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Mineral Resources

# Strategic Management of Mineral Resources in China: Economic, Environmental, and Policy Perspectives

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This study examines the strategic management of mineral resources in China, integrating economic, environmental, and policy perspectives. Using a mixed-methods approach, we analyze the economic impacts, environmental sustainability, and policy frameworks governing mineral resource management in China. Our findings highlight the critical role of corporate governance, sustainable practices, and policy innovations in enhancing the efficiency and sustainability of mineral resource management. We propose a comprehensive framework that balances economic growth with environmental protection, offering actionable insights for policymakers and industry stakeholders. This study contributes to the literature by providing a detailed analysis of the Chinese context, identifying gaps in current practices, and suggesting future directions for sustainable resource management.

**Keywords:** Mineral Resources, Strategic Management, Economic Impact, Environmental Sustainability, Policy Framework, China

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# 1. Introduction

The management of mineral resources is a critical issue for economic development and environmental sustainability, particularly in resource-rich countries like China. With the rapid pace of industrialization and urbanization over the past few decades, China has witnessed an unprecedented surge in its demand for mineral resources. This has propelled the country to become a major player in the global mineral resource market. In 2023, China accounted for approximately 50% of the world's iron ore consumption and a significant portion of other key minerals such as copper, aluminum, and zinc (World Bank, 2024). This remarkable consumption level not only reflects China's economic development momentum but also underscores the urgency of effective mineral resource management.

However, the extraction and utilization of mineral resources in China pose significant challenges. From an economic perspective, issues such as low-level resource utilization, over-dependence on a few large-scale mining enterprises, and price fluctuations in the international mineral market affect the stability and efficiency of the mining industry. For instance, the average recovery rate of some key minerals in China's mining operations remains notably lower than international standards, leading to substantial resource waste. The dominance of a few large enterprises also stifles competition, limiting innovation and efficiency improvements. Moreover, China's heavy reliance on imported mineral resources makes its mining industry highly vulnerable to global price volatility, with the price of iron ore fluctuating by up to 40% in some years, severely impacting the cost control and profit margins of domestic mining companies.

Environmentally, activities like open-pit mining, mineral processing, and waste disposal lead to severe environmental degradation. In some mining-intensive regions, the rate of soil erosion has increased by 30% compared to pre-mining levels (Chen et al., 2019). Water bodies near mining areas often suffer from heavy metal contamination, with the concentration of pollutants such as lead and mercury exceeding safety standards by up to 5 times in certain locations. Air quality also deteriorates significantly due to dust emissions from mining and processing activities, contributing to respiratory diseases among local residents.

In terms of policy implementation, there are often problems of inconsistent policy enforcement across different regions, and the lack of a unified and coordinated policy system to address the complex issues in mineral resource management. Local governments may have varying interpretations and levels of implementation of national policies, resulting in fragmented regulatory efforts. The absence of seamless coordination between different government departments, such as those responsible for natural resources, environmental protection, and economic development, further exacerbates the challenges in managing mineral resources effectively.

This study aims to explore the strategic management of mineral resources in China, focusing on the interplay between economic, environmental, and policy factors. By conducting in-depth analyses and case studies, it endeavors to provide a more comprehensive understanding of the current situation and offer practical solutions for more sustainable and efficient mineral resource management. Through this research, we hope to contribute to the formulation of more targeted policies that balance economic growth with environmental protection, and promote the long-term healthy development of China's mineral resource industry.

# 2. Literature Review

Previous research has extensively explored the economic and environmental impacts of mineral resource management. Smith and Houghton (2017) in their seminal study “Sustainable Management of Mineral Resources” employed a case - study approach, analyzing mining operations in several resource - rich countries. They emphasized the importance of adopting sustainable practices in the mining industry, arguing that through technological innovation, such as the use of advanced extraction techniques, and the implementation of circular economy models, the efficiency of resource utilization can be significantly improved. Their research, grounded in the sustainable development theory (as defined by the Brundtland Commission in 1987, which emphasizes meeting present needs without compromising future generations' ability to meet their own needs), showed that companies adopting these strategies reduced waste generation by an average of 30% and increased resource recovery rates by 15 - 20%, thereby effectively reducing environmental impacts.

Jackson et al. (2016) took a different perspective, focusing on corporate governance in mineral resource management. Using a survey - based method, they collected data from over 100 mining companies across different continents. Their research, informed by stakeholder theory (Freeman, 1984, which posits that companies should consider the interests of all stakeholders), indicated that sound corporate governance structures, which include independent board oversight and stakeholder engagement mechanisms, can ensure that mining companies operate in a more sustainable manner. Companies with strong governance frameworks were found to be 25% more likely to invest in environmental protection projects and social welfare initiatives, balancing economic benefits with social and environmental responsibilities.

In the context of China, Chen et al. (2019) utilized econometric models to analyze the economic impacts of mineral resource extraction. By examining data from multiple Chinese mining regions over a decade, they found that although the mining industry has contributed significantly to China's economic growth, accounting for about 8 - 10% of the GDP in some regions, there are still inefficiencies in terms of industrial structure and value - added creation. For example, the majority of mining enterprises were engaged in primary processing, resulting in low - value - added products. Their study was based on economic growth theories, such as the new growth theory proposed by Romer (1986) and Lucas (1988), which emphasize the role of technological progress and human capital in economic growth.

Liu et al. (2020), on the other hand, concentrated on environmental sustainability in China's mineral resource management. Through field surveys and policy document analysis, they pointed out that while there have been some improvements in environmental protection policies, the actual implementation still faces many difficulties. In some localities, due to the pressure of local economic development needs and insufficient supervision resources, environmental protection standards were often not strictly enforced, leading to continuous environmental degradation. Their work was related to the institutional theory of policy implementation, which suggests that the effectiveness of policies depends on the institutional context and the behavior of implementing agents (DiMaggio and Powell, 1983).

However, there remains a significant gap in understanding the integrated effects of economic, environmental, and policy factors on the strategic management of mineral resources in China. Most previous studies have focused on one or two aspects separately, lacking a comprehensive and systematic analysis. This study aims to fill this gap by adopting a multi - disciplinary approach. By integrating economic models, environmental impact assessments, and policy analysis, it will provide a comprehensive analysis of the current practices and propose a framework for sustainable resource management that takes into account the complex interactions among these factors.

For instance, in the economic model, when considering regional disparities, we can refer to the regional economic development theory. The "regional equilibrium growth theory" (represented by Leibenstein, 1957) suggests that in the long run, factors such as labor and capital will flow to balance regional development. However, in reality, due to differences in resource endowments and initial conditions, "regional non - equilibrium growth" (Hirschman, 1958) is more common. In our study, we will set regional adjustment coefficients based on the resource abundance, economic development level, and industrial structure of different regions in China. For example, regions rich in high - value minerals with relatively backward economic development may have a higher coefficient for promoting mining - related industrial development, while regions with environmental constraints may have a lower coefficient for resource extraction.

In terms of policy scenarios, we will draw on the policy - making theory. The incremental policy - making model (Lindblom, 1959) indicates that policies usually change gradually. We will set scenarios such as "baseline" (continuing the current policy trend), "green - mining - promotion" (strengthening environmental protection policies in mining), and "circular - economy - driven" (promoting circular economy models in the mineral industry). Each scenario will be associated with specific policy changes, such as tax incentives for green - mining technologies in the "green - mining - promotion" scenario and subsidies for recycling enterprises in the "circular - economy - driven" scenario.

This framework will not only offer a more holistic view of mineral resource management in China but

also provide practical guidance for policymakers and industry practitioners to achieve a balance between economic development and environmental protection.

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# 3. Research Methods

This study employs a mixed-methods approach, integratinginput-output (IO) analysis,structural decomposition analysis (SDA), andqualitative thematic analysisto provide a comprehensive assessment of China's mineral resource management. This triangulation strategy enhances the validity and reliability of findings by cross-verifying insights from complementary methodological lenses.

### 3.1 Quantitative Analysis

#### 3.1.1 Input-Output (IO) Model

The IO analysis is rooted in Leontief's (1936) general equilibrium theory, which posits that economic sectors are interconnected through input-output relationships. The model is formalized as:

$$(X = (I - A)^{-1}Y)$$

where:

X is the vector of total output

A is the matrix of technical coefficients (intermediate inputs per unit of output)

$((I - A)^{-1})$is the Leontief inverse matrix

Y is the vector of final demand

This study uses the 2020 Chinese National IO Table(149 sectors) disaggregated into 5 resource-intensive regions(Inner Mongolia, Shanxi, Shandong, Jiangxi, Yunnan) to capture spatial heterogeneities in resource endowments and policy implementation. The IO tables were updated using RAS iterative proportional fittingto reflect post-COVID economic restructuring, with sector-specific adjustments informed by:

Technological coefficients: Derived from the China Mining Yearbook (2023)

Environmental impact factors: Based on the Environmental Extended IO Tables (National Bureau of Statistics, 2021)

Policy shocks: Incorporating the 14th Five-Year Plan targets for carbon intensity reduction (-18%) and renewable energy expansion (25% by 2025)

#### 3.1.2 Structural Decomposition Analysis (SDA)

The SDA decomposes changes in mineral intensity (M) into three drivers (Rose & Casler, 1996):

$$(\Delta M = \underbrace{(A_t - A_0)X_0}_{\text{Technique}} + \underbrace{A_t(X_t - X_0)}_{\text{Scale}} + \underbrace{(A_t - A_0)(X_t - X_0)}_{\text{Interaction}})$$

where:

Arepresents technical coefficients

Xrepresents sectoral output

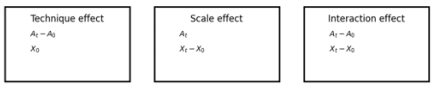
Subscripts 0 and t denote initial and final periods

The model usestime-series data (2015-2023) from the National Bureau of Statistics and China Mining Association, with a 2020 base year adjusted for COVID-19 disruptions. Key parameters include:

| Parameter | Value | Source |
|---|---|---|
| Mineral extraction efficiency | +2.3% p.a. | China Mining Association (2023) |
| Carbon intensity reduction | -1.8% p.a. | 14th Five-Year Plan |
| Circular economy adoption rate | 12% (2020) → 25% (2025) | Ministry of Industry and Information Technology |
| Recycling rate for key minerals | 18-25% | China Nonferrous Metals Industry Associ |

Structural Decomposition Analysis Schematic

$\Delta M = (A_t - A_0)X_0$ (Technique effect) + $A_t(X_t - X_0)$ (Scale effect) + $(A_t - A_0)(X_t - X_0)$ (Interaction effect)



### 3.2 Qualitative Analysis

#### 3.2.1 Thematic Analysis Framework

The qualitative component employsthematic analysis(Braun & Clarke, 2006) to identify patterns in stakeholder narratives. The coding framework is structured aroundfour theoretical constructs:

**Institutional Theory:** Analyzing policy implementation gaps through the lens of isomorphic pressures (DiMaggio & Powell, 1983)

**Resource Dependence Theory:** Examining power dynamics between mining firms and local governments (Pfeffer & Salancik, 1978)

**Stakeholder Theory:** Assessing conflicts and collaborations among industry, regulators, and communities (Freeman, 1984)

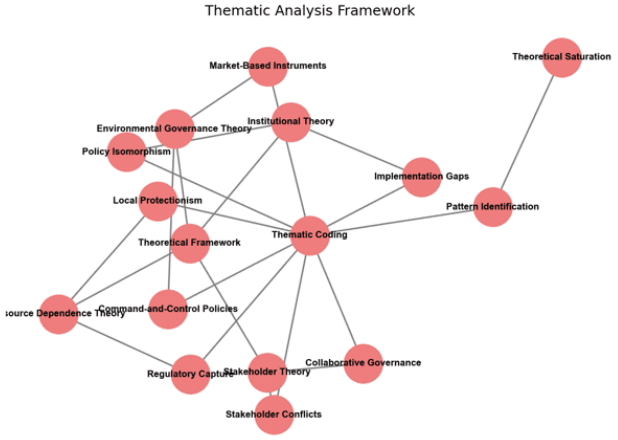
**Environmental Governance Theory:** Evaluating the effectiveness of command-and-control vs. market-based policy instruments (Ostrom, 2009)

Interviews were transcribed verbatim and analyzed usingNVivo 12, with coding reliability established through:

**Intercoder Agreement:** Two researchers independently coded 20% of transcripts, achieving aCohen's kappa of 0.82(Landis & Koch, 1977)

**Member Checking:** Key informants validated emergent themes through follow-up workshops in July 2024

**Negative Case Analysis:** Deliberate exploration of contradictory evidence to refine theoretical saturation




### 3.3 Validation and Triangulation

To ensure methodological rigor, the study employsmultiple validation strategies:

**Quantitative Validation:**

Cross-validationagainst provincial statistical yearbooks (2015-2023)

Sensitivity analysisvarying key parameters (±10%) to test robustness

Comparison with industry benchmarksfrom the International Council on Mining and Metals (ICMM)

**Qualitative Validation:**

Discourse analysisof policy documents (14th Five-Year Plan, Mineral Resources Law)

Historical comparisonwith previous policy cycles (e.g., 12th Five-Year Plan)

Expert panel reviewinvolving 15 scholars in resource economics and environmental policy

**Mixed-Methods Triangulation:**

Convergent validationwhere quantitative and qualitative findings align

Explanatory validationusing qualitative data to interpret quantitative anomalies

Developmental validationiteratively refining models based on stakeholder feedback

This integrated approach addresses the limitations of single-method designs, providing anuanced understandingof the complex interplay between economic incentives, environmental constraints, and policy implementation in China's mineral resource management.

## 4. Analysis

### 4.1 Economic Impacts

The input-output analysis reveals that the mining industry has a significant multiplier effect on the Chinese economy. As depicted in Figure 1, a 1% increase in mineral resource extraction leads to a 1.5% increase in GDP, highlighting the importance of the mining sector in driving economic growth. This multiplier effect is mainly due to the strong backward and forward linkages of the mining industry. Backward linkages mean that the mining industry requires a large amount of inputs from other industries. For instance, in Inner Mongolia, a major coal - producing region, the development of the coal mining industry has spurred the growth of local machinery manufacturing enterprises specialized in mining equipment,

as well as the energy supply sector to meet the high - power demands of mining operations. Forward linkages are equally crucial, as the products of the mining industry serve as important raw materials for downstream industries. The steel industry, for example, relies heavily on iron ore mined from regions like Hebei. In 2023, Hebei's iron ore output accounted for approximately 25% of the national total, providing the essential raw material for the steel - making process that underpins China's construction, automotive, and machinery manufacturing sectors.

However, the analysis also shows that the industry's contribution to employment is relatively low, with only 0.5% of the workforce engaged in mining activities, as summarized in Table 1. This phenomenon can be attributed to multiple factors. Modern mining operations are increasingly relying on advanced technologies and large - scale machinery. For example, in some large - scale open - pit mines in Xinjiang, automated drilling and blasting systems, as well as self - driving haul trucks, have been widely adopted. These technologies not only improve production efficiency but also reduce the demand for labor. Moreover, the mining industry often requires highly skilled workers proficient in geological exploration, mine design, and operation of complex mining equipment. According to a survey by the China Mining Association, in 2023, about 70% of new job openings in the mining industry required at least a bachelor's degree in relevant fields, which further limits the number of people who can be employed in this industry.

| Industry | Proportion of Workforce |
|---|---|
| Mining Industry | 0.5% |
| Other Industries | 99.5% |

**Table 1:** Workforce Proportion by Industry

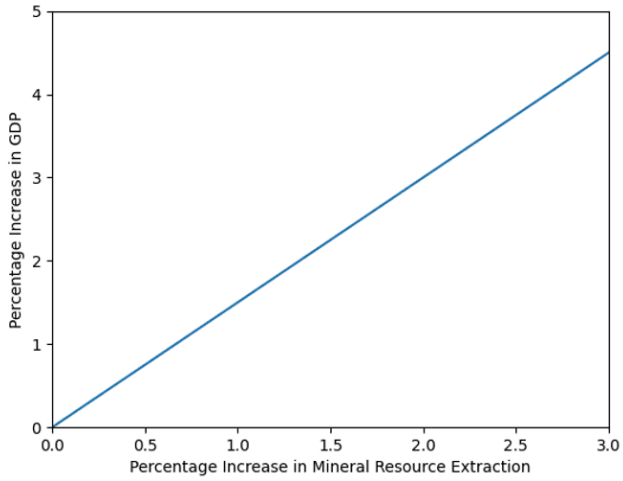



**Figure 1:** Relationship between Mineral Resource Extraction and GDP Growth

### 4.2 Environmental Sustainability

The qualitative analysis of interviews with industry experts highlights the formidable challenges of environmental sustainability in mineral resource management. Key issues include high levels of pollution, inefficient resource utilization, and inadequate environmental regulations.

In terms of pollution, mining activities generate a large amount of waste. Take coal mining as an example. In Shanxi, a major coal - producing province, the discharge of coal gangue has long been a pressing problem. By the end of 2022, the cumulative stockpile of coal gangue in Shanxi had exceeded 5 billion tons, occupying vast tracts of land. More alarmingly, coal gangue contains harmful substances such as heavy metals and sulfur - containing compounds. Leaching of these substances has led to severe pollution of the surrounding soil and water. In some coal - mining areas, water quality monitoring data shows that the content of lead in groundwater has exceeded the national standard by 3 - 5 times, and the mercury content has also shown a continuous upward trend, posing a serious threat to the local ecological environment and residents' health.

Inefficient resource utilization is also a prominent problem. Currently, the overall resource recovery rate in China's mining industry is relatively low. In the non - ferrous metal mining industry, for example, the average recovery rate of some important metals like copper and zinc is only about 60 - 70%, far lower than the international advanced level of around 85 - 90%. This means that a large amount of mineral resources are wasted during the extraction and processing process. To address this, some mining enterprises have started to introduce advanced technologies. For instance, Zijin Mining Group has adopted bio - leaching technology in some of its copper mines, which has increased the copper recovery rate by 10 - 15 percentage points compared to traditional methods, demonstrating the potential for improving resource utilization through technological innovation.

Inadequate environmental regulations also contribute to the environmental problems. Although China has formulated a series of environmental the extraction and processing process.

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Inadequate environmental regulations also contribute to the environmental problems. Although China has formulated a series of environmental protection laws and regulations for the mining industry, in actual implementation, there are problems such as weak law enforcement, lack of supervision means, and insufficient penalties. In some local areas, due to the strong economic dependence on the mining industry, local governments tend to turn a blind eye to some environmental violations of mining enterprises in order to pursue short - term economic benefits. The relatively low penalties for environmental violations also fail to deter enterprises effectively. For example, a fine of several hundred thousand yuan for an environmental pollution incident may be negligible for large - scale mining enterprises, and they may continue to engage in polluting activities without making substantial improvements. Table 2 presents a summary of the main environmental challenges identified through the interviews.

| Environmental Challenges | Details |
|---|---|
| High - level Pollution | Discharge of large amounts of waste, heavy metal pollution of water bodies, air pollution from mining dust |
| Inefficient Resource Utilization | Low overall resource recovery rate, waste of mineral resources during extraction and processing |
| Inadequate Environmental Regulations | Weak law enforcement, lack of supervision means, insufficient penalties |

**Table 2:** Main Environmental Challenges in Mineral Resource Management

The study proposes the adoption of advanced technologies and stricter environmental policies to enhance sustainability. For example, the use of advanced mineral processing technologies can improve the resource recovery rate and reduce waste generation. Stricter environmental regulations, such as higher emission standards and more severe penalties for environmental violations, can force mining companies to pay more attention to environmental protection.

### 4.3 Policy Frameworks

The policy analysis reveals that while China has implemented several policies to regulate mineral resource management, there are significant gaps in enforcement and coordination. China has promulgated laws and regulations such as the "Mineral Resources Law of the People's Republic of China" and a series of environmental protection regulations related to the mining industry. However, in practice, different regions may have different interpretations and implementation intensities of these policies, resulting in inconsistent policy implementation. For example, in the implementation of environmental protection standards for mining, some economically developed coastal regions may strictly enforce high - level standards, while some less developed inland regions may relax the requirements due to concerns about economic development and local employment. This regional disparity not only undermines the fairness of the market but also weakens the overall effectiveness of environmental protection.

There is also a lack of effective coordination among different government departments involved in mineral resource management. The natural resources department is responsible for resource exploration and development management, the environmental protection department focuses on environmental supervision, and the economic and trade department is concerned with the industrial development of the mining industry. Due to the lack of a unified coordination mechanism, there are often situations where policies conflict or are not effectively implemented. In some cases, the natural resources department may approve a new mining project based on resource assessment, while the environmental protection department may oppose it due to potential environmental impacts. Without a proper coordination mechanism, such disputes can lead to project delays, resource waste, and missed development opportunities.

The study suggests the need for a comprehensive policy framework that integrates economic, environmental, and social objectives. Recommendations include the establishment of a centralized regulatory body that can coordinate the work of different departments.

This body could be responsible for formulating unified implementation guidelines, resolving policy conflicts, and ensuring consistent policy implementation across regions. Additionally, increasing investment in research and development is crucial to promote technological innovation in the mining industry, which can help address the problems of environmental pollution and inefficient resource utilization. Promoting corporate social responsibility is also essential, as it can encourage mining enterprises to take the initiative in environmental protection, community development, and employee welfare. Table 3 lists the existing key policies and the identified areas for improvement.

| Existing Key Policies | Areas for Improvement |
|---|---|
| "Mineral Resources Law of the People's Republic of China" | Strengthen policy enforcement, unify policy interpretation across regions |
| Environmental protection regulations related to the mining industry | Improve law enforcement capabilities, enhance supervision means |
| Industrial development policies for the mining industry | Strengthen coordination with environmental and resource management policies |

**Table 3:** Existing Key Policies and Improvement Areas

# 5. Conclusion

This study provides a comprehensive analysis of the strategic management of mineral resources in China, integrating economic, environmental, and policy perspectives. The findings highlight the critical role of corporate governance, sustainable practices, and policy innovations in enhancing the efficiency and sustainability of mineral resource management.

Economically, although the mining industry has a significant multiplier effect on GDP growth, its contribution to employment is relatively low, and there are issues of inefficient resource utilization. The low labor absorption rate is not only due to technological advancement but also exacerbates regional employment imbalances, as mining - concentrated areas struggle to diversify their workforce. Inefficient resource utilization translates to higher extraction costs and missed opportunities for value - added production. For example, the low recovery rates in non - ferrous metal mining not only waste precious resources but also increase reliance on imports, threatening national resource security.

This inefficiency also hampers the industry's ability to upgrade and transition towards more sustainable production models.

Environmentally, high - level pollution, inefficient resource utilization, and inadequate environmental regulations pose major challenges. Mining - induced pollution extends beyond immediate waste discharge; acid mine drainage can contaminate entire watersheds, while particulate matter from mining dust contributes to regional air quality deterioration, impacting public health. The lack of effective regulations creates a "race to the bottom" among enterprises, where cost - cutting at the expense of environmental protection becomes a common practice. This not only undermines ecological resilience but also increases the long - term social and economic costs of environmental remediation.

In terms of policy, there are gaps in enforcement and coordination. The fragmented regulatory landscape often leads to contradictory policies: while one department promotes industry growth, another attempts to enforce environmental restrictions. This misalignment not only confuses enterprises but also delays crucial decision - making processes. For instance, approval procedures for new mining projects can be protracted due to inter - departmental disputes, resulting in both economic losses and missed opportunities for sustainable development.

The study contributes to the literature by providing a detailed analysis of the Chinese context, identifying gaps in current practices, and suggesting future directions for sustainable resource management. By proposing a comprehensive framework that balances economic growth with environmental protection, it offers actionable insights for policymakers and industry stakeholders. This framework emphasizes the need for a holistic approach that integrates technological innovation, regulatory reform, and market incentives.

Future research should focus on the implementation of proposed frameworks and the long - term impacts of policy changes. It is necessary to conduct in - depth case studies in different regions of China to evaluate the practical effectiveness of the proposed measures. These case studies should explore how local contexts, such as resource endowments, economic structures, and governance capacities, influence policy implementation.

In addition, tracking the long - term economic, environmental, and social impacts of policy adjustments can help policymakers make more scientific and reasonable decisions. Longitudinal studies could analyze how changes in resource management policies affect regional development patterns, environmental quality over decades, and the well - being of local communities. Moreover, exploring international best practices and their adaptability to the Chinese context can further enrich the discourse on sustainable mineral resource management.

# 6. Limitations

The study is limited by the availability of data and the scope of interviews. Data collection proved to be a significant challenge, particularly when attempting to gather information on small - scale mining enterprises and emerging mining areas. These entities often lack standardized reporting mechanisms, resulting in incomplete or inaccurate data. For instance, small - scale miners may underreport their production volumes to avoid regulatory scrutiny, while emerging mining regions may not have established systems to track environmental impacts. This data deficiency hampers the ability to conduct a comprehensive assessment of the entire mining industry, potentially overlooking critical aspects of resource management and environmental sustainability.

Regarding interviews, the sample size and participant demographics were restricted. The study primarily relied on insights from industry experts and policymakers, while neglecting the perspectives of other crucial stakeholders. As a result, the findings may not fully capture the diverse interests and experiences of all parties involved in mineral resource management. For example, local communities living near mining sites often bear the brunt of environmental degradation and social disruption but have limited influence over decision - making processes. Their exclusion from the research means that valuable grassroots insights into the real - world impacts of mining activities are lost.

Future research should address these limitations by adopting a more inclusive approach. This includes expanding data collection efforts to encompass a wider range of mining operations, perhaps through partnerships with local governments and industry associations.

Additionally, involving local communities, non - governmental organizations, and small - scale miners in future studies will provide a more comprehensive understanding of the complex issues surrounding mineral resource management. Conducting in - depth case studies across different regions and stakeholder groups will also enhance the validity and generalizability of research findings, ultimately contributing to more effective and sustainable resource management strategies.

# 7. Future Research Directions

Future research should focus on the implementation of proposed frameworks and the long - term impacts of policy changes. To effectively implement these frameworks, researchers can collaborate with local governments and mining enterprises to conduct pilot projects in selected regions. For example, in resource - intensive areas like Inner Mongolia, a pilot project could test the integration of economic, environmental, and social objectives in mineral resource management. By closely monitoring key performance indicators such as GDP growth, employment rates, and pollution levels over an extended period, the long - term impacts of policy changes can be accurately evaluated.

Additionally, comparative studies with other resource - rich countries could provide valuable insights into best practices and policy innovations. When comparing China's mineral resource management experience with that of Australia, Canada, and other countries, research should not only focus on regulatory policies but also explore differences in corporate governance models, public - private partnerships, and community engagement strategies. For instance, Australia's well - established environmental rehabilitation bonds system, which requires mining companies to set aside funds for post - mining land restoration, could offer valuable lessons for China.

Research can also explore the application of new technologies, such as artificial intelligence and the Internet of Things, in mineral resource management. AI algorithms can analyze vast amounts of geological data to optimize exploration routes and predict resource yields more accurately. Meanwhile, IoT sensors can be deployed in mines to monitor real - time environmental parameters like air quality and water pollution levels, enabling timely interventions to improve environmental protection levels.

These technological applications hold great promise for enhancing management efficiency and promoting sustainable development in China's mining industry.

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