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Multidimensional Impact Analysis of Corrupt Practices in Nickel Mining on Sustainable Development in North Maluku

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ABSTRAK

Studi ini mengkaji dampak multifaset dari praktik korupsi di industri pertambangan nikel di Maluku Utara. Praktik korupsi di sektor pertambangan masih menjadi persoalan utama yang menyebabkan berbagai permasalahan konflik agraria, kerusakan lingkungan, ketimpangan ekonomi, dan permasalahan kesehatan. Berbagai penelitian menunjukkan praktik korupsi ini lahir dari skema yang sama yaitu eksploitasi sumber daya alam yang berlebihan karena adanya penyalahgunaan wewenang para elit politik di tingkat lokal dan nasional yang berkelindan dengan para pengusaha untuk melakukan tindakan maladministrasi seperti merekayasa izin usaha pertambangan, menerbitkan perizinan yang tumpang tindih dan menguasai lahan. Penelitian kualitatif ini mengumpulkan data melalui wawancara, observasi lapangan, dan dokumentasi. Analisis data meliputi reduksi, penyajian, dan penarikan kesimpulan. Penelitian menunjukkan bahwa bisnis pertambangan nikel di Maluku Utara masih bertentangan dengan prinsip kelestarian lingkungan yang berkelanjutan, hak asasi manusia, dan abai terhadap hak hidup komunitas lokal. Oleh karena itu, untuk mengurangi dampak eksploitasi pertambangan, pengusaha memerlukan tanggung jawab sosial perusahaan yang lebih kuat, kebijakan pemerintah yang efektif, membangun kemitraan kolaboratif, menghilangkan korupsi institusional, dan mengedepankan pendekatan holistik dan terpadu terhadap masyarakat sekitar tambang melalui program pembangunan sosial dan ekonomi, yang mengutamakan kesejahteraan masyarakat dan meningkatkan kualitas lingkungan, komunitas, kesehatan, dan perekonomian lokal.

ABSTRACT

This study examines the multifaceted impacts of corrupt practices in the nickel mining industry in North Maluku. Corrupt practices in the mining sector remain a major issue, leading to various problems such as agrarian conflicts, environmental degradation, economic inequality, and health issues. Numerous studies indicate that these corrupt practices stem from the same scheme such as excessive exploitation of natural resources due to abuse of power by political elites at both local and national levels, who collude with entrepreneurs to commit maladministration mining permits, issuing overlapping licenses, and seizing land. This qualitative research collects data through interviews, field observations, and documentation. Data analysis includes reduction, presentation, and conclusion drawing. The study reveals that the nickel mining business in North Maluku still contradicts the principles of sustainable environmental conservation, human rights, and neglects the living rights of local communities. Therefore, To mitigate the impacts of mining exploitation, entrepreneurs need stronger corporate social responsibility, effective government policies, building collaborative partnerships, eliminating institutional corruption, and prioritizing a holistic and integrated approach to surrounding communities through social and economic development programs that emphasize community welfare and improve the equality of the environment, community, health, and local economy.

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INTRODUCTION

Nickel mining has been a significant industry with far-reaching impacts on both the environment and communities. It plays a crucial role in the global economy, yet the industry has also been plagued by issues of structural corruption, leading to widespread social, health, economic and environmental consequences. In the context of Ghana, the mining industry has had significant impacts on both the environment and the health of local communities (Emmanuel et al., 2018). Furthermore, in Australia, the ongoing colonial legacy has resulted in profound trauma and lasting impacts on the indigenous communities, which must be addressed for sustainable change to occur (Bartzas et al., 2021; Edwards et al., 2014; Emmanuel et al., 2018; Meshram et al., 2019; Mudd, 2010; Nti et al., 2020).

The development of nickel mining fundamentally must have a sustainability vision. The theory of sustainable development assumes the alignment and balance between the human population and available natural resources, so that they can be directed towards long-term economic and social development that can be utilized for both the present and the future (Ben Eli, 2015; Fauzi & Oxtavianus, 2014; Szymańska, 2021). In the case of Indonesia, Budhyono (in Sapar & Syafruddin, 2021) stated that efforts to increase the economic and social development of mining areas often result in environmental damage and conflict due to the confiscation of community land due to the lack of social legitimacy from the community.

In Indonesia, several regions have significant nickel reserves, such as Sulawesi (54.7%) and North Maluku (44.6%). Specifically for nickel, there are currently 51 active mining permits (IUP) in North Maluku out of a total of 108 permits in the mineral and metal mining sector (Transparency International Indonesia, 2024). However, the reality of nickel mining operations has had many adverse impacts on the lives of North Maluku residents. This is primarily driven by exploitative practices that often disregard principles of anti-corruption, social, and ecological sustainability. These practices stem from the collusion between oligarchs and central and local government actors who easily grant mining permits, leading to uncontrolled nickel exploitation (Transparency International Indonesia, 2024). Corrupt practices in the mining sector align with cases in the land sector, which generally occur due to the formulation and enforcement of policies and regulations that are not strict. This creates opportunities for elites to abuse their power arbitrarily (Burns, T, et al., 2012).

In this paper, we will explore the multi-dimensional impacts of nickel mining, shedding light on its environmental, social, and economic effects. Through an in-depth analysis, the research aims to provide a comprehensive understanding of the challenges and opportunities associated with the nickel mining industry, as well as potential pathways for sustainable change. To fully understand the complexities surrounding the nickel mining industry and its impacts, it is essential to inquire into the various dimensions of this issue.

Literature Review

Mining Corruption

Mining's impact is devoted to structural corruption. Regulation No. 3 of 2020 on Mining Mines and Coal centralizes mining management authority and ignores anti-corruption standards, making it harder to fight corruption (Fernando et al., 2023). Due to insufficient public participation in the political-legislative process, mining bills were drafted. The abolition of *AMDAL* obligations and the simplification of land licenses and investment criteria have affected Indonesia's mineral and coal mining corruption (Sulaiman, 2023). Corruption in mining company licensing has affected numerous

regional leaders and the private sector. Because mining and environmental restrictions overlap, regional political elites' negligence has damaged the ecology and ecosystem (Tegnan et al., 2021). Local governments and mining companies may cooperate to mine forbidden areas, resulting in corruption. For instance, corruption may arise due to the abuse of authority or the exploitation of a position for the benefit of oneself and the company (Anwar et al., 2021).

Political, Social and Environmental Impacts

Corrupt practices in the mining sector often involve political actors, officials, bureaucrats, and entrepreneurs who possess significant power and capital. These actors can use their authority to facilitate the process of granting Mining Business Permits (IUP), leading to overlapping permits, falsification of IUP issuance dates, and deliberate corrupt acts. Such violations constitute maladministration that breaches the law (Nguyen et al., 2021; Ridzuan et al., 2019). These corrupt practices have a substantial impact on economic, socio-political, and environmental aspects (Anshori, 2016).

Health Impact

Nickel mining activities can have direct and indirect health effects on communities living in proximity to mining sites. Exposure to pollutants released during mining and processing activities can lead to respiratory problems, skin conditions, and other health issues. Furthermore, the contamination of water sources by heavy metals and other harmful substances can result in long-term health hazards for local populations, including an increased risk of waterborne diseases and other health complications. As we continue to delve deeper into the multi-dimensional impacts of nickel mining, it becomes evident that addressing these complex challenges requires a holistic approach that considers the interconnectedness of environmental, social, economic, and health factors. By recognizing and understanding the various dimensions of this issue, we can work towards sustainable solutions that prioritize the well-being of both the environment and affected communities (Begum et al., 2022; Chaitanya Reddy et al., 2021; Chen et al., 2021; Emmanuel et al., 2018; Thiagarajan & Koh, 2021)

Economy Impact

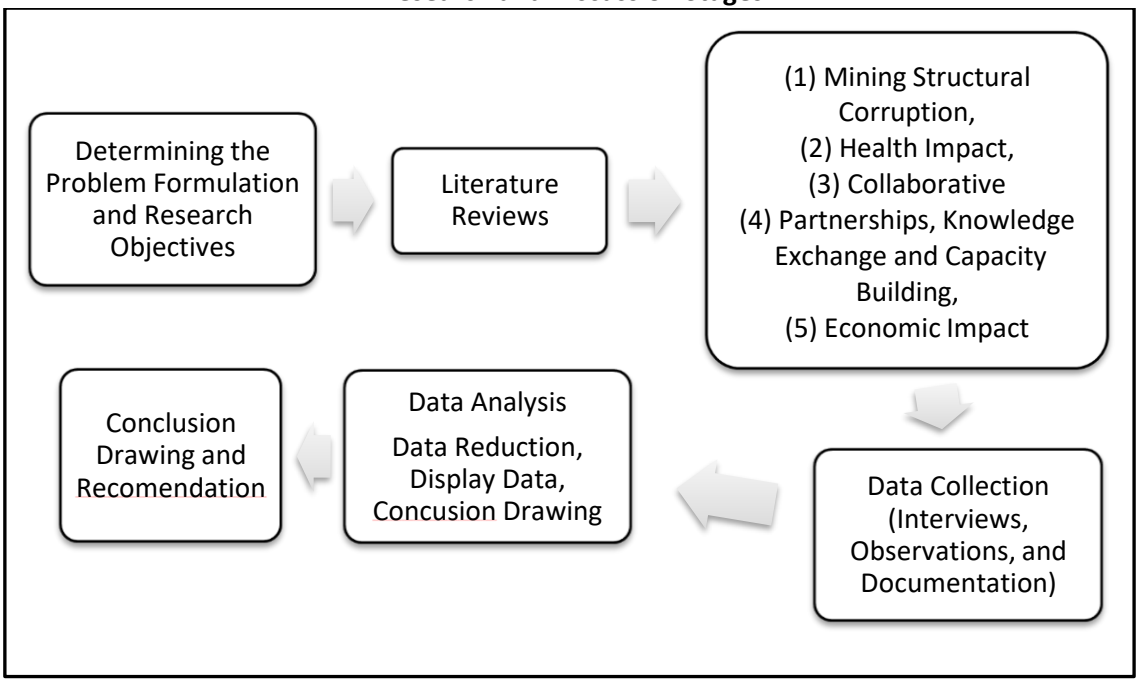
The industrial and mining production sectors play a positive role in the economic growth. It can even boost economic growth in the Province (Fazaalloh, 2024). Mining production has an impact on increasing corporate social responsibility and economic growth (Yousefian et al., 2023). Several research results such as (Camara, 2023) found that bauxite mining drove economic growth in Guinea during the 1986–2020 period. Another researcher concluded that foreign investment in mining had a positive impact on economic growth in Ghana (Ennin & Wiafe, 2023).

The novelty of this research focuses on handling the impacts caused by nickel mining in North Maluku, namely structural corruption, health impacts, economic impacts, social impacts, and environmental impacts. The results of this research also present various solutions and recommendations to reduce the negative impacts of nickel mining and offer sustainable development in North Maluku.

RESEARCH METHODS

This research method uses a qualitative approach. We gathered all the information about mining corruption, environmental harm, the marginalization of communities near the mine, and attempts to address issues related to the social, political, economic, environmental, and development effects of the mining process through a variety of methods, including key informant interviews, media documentation, past research findings, and field observations at multiple mining sites. Several digital maps from the GIS of the Energy, Mineral Resources, and Coal Service of North Maluku Province were also used to get information about Mining Business Areas (WUP), Mining Business Permit Areas (WIUP), and the province's mining potential spread out across the whole area. The theme of this qualitative research is the effects of nickel mining on different levels. The research collects data about mining and analyzes it using both inductive and deductive methods (Creswell, 2013: 45). It also figures out the problem statement, research goals, and several indicators. This research uses data analysis techniques, which consist of three streams of activities that occur simultaneously: data reduction, data presentation, and conclusion drawing and verification. Data analysis uses the Milles and Huberman (2007) approach, which states that data analysis is an iterative and continuous process and is a series of analysis activities that follow each other over data reduction, data presentation, and conclusion drawing.

Figure 1.
Research and Discussion Stages

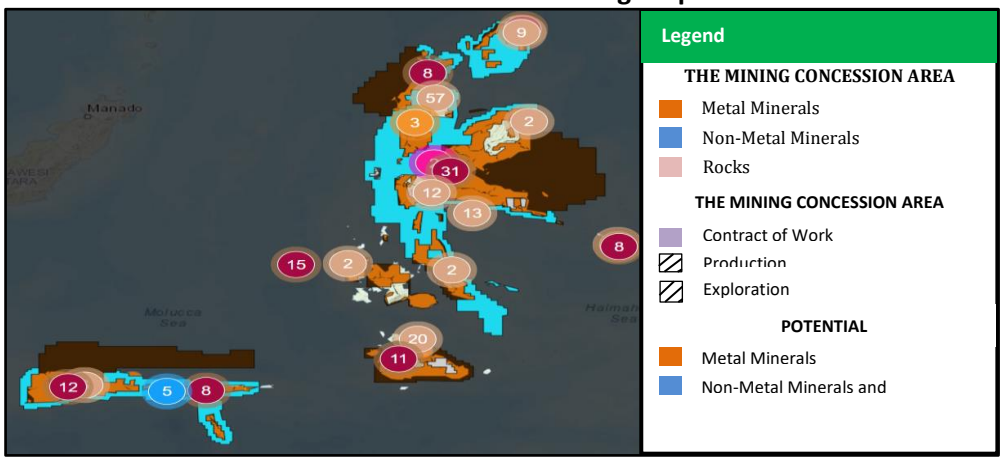


Source: The Research Methodology Flow Chart is by the Concept of Creswell (2013) & Milles and Huberman (2007)

RESULTS AND DISCUSSIONS

North Maluku Province is rich in mineral resources, as well as other valuable metals and rocks. Most of the land areas on Halmahera Island, Morotai Island, Bacan Island, Obi Island, Taliabu Island, Sulawesi Island, and Mangoli Island have the potential for metallic and non-metallic minerals. This includes several small islands, including Doi Island in North Halmahera Regency, Pakal Island in East Halmahera Regency, and Gebe Island in Central Halmahera Regency.

Figure 2.
North Maluku on a Mining Map



Source: https://minerba.malutprov/go.id/#map=7/0.07280190671737824/125.118087

The Mining Business Permits (IUP) Contract of Work and the Production IUP, which are business permits issued following the completion of the Exploration IUP, enable the execution of various stages of production operations. In the meantime, the government grants an exploration IUP, a business permit, to conduct general investigation, exploration, and feasibility study activities within a special mining business permit area. The IUP Contract of Work is an agreement between the government and an Indonesian legal entity company to carry out mineral mining business activities.

Table 1 presents the mining output results in North Maluku, demonstrating the profits generated by production. The BPS data for the year 20204 includes regions that have significant mining production results. These regions include East Halmahera, which produced 11,978,860 tons of nickel; Central Halmahera, which produced 14,672,174 tons of nickel; South Halmahera, which produced 13,291,607 million tons of nickel; North Halmahera, which produced 4.2 tons of gold and silver and 5.2 tons of silver; West Halmahera, which produced 36,140 tons of iron sand; and Taliabu Island, which produced 1,812,867 tons of iron ore.

Table 1.
Production of Mining in Ton by Product and Regency/Municipality in Maluku Utara Province, 2023

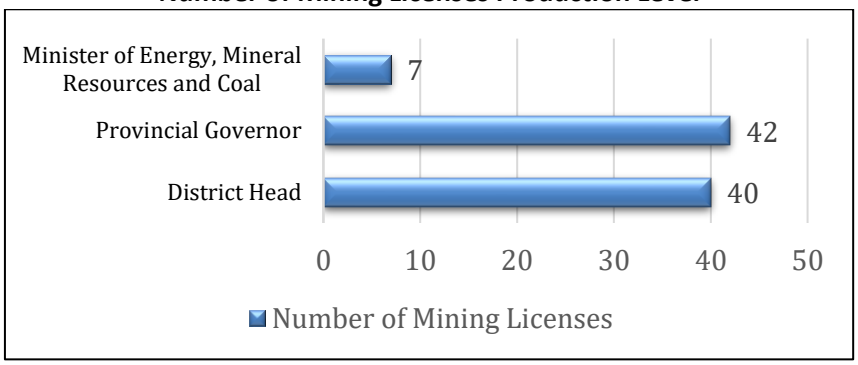
Regency/City	Nickel	Gold	Silver	Iron Sand	Ori Sand
Central Halmahera	14.672.174	-	-	-	-
East Halmahera	11.978.860	-	-	-	-
South Halmahera	13.291.607	-	-	-	-
West Halmahera	-	-	-	36.140	-
North Halmahera	-	4,2	5,2	-	-
City of Tidore Islands	-	-	-	-	-
Ternate City	-	-	-	-	-
Morotai Island	-	-	-	-	-
Sula Islands	-	-	-	-	-
Taliabu Island	-	-		-	1.812.867
Total	39.942.641	4,2	5,2	36,140	1.812.867

Source: BPS North Maluku province (Latara A.R. Fadlun) (2024)

There are three types of mining business permits (IUP). These are the exploration IUP, the production IUP, and the work contract IUP. On average, the Governor of North Maluku issues 42 mining licenses; the Regent issues 40 mining licenses; and the Minister of Energy and

Mineral Resources issues 7 mining licenses. Regarding differences in authority and the number of IUPs issued, this is due to changes in the implementation of laws and regulations regarding mining.

Chart 1.
Number of Mining Licenses Production Level

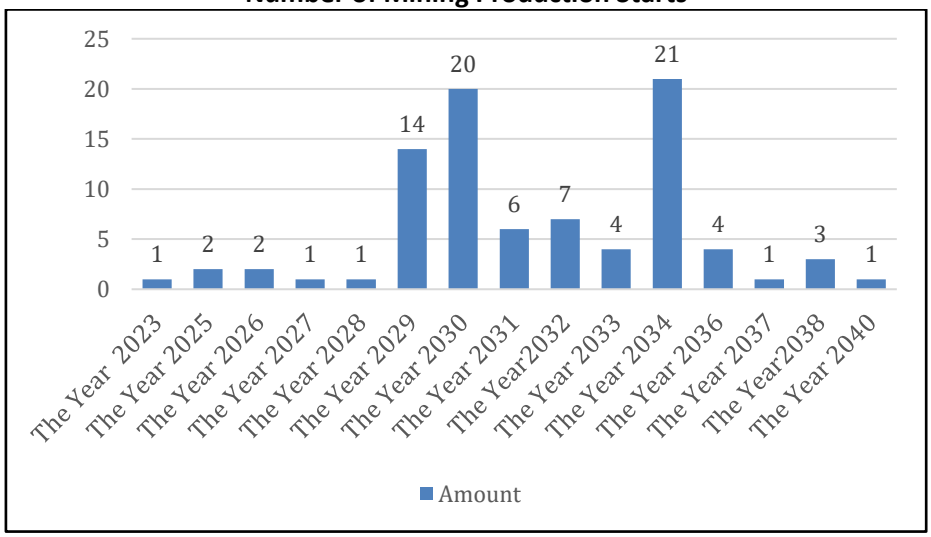


Source: MINERBA Registered IUP with the Director General of Minerals of the Republic of Indonesia and Coal (data as of May 2019)

Initially, the Regent or Mayor could issue mining regulations. However, in response to various regional issues, the government implemented a new regulation limiting mining permits issued to the Governor and the Minister of Mines. On average, companies do not have their addresses in North Maluku, but outside the region.

Chart 2 displays the average number of mining licenses from 2023 to 2040. We expect the highest mining processing production to begin in 2029 with 14 mining licenses, followed by 30 in 2030 and 24 in 2034. To put it more clearly, each of the years 2023, 2027, 2028, 2037, and 2040 corresponds to one license. 2025 and 2026 amount to 2 mini-licenses; 2038 amount to 3 mining licenses; 2031 and 2036 amount to 4 mining licenses each; 2031 amount to 6 mining licenses; 2032 amount to 7, 2029 amount to 14, 2030 amount to 20, and 2034 amount to 21 minimum licenses.

Chart 2.
Number of Mining Production Starts

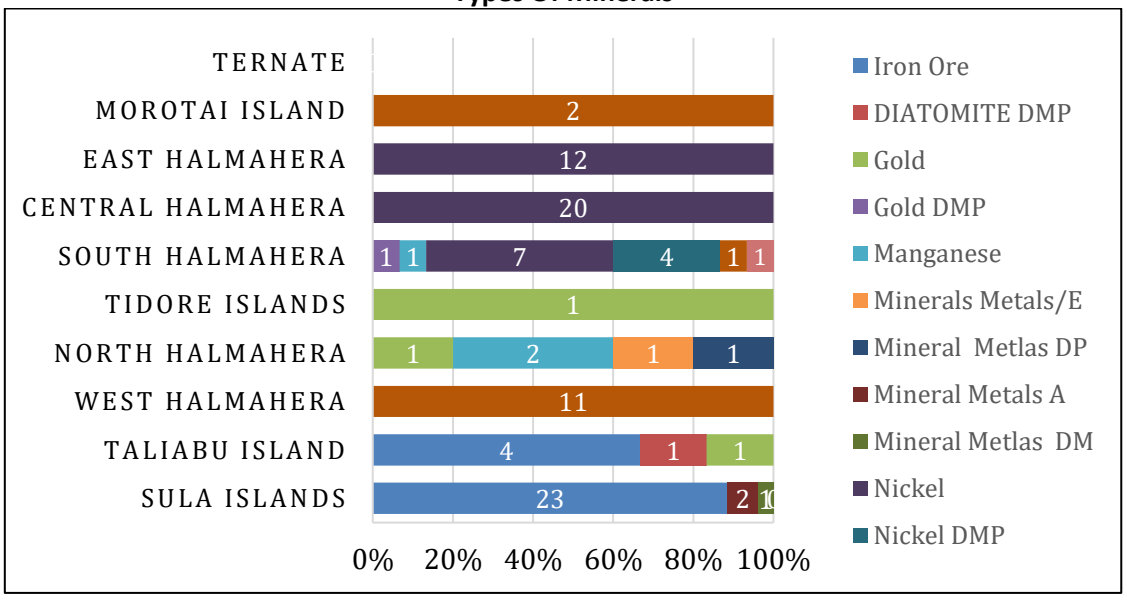


Source: MINERBA Registered IUP with the Director General of Minerals of the Republic of Indonesia and Coal (data as of May 2019)

Most regencies and cities in North Maluku, except Ternate City, have distributed mining potential across multiple locations. These mines' primary focus is on the extraction of nickel and iron sand. There are now 12 functioning firms in East Halmahera that have obtained permits for the nickel mining industry. Central Halmahera has a total of 20 permits for nickel mining businesses, while South Halmahera has a total of 7 permits for nickel mining businesses. In the West Halmahera region, there are a total of 11 mining firms that mostly focus on extracting iron sand. Additionally, two iron sand mining businesses have received permission to operate on Morotai Island. The most prominent gold mining enterprises are located in North Halmahera, South Halmahera, and the Tidore Islands.

Currently, the Sula Islands host a total of 23 mining enterprises, whereas Taliabu Island is home to 4 mining enterprises, specifically the DMP Iron Sand mine and other mineral resources. The number of IUPs issued by Morotai Island is as follows: 2 IUPs for Iron Sand, 12 Nickel IUPs for East Halmahera, 20 Nickel IUPs for Central Halmahera, 1 DMP gold IUP, 1 Manganese IUP, 7 Nickel IUPs, 4 DMP Nickel IUPs, 1 DMP Iron Sand IUP, 1 DMP Copper and Gold IUP with a total of 15 IUPs for South Halmahera, 1 Gold IUP for Tidore Islands, 1 Gold IUP, 2 Manganese IUPs, 1 Metal/E Mineral IUP, 1 DP Metal Mineral IUP with a total of 5 IUPs for North Halmahera, and 11 Iron Sand IUPs for West Halmahera and Taliabu Island. There are a total of 6 mining permits (IUPs), consisting of 4 for iron ore, 1 for copper, 1 for DMP gold, and 1 for gold. In the Sula Islands, there are a total of 26 mining permits (IUPs), consisting of 23 for iron ore, 2 for DA mineral metal, and 1 for iron sand.

Chart 3.
Types Of Minerals



Source: MINERBA Registered IUP with the Director General of Minerals of the Republic of Indonesia and Coal (data as of May 2019)

Multi-Dimensional Impacts

Political, Social and Environmental Impacts

Corrupt practices in the nickel mining sector have long-term and far-reaching impacts on various aspects of society. This situation results from the negligence of political elites, both at the national and local levels, who collude with entrepreneurs to exploit nickel resources for their personal and group interests (Umam et al., 2020). Weak oversight of Indonesia's

commodity management accelerates environmental degradation in regions rich in natural resources (Lukito, 2016). Additionally, nickel mining areas often cause conflicts with communities, whose lands are seized, disrupting their living spaces. Land conflicts in mining areas are a common phenomenon due to the involvement of businessmen in influencing government policies on land issues (Rachman, Noer Fauzy & Savitri, 2011).

Table 2.
Political, Social, and Environmental Impact

No	Mining and Environmental Care Institutions and Communities	Evaluation Result
1.	***Forum Studi Halmahera (FOSHAL)***	Nickel down streaming had a negative impact and destroyed many rivers such as the Akejira and Ake Kobe Rivers which stretch past the settlements of Woekop Village, Worjerana Village, Kulo Jaya Village, and Lukulamo Village, Central Weda, Central Halmahera Regency. directly resulting in uncontrolled deforestation.
2.	**WALHI**	The government must take concrete steps by ratifying and revising several laws, including the Climate Change Bill, revising the Disaster Law, and ratifying the Indigenous Law Communities Bill. We expect the climate change bill to regulate mitigation and adaptation, particularly on small islands. The Indigenous Peoples Bill then regulates and encourages accelerated recognition of traditional territories and their actors.
3.	**Samurai Maluku Utara, IPMA Sagea-Kiya, TOGAMMOLOKA**	Saving the coast and small islands in North Maluku, calling for the saving of Mount Wato-wato, saving Sagea Village from environmentally destructive industries, saving the Obi community from threats from the PT Harita Group, rejecting the existence of PT Priven Semut, and asking for an end to the repressive people's movement.
4.	**Forest Watch Indonesia (FWI)**	The regions of Maluku and North Maluku experienced deforestation totaling 358,830.20 hectares during the period from 2017 to 2021, with an annual rate of 89,707.55 hectares. In 2017, the forest area was 6,256, 420.20 hectares, which the decreased to 5,897,590.00 hectares.
6.	**Transparency International Indonesia**	Corrupt practices in the mining sector in North Maluku take the form of abuse of power, displacement of local and indigenous lands leading to conflicts, corruption in land registration and certification, clienteles/patronage, illicit financial flow (IFF), revolving door, conflict of interest, hingga politically-exposed persons (PEPs).

No	Mining and Environmental Care Institutions and Communities	Evaluation Result
7.	***Jaringan Advokasi Tambang (JATAM)***	JATAM claims that Abdul Gani Kasuba's two periods as Governor of North Maluku were corrupt due to his granting of 54 mining licenses, debates on regional spatial planning (RTRW), and operational permissions to illegal mining businesses. In the Governor's first year in 2014–2019, 26 IUPs were allegedly fake and violated Law Number 4 of 2009 on Minerals and Coal (later revised into Law Number 3 of 2020) and PP Number 23 of 2010 on Implementation of Mineral and Coal Mining Business Activities. Delegation of Authority to Grant Mineral and Coal Mining Business Licenses, Minister of Energy and Mineral Resources (ESDM) No. 25 of 2015.

Source: Data processed from various informants, 2024

Specifically, in the context of North Maluku, the development of actors and their modes of corruption is becoming more complex through network work, expanding and/or higher outside the village administration, which is indicated to occur in both Central Halmahera and East Halmahera. The International Transparency Report (2024), explains the alleged involvement of legal officers (Polri and TNI) in the politics of land plotting which act as backers for plotting groups, and even become a tool for companies to pressure residents to release their land to the company. Some residents rejected the company's presence, even experiencing intimidation and threats.

Health Impacts

The rise in population in communities surrounding PT IWIP and mining operations has resulted in indirect effects on air quality, namely in the form of dust pollution. In addition, population growth and nickel mining operations are believed to influence changes in water quality and sanitation conditions in the villages surrounding mining firms. The proliferation of unregulated plastic garbage in residential areas exacerbates this problem. Following the establishment of PT IWIP in Central Halmahera, there was a rise in instances of ISPA (acute respiratory infections) and diarrhea, believed to be a result of the decline in environmental conditions (ARI due to reduced air quality and diarrhea due to diminished water quality and sanitation). Pollution in Halmahera seas has made life worse for people who live on the coast of Halmahera's biggest island, Obi Island, which is an epicenter for nickel exploration and is thought to be the cause of the pollution.

Economic Impacts

In addition to its environmental and social consequences, the nickel mining sector also exerts a substantial economic influence. According to data from the Central Statistics Agency (BPS), North Maluku has the greatest economic growth rate among the 38 provinces in Indonesia. In 2023, this province experienced a year-on-year (YoY) economic growth rate of 20.49%. Central Sulawesi had the second-highest economic growth rate, reaching 11.91%. Next, East Kalimantan secured the third position with a growth rate of 6.22%. The incorporation of North Maluku, which has the highest economic growth in Indonesia, has a significant impact on the country's downstream nickel industry.

According to data provided by the North Maluku Central Statistics Agency (BPS), the impoverished population of North Maluku was 79.87 thousand individuals in March 2022. By September 2022, it increased to 82.13 thousand people and further surged to 83.80 thousand people by March 2023. The establishment and close supervision of the nickel downstream business in North Maluku has not resulted in any tangible economic benefits for the local population, especially those living near the downstream area. Conversely, the local population has experienced adverse effects as a result of the depletion of economic resources, such as agricultural land, gardens, and fishing sites in the waterways.

Table 3.
Comparison of North Maluku's Economic Growth in the Last Three Years

Economic Growth	2021	2022	2023
Industries	81.83	76.74	41.32
Mining	52.73	42.24	49.07
Agriculture	2.37	3.22	4.25
Trade	2.11	7.31	5.78
Government administration	0.2	0.31	1.46
Construction	2.09	5.97	0.38
Transportation and Warehousing	0.021	22.32	3.28
Information & Communication	8.5	5.57	2.21
Other	2.55	8.24	3.14

Source: BPS North Maluku province (Latara A.R. Fadlun) (2024)

Solutions To Reduce The Bad Impact

First, Collaborative Partnerships. Collaborative partnerships between government agencies, non-governmental organizations, and local communities are instrumental in fostering sustainable change within the nickel mining sector. By fostering dialogue, sharing expertise, and co-creating solutions, these partnerships have the potential to address the complex challenges posed by nickel mining comprehensively and inclusively. Furthermore, the involvement of diverse stakeholders can lead to the development of innovative approaches that balance economic development with environmental and social sustainability (Karsadi & Aso, 2023; Koohsari et al., 2024; Stepanov et al., 2022; Tahir et al., 2022).

Second, Knowledge Exchange and Capacity Building. Stakeholder information exchange and capacity building are essential to nickel mining sustainability. Sharing best practices, experience, and technologies can help local communities, government agencies, and mining corporations work together for sustainability. Capacity-building programs that improve local skills and resources can help nickel mining-affected communities become resilient and self-sufficient. The nickel mining business is complicated, thus a multifaceted approach is needed to handle its many effects. We can create a more sustainable and inclusive future for the industry and the communities it affects by exploring creative techniques for environmental rehabilitation, cultural preservation, ethical supply chains, climate resilience, and knowledge exchange (Begum et al., 2022; Chaitanya Reddy et al., 2021; Chilakamarry et al., 2021; Coman et al., 2013; Genchi et al., 2020; Mudd, 2010; Nurlaela et al., 2020; Ohshiro et al., 2016; Poteete et al., 2009; Stepanov et al., 2022; Tahir et al., 2022; Thiagarajan & Koh, 2021; Yang & Shen, 2010).

Third, Sustainable Development Initiatives and Corporate Social Responsibility. Sustainable development techniques are necessary due to the numerous negative effects of nickel mining.

We promote community empowerment, responsible mining, and rehabilitation and replanting. Nickel mining companies are incorporating sustainable development to decrease environmental impact, benefit local people, and boost economic stability. Nickel mining companies have increased CSR efforts to address social and environmental issues. Companies recognize the importance of indigenous rights, local stakeholder engagement, and sustainable environmental management. This program uses ethics and accountability to improve nickel mining towns' social and economic outcomes.

Fourth, Governmental Policies and Regulations. Effective government policies and regulations shape the nickel mining sector and its implications. Governments must set and enforce strict environmental standards, supervise and regulate mining operations, and divide economic advantages fairly. Strong policies can increase environmental protection, social inclusion, and economic resilience, protecting present and future generations.

Fifth, Technological Innovations. In addition to sustainable development initiatives, technological innovations play a crucial role in minimizing the environmental impact of nickel mining. Advancements in mining technologies and practices, such as the use of automated equipment and sophisticated monitoring systems, have the potential to reduce the industry's ecological footprint. Furthermore, the development and implementation of eco-friendly extraction and processing methods can significantly mitigate the environmental degradation caused by traditional mining practices.

Sixth, Community Empowerment and Inclusion. Empowering and including local communities in decision-making processes related to nickel mining is essential for fostering sustainable change. Through active participation in project planning, implementation, and monitoring, communities can voice their concerns, contribute traditional knowledge, and ensure that their rights and well-being are prioritized. This approach not only strengthens the social fabric of affected regions but also promotes sustainable development that aligns with the needs and aspirations of local populations.

Seventh, Research and Education. Investing in research and education initiatives focused on the impacts of nickel mining is crucial for advancing sustainable solutions. By supporting scientific studies, promoting environmental education, and disseminating knowledge about the potential risks associated with nickel mining, stakeholders can make informed decisions and proactively address challenges. Additionally, research can drive innovation in sustainable mining practices and environmental remediation techniques, ultimately contributing to long-term environmental and social sustainability. As the nickel mining industry continues to evolve, it is imperative to recognize the interconnected nature of environmental, social, economic, and technological aspects. By embracing a holistic approach that integrates sustainable development initiatives, community empowerment, technological innovations, and ongoing research and education, it is possible to navigate the complexities of nickel mining in a way that promotes positive outcomes for both the environment and the communities impacted by mining activities (Bartzas et al., 2021; Genchi et al., 2020; Mudd, 2010; Nurlaela et al., 2020).

Eighth, Environmental Rehabilitation and Restoration. It is essential to acknowledge the significance of environmental rehabilitation and restoration in mitigating the ecological impacts of nickel mining. The restoration of land and ecosystems affected by mining activities is a critical aspect of sustainable development. Through reforestation programs, soil remediation efforts, and the establishment of biodiversity conservation areas, the adverse effects on local flora and fauna can be minimized. By prioritizing the restoration of natural habitats, communities can also benefit from improved air and water quality, as well as the preservation of ecological balance.

Ninth, Cultural Preservation, and Indigenous Rights. Nickel mining damages indigenous rights and culture, which are ignored. Mining can affect indigenous culture, livelihoods, and historic sites. Sustainable development must protect culture and indigenous rights. Interacting with indigenous people, valuing their knowledge and practices, and involving them in decision-making can build sustainable solutions that respect cultural legacy, indigenous rights, and economic development. Nickel mining harms indigenous rights, culture, and the environment. Sustainable development can protect indigenous cultures and traditions by embracing cultural preservation and indigenous rights. Indigenous communities must be engaged, their knowledge and traditions acknowledged, and their participation in decision-making to establish sustainable solutions that honor cultural heritage, preserve indigenous rights, and encourage economic growth.

Tenth, Ethical Supply Chains and Market Demand. Supply chain and market demand ethics must be considered when assessing nickel mining's downstream effects. Sustainable development requires careful nickel sourcing and ethical labor standards across the supply chain. Collaboration between mining companies, manufacturers, and consumers can increase demand for ethically produced nickel, encouraging responsible mining. Ethical supply networks can help nickel mining survive by promoting global transparency and accountability. Nickel mining's downstream effects need ethical considerations of supply chains and market demand. Responsible nickel sourcing and ethical labor standards are essential throughout the supply chain. Collaboration between mining companies, manufacturers, and consumers can increase demand for ethically produced nickel, encouraging responsible mining. Ethical supply chains can help the nickel mining industry survive by promoting global transparency and accountability.

Eleventh, Adaptive Strategies for Climate Resilience. As climate change proceeds, nickel mining must adapt to changing environmental conditions. Mining enterprises must incorporate climate resilience methods for long-term sustainability. This includes water management to reduce extreme weather occurrences, energy-efficient technology to cut carbon emissions, and climate-resilient infrastructure. By anticipating climate change concerns, the industry may improve its resilience and reduce its environmental impact. In the face of changing environmental conditions, the nickel mining business needs climate resilience techniques to survive. Water management to reduce extreme weather events, energy-efficient technologies to reduce carbon emissions, and climate-resilient infrastructure are crucial to improving the industry's resilience and reducing its environmental footprint in the face of climate change.

Twelfth, Promoting Environmental Rehabilitation and Restoration. Environmental rehabilitation and restoration are key to reducing nickel mining's environmental impact. These programs restore mining-affected land and ecosystems, promoting sustainable development. Reforestation and soil remediation help restore vegetation and soil quality in affected areas. Biodiversity conservation areas also preserve local flora and fauna and restore ecological equilibrium. Restoring ecological equilibrium in nickel mining sites requires environmental restoration and conservation. Reclamation and restoration initiatives restore mining-damaged land and natural habitats and ecosystems. The industry may reduce long-term environmental damage and preserve biodiversity and ecological stability by priority. So far there are still gaps, Collaborative Governance is still weak because it has not involved all stakeholder actors, from local government, academics, the private sector, community groups, and the media in environmental restoration issues (Alfiandri & Irawan, 2023).

Thirteenth, Inclusive Stakeholder Engagement for Sustainable Solutions. To achieve a truly sustainable future for the nickel mining industry and the communities it impacts, inclusive

stakeholder engagement is paramount. This involves actively involving all relevant parties, including local communities, indigenous groups, governmental organizations, non-governmental organizations, and industry stakeholders in decision-making processes. By creating platforms for open dialogue and collaboration, the industry can address concerns, gather diverse perspectives, and collectively develop solutions that are both environmentally and socially responsible. Inclusive stakeholder engagement can lead to the co-creation of impactful policies, practices, and initiatives that prioritize the well-being of all stakeholders and the environment.

Fourteenth, Integrated Ecosystem Management for Long-Term Sustainability. The concept of integrated ecosystem management goes beyond the immediate environmental impacts of nickel mining. It involves considering the interconnectedness of ecosystems, biodiversity, and natural resources in the broader context of sustainable development. Adopting an integrated approach to ecosystem management entails implementing measures that not only mitigate the direct effects of mining but also promote the overall health and resilience of the surrounding ecosystems. This may involve comprehensive environmental impact assessments, habitat restoration programs, and the establishment of protected areas to safeguard critical biodiversity hotspots. By embracing this holistic perspective, the industry can contribute to the conservation and sustainable use of natural resources for future generations.

Fifteenth, Innovation, and Research for Continuous Improvement. Investing in innovation and research plays a pivotal role in driving continuous improvement within the nickel mining industry. This includes exploring and implementing advanced technologies for more efficient and environmentally sound mining practices, as well as researching to better understand the ecological and social impacts of mining activities. By fostering a culture of innovation and supporting research initiatives, the industry can proactively identify and address emerging challenges, while also identifying opportunities to enhance sustainability. Moreover, collaboration with scientific institutions, research organizations, and experts can lead to the development of cutting-edge solutions that align with the principles of sustainable development and responsible resource utilization. As we move forward, the pursuit of sustainability in the nickel mining industry requires a steadfast commitment to holistic approaches, innovation, and collective engagement. By integrating inclusive stakeholder participation, adopting integrated ecosystem management, and prioritizing continuous improvement through innovation and research, the industry can strive towards a more sustainable and harmonious coexistence with the environment and surrounding communities (Coman et al., 2013; Karsadi & Aso, 2023; Masrich et al., 2023; Taufik et al., 2021; Yang & Shen, 2010).

Sixteenth, Cultural Preservation and Indigenous Rights: Upholding Heritage and Identity. Preserving cultural heritage and upholding indigenous rights is fundamental to the sustainable coexistence of the nickel mining industry and indigenous communities. It requires not only respecting traditional knowledge and practices but also actively involving indigenous groups in decision-making processes that affect their lands and resources. Moreover, fostering partnerships with indigenous communities to develop sustainable economic opportunities that align with their cultural values is essential for preserving their heritage and securing their rights.

Seventeenth, *Sustainable Development Through Local Empowerment: Building Resilient Communities.* Empowering local communities through sustainable development initiatives is integral for building resilience and ensuring their well-being amidst nickel mining activities. This involves investing in community development programs, promoting local entrepreneurship, and providing access to education and healthcare. By nurturing self-sufficiency and economic empowerment at the grassroots level, the industry can contribute to the long-term prosperity of communities and mitigate any adverse social impacts associated with mining operations.

Eighteenth, Sustainable Resource Management and Innovation: Balancing Demand and Conservation. Long-term sustainability requires balancing sustainable resource management and nickel demand. Innovative methods for resource extraction and recycling, as well as responsible use and production, can reduce the industry's environmental impact while satisfying market demand. A healthy balance between resource use and conservation necessitates a circular economy that emphasizes resource efficiency and waste reduction.

Finally, nickel mining sustainability needs resource management, environmental rehabilitation, cultural preservation, and local empowerment. Prioritizing these criteria and involving stakeholders can help the sector achieve ecological integrity, cultural diversity, and community well-being. Nickel mining impacts human rights, culture, the environment, and locals (Karsadi & Aso, 2023; Nurlaela et al., 2020). Mining's environmental impacts, social and economic growth in affected communities, indigenous rights and cultural heritage, and industry corruption must be addressed holistically.

CONCLUSIONS

The multi-dimensional impacts of nickel mining necessitate a collective effort to enact meaningful change. Through sustainable development initiatives, corporate social responsibility, effective governmental policies, and collaborative partnerships, it is possible to mitigate the adverse effects of nickel mining while promoting the well-being of communities and the environment. By embracing a holistic and integrated approach, it is feasible to pave the way for a more sustainable and equitable future in regions impacted by nickel mining. Some of the suggestions are to improve corporate social responsibility, make government policies that work, and form partnerships to work together to lessen the bad effects of nickel mining and improve community and environmental health. These suggestions include looking at the problem as a whole and reducing the environmental damage in circular communities that are affected by nickel mining.

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