



Building Environmental Sustainability through Reclamation and Management of Non-Forestry Cultivation Areas for the Coal Mining Industry

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Abstract: The coal mining industry has a significant impact on the environment, especially through ecosystem damage and land degradation. This study discusses the importance of reclamation and management of non-forestry cultivation areas to build environmental sustainability around mining areas. Reclamation aims to restore the ecological function of post-mining land through replanting, soil management, and natural habitat improvement. In addition, proper management of non-forestry cultivation areas can support ecological balance and economic sustainability for local communities. This study examines effective reclamation methods and sustainable management strategies for non-forestry cultivation areas, as well as their implications for environmental sustainability and the welfare of surrounding communities.

Keywords: Environmental Sustainability, Reclamation, Management of Non-Forestry Cultivation Areas, Coal Mining Industry, Land Degradation, Ecosystem Restoration, Economic Sustainability, Community Welfare.

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1. Introduction

Reclamation and management of non-forestry cultivation areas on former coal mine land is an important step in building environmental sustainability [1], [2]. With an integrated approach, involving multiple stakeholders, and supportive policies, reclamation efforts can provide sustainable economic and ecological benefits [3], [4], [4], [4], [5].

Coal mining is one of the industries that has a major impact on the environment [6]. The mining process results in, among others, deforestation and habitat loss; soil degradation and land topography change; and Water and air pollution due to waste and emissions from coal mining and processing processes. After the mining process is completed, ex-mining land often becomes unproductive critical land. Reclamation is the process of restoring the land into land that can be reused for various activities, including non-forestry cultivation activities [5].

Reclamation of former coal mining land involves several important steps, namely returning the soil to

a more stable and productive condition; replanting local vegetation to restore the ecosystem; and Establishing a good water management system to prevent erosion and pollution [7] Non-forestry cultivation, such as agriculture, livestock, and horticulture, can be a good alternative to the use of ex-mining land [8] The advantages of managing non-forestry cultivation areas include improving the welfare of local communities through the provision of jobs and sources of income; reducing dependence on the exploitation of non-renewable natural resources; and support environmental sustainability with environmentally friendly farming practices [9].

Strict government regulations are needed to ensure that mining companies are properly reclaiming (Burger, 2011; Singh et al., 2017). Some of the key policies include regulations on post-mining land reclamation and restoration obligations; supervision and law enforcement against companies that do not comply with regulations; and incentives for companies that succeed in reclaiming well and contributing to environmental sustainability. Active community participation and support from academics are very important in the process of reclamation and management of non-forestry cultivation areas (Long, 2023; Sazili et al., 2023). Education and training for local communities on good reclamation and cultivation techniques can increase the effectiveness of the program [14], [15].

2. Background to Our Papers

Building environmental sustainability through reclamation and management of non-forestry cultivation areas in the coal mining industry faces several very critical urgency and challenges [16], [17] Some of them are as follows: first, ecosystem degradation and biodiversity loss, coal mining activities often cause major damage to natural habitats, which impacts biodiversity [18], [19] Improper reclamation can exacerbate environmental damage. Mining can result in the loss of endemic and endangered species due to drastic changes in the natural environment of local communities [18], [20].

Second, Environmental Pollution through mining waste, such as tailings and mining acids, can contaminate water sources and soils, resulting in serious health impacts for humans and ecosystems. Coal mining activities produce dust and toxic gas emissions that contribute to air pollution and climate change [18], [20].

Third, Soil Erosion and Damage, so in the mining process it can damage the soil structure, resulting in more severe erosion and a decrease in soil fertility. Difficult Recovery: Soils damaged by coal mining are difficult to reclaim to conditions that support native biodiversity [21][22] .

Fourth, social and economic disruption because in general mining activities can displace local communities and damage their livelihoods that depend on local land and natural resources. The distribution of economic benefits from mining is often uneven, leading to social and economic inequalities in local communities [23].

Fifth. Regulatory complexity and compliance It was found that many mining companies do not strictly adhere to environmental regulations, either due to negligence or lack of effective law enforcement. Existing regulations are often not strong enough or not fully implemented to protect the environment and society from the negative impacts of mining [1], [24].

Sixth, long-term risks and public health such as pollution from coal mining activities can cause serious health problems, including respiratory diseases, cancer, and skin diseases. The environmental impacts of coal mining can last long after the mine is closed, requiring long-term monitoring and rehabilitation efforts [25], [26].

Problem Formulation 1). What is the Effectiveness of Regulations and Policies Related to Reclamation and Management of Non-Forestry Cultivation Areas in the Coal Mining Industry?, 2) What is the Impact of Reclamation and Management of Non-Forestry Cultivation Areas on Environmental Sustainability and the Welfare of Local Communities?, and 3) What are the Roles and Challenges of the Government in Supervising and Encouraging Reclamation and Management of Non-Forestry Cultivation Areas in the Coal Mining Industry?.

The purpose of this study is to restore the ecological function of post-mining land through replanting,

soil management, and natural habitat improvement. In addition, proper management of non-forestry cultivation areas can support ecological balance and economic sustainability for local communities. The other is to investigate the effectiveness of regulations, the impact of reclamation, and the government's role in monitoring and encouraging reclamation and management of non-forestry cultivation areas in the coal mining industry.

3. Methodology

The type of research used is the survey method, with a qualitative descriptive approach, namely through exploratory observations in the field and then analyzing the data obtained from the field to get an overview of the implementation of reclamation of ex-mining land carried out by the company and how the company's efforts to optimize the reclamation pattern and evaluate the results of the reclamation whether it is in accordance with the RKTTL Document and Plan Document Reclamation.

Data collection through primary data was obtained directly through field observations and interviews with employees who were directly involved in reclamation activities. The observation was carried out in the field to obtain factual data on the state of reclamation of ex-mining land at pt. Mahakam sumber jaya (MSJ). Secondary data was obtained from various sources in the form of data collected from the east kalimantan provincial mining and energy office and various related agencies. The data analysis technique uses mille and huberment theory, stating that there are three components of qualitative data analysis, namely: data reduction, data display, and conclusion drawing/verification. The research locations are as follows:

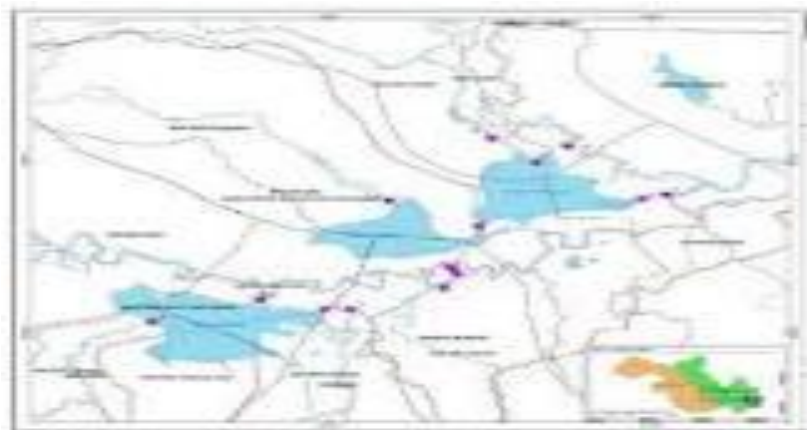


Figure 1. Location of PT. Mahakam Sumber Jaya (MSJ)

The development of the research instruments used and their application in the research process is by means of limited interviews, namely in the form of conversations between interviewers and respondents, the answers submitted by the respondents are painted as necessary. Furthermore, data collection is carried out by direct observation in the field. The main requirements that must be met in this observation technique are the clarity of the criteria to be observed and consistency in assessing the criteria that have been set. To determine the success rate of reclamation implementation in the former mining area of the Non-Cultivation Forestry Zone (KBNK), standards are needed from the Regulation of the Minister of Energy and Mineral Resources No. 18 of 2008 as follows:

Table 1 Criteria for Successful Reclamation in the KBNK Area

No	Kegiatan Reklamasi	Kegiatan	Parameter	Rencana	Realisasi	Standar Keberhasilan			Hasil Evaluasi
						Baik	Sedang	Buruk	
1				man >pohon		(dilaskan a kan sempurna)	dilaksanakan)	yg dilaksanakan)	
		Penebaran tanah zona pengakaran	a. Luas areal yang ditabur	27(ha)	9.02(ha)	>75 dari rencana	50-75% dari rencana	<50% dari rencana	
		Penanaman	b. pH tanah	6-8	3,4-7,8	5-6	4,5-5	<4,5	
2	Penanaman		a. Luasareal penanaman	18(ha)	4,26(ha)	>80% Dari rencana	60-79% Dari rencana	<60% Dari rencana	
			a.Jenis tanaman	>Segon >Meranti >Kapur >ulin >nuah	>Segon >Meranti >Kapur >ulin	>80% Sesuai rencana	60-80% dari rencana	<60 Dari rencana	
			b. Pertumbuhan tanaman	90%	85%	>80% Rasio tumbuh	60-80%	<60%	
	Pemeliharaan		a. Pemupukan	100%	80	>80% Dari rencana	60-79% Dari rencana	<60% Dari rencana	
			b. Pengendalian gulma,hama dan penyakit			berdasarkan hasil analisis	Kurang berdasarkan hasil analisis	Tidak berdasarkan hasil analisis	
			c. Penyulaman	100%	90%	>80% Dari jumlah tanaman yg mati	60-79% Dari jumlah tanaman yg mati	<60% Dari jumlah tanaman yg mati	
3	Penyelseaian Akhir	Pemenuhan Standar Reklamasi	Prosentase Keberhasilan	90%	85%	>80% Sesuai tingkat keberhasilan Reklamasi	60-79% Kurang Sesuai tingkat keberhasilan Reklamasi	<60% Tidak Sesuai tingkat keberhasilan Reklamasi	

4. Discussion

Regulatory effectiveness:

Law Number 3 of 2020 and the Job Creation Law strengthen and clarify provisions on post-mining land reclamation and restoration obligations. Mining business license holders are required to carry out reclamation and post-mining in accordance with the approved plan, provide guarantee funds, and report the implementation of these activities to the government. Effective implementation of these regulations is essential to maintain ecological balance and environmental sustainability after mining activities are completed.

The government through the Ministry of Energy and Mineral Resources, the Provincial Mining Office, and other related agencies supervise the implementation of reclamation and post-mining. Companies that do not fulfill their obligations may be subject to administrative sanctions, including revocation of business licenses. Law Number 3 of 2020 amends several provisions in Law Number 4 of 2009, including provisions on the obligation to reclaim and restore post-mining land. Some important points related to these obligations in Law Number 3 of 2020 are as follows:

1. Article 99, Paragraph (1): IUP and IUPK holders are obliged to carry out reclamation and post-mining. Paragraph (2): Reclamation and post-mining as intended in paragraph (1) shall be carried out in accordance with the reclamation plan and post-mining plan approved by the Minister, governor, or regent/mayor in accordance with their authority.
2. Article 100, Paragraph (1): IUP and IUPK holders are obliged to provide reclamation guarantee funds and post-mining guarantee funds. Paragraph (2): The reclamation guarantee fund and the post-mining guarantee fund as intended in paragraph (1) are placed in government banks. Paragraph (3): Reclamation guarantee funds and post-mining guarantee funds can be disbursed in accordance with the implementation of the stages of reclamation and post-mining activities.
3. Article 101, Paragraph (1): Ministers, governors, or regents/mayors in accordance with their authority shall evaluate the implementation of reclamation and post-mining. Paragraph (2): In the event that IUP and IUPK holders do not carry out their reclamation and post-mining obligations, the reclamation guarantee fund and post-mining guarantee fund can be disbursed by the government to carry out the reclamation and post-mining.

The Job Creation Law or Omnibus Law also changes several provisions in Law Number 4 of 2009 concerning Mineral and Coal Mining, including regarding reclamation and post-mining. Some important points related to these obligations in the Job Creation Law are Article 39, amendments to Article 99 of the Mineral and Mineral Law: The Job Creation Law strengthens reclamation and post-mining obligations by adding more detailed provisions on the preparation, implementation, and evaluation of reclamation plans and post-mining plans. Amendments to Article 100 of the Mineral and Mineral Law: The Job Creation Law emphasizes the obligation to provide reclamation guarantee funds and post-mining guarantee funds as well as the disbursement procedure.

National regulations and corporate policies governing the reclamation and management of non-forestry cultivated areas in the mining industry are designed to ensure that mining activities not only meet legal obligations but also contribute positively to environmental sustainability and the well-being of local communities [27]. Compliance with regulations and the implementation of strong internal policies are essential to achieving goals [28]. Regulatory conditions related to mining continue to evolve to improve environmental sustainability and the well-being of local communities. Compliance with these regulations and the implementation of progressive internal policies are essential to ensure that the mining industry can operate responsibly and sustainably. The following are the rules that govern.

Law Number 3 of 2020 concerning Amendments to Law Number 4 of 2009 concerning Mineral and Coal Mining (Mineral and Coal Mining Law). Emphasizing the company's obligation to carry out reclamation and post-mining. It also strengthens the provisions on the provision of reclamation and post-mining guarantee funds. Meanwhile, in Law Number 11 of 2020 concerning Job Creation (Job Creation Law or Omnibus Law), several provisions in the Mineral and Mineral Law and the Environmental Protection and Management Law (PPLH Law) have been amended. Simplify licensing procedures and strengthen

supervision of reclamation and environmental management activities. Requires the preparation of an Environmental Management Plan (RKL) and an Environmental Monitoring Plan (RPL) as part of the requirements for environmental permits.

Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Penyelenggaraan dan Pengelolaan Lingkungan Hidup Sebagai pelaksanaan dari UU Cipta Kerja, mengatur lebih lanjut tentang tata cara penyusunan, penilaian, dan persetujuan dokumen lingkungan. Menetapkan mekanisme pengawasan dan penegakan hukum terhadap pelanggaran lingkungan. Berdasarkan peraturan menteri lingkungan hidup dan kehutanan nomor 1 tahun 2021 tentang Program Penilaian Peringkat Kinerja Perusahaan Dalam Pengelolaan Lingkungan Hidup (PROPER). Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 7 Tahun 2020 tentang Tata Cara Penetapan dan Evaluasi Rencana Pasca-Tambang serta Kewajiban Reklamasi dan Pasca-Tambang pada Kegiatan Usaha Pertambangan. Mengatur prosedur penetapan dan evaluasi rencana pasca-tambang. Menetapkan kewajiban perusahaan untuk menyediakan dana jaminan reklamasi dan pasca-tambang [11], [29], [30].

Impact of Reclamation and Management of Non-Forestry Cultivation Areas on Environmental Sustainability and Local Community Welfare

Mining activities of PT. Mahakam Sumber Jaya is carried out with an open mining system (*surface mining/open mine*). In order to increase production, the activities of stripping the top soil, excavating and removing the *overburden* and quarrying coal are all carried out mechanically using heavy equipment on several mine blocks simultaneously. The mining stages that will be carried out include:

1. Land Clearing

Activities at this stage include felling trees, cleaning the cover soil from cover plants. At this stage, the equipment used includes: *excavators* and *bulldozers*. The *land clearing* process is carried out using human labor with heavy equipment. Wooden stands with a diameter of more than 30 cm are cut using *chainsaws*, while small wooden stands, shrubs and tree pillars are knocked down using bulldozers. Shrubs, leaves and branches of wood that have been cleaned are collected in a place that does not interfere with the mining process and can be used for construction purposes.



Figure 1. *Land Clearing Activities* in Block D

The impact on the environment from *land clearing* activities is an increase in the rate of soil erosion, especially during the rainy season. Erosion will have a further impact on decreasing soil fertility and turbidity of the waters around the location. In addition, land clearing activities have an impact on the existence of local flora and fauna.

2. Top Soil Stripping

Activities at this stage include excavation of cover soil in the form of soil with a thickness of 1.5 m which is usually reddish in color. After being excavated, it is then transported to the disposal soil area or *stock soil area*. The equipment used includes: excavator, *shovel*, *Dozer*, *DT/Articulate dump truck*. Topsoil is a soil that has high nutrients and is very necessary to restore soil fertility. The thickness of the peeled topsoil layer is between 20-60 cm. Stripping of topsoil is carried out after clearing the land using an excavator. The peeled top soil is then collected in a special place that is protected from the danger of erosion, so that it can be used for the purpose of reclamation of ex-mining land in the future.



Figure 2. Top Soil Picking Activities

Table 2. Stripping and Filling of Soil and *Blue Clay*

Top soil stripping consists of the type of material, location of peeling, stockpiling, total and unit.				
Soil and Blue Clay				
Kind Material	Location Materials	Location Hoarding	Total	Unit
Soil & Blue Clay	J2-1S CK	BF K0-1	58,296.24	Bcm
	M3-34 CK	Disp, Stock soil M3-34	1,989,037.45	Bcm
	J2-1N LCI	Disp, stock soil LW East	28,770.44	Bcm
	M3-34 LCI	Disp, Stock soil M3-34	7,131,279.39	Bcm
Total			9,207,383.53	Bcm

Table 3. Soil Stripping and Filling

Soil				
Kind Material	Location Stripping	Location Hoarding	Total	Unit
Soil	M3-34 CK	Stock soil M3-34	176,546.16	bcm
	M3-34 LCI	Stock soil M3-34	304,347.96	bcm
Total			480,894.12	bcm

The *Top Soil/Sub Soil* (Soil) layer is a layer of soil that is relatively fertile and is a place for plants to grow. The nutrient content and other soil properties in the soil layer are much better than the layer below. Visually in the field, the soil layer is characterized by red, yellowish-red or brownish-red, and the soil layer underneath is usually whitish-yellow or gray. Physically, it is usually characterized by the presence of plant roots in the soil layer and the clay content is high (sticky). The thickness of the soil layer depends on the slope of the land. On flat land, the soil layer is usually very thick, while on slope land, it is less thick. The average layer thickness is about 2 m. For reclamation activities of ex-mining land, the soil layer must be saved and protected from contamination by *overburden* (*blue clay*) and *reject* coal, so that the growth of reclaimed plants is good. If the *disposal* or pit dump land is not ready to be coated with soil, while soil layer excavation activities must be carried out, then a location must be found for soil stockpiles. If the disposal or pit *dump* land is ready to be layered, then the need for soil layering can be taken from the location of the soil stockpile. *Stock soil* piles must be protected from erosion by planting *cover crops* and regulating surface water flow.

Impact on Environmental Sustainability is due to the fact that reclamation often involves altering native landscapes that can damage local ecosystems, including mangrove forests, seagrass meadows, and other marine habitats [31] Reclamation activities can lead to increased sedimentation and pollution that can damage water quality and disrupt aquatic biota life. Inappropriate land use can lead to erosion and deterioration of soil quality, which has an impact on long-term land productivity. Hydrological Disturbances: Reclamation can alter water flow patterns, potentially causing flooding or drought in the surrounding area [32].

The impact on the welfare of local communities is that reclamation often involves the eviction of people living in the area and can deprive them of their livelihoods, especially for fishermen and farmers. On the other hand, reclamation can create new job opportunities, both during the construction phase and in the management of new areas being built. Large-scale development can change the social and cultural structure of local communities, both in terms of housing patterns, social interaction, and local culture.

Land-use change often creates conflicts between local communities, governments, and developers, especially if there is no community consultation and participation in the planning process. Efforts to minimize negative impacts and maximize the benefits of reclamation and management of non-forestry cultivated areas, some steps that can be taken include:

1. Conduct a comprehensive environmental impact study before starting a reclamation project to identify and manage potential negative impacts.
1. Involve local communities in the planning and decision-making process to ensure that their interests and needs are taken into account.
2. Undertaking efforts to restore degraded ecosystems, such as mangrove forest rehabilitation and marine habitat restoration.
3. Adopt a management approach that considers the balance between development and environmental conservation.
4. Ensure that there are policies and regulations in place that support sustainable environmental management as well as effective law enforcement.

The Government's Role and Challenges in Supervising and Encouraging Reclamation and Management of Non-Forestry Cultivation Areas in the Coal Mining Industry

The government has a very large role in accordance with article 33 paragraph 3 of the 1945 Constitution of the Republic of Indonesia, to manage coal potential. Through the constitution, the government has a mandate to manage coal mining, but it is intended for the greatest possible prosperity of the people. Therefore, it is a word discourse controlled by the state. "The earth and water and the natural resources contained in it are controlled by the state and used for the greatest possible prosperity of the people", meaning that the word controlled by the state is only limited to civil privacy, so the role of the government is not to own but to take care of and manage it as well as possible.

Likewise, law enforcement against companies that do not comply with regulations on post-mining reclamation involves various government agencies and strict sanctions mechanisms. Effective supervision and strict law enforcement are important to ensure mining companies are responsible for the environment and surrounding communities, and support the sustainability of the post-mining environment.

Supervision of the implementation of reclamation and post-mining is carried out by several government agencies in accordance with the level of authority. The Ministry of Energy and Mineral Resources (EMR), through the Directorate General of Minerals and Coal (Ditjen Minerba), Ministry of Energy and Mineral Resources is responsible for supervising and evaluating the implementation of reclamation and post-mining in companies that have mining business licenses (IUP) and special mining business permits (IUPK) issued by the central government. The Provincial Mining and Energy Office supervises the implementation of reclamation and post-mining in companies with permits issued by the provincial government.

Law enforcement against companies that do not comply with regulations on post-mining reclamation

involves several mechanisms and sanctions that can be applied. Like Administrative sanctions, based on Law Number 4 of 2009 concerning Mineral and Coal Mining and its amendments in Law Number 3 of 2020, as well as the Job Creation Law, administrative sanctions can be in the form of written warnings, temporary suspension of part or all exploration activities or production operations, and revocation of mining business licenses (IUP) or special mining business licenses (IUPK).

Disbursement of Reclamation and Post-Mining Guarantee Funds, if the company does not carry out its reclamation and post-mining obligations, the government is authorized to disburse the reclamation guarantee funds and post-mining guarantee funds that have been placed in government banks. The funds will be used to carry out reclamation and post-mining by a third party appointed by the government.

Criminal Sanctions, if violations of reclamation and post-mining provisions cause serious environmental damage, the company may be subject to criminal sanctions in accordance with applicable laws and regulations. This includes criminal sanctions based on the Environment Law and other related regulations. Fines, companies can also be subject to financial fines as part of administrative or criminal sanctions. The amount of the fine is determined based on the level of violation and the impact caused.

Law enforcement procedures typically involve the government by conducting regular inspections and audits as well as surprise inspections to ensure companies comply with reclamation and post-mining provisions. Companies are required to compile and submit periodic reports on reclamation and post-mining [33] This report is evaluated by the competent agencies such as the Ministry of Energy and Mineral Resources and Coal, the Ministry of Environment and Forestry. Several actions can be taken if errors are found in the evaluation process such as: Corrective Action, if non-compliance is found, the government can issue corrective action instructions that must be fulfilled by the company within a certain period of time. Application of Sanctions, if the company fails to comply with the instructions for corrective action, administrative or criminal sanctions are applied in accordance with the applicable provisions.

Rewarding companies that successfully reclaim and contribute to environmental sustainability is an important step to encourage responsible mining practices. Through awards, ease of licensing, partnerships, and public recognition, governments can create a supportive environment for companies to continuously improve their environmental performance and contribute to long-term sustainability. Gold and Green Proper: The Company Performance Rating Assessment Program in Environmental Management (PROPER) by the Ministry of Environment and Forestry (MoEF) assigns gold and green ratings to companies that have excellent environmental performance.

The government can provide various incentives to encourage mining companies to carry out post-mining land reclamation properly and contribute to environmental sustainability. These incentives can be in the form of financial incentives, awards, as well as ease of licensing and operational support. Here are some forms of incentives that can be given: Companies that successfully carry out land reclamation well can get tax incentives, such as:

First, Income Tax Reduction (PPh): Income tax deduction for expenses incurred in reclamation and environmental restoration activities. Kedu, Land and Building Tax Reduction (PBB): Discounts or exemptions of land and building taxes for land that has been reclaimed and used for environmentally friendly productive activities.

Awards from governments or environmental agencies can provide recognition to companies for their efforts in reclaiming and maintaining environmental sustainability. Examples of awards include, Kalpataru award: An award from the government for companies that show a high commitment to environmental conservation.

Companies that have a good track record in reclamation and environmental restoration can be given ease of approval for future projects, including:

First, Ease of Extension of Mining Business Licenses (IUP): A faster and simpler process for license extensions for companies with good environmental performance.

Second, Priority in Applying for New Permits: Companies can be prioritized in applying for permits for new mining areas or operational expansions.

The government can provide access to low-interest funding sources or grants to support reclamation and environmental management activities, such as the provision of low-interest credit through government banks or financial institutions for reclamation and environmental sustainability projects. Grants from governments or donor agencies to fund innovative projects in reclamation and environmental management.

The government can facilitate partnerships between companies and research institutions, universities, and NGOs to develop and implement best practices in reclamation and environmental sustainability. The benefits of this partnership include collaboration with research institutions to develop new technologies and methods in reclamation. A training program for company staff to improve their skills in environmental management.

Publication and promotion of the company's success in reclamation and environmental management through mass media and *government platforms* can enhance the company's reputation. This public recognition can provide long-term benefits in the form of improving the company's positive image in the eyes of the public, investors, and consumers. Increase trust from the government, the community, and other stakeholders.

The government has a key role in post-mining sustainability, the use of reclaimed ex-mining land can be carried out in various ways to support sustainable economic development. Here are some strategies that can be implemented:

1. After being reclaimed, the former mining land can be used for agriculture or plantations. Crops such as fruit trees, vegetables, or industrial crops such as oil palm and rubber can be planted to provide a long-term source of income for the surrounding community.
2. Former mining land can be converted into a livestock area for animals such as cows, goats, or sheep. In addition, the former mining ponds can be used for fish farming, which can be a source of protein and additional income for the community.
3. Reclamation of former mining land by replanting trees can help restore ecosystems and provide timber as an economic resource. Restored forests can also provide ecological benefits, such as carbon sequestration, biodiversity protection, and erosion control.
4. Ex-mining land that has been reclaimed and restored can be developed into an ecological tourism destination. This could include recreational parks, hiking areas, bird-watching, and other natural activities that attract tourists and support the local economy.
5. Former mining land can be used for renewable energy projects, such as the installation of solar panels or wind turbines. This not only provides a clean energy source but also provides jobs and increases local energy independence.
6. Ex-mining land can be used for the development of housing, schools, health facilities, and other infrastructure that supports the welfare of the community. This can help improve the quality of life of the surrounding community.
7. The former mining area can be used as a light industrial area or a place for small and medium enterprises (SMEs). This can create new jobs and diversify the economy in the area.

With the right approach, ex-mining land can be a valuable asset and support a sustainable economy and the welfare of local communities [34] To ensure that the use of ex-mining land is in accordance with the principles of sustainable development, several steps need to be taken: Conduct environmental impact assessments to ensure that reclamation projects do not create new negative impacts and comply with applicable environmental standards. Involve local communities in the planning and implementation process of reclamation projects to ensure that their needs and aspirations are met. Conduct continuous monitoring and evaluation to ensure that the reclamation is proceeding as planned and achieving the desired goals.

Table 4. Evaluation of the Implementation of Reclamation in the KNBK Area

No	Reclamation Activities	Activities	Parameter	Plan	Realization	Success Standards			Result Evaluation
						Good	Keep	Bad	
1.	Land Arrangement	Land clearing arrangement	a. Area laid out	27 (ha)	13,73 (ha)	>80%	60-79%	<60%	50,86%
			b. Stability of the pile	Stable	There are avalanches and erosion of grooves	There are no avalanches, only spark erosion	A slight avalanche, erosion of grooves occurs	Many avalanches, trench erosion formed	70%
		Restocking of ex-mining land	a. Area of landfill	0 (ha)	10,15 (ha)	>80%	60-79%	<60%	80%
			b. Stability of the pile	Stabil	Slight landslide and erosion of grooves	There are no avalanches, only spark erosion	A slight avalanche, only erosion of the grooves	Many avalanches, drainage erosion formed	70%
		Material Management of Mine Acid Water Plant	a. Material Management	PAF and NAF Analysis	About 75% are done	>80% of the plan	60-79% of the plan	<60% of the plan	85%
			b. Mine acid water management	Meet BML	Meet BML	Menuhi BML pH 6-9	-	Does not meet BML	90%
		Erosion control advice	a. Drainage channels	Well made	Not good	Well made	Makeshift	Not made	70%
			b. Erosion control buildings	No erosion	Groove erosion formed	There are no erosion grooves, only spark erosion is formed	There are few erosion grooves, only erosion of grooves is formed	There are many erosion grooves, drainage	71%

								erosio n is forme d	
			c. Sedime nt sedime ntation ponds	Meet BML	Meet BML	Meets BML pH 6-9	-	Does not meet BML	80%
2.	Revegetation and Civil Works	Managem ent of planting media (top soli)		>Spreading Soil >Cover crop planting >Chemical fertilizer applicati on > tree planting	>Spreading Soil >Cover crop planting >Chemical fertilizer application > tree planting	Planted cover crops and the applicatio n of compost or other soil quality improve ment materials (perfectly impleme nted)	Planted cover crops and applicatio n of compost or repair materials (jksalaha one is not not impleme nted)	No cover crops or compo st or remed iation applic ations (none imple mente d)	80%
		Soil dispersal of planting rooting zones	a. Area sown	27 (ha)	9,02 (ha)	>75 from the plan	50-75% from the plan	<50% from the plan	33,40%
			b. Soil pH	5-8	5,60	5-6	4,5 - 5	<4,5	85%
		Planting	a. Plantin g Area	18 (ha)	4,26 (ha)	>80% from the plan	60-79% from the plan	<60% from the plan	23,66%
			b. Plant types	Segon, Meranti, Lime, Ulin, Fruit	Segon, Meranti, Kapur, Ironwood	>80% As planned	60- 80% from the plan	<60% from the plan	80%
			c. Plant grow th	90%	85%	>80% Growth rate	60 – 80%	<60%	94,4%
		Mainte nance	a. Fertiliz ation	100%	80%	>80% from the plan	60 – 79% from the plan	<60% from the plan	80%

				b. Weed, pest and disease control	Weed control, pest control, and disease	Weed control	Based on the results of the analysis	Less based on analysis results	Not based on analysis	70%
				c. Embroidery	100%	90%	>80% of the number of plants that died	60 – 79% of the number of plants that died	>60% dari jumlah tanam an yang mati	90%
3.	of the number of plants that died	Compliance with Reclamation Standards	Success Percentage	90%		85%	>80% According to the success rate of reclamation	60 – 79% Not in line with the level of reclamation success	<60% Not according to the success rate of Reclamation	94,4%

Data Source: Perimer Data in 2024

Overall, the percentage of success in the implementation of reclamation in the KBNK area is as follows:

$(50,86+70+80+70+85+90+70+71+80+80+33,40+85+23,66+80+94,4+80+70+90+94,4)\% =$

1,482,72%

19

=78,03 (Medium category)

The success rate of reclamation implementation in the former mining area of the Non-Forestry Business Zone (KBNK) uses the standard of the Ministerial Regulation and Mineral Resources No. 18 of 2008. In contrast to the aquaculture area (KBK), standards are needed in accordance with the Regulation of the Minister of Forestry of the Republic of Indonesia number: P. 60/Menhut-II/2009 concerning Guidelines for Assessing the Success of Reclamation Criteria for Reclamation Success in accordance with regulations. In the government's efforts to achieve a balance between economic benefits and environmental sustainability as well as the welfare of local communities in reclamation activities and management of non-forestry cultivation areas, several appropriate approaches can be applied. Here are some steps that can be taken:

1. Integrated and Sustainable Approach: Conduct a detailed Environmental Impact Analysis (EIA) before starting a project to identify and mitigate negative impacts on the environment and society. Involve local communities in the planning and decision-making process to ensure that their interests and needs are taken into account. This can be done through public consultations, workshops, and focus group discussions.
2. Ecosystem-Based Management: Adopting a management approach that considers the balance between ecosystem development and preservation. For example, by maintaining buffer zones and ecological corridors.

3. **Ecosystem Restoration and Rehabilitation:** Carry out efforts to restore degraded ecosystems, such as mangrove forest rehabilitation, seagrass restoration, and other efforts to restore ecosystem function.
4. **Effective Management Strategies by:** Implementing environmentally friendly farming and cultivation practices, such as agroforestry, organic farming, and other sustainable cultivation technologies. Encourage the diversification of the local economy through the development of small and medium enterprises (SMEs), ecotourism, and creative industries based on local potential. Provide education and training to local communities on sustainable environmental management practices and new skills needed to capitalize on emerging economic opportunities.
5. **Supportive Policies and Regulations:** Implement policies and regulations that support environmental protection and sustainable management of natural resources, and ensure effective law enforcement. Provide economic incentives to encourage sustainable practices, such as subsidies for green technologies, green taxes, and payment schemes for environmental services (PES). Conduct regular monitoring and evaluation of land reclamation and management activities to ensure that sustainability goals are achieved and make adjustments where necessary.
6. **Technology and Innovation:** Using technologies that have minimal impact on the environment in the reclamation and cultivation process, such as bioengineering technology for soil stabilization and water-efficient cultivation techniques. Implementing innovations in natural resource management, such as integrated water management systems and efficient waste treatment technology.

The six approaches celebrated above are steps so that reclamation activities and management of non-forestry cultivated areas can provide significant economic benefits without sacrificing environmental sustainability and the welfare of local communities.

5. Synopsis of the Main Research Outcomes

This study discusses the strengthening and explanation of the obligation of post-mining land reclamation and restoration through Law Number 3 of 2020 with the following main summary: Regulation of post-mining reclamation and restoration, indicated by mining business license holders are required to carry out reclamation from post-mining according to the approved plan and report its implementation to the government. This regulation aims to maintain ecological balance and environmental sustainability after mining activities are completed. Supervision and sanctions as a form of government role to carry out supervision are carried out by the Ministry of Energy and Mineral Resources. Companies that do not fulfill their obligations can be subject to administrative sanctions up to the revocation of their business licenses.

Key points in Law Number 3 of 2020: Article 99, IUP and IUPK are required to carry out reclamation from post-mining according to the approved plan. Article 100, must provide reclamation and post-mining guarantee funds placed in government banks. Article 101, evaluation of the implementation of reclamation and post-mining by the government. Guarantee funds can be disbursed if the company does not fulfill its obligations. There is also an emphasis on the Job Creation Law, emphasizing the point of strengthening reclamation and post-mining obligations with more detailed provisions. Facilitate licensing procedures and strengthen supervision of reclamation activities and environmental management.

The impact of mining activities can be seen from the environmental aspect that deforestation and topsoil stripping can increase erosion, reduce soil fertility, and damage local ecosystems. The local community aspect can cause evictions and loss of livelihoods, but can also create new jobs and change social and cultural structures. The Post-Mining Land Management and Reclamation Strategy is to involve local communities in the planning and decision-making process. Carry out efforts to restore degraded ecosystems. Adopt a management approach that considers the balance between development and environmental conservation. Develop policies and regulations that support sustainable environmental management and effective law enforcement. The role of the government is to manage coal potential for the welfare of the people in accordance with the mandate of Article 33 paragraph 3 of the 1945 Constitution. Supervise the implementation of reclamation and post-mining by mining companies. Enforce administrative and criminal sanctions for companies that do not comply with regulations. The provision of incentives and awards is realized through fiscal incentives, such as reductions in income tax and land and

building tax. Awards, such as PROPER, for companies with good environmental performance. Ease of licensing for companies with a good environmental track record. Access to low-interest funding sources or grants for reclamation projects. Post-mining land use can be in agriculture and plantation situations, livestock and fisheries, forest restoration, ecotourism development, renewable energy projects, infrastructure for community welfare, and light industrial areas or UMKM.

6. Conclusions

Building environmental sustainability after coal mining requires intensive reclamation efforts and proper management of non-forestry cultivation areas. Post-mining land reclamation has proven to be effective in restoring ecological functions, including improving soil quality and restoring natural habitats. The implementation of effective reclamation methods, such as replanting and good soil management, plays a key role in achieving this goal. In addition, sustainable management of non-forestry cultivation areas can support ecological balance while providing economic benefits to local communities. Thus, through a good reclamation strategy and proper management of cultivation areas, environmental sustainability can be realized, and the welfare of the community around the mining area can be improved.

7. Limitations, Implications, and Further Directions of Research

Limitations: While the laws mandate post-mining reclamation and restoration, ensuring compliance among all companies remains a significant challenge. Effective monitoring and enforcement mechanisms are critical but can be resource-intensive and require consistent government oversight. The requirement for reclamation guarantee funds might pose financial challenges, particularly for smaller mining companies, potentially leading to non-compliance or operational difficulties. Implementing reclamation and post-mining plans effectively involves complex technical processes that require expertise, time, and resources. Variations in soil types, ecological conditions, and climate can also impact the success of reclamation efforts. Despite regulatory provisions, the social impacts of mining and subsequent reclamation on local communities are complex. Displacement, changes in land use, and potential conflicts over land rights can affect the well-being of local populations.

Implications: Effective implementation of reclamation and post-mining regulations is essential for restoring ecological balance and maintaining biodiversity in mining areas. This contributes to long-term environmental sustainability and reduces the negative impacts of mining activities. Properly reclaimed land can be repurposed for agriculture, forestry, or other economic activities, providing long-term benefits to local economies. Additionally, compliance with reclamation requirements can enhance the reputation of mining companies, potentially leading to better investment opportunities and market acceptance. The evolving regulatory framework indicates a shift towards stricter environmental standards and sustainable mining practices. This trend may influence other industries and promote broader environmental stewardship across sectors. Successful reclamation efforts can improve the quality of life for local communities by providing new economic opportunities, reducing health risks associated with mining, and restoring land for productive use.

Further Directions of Research: Research should focus on developing comprehensive metrics and methodologies for assessing the success of reclamation efforts. This includes ecological, economic, and social indicators to ensure a holistic evaluation. Investigate and document best practices and technological innovations in reclamation and post-mining restoration. This can include case studies of successful projects and the development of new techniques for soil stabilization, vegetation regrowth, and ecosystem restoration. Explore effective models for involving local communities in the planning and implementation of reclamation projects. Research should focus on participatory approaches that ensure community needs and perspectives are incorporated. Conduct longitudinal studies to evaluate the long-term impacts of current policies and regulations on environmental sustainability and community well-being. This can help identify gaps and areas for improvement in the regulatory framework. Study the economic viability of different post-reclamation land uses, including agriculture, forestry, and renewable energy projects. This can provide valuable insights for policymakers and companies in making informed decisions about land use planning. Investigate the impact of climate change on reclamation efforts and develop adaptive

strategies to ensure the resilience of restored ecosystems. This includes studying the effects of changing weather patterns, water availability, and other climatic factors on reclamation projects.

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