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Post-Mining Land Use Regulations and Practices in the United States of America: Lesson for Indonesia

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A B S T R A C T

This research assesses practices and legislation about post-mining land utilization in the United States. This paper examines insights from these practices and legislation within the Indonesian legal environment. This study employs a normative legal methodology within a comparative legal framework. The research indicates that the United States's post-mining land use policies and practices are regulated by the Surface Mining Control and Reclamation Act (SMCRA) and different federal regulations supporting public purposes such as airports, shopping centers, and industrial zones. Rigorous supervision is enforced on post-mining land prior to its designation as appropriate for use. Specialized land management methods are implemented when mining occurs on prime agricultural land. The efficacy of reclamation is significantly contingent upon the use of scientifically substantiated optimal management practices that emphasize ecological restoration and biodiversity enhancement. Longitudinal studies in the United States about ecological reclamation demonstrate that effective strategies, including surface soil replacement and customized planting schemes, markedly enhance the likelihood of successful revegetation of former mining sites. The United States offers a robust framework underpinned by comprehensive policies and efficient implementation that Indonesia can adopt. Future adoption of post-mining land use policies and practices in Indonesia should establish a harmonious equilibrium that fosters sustainable development, preserves environmental integrity, and promotes active community engagement.

KEYWORDS: ***Post-Mining; Land Use; Regulations; Practices;***

1. I N T R O D U C T I O N

Mining has long been a cornerstone of industrial growth and economic development in the United States. From the early days of coal and gold extraction to contemporary

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operations involving copper, rare earth elements, and shale gas, extractive industries have contributed significantly to employment, infrastructure development, and energy security. However, the environmental legacy of mining—particularly in its post-operational phase—has provoked increasing concern among regulators, researchers, and local communities. Abandoned mines, contaminated watersheds, subsidence, soil degradation, and socio-economic decline in mining-dependent towns represent some of the most enduring challenges associated with resource exploitation. As the nation increasingly embraces sustainability principles and transitions toward a green economy, attention has shifted to how former mine lands can be rehabilitated and repurposed through robust regulatory frameworks and adaptive land use strategies.[1]

Post-mining land use (PMLU) is defined as the designation and management of former mine lands for productive or ecologically stable uses after mineral extraction ceases. In the United States, this process is heavily regulated at both the federal and state levels. The most prominent regulatory framework is the Surface Mining Control and Reclamation Act (SMCRA) of 1977, which mandates that mine operators restore lands to conditions capable of supporting pre-mining land uses or to higher-value alternative uses approved during the permitting phase. Under SMCRA, mining companies must submit detailed reclamation plans, secure performance bonds to guarantee rehabilitation, and ensure compliance with long-term monitoring requirements. Despite these provisions, the implementation of post-mining land use regulations remains uneven across states, leading to significant variability in environmental outcomes, land productivity, and community satisfaction.[2]

The complexity of post-mining land transitions is exacerbated by the fact that SMCRA primarily governs surface coal mining, while other forms of mining—such as hardrock and industrial mineral extraction—are regulated under a fragmented array of federal and state laws. For instance, the 1872 General Mining Law, which governs hardrock mining on federal lands, contains no explicit reclamation requirements, thereby placing much of

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[1] Leanne Bowie and Jonathan Fulcher, 'Planning for Post-Mining Land Uses', no. September (2017) <http://www.hdc.nsw.gov.au/honeysuckle>.

[2] Agung Dwi Sutrisno, Chun-Hung Lee, and I Wayan Koko Suryawan, 'Examining Community Desire to Change for Adaptive Transition in Post-Mining Ecological Sustainability: Community Transition in Post-Mining Sustainability', *The Extractive Industries and Society*, 20 (2024), p. 101537, doi:https://doi.org/10.1016/j.exis.2024.101537.

the regulatory burden on state agencies. This legal pluralism creates inconsistencies in reclamation standards, enforcement rigor, and long-term land use planning. Moreover, the absence of a unified federal policy on non-coal post-mining land use has made it difficult to assess national performance trends or to formulate cross-sectoral recommendations.[3]

The environmental and socio-economic stakes of PMLU are considerable. Degraded mine lands can present persistent hazards to human health and ecosystems through acid mine drainage, heavy metal leaching, and loss of biodiversity. At the same time, such lands also present opportunities for ecological restoration, carbon sequestration, renewable energy development, and community revitalization. For example, numerous former coal mining sites in Appalachia have been converted into solar farms, cattle pastures, wetlands, or recreational parks. These initiatives underscore the potential for reimagining post-mining landscapes as assets rather than liabilities. However, realizing such potential requires coherent policies, scientific guidance, and inclusive governance models that actively engage affected communities in decision-making processes.[4]

Research has shown that successful post-mining land use depends on a range of technical, institutional, and socio-political factors. Ecologically, site-specific conditions such as soil fertility, slope stability, hydrology, and regional climate influence the feasibility of various land uses. Institutionally, the capacity of state agencies to enforce reclamation standards, monitor long-term outcomes, and respond to stakeholder concerns is crucial. Socio-politically, the inclusion of local communities—especially Indigenous populations, rural households, and historically marginalized groups—has been shown to enhance the legitimacy and sustainability of land use decisions. Unfortunately, many PMLU processes in the U.S. still exhibit technocratic tendencies, with minimal community involvement beyond mandated public hearings during the permitting stage.[5]

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[3] Rian Saputra and others, 'Ecological Justice in Indonesia and China Post- Mining Land Use ?', *Journal of Law, Environmental and Justice*, 2.3 (2024), pp. 254–84, doi:10.62264/jlej.v2i3.108.

[4] Jeff Skousen and Carl E. Zipper, 'Post-Mining Policies and Practices in the Eastern USA Coal Region', *International Journal of Coal Science and Technology*, 1.2 (2014), pp. 135–51, doi:10.1007/s40789-014-0021-6.

[5] S. Cooper, 'Maximising Post-Mining Land Use: Queensland Government Reforms', *Proceedings of the International Conference on Mine Closure*, 2019-Septe (2019), pp. 969–81, doi:10.36487/ACG_rep/1915_76_Cooper.

Another critical issue is the economic sustainability of post-mining land uses. While ecological restoration is often prioritized in regulatory language, economic viability remains a central concern for both policymakers and local residents. The conversion of mined lands into commercial or industrial zones, logistics centers, or renewable energy sites is frequently seen as a pragmatic way to offset the economic decline following mine closure. Yet such transitions can generate new conflicts over land ownership, zoning laws, and environmental externalities. For instance, while solar energy projects on reclaimed mine sites offer a low-carbon development pathway, they may also lead to the exclusion of local stakeholders if decisions are made without transparent consultation or equitable benefit-sharing mechanisms.[6]

Financial assurance mechanisms, such as reclamation bonds, are intended to safeguard against incomplete or failed reclamation efforts. However, these systems have proven inadequate in numerous instances, especially during economic downturns when mining firms declare bankruptcy or restructure their liabilities. In such cases, states are left with the fiscal burden of restoring lands without sufficient funding or legal recourse. Bonding shortfalls are particularly acute in the hardrock mining sector, where regulatory oversight is often weaker and long-term liabilities are more complex. The resulting "zombie landscapes"—partially reclaimed or abandoned sites with ambiguous legal status—pose ongoing risks to surrounding communities and ecosystems.[7]

A further complication lies in the evolving definitions of "successful" post-mining land use. Historically, success was measured by technical criteria such as regrading, revegetation, and erosion control. However, recent scholarship and policy developments have expanded this definition to include ecosystem services, climate resilience, and social equity. This shift reflects a broader transformation in land management thinking, wherein mined lands are seen not merely as environmental problems to be mitigated, but as potential contributors to sustainable development goals (SDGs). This reimagining of post-mining landscapes aligns with global efforts to mainstream biodiversity, mitigate climate

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[6] Julia Keenan and Sarah Holcombe, 'Mining as a Temporary Land Use: A Global Stocktake of Post-Mining Transitions and Repurposing', *The Extractive Industries and Society*, 8.3 (2021), p. 100924, doi:https://doi.org/10.1016/j.exis.2021.100924.

[7] Muhammad Bagus Adi Wicaksono and Wiwit Rahmawati, 'Ecological Justice-Based Reclamation and Post-Mining Regulations in Indonesia : Legal Uncertainty and Solutions', *Journal of Law, Environmental and Justice*, 2.2 (2024), pp. 109–36, doi:10.62264/jlej.v2i2.103.

change through land-based solutions, and promote just transitions in extractive economies.[8]

Despite these promising developments, significant knowledge gaps persist in the academic and policy literature. Most studies focus either on regulatory analysis or technical restoration methods, with limited integration between policy frameworks and practical land use outcomes. Comparative analyses across states and mining sectors are scarce, making it difficult to generalize best practices or evaluate the systemic impacts of different regulatory regimes. Moreover, empirical data on long-term land use trajectories—such as changes in land value, biodiversity metrics, or community well-being—are often lacking. This gap hampers efforts to assess the sustainability of various PMLU models and to inform evidence-based policymaking.[9]

In Indonesia, the framework for mining regulations is established by Law No. 3 of 2020, which amends Law No. 4 of 2009 concerning Mineral and Coal Mining and addresses the critical aspect of post-mining land reclamation. Nonetheless, the absence of regulations governing the utilization of post-mining land prompts a critical examination of the appropriate uses and objectives for such areas. Following a thorough analysis of the practices and regulations on post-mining land in the United States, this paper seeks to further elucidate the forthcoming regulations and practices for utilizing post-mining land in Indonesia.

To illustrate the originality of this paper, the author conducts a comparative analysis with earlier works of a similar kind from diverse sources, including: Initially, there exists a scholarly article titled "Transitional and Post-Mining Land Uses: A Global Review of Regulatory Frameworks, Decision-Making Criteria, and Methods." The findings of this study indicate that post-mining land management constitutes a fundamental component of surface mining and quarrying activities. In this context, the inquiries pertain to the actions prescribed by existing laws and regulations, the specific type of land reclamation that should be executed, the unique conditions present in each mining area, the suitable

[8] Muhammad Bagus Adi Wicaksono and Devi Triasari, 'Coal Post-Mining Reclamation Policies in Several Countries : Lessons for Indonesia', *Journal of Law, Environmental and Justice*, 2.3 (2024), pp. 229–53, doi:10.62264/jlej.v2i3.106.

[9] Adator Stephanie Worlanyo and Li Jiangfeng, 'Evaluating the Environmental and Economic Impact of Mining for Post-Mined Land Restoration and Land-Use: A Review', *Journal of Environmental Management*, 279.xxxx (2021), p. 111623, doi:10.1016/j.jenvman.2020.111623.

land uses, and the criteria and methodologies through which these can be ascertained. The literature review undertaken in this study has uncovered that, alongside the conventional 4R actions of land management—remediation, restoration, reclamation, and rehabilitation—two additional actions, repurposing and co-purposing, have been introduced to effectively address the social and economic ramifications of mine closures. Moreover, many land uses have been meticulously recorded and classified into 11 primary categories, 38 subcategories, and 119 distinct alternatives. Nine criteria for the selection of land use were delineated and articulated through 72 attributes that functioned as input data for 22 multicriteria methodologies, which were predominantly employed in conjunction with two or more approaches.[10]

The document titled "Managing and Reforesting Degraded Post-Mining Landscapes in Indonesia: A Review." The findings of this article indicate that tropical forests are among the most diverse ecosystems globally, characterized by immense biodiversity—the increase of natural resource exploitation by open-pit mining results in heightened land and tropical forest degradation. Evidence-based methodologies are essential to restore its functionality. This article delineates the current coal mining practices, encompassing regulatory considerations and reclamation responsibilities, the methodologies employed at diverse mining locations with varying land attributes, and the reclamation initiatives for post-mining landscapes in Indonesia. The regulations differentiate between mining property within forest areas and that outside, particularly regarding permit authority and the assessment of reclamation success rates. This study delineates coal-mining processes, commencing with land clearance activities and subsequently involving storing soil layers and overburdened materials. In this phase, the appropriate management of potentially acid-generating materials is essential to avert acid mine drainage. This document progressively covers research findings and field applications during the reclamation stage, focussing on rearranging overburden and soil components, controlling acid mine drainage and erosion, managing drainage systems, and settling ponds and pit lakes. Numerous initiatives to rehabilitate post-coal-mining landscapes and their efficacy have been documented and emphasized. Numerous success narratives indicate that post-coal-mining landscapes can be rehabilitated into forests that yield ecosystem services and products. A comprehensive set of science-based best management practices for post-coal-

[10] Chrysoula Pagouni and others, 'Transitional and Post-Mining Land Uses: A Global Review of Regulatory Frameworks, Decision-Making Criteria, and Methods', *Land*, 13.7 (2024), doi:10.3390/land13071051.

mine reforestation is essential to enhance the efficacy of forest reclamation and restoration on post-coal-mining sites. This involves strategically planting high-value hardwood trees, improving survival rates and growth, and expediting the establishment of forest habitats by implementing appropriate tree-planting techniques. The monitoring and assessment component is essential, as corrective measures may be implemented based on the varying success rates associated with distinct site features.[12]

This study enhances the ongoing discourse surrounding environmental governance, land use planning, and sustainability science by analyzing post-mining land use in the United States. Moreover, the outcomes derived from post-mining land practices and utilization in the United States will be correlated with those in Indonesia. This connection aims to offer valuable insights into enhancing regulatory frameworks and fostering more adaptive, inclusive, and environmentally sustainable land restoration approaches in Indonesia. Consequently, this study responds to the increasing interest among scholars, policymakers, and practitioners for practical insights on shifting from an extractive land economy to a regenerative one.

2. RESEARCH METHODS

This research constitutes a normative legal examination employing legislative,[13] conceptual, and comparative methodologies.[14] The legislative approach involved thoroughly examining all legal regulations pertinent to the issues addressed in this paper. A selection of these statutes encompasses Law Number 3 of 2020, which pertains to amendments made to Law Number 4 of 2009 regarding mineral and coal mining, as well as the Surface Mining Control and Reclamation Act (SMCRA) established in 1977. It is essential to incorporate the specific type of legislation utilized as legal material in this paper, encompassing both the legislative frameworks of Indonesia and the United States. In the interim, a conceptual framework was established to formulate an optimal vision for

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[12] Pratiwi and others, 'Managing and Reforesting Degraded Post-Mining Landscape in Indonesia: A Review', *Land*, 10.6 (2021), doi:10.3390/land10060658.

[13] Rachmawaty Rachmawaty, Matthew Marcellinno Gunawan, and Novi Nurviani, 'Judicial Perspectives on the Equitable Resolution of Anti-SLAPP Cases: Insights from Indonesia', *Journal of Law, Environmental and Justice*, 2.1 (2024), pp. 18–41, doi:10.62264/jlej.v2i1.88.

[14] Willy Naresta Hanum, Tran Thi Dieu Ha, and Nilam Firmandayu, 'Eliminating Ecological Damage in Geothermal Energy Extraction : Fulfillment of Ecological Rights by Proposing Permits Standardization', *Journal of Law, Environmental and Justice*, 2.2 (2024), pp. 205–28, doi:10.62264/jlej.v2i2.105.

post-mining land utilization in Indonesia.[15] The comparative law methodology is employed to analyze the regulations and practices surrounding post-mining land use in the United States and to integrate these insights into forthcoming regulations for post-mining land use in Indonesia.

3. RESULTS AND DISCUSSION

Post-Mining Land Use Regulations in United States of America

The regulations governing post-mining land use in the United States have evolved considerably, serving as a crucial element within the broader context of the mining industry and adapting to various ecological, socio-economic, and regulatory advancements. These regulations aim to guarantee the sustainable restoration of mined lands, enabling their reintegration into productive use that addresses the requirements of local communities and ecosystems.[16]

The potential applications of land following mining activities in the United States are diverse, encompassing classifications such as prime agricultural land, grazing areas, habitats for wildlife, forestry, and urban expansion. The classifications are emphasized by a regulatory framework designed to facilitate these transitions. The efficacy of post-mining land utilization is significantly influenced by many factors, encompassing ecological conditions, community preferences, and regulatory frameworks. These regulations frequently require that reclamation practices restore the land to a condition that is at least equivalent to its pre-mining state, promoting a comprehensive approach to land use that integrates ecological restoration, economic sustainability, and community involvement.[17]

An in-depth examination by Fogarty et al. underscores the necessity for post-mining land use decisions to involve diverse stakeholders, ranging from local communities to regulatory bodies, while considering multiple factors, including environmental

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[15] Ponco Hartanto, Subagio Gigih, and Riami Chancy, 'Discourse of Ecological Damage as a State Financial Loss : Evidence from Indonesia', *Journal of Law, Environmental and Justice*, 2.3 (2024), pp. 307–31, doi:10.62264/jlej.v2i3.110.

[16] Worlanyo and Jiangfeng, 'Evaluating the Environmental and Economic Impact of Mining for Post-Mined Land Restoration and Land-Use: A Review'.

[17] R. I. Maczkowiack and others, 'Grazing as a Post-Mining Land Use: A Conceptual Model of the Risk Factors', *Agricultural Systems*, 109 (2012), pp. 76–89, doi:10.1016/j.agsy.2012.03.002.

evaluations and land potential. Furthermore, rehabilitation initiatives are informed not solely by the physical attributes of the disturbed land but also by legal requirements that prescribe permissible and advantageous applications following mining activities. Recent studies highlight the significance of incorporating stakeholder interests and environmentally-focused planning into these processes, wherein the post-mining landscape can serve various functions, encompassing recreational, aesthetic, and ecological roles.[18]

The significance of innovative methodologies in evaluating and improving the capabilities of land following mining activities is paramount. For example, employing geospatial models can significantly enhance land reclamation planning and implementation phases by assessing land appropriateness for diverse applications and current conditions. Such methodologies facilitate a more precise restoration initiative that aligns directly with sustainable development objectives. Integrating sophisticated technologies can enhance the efficiency of planning and design processes, thereby facilitating a more profound comprehension of regulatory frameworks and ecological possibilities.[19]

The utilization of land following mining activities, along with the relevant regulatory structures in the United States, plays a pivotal role in mitigating the environmental repercussions of mining and ensuring that rehabilitated areas serve the community's needs effectively. Land administration following mining activities is centered on established land uses, policies, and practices, especially in the coal-abundant areas of the Eastern United States.[20]

The Surface Mining Control and Reclamation Act (SMCRA) stands as a pivotal regulation in the United States, requiring the restoration of mined lands to their original conditions or, in certain instances, to a state conducive to alternative land uses, including

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[18] Margarita Ignatyeva, Vera Yurak, and Natalia Pustokhina, 'Recultivation of Post-Mining Disturbed Land: Review of Content and Comparative Law and Feasibility Study', *Resources*, 9.6 (2020), doi:10.3390/RESOURCES9060073.

[19] Sonja Kivinen, 'Sustainable Post-Mining Land Use: Are Closed Metal Mines Abandoned or Re-Used Space?', *Sustainability (Switzerland)*, 9.10 (2017), pp. 29–33, doi:10.3390/su9101705.

[20] Tessa Toumbourou and others, 'Political Ecologies of the Post-Mining Landscape: Activism, Resistance, and Legal Struggles over Kalimantan's Coal Mines', *Energy Research & Social Science*, 65 (2020), p. 101476, doi:https://doi.org/10.1016/j.erss.2020.101476.

agriculture, wildlife habitats, or recreational areas. As noted by Skousen and Zipper, the post-mining land uses widely recognized in the eastern United States encompass prime farmland, hay land, pasture, biofuel crops, forestry, wildlife habitats, and the development of building sites. The ramifications of this legal framework are significant—complying with such regulations not only meets legal requirements but also aids in restoring ecosystem services, thereby improving the overall societal value of these lands.

Implementing effective reclamation practices is integral to attaining successful outcomes in land use. Approaches like the Forestry Reclamation Approach (FRA) are meticulously crafted for the unique context of Appalachian coal mines, emphasizing the restoration of Indigenous forests and their integral ecosystem services, encompassing wood production and carbon sequestration. This methodology has demonstrated superiority over traditional techniques, which frequently struggle to create enduring forest ecosystems. Moreover, research highlights the significance of employing indigenous tree species in reclamation initiatives, demonstrating their capacity to bolster ecological diversity and enhance growth outcomes in landscapes affected by mining activities.[21]

The economic and social aspects of post-mining land use warrant careful consideration. Ecological rehabilitation strategies are designed to facilitate environmental recovery and create economic opportunities for local communities. The effective restoration of coal mining sites can foster the development of new forestry and recreational ventures, thereby enhancing local economic prospects. Furthermore, the significance of community involvement has been underscored as an essential element in restoring these lands, enhancing social capital, and fostering engagement in environmental restoration efforts. The involvement in this matter is crucial, especially in areas undergoing significant deterioration due to mining operations.[22]

Regulations concerning post-mining land use in the United States dictate the restoration and stewardship of landscapes once mining operations have concluded,

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[21] I Made Ronyastra, Lip Huat Saw, and Foon Siang Low, 'Monte Carlo Simulation-Based Financial Risk Identification for Industrial Estate as Post-Mining Land Usage in Indonesia', *Resources Policy*, 89 (2024), p. 104639, doi:https://doi.org/10.1016/j.resourpol.2024.104639.

[22] A Arratia-Solar and others, 'Conceptual Framework to Assist in the Decision-Making Process When Planning for Post-Mining Land-Uses', *The Extractive Industries and Society*, 10 (2022), p. 101083, doi:https://doi.org/10.1016/j.exis.2022.101083.

thereby safeguarding the rehabilitation of ecosystems for subsequent utilization. At the core of this framework lies the Surface Mining Control and Reclamation Act of 1977 (SMCRA), which stipulates that land affected by mining operations must be restored to a state that can sustain pre-mining functions or potentially "higher or better uses." This legislative mandate acknowledges the ecological consequences of mining and aims to alleviate adverse effects through systematic land-use strategies.[23]

In the United States, post-mining land uses encompass a variety of applications, including prime farmland, wildlife habitats, forestry, and recreational areas, among others. The practical implementation of these land use practices relies on thorough policy frameworks that consider the distinct ecological characteristics of each location. Contemporary post-mining approaches highlight the necessity of land reclamation methods that reinstate ecosystem services, enhance biodiversity, and elevate the overall ecological integrity of the landscape. For example, the reclamation process frequently emphasizes the importance of native plant species to rejuvenate local flora and fauna, thus improving ecological results and resilience.[24]

Ecological restoration in post-mining landscapes is essential for rejuvenating regions impacted by mining operations. Research suggests that ecological restoration encompasses the re-establishment of vegetation, the stabilization of soils, and the enhancement of water retention capabilities. Effective reclamation is realized through customized strategies encompassing the deliberate incorporation of Indigenous plant species, implementing optimal management techniques, and ongoing assessment and analysis. These practices aim to rehabilitate the land and cultivate environments that can deliver vital ecosystem services, including carbon sequestration and water filtration.[25]

Notwithstanding these frameworks, obstacles remain in realizing sustainable land use following mining activities. Many restored sites encounter challenges in attaining the

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[23] Abdul Kodir and others, 'Integrated Post Mining Landscape for Sustainable Land Use: A Case Study in South Sumatera, Indonesia', *Sustainable Environment Research*, 27.4 (2017), pp. 203–13, doi:https://doi.org/10.1016/j.serj.2017.03.003.

[24] Moshood Onifade and others, 'Advancing toward Sustainability: The Emergence of Green Mining Technologies and Practices', *Green and Smart Mining Engineering*, 1.2 (2024), pp. 157–74, doi:https://doi.org/10.1016/j.gsme.2024.05.005.

[25] Ruth Preciado Jeronimo, Edwin Rap, and Jeroen Vos, 'The Politics of Land Use Planning: Gold Mining in Cajamarca, Peru', *Land Use Policy*, 49 (2015), pp. 104–17, doi:https://doi.org/10.1016/j.landusepol.2015.07.009.

ecological diversity characteristic of undisturbed ecosystems. Research indicates that certain reclaimed regions in West Virginia have yet to restore the rich biodiversity characteristic of Appalachian forests. This prompts a critical examination of the current regulatory frameworks and underscores the necessity for enhanced ecological evaluations to guide reclamation approaches more congruent with natural ecosystems.[26]

In conclusion, the regulations governing post-mining land use in the United States are established by synthesizing legislative requirements and ecological considerations to rehabilitate landscapes subjected to mining activities. Despite notable advancements in establishing varied post-mining land uses and ecological restoration techniques, persistent challenges necessitate ongoing enhancement and creativity in reclamation strategies to guarantee that former mining sites yield beneficial outcomes for both the environment and society.[27]

Alongside regional methodologies, the framework governing post-mining land utilization is transforming to incorporate increasingly rigorous standards. The efficacy of these regulations relies on enforcement mechanisms that ensure mining corporations are held accountable for their reclamation responsibilities. The regulatory framework in the United States is progressively acknowledging the need for thorough evaluations considering ecological and socio-economic elements during the reclamation process, thus promoting sustainable development goals in previously mined regions.[28]

In conclusion, the progression of post-mining land use in the United States embodies a multifaceted interaction of regulatory structures, reclamation techniques, and community involvement approaches designed to restore ecological balance and fulfill societal requirements. The successful application of these strategies guarantees adherence to legal requirements and bolsters the resilience and productivity of previously mined landscapes. In summary, the regulatory framework surrounding post-mining land use in

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[26] Jorge A Rincón Barajas, Christoph Kubitza, and Jann Lay, 'Large-Scale Acquisitions of Communal Land in the Global South: Assessing the Risks and Formulating Policy Recommendations', *Land Use Policy*, 139 (2024), p. 107054, doi:https://doi.org/10.1016/j.landusepol.2024.107054.

[27] Thomas Measham and others, 'Beyond Closure: A Literature Review and Research Agenda for Post-Mining Transitions', *Resources Policy*, 90 (2024), p. 104859, doi:https://doi.org/10.1016/j.resourpol.2024.104859.

[28] Xiangzheng Deng and others, 'Agricultural Land-Use System Management: Research Progress and Perspectives', *Fundamental Research*, 2024, doi:https://doi.org/10.1016/j.fmre.2024.10.012.

the United States is intricate, weaving together ecological factors, community requirements, and established regulations. Continuous progress in policy and technology is enhancing the potential of repurposed mined lands, advocating for a future where these environments can flourish after mining activities cease.

Post-Mining Land Use Practices in United States of America

The evaluation of land use practices following mining activities in the United States demonstrates a complex strategy focused on converting former mining areas into environmentally sound and economically viable landscapes. The coal mining sector in the United States has adopted a range of practices for land use after mining, which can be classified into multiple categories. These encompass the advancement of agriculture, the preservation of wildlife habitats, the establishment of recreational spaces, and the management of forestry, all aligned with regulatory frameworks to uphold ecological integrity and ensure usability for future generations.[29]

A significant approach in utilizing land following mining activities involves transforming excavated areas into fertile agricultural land and grazing pastures. This reclamation method frequently necessitates the effective restoration of soil profiles and the improvement of soil fertility, both essential for sustaining agricultural production and livestock management. The success of reclamation initiatives is intricately connected to the strategies employed in the early phases of mining; a holistic methodology that includes environmental oversight and soil restoration generally leads to enhanced productivity of the restored land.[30]

A significant consideration in the realm of post-mining land use within the United States is the creation of wildlife habitats aimed at reinstating biodiversity and natural ecosystems in areas that have been previously disrupted. These habitats function as buffer zones, fostering diverse flora and fauna crucial for maintaining ecological equilibrium. Establishing appropriate habitats necessitates meticulous planning to address potential

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[29] Martín Obaya, Diego I Murguía, and Daniela Sánchez-López, 'From Local Priorities to Global Responses: Assessing Sustainability Initiatives in South American Lithium Mining', *The Extractive Industries and Society*, 19 (2024), p. 101509, doi:https://doi.org/10.1016/j.exis.2024.101509.

[30] Caroline M Beckman and others, 'Incorporating Justice, Equity, and Access Priorities into Land Trusts' Conservation Efforts', *Biological Conservation*, 279 (2023), p. 109926, doi:https://doi.org/10.1016/j.biocon.2023.109926.

pollution and guarantee the sustained health of these ecosystems, frequently incorporating long-term management strategies and active community engagement.[31]

Recreational developments, including parks and nature reserves, are significant components of various post-mining policies. These areas serve as venues for community interaction and environmental learning while simultaneously elevating the aesthetic appeal of previously degraded landscapes. Incorporating recreational areas into post-mining land use strategies can benefit local economies, enhance tourism, and promote outdoor pursuits. Such practices require the cooperation of diverse stakeholders, encompassing miners, local authorities, and environmental groups, to guarantee sustainability.[32]

The practices surrounding post-mining land use in the United States have evolved significantly over the years, influenced by ecological, economic, and social factors. The successful reclamation and restoration of mined lands is essential for alleviating the environmental consequences of mining, improving soil and water quality, and fostering biodiversity. The intricate nature of these challenges demands a comprehensive strategy for reclamation and restoration that integrates biological, geological, and socio-economic elements.[33]

A pivotal consideration in post-mining land use is the rehabilitation of ecosystems to foster fauna and enhance biodiversity. Cross et al. highlight the necessity of continuous ecological monitoring throughout the mining lifecycle to effectively guide recovery initiatives and comprehend the effects of mining activities on fauna assemblages. They contend that ecological recovery initiatives should not pursue the singular goal of complete ecosystem restoration but rather emphasize the restoration of functional ecosystems capable of sustaining native wildlife populations. Incorporating Indigenous

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[31] Isaac Ahakwa, 'Towards Land Degradation Neutrality: Does Green Energy and Green Human Capital Matter?', *Renewable and Sustainable Energy Reviews*, 197 (2024), p. 114396, doi:https://doi.org/10.1016/j.rser.2024.114396.

[32] Sarah Jane Fox, '"Exploiting – Land, Sea and Space: Mineral Superpower" In the Name of Peace: A Critical Race to Protect the Depths and Heights', *Resources Policy*, 79 (2022), p. 103066, doi:https://doi.org/10.1016/j.resourpol.2022.103066.

[33] Zonaira Qaiser and others, 'Chapter 8 - Transforming Land Use toward Carbon Neutral Agriculture', in *Agriculture Toward Net Zero Emissions*, ed. by Sandeep Kumar and Ram Swaroop Meena (Academic Press, 2025), pp. 125–51, doi:https://doi.org/10.1016/B978-0-443-13985-7.00009-9.

species, especially via the simultaneous introduction of mycorrhizal fungi and plant seeds, has been emphasized as a practical approach to expedite the restoration process in altered landscapes.[34]

Furthermore, the physical and chemical limitations imposed on soils post-mining present considerable obstacles to land productivity. Tibbett emphasizes the importance of soil rehabilitation, especially in transforming mined regions into viable pastures or forests. Reclaimed sites frequently encounter nutrient deficiencies and modified soil profiles, which may impede the successful establishment of sustainable vegetation. Research demonstrates that effective soil management techniques, such as preserving topsoil and thoughtfully choosing native plant species, can improve rehabilitation results.[35]

In the United States, legislative measures like the Clean Water Act and regulations instituted by the Bureau of Land Management (BLM) have been pivotal in developing post-mining reclamation practices. Baeten et al. examine the implications of federal policies that safeguard water quality, highlighting the establishment of guidelines that mandate the reclamation of mined areas to address pollution concerns. The Bureau of Land Management and various regulatory entities have instituted criteria that require the evaluation of prospective land utilizations—be it for agricultural purposes, recreational activities, or wildlife habitats—before initiating mining activities. This forward-thinking strategy fosters sustainable results that resonate with community requirements and ecological well-being.[36]

Furthermore, advancements in restoration planning have surfaced, promoting the integration of ecosystem service considerations that emphasize the importance of both environmental restoration and socio-economic advantages. Using the Driving Forces–Pressures–State–Impact–Response (DPSIR) framework facilitates a thorough evaluation of the possible consequences of mining activities and the efficacy of reclamation strategies. According to Döhren and Haase, incorporating ecological health assessments into

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[34] Pablo Jimenez-Ayora and others, 'Citizen Empowerment through Land Reform', *Journal of Comparative Economics*, 52.3 (2024), pp. 592–613, doi:https://doi.org/10.1016/j.jce.2024.04.003.

[35] Carl E Zipper and Jeff Skousen, 'Coal's Legacy in Appalachia: Lands, Waters, and People', *The Extractive Industries and Society*, 8.4 (2021), p. 100990, doi:https://doi.org/10.1016/j.exis.2021.100990.

[36] Christine A Daly and others, 'Reclaiming Homeland - An Evaluation of Traditional Land Use Planning in Oils Sands Mine Closure and Reclamation Plans', *Resources Policy*, 103 (2025), p. 105552, doi:https://doi.org/10.1016/j.resourpol.2025.105552.

reclamation planning is crucial for developing resilient landscapes that fulfill ecological and community objectives.

The significance of indigenous knowledge in reclamation processes highlights the necessity of cultural sensitivity and active community participation in land use planning. Butler et al. emphasize the importance of customizing rehabilitation initiatives to impacted communities' distinct social and environmental contexts, frequently leading to more embraced and efficacious results.[37]

Ultimately, the variety of post-mining land use practices in the U.S. illustrates the differences in ecological contexts, regulatory frameworks, and community anticipations. As mining operations progress and closure methodologies advance, there will be a growing emphasis on sustainable practices that harmonize ecological restoration with societal requirements, guaranteeing that former mining sites can yield enduring advantages for both the environment and local communities.[38]

A multitude of regulatory frameworks, ecological factors, and the preferences of local communities influence the practices surrounding land use after mining in the United States. The Surface Mining Control and Reclamation Act (SMCRA) stipulates that mining-related land should be rehabilitated to a condition equal to or surpassing its initial state. Nonetheless, the reclamation process frequently results in soil compaction caused by heavy machinery, which significantly obstructs the establishment of tree species, thereby constraining reforestation initiatives. For example, research indicates that grasses and herbaceous plants primarily inhabit the majority of reclaimed mined areas, while the establishment of trees is impeded by elevated soil density. Ripping or decompaction techniques can markedly improve tree growth on these rehabilitated sites.[39]

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[37] James Mitchell, 'Pulling the Rug out from under: The Land Tenure Dynamics of Mining Concessions in Sub-Saharan Africa', *The Extractive Industries and Society*, 3.4 (2016), pp. 1117–29, doi:https://doi.org/10.1016/j.exis.2016.10.003.

[38] Thandekile Dube and others, 'Assessment of Land Use and Land Cover, Water Nutrient and Metal Concentration Related to Illegal Mining Activities in an Austral Semi–Arid River System: A Remote Sensing and Multivariate Analysis Approach', *Science of The Total Environment*, 907 (2024), p. 167919, doi:https://doi.org/10.1016/j.scitotenv.2023.167919.

[39] Terah U De Jong and Titus Sauerwein, 'State-Owned Minerals, Village-Owned Land: How a Shared Property Rights Framework Helped Formalize Artisanal Diamond Miners in Côte d'Ivoire between 1986 and 2016', *Resources Policy*, 70 (2021), p. 101920, doi:https://doi.org/10.1016/j.resourpol.2020.101920; Vimal

The notion of post-mining land use in the United States transcends simple restoration, incorporating the delivery of diverse ecosystem services and addressing societal requirements. Post-mining land uses are widely recognized and encompass agriculture, forestry, wildlife habitats, and zones earmarked for development. Various considerations, such as ecological potential, community preferences, prevailing regulations, and the site's inherent physical attributes, frequently influence determining particular land use. As a result, an essential aim of effective reclamation initiatives is to discern and incorporate community requirements and ecological sustainability into land-use planning.[40]

Furthermore, the established rehabilitation practices in areas such as Appalachia underscore the necessity for appropriate soil reconstruction to foster sustainable ecosystems, including grasslands and forests. In diverse regions nationwide, methodologies have developed that aim to harmonize economic sustainability with ecological soundness. For example, although a considerable percentage of Virginia's reclaimed lands are intended for forestry, they frequently fail to sustain long-term productivity because of insufficient design and management approaches during the reclamation process. The literature suggests a prevailing agreement on employing scientifically grounded management practices to achieve favorable results in post-mining reclamation initiatives.[41]

The practices surrounding post-mining land use in the United States illustrate a multifaceted relationship among ecological restoration, community requirements, and regulatory structures designed to mitigate the adverse effects of mining operations. The practice of mining frequently results in considerable land degradation, thus necessitating

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Chandra Pandey and others, 'Chapter 1 - The Agricultural Extensification on Polluted Lands', in *Designer Cropping Systems for Polluted Land*, ed. by Vimal Chandra Pandey and others (Elsevier, 2024), pp. 1–84, doi:https://doi.org/10.1016/B978-0-323-95618-5.00004-X.

[40] George Ofosu and Francis Arthur-Holmes, 'Transforming Ghana's ASM Industry: The Intersection of "Mining Schemes" and Stakeholder Collaboration', *Resources Policy*, 105 (2025), p. 105610, doi:https://doi.org/10.1016/j.resourpol.2025.105610; De Jong and Sauerwein, 'State-Owned Minerals, Village-Owned Land: How a Shared Property Rights Framework Helped Formalize Artisanal Diamond Miners in Côte d'Ivoire between 1986 and 2016'.

[41] Pandey and others, 'Chapter 1 - The Agricultural Extensification on Polluted Lands'.

the implementation of effective post-mining strategies to restore ecological integrity and facilitate sustainable land uses.[42]

An esteemed methodology involves classifying and strategizing permissible post-mining land utilisations, which may encompass prime agricultural land, hayfields, biofuel cultivation, forestry, wildlife habitats, and development tailored to community requirements. The aim in this context transcends the simple act of land reclamation; it seeks to refine the land for prospective uses, thus guaranteeing the restoration and augmentation of ecosystem services. Policies that support these applications have been developed and underscore the significance of addressing local societal requirements and ecological integrity.[43]

The methodologies employed in land reclamation exhibit considerable diversity across various mining regions within the United States, especially when contrasting the Eastern coal region with other areas. In the Eastern regions, a concerted effort has been made to rehabilitate forests and wildlife habitats, fostering biodiversity and enhancing ecological integrity. The selection of post-mining land use necessitates a thorough examination of the environmental repercussions of mining activities, including soil degradation and contamination, which may hinder the success of reclamation efforts if not properly managed.[44]

The implementation of revegetation initiatives and restoration methodologies constitutes a fundamental aspect of land management following mining activities. The effective rehabilitation of plant communities can elevate the aesthetic value of mined terrains while simultaneously fostering enhancements in air and soil quality and bolstering the resilience of the broader ecosystem. Methods involving engineered soils sourced from industrial by-products have been explored for their capacity to function as viable growth substrates in reclamation initiatives. These practices underscore the

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[42] De Jong and Sauerwein, 'State-Owned Minerals, Village-Owned Land: How a Shared Property Rights Framework Helped Formalize Artisanal Diamond Miners in Côte d'Ivoire between 1986 and 2016'.
[43] Pandey and others, 'Chapter 1 - The Agricultural Extensification on Polluted Lands'.
[44] Shunlin Liang and others, 'Advancements in High-Resolution Land Surface Satellite Products: A Comprehensive Review of Inversion Algorithms, Products and Challenges', *Science of Remote Sensing*, 10 (2024), p. 100152, doi:https://doi.org/10.1016/j.srs.2024.100152.

importance of tailoring contemporary reclamation strategies to align with the community's ecological goals and aspirations.[45]

Moreover, the socio-economic dimensions of post-mining land utilization, including community perceptions and anticipations, significantly influence the efficacy of these initiatives. Local communities are becoming more engaged in the reclamation process, highlighting the necessity for land uses that resonate with their values and foster economic opportunities, including agriculture and tourism. Effective communication and stakeholder engagement are essential in formulating post-mining land use policies that align with community aspirations while promoting environmental sustainability.[46]

Ultimately, land use practices following mining activities in the United States are continuously developing and progressively shaped by the tenets of sustainability and the involvement of local communities. Continuous inquiry and the formulation of policies are crucial for enhancing land utilization post-mining, ensuring the preservation of environmental integrity alongside the fortification of socio-economic resilience.[47]

In summary, while significant advancements have been made in post-mining land use practices across the United States, challenges remain. Emphasizing the importance of community engagement, incorporating ecological evaluations into decision-making frameworks, and refining rehabilitation methodologies are crucial for improving the effectiveness of habitat restoration efforts. The potential for developing functional and sustainable landscapes post-mining can be significantly enhanced by harmonizing regulatory frameworks and community interests with ecological restoration objectives. Furthermore, adopting agroforestry is gaining acknowledgment, particularly in regions where tree cultivation can enhance soil vitality and sequester carbon emissions. When reimagined as landscapes that harmoniously blend agricultural and forested components,

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[45] George Ofosu and Francis Arthur-Holmes, 'Transforming Ghana's ASM Industry: The Intersection of "Mining Schemes" and Stakeholder Collaboration', *Resources Policy*, 105 (2025), p. 105610, doi:https://doi.org/10.1016/j.resourpol.2025.105610.

[46] Heidi Hausermann and others, 'Land-Grabbing, Land-Use Transformation and Social Differentiation: Deconstructing "Small-Scale" in Ghana's Recent Gold Rush', *World Development*, 108 (2018), pp. 103–14, doi:https://doi.org/10.1016/j.worlddev.2018.03.014.

[47] Claudia Coral and others, 'Understanding Institutional Change Mechanisms for Land Use: Lessons from Ecuador's History', *Land Use Policy*, 108 (2021), p. 105530, doi:https://doi.org/10.1016/j.landusepol.2021.105530.

regions once earmarked for mining can generate economic advantages while concurrently promoting environmental restoration. This environmentally aware approach reflects broader initiatives prioritizing sustainable land-use practices post-extraction, aiming to address the persistent issues associated with mining operations. The methodologies associated with post-mining land utilization in the United States demonstrate a commitment to restoring previously mined regions' ecological integrity while providing socio-economic benefits through diverse land-use approaches, including agriculture, recreation, and habitat restoration. Ensuring the sustainability of these practices requires ongoing investigation into soil management, proactive community involvement, and rigorous adherence to regulatory frameworks that promote ecological integrity and functionality.

Post-Mining Land Use Regulations and Practices for Indonesia: Lessons from U.S.A

Over the decades, the evolution of post-mining land management and practices in the United States offers insightful lessons for nations such as Indonesia, which grapple with the complexities associated with mining operations. A comprehensive grasp of the policies, regulations, and best practices utilized in the U.S. can provide a foundational framework for Indonesia as it endeavors to attain sustainable land reclamation and land use following mining activities.[48]

In the United States, recognized post-mining land utilisations encompass prime agricultural land, habitats for wildlife, recreational spaces, and forestry activities. Skousen and Zipper assert that effective reclamation policies must be customized to address societal requirements, reinstating ecosystem services, promoting biodiversity, and enabling new land uses that resonate with community values and environmental potential. This comprehensive approach entails evaluating factors such as community preferences and soil conditions to ascertain appropriate post-mining land uses.[49]

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[48] Ernesto López-Morales and others, 'Land and Housing Price Increases Due to Metro Effect: An Empirical Analysis of Santiago, Chile, 2008–2019', *Land Use Policy*, 132 (2023), p. 106793, doi:https://doi.org/10.1016/j.landusepol.2023.106793.

[49] David de Barros Galo, José Ângelo Sebastião Araújo dos Anjos, and Luis Enrique Sánchez, 'Are Mining Companies Mature for Mine Closure? An Approach for Evaluating Preparedness', *Resources Policy*, 78 (2022), p. 102919, doi:https://doi.org/10.1016/j.resourpol.2022.102919.

An essential aspect of proficient post-mining management is the formulation of comprehensive mine reclamation plans, which are necessitated by regulatory frameworks that demand an assessment of environmental consequences. For example, Hasii and Gasii emphasize the significance of environmental management in revitalizing land productivity after closure, which impacts the selection of reclamation strategies. Furthermore, the cohesive strategies articulated by Wang et al. underscore the significance of utilizing adaptive management methodologies to tackle issues like soil degradation and pollution risks, thereby enhancing vegetation cover progressively through deliberate planting and maintenance efforts.[50]

In sustainable management practices, Indonesia stands to gain knowledge derived from adaptive land-use planning strategies utilized in the United States. Regions that have undergone mining activities can be transformed for many sustainable applications, such as agriculture, forestry, and eco-tourism, all of which present economic viability and environmental integrity. The notion of post-mining agricultural land, as elucidated by Ansahar et al., presents promising strategies for repurposing land while ensuring the preservation of soil health and productivity. Moreover, Fogarty et al. promote a collaborative methodology that engages local communities in decision-making regarding post-mining land use, thus improving reclamation initiatives' social acceptance and efficacy.[51]

Land management following mining activities is pivotal to environmental restoration and sustainability initiatives. The experiences observed in the United States offer significant insights for Indonesia in formulating effective reclamation strategies following mining activities, especially as it confronts analogous environmental challenges associated with open-pit coal mining.[52]

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[50] Ebenezer Ebo Yahans Amuah and others, 'Environmental Impact Assessment Practices of the Federative Republic of Brazil: A Comprehensive Review', *Environmental Challenges*, 13 (2023), p. 100746, doi:https://doi.org/10.1016/j.envc.2023.100746.

[51] Vimal Chandra Pandey and others, 'Chapter 6 - Sustainability of Aromatic Plant Cultivation on Polluted Lands', in *Aromatic Plant-Based Phytoremediation*, ed. by Vimal Chandra Pandey and others (Elsevier, 2024), pp. 189–238, doi:https://doi.org/10.1016/B978-0-443-19082-7.00002-6.

[52] L A James, S A Lecce, and R T Pavlowsky, '6.52 - Impacts of Land-Use and Land-Cover Change on River Systems', in *Treatise on Geomorphology (Second Edition)*, ed. by John (Jack) F Shroder, Second Edi (Academic Press, 2022), pp. 1191–236, doi:https://doi.org/10.1016/B978-0-12-818234-5.00089-4.

In the United States, especially within the Appalachia region, the Surface Mining Control and Reclamation Act (SMCRA) of 1977 represented a pivotal transformation towards enforced reclamation practices designed to rehabilitate mined lands for productive purposes or to facilitate more valuable post-mining land uses. Post-mining land uses that have gained acceptance encompass prime farmland, hay land, biofuel crops, forestry, wildlife habitat, and urban development. Regulations have been established to promote effective land restoration, ensuring the provision of ecosystem services essential for the requirements of future societies. The execution of the Forestry Reclamation Approach (FRA) stands out for its focus on reinstating native forests, thereby augmenting both ecological and economic values on lands that have previously undergone mining activities.[53]

The evolution of reclamation practices over the years reflects a thoughtful response to the pressing environmental challenges posed by soil compaction and fertility issues commonly found on mined lands. Compacted soils frequently undermine reforestation initiatives, requiring strategies to mitigate soil compaction to promote robust tree growth and enduring land utilization. Enhancing the physical and chemical properties of soil and carefully selecting appropriate vegetation is essential for attaining successful reclamation results. The existence of varied plant life has demonstrated a capacity to enhance hydrological properties and facilitate ecological rejuvenation.[54]

Insights drawn from U.S. experiences highlight the imperative for cohesive planning incorporating biodiversity and habitat restoration with economic recovery efforts. The deliberate selection of land use in reclamation demonstrates a comprehension of the necessary equilibrium between ecological restoration and economic sustainability. Successful reclamation transcends the simple act of restoring land to its former condition;

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[53] De Jong and Sauerwein, 'State-Owned Minerals, Village-Owned Land: How a Shared Property Rights Framework Helped Formalize Artisanal Diamond Miners in Côte d'Ivoire between 1986 and 2016'; Pandey and others, 'Chapter 1 - The Agricultural Extensification on Polluted Lands'.

[54] Daivi Rodima-Taylor, 'Digitalizing Land Administration: The Geographies and Temporalities of Infrastructural Promise', *Geoforum*, 122 (2021), pp. 140–51, doi:https://doi.org/10.1016/j.geoforum.2021.04.003.

it necessitates the development of functionalities that harmonize with ecological integrity and promote enduring land sustainability.[55]

In Indonesia's mining practices, particularly following the reforms instituted by the New Mining Act (2020), it is imperative to enhance reclamation obligations akin to those implemented in the United States. By examining the diverse post-mining land management strategies implemented in the U.S., Indonesia can aspire to refine its reclamation policies to promote environmental sustainability and economic advancement. Integrating community-oriented strategies in reclamation is crucial, as it can enhance adherence to regulations and promote a comprehensive and inclusive methodology for land restoration following mining activities. In summary, incorporating U.S. reclamation principles and practices presents a viable approach for Indonesia to address the adverse effects of mining, optimize land use, and ultimately bolster ecological resilience while confronting the intricacies of post-mining environments.[56]

The success of reclamation initiatives fundamentally hinges on applying scientifically supported best management practices that emphasize ecological restoration and the enhancement of biodiversity. In the United States, longitudinal studies of ecological reclamation reveal that effective practices, including topsoil replacement and customized planting strategies, markedly enhance the likelihood of successful revegetation of mined lands. This understanding requires adaptation to the specific local contexts in Indonesia to effectively address ecological risks and enhance post-mining landscapes.

In summary, the reclamation and management of post-mining lands pose intricate challenges that require proactive and adaptive strategies. The United States presents a framework distinguished by its robust policies and pragmatic implementations that Indonesia could adopt. Future practices in Indonesia should pursue a harmonious

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[55] Ian D Hodge and William M Adams, 'Property Institutions for Rural Land Conservation: Towards a Post-Neoliberal Agenda', *Journal of Rural Studies*, 36 (2014), pp. 453–62, doi:https://doi.org/10.1016/j.jrurstud.2014.05.004.

[56] Martín Obaya, Diego I Murguía, and Daniela Sánchez-López, 'From Local Priorities to Global Responses: Assessing Sustainability Initiatives in South American Lithium Mining', *The Extractive Industries and Society*, 19 (2024), p. 101509, doi:https://doi.org/10.1016/j.exis.2024.101509; Xiangzheng Deng and others, 'Agricultural Land-Use System Management: Research Progress and Perspectives', *Fundamental Research*, 2024, doi:https://doi.org/10.1016/j.fmre.2024.10.012; Thomas Measham and others, 'Beyond Closure: A Literature Review and Research Agenda for Post-Mining Transitions', *Resources Policy*, 90 (2024), p. 104859, doi:https://doi.org/10.1016/j.resourpol.2024.104859.

equilibrium that fosters sustainable development, upholds environmental integrity, and encourages active community participation.

4. CONCLUSION

The study's findings indicate that the governance and implementation of post-mining land utilization in the United States are grounded in the Surface Mining Control and Reclamation Act (SMCRA) alongside an array of federal regulations. Consequently, post-mining land use in the United States is directed toward public objectives, including establishing airports, shopping centers, and industrial zones. Rigorous oversight is implemented on post-mining land before its designation as appropriate for utilization. Particular protocols for soil management are implemented when extraction activities occur on prime agricultural terrain. The achievement of reclamation is fundamentally contingent upon applying empirically validated best management practices, which prioritize ecological restoration and the enhancement of biodiversity. In the United States, longitudinal studies on ecological reclamation demonstrate that effective practices, such as surface soil replacement and customized planting strategies, markedly enhance the probability of successful revegetation of former mining sites. This comprehension necessitates a nuanced approach tailored to the unique local context of Indonesia in order to effectively mitigate ecological risks and enhance post-mining landscapes. In conclusion, the intricacies of reclamation and post-mining land management necessitate implementing proactive and adaptive strategies to address their multifaceted challenges. The United States presents a structured approach defined by robust policies and effective execution that Indonesia may consider adopting. Future practices in Indonesia should strive for a harmonious equilibrium that fosters sustainable development, upholds environmental integrity, and stimulates active community engagement.

5. CONFLICTING INTEREST STATEMENT

The authors state that there is no conflict of interest in the publication of this article.

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