Nickel mining on small islands and the conservation mandate: A regulatory review and policy analysis based on the Raja Ampat case study

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Abstract: Indonesia plays a strategic role in global mineral supply, but the expansion of mining into coastal–small-island areas demand governance that balances down streaming objectives with the conservation mandate. This article presents a regulatory review and policy analysis illustrated by the Raja Ampat case. The policy framework examined includes Government Regulation (PP) No. 25 of 2024, Ministry of Energy and Mineral Resources Regulation (Permen ESDM) No. 15 of 2024, and Ministerial Decree (Kepmen ESDM) No. 177.K/MB.01/MEM.B/2024. The analysis shows that: (i) licensing and enforcement instruments have been strengthened, as reflected in corrective actions against non-compliant permits; (ii) in small-island contexts with high conservation value, the principal risks stem from sedimentation and declining water quality, which affect coral-reef ecosystems and fisheries–tourism livelihoods; and (iii) the effectiveness of regulations is highly determined by consistency of implementation, data traceability, and public participation. Policy recommendations include indicator-based enforcement (quarterly inspections and an RKAB compliance dashboard), a sediment-focused “AMDAL+” environmental impact assessment for coastal–reef settings, synchronizing a “small-island/geopark” filter in WIUP/WIUPK designation, supply-chain transparency, and strengthening local economic alternatives that are compatible with conservation. The findings affirm that a balance between economic growth and ecosystem sustainability can be achieved through a combination of stringent licensing screening, adaptive monitoring, and transparent governance.

Keywords: mineral mining; small islands; conservation; environmental policy

1. Introduction

Indonesia, endowed with abundant natural resources, holds a strategic position in the global economy, particularly in mineral commodities such as nickel, copper, gold, and coal (Yang et al., 2025). The mining sector makes a substantial contribution to national revenue, export earnings, and employment (Lauer et al., 2025). However, behind these economic gains, mining activities often entail significant environmental consequences ranging from deforestation, water contamination, and coastal–coral degradation to the loss of ecosystem services which ultimately affect the well-being of local communities (Rasheed et al., 2025). An imbalance in the distribution of benefits and risks frequently arises when affected communities do not receive benefits commensurate with the ecological and social burdens they bear (Wang et al., 2025).

In response to these challenges, the Government of Indonesia has, in recent years, restructured its regulatory framework with a stronger emphasis on the conservation mandate a legal obligation to protect, maintain, and/or restore environmental values alongside

enhanced instruments for licensing and compliance monitoring. Key regulatory instruments include Government Regulation (PP) No. 25 of 2024 (amending PP No. 96/2021), Ministerial Decree of Energy and Mineral Resources (Kepmen ESDM) No. 177.K/MB.01/MEM.B/2024 (guidelines for the expansion of WIUP/WIUPK within a conservation framework), and Ministerial Regulation (Permen ESDM) No. 15 of 2024 (refining the RKAB mechanism). At the coastal and small-island level, Law No. 1 of 2014 reinforces the principles of protection and precaution in granting or extending mining permits within vulnerable and high-conservation-value areas.

To illustrate the tension between economic downstreaming and ecological protection, this article presents Raja Ampat as a case study. The region represents a globally significant tropical marine ecosystem of exceptional sensitivity, where any extractive activity requires rigorous assessment of cross-ecosystem risks and integrated coastal–coral management (Alo et al., 2025). Recent developments in licensing demonstrate notable dynamics in enforcement and supervision, including corrective actions taken by the government against several nickel permits and the tightening of monitoring requirements for those still in operation (Masuku et al., 2025). These developments suggest that regulatory effectiveness depends not only on the strength of written norms but also on the consistency of their implementation in practice covering RKAB compliance, inspections, sanctions, and transparency in reclamation and post-mining activities.

This paper constitutes a regulatory review and policy analysis supported by the illustrative case of Raja Ampat rather than empirical fieldwork. The analysis draws upon legal frameworks, government documents, scientific publications, and credible third-party reports. Within this design, the paper aims to: (i) examine the alignment between the conservation mandate particularly for small islands and strategic mineral mining policies; (ii) identify implementation gaps within licensing and monitoring instruments; and (iii) propose actionable policy recommendations to enhance operational effectiveness.

2. Methods

This study employed a qualitative–descriptive approach that combined regulatory review and policy analysis to evaluate the implementation of the conservation mandate within Indonesia's mineral mining governance, particularly in small-island contexts (Leeuwerik, 2025). The research process involved several stages, including the identification and classification of legal instruments, content analysis of regulatory provisions, and the formulation of policy recommendations based on normative findings (Natwora et al., 2025). This approach was chosen for its suitability in assessing the integration between economic policy objectives and environmental protection mechanisms in mining licensing and monitoring systems.

The primary materials consisted of national legal and policy documents, including Government Regulation (PP) No. 25 of 2024, Ministerial Regulation (Permen ESDM) No. 15 of 2024, Ministerial Decree (Kepmen ESDM) No. 177.K/MB.01/MEM.B/2024, and Law No. 1 of 2014 concerning the Management of Coastal Areas and Small Islands (Przesdzink et al., 2025). Each document was systematically examined to identify provisions related to licensing, monitoring, and compliance mechanisms, and then categorized according to its regulatory domain (Deng et al., 2025).

In addition, secondary data were drawn from government reports, peer-reviewed publications, and credible institutional or media sources such as Climate Rights International, Mongabay, Reuters, and the Associated Press to contextualize the implementation of mining policies. The analysis applied a policy coherence and gap analysis framework to assess the consistency among regulations and the effectiveness of their implementation (Manczinger et al., 2025). The Raja Ampat case was used as a critical case study to illustrate licensing dynamics and regulatory enforcement within a conservation framework. Data reliability was ensured through cross-validation between official legal repositories and independent reports.

3. Results and discussion

3.1 Regulatory reforms and governance implications

In recent years, the Government of Indonesia has strengthened mining governance by restructuring the licensing system, clarifying reporting accountability, and placing conservation at the center of decision-making (Park et al., 2025). Three key regulatory instruments that signify this policy shift include Government Regulation (PP) No. 25 of 2024 (amending PP No. 96/2021), Ministerial Regulation (Permen ESDM) No. 15 of 2024 (amending Permen ESDM No. 10/2023 on RKAB), and Ministerial Decree (Kepmen ESDM) No. 177.K/MB.01/MEM.B/2024 (providing operational guidelines for the expansion of WIUP/WIUPK within a conservation framework) (Government of the Republic of Indonesia, 2024; Ministry of Energy and Mineral Resources of the Republic of Indonesia (MEMR), 2024). Collectively, these instruments shift the governance focus from mere licensing acceleration toward a pro-compliance and pro-conservation paradigm (Donázar-Aramendía et al., 2025). This mutually reinforcing regulatory framework can be visualized to show the synergy between the three main instruments in Figure 1.

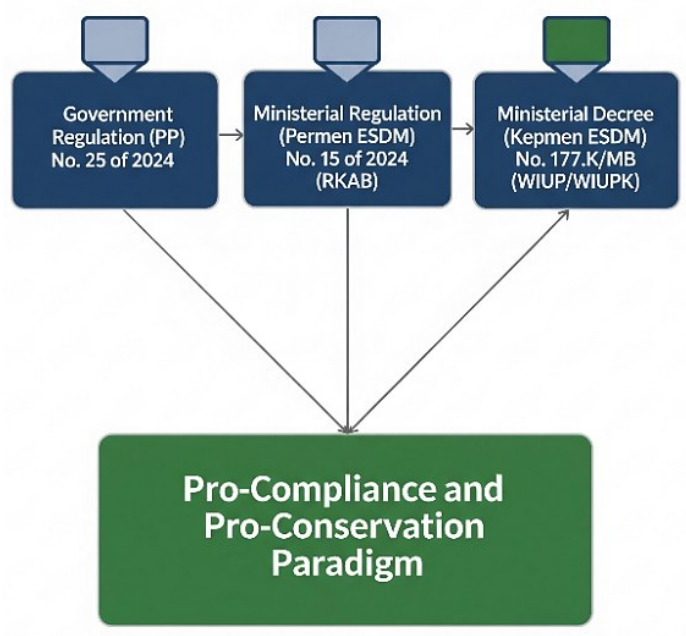

Figure 1. Regulatory framework overview

PP No. 25/2024 stipulates that the continuity of a mining license is now determined by performance and compliance. The extension of IUP/IUPK licenses is no longer administrative but contingent upon evidence-based evaluation of obligations ranging from RKAB consistency and reclamation/post-mining achievements to reporting compliance and state revenue realization (Li et al., 2025). Upstream, the process of determining WIUP/WIUPK areas must be integrated with spatial planning and consider the conservation status of high-value ecosystems to ensure licensing decisions align with environmental carrying capacity (Hanke et al., 2025). The regulation also reinforces a chain of administrative sanctions from guidance and suspension to license revocation to correct repeated noncompliance (Government of the Republic of Indonesia, 2024). Implicitly, this regulation links environmental and social performance with business certainty: a license continues only if compliance standards are met (Badruzzaman et al., 2025).

In line with this, Permen ESDM No. 15/2024 repositions the RKAB from a routine document into a contractual accountability instrument. The regulation allows for limited RKAB revisions within the same fiscal year but only under justified circumstances such as reduced environmental carrying capacity or unforeseen constraints while standardizing its format,

content, and reporting schedule. Consequently, operational, water quality, and reclamation reports are no longer mere administrative archives but serve as indicator-based monitoring data directly connected to corrective actions or sanction decisions, as outlined in PP No. 25/2024 (Ministry of Energy and Mineral Resources of the Republic of Indonesia (MEMR), 2024a, 2024b). Within this framework, the RKAB functions as a control panel linking production targets with conservation obligations (Laoufi et al., 2025).

A more explicit conservation dimension is embedded in Kepmen ESDM No. 177/2024, which introduces conservation considerations from the early stage of proposing mining area expansions. The regulation requires convincing technical environmental justification and grants authorities the power to reject or postpone expansion proposals until mitigation requirements are fulfilled. Consequently, decisions regarding WIUP/WIUPK expansion evolve from being purely administrative to conservation-oriented decisions, particularly for small islands, geoparks, or high-conservation-value areas (Ministry of Energy and Mineral Resources of the Republic of Indonesia (MEMR), 2024a, 2024b). Synchronization with spatial planning and RKAB monitoring instruments helps narrow the gap between regulatory norms and practical implementation.

The orchestration of these three instruments has begun to materialize in field enforcement. The events of June 10–11, 2025, in Raja Ampat when the government revoked four nickel mining permits and maintained one outside the geopark boundary under stricter supervision illustrate how spatial screening, RKAB accountability, and sanction mechanisms can jointly correct deviations from the conservation mandate (Associated Press, 2025; Mongabay, 2025a; Reuters, 2025a). This strict licensing and performance evaluation cycle can be seen more clearly through the timeline of compliance and mining policy in Figure 2.

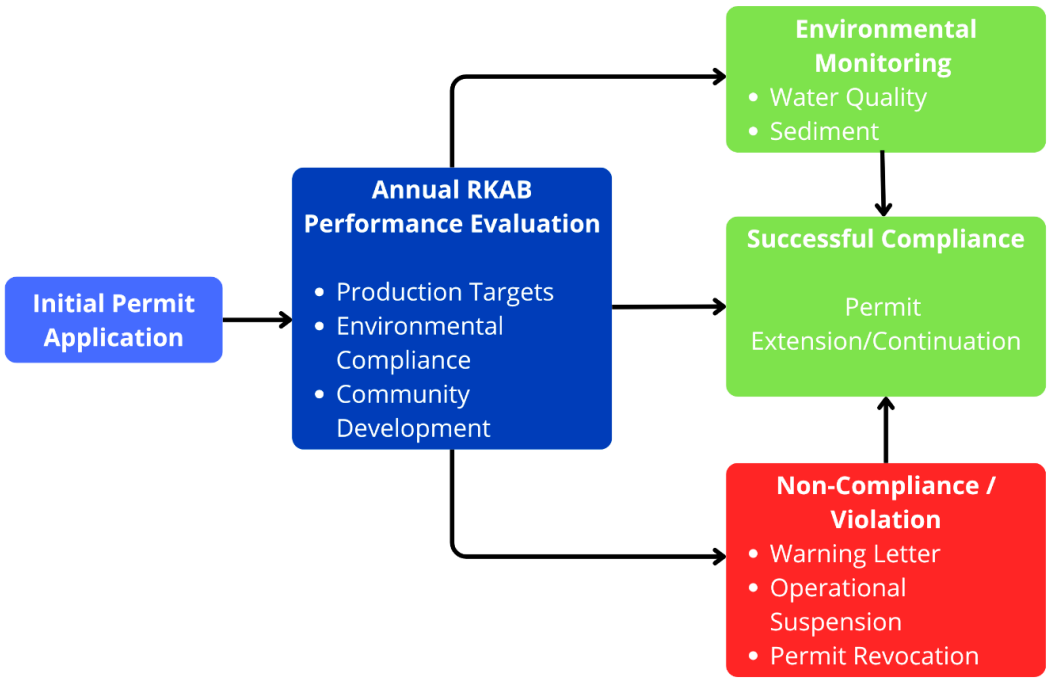

Figure 2. Mining policy & compliance timeline

The Figure 2 shows that the mining policy and compliance process includes strict evaluation based on performance and environmental compliance, leading to corrective action or license revocation. This incident also underscores the importance of caution when interpreting claims of “mining expansion” in sensitive regions without referencing the current legal status of permits (Barkan et al., 2025). Nevertheless, the effectiveness of these norms largely depends on the consistency of implementation. Major challenges include uneven monitoring capacity such as limited human resources, laboratory facilities for water quality, and sediment-monitoring instruments especially in remote regions (Sanad et al., 2025); lack of supply-chain traceability

(from ore to smelter to end-user), which affects global reputation risks (Lee et al., 2025); and inconsistent application of the "small island" filter throughout the licensing cycle, from WIUP/WIUPK designation to post-mining phases (Danovaro et al., 2025). To address these gaps, proposed technical policies include establishing quarterly inspection targets, publishing RKAB compliance dashboards (covering reclamation progress, water quality, and sediment load) for each entity, and strengthening AMDAL+ Sediment assessments for coral reef waters. Such approaches ensure that collected data directly drive corrective actions and promote transparency (Government of the Republic of Indonesia, 2024; Ministry of Energy and Mineral Resources of the Republic of Indonesia (MEMR), 2024a, 2024b).

Overall, these regulatory reforms reflect a paradigm shift from licensing acceleration toward performance- and conservation-based governance. The key to success lies not only in the strength of legal texts but also in the depth of reporting, firmness in enforcement, and transparency that enables public and stakeholder participation in sustaining compliance.

3.2 Mineral resource conservation on small islands

Mineral conservation requires extraction strategies that are both efficient and sustainable, ensuring long-term resource availability while maintaining ecosystem functions particularly in highly sensitive coastal and small-island environments (Martínez et al., 2025). Recent literature emphasizes that sedimentation and water quality degradation are the primary drivers of coral reef decline: increasing sediment loads reduce coral cover, alter community structures, and weaken ecosystem services such as fisheries, shoreline protection, and tourism (Portocarrero Banda et al., 2025). The mechanisms operate through turbidity that suppresses photosynthesis, abrasion that damages coral tissues, and the transport of dissolved pollutants that disrupt coral physiology (Climate Rights International, 2025; Yayasan Konservasi Alam Nusantara (YKAN), 2025). Thus, mineral conservation is not merely an issue of resource-use efficiency but also of ecological pressure management across the entire mining value chain (Yang et al., 2025).

Operationally, exploration and extraction practices must adopt low-sediment and low-waste technologies (e.g., strict overburden management, runoff control, mine water containment, and progressive rehabilitation) and align production planning with environmental carrying capacity to ensure disturbance rates remain within ecosystem recovery limits. The AMDAL framework should be expanded into AMDAL+ Sediment, incorporating sediment thresholds, dispersion modeling (including hydrodynamics, tidal variations, and extreme rainfall), and paired upstream–downstream monitoring designs measuring turbidity, TSS, and water quality at fixed stations. Such a design enables early detection and adaptive operational correction while providing a quantitative basis for reducing production intensity when environmental indicators approach risk thresholds (Climate Rights International, 2025; Yayasan Konservasi Alam Nusantara (YKAN), 2025).

In the reclamation and post-mining phases, success indicators must focus on the restoration of ecosystem functions land, vegetation, hydrology, and water quality supported by adequate financial assurance and independent verification. Permen ESDM No. 15/2024 positions RKAB reporting as the foundation for evaluation, where material deviations may trigger administrative actions such as guidance, suspension, or license revocation if obligations are not fulfilled (Ministry of Energy and Mineral Resources of the Republic of Indonesia (MEMR), 2024). Evidence from nickel mining policies across various sites indicates that transparency in reporting and consistent sanction enforcement correlates with reduced environmental and social risks; conversely, weak oversight is associated with increased ecological pressures and reputational risks along the global supply chain (Climate Rights International, 2025; Reuters, 2024). Therefore, the success of mineral conservation depends on the integration of technical–ecological indicators, financial accountability, and data transparency, ensuring that reporting translates into tangible corrective action.

3.3 Case study: Raja Ampat licensing dynamics and ecological risks

Raja Ampat represents the epicenter of global marine biodiversity, characterized by tropical coral reef complexes that are extremely sensitive to physical and chemical disturbances (Tefera et al., 2025). This ecological context requires that all extractive activities adhere to the highest precautionary standards and undergo conservation-based licensing screening, including spatial assessment against geopark and high-conservation-value designations, as well as the capacity of monitoring systems to maintain water quality (Yayasan Konservasi Alam Nusantara (YKAN), 2025). Within this framework, mining policy and conservation are inseparable licensing decisions themselves serve as instruments to uphold strict ecological risk thresholds.

The enforcement actions of June 10–11, 2025, when the government revoked four nickel mining permits in Raja Ampat and maintained PT Gag Nikel under enhanced monitoring because it operated outside the geopark boundary, demonstrate the functioning of legal mechanisms to correct deviations from conservation norms (Associated Press, 2025; Mongabay, 2025b; Reuters, 2025b). This case highlights that narratives of “mining expansion” in sensitive regions must be interpreted within the context of the latest licensing chronology rather than assumed trends, as license statuses and oversight conditions may change substantively.

Ecologically, deforestation on small islands increases sediment loads into coastal waters. Elevated sedimentation reduces coral cover, alters community structures, and diminishes ecosystem services such as coastal protection, fisheries, and tourism thereby affecting the socio-economic resilience of local communities. National experiences from other nickel regions, such as Weda and Obi, reveal that weak monitoring can lead to water quality deterioration and health implications. Therefore, Raja Ampat requires stricter environmental monitoring standards than typical mainland mining sites (Climate Rights International, 2025; Reuters, 2025c).

Governance implications for Raja Ampat include the implementation of indicator-based water quality monitoring (turbidity/TSS, dissolved metals, and biological parameters), sediment dispersion modeling to predict spatial impacts on reefs, and open reporting mechanisms to enable public and stakeholder oversight. Concurrently, operational supervision must be linked to RKAB obligations especially progressive reclamation, runoff control, and overburden management with escalating sanctions applied when indicators exceed defined thresholds. Policy-wise, this approach aligns with the precautionary conservation principle, which prioritizes prevention over costly restoration (Otgonbaigal et al., 2025).

Looking ahead, governance in Raja Ampat should prioritize license screening and/or expansion based on geopark and small-island status, ensure Free, Prior, and Informed Consent (FPIC) for indigenous communities, and promote local economic diversification through ecotourism and sustainable fisheries to ensure positive net benefits for the region. Through a combination of law enforcement, adaptive monitoring, and data transparency, the balance between mineral economic value and the conservation mandate can be maintained without compromising the ecosystem integrity that underpins local livelihoods and welfare.

3.4 Policy direction: From norms to implementation

Building upon the regulatory reforms and case study findings, future policy directions must shift focus from normative compliance toward measurable implementation. The main policy recommendations proposed to strengthen mining governance and conservation are summarized in Figure 3.

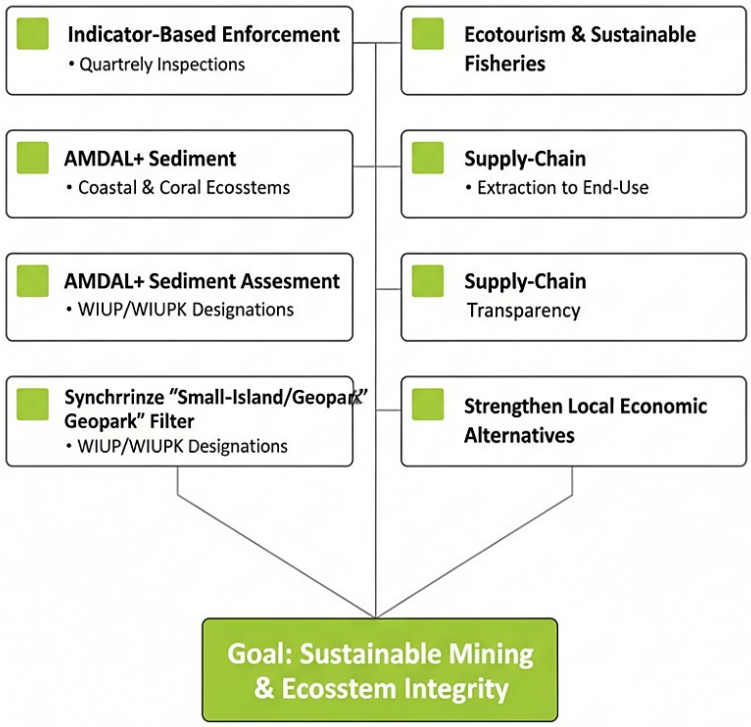

Figure 3. Policy recommendations

The detailed policy recommendations are as follows: Enforcement should be guided by clear indicators such as quarterly inspection targets, RKAB compliance dashboards for each company (covering reclamation progress, water quality, and sediment load), and progressive sanctions consistently applied from suspension to revocation in cases of repeated noncompliance. In coastal–coral areas, the environmental assessment instrument must evolve into AMDAL+ Sediment, featuring explicit sediment thresholds, spatial sediment-dispersion models, and paired upstream–downstream monitoring to enable adaptive operational adjustments before ecological thresholds are exceeded. At the spatial screening stage, conservation principles should serve as a licensing filter: the designation of small islands and/or geoparks must guide the rejection or revision of proposed WIUP/WIUPK designations or expansions, consistent with the mandate of Law No. 1/2014 and the operational guidance of Kepmen ESDM No. 177/2024.

Downstream, supply-chain transparency tracking nickel from extraction to end-user is essential to mitigate global reputational risks and harmonize environmental standards among operators. To ensure a positive net impact for communities in high-conservation-value areas, fiscal and technical policies should incentivize local economic alternatives such as ecotourism and sustainable fisheries, ensuring that economic gains from mineral resources do not compromise ecosystem integrity.

4. Conclusion

This study demonstrates that Indonesia's recent regulatory reforms particularly PP No. 25/2024, Permen ESDM No. 15/2024, and Kepmen ESDM No. 177/2024 mark a significant paradigm shift in mining governance from permit acceleration toward performance and conservation-based management. Within the context of small islands such as Raja Ampat, the alignment between the national down streaming agenda and ecological protection requires consistent implementation, measurable compliance indicators, and transparent data systems. The analysis highlights that the effectiveness of regulation is not determined solely by legal provisions but by their operational execution especially through strengthened RKAB accountability, periodic inspections, and integration of conservation filters in WIUP/WIUPK designation. The introduction of AMDAL+ Sediment, incorporating sediment thresholds and

paired monitoring systems, offers a practical tool to anticipate and mitigate coastal–coral degradation linked to mining operations.

The findings suggest several policy implications. First, regulatory enforcement should adopt indicator-based evaluation and publish compliance dashboards to enhance public oversight. Second, the licensing process must embed conservation criteria such as geopark and small-island status as mandatory filters to prevent ecological risks. Third, supply-chain transparency and traceability from mine to end-user are essential to reduce reputational risks and align Indonesia's mining governance with global sustainability standards. Finally, long-term resilience in small-island economies depends on diversifying local livelihoods through ecotourism and sustainable fisheries, ensuring that economic gains from mineral resources do not compromise ecosystem integrity. In conclusion, achieving a balance between economic growth and environmental sustainability in Indonesia's mining sector is attainable through an integrated framework that combines stringent licensing, adaptive monitoring, transparent governance, and community-centered economic alternatives. This approach not only strengthens national resource management but also reinforces Indonesia's leadership in promoting responsible mining within ecologically sensitive regions.

Author's Declaration

Author contribution

Wahyudi Zahar: conceptualized the study, conducted regulatory and policy analysis, and wrote and revised the final manuscript. **Fadhila Achmadi Rosyid**: contributed to the review of mining regulations, policy data validation, and manuscript editing.

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Competing interest

The authors declare that they have no conflict of interest. They are not affiliated with or involved in any organization or entity that has a financial interest (such as honoraria, educational grants, consulting, stock ownership, or expert testimony) or non-financial interest (such as personal or professional relationships, affiliations, or beliefs) in the subject matter or materials discussed in this manuscript.

Ethical clearance

This research does not involve humans as subjects. All data analyzed in this study were obtained from publicly available legal documents, government publications, and secondary scientific sources.

Data availability

All data supporting the findings of this study are derived from publicly accessible sources, including government regulations, ministerial decrees, academic journals, and credible institutional reports. The compiled dataset and reference materials are available upon reasonable request from the corresponding author.

AI statement

The grammatical structure and readability of this article were improved using ChatGPT (OpenAI) to assist in language refinement. The authors have rechecked the accuracy and contextual correctness of all generated sentences with respect to the topic and data of this study. The final text has been validated and verified by an English language expert from the Faculty of Mining and Petroleum Engineering, Institut Teknologi Bandung. No AI-generated data, tables, or figures were included in this article.

Publisher's and Journal's Note

Researcher and Lecturer Society as the publisher, and the editor of Journal of Engineering Researcher and Lecturer state that there is no conflict of interest towards this article publication.

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