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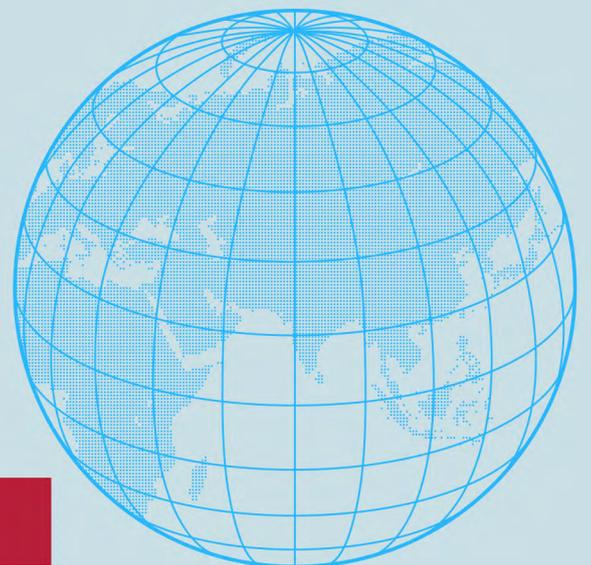
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Unlocking India's Mineral Potential

Bridging the Gap Between
Challenges and Ambitions

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Unlocking India's Mineral Potential

Bridging the Gap Between Challenges and Ambitions

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Abbreviations

AMD	Acid Mine Drainage
CAGR	Compound Annual Growth Rate
CSR	Corporate Social Responsibility
DMF	District Mineral Foundation
EITI	Extractive Industries Transparency Initiative
EL	Exploration Licence
ESAM	Environmentally Extended Social Accounting Matrix
ESG	Environmental, Social, and Governance
FDI	Foreign Direct Investment
GSI	Geological Survey of India
GVA	Gross Value Added
HCL	Hindustan Copper Limited
HDI	Human Development Index
IBM	Indian Bureau of Mines
ICMM	International Council on Mining and Metals
IRMA	Initiative for Responsible Mining Assurance
MCI	Mining Contribution Index
MECL	Mineral Exploration and Consultancy Limited
MIDR	Mining-Induced Displacement and Resettlement
MMDR	Mines and Minerals (Development and Regulation) Act
NALCO	National Aluminium Company Limited
NCMM	National Critical Mineral Mission
NMEDT	National Mineral Exploration and Development Trust
NMEP	National Mineral Exploration Policy
NMET	National Mineral Exploration Trust
NMP	National Mineral Policy
OECD	Organisation for Economic Co-operation and Development
OGP	Obvious Geological Potential
SDG	Sustainable Development Goal
SLO	Social Licence to Operate
SMAI	Sustainable Mining Attractiveness Index

Executive Summary

As India transitions to a net-zero emission economy and seeks to secure its energy sovereignty, the mining sector is transforming from one that supplies basic commodities to one that underpins the green transition. The deployment of renewable energy technologies, electric mobility, and advanced manufacturing relies heavily on a secure supply of minerals in general, and critical minerals in particular. The mining sector has fiscal linkages with the government and non-fiscal linkages with the rest of the economy. The mining sector can catalyse the country's economic growth and the well-being of local communities through its backward and forward linkages with other sectors of the economy. A recent CSEP study found that the non-fuel minerals sector has high output and labour multipliers, indicating that the climate transition can be a source of inclusive economic growth. Today, minerals and their derivatives make up almost all the built-up world around us. However, unlocking India's mineral potential requires navigating several complex historical challenges.

A paradox often discussed with natural resource endowments is that while they have the potential to contribute to countries' economic growth and development, these may not be realised economically, equitably, or sustainably. The resource curse, also known as the paradox of plenty, refers to a situation in which a country or jurisdiction underperforms economically despite possessing valuable natural resources.

In India, evidence of the resource curse paradox is visible at the sub-national level. Despite collecting substantial mineral royalties, Odisha and Chhattisgarh perform relatively poorly on the Sustainable Development Goals (SDGs) and the Human Development Index (HDI) and have per capita incomes below the national average.

While mining provides the raw materials needed to run modern society and has provided a positive impetus to economic growth through downstream sector linkages and job creation, it has also led to several negative externalities. These adverse impacts include imbalances in the local climate—depletion of biodiversity of flora and fauna, air, soil, and water pollution—and other ecological disruptions affecting all life forms. Mining-induced displacement and resettlement (MIDR) may not be a statistically significant category within the broader development-induced displacement and resettlement, but it entails high social exploitation costs.

Regulatory Evolution

The Mines and Minerals (Development and Regulation) (MMDR) Act, 1957, enacted by the Union government, is currently the principal legislation governing the mining sector in India. Various amendments have been made to the MMDR Act since, with the goal of creating a fair and open mining policy regime that attracts more investments. The amendments in 2015 instituted auctions as the sole method for granting mineral concessions, aiming to increase transparency in the process.

In June 2023, India released its first list of 30 critical minerals crucial to economic development and national security. The period from 2023 to 2025 marked a transition from policy formulation to implementation, driven by the urgent need to secure mineral supply chains for India's energy transition. Building on the amendments to the MMDR Act in 2023, the government announced a National Critical Mineral Mission (NCMM) in 2025 to strengthen the entire mineral value chain, from domestic exploration to overseas acquisition of mineral assets. The new Exploration Licence (EL) regime achieved its first major success in late 2025, with preferred bidders announced for seven deep-seated mineral blocks, including gold and rare-earth elements.

Since 2011–2012, the share of mining in the country's gross value added (GVA) has steadily declined, and value added has grown only at around 1.7% compound annual growth rate (CAGR) until 2021–2022, compared to 5.5% CAGR for the whole economy. Due to various barriers in the mining sector, India has historically struggled to attract substantial foreign direct investment (FDI). Only around 29% of India's obvious geological potential (OGP) has been explored as of 2023. Unlike the needs for bulk commodities, critical mineral discoveries require long-term and high-risk capital investments for deep-seated exploration. Globally, junior explorers drive such exploration activities but have been deterred by the lack of a seamless transferability of the EL to a Mining Lease.

The Path Forward

Tensions are severe between India's growing commodity demand and a woeful legacy of social conflicts and environmental mismanagement. The mining potential of India cannot be unlocked solely through geological discoveries or regulatory reforms;

it requires strategic thinking that brings together the state, industry, and society. These changes can be thought of along two pillars:

- **Attracting investment:** Regulatory changes are needed to spur the investment the sector needs. India must offer more incentives, or the right policy environment, as in Australia and Canada, to ensure that more capital flows into domestic exploration and mining. These enhanced exploration efforts would also be a component of intergenerational equity, converting India's theoretical geological potential into known resources, adding to the stock of capital available to future generations.
- **Attaining the social licence to operate (SLO):** The mining industry must earn its SLO. As the CSEP Sustainable Mining Attractiveness Index (SMAI) study (2023) demonstrates, the correlation between mineral wealth and human development remains incongruent in many districts. The next wave of mining projects (especially those for critical minerals) must be operationalised, shedding the conflicts of the past generations, and companies must adopt higher global environmental, social, and governance (ESG) standards as an innate part of their operational strategies.

Responsible mining practices must not be seen as a regulatory burden or ethical preference, but rather a prerequisite for India's domestic manufacturing and energy security.

1. The Role of Mining in Civilisation

From the cultivation of crops to the domestication of livestock and the extraction of useful minerals, early humans have used the natural resources available to them to increase their welfare. Mining provided early humans with sturdier structures, tougher tools, and the materials required for the arts. It has been inextricably linked to the development of civilisation, with various eras described by the key minerals or metals worked at the time: the copper, bronze, and iron ages.

Today, the relationship between mining and development has taken on a new strategic lens. As India transitions to a net-zero emission economy and seeks to secure its energy sovereignty, the mining sector is transforming from one that supplies basic commodities to one that underpins the green transition. India also needs to build a resilient manufacturing base and gain access to a resilient supply of raw materials to feed it. The deployment of renewable energy technologies, electric mobility, and advanced manufacturing relies heavily on a secure supply of minerals, in general, and critical minerals, in particular. However, unlocking India's mineral potential requires navigating several complex historical challenges.

Mining in India goes back multiple millennia, with evidence of terracotta bricks, bronze working, and precious-metal jewellery dating back to the Indus Valley Civilisation (25th century BCE) (Sugandhi, 2015) and the more recent Iron Pillar of Delhi (5th century CE) (Kamrani, 2019). The state of Rajasthan is home to the world's oldest zinc mine and smelting site, Zawar, as well as the site of one of the oldest lead mines in the world, Rajpura-Dariba, both dating to 1,000 BCE (Willies et al., 1984). Other known minerals and metals in ancient India included brass, steel, bronze, and copper (Biswas & Biswas, 1996). While more formalised mining was introduced during British rule, the sector grew rapidly after independence, driven by the Five-Year Plans. The post-independence era witnessed an expansion of exploration, thereby increasing the national mineral inventory. Many government agencies and public sector organisations were established to explore and extract minerals, and strategies were adopted to expand and modernise mining activities through increased mechanisation, new technologies, and the assimilation of scientific innovation.

As civilisation and technology progressed and industrial demand increased, so did the sheer geographic scale of mining activities. While the first mines began

in isolated areas with high levels of mineralisation, the current global mining footprint is estimated to exceed 65,000 km²—an area roughly the size of Sri Lanka (Tang & Werner, 2023). This increase in mining activity has been necessitated by the exponential increase in the demand for primary resources, including fossil fuels—coal, oil, and gas—and non-fuel metallic and non-metallic resources. These resources constitute the inputs required by all other sectors of the economy, including energy, agriculture, industry, and services. Today, minerals and their derivatives make up almost all the built-up world around us—from the buildings we live in, the trains we travel on, and the machinery required to manufacture the device or paper on which this text is written.

Over time, the mining sector earned multiple adjectives: from imperative, for its widespread economic benefits and raw material security, to monstrous, for its devastating environmental and local community impacts. However, global economic growth persists, along with its insatiable appetite for mineral inputs across all primary, secondary, and tertiary activities. Consequently, mining cannot be wished away. Nevertheless, all efforts must be made to ensure the sector operates efficiently and adopts optimal environmentally and socially responsible practices, benefiting affected communities now and in the future.

This paper aims to identify a pathway for India to unlock its mineral potential that accounts for community needs, addresses environmental impacts, and attracts capital and expertise. It argues that India will require strategic thinking to achieve its critical mineral ambitions, while avoiding the mistakes of the past and those made by other jurisdictions. The remainder of this paper is structured as follows. Section 2 outlines the significance of the mining sector through economic linkages. Section 3 highlights the social and environmental costs of the sector. The evolution of India's regulatory framework, with a focus on the recent policy shifts, is covered in Section 4. Section 5 of the paper provides a snapshot of India's mineral economy. Section 6 analyses some of the paradoxes of resource management, specifically looking at the resource curse and the principle of intergenerational equity. Section 7 makes a case for responsible mining practices and highlights some of the challenges in achieving them. Finally, Section 8 concludes with policy recommendations centred on attracting investment while securing the SLO.

2. Economic Linkages of the Mining Sector

The mining sector has fiscal linkages with the government and non-fiscal linkages with the rest of the economy. The revenue that the government earns from auction premiums, royalties, and other mineral taxes can be used to develop state and local infrastructure. The mining sector can catalyse the country's economic growth and the well-being of local communities through its backward and forward linkages with other sectors of the economy. Backward linkages refer to the impact of an increase in a downstream industry's output on its demand for inputs from upstream industries. In contrast, forward linkages refer to how changes in the output of an upstream industry stimulate downstream industries that use its products. For example, mining, a primary sector, requires machinery and fuel, while many downstream industries use the minerals produced as raw materials. Though mining companies must devote their attention to extracting minerals responsibly, Central, State, and local governments must facilitate enabling policy regimes, invest in vocational education and training, provide adequate infrastructure, provide real-time information, and ensure strict monitoring (Östensson, 2020).

The linkages of mining activities can operate at the local, state, and national levels. At the local level, the backward linkages work through employing local communities, sourcing some of the inputs from local enterprises, and creating the infrastructure, say roads and rail, which, apart from the mining companies, local actors can also use. The beneficiation and processing of extracted minerals can provide similar benefits through forward linkages in the local areas. Since mining activities can involve large-scale production, extraction activities are linked to national and international actors through backward and forward linkages. The engineers, managers, and geologists are sourced from within the country and abroad. Mining equipment and technology are similarly sourced, and the same holds for other related raw materials. The forward and downstream linkages are realised through the processed ores and minerals consumed by other industries, including power generation, steel, aluminium, cement, automobiles, and infrastructure, including rail, road, and real estate. Some of the minerals have become critical for manufacturing clean energy generation equipment.

Multipliers represent the strengths of backward and forward linkages. The backward linkage of a sector reflects the effects of a unit increase in the final demand of this sector on overall economic activity. These arise from the procurement of goods and services required by the mining industry to operate. The forward linkage for a sector reflects the effects of a unit increase in this sector's production on overall economic activity. These relate to the beneficiation of extracted ores and minerals through refining, smelting, and further downstream processing before the commodity reaches the final consumer. The induced linkages refer to the increase in consumption of goods and services resulting from the spending of earnings by mining sector employees and suppliers. Consumption linkages induce income and employment (Roe & Round, 2018). However, the multipliers may have differential impacts across local and distant regions (De Haas & Poelhekke, 2019).

The CSEP Environmentally Extended Social Accounting Matrix (ESAM) for India 2019–20 (Chadha, Sivamani, & Verma, 2023) provides a quantitative assessment of sectoral linkages in the Indian economy. The study computes “output multipliers,” defined as “the ratio of the change in the economy's total output to a unit increase in the final demand of a given sector.” The output multipliers incorporate the first-level inter-industry effects, transmission to households without income feedback, and consequent income feedback effects. The results indicate that certain non-fuel minerals have relatively high output multipliers. For example, iron ore and other metallic minerals have multipliers of 5.02 and 5.26, respectively. This computation implies that an additional demand of ₹1 lakh in either sector would lead to an economy-wide output increase of over ₹5 lakh through direct, indirect, and induced effects.

The study also computes “labour income multipliers,” which estimate the wages generated throughout the economy for a unit increase in the final demand of a given sector—labour-intensive sectors would have larger labour income multipliers. These multipliers could indicate to policymakers which sectors have the potential to significantly enhance labour incomes for specific demographic groups. The CSEP-ESAM data show that for an additional demand of ₹1 lakh in iron ore or other metallic minerals, the economy-wide increase in wages would be ₹0.48 lakh and ₹0.55 lakh, respectively. These values are higher than the multipliers for fossil fuels (coal and crude petroleum), thus suggesting that India's pivot towards

non-fuel minerals will not only secure the resources required for the green transition but will also induce more inclusive growth. In general, primary sectors, including agriculture, allied sectors, and mining, generate the highest labour income multipliers for most social groups in rural regions (Chadha, Sivamani, & Verma, 2023).

The relatively high multipliers of the non-fuel mining sector provide a policy opportunity. The sector has the potential to become a catalyst for employment growth, not only in extraction activities but also in allied and downstream industries. To realise these multipliers, policies need to emphasise sectoral skill development, particularly for those living in mining-affected areas, to enable tangible local economic development.

3. Negative Externalities of Mining

While mining provides the raw materials needed to run modern society and has provided a positive impetus to economic growth through downstream sector linkages and job creation, it has also led to several negative externalities (United Nations, 2021). These adverse impacts include imbalances in the local climate, depletion of biodiversity in flora and fauna, air, soil, and water pollution, and other ecological disruptions affecting all life forms.

Land degradation is one of the most visually evident impacts of mining activities. While open-cast mining has a more discernible impact on the surface, underground mines also adversely impact the land above, such as through mine subsidence (where the land sinks due to a collapsed underground mine), posing an injury hazard for those living above (Lee & Abel Jr., 1983). Various mining activities can impact land productivity, including clearing vegetation, blasting, drilling, and storing waste material that may contain toxic substances, further degrading the environment. The Jharia coalfields (located in Dhanbad, Jharkhand, India) have not only experienced long-term land degradation due to coal mining waste polluting the soil but also suffered a century-long coalfield fire that has rendered the land unproductive and unsafe for habitation (Singh, 2019). Hundreds of thousands of people living in local communities in Jharia have borne the brunt of these impacts, including lingering risks of ground subsidence from abandoned underground mines and exposure to toxic fumes released by the fires.

Air pollution from mining also comes from dust and particulate matter released during blasting, drilling, and material transport, adversely affecting mine workers and residents in surrounding areas. Long-term exposure to silica, coal dust, heavy metals, and other toxic substances can lead to serious and chronic respiratory issues and cancer (US Centers for Disease Control and Prevention, 2025). Mining activities in Tamnar, Raigarh district, Chhattisgarh, for example, increased the risk of respiratory diseases and tuberculosis amongst the local population, many of whom were tribal (Shrivastava & Chakma, 2020). Moreover, mine workers, especially coal mine workers, face increased risks of mine dust lung diseases, such as black lung or silicosis; the prevalence in India is 3%, higher than the global average (Vanka, Shukla, & Gomez, 2022).

Mining activities can lead to negative externalities on surficial and groundwater. For example, mining activities instigating large-scale land disturbances exacerbate acid mine drainage (AMD). Sulphide minerals in many mines react with the air and water to create sulphuric acid; this runoff can further leach heavy metals from rocks and pollute water bodies. AMD, mining effluents, and soil erosion can make water bodies uninhabitable for certain aquatic life and toxic for humans and animals drinking from them. As polluted water can travel through waterways, this threat is not limited to the mining vicinity but extends to areas downstream. For example, the Makum coalfield, located in Assam, India, has released direct acidic mine discharges containing high concentrations of iron, nickel, lead, and cadmium, which are then carried to neighbouring regions (Equeenuddin et al., 2010).

Mining activities may cause communities to lose parts of their habitats and earnings from growing crops, grazing cattle, or harvesting from forests, and force them to move away. To pave the way for new mining activities and reduce the impacts they can have on local communities, people living in and around the mineralised area are often moved to other areas. MIDR may not be a statistically significant category within the broader development-induced displacement and resettlement, but it entails high social exploitation costs (Terminski, 2012). In India alone, MIDR is estimated to have affected anywhere from 1.5 million to 2.5 million people between 1950 and 1990—primarily in Jharkhand and surrounding regions, home to several tribal and impoverished communities. Other countries also face issues with

large-scale MIDR, including China, Indonesia, and several African countries. In India, studies have shown that fewer than 20% of displaced persons have been resettled (Fernandes, 2021); this figure does not include rehabilitation, which entails rebuilding the economic and cultural lives of those resettled.

Mining activities impact not only human lives but also the lives of local wildlife. Local wildlife faces the effects of land, air, and water pollution, as well as noise pollution, and some animals may require resettlement if these disturbances are too great for their survival. Poorly managed mines pose serious risks to local biodiversity—from animals to plants to fungi to insects. As demand for minerals increases, particularly those required for the transition to green technologies (Chadha, Sivamani, & Bansal, 2023a), more land will also be impacted by mining. The potential ramifications of the ecological ruin caused by unsustainable mining may even exceed those averted by climate change mitigation (Sonter et al., 2020).

While these negative externalities are severe and can harm communities and the environment, they are not necessarily inevitable. The challenge policymakers face is in designing and implementing governance frameworks to manage, mitigate, and offset these adverse impacts. Such offsets require a multi-pronged approach that involves strong regulatory capacities, industry-driven responsibility measures (such as corporate social responsibility [CSR]), and dedicated mechanisms to support affected communities, such as the District Mineral Foundation (DMF) in India. Policymakers can use analytical frameworks, such as the CSEP SMAI (Chadha et al., 2023), to assess whether the benefits from mining activities have percolated to socioeconomic gains. The pathways to enabling responsible mining practices are explored further in subsequent sections of this paper.

These negative externalities are a major hurdle to unlocking India's mineral potential. The legacy of environmental mismanagement and the ill-treatment of communities have eroded the trust needed to operate new projects. Thus, strategic thinking is required to ensure that all new projects have established the SLO, obtained through free, prior, and informed consent. Without enabling this shift, India's mining ambitions may be delayed by community resistance and legal delays.

4. India's Regulations and Institutions

India, along with parts of Australia, Africa, and South America, was part of the ancient Gondwana supercontinent, which broke up around 180 million years ago. Consequently, India's mineral geology and potential can be compared with those of these mineral-rich regions (Krishnan, 2022). Expanding a vibrant non-fuel mining sector in India can create employment opportunities for local communities, generate fiscal gains for State governments, and build linkages with downstream industries. Such effects are particularly relevant to India's mineral-rich districts, inhabited by some of the country's poorest communities, where mining development could create jobs and promote broader social development.

Given India's commitments to a clean climate regime, it also needs to ensure its mineral security to support the future of manufacturing clean energy technologies, electric vehicles, and high-tech manufacturing. The ease of doing business, along with regulatory and enforcement mechanisms in the mining sector, must be simple yet effective. Given the impact the mining sector can have, and has had, on the environment and communities, any further developments must ensure sustainable and responsible practices, with companies adhering to global good practices and principles.

One of the earliest organisations working in the mining sector in South Asia was the Geological Survey of India (GSI), established in 1851 by the East India Company, which initiated modern geological mapping, research, and exploration in the region (Fox, 1947). Through GSI's efforts, India identified the potential of its coal, iron ore, limestone, and gold resources and opened various mines across the country.

Since independence, the Government of India has considered the mining industry, including the metals, non-metals, and energy sectors, a major component of industrial and economic growth, capable of facilitating sustained economic growth (Ministry of Mines, 2023):

“India is well endowed with natural resources, particularly minerals, which serve as raw material for many industries, paving a path for rapid industrialisation and infrastructural development.”

As a result, India's national government decided to organise a Mineral Policy Conference in 1947, immediately after independence. Following this, several legislative measures were introduced to facilitate the development of India's minerals industry (Dorian, 1989). The MMDR Act, 1948, the Mineral Concession Rules, and the Mineral Conservation and Development Rules were instrumental in reforming the mining industry (Madan, 1979). The MMDR Act, enacted by the Union government, replaced the 1948 Act and is currently the principal legislation governing the mining sector in India, laying down the legal framework for regulating mines and developing minerals other than petroleum and natural gas (Singh & Kalirajan, 2003).

The Ministry of Mines is responsible for administering the Mines and Minerals (Development and Regulation) Act, 1957, and the rules made thereunder for all mines and minerals other than coal, natural gas, and petroleum. It undertakes surveys, exploration, and mining, except for atomic minerals and coal, for which its activities are limited to regional exploration. The Ministry also administers the Offshore Areas Mineral (Development and Regulation) Act, 2002, and the rules made thereunder. Additionally, it is responsible for the planning, development, control, and support of industries related to mineral wealth. It administers and manages the GSI, headquartered in Kolkata, and the Indian Bureau of Mines (IBM), headquartered in Nagpur. Three public sector mining undertakings—National Aluminium Company Limited (NALCO), Hindustan Copper Limited (HCL), and Mineral Exploration and Consultancy Limited (MECL)—are also administered by the Ministry.

The Seventh Schedule of the Constitution of India, adopted in 1950, provided details on the allocation of powers between the Union and State governments. Regulation of minerals and mining falls under the purview of both the Union and State governments in India. Broadly, the Union government can formulate legislation and policies for the mines and minerals sector, while the State governments implement these policies and regulate the industry. The shared responsibility allows states to cater to the specific needs of their geologies, environments, and people while also allowing for a standardised national framework for the sector.

In 1956, as part of the Industrial Policy Resolution, India created a minerals classification scheme to control mineral development better. Minerals were classified into three categories: (1) strategic minerals—to be developed by the State; (2) minor minerals—to be developed by the private sector; and (3) all other minerals—to be exploited by the State. The Central government also expanded several mineral-related organisations during the 1950s to facilitate mineral development in India. These included the GSI, IBM, the Office of the Coal Controller, and the Department of Mines under the then Ministry of Natural Resources and Scientific Research (Madan, 1979). The State governments set up mineral development corporations to promote local mineral development. Almost all of the Indian mining sector was controlled by the Central and State governments by the 1960s.

The mining sector in India remained under State ownership until 1991, with restrictions on private investment. The policy was designed in the backdrop of the Industrial Policy Resolution, 1956, which assigned major minerals such as coal, lignite, mineral oils, iron ore, copper, zinc, and atomic minerals to Schedule A, which was exclusively reserved for the public sector. Minor minerals assigned to Schedule B attracted private participation in the mining activities (Raza & Dwivedi, 2019). A formal list of 31 minor minerals was declared after the MMDR Amendment Act, 2015 (Industries & Commerce [M.II] Department, Government of Andhra Pradesh, 2016).

The New Industrial Policy, 1991, was introduced to deregulate industries and liberalise provisions related to domestic and foreign investments (Singh & Kalirajan, 2003). In 1993, the first National Mineral Policy (NMP) was introduced to facilitate private and foreign participation in the mineral industry (IBM, 2015). It was subsequently reviewed in 1997, 1999, and 2000. The New National Mineral Policies also empowered State governments to make decisions without the Central government's permission. The MMDR Act, 1957, has been amended to incorporate these changes. Until the early 1990s, FDI was prohibited in the mining sector. Mineral concessions were restricted to firms with less than 40% foreign holding. The FDI limit was raised to 50% in 1993, with no limit on captive mines.¹ In February 2000, 74% of FDI was permitted for the exploration and mining of diamonds and precious stones. Finally, in 2006,

¹ Captive mines are owned by companies that supply the raw materials for their own industrial consumption (such as a steel company owning an iron ore mine). Merchant mines supply raw materials to the open market.

the mining sector was opened to 100% FDI (Raza & Dwivedi, 2019).

Though the MMDR Act, 1994 and the MMDR Act, 1999, along with changes to the FDI regulations, generated significant interest among the international mining community to invest in India, most mining companies still found the regulatory processes regressive and non-transparent. As a result, India failed to attract substantial international exploration and mining investments, especially in non-bulk commodities, even during the peak of global mineral exploration investment.

The Hoda Committee Report on the NMP (2006) (Planning Commission, 2006) and the NMP (2008) (Ministry of Mines, 2008) outlined reforms to encourage the flow of private investment further and to introduce state-of-the-art technology in the exploration and mining of non-fuel minerals. However, serious flaws were detected in the allocation of coal mines during 1993–2010, later declared illegal by the Supreme Court in August 2014. As a result, all non-coal mining allocations also came to a standstill during 2010–2015. In addition, an enquiry into mining irregularities led to the closure of mining in Karnataka and Goa, and to partial closures in Odisha and Jharkhand.

The MMDR Amendment Act, 2015, removed discretion as a criterion for granting mineral concessions; the amended Act instituted auctions as the sole method for granting mineral concessions, aiming to increase transparency in the process (Chadha & Sivamani, 2021). The DMF funds were also introduced in the amendments to address the long-standing demand of local people in mining areas affected by mining operations. Alongside the introduction of DMFs, the National Mineral Exploration Trust (NMET)² was also established, which collected a share of a mining company's royalties to fund exploration activities. In addition, the government approved a new National Mineral Exploration Policy (NMEP) in 2016 (Ministry of Mines, 2016). This policy stated that the government would publish pre-competitive geoscience baseline data of the highest standards and fund the generation of such data. The policy also mentioned launching special initiatives to probe deep-seated mineral deposits. In 2019, the government approved the new NMP, which outlined policies to accelerate the growth of non-fuel mineral production (Minis-

try of Mines, 2019). It also emphasised the need for proper exploration, streamlining regulatory mechanisms, and operating with the utmost environmental and social responsibility.

In March 2021, amendments to the MMDR Act were introduced. They created a level playing field between captive and merchant miners by removing end-use restrictions on auctions and allowing captive miners to sell up to 50% of their minerals after meeting their captive requirements. They have also remedied the imbalance of revenues paid to the exchequer between government-operated and private mines, among other amendments.

In June 2023, India released its first list of 30 critical minerals crucial to economic development and national security. Later, the MMDR Act was amended in August 2023. Several amendments to the MMDR Act, 2023, focused on exploring and mining critical minerals in India. The announcements included a new list of critical and strategic minerals within the Act and the addition of a new EL to encourage their reconnaissance and prospecting.

The period from 2023 to 2025 marked a transition from policy formulation to implementation, driven by the urgent need to secure mineral supply chains for India's energy transition. Building on the amendments to the MMDR Act in 2023, the government announced the NCMM in 2025 to strengthen the entire mineral value chain, from domestic exploration to overseas acquisition of mineral assets. Alongside this mission, the Ministry of Mines has also conducted several tranches of critical mineral auctions, starting in November 2023, with 34 out of 55 unique blocks being successfully bid out and graphite accounting for the largest share (15 blocks of 34). The new EL regime achieved its first major success in late 2025, with preferred bidders announced for seven deep-seated mineral blocks, including gold and rare-earth elements. Simultaneously, the government launched the first round of offshore mineral auctions in November 2024, offering 13 blocks, including construction sand and polymetallic nodules; however, there have been no updates on the auctions a year later.

India's stagnant FDI in the mining sector, along with its poor performance in global mining attractiveness rankings, shows that the existing regime has not been sufficient to attract junior explorers, who drive explo-

² The NMET was renamed the National Mineral Exploration and Development Trust (NMEDT), through the MMDR, 2025.

ration globally, and large mining companies, which invest capital. India will need to pivot to a more competitive exploration regime that incentivises high-risk capital and rewards mineral discoveries, rather than relying mostly on public sector agencies. A paper on incentivising non-fuel mineral exploration in India (Chadha, Sivamani, & Bansal, 2023b) proposes a strategic pathway to reform the exploration policy regime, granting exploration companies the right to mine their discoveries while maintaining the auction system for allocating mineral blocks.

5. The Indian Mineral Economy

India extracts 95 minerals, including 4 fuel minerals, 10 metallic minerals, 23 non-metallic minerals, 3 atomic minerals, and 55 minor minerals (such as construction materials). During the year 2021–2022, mineral production was reported across 19 states. Of the total value of mineral production, the bulk, about 97%, was confined to only seven states: Odisha with a share of 44.11%, followed by Chhattisgarh (17.3%), Rajasthan (14.1%), Karnataka (13.2%), Jharkhand (4.4%), Madhya Pradesh (2.4%), and Maharashtra (1.5%). Table 1 and Figure 1 depict some of the changes in the mining sector since 2011–2012 and contextualise the share of mining GVA in the national economy. Since 2011–2012, the share of mining in the country's GVA has steadily declined, and value added has grown only at around 1.7% CAGR until 2021–2022, compared to 5.5% CAGR for the whole economy.

India ranked 11th globally in terms of the value of metallic minerals and coal production in 2018 and retained that position in 2020. Most countries saw a decline in mineral production in 2020 due to COVID-19, barring China and Canada. Thirteen of the top 20 producer positions in 2020 were dominated by upper-middle or higher-income economies. The remaining seven were lower-middle or low-income countries: India, Indonesia, the Democratic Republic of Congo (DRC), Ukraine, Zambia, Uzbekistan, and Iran (International Council on Mining and Metals [ICMM], 2022).

The ICMM seeks to improve sustainable mineral and metal development and has developed a Mining Contribution Index (MCI), which aims to reflect the mining sector's importance to the economy. The index complements the ICMM's 10 Mining Principles, which provide a benchmark for industry performance in environmental and social areas. India's MCI ranking dropped from 59 in 2018 to 74 (out of 110 countries) in 2025. Additionally, as of December 2025, only one Indian mining company was a member of the ICMM (ICMM, 2025). The Fraser Institute undertakes a similar indexing exercise through its annual survey of mining and exploration companies, which evaluates mining jurisdictions' governance and geology factors. India last appeared in its assessment in 2016, ranking 97 out of 104 jurisdictions, before falling out of the assessment entirely due to a lack of responses from mining companies (Fraser Institute, 2017).

Table 1: Indicators on Mining in India

Indicator	2011–2012	2016–2017	2021–2022	2023–2024
Mining & Quarrying GVA in ₹ crore*	2,61,035	3,49,248	3,09,276	3,30,007
% Share in India's GVA	3.2	3.1	2.2	2.0
Index of Mineral Production (base 2011–2012)**	100.0	102.5	113.3	128.9
Number of Reporting Mines in India***	2,928	1,616	1,319	2,046
Cumulative FDI in the Mining Sector since April 2000 in ₹ crore	4,137	12,403	19,478	21,473
% Share in Total FDI	0.54	0.68	0.55	0.52

Source: Ministry of Mines (2023); Ministry of Statistics and Programme Implementation (2025); Department for Promotion of Industry and Internal Trade (2025).

Notes:

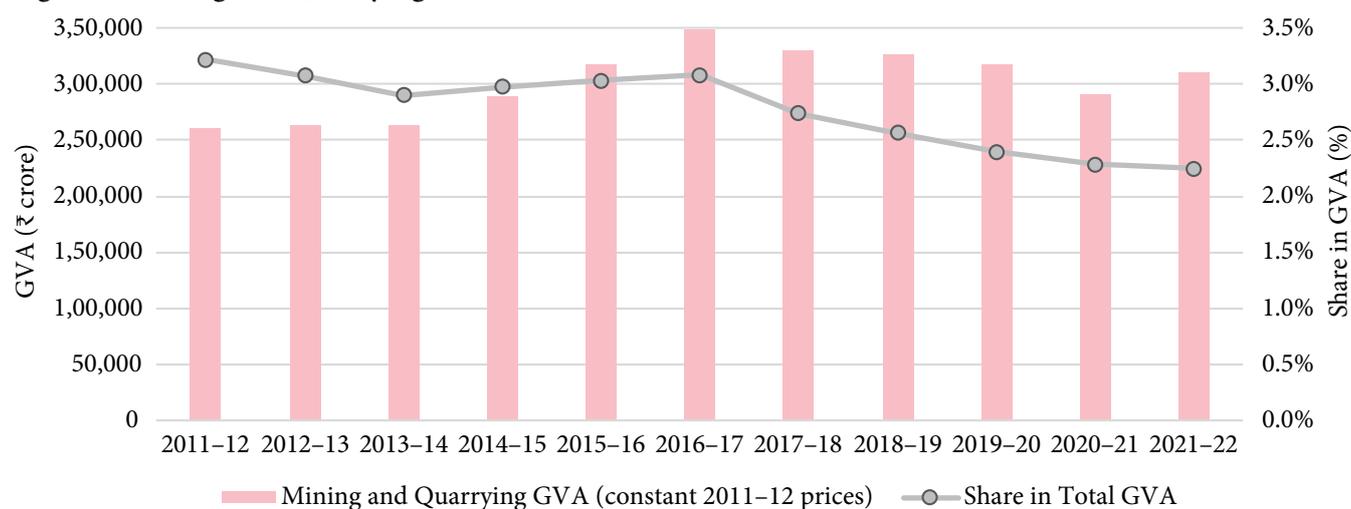
*Values in constant 2011–2012 prices; includes fuel, atomic, and minor minerals.

**Excludes fuel, atomic, and minor minerals.

***Reporting mines refers to a mine where any developmental work takes place.

FDI = foreign direct investment; GVA = gross value added.

Figure 1: Mining and Quarrying Gross Value Added



Source: Ministry of Statistics and Programme Implementation (2025).

Note: GVA = gross value added.

6. Resource Management and Mismanagement

A paradox often discussed with natural resource endowments is that while they have the potential to contribute to countries' economic growth and development through increased FDI, fiscal revenue, export earnings, and job creation, these may not be realised economically, equitably, or sustainably (Sachs & Warner, 1995). The challenge lies in recognising and overcoming the economic and societal externalities that cause the resource curse (Organisation for Economic Co-operation and Development [OECD], 2009). The resource curse, also known as the paradox of plenty, refers to a situation in which a country underperforms economically despite possessing valuable natural resources (Fernando, 2025). Poor governance (such as corruption or rent-seeking), neglect of other sectors, or overdependence on a single resource can lead to the resource curse. Nigeria suffered from this curse after the rapid growth of its oil industry in the late 1950s: the country saw over-reliance on the sector (leaving the economy vulnerable to global price fluctuations), corruption in resource management, and violence stemming from rising inequalities (Mähler, 2010).

Similarly, the DRC has faced several issues associated with its extensive resources of cobalt (required in batteries for electric vehicles) and coltan (which contains tantalum needed to manufacture capacitors for mobile phones); the mining sector has been plagued

by several environmental externalities, poor working conditions, and child labour, underpinned by government corruption that has halted reform (Gross, 2023).

Zambia, where copper accounts for about 70% of its exports (African Development Bank Group, 2022), experienced economic growth and macroeconomic stability during the global commodity boom of 2003–2011. Despite these global tailwinds, the country saw increased income inequality and reduced human development parameters (United Nations Trade and Development [UNCTAD], 2017). While some other commodity-rich and dependent developing countries benefitted during this period and increased their support for poverty-reduction and development programmes, Zambia seems to have suffered the ill effects of the resource curse due to its weak institutional frameworks and planning (Unceta, 2021).

Well-governed natural resource endowments may still lead to unintended economic consequences. The Dutch disease thesis (The Economist, 1977) was proposed in the 1970s, arguing that resource abundance could disincentivise more innovative sectors of the economy, which may have greater economic linkages and technological externalities. This hypothesis originated from analysing the Netherlands' economic crisis after the discovery of vast natural gas deposits in the North Sea. It was proposed that this discovery triggered an increase in foreign investment in the sector, leading to a spike in the currency's value and consequently reducing the export competitiveness of other sectors.

Though some resource-rich countries have remained poor, some, like Chile and Botswana, have recently defied the trend. Botswana has benefited from its mineral wealth, particularly diamond mines, supported by a stable political regime and sound economic policies (International Monetary Fund, 2018). Chile has also avoided the resource curse and is currently the largest copper miner (24% of global share) and the second-largest lithium miner (27% of global share) (International Trade Administration, 2025). The sector has also provided an additional growth push to developed nations, such as Australia, Canada, and the US, in the 20th century.

In India, evidence of the resource curse paradox is visible at the sub-national level. Table 2 shows the royalty collections of the major mining states of India and contrasts this with developmental statistics. Despite collecting substantial mineral royalties and funds under DMFs, Odisha and Chhattisgarh perform relatively poorly on the SDGs and the HDI and have per capita incomes below the national average.

While well-utilised natural resources have the potential to uplift impoverished communities, some argue that their use, or overuse, raises an ethical dilemma about whether future generations can also benefit

from them. The problem lies in determining to what extent today's poor should have the right to use resources for their betterment rather than saving them for the theoretical future rich (Henckens, 2021). Much has been written on this philosophical issue: John Rawls' *A Theory of Justice* (1971) tackles "distributive justice" (i.e., a fair allocation of resources) and suggests the existence of an obligation to save enough resources to ensure that future generations can enjoy the same, or greater, opportunities as the present one does. James Tobin (1974), writing on utilising a university's financial endowment, states that "the trustees of an endowed institution are the guardians of the future against the claims of the present. Their task is to preserve equity among generations."

Intergenerational equity is the principle that the present generation must pass on sufficient natural resources to future generations so that they can lead a similar or better quality of life (Oxford Reference, 2025). On exhaustible resources and for upholding intergenerational equity, R. M. Solow (1974) concluded that "...earlier generations are entitled to draw down the pool (optimally, of course!) so long as they add (optimally, of course!) to the stock of reproducible capital."

Table 2: Select Statistics on the Top 12 Mining States in India

State	Total Royalty Collection (₹ crore) (2021–2022)	Share in Total Royalty Collection (%) (2021–2022)	Per Capita Income (₹) (2021–2022)	HDI (2021)	Rank in SDG Index of India (2020–2021)	Total DMF Collected (₹ crore) (2015–2025)
Andhra Pradesh	414	1.1	1,92,587	0.630	4	2,622
Chhattisgarh	8,839	22.8	1,20,704	0.605	27	14,768
Goa	98	0.3	4,72,070	0.751	4	243
Gujarat	252	0.6	2,41,930	0.638	10	1,908
Jharkhand	2,791	7.2	84,059	0.589	35	17,330
Karnataka	2,542	6.5	2,65,623	0.667	4	6,228
Madhya Pradesh	1,488	3.8	1,21,594	0.596	23	9,574
Maharashtra	305	0.8	2,15,233	0.688	9	7,257
Odisha	17,948	46.3	1,28,181	0.597	27	61,625
Rajasthan	3,676	9.5	1,35,962	0.638	30	11,196
Tamil Nadu	179	0.5	2,42,253	0.686	2	1,787
Telangana	225	0.6	2,70,839	0.647	10	3,987
India	38,841	100.0	1,48,524	0.633	–	2,58,064

Source: Ministry of Mines (2023); Reserve Bank of India (2023); Global Data Lab (2025); NITI Aayog (2024); Ministry of Mines (2026).

Note: HDI = Human Development Index; SDG = Sustainable Development Goal; DMF = District Mineral Foundation.

The Norwegian *Government Pension Fund Global*, or Oil Fund, is an example of converting surplus revenues from the country's petroleum sector into capital. Currently one of the largest sovereign wealth funds with a market value of US\$ 1.4 trillion (translating to over US\$ 240,000 per capita), it was established in 1990 to protect the economy from oil price shocks and to manage the challenges of an ageing population (Norges Bank Investment Management, 2025). With its well-designed macroeconomic policies and strong political, economic, and judicial institutions, Norway may have avoided many of the ill effects of the resource curse and the Dutch disease (Larsen, 2006). Their approach demonstrates that natural resources can be managed sustainably, creating benefits for both present and future generations, and can serve as a framework for other nations to efficiently and equitably manage their natural resources (Sy, Arezki, & Gylfason, 2012). Mineral exploration can also contribute to intergenerational equity; these activities convert a country's unknown theoretical geological potential into a tangible, defined (albeit depletable) resource asset, thereby adding to the stock of capital available for future generations to manage and benefit from.

The resource curse need not be inevitable for India if the principle of intergenerational equity is followed. Policymakers must enable the conversion of untapped geological potential into economic assets through exploration and ensure that revenues from mining operations are utilised for long-term physical and human capital formation. Such conversion requires strategic thinking that prioritises long-term value generation over short-term revenue windfalls. With the substantial funds collected under DMFs (though plagued by a low utilisation rate of 20.7% as of the end of 2025), substantial investments can be made to improve community well-being, with a focus on education, skilling, healthcare, and infrastructure.

7. A Case for Responsible Mining in India

The adverse impacts of mining on communities and the environment need to be managed through better planning, including environmental impact assessments, environmental management systems, mine and post-closure plans, and simultaneous rehabilitation and closure plans (OECD, 2025). India has the potential to encourage mineral-led sustainable development with its vast geological potential, which

is especially important given that some of the poorest communities inhabit regions with significant mineral resources. In an industry as disruptive as mining, it is even more prudent for companies to ensure that they have the "SLO"—the ongoing acceptance of a company's practices by its employees, stakeholders, and the public. Policymakers must have access to relevant information to inform their decision-making, particularly in regions where there is a significant gap between the scale of mining and the level of development. The CSEP SMAI (Chadha et al., 2023) is one such study that highlights districts with mining production (or potential). It provides recommendations on where policy and regulatory attention could facilitate positive development.

Several challenges persist in India's mining sector. Some can be attributed to a lack of alignment with global good practices. For example, despite the efforts of the GSI and other exploration agencies, only 29% of India's OGP has been explored as of 2023. There is an urgent need to incentivise private and foreign players to utilise the vast mineral abundance optimally. Other policy issues that may need consideration include the high taxes and duties in the mining sector (FE Bureau, 2022), the peculiarities of the system of auctions to allocate mineral resources (Chadha & Sivamani, 2021), and the time companies incur in obtaining the relevant environmental and social clearances (Bansal & Kapoor, 2022). Additionally, regulators should enforce the laws governing the sector, including curbing illegal mining, ensuring operations adhere to prescribed safety and environmental standards, providing support to vulnerable communities to prevent exploitation, and verifying that mines are properly closed after operations cease.

Due to various barriers in the mining sector (some of which have been highlighted in this paper), India has historically struggled to attract substantial FDI. It has failed to increase its share even during global peaks in mining investment. Given that exploration and mining are highly capital-intensive and require advanced technologies to responsibly and efficiently extract available resources, the issue of inadequate financing needs to be addressed. Domestic investments alone may not be sufficient, especially for mining critical minerals, for which India lacks expertise. Unlike bulk commodities, critical mineral discoveries require long-term and high-risk capital investments for deep-seated exploration. Globally, junior explorers (smaller companies focused on the discovery and early development of new mineral

deposits) drive such exploration activities, but have been deterred by the lack of seamless transferability from the EL to a Mining Lease (Chadha, Sivamani, & Bansal, 2023b). India needs more than just publicly managed NMET to incentivise foreign private sector investments in exploration, which can bring not just technical expertise but also international good practices in responsible exploration and mining.

While India seeks to attract capital investments in the sector, this also poses a risk of failing to ensure that environmental and social safeguards are met. Aiming for faster clearance processes and operationalisation of mining assets could adversely impact the ability to gain the SLO from communities, thereby increasing the risk of project delays. The strategic pathway India must follow should not dilute standards to speed up new mining activities but should rather aim to implement mechanisms that de-risk new mining investments. For example, this could be achieved by working with communities in areas with high geological potential before any mining activities commence, helping to bring them on board for future projects at an earlier stage. If communities are informed about their rights, benefits, and risks to their livelihoods in advance, they would be better placed to become stakeholders in mining projects.

Various international organisations have been established to promote responsible mining, which policymakers can use to lay a framework for sustainable mineral development. The ICMM has its 10 principles for good practices in ESG requirements of mining companies; the Extractive Industries Transparency Initiative (EITI) aims to increase transparency in resource management; and the Initiative for Responsible Mining Assurance (IRMA) provides standards and assessments for social and environmental performance in mines.

Developing environmentally and socially responsible mining would help bring jobs and social development to these districts, generate fiscal gains for State governments and create linkages with downstream industries. These developments must ensure sustainable operations, including adherence to global practices and principles of community welfare and environmental protection.

8. Policy Recommendations

The Indian mining sector faces a plethora of challenges, which cannot be solved solely through individual regulatory amendments. While some of the reforms introduced in 2023–2025 have been vital steps, they have not yet led to large-scale foreign investment in the sector. Historically, the sector has been viewed from a resource and fiscal perspective, providing raw materials for industry and generating revenues for the State. The environmental and social safeguards have at times been seen as regulatory hurdles. A paradigm shift in strategic thinking is required to view mining activities as a broader source of economic and social development. Such norms entail creating an attractive mining policy environment, like those in Australia and Canada, to attract capital for domestic exploration. Simultaneously, the industry must earn its SLO by adopting international ESG standards, enabling mineral wealth to drive human development.

To bridge the existing gap between India's mineral ambitions and its current reality, strategic thinking is required to build a mining sector that accounts for all stakeholders' needs along the mining value chain, as highlighted across eight key enablers of an efficient, equitable, and responsible mining sector (Table 3) (Chadha & Sivamani, 2020).

Table 3: Eight Enablers of an Efficient, Equitable, and Responsible Mining Sector

Enabler	Sections in the Paper	Strategic Thinking
Economic catalyst	2	Raw ore should be processed domestically, particularly for critical minerals, enabling downstream integration and capturing the large multiplier effects within the country.
Local job creation	2	Human capital needs to be developed further, particularly in skilling. Pre-emptive skilling campaigns can be launched in areas with high geological potential, enabling local communities to find employment opportunities in the mining sector.
Environmental sustainability	3	Environmental and mine closure norms must be strengthened and better enforced.
Welfare of communities	3, 7	Local communities must be made active stakeholders in the mine's business operations and be provided a fair share of the benefits. Such inclusion will help increase trust and gain the SLO.
Fiscal viability	4	The high taxes and statutory payments may deter further investments in the sector. Rationalising rates and matching them with international good practices can help make India more competitive globally. The State should get its fair share of returns without adversely impacting the business case for mining companies.
Globally competitive	4, 5	India must prioritise incentivising capital investments. There cannot be sole reliance on the State and domestic companies. The strategy must attract junior explorers and international mining companies by providing a seamless transfer of licences from exploration to mining.
Mineral security (21st century)	4, 7	There needs to be differentiated, fast-tracked policies to encourage the production of critical minerals, given their higher risks, capital requirements, and technology requirements.
Intergenerational equity	6	There needs to be a serious rethink of how royalties and DMF funds are utilised. By allocating some funds to long-term assets rather than spending them all now, future generations can also benefit from the mining activities underway today. Exploration may also be considered a form of intergenerational equity, as it uncovers assets for future use.

Source: Authors' summary comments.

Notes: DMF = District Mineral Foundation; SLO = social licence to operate.

Responsible mining practices must not be seen as a regulatory burden or ethical preference, but rather a prerequisite for India's domestic energy security. By imbibing these principles, mineral-rich states can avoid the burden of the resource curse, and India can

enable a just transition. Furthermore, by leveraging the high economic multipliers of the non-fuel mineral sector, India can ensure that the extraction of the raw materials required for the green transition also drives employment growth and inclusive development.

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About the authors

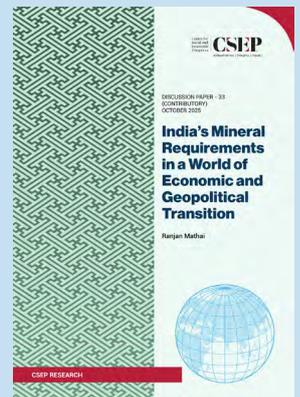
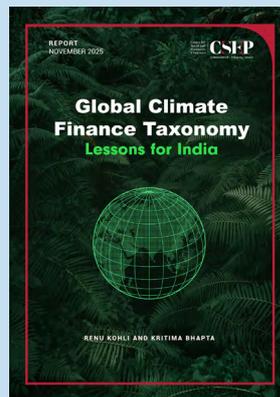
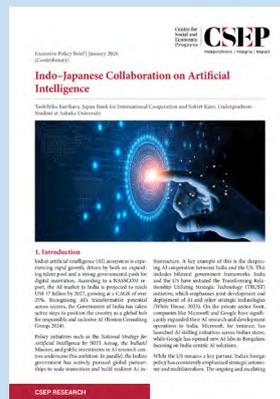
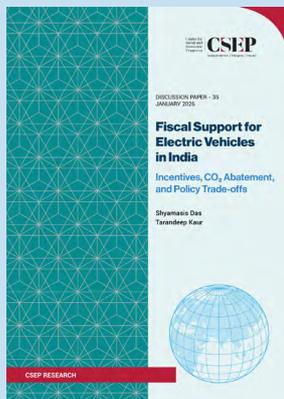
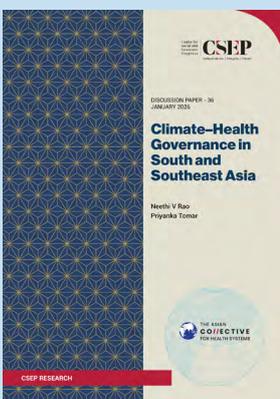
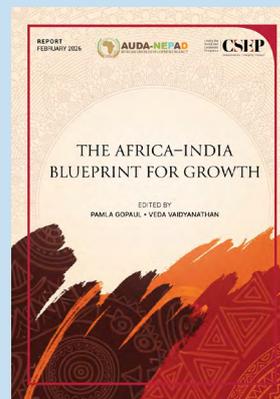
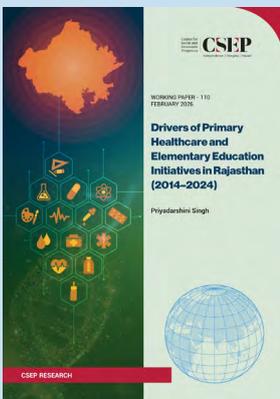
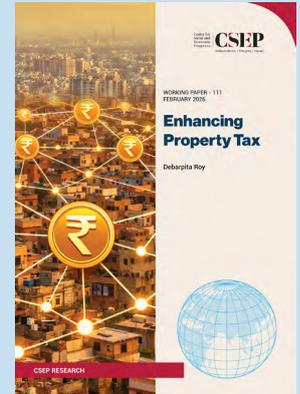
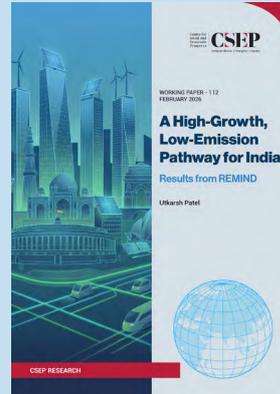


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