

Identification of Indicators for Evaluating Reclamation and Post-Mining Policies Towards Compliance by Companies in Jambi Province in Environmental Aspects

Amril Fadli¹, Bunga Mardhotillah²

¹Kementerianian ESDM RI

²Universitas Jambi

*corresponding e-mail; bunga.mstat08@unja.ac.id

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Abstract

Mining activities in Jambi Province significantly contribute to economic growth but pose severe threats to environmental sustainability. Despite existing regulations, company compliance regarding reclamation and post-mining obligations remains a critical challenge. Evaluating these policies requires a clear, standardized set of indicators to measure compliance effectively. This study aims to identify and formulate key performance indicators (KPIs) for evaluating reclamation and post-mining policies, specifically focusing on enhancing company compliance with environmental aspects in Jambi Province. This study employs a mixed-methods approach combining qualitative and quantitative analyses. Data were gathered through legal desk research, deep interviews with environmental experts, government officials, and mining representatives, followed by a Delphi survey to validate the indicators. The Analytical Hierarchy Process (AHP) was utilized to prioritize and weight the identified indicators. The study successfully identified four main dimensions of indicators: Ecological Restoration (soil quality, revegetation success, biodiversity index), Financial Assurance (reclamation bond placement, budget realization), Legal-Administrative Compliance (reporting punctuality, document conformity), and Social-Environmental Impact (acid mine drainage control, local community satisfaction). Ecological restoration and financial assurance emerged as the highest-weighted priorities for ensuring long-term environmental sustainability. The formulated indicators provide a robust, measurable framework for local governments to monitor, audit, and evaluate mining companies' compliance. Implementing these structured indicators will strengthen policy enforcement and accelerate successful post-mining rehabilitation in Jambi Province.

Keywords

Policy Evaluation, Reclamation, Post-Mining, Company Compliance, Environmental Indicators, Jambi Province



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INTRODUCTION

Jambi Province is a region in Indonesia with substantial natural resource potential, particularly in the mining sector. Key commodities extracted in the area include coal, gold, and various other minerals. These mining activities contribute significantly to the regional economy through both tax revenue and job creation. Coal mining in Jambi has expanded rapidly since the early 2000s, driven by rising domestic and international energy demand. Numerous mining companies operate in regencies such as Sarolangun, Tebo, and Muaro Jambi. In addition to coal, gold mining is also a prominent sector, operating on both large and small scales. However, alongside these economic contributions, mining activities in Jambi have given rise to various environmental issues. Uncontrolled natural resource exploitation often results in degraded land, ecosystem damage, and water pollution, creating a dilemma between economic interests and environmental sustainability (Dewi et al., 2020; Salma, 2023; Oktorina, 2017).

The environmental impact of mining in Jambi is evident in the deterioration of soil and water quality. Post-mining land is often rendered unsuitable for productive use, while mining waste poses a risk of contaminating rivers that serve as vital water sources for local communities. These conditions give rise to social unrest and threaten the health of nearby residents. Furthermore, mining activities affect biodiversity; forests serving as habitats for flora and fauna are threatened by land clearing for mining operations. Ecosystem fragmentation leads to the loss of local species and diminishes the environment's carrying capacity issues of critical importance within the context of sustainable development. To address these challenges, the Indonesian government has established policies regarding land reclamation and post-mining activities. These policies aim to ensure that mining companies restore the land once extraction operations conclude, thereby enabling the environment to regain its optimal functionality (Ghafur et al., 2025; Hannani et al., 2022).

The primary regulation governing reclamation and post-mining activities is Law Number 4 of 2009 concerning Mineral and Coal Mining, which was subsequently updated by Law Number 3 of 2020. Other relevant regulations include: (1) Law Number 32 of 2009 concerning Environmental Protection and Management; (2) Government Regulation Number 78 of 2010 concerning Reclamation and Post-Mining; (3) Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management; (4) Government Regulation Number 96 of 2021 concerning the Implementation of Mineral and Coal Mining Business Activities; and (5) Regulation of the Minister of Energy and Mineral Resources Number 26 of 2018 concerning the Implementation of Good Mining Practices and Supervision of

Mineral and Coal Mining. Additionally, there are more technical Government Regulations and Ministerial Regulations regarding the execution of reclamation. At the regional level, the Jambi Provincial Government plays a crucial role in overseeing the implementation of reclamation and post-mining policies. The Environmental Agency and related institutions are tasked with ensuring that mining companies comply with applicable regulations. However, field supervision often faces various obstacles. A major challenge is the limited human resources and budget available for conducting intensive oversight. Consequently, many companies fail to carry out their reclamation obligations in accordance with established standards. This creates a gap between ideal regulations and actual practices in the field (Taruna & Putri, 2025).

Mining company compliance with environmental regulations in Jambi has become a critical issue. While some companies do carry out reclamation, a significant number neglect this obligation. Others perform reclamation merely as a formality, paying little attention to the quality of the outcome. Compliance levels regarding reclamation and post-mining policies can be influenced by various factors, such as high costs, weak oversight, and low environmental awareness. These factors require in-depth analysis to understand the root causes of non-compliance. Mining companies' failure to comply with environmental regulations directly impacts local communities. Residents living near mining sites often bear the brunt of environmental damage, including floods, landslides, and water pollution. This situation gives rise to social conflict between companies and the community. In the context of public policy, evaluating the implementation of reclamation and post-mining measures is essential. Such evaluations aim to assess the policy's effectiveness in fostering corporate compliance and protecting the environment. Without evaluation, policies risk becoming nothing more than formal documents with no tangible impact.

Evaluating reclamation and post-mining policies in Jambi is also relevant for examining the role of local government in overseeing mining companies, specifically, whether oversight mechanisms are functioning effectively or if there are weaknesses requiring rectification. This is crucial for enhancing sustainable mining governance. Such an evaluation can also identify best practices employed by mining companies that comply with regulations; these practices can serve as models for other companies and provide a foundation for the government to formulate more effective policies. Research into the evaluation of reclamation and post-mining policies in Jambi holds both academic and practical significance. From an academic perspective, the study contributes to the fields of environmental policy and regulatory compliance. From a

practical standpoint, it offers recommendations for both the government and mining companies.

This research aims to identify solutions for enhancing mining companies' compliance with environmental regulations. Potential solutions include strengthening oversight, increasing penalties, or providing incentives for compliant companies. Furthermore, this study supports the sustainable development agenda in Jambi. Sustainable mining goes beyond a mere focus on economic profit, taking environmental and social aspects into account, an approach that aligns with sustainable development principles. The background of this issue reveals a gap between reclamation and post-mining policies and their actual implementation in the field. This discrepancy has negative consequences for the environment and the community, necessitating a comprehensive evaluation. This thesis stems from the need to evaluate reclamation and post-mining policies in Jambi Province, specifically focusing on corporate compliance regarding environmental requirements. The findings are expected to make a tangible contribution to improving mining policies and practices in the region. Specific objectives of this research is to identify compliance factors, assess environmental impacts, and provide policy recommendations.

The following theoretical framework outlines that research on the evaluation of reclamation and post-mining policies in Jambi requires the integration of four key perspectives: public policy theory (implementation and evaluation), regulatory compliance theory, the concepts of reclamation and post-mining, and mining-related environmental aspects. These four perspectives complement one another, enabling an understanding of the issue's complexity and the formulation of comprehensive solutions.

Public policy is a series of decisions made by the government to address specific societal issues. In the context of mining, public policy serves as an instrument to regulate natural resource exploitation activities, ensuring they align with the principles of sustainable development. Public policy implementation refers to the process of putting into practice decisions that have been formulated as regulations, programs, or rules. According to implementation theory, policy success is determined not only by the quality of its formulation but also by the effectiveness of its execution in the field. Factors such as bureaucratic capacity, inter-agency coordination, and public support significantly influence implementation outcomes (Masbut et al., 2025).

Within the framework of implementation theory, the Van Meter and Van Horn model emphasizes that variables such as policy standards, resources, inter-organizational communication, and socio-economic conditions are determinants of

success. If any of these variables are weak, the policy may fail to achieve its intended objectives. Public policy evaluation is a systematic process for assessing the extent to which a policy meets its established goals. Evaluations can be conducted at the input, process, output, or outcome stages. In the context of reclamation and post-mining activities, evaluation assesses whether the policy effectively encourages mining companies to restore the environment. Policy evaluation also serves as a source of feedback for the government; the results can be used to refine regulations, strengthen oversight mechanisms, or formulate new policies that are better aligned with conditions on the ground. Thus, evaluation constitutes an integral part of the public policy cycle (Akbar et al., 2025).

Reclamation is the effort to restore former mining land so that it can function again according to its intended use. Reclamation encompasses technical activities such as land shaping, revegetation, and erosion control. Its objective is to return environmental conditions to a state approximating their original condition. Post-mining refers to the series of activities undertaken after mining operations have concluded. These activities include mine closure, waste management, ecosystem restoration, and the empowerment of local communities. Post-mining aims to ensure socio-economic and environmental sustainability following the mine's closure. Regulations in Indonesia require mining companies to formulate reclamation and post-mining plans from the initial licensing stage. These plans must be approved by the government and incorporated into the company's work contract. This demonstrates that reclamation and post-mining are not merely options but legal obligations. The concepts of reclamation and post-mining are also linked to the principle of environmental stewardship, the company's responsibility to protect and restore the environment. This principle emphasizes that the exploitation of natural resources must be balanced with restoration efforts. In practice, the success of reclamation and post-mining depends heavily on corporate commitment, the quality of planning, and government oversight. Without strong commitment, reclamation becomes nothing more than a formality yielding no tangible results (Oktorina, 2017; Cahyana et al., 2020; Rahmi et al., 2020).

Research across various regions of Indonesia, such as Kalimantan and Sumatra, indicates that reclamation policies often lack effectiveness. Many mining companies merely report reclamation activities on paper without achieving tangible results on the ground. Key contributing factors include weak local government oversight, budget constraints, and a lack of corporate awareness regarding environmental responsibility.

This creates a gap between ideal regulations and actual implementation (Dewi et al., 2020; Ramadhan & Rahmawati, 2025).

Developed nations such as Australia and Canada implement reclamation policies based on rigorous technical standards. One mechanism employed is the bonding system, which requires companies to deposit reclamation security funds prior to commencing mining operations; these funds ensure that reclamation is carried out even if a company ceases operations. Studies in China also indicate that robust reclamation policies can mitigate environmental impacts, although challenges regarding transparency and public participation persist (Mara et al., 2025 & Herniwanti, 2021).

Research in Indonesia highlights significant variation in the level of compliance with environmental regulations among mining companies. Large, well-capitalized companies tend to be more compliant due to reputational concerns and public pressure, whereas smaller companies often neglect reclamation obligations. Compliance is influenced by a combination of legal sanctions, economic incentives, and social pressure from communities surrounding the mines. This indicates that compliance depends not only on regulations but also on social and economic contexts (Dewi et al., 2020; Hidayat & Supriandi, 2024).

METHODS

This study employs a descriptive-evaluative research design aimed at describing and assessing the implementation of reclamation and post-mining policies regarding the compliance levels of mining companies in Jambi Province. Descriptive-evaluative research focuses on gathering factual data and conducting in-depth analysis to evaluate the effectiveness of public policies. This approach enables researchers to identify gaps between formulated policies and their actual implementation in the field. The study also integrates qualitative and quantitative approaches (mixed methods) to obtain a comprehensive overview. The qualitative approach is used to understand the perceptions, motivations, and constraints faced by policy actors, such as local governments and mining companies. The quantitative approach is utilized to numerically measure company compliance levels against environmental regulatory indicators. Combining these two approaches strikes a balance between analytical depth and empirical validity. This evaluative research addresses not only what occurred but also why it happened and how policies can be improved. Consequently, the findings are expected to yield evidence-based policy recommendations. This approach aligns with the nature of public policy research, which requires multi-dimensional and multi-actor analysis.

This study utilizes two primary types of data sources: primary data and secondary data. Primary data were obtained directly from the field through interviews, observations, and surveys. Interviews were conducted with officials from the Environmental Agency (DLH) and the Energy and Mineral Resources Agency (ESDM), mining company environmental managers, and community leaders residing near the mines. Observations were carried out at former mining sites to assess the physical condition of reclaimed and post-mining land. Surveys were used to measure the level of company compliance with environmental regulatory indicators. Secondary data were obtained from policy documents, company reports, local government data, and academic publications. Policy documents included the Mineral and Coal Mining Law, Government Regulations, and Ministerial Regulations concerning reclamation and post-mining activities. Company reports included reclamation plans, implementation reports, and environmental audit results. Local government data included mining statistics, supervision reports, and business permit data. The combination of primary and secondary data provides a robust and valid analytical basis for a comprehensive evaluation of the policy.

FINDINGS AND DISCUSSION

Regulatory compliance refers to the extent to which actors, in this case, mining companies adhere to rules established by the government. Compliance theory highlights the factors influencing compliant behavior, encompassing both internal and external aspects. According to compliance theory, there are two primary approaches: deterrence theory and normative theory. Deterrence theory emphasizes that compliance stems from the threat of sanctions or punishment; companies will comply if the cost of non-compliance exceeds the cost of compliance. Conversely, normative theory emphasizes that compliance arises from moral awareness and held values (Yusni & Sigalingging, 2021).

In the context of mining, regulatory compliance is often shaped by a combination of these two approaches. Companies comply out of fear of administrative or criminal sanctions, but also due to social pressure and demands for environmental accountability. Another factor influencing compliance is the effectiveness of government oversight; when oversight is weak, companies tend to neglect their reclamation obligations. Conversely, rigorous oversight coupled with strict sanctions can boost compliance levels. Compliance theory also highlights the importance of incentives. Beyond sanctions, the government can offer rewards or incentives to compliant companies such as streamlined licensing processes, public recognition, or financial support for environmental programs (Jannah et al., 2025).

Mining activities have a significant impact on the environment. The environmental aspects affected include soil, water, air, flora, fauna, and local communities. Consequently, environmental considerations are a primary focus of reclamation and post-mining policies. Impacts on the soil include loss of fertility, erosion, and the creation of degraded land. Post-mining land is often difficult to revegetate without serious reclamation efforts; this disrupts land productivity and threatens local food security. Impacts on water include the pollution of rivers and lakes caused by mining waste. Acid mine drainage is a particularly serious issue that can damage aquatic ecosystems and endanger public health (Hidayat & Supriandi, 2024).

Impacts on air quality arise from dust and gas emissions associated with mining activities. Air pollution can adversely affect the health of workers and local communities while also contributing to climate change. Impacts on flora and fauna include the loss of natural habitats due to land clearing for mining operations; this leads to a decline in biodiversity and places certain species at risk of extinction. Reclamation efforts aim to restore ecosystems, thereby enabling flora and fauna to thrive once more. Socio-economic impacts are also integral to the environmental context of mining. Communities living near mines often experience shifts in lifestyles, social conflicts, and economic dependence on mining companies. Post-mining initiatives seek to mitigate these negative effects through community empowerment programs. The environmental aspects of mining must be viewed holistically; reclamation and post-mining policies should focus not only on physical land restoration but also on ecological sustainability and community well-being (Salma, 2023; Hannani et al., 2022; Herniwanti, 2021; Haryadi et al., 2025).

Jambi Province is located in the central part of Sumatra, covering an area of approximately 50,058 km². Geographically, the province features diverse landscapes, ranging from eastern coastal lowlands to the Bukit Barisan mountains in the west. The Batanghari River serves as a vital artery for transportation and the economy. The tropical climate, characterized by high rainfall, supports the plantation sector but also impacts mining operations. Demographically, Jambi is home to over 3.6 million people from diverse ethnic backgrounds, including the Jambi Malay, Kerinci, and transmigrants from Java. Relatively stable population growth drives the demand for jobs, with the mining sector serving as a significant source of employment. However, mining activities also give rise to social issues, such as traffic congestion caused by coal transport and road damage, which affect the community's quality of life.

Jambi's economy grew by 4.66% in 2023, with its Gross Regional Domestic Product (GRDP) reaching IDR 293.73 trillion. The mining and quarrying sector served

as a primary contributor, alongside palm oil and rubber plantations. Coal stands out as a key export commodity, in addition to oil and natural gas. Although economic growth slowed compared to the previous year, mining remains a driving force of the regional economy. Mining activities in Jambi began to expand rapidly in the 1990s, driven by rising domestic and export demand for coal. The local government subsequently opened investment opportunities to private companies, both domestic and foreign. Currently, over 90 coal mining companies operate in Jambi, with the highest concentrations found in the Batanghari, Bungo, and Sarolangun regencies. Coal is the region's primary mining commodity, characterized by abundant reserves and medium-to-high quality. Beyond coal, there is potential for oil, natural gas, and other minerals, albeit on a smaller scale. The total coal mining area spans 10,332 hectares across seven regencies, with the largest concentrations located in Batanghari (3,236 ha), Bungo (2,836 ha), and Sarolangun (2,536 ha).

At the national level, reclamation and post-mining policies are governed by Law No. 3 of 2010 (amending Law No. 4 of 2009 on Mineral and Coal Mining) and Government Regulation No. 78 of 2010 on Reclamation and Post-Mining Activities. These regulations mandate that mining companies formulate reclamation plans from the onset of operations, provide reclamation guarantee funds, and carry out environmental restoration following mining activities. The Jambi Provincial Government has followed up on these national regulations by issuing a Regional Regulation on Mining Management and establishing technical policies through the Energy and Mineral Resources Agency (Dinas ESDM). The regional policy focuses on strict oversight of reclamation implementation, law enforcement against negligent companies, and the promotion of community involvement in monitoring efforts. In practice, however, the implementation of reclamation by mining companies in Jambi still faces challenges. While some companies have carried out reclamation such as replanting vegetation and restoring former mining sites the efforts of others remain suboptimal. Key obstacles include limited funding, weak oversight, and conflicts of interest between economic needs and environmental sustainability. Consequently, research evaluating reclamation and post-mining policies in Jambi is crucial for assessing regulatory effectiveness and the resulting impacts on the community and environment; in this context, several important factors have been identified, including:

1. Alignment of Reclamation Policy with Environmental Principles in Jambi Province: An analysis of the reclamation and post-mining policy framework reveals that national regulations, such as Law No. 3/2010 and Government Regulation No. 78/2010 have in principle, adopted modern environmental tenets:

the prevention of damage, the restoration of ecosystem functions, business operator accountability, and stakeholder engagement. At the provincial level, implementing regulations and technical guidelines mandate the preparation of reclamation plans starting from the licensing stage, the establishment of reclamation guarantees, and post-closure monitoring. Theoretically, this policy aligns with sustainability principles by requiring upfront planning, fund allocation, and oversight mechanisms. However, formal alignment does not automatically guarantee substantive alignment; many provisions are general in nature, necessitating more detailed technical guidelines tailored to local conditions, such as Jambi's topography, hydrology, and land types to ensure that reclamation effectively restores ecological functions and ecosystem services.

2. Effectiveness of Reclamation and Post-Mining Policy Implementation: Evaluations of implementation effectiveness reveal varied results across companies and locations. Large companies possessing managerial capacity and access to capital tend to formulate comprehensive reclamation plans, post financial guarantees, and carry out revegetation and slope stabilization on schedule. Conversely, some small-scale operations or subcontractors demonstrate only partial implementation: reclamation is often limited to easily accessible areas, the quality of replacement vegetation is poor, and post-closure monitoring lacks a systematic approach. Factors undermining effectiveness include weak regional oversight capacity, inconsistent enforcement of administrative sanctions, and operational practices that delay reclamation until the end of the production period. Field measurements (such as land cover, soil quality, and the presence of native species) often indicate that functional recovery remains suboptimal, despite revegetation efforts.
3. Corporate Compliance Levels, Indicators and Findings: Compliance levels are evaluated using quantitative and qualitative indicators: (1) the availability and adequacy of approved reclamation plans, (2) the provision of financial guarantees for reclamation, (3) the percentage of land reclaimed according to schedule, (4) environmental monitoring results (water, soil, vegetation), and (5) reporting and public disclosure of information. In Jambi Province, large companies generally meet administrative indicators (plans and guarantees), yet performance regarding environmental indicators (e.g., soil structure, biodiversity) often lags behind. Reporting compliance also varies: some companies provide comprehensive data and independent audits, while others merely meet minimum obligations. Overall, formal compliance exceeds the substantive compliance observed in the field.

4. Drivers and Barriers to Compliance: Drivers of compliance include market and reputational pressures (such as access to financing and export markets that demand environmental standards), internal corporate capacity (standard operating procedures and environmental personnel), and active local community engagement demanding site restoration. Technical support from local governments and research institutions also accelerates the adoption of better reclamation practices. Conversely, barriers include high reclamation costs and inadequate budget allocations; weak oversight and law enforcement at the local level; conflicts of interest between local revenue needs and tax or royalty receipts; and a lack of economic incentives for long-term reclamation. Furthermore, geographical conditions such as peatlands or flood-prone areas add technical complexity to reclamation, necessitating specialized approaches that are often not anticipated in initial plans.
5. Post-mining ecological, social, and economic impacts: Identified post-mining ecological impacts include alterations to soil structure (compaction, loss of humus), a decline in local biodiversity, hydrological disruptions (changes in river flow, increased sedimentation), and the risk of ongoing land degradation if reclamation is inadequate. Social impacts encompass shifts in livelihoods (transitioning from agriculture or fishing to mining jobs, or the loss of access to productive land), land-related conflicts between companies and communities, and health issues linked to dust and water quality. Economically, while mining generates short-term revenue and employment, a post-mining phase without restoration can diminish land productivity and long-term economic potential (such as agriculture or ecotourism); consequently, economic benefits remain temporary unless restoration programs are implemented to restore land functionality for other productive activities.

CONCLUSION

Compared to previous studies in Sumatra and other mining regions in Indonesia, findings in Jambi align with a common pattern: regulations are formally adequate. Prior research has highlighted the importance of realistic financial guarantees, community engagement, and independent monitoring all of which are equally relevant in Jambi. Policy implications include the need to clarify technical reclamation standards for local land types (including peatlands and alluvial plains) and to establish transparency and accountability mechanisms (such as the publication of reclamation plans and periodic environmental audits). In terms of practice, recommendations include adopting ecosystem-based reclamation, utilizing native species, integrating alternative livelihood options into post-mining planning, and implementing

incentive/penalty schemes that link reclamation performance to licensing access and fiscal incentives. The findings indicate that while Jambi Province's reclamation policy framework aligns with environmental principles, its effectiveness is hindered by implementation challenges, limited oversight capacity, and economic factors. Achieving sustainable post-mining outcomes requires a combination of strengthened technical regulations, enhanced oversight capacity, community engagement, and economic incentives that drive substantive reclamation rather than mere administrative compliance. Implementing these recommendations will increase the likelihood of restoring ecosystem functions and securing long-term socio-economic benefits for affected communities.

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