Environmental Law in Mining Activities and Its Impact

Edy Lisdiyono[1, a)], Ema Nur Hayati[1, b)], Herlina Reza Maharani[1, c)]

[1]*Faculty of Law, Universitas 17 Agustus 1945, Semarang, Indonesia*

[a)] Corresponding author: edylisdiyono@untagsmg.ac.id
[b)] ema-nurhayati@untagsmg.ac.id
[c)] herlinarezamaharani@gmail.com

Abstract. Mineral and coal mining activities are strategic sectors that make a significant contribution to the national economy, but on the other hand have the potential to have a negative impact on the environment. This paper examines the environmental legal framework that governs mining activities in Indonesia and the impacts of their implementation. This paper uses a normative juridical method with a legislative approach, analyzing Law Number 32 of 2009 concerning Environmental Protection and Management and Law Number 3 of 2020 concerning Mineral and Coal Mining as the main legal instruments. The results of the study show that although regulations have regulated the obligations of mining business actors such as AMDAL, reclamation, and post-mining, implementation in the field still faces various obstacles. The impacts of mining activities include ecosystem damage, water and soil pollution, public health disturbances, and social conflicts. The problem is increasingly complex with the rampant practice of unlicensed mining which has reached more than 2,700 locations in Indonesia. Environmental law enforcement in the mining sector requires strong coordination between the central and local governments, the implementation of strict administrative and criminal sanctions, and continuous supervision to ensure that the principles of sustainable development can be realized. This paper recommends the need to strengthen the monitoring system, licensing transparency, and community participation in mining management to maintain a balance between the use of natural resources and the preservation of the environment for future generations.
Keyword: Environmental Law; Mining Activities; Environmental Impact; Sustainable Development.

1 Introduction

Indonesia possesses vast reserves of minerals and coal that have shaped its economic trajectory for decades. The extractive sector contributes substantially to national income, regional development, and employment opportunities. Mining revenues support infrastructure expansion and public spending, reinforcing the perception that mineral exploitation is indispensable for economic growth. Yet the same activities that generate prosperity also produce significant environmental and social costs that demand careful legal regulation[1].

Environmental law developed as a response to the realization that industrial expansion can damage ecosystems and threaten public health. Over time, it evolved into a distinct field of law dedicated to safeguarding natural resources and ensuring that development does not undermine ecological balance. In Indonesia, environmental law has become increasingly central to governance, especially in sectors with high ecological impact such as mining.

The constitutional mandate that natural resources be controlled by the state for the greatest prosperity of the people establishes both authority and obligation [2]. This principle requires the government to regulate mining activities in a way that secures economic benefits while protecting environmental integrity. State control is not merely administrative power; it embodies responsibility to manage resources sustainably and equitably [3].

Statutory frameworks reinforce this constitutional foundation. Environmental protection legislation outlines core principles such as sustainability, precaution, state responsibility, community participation, and the polluter pays doctrine. Mining legislation integrates these principles into sector-specific rules governing licensing, operational

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standards, reclamation duties, and post-mining obligations [4]. The structure of regulation reflects an attempt to harmonize economic policy with ecological preservation.

Despite comprehensive laws, implementation remains a persistent challenge. Regulatory overlap, inconsistent supervision, and limited institutional capacity weaken enforcement efforts. Economic interests often exert strong influence over decision-making processes, creating tension between growth targets and environmental safeguards. The gap between normative standards and actual practice raises questions about regulatory effectiveness.

Mining activities fundamentally alter landscapes [5]. Open-pit excavation removes vegetation, strips topsoil, and reshapes terrain on a massive scale. Underground operations also disturb geological structures and hydrological systems. These transformations can lead to soil instability, increased erosion, and long-term degradation of land productivity.Water contamination represents one of the most severe environmental risks associated with mining. Exposure of sulfide minerals to air and water generates acidic drainage that mobilizes toxic metals. Rivers and groundwater sources may become contaminated with substances that endanger aquatic life and human health. Sedimentation further reduces water quality and disrupts ecological balance [6].

Air pollution compounds these impacts. Dust particles from blasting and transportation spread into surrounding communities, affecting respiratory health. Heavy machinery emits gases that degrade air quality and contribute to climate change. Continuous exposure to such pollutants can impose lasting health burdens on nearby populations. The biological consequences of mining extend beyond immediate pollution. Deforestation and land clearing eliminate habitats for wildlife, fragment ecosystems, and reduce biodiversity. Species that rely on stable ecological conditions face displacement or extinction [7]. The loss of biodiversity diminishes ecological resilience and undermines environmental services essential for human survival.

Social impacts are equally complex. Land acquisition for mining projects often generates disputes, particularly where customary land rights are involved. Communities may experience displacement or changes in traditional livelihoods. While mining can create employment, benefits are not always distributed evenly, and economic disparities may widen. Public health concerns arise when environmental degradation intersects with daily life. Contaminated water sources, polluted air, and exposure to hazardous substances increase the risk of disease. Health effects may include respiratory disorders, neurological damage from heavy metals, and other chronic conditions. These outcomes demonstrate that environmental harm directly affects human welfare [8].

Preventive legal instruments play a crucial role in addressing these risks. Environmental impact assessment mechanisms require project proponents to evaluate potential ecological and social consequences before operations begin. This process encourages early identification of risks and the development of mitigation strategies. Proper implementation of assessment procedures is vital for informed decision-making. Licensing systems incorporate environmental approval as a prerequisite for business operations. Risk-based approaches aim to streamline procedures while maintaining safeguards [9]. Nevertheless, the integrity of the licensing process depends on transparency, accountability, and rigorous evaluation of environmental feasibility.

Reclamation obligations seek to restore land disturbed by mining activities. Companies are required to reorganize former mining sites, manage soil layers, and undertake revegetation efforts. Effective reclamation can reduce long-term environmental damage and support future land use. However, inadequate planning or weak supervision may result in abandoned sites that pose safety and ecological hazards. Post-mining responsibilities extend beyond immediate restoration [10]. Long-term monitoring and management are necessary to prevent ongoing pollution from acid drainage or residual waste. Sustainable closure planning helps mitigate the risk of economic decline in regions heavily dependent on extractive industries.

Financial guarantee mechanisms reinforce corporate accountability. By requiring companies to deposit funds for reclamation and post-mining activities, the legal system provides a safeguard against corporate default. These guarantees operationalize the principle that environmental costs must be borne by those who generate them. Enforcement mechanisms include administrative sanctions, civil liability, and criminal penalties. Administrative measures range from warnings to permit revocation. Civil remedies enable compensation and environmental restoration claims. Criminal provisions impose penalties for serious violations, underscoring the gravity of environmental offenses.

Illegal mining presents a serious obstacle to effective governance. Unlicensed operations often disregard environmental standards and evade regulatory oversight. Their proliferation intensifies ecological degradation and undermines legitimate enforcement efforts. Addressing this issue requires coordinated action and stronger monitoring systems. The principles of sustainable development provide a normative framework for balancing economic and environmental interests. Resource utilization must meet present needs without compromising the ability of future generations to meet their own. In the mining sector, this principle demands careful planning, strict compliance, and long-term environmental stewardship.

Community participation strengthens environmental governance by incorporating local perspectives into decision-making processes. Public consultation enhances transparency and promotes social legitimacy. Meaningful participation also increases the likelihood that environmental management measures address actual community concerns. A comprehensive evaluation of environmental law in mining must therefore consider legal design, institutional capacity, enforcement practices, and measurable ecological outcomes. The effectiveness of regulation depends not only on statutory clarity but also on political will and administrative competence. Ensuring sustainable mining requires an integrated approach that aligns constitutional mandates, legislative instruments, and practical enforcement with the overarching goal of environmental preservation and social justice.

2 Method

This research applies a normative juridical method to examine the regulation of environmental protection in mineral and coal mining activities in Indonesia [11]. The study focuses on the coherence, structure, and effectiveness of statutory provisions governing environmental management and mining operations. Legal norms are treated as the primary object of analysis, with emphasis on their formulation, hierarchy, and practical implications. The approach relies on statutory analysis as the central framework. Key legislation concerning environmental protection and mineral and coal mining forms the backbone of the examination. Constitutional provisions regarding state control over natural resources are reviewed to clarify the philosophical and legal foundations of mining governance. Statutory instruments are interpreted systematically to identify their regulatory scope and internal consistency.

The research also adopts a conceptual approach grounded in established principles of environmental law [12]. Concepts such as sustainable development, precaution, polluter pays, state responsibility, and community participation guide the analytical framework. These principles serve as benchmarks to assess whether mining regulations reflect internationally recognized environmental standards and contemporary legal theory. Primary legal materials constitute the main data source. These include the Constitution of the Republic of Indonesia, legislation on environmental protection and management, laws regulating mineral and coal mining, relevant government regulations, and ministerial decrees related to environmental impact assessment, reclamation, and post-mining obligations. Each instrument is examined in its authoritative text to avoid interpretative distortion.

Secondary legal materials complement the primary sources [13]. Scholarly books, peer-reviewed journal articles, and academic commentaries on environmental law and mining governance are used to enrich doctrinal analysis. These materials provide theoretical grounding and critical perspectives that support systematic evaluation of regulatory effectiveness. The research design incorporates a legislative approach to trace the evolution of mining and environmental regulation [14]. Amendments to mining law and regulatory reforms in environmental licensing are examined to understand shifts in policy direction. Attention is given to how recent reforms restructure licensing systems and redefine corporate obligations.

A qualitative analytical technique is employed to interpret legal norms [15]. Provisions relating to environmental impact assessment, environmental approval, reclamation, and post-mining guarantees are analyzed to determine their substantive requirements. The study evaluates how these mechanisms are intended to function within the broader regulatory system. The method includes comparative examination within the domestic legal framework. Overlapping provisions between environmental protection law and mining law are identified and analyzed to detect potential inconsistencies or regulatory fragmentation. This internal comparison highlights areas where coordination between legal instruments may require improvement.

Doctrinal interpretation is conducted using systematic and teleological methods. Systematic interpretation situates each provision within the broader legal structure, ensuring coherence with higher norms. Teleological interpretation considers the objectives of environmental protection and sustainable resource management embedded in the legislation. The research also evaluates enforcement mechanisms embedded in statutory law. Administrative sanctions, civil liability under strict liability principles, and criminal penalties are examined to assess their deterrent capacity. The analysis considers whether the structure of sanctions aligns with the severity of environmental harm associated with mining activities.

Legal obligations concerning reclamation and post-mining activities are examined in detail. The study reviews regulatory requirements for land restoration, financial guarantees, and long-term environmental monitoring. These obligations are assessed against theoretical standards of environmental accountability and restorative justice. Although the research is normative, it incorporates empirical references drawn from documented cases of environmental degradation linked to mining activities. These references are used to illustrate the practical implications of regulatory gaps and enforcement weaknesses. Empirical observations serve as contextual support for doctrinal critique.

The scope of the study is limited to mineral and coal mining within Indonesian jurisdiction. It does not extend to comparative international analysis, except where general environmental principles inform theoretical discussion. This delimitation ensures focused examination of national regulatory structures and their implementation challenges. Data analysis proceeds through classification, interpretation, and evaluation. Legal materials are categorized according to thematic areas such as licensing, environmental assessment, reclamation, and liability. Each category is examined systematically to identify strengths, weaknesses, and areas requiring reform.

Through this structured normative method, the research aims to provide a comprehensive assessment of the environmental legal framework governing mining activities. The methodological design ensures logical progression from constitutional principles to statutory provisions and enforcement mechanisms. By grounding analysis in established legal theories and current regulatory developments, the study offers a relevant and academically rigorous contribution to discourse on environmental law and extractive industry governance.

3 Result and Discussion

Indonesia has constructed a layered environmental legal framework intended to regulate mineral and coal mining activities through constitutional mandates, statutory instruments, and implementing regulations. The constitutional provision on state control over natural resources establishes a legal foundation that places mining governance within the broader objective of public welfare [16]. This constitutional orientation shapes subsequent legislation and affirms that resource exploitation must serve collective interests rather than narrow economic gain. Statutory regulation demonstrates a formal commitment to environmental protection. The Environmental Protection and Management Law sets out fundamental principles, including sustainability, precaution, polluter pays, state responsibility, and community participation. These principles function as normative standards that should guide every stage of mining activity, from exploration to post-mining closure [17]. The Mining Law integrates environmental obligations into licensing and operational requirements, reflecting an attempt to align sectoral regulation with environmental law.

Despite this structured framework, the findings indicate significant regulatory overlap between environmental legislation and mining-specific regulation [18]. Certain provisions concerning reclamation, post-mining obligations, and environmental approval appear in multiple instruments with varying levels of detail. This fragmentation creates interpretative uncertainty and weakens administrative coordination. The absence of harmonized guidelines often complicates implementation at the regional level. The licensing system reflects a shift toward risk-based business regulation, incorporating environmental approval as an integral requirement [19].

Environmental impact assessment remains a central preventive mechanism. In theory, no mining operation may proceed without prior evaluation of its ecological consequences. The study finds that this procedural safeguard is well-established in formal regulation but frequently undermined by inadequate review capacity and limited public oversight [20]. Environmental impact assessment documents are designed to identify significant environmental risks, propose mitigation measures, and outline monitoring strategies. The required components, including analytical frameworks, environmental management plans, and monitoring plans, provide a structured methodology for impact prediction and control. However, the quality of submitted assessments varies widely, and technical review bodies often face resource constraints that limit rigorous evaluation [21]. Reclamation and post-mining obligations represent a critical component of environmental accountability. Regulations require companies to restore disturbed land, manage topsoil, conduct revegetation, and ensure water management. The research shows that while reclamation planning is mandatory, implementation remains inconsistent. Several former mining sites remain inadequately restored, leaving open pits and degraded landscapes that pose ecological and safety risks.

Financial guarantee mechanisms are intended to secure compliance with reclamation duties. Mining companies must deposit funds to ensure restoration even in cases of insolvency or non-performance. Although this instrument embodies the polluter pays principle, practical challenges arise in calculating adequate guarantee amounts and ensuring that funds are sufficient to cover long-term restoration costs [22]. The environmental impacts identified in the study confirm that mining activities significantly alter physical and chemical components of the environment. Open-pit mining changes topography, increases erosion rates, and reduces soil fertility. Loss of topsoil undermines future land productivity and complicates ecological recovery efforts. Sedimentation in rivers and water bodies reflects downstream consequences of land disturbance [23].

Water pollution emerges as one of the most severe and persistent impacts. Acid mine drainage and heavy metal contamination affect both surface water and groundwater. Toxic elements such as mercury, arsenic, cadmium, and lead enter aquatic ecosystems and may accumulate in the food chain. The long-term persistence of these pollutants presents serious challenges for environmental remediation [24]. Air quality degradation also constitutes a measurable impact.

Dust generated from blasting and material transport spreads into surrounding communities, affecting respiratory health. Emissions from heavy machinery contribute to greenhouse gas accumulation and local air pollution. Monitoring obligations exist, yet enforcement varies depending on regional administrative capacity [25].

Biological impacts are evident through habitat destruction and biodiversity loss. Land clearing for mining eliminates forest cover and fragments ecosystems [26]. Endemic and endangered species face heightened vulnerability due to habitat disruption. Aquatic organisms suffer from water contamination and altered hydrological patterns. These ecological effects demonstrate that mining impacts extend beyond immediate extraction sites. The research highlights that environmental damage often produces social consequences. Communities living near mining areas encounter land disputes, reduced agricultural productivity, and loss of traditional livelihoods [27]. Although mining operations may create employment opportunities, economic benefits are not always equitably distributed. Social tension may arise where environmental costs outweigh perceived economic gains.

Public health implications further illustrate the depth of mining impacts. Exposure to contaminated water and air increases the risk of chronic illness [28]. Heavy metal accumulation in food sources can lead to neurological and systemic disorders. These health risks underscore the interconnected nature of environmental degradation and human welfare. Illegal and unlicensed mining presents an additional layer of complexity. The proliferation of unauthorized operations demonstrates weaknesses in regulatory oversight [29]. Such activities frequently disregard environmental safeguards, leading to uncontrolled pollution and land degradation. Enforcement against illegal mining requires coordinated action between central and local authorities.

Administrative sanctions are available to address regulatory violations. Written warnings, government coercive measures, permit suspension, and revocation form part of the enforcement toolkit. The study finds that these sanctions are sometimes applied inconsistently, reducing their deterrent effect. Effective enforcement depends on transparent procedures and political commitment [30]. Civil liability mechanisms strengthen environmental protection by allowing affected parties to seek compensation and restoration [31]. The principle of strict liability reduces the evidentiary burden for victims of environmental harm. This doctrinal approach reflects recognition that mining activities carry inherent environmental risk. Nevertheless, access to justice may be limited by procedural and financial barriers.

Criminal liability provisions provide the most severe form of sanction. Environmental crimes related to pollution, illegal disposal of hazardous waste, or failure to comply with environmental permits may lead to fines and imprisonment. Corporate entities and their managers can be held accountable. The deterrent potential of criminal law depends on effective investigation and prosecution. The study also reveals challenges in intergovernmental coordination. Decentralization policies distribute authority between central and regional governments. While local authorities play a key role in supervision, variations in administrative capacity lead to uneven enforcement. Clear division of authority and consistent standards are necessary to improve regulatory coherence.

Monitoring and reporting requirements aim to ensure continuous oversight of environmental performance. Mining companies must report on water quality, air emissions, soil conditions, and biodiversity indicators. However, data transparency and public accessibility remain limited in some regions. Strengthening monitoring systems would enhance accountability. The principles of sustainable development and precaution provide a theoretical foundation for evaluating regulatory performance. Sustainable development requires balancing present economic benefits with long-term environmental preservation. The precautionary approach mandates preventive action even where scientific certainty is incomplete. The findings indicate that these principles are formally embedded in law but not always fully realized in practice.

Community participation is recognized as an essential component of environmental governance. Public consultation during environmental impact assessment processes offers an avenue for local voices. Effective participation increases transparency and strengthens legitimacy. The research suggests that meaningful engagement remains uneven and requires institutional support. Long-term environmental consequences persist even after mining operations cease. Acid mine drainage and heavy metal contamination may continue for decades. Abandoned pits can pose safety hazards and serve as sources of ongoing pollution. Post-mining management therefore demands sustained monitoring beyond the operational lifespan of a project.

Economic dependence on mining also generates structural vulnerability. Regions heavily reliant on extractive industries may face economic decline when resources are depleted. Diversification strategies are necessary to mitigate the so-called resource curse. Environmental rehabilitation should be integrated with broader regional development planning. Overall, the results demonstrate that Indonesia possesses a comprehensive environmental legal framework for mining activities, yet practical implementation remains uneven. Legal principles are clearly articulated, and enforcement mechanisms exist across administrative, civil, and criminal domains. The central challenge lies in translating normative standards into consistent practice.

Strengthening regulatory coordination, enhancing supervision capacity, ensuring transparency in licensing, and reinforcing sanctions are critical steps toward more effective environmental governance. A coherent approach that integrates constitutional mandates, statutory obligations, and enforcement mechanisms is essential to achieve sustainable mining. The discussion confirms that legal reform alone is insufficient without institutional integrity and active community engagement to safeguard environmental sustainability and social justice.

4 Conclusion

Indonesia has established a comprehensive legal framework to regulate environmental protection in mineral and coal mining activities, grounded in constitutional mandates and reinforced by statutory instruments. Core principles such as sustainable development, precaution, polluter pays, and state responsibility are clearly embedded in national legislation. However, significant gaps persist between normative regulation and practical enforcement. Overlapping rules, limited institutional capacity, weak supervision, and inconsistent sanctions reduce the effectiveness of environmental governance. Environmental impact assessments, reclamation duties, and financial guarantees are formally required but not always implemented to their full potential. Mining activities continue to generate serious ecological, social, and public health impacts, including land degradation, water contamination, biodiversity loss, and community conflict. Long-term environmental risks remain even after mining operations cease. Strengthening regulatory coordination, improving transparency, enforcing strict liability and criminal accountability, and enhancing community participation are essential to ensure that mining contributes to economic development without compromising environmental sustainability and intergenerational justice.

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