapur -ii	Mixed	Public	0.18	ECL
Jogidih	UG	Public	0.04	BCCL
Kharkaree	UG	Public	0.02	BCCL
Maheshpur	UG	Public	0.02	BCCL
Salanpur	UG	Public	0.07	BCCL
Muudidih	UG	Public	0.01	BCCL
Bhagaband	UG	Public	0.02	BCCL
P. B. Project	UG	Public	0.02	BCCL
Kb 10/12 Pits	UG	Public	0.003	BCCL
Bastacolla	UG	Public	0.13	BCCL
Bhowrah(north) Colliery	UG	Public	0.01	BCCL
Moonidih Project	OC	Public	0.53	BCCL
Muraidih	OC	Public	1.04	BCCL

Name of Mine	Operation Type (OC=Open cast mine UG=Underground mine)	Public/Private	Production (MT) 2019-20	Mine Owner Name
Amalgamated Bocp Mine	OC	Public	1.65	BCCL
Amalgamated Block-iv Govindpur	OC	Public	0.58	BCCL
Nichitpur	OC	Public	0.61	BCCL
Sendra Bansjora	OC	Public	1.17	BCCL
Kankanee	OC	Public	0.38	BCCL
Bansdeopur	OC	Public	0.03	BCCL
E. Bassuriya	OC	Public	0.54	BCCL
Amalgamated Dhansar. Colliery	OC	Public	0.83	BCCL
Ena	OC	Public	1.67	BCCL
Kenduadih	OC	Public	0.13	BCCL
Rajapur	OC	Public	2.23	BCCL
Amalgamated N.T.S.T. Jeenagora Colliery	OC	Public	2.54	BCCL
<b>Total</b>			<b>31.165</b>	

**Source:** Singhal K; Gupta P; Mohammad F; Coal transition- Jharkhand Working Paper, National Foundation for India, September 2022

This is especially true for coal scavengers, who risk their lives daily to make a living through illegal mining. It is very common to spot men, women and children scavenging for coal in discontinued mines that have not been closed properly by the mining authorities as per standard protocols.

Apart from illegal mining, coal scavengers also collect coal remnants that fall from trains during transit or are discarded in stockyards and dumps. They then sell these illegally in nearby towns and cities, or to coal mafias at high margins. This creates an underground black market. Since no safety measures are taken, coal picking is dangerous and can result in burns, inhalation of toxic fumes, and legal repercussions for trespassing.

Over the years the coal sector has witnessed a steady decline in formal employment. CIL has stopped hiring new workers for mining, which has caused a rise in illegal coal picking. To continue their work, these illegal coal pickers must give a part of their earnings as bribes to illegal nexus.

**Figure 4.5: A Man Tying Sacks of Illegally Mined Coal to a Bicycle in Jharia**



Source: <https://www.context.news/just-transition/long-read/children-of-indias-burning-coalfields-dream-of-a-fire-free-future>

Photo Courtesy: Thomson Reuters Foundation/Tanmoy Bhaduri

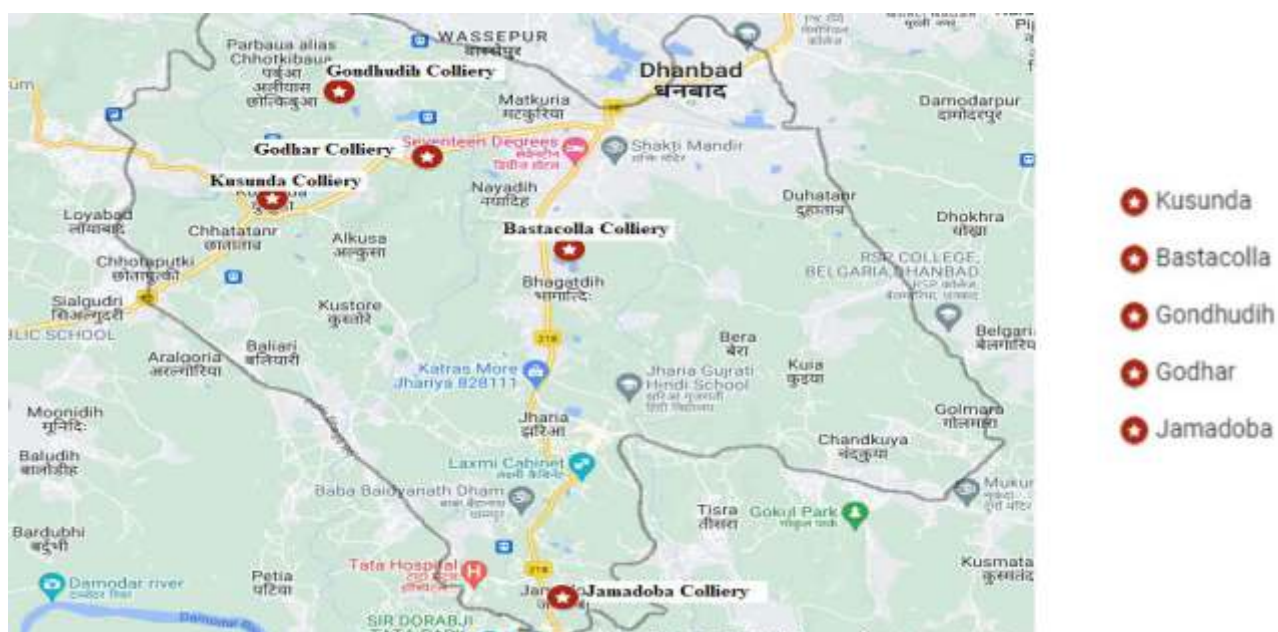
In a bid to help these coal-scavenging communities move away from such precarious lies of work and to rehabilitate them to safer regions away from coal cave-ins and coal fires- the Belgaria township was built under the Jharia Master Plan that was approved in August 2009.<sup>22</sup>

However, the lack of basic facilities like reliable water supply, planning issues like proper drainage and garbage disposal arrangements, adequate connectivity and commute facilities, and schools for the children along with the lack of employment opportunities, have resulted in people relocating back illegally near the mines, despite Belgaria being only 7kms from Jharia.

Presently government authorities are working on creating shared workstations in Belgaria alongside providing skill training and upgradation facilities in indigenous handicrafts to the resettled population. Further, they are also looking into solar energy projects such as the creation of solar-powered drinking water projects in the region to increase the provision of essential facilities and make the resettlement region more habitable.

22. <https://india.mongabay.com/2022/08/jharia-fires/>

**Figure 4.6: Parts of the Jharia Coalfield Covered Under this Study**



## Baseline Scenario

**Primary Sector:** As per our interactions with local stakeholders and a thorough review of secondary literature, the primary economic activity of the district is mining and quarrying. Dhanbad is the only district in the state of Jharkhand which has a significant portion of the population engaged in non-agricultural activities than in agricultural ones. About 48.7 percent of people are engaged in agriculture and 51.2 percent are engaged in the industrial field<sup>23</sup> given the abundance of coal, and minerals like limestone, quartz, granite, felspar and fireclay.<sup>24</sup>

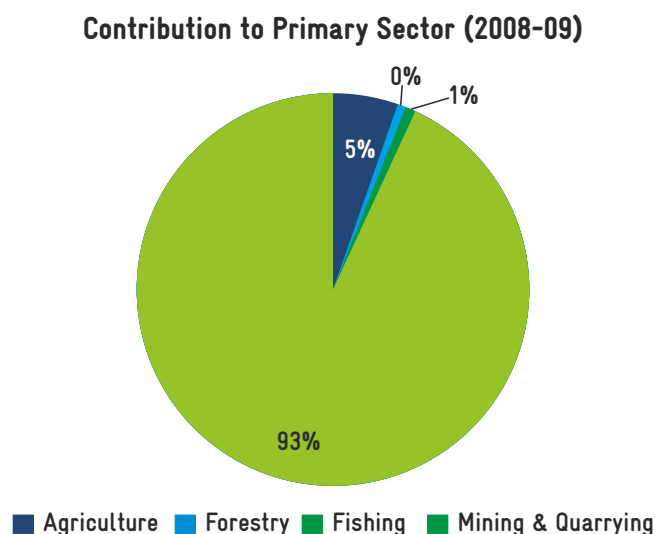
Besides mining, agriculture is the next most important economic activity in the district; however, it is largely rain-fed and consists of monocropping. The major crops grown in the district are paddy maize, finger millet, mustard, chickpea, potato, onion, mango, guava and jack fruit.

23. <https://dhanbad.kvk4.in/district-profile.php>

24. [https://ibm.gov.in/writereaddata/files/07092014124145IMYB\\_2012\\_11\\_13%20JHARKHAND.pdf](https://ibm.gov.in/writereaddata/files/07092014124145IMYB_2012_11_13%20JHARKHAND.pdf)



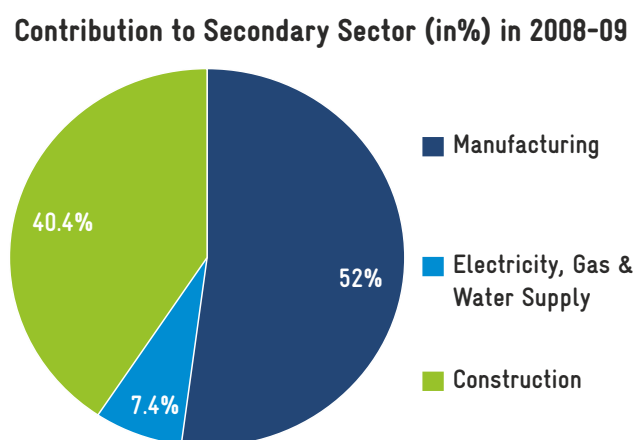
**Figure 4.7: Primary Sector Composition in the Dhanbad District**



Source: <https://nsdcindia.org/sites/default/files/files/jharkhand-sg-report.pdf>

**Secondary Sector:** In Dhanbad, manufacturing takes up the lion's share of the secondary sector (refer Figure 4.8). Due to the abundance of coal, the district is one of Jharkhand's most industrialised regions of the state. It has several large and medium-sized industries (refer Table 4.3) in the coal, electricity, steel, and non-metallic mineral sectors as well as industries manufacturing coke and other coal products. However, the primary industries in this sector are coal washing and coke production.

**Figure 4.8: Secondary Sector Composition in the Dhanbad District**



Source: <https://nsdcindia.org/sites/default/files/files/jharkhand-sg-report.pdf>

Also, several MSMEs in the state generate considerable employment in this sector (refer Figure 4.9). While mineral-based MSMEs take up lion's share of the investments made in MSMEs – garments, woodwork and repairing services are the next most prominent enterprises in the district. At the same time, several PSUs like IISCO and CIL operate several underground and open-cast mines in this region, there are also several thermal power generating facilities here such as the Maithon Power Plant which is run jointly by Tata Power & Damodar Valley

Corporation. This plant was one of India's first public-private power projects and has two units with a total capacity of 1050 MW and supplies power to four states namely New Delhi, Jharkhand, West Bengal, and Kerala.

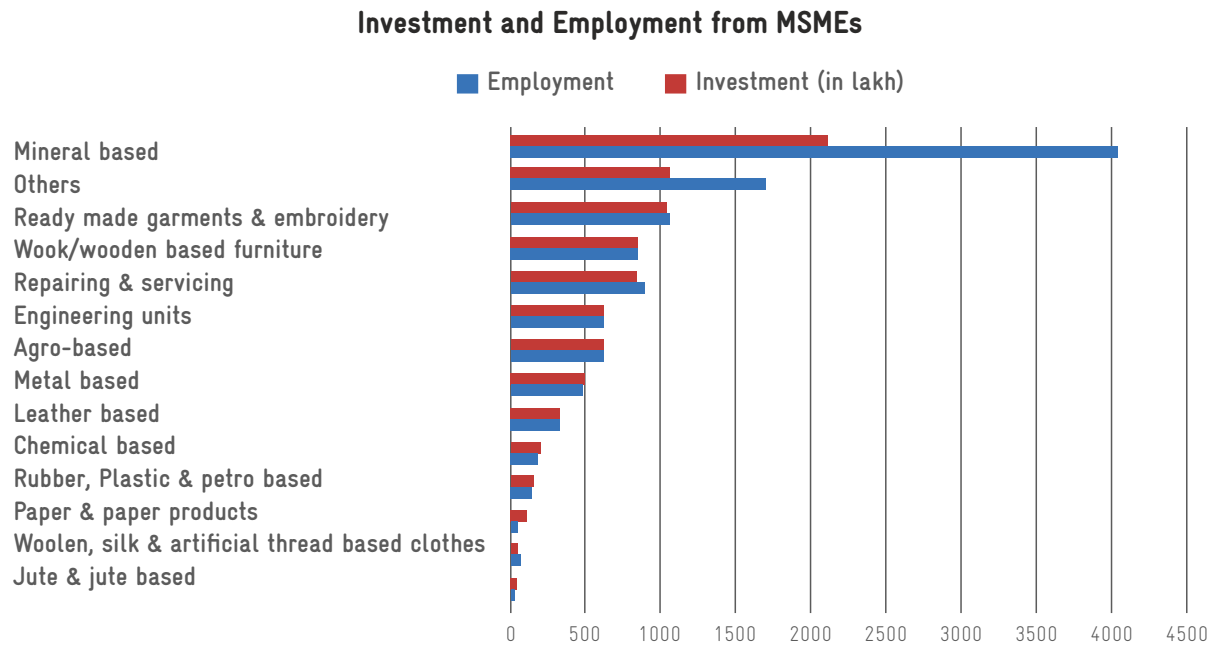
Finally, we have the construction sector which contributes approximately 40 percent of the secondary sector and is largely motivated by the rapid pace of industrial growth and urbanisation in the district.

**Table 4.3: Large and Medium-sized Industries in the Dhanbad District**

Sl No.	Name	Area
<b>Large Scale Industries/ Public Sector Undertakings</b>		
1	Bharat Coking Coal Limited	Dhanbad
2	Eastern Coalfield Limited	Mugma
3	Damodar Valley Corporation	Maithan, Panchet
4	Tata Iron and Steel Co. (TISCO)	Digwadih
5	Indian Iron and Steel Co. (IISCO)	Jamadoba
<b>Medium Scale Enterprises</b>		
1	Valley Magnetite Co.	Chirkunda
2	Maithan Ceramic Pvt. Ltd.	Chirkunda
3	Valley Refractories Pvt. Ltd.	Chirkunda
4	Kunj Iron Products Ltd.	Chirkunda
5	Anup Malleables Ltd.	Govindpur
6	ACC Cement Co.	Sindri
7	Hindustan Malleable and Forging Ltd.	Bhuli
8	Jagran Prakashan Ltd.	Dhanbad
9	Rajhans Refractories Pvt. Ltd.	Katrasgarh
10	Jharia Fire Bricks and Potteries	Dhansar
11	I.D.L. Industries Ltd.	Dhanbad

Source: <http://dcmsme.gov.in/old/dips/DIPS%20dhanbad.pdf>

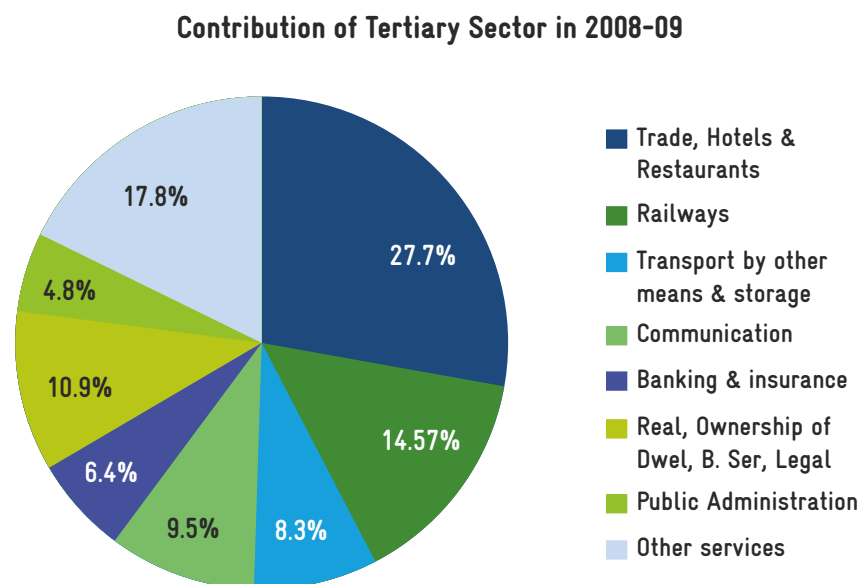
**Figure 4.9: Investments Made and Employment Generated in the MSME Sector in the Dhanbad District**



Source: <http://dcmsme.gov.in/old/dips/DIPS%20dhanbad.pdf>

**Tertiary Sector:** The trade and hospitality sector make the highest contribution to the district economy from the tertiary sector, followed by railways and the transport sector. Given the fact that logistics form a significant part of the coal and mineral value chain –it is inevitable that the transport and railways together take up the lion's share in the tertiary sector that generates a significant number of direct and indirect livelihoods.

**Figure 4.10: Tertiary Sector Composition in the Dhanbad District**



Source: <https://nsdcindia.org/sites/default/files/files/jharkhand-sg-report.pdf>

## Strategies for Diversification

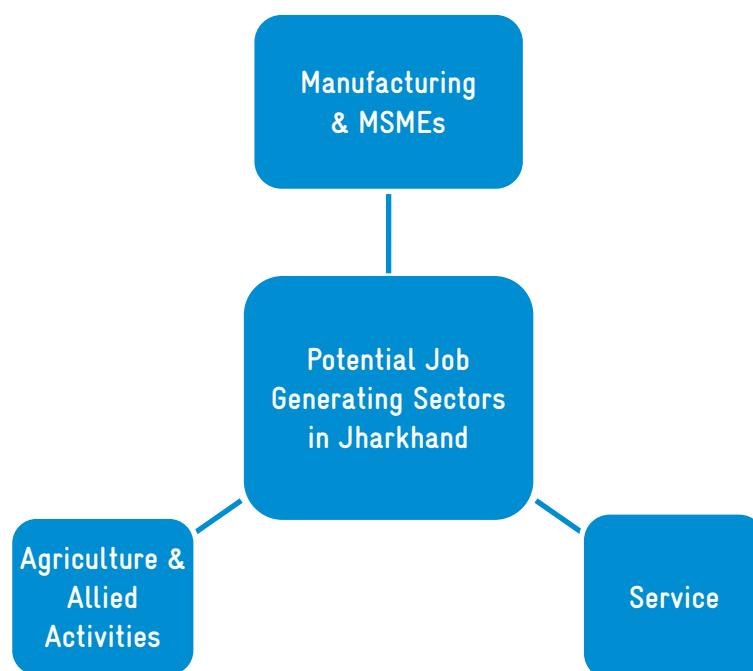
The following initiatives will be crucial for worker transition in the coming years and will require extensive assistance from the central and state governments and industry leaders.

Economic diversification is a crucial component of any just transition plan. Moving away from a coal-centred economy to one with ecological sustainability at its core can help promote the creation of local green jobs, contribute to government revenues, and benefit the local coal-dependent workforce.

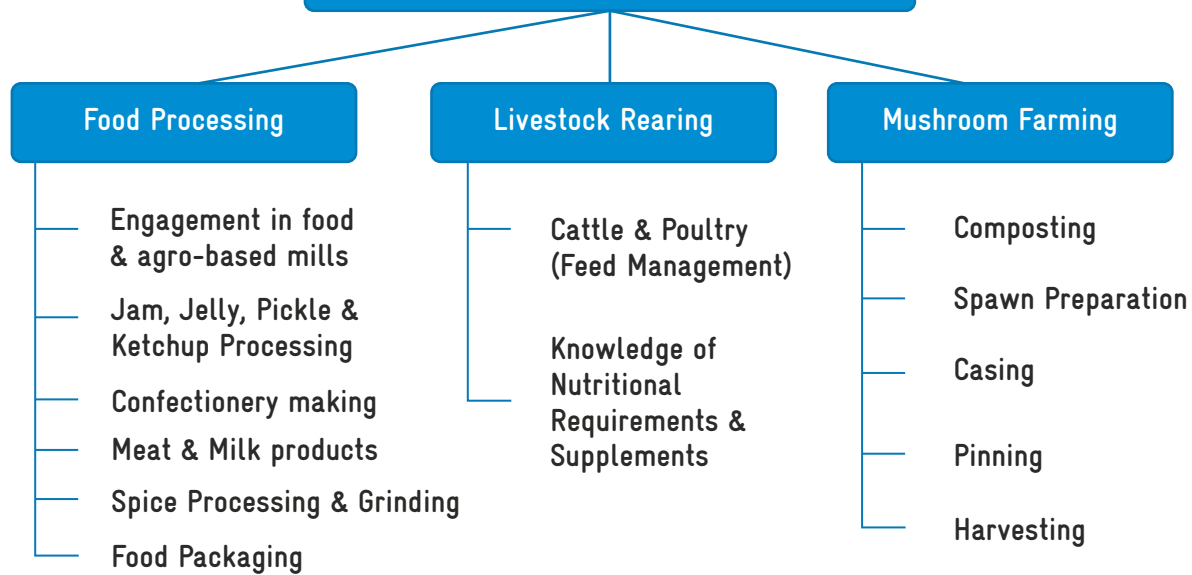
One of the key strategies to ease the friction arising from the coal “phase-out” would be to raise the livelihood-generating capacity of the secondary sector (emphasising, especially MSMEs) in Dhanbad to achieve balanced economic diversification in the district. A few avenues that can be explored in this regard are:

1. Identifying the opportunities for traditional jobs like pottery making, preparing relevant skill training modules for target groups, and creating market linkages.
2. Creating community workstations in rehabilitation townships like the Belgaria, Baliapur CD block for reviving the traditional skill sets.
3. Exploring opportunities in other labour-intensive sectors like alloy steel casting, cement and other manufacturing facilities including equipment for fettling and grinding, heat treatment, furnaces, and metallographic testing facilities to understand the skill sets that would be required for this job market transition.

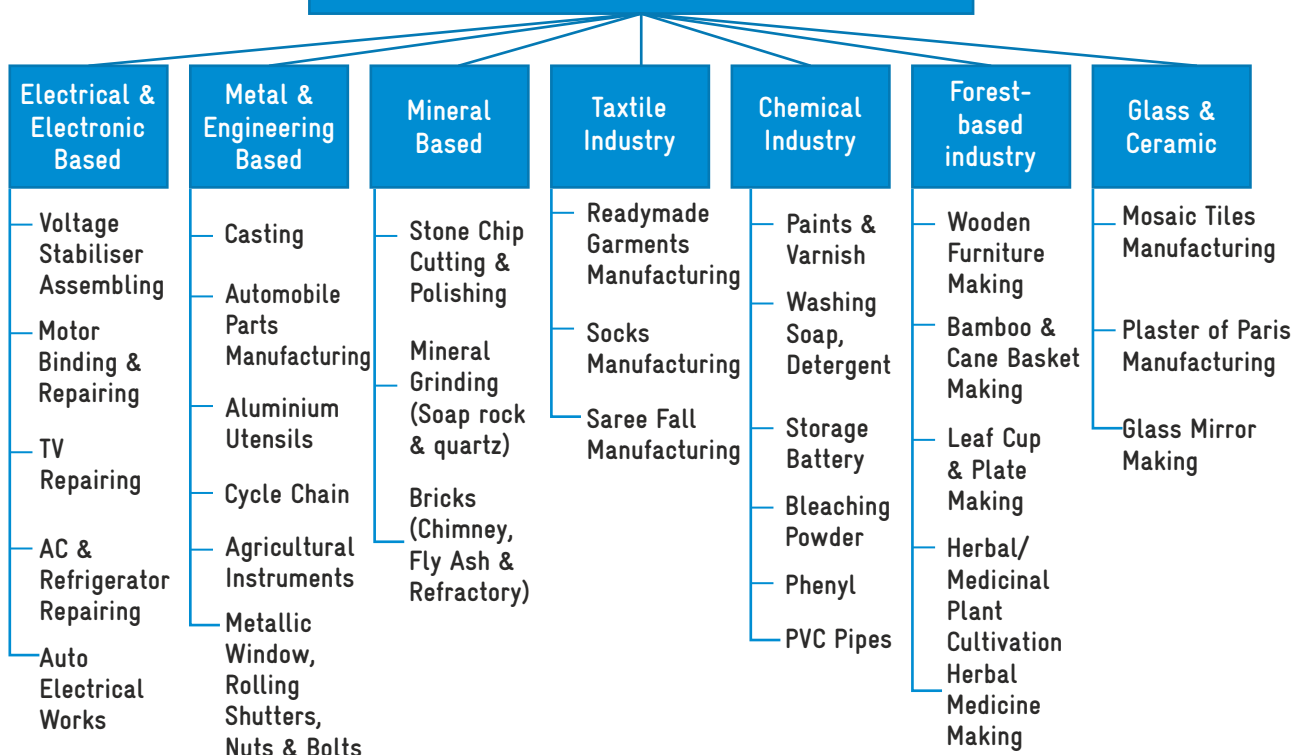
## Jharkhand Skill Matrix

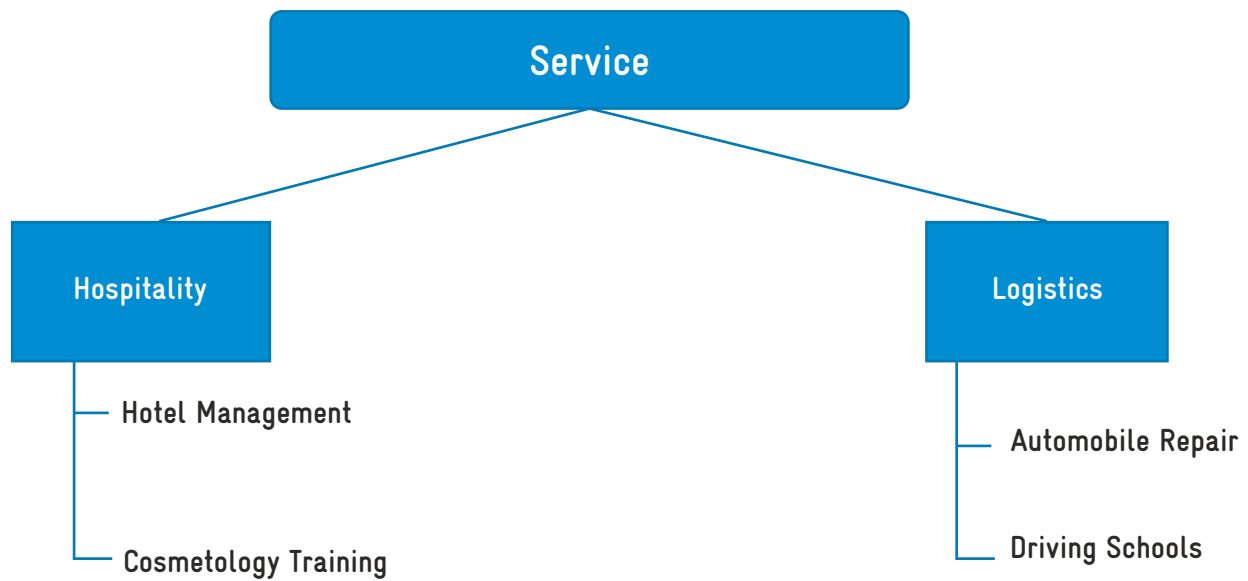


## Agriculture & Allied Activities



## Manufacturing & MSMEs

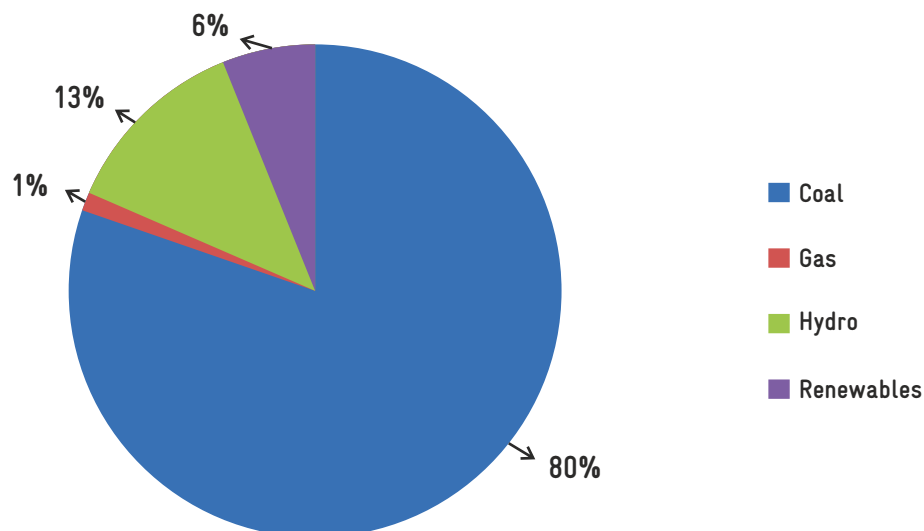




## West Bengal

Lying on the easternmost part of the Indo-Gangetic plains, West Bengal is the primary business and financial hub of Eastern India. It is the 4th largest in terms of population and the 10th largest consumer of electricity, accounting for nearly 4.38 percent of total energy consumption in India.<sup>25</sup> While the state has achieved a significant level of electrification, However, much of that energy is coal-based, considering the abundance of coal in the state (refer to Figure 5.1).

**Figure 5.1: Shares in Installed Capacity of Power Utilities in West Bengal as on 31.01.2023**



Source: [https://cea.nic.in/wp-content/uploads/installed/2023/01/IC\\_Jan\\_2023.pdf](https://cea.nic.in/wp-content/uploads/installed/2023/01/IC_Jan_2023.pdf)

25. [https://powermin.gov.in/sites/default/files/uploads/joint\\_initiative\\_of\\_govt\\_of\\_india\\_and\\_West\\_Bengol.pdf](https://powermin.gov.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_West_Bengol.pdf)

The Raniganj Coal Belt, an ancient coal mine, has helped fuel the growth of mining towns and steel industries in West Bengal over the centuries. The coal in this region was abundant but it was not until British rule that the commercial potential of coal was recognised and exploited in the latter half of the 18th century. The coal from this region fuelled the expansion of the British empire in the Indian sub-continent and still contributes significantly to the national coal production. The coalfield spans approximately 443.50 sq. km across several districts, including Bardhaman, Birbhum, Bankura, Purulia, and Dhanbad in Jharkhand, with the heart of the coalfield situated in the Bardhaman district between the rivers Ajoy and Damodar.<sup>26</sup>

Despite being home to some of the oldest collieries in the nation, the coalfield hardly shows any signs of ageing with new mining spots being identified, indicating the extent of its untapped reserves. At present, ECL operates 98 mines in the region- 77 underground and 21 open-cast mines, employing approximately 73,000 workers.<sup>27</sup>

Lying on the eastern part of the Raniganj coalfield is the Paschim Bardhaman – Bankura coal belt. The mines here are some of the best reserves of prime non-coking coals in the nation thus spearheading the development of several heat-intensive industries like glass, ceramics, refractories, forging and so on. Apart from coal, the region is also abundant in several other minerals such as iron ore, calcium carbonate, manganese, bauxite, and laterite. Further places like Barakar are also rich in high-quality fireclay and brick clay which has formed the basis of a rich terracotta and pottery industry in the region.

The massive resource base and connectivity of this region have been the driving force behind the development of the Durgapur-Asansol industrial belt. This industrial complex consists of critical industries like Chittaranjan Locomotive Works, Damodar Valley Corporation (DVC), Indian Iron & Steel Company (IISCO), Durgapur Steel Plant, Durgapur Projects Limited (DPL) which makes it the nerve-centre of the economy of West Bengal.<sup>28</sup>

After the Hooghly Industrial Belt, this is the second most industrialised region in the state that is often compared to the Ruhr Coal mining district in Germany, given its role in transforming the surrounding regional economy.

## Case Study in Focus – Paschim Bardhaman-Bankura

The Paschim Bardhaman- Bankura region consists of significant coal seams from the Mejia block to the Barjora block across the Damodar River in the northwest of the Bankura district. Between 2010-2011, two open-cast collieries have been newly established in this region, the North Barjora coal mine and the Trans-Damodar coal mine, with respective surface areas of approximately 5.5 square km and eight square km.<sup>29</sup>

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26. [https://en.wikipedia.org/wiki/Raniganj\\_Coalfield](https://en.wikipedia.org/wiki/Raniganj_Coalfield)

27. [https://www.iitk.ac.in/JTRC/file/What%20is%20Just%20Transition\\_JTRC\\_IIT%20Kanpur\\_1st%20December%202022.pdf](https://www.iitk.ac.in/JTRC/file/What%20is%20Just%20Transition_JTRC_IIT%20Kanpur_1st%20December%202022.pdf)

28. Maji, G., & Malik, U. S. . (2021). Spatio-Temporal Changing Scenario of Growth and Structure of Manufacturing Industries in Asansol-Durgapur Region, West Bengal. *Asian Journal of Geographical Research*, 4(3), 1-17. <https://doi.org/10.9734/ajgr/2021/v4i389>

29. Banerjee, R., & Mistri, B. (2019). Impact of coal mining in diversification of rural livelihoods: A case study in the barjora colliery area of bankura district, west Bengal. *Space and Culture, India*, 6(5), 228-240.

**Figure 5.2: Open-cast Collieries at Barjora (Trans-Damodar and Barjora North)**



**Table 5.1: Coal Reserves in Barjora as a Percentage of Total Coal Reserves in India and West Bengal in Million Metric Tonnes (as of 01.04.2020)**

Coal Reserves	Proved	Indicated	Inferred	Total
India	163460.84	150391.96	30168.04	344020.84
West Bengal	15189.25	1325.31	4622.73	32937.29
Barjora	200.79	-	-	200.79
Barjora's reserves as a percentage of West Bengal's reserves	1	-	-	0.6
Barjora's reserves as a percentage of India's reserves	0.1	-	-	0.06

Source: [https://ibm.gov.in/writereaddata/files/04272022135005Coal\\_Lignite%20\\_AR.pdf](https://ibm.gov.in/writereaddata/files/04272022135005Coal_Lignite%20_AR.pdf)

The 700-acre North Barjora coal mine spans the villages of Manohar, Baguli, Ghutghoria, Sitarampur, Saharjora, Tikargram, and Baraphukhuria in the Bankura district of West Bengal. The mine, which was managed by DVC and Eastern Mining and Trade Agency until 2006, along with 203 other coal blocks throughout the nation, was directed to be shut down by the Supreme Court in 2014. At an open bid auction in 2015, the ownership rights for the mine were purchased by West Bengal Power Development Corporation Limited (WBPDCCL). Subsequently, 228 hectares of land were leased to Montecarlo-Barjora Mining Private Ltd for INR 918.58 crore<sup>30</sup> thus, giving them the rights to extract coal from the mine.

30. <https://www.landconflictwatch.org/conflicts/explosions-from-bengal-s-barjora-coal-mine-crack-houses-residents-demand-rehabilitation-compensation>



**Figure 5.3: The North Barjora Coal Mine in Bankura**



**Source :** Captured by Authors during field study

Before coal mining, Barjora was a small village encircled by dense jungles till the turn of the last century. It had semi-fertile land which formed the basis of a thriving agrarian economy. The Sunri, Bauri, and Bagdi castes made up a sizable section of the local population.<sup>31</sup>

Later in 1959, a single-lane state highway, the Durgapur Barrage, was constructed by the DVC linking Barjora to Durgapur and Asansol, which are located on the left bank of the river Damodar, on one side, and the District Headquarters, Bankura, on the other.

Barjora has grown significantly in the past decade, recording major spikes in population growth rates alongside male and female labour force participation rates. During the rapid industrialisation between 1960 and 1980, the village barely attracted any opportunities, despite being located approximately 22km from Durgapur. However, this changed in the early 1990s with several notable industrial houses and their ancillaries facing closure in and around Durgapur, which gave a much-needed industrial boost to Barjora. Although many of the early industries were private ones that were setup with the sole aim of evading the West Bengal Pollution Control Board's pollution norms, it worked to kickstart industrial activities in the region. Besides that, there were other factors such as the availability of land at affordable rates, cheap labour and a reliable energy supply that was made possible by the proximity to the Mejia thermal power station.

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31. Samanta, G. (2017). New urban territories in West Bengal: Transition, transformation and governance. Subaltern urbanisation in India: An introduction to the dynamics of ordinary towns, 421-441.

**Figure 5.4: North Barjora Coal Mine Plan**



**Source :** Captured by Authors during field study

In 2000, Barjora had five operational industries and with the rising number of the non-agricultural labour force, in 2001 it became a census town. Between 2000-05, nine more industries emerged in the region. Many of the initial industries were sponge iron and ferroalloys. Apart from them, at present, there are also two open cast mines operating in the town under public-private partnership. These massive mining operations have also been accompanied by resettlement and rehabilitation programmes of two-three villages in nearby colonies of Bara Pukhuria, Ghutghoria, Pheguasol and Tikargram.

**Figure 5.5: A Rehabilitated Colony in Bara Pukhuria (near North Barjora Colliery)**



**Source :** Captured by Authors during field study

Besides, overburdens were used to fill in the exhausted sections of the mine following which the topsoil was treated to make the land suitable for alternate uses. At the North Barjora mines, for every overburden that exceeds 60m, the mine authority WBPDCCL is mandated to cover the topsoil and afforest the area<sup>32</sup> with various plantations of neem, mango, banyan, sheesham, jackfruit, earleaf acacia and Indian blackberry as part of their eco-restoration plans for closed mines and its surrounding regions.

**Figure 5.6: Neem Plantations in Overburdens near North Barjora Coal Mine**



**Source :** Captured by Authors during field study

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32. Data from field interactions

Apart from the North Barjora colliery, another mine in the Barjora coalfield is the Trans-Damodar coal mine. It was initially owned by the West Bengal Mineral Development and Trade Corporation which operated it since 2005. However, it was closed in 2015, following which DPL purchased the rights to carry out mining operations in the coal mine for INR 150 crores.<sup>33</sup>

**Figure 5.7: Trans-Damodar Coal Mine in Bankura**



**Source :** Captured by Authors during field study

The mines cover an area of about 379 hectares, spanning the villages of Shalgara, Chunpura, Gokul Mathura, Kishoripur, Jaisinghpura, and Paharpur. The capacity of this coal mine is 1 million tonnes per annum<sup>34</sup> with proven coal reserves of about 48.4 million tonnes.

**Figure 5.8: Overburden at the Trans-Damodar Coal Mine**



**Source :** Captured by Authors during field study

33. <https://www.landconflictwatch.org/conflicts/workers-demand-wages-from-dpl-for-trans-damodar-colliery-in-west-bengal>

34. [https://www.gem.wiki/Trans\\_Damodar\\_coal\\_mine](https://www.gem.wiki/Trans_Damodar_coal_mine)

## Baseline Scenario

**Primary Sector:** According to our conversations with the locals, agriculture, alongside mining and quarrying, is a crucial industry in this area. Despite the limited amount of arable land, agriculture is still widely practiced, and the double cropping system is utilised. Rice, mustard, sesame, and various vegetables such as pumpkin, cucumber, chilli, and potato are the primary crops in this region. However, due to the development of coal mining, a considerable portion of agricultural plots have been converted to mining plots, resulting in a decline in soil quality and agricultural productivity in the remaining plots. Furthermore, the agricultural output in this region is inconsistent due to the heavy reliance on rainfall and inadequate irrigation facilities.

Besides agriculture, coal deposits in Mejhia, Borjora, and China clay in the districts of Kharidungri and Bagjabra are principally responsible for the industrial boom in this region. Key industrial industries include food processing, refractories, polymers & plastics, ferroalloys, and refractory materials.

**Secondary Sector:** The coal reserves in Mejia and Barjora, along with the China clay in the districts of Kharidungri and Bagjabra are principally responsible for this region's industrial boom. As per 2011-12, data approximately 260 registered factories are employing about 13,211 people. Besides that, there are approximately 3608 MSMEs that are employing about 21,121 workers daily.<sup>35</sup>

Moreover, the region is also mineral rich which has led to the growth of mineral and metal-based industries as well, such as ferroalloys, refractories, steel and aluminium. In the case of MSME, there exists a robust handicraft (dhokra, bamboo craft, terracotta, stonecraft) and textile industry (Baluchari silk saree) which also the district considerable revenue (refer to Figure 5.9).

**Table 5.2: List of Large and Medium Industries in Paschim Bardhaman-Bankura Region**

Sl No.	Name	Area
<b>Large Scale Industries/ Public Sector Undertakings</b>		
1	Dimension Steel & Alloy Pvt. Ltd	Bankura
2	Surya Alloy Industries Ltd	Bankura
3	Rohit Ferro Tech Ltd	Bankura
4	Shree Ambey Ispat Pvt Ltd	Bankura
5	Capricon Ispat Udyog Ltd	Bankura

35. <https://sisikolkata.gov.in/uploads/2021/03/districtprofiles/2018-19/DIPS-Bankura-2018-19.pdf>

Sl No.	Name	Area
6	Amit Ferro Alloy & Steel Pvt Ltd	Bankura
7	Emami Cement Ltd	Bankura
8	SPS Ispat &Power Ltd	Bankura
9	BDG Metal & Power Ltd	Bankura
10	Ankit Metal &Power Ltd	Bankura
11	GPT Castings Ltd	Bankura
12	Vasudev Ispat Pvt. Ltd	Bankura
13	Embee Ferro Alloy Pvt Ltd	Bankura
14	Sova Ispat Ltd	Bankura
15	Supersmelt Industries Pvt Ltd	Bankura
16	Ankur Urza Ltd	Bankura
17	Cosmic Ferro Alloy Ltd	Bankura
18	Xpro India Ltd	Bankura
19	Joyous Blocks & Panels Pvt Ltd	Bankura
20	SRMB Srijan Ltd	Bankura
21	Kangsabati Co-operative Spinning Mills	Bankura
22	Bhagawati Fastners Pvt Ltd	Bankura
23	Srijan Multipurpose Services Ltd	Bankura
24	Mansa Natural Resources Pvt Ltd	Bankura
25	Laxmi Cement Ltd	Bankura
26	J. K Golden Casting & Ispat Ltd	Bankura
27	Brahm Nirman Pvt Ltd	Bankura
28	Brahm Energy Pvt Ltd	Bankura
29	Inox Air Products Pvt Ltd	Bankura
30	Bitchem Asphalt Pvt Ltd	Bankura
31	Durgapur Steel Plant	Durgapur
32	Durgapur Projects Limited	Durgapur

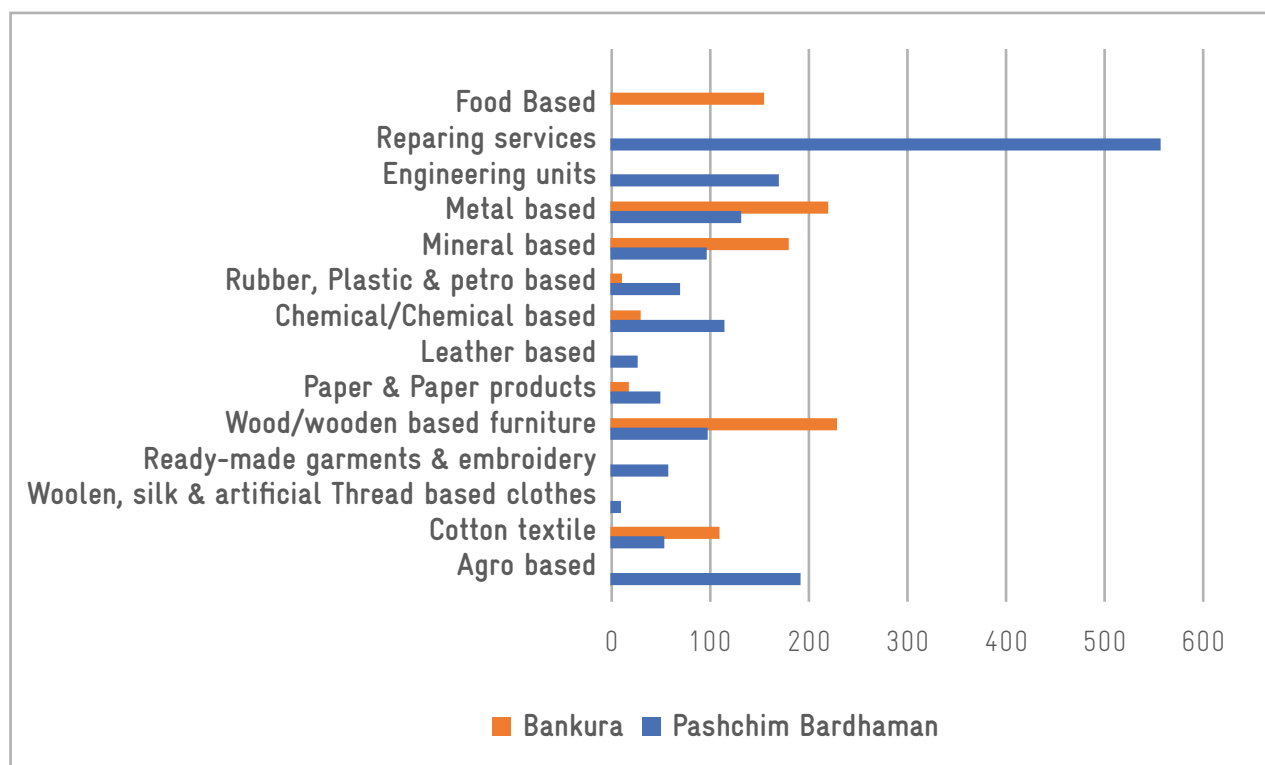
Sl No.	Name	Area
33	Alstom Power Boilers Ltd. (earlier known as ACC-Vickers Babcock and later as ACC-Babcock)	Durgapur
34	Philips Carbon Black Limited	Durgapur
35	Durgapur Cements Works	Durgapur
36	Durgapur Chemical Ltd	Durgapur
37	Birla Corporation Ltd	Durgapur
38	Graphite India Limited,	Durgapur
39	East India Pharmaceutical Company	Durgapur
40	Durgapur Fertiliser Project	Durgapur
41	Hindustan Petroleum Corp. Ltd. Durgapur	Durgapur
42	Mining and Allied Machinery Corporation	Durgapur
43	Unitech Cement Durgapur	Durgapur
44	Ultratech Cement Ltd. Durgapur	Durgapur
45	Power Grid Corporation Of India Ltd Durgapur	Durgapur
46	Indian Oil Corporation Ltd.. Durgapur	Durgapur
47	Adhunik Ispat Pvt Ltd. Durgapur	Durgapur
48	Jagadamba Fiscal Services Pvt. Ltd. (Cement & Pig Iron)	Durgapur
49	Mangalam Jute Mill Durgapur	Durgapur
50	C P Sponge Iron Pvt Ltd. Durgapur	Durgapur
51	Shri Ramrupi Balaji Iron Durgapur	Durgapur
52	Corporate Ispat Alloys Ltd Durgapur	Durgapur
53	Kartik Alloys Ltd. Durgapur	Durgapur
54	Shyam Shri Steels Ltd. Durgapur	Durgapur
55	Sova Ispat Alloys Ltd. Durgapur	Durgapur
56	Shyam Ferro Allys Ltd. Durgapur	Durgapur
57	C P Re-rolling Pvt. Ltd. Durgapur	Durgapur

Sl No.	Name	Area
<b>Medium Scale Industries</b>		
1	Icore Polyfab Pvt. Ltd.	Bankura
2	Kalika Fuel & Chemical Indus	Bankura
3	India Dairy Products Ltd.	Bankura
4	Govinda Impex Pvt. Ltd.	Bankura
5	Hindusthan Seals Ltd.	Bankura
6	Manakshia Steel Ltd	Bankura
7	Sodepur Engineering Ltd.	Bankura
8	Hooghly Metals Pvt. Ltd.	Bankura
9	Concast Infrastructures (P) Ltd.	Bankura
10	Concast Bengal Indus Ltd.	Bankura
11	Exodus Knitwear Pvt. Ltd.	Bankura
12	Ramdiha Refrigeration Pvt. Ltd.	Bankura
13	Crescent Manufacturing Pvt. Ltd.	Bankura
14	Shree M.P. Ispat & Power Ltd.	Bankura
15	B.D.Casting Pvt. Ltd.	Bankura
16	R.G.Steel Pvt. Ltd.	Bankura
17	Capricorn Ispat Udyog	Bankura
18	Tanushree Ispat Pvt. Ltd.	Bankura
19	Pallisree Ltd., (Lakshmisagar Unit)	Bankura

Source: <https://sisikolkata.gov.in/uploads/2021/03/districtprofiles/2018-19/DIPS-Bankura-2018-19.pdf>  
<http://www.msmedikolkata.gov.in/uploads/2021/03/districtprofiles/2018-19/DIPS-Paschim%20Bardhaman-2018-19.pdf>



**Figure 5.9: Number of Existing Micro and Small Enterprises in Paschim Bardhaman & Bankura**



Source : <http://www.msmedikolkata.gov.in/uploads/2021/03/districtprofiles/2018-19/DIPS-Paschim%20Bardhaman-2018-19.pdf>  
<https://sisikolkata.gov.in/uploads/2021/03/districtprofiles/2018-19/DIPS-Bankura-2018-19.pdf>

**Service Sector:** The majority of the service sector in the area is composed of trade and tourism, with banking services, legal advice, and insurance following closely behind. The region is a popular tourist destination year-round because of its various attractions, such as Durgapur Deer Park, Nachan Bird Sanctuary, Susunia Hill, Murutbaha Eco Park, and Bikna Village.

## Strategies for Diversification

To mitigate the negative effects of the coal "phase-out," enhancing the capacity of the secondary sector, especially MSMEs, to create employment opportunities and achieve economic diversification in the Paschim Bardhaman – Bankura region is a key approach. The success of worker transition in the next few years will depend significantly on several initiatives that will necessitate significant support from both the central and state governments as well as industry leaders such as-

1. Identifying and promoting traditional, indigenous crafts such as dhokra craft, silk weaving, and clay pottery, by developing relevant skill training modules for target groups and establishing market linkages. While some villages like Dariyapur and Bikna have residents who specialise in handicrafts, it is necessary to highlight these cases as best practices and provide greater support.

**Figure 5.10: A Dhokra Artisan in Dariyapur, Purba Bardhaman**



Source : Captured by Authors during field study

**Figure 5.11: Dhokra Crafts at Dariyapur, Purba Bardhaman**



Source : Captured by Authors during field study

2. Increasing engagement of the primary sector in the region, which comprises mostly agriculture alongside mining and quarrying, it is necessary to provide proper training in advanced farming techniques and establish Farmer Producer Organisations (FPOs). Additionally, since mine operators in the area often engage in horticulture on mine overburdens and depleted sections of mines by covering them with topsoil, horticulture could be another promising sector that could aid in greening the coal value chain.

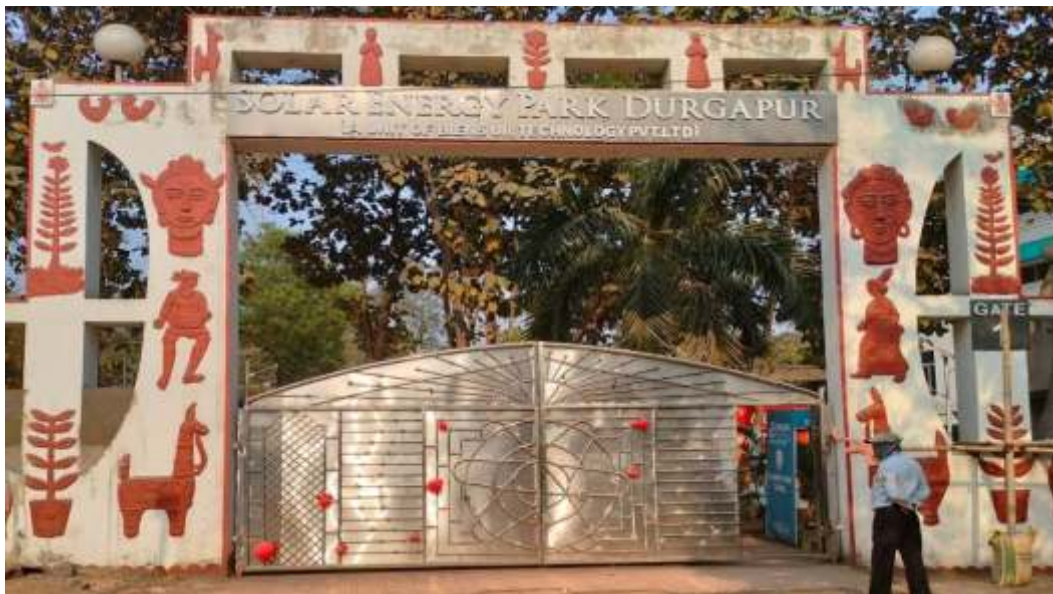
**Figure 5.12: Women Farmers Toiling in Paddy Fields in Galsi, Purba Bardhaman**



**Source :** Captured by Authors during field study

3. Exploring opportunities in the renewable energy sector through the creation of an end-to-end solar value chain in the region and creating greater prospects for their integration in the region.

**Figure 5.13: Solar Energy Park in Durgapur**



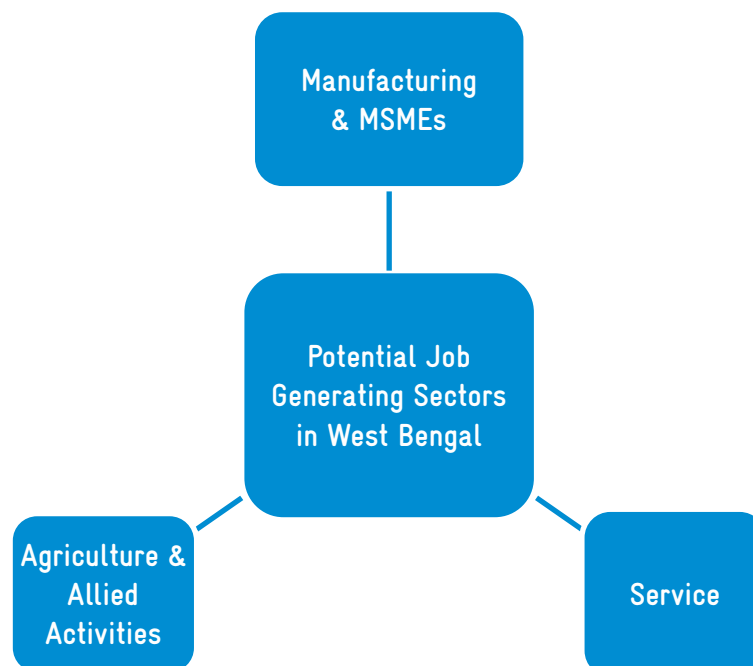
**Source :** Captured by Authors during field study

**Figure 5.14: Solar Panels at a Public Auditorium in Durgapur**

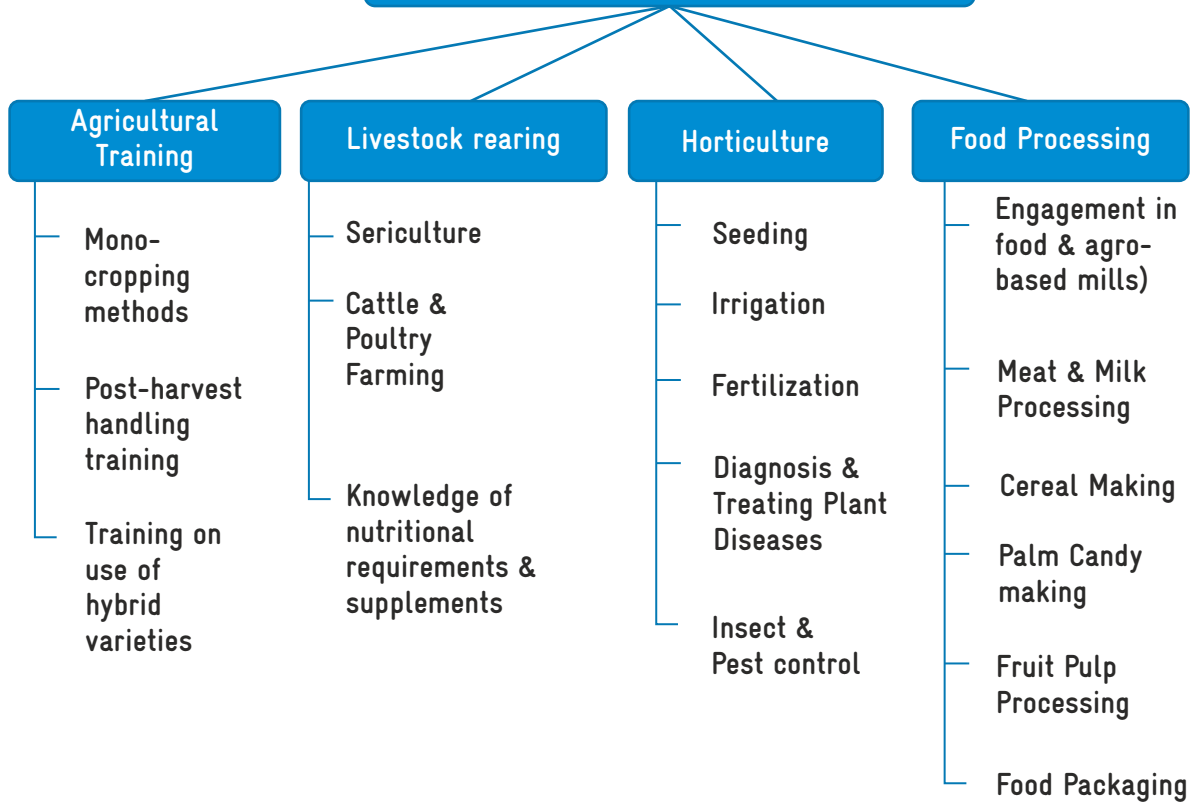


Source : Captured by Authors during field study

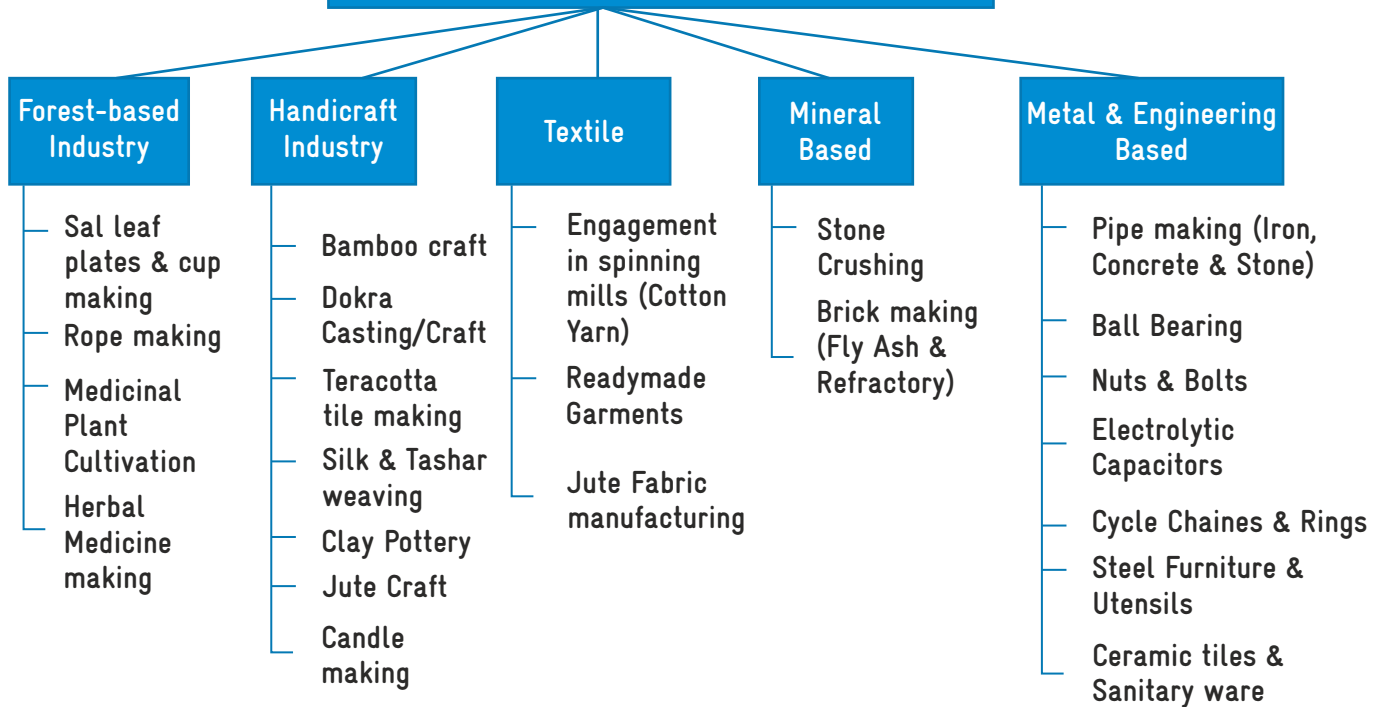
### West Bengal Skill Matrix

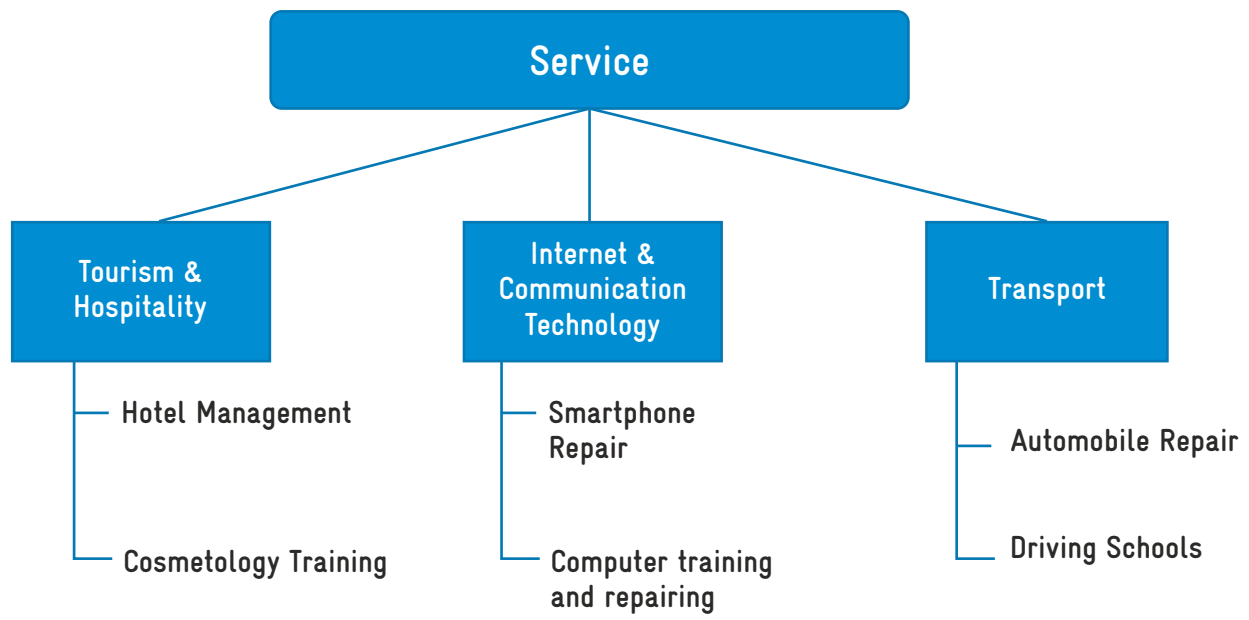


## Agriculture & Allied Activities



## Manufacturing & MSMEs







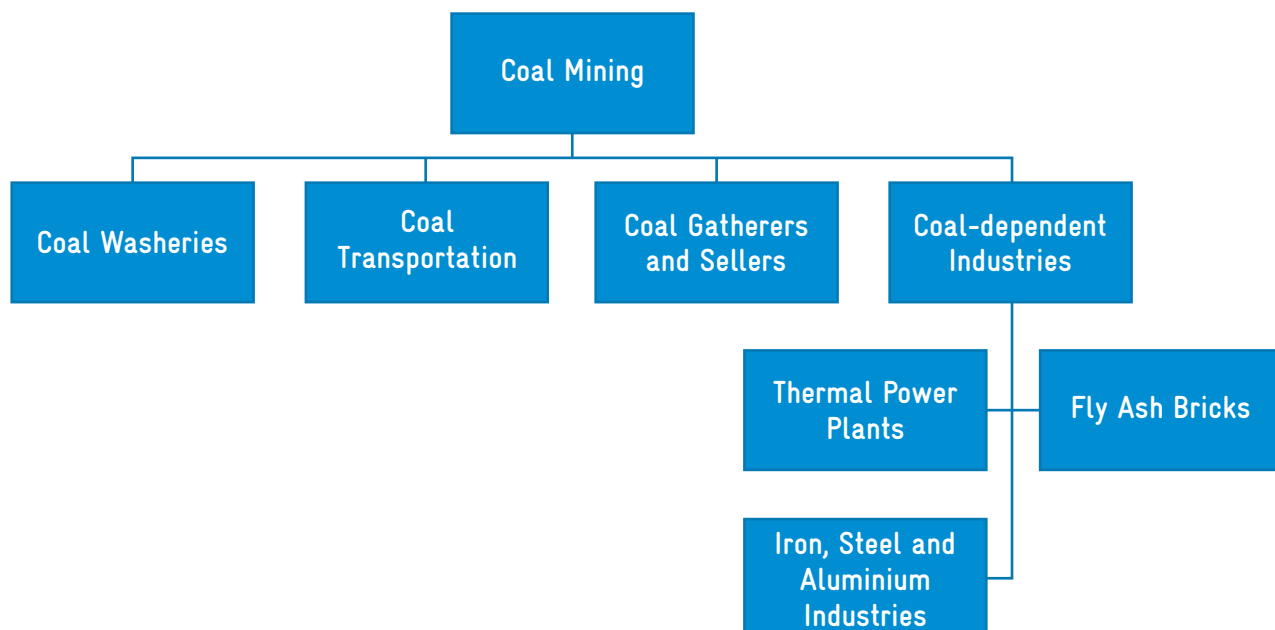
## Coal value chain in the Eastern Coal belt

For over a century and a half, coal mining has been extensively carried out in eastern India, resulting in significant social impacts in the region such as migration and urbanization due to industrialisation, leading to permanent changes in the physical environment. Currently, both underground and open-cast collieries are operated by the Central and state governments, and coal is transported to customers through an efficient distribution system, forming the coal value chain. Understanding the coal value chain provides valuable insights into the current state of the mining industry and identifies economic activities that are directly or indirectly linked to it. This is a crucial step in assessing the potential socio-economic consequences that could arise from the closure of coal mines.

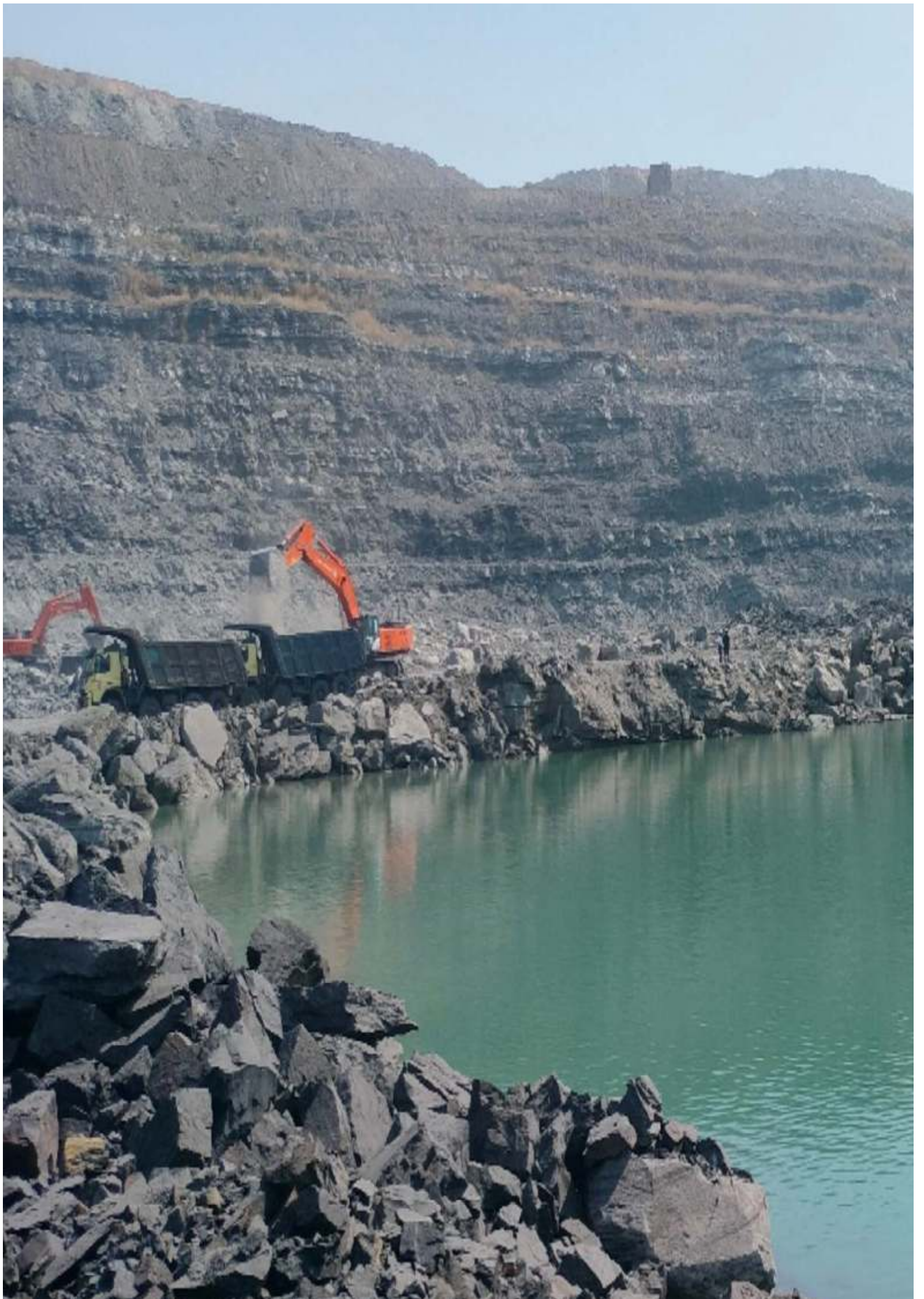
As per our interactions with stakeholders, Figure 6.1 shows the different segments of the coal value chain in eastern India. Here we see that the primary activity of coal mining gives rise to secondary industries such as coal washing and coal transportation alongside an underground economy of illegal coal gathering and selling. Coal transportation again has the highest degree of informality in the entire value chain as there are hardly any official records of the number of people engaged in the sector and the nature of their involvement.

Finally, we have the end-use industries or the coal-dependent industries like thermal power plants, fly ash brick units and the iron, steel, and aluminium industries which either buy coal from the mine operating authority or have their captive mines. Amongst these industries, the thermal power plants and fly ash brick units report a considerable degree of informality as they attract migrant labourers from nearby states and districts.

**Figure 6.1: Coal-based Activities in the Eastern Coal Belt**







## Women in the Coal Value Chain

Historically, coal extraction has been extremely gendered with women working on the fringes of the value chain, excluded from participating in the mainstream economy along with its accruing benefits. In the past, when coal mining started in the eastern belt, women participated in extraction processes as a member of the family labour system, aiding the male members and working in limited capacities. However, in the following decades, they became individual miners themselves as certain communities like the “Bauris” were perceived to be traditional “coal cutters” by the British administration.<sup>36</sup>

These women miners primarily belonged to the lower castes and the indigenous tribes who traditionally inhabited the Salforests present in the Raniganj coalbelt back then. At that time, their involvement was limited to simple methods of extracting resources that were labour-intensive and surface-bound. These women eventually came to be known as “gin girls” because they had to rotate the wooden “gin” (a kind of modified horse gin) and use iron chains to carry coal out of the mines. As steam engines began to be phased out, and with the advent of the Indian Railways, these women started working as loaders, as they lifted the coal excavated by the male workers of their family.

Post-1920s, as coal demand began to rise in the country, coal production also underwent several changes wherein open-cast mines were replaced by underground ones and women were prohibited from entering them, thus making mining a masculine domain. The Mines Act (1923) legally prohibited mine owners from employing women in underground mines and finally, a ban in 1952 directed that apart from surface work in dayshifts, women could not be employed in mines. This brought down the time of waged work for women from 16 hours to 9 hours thus marginalising them further. While these legislations were presented under the pretext of “protecting” women from unsafe working conditions in the mines, they ended up reducing the female workforce participation rate, thus pushing them to the periphery. In the 1900s, women formed about 48 percent of the total labourforce in Raniganj and this proportion rose to 61 percent in the 1920s. Beyond this, however, this percentage fell to 55 percent in the 1950s, to 22 percent in the 1970s before finally dropping to a mere 6 percent in the mid-1990s.<sup>37</sup>

Today, with newer and advanced mining technologies like dragline-based open cast mining, deployment of heavy machinery in the mines and mechanisation of coal extraction, women have been side-lined to largely unskilled roles and there has been little to no efforts to impart any form of skill-training to help them adapt to the structural changes in the coal value chain and bring them back to the workforce. Rather they have been forced to either work in alternative industries (like agriculture or handicrafts making) or resort to coal scavenging to make ends meet.

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36. Lahiri-Dutt, K. (2001). From gin girls to scavengers: Women in Raniganj collieries. *Economic and Political Weekly*, 4213-4221.

37. i.d

Given this background, as we face the critical issue of natural resource degradation in the mining regions which has made a transition to renewables along with an increased need for greener jobs imperative shortly, we must also ensure that all emerging jobs are fair to both genders. New skills and alternate labour-absorbing sectors that emerge instead of the coal and thermal energy sectors must allow for correcting the gender imbalance in workforce participation that exists in these mining regions thus allowing women, a fair chance at a safe and fulfilling livelihood. Only then we can ensure that the transition is just wherein the coats of this shift do not fall disproportionately on anyone.



## Conclusion

One of the most notable aspects of the eastern coal belt is that certain sections, such as the Jharia and Raniganj coalfields, have yet to be fully depleted, as the CIL expands its mining operations to meet the nation's increasing coal demand. Our fieldwork suggests that job loss is not an immediate concern for existing mines and thermal power plants, as most have reduced their permanent workforce in favour of contractual workers. However, the permanent workforce is ageing, and their retirement is likely to coincide with mine closures, which may pose challenges in securing social security benefits like pensions. The informal and contractual workers will be the most affected by the closures, and it will be crucial to provide skill upgradation opportunities to ensure their employability in alternate industries with acceptable wages.

Although mine closures may not be an immediate short-term concern for the nation, transition planning is necessary. Over the next decade, there will be a significant demand for skilled labour, especially in the renewables sector, accompanied by a rise in the greening of existing industries. Therefore, it is crucial to prepare the workforce for future employment opportunities. The Central and state governments must invest in education, vocational training, and skill development facilities to enable a sustainable and equitable industrial and labour transition.

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