

Analysis of Trade-Offs in the Dynamics of Nickel Export Trade and the Risk of Environmental Degradation: A Case Study of Weda Bay, Maluku

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ABSTRACT

In the current downstream era, nickel has become a leading export commodity in Indonesia, particularly in the Weda Bay region of Maluku. Nickel exports have had a significant impact on Indonesia's national export trade, with global demand for nickel influenced by high global production levels of electric vehicle batteries, which have driven industrial expansion and increased export volumes. On the other hand, the development of nickel production and exports has also raised various challenges, such as environmental degradation, which requires serious attention. The objective of this study is to analyze the trade-off between the economic benefits generated by nickel exports and the environmental impacts occurring in Weda Bay. In this study, data was collected through literature reviews and relevant secondary data, enabling researchers to comprehensively describe the dynamics of nickel export trade and its implications for social and environmental conditions. The analysis results indicate that nickel exports make a significant contribution to the national and regional economies; however, nickel mining practices have caused environmental ecosystem degradation, water pollution, and changes in the social structure of surrounding communities. Therefore, the government's role is crucial in minimizing the negative externalities of nickel mining practices, namely through strengthening regulations, and environmental policies, implementing environmentally friendly technologies, and increasing community involvement in the monitoring and management of natural resources. With the right and appropriate management strategies, it is hoped that the mining area in Weda Bay can become a national nickel export source while maintaining environmental sustainability to create welfare for the surrounding community.

Keywords: Nickel, Environment, Government, Economy

1. INTRODUCTION

Nickel has become a highly sought-after commodity by various countries, playing a crucial role in multiple sectors, including industry, healthcare, and medicine. Indonesia's geographical region is believed to contain 52% of the world's nickel reserves (Syarifudin, 2022). According to the United States Geological Survey, Indonesia's nickel reserves reach 21 million tons, while the Geological Agency states that Indonesia's nickel resources even reach 11.7 billion tons. In the current downstream era, nickel has become a leading export commodity in Indonesia, particularly in the Weda Gulf region of Maluku. Nickel exports have significantly impacted Indonesia's national export trade, where global nickel demand is influenced by the high level of global electric vehicle battery production, which has driven industry expansion and increased export volumes. Based on data from the World Bank through WITS, Indonesia's ferro-nickel exports were recorded at approximately USD 15.29 billion in 2023, with an export volume of 8.53 million kilograms. This figure increased compared to 2022, which stood at USD 13.62 billion with a volume of 5.78 million kilograms.

Locations such as Obi Island and Halmahera are known to have high-quality nickel content that is crucial for the stainless steel industry and electric vehicle batteries. In addition to having large nickel reserves, North Maluku is also considered a strategic area in terms of logistics and maritime transport access. Its position on international trade routes allows mining products to be shipped directly to key destination countries, such as China and South Korea. The central and local governments support the development of industries in this region through policy incentives, particularly those aimed at encouraging downstream processing in the mining sector. This reflected in the development of integrated industrial zones, such as those based on mining, on Obi Island and the Weda Bay industrial area. The existence of supporting infrastructure, such as refining facilities (smelters) and dedicated ports, also accelerates the processes of mining, processing, and exporting derivative products that have higher economic value compared to raw ore.

On the other hand, the development of nickel production and exports also poses various challenges, such as environmental degradation, which requires serious attention. The rapid expansion of the nickel industry in this region has caused significant environmental damage, including massive deforestation, ecosystem pollution, and disruption to the livelihoods of local communities that are heavily dependent on nature. Furthermore, the increase in nickel production that is not matched by adequate environmental management has the potential to create systemic and prolonged socio-ecological disasters (Syarifudin, 2022). This finding aligns with the research conducted by Ananda, S. A. (2025), which demonstrates that the mining activities of PT IWIP in Central Halmahera have a significant environmental and social impact. Although this sector contributes to economic growth, its activities lead to damage to the quality of water, air, and soil, as well as the destruction of mangrove areas, the loss of agricultural land, and the disruption of marine ecosystem balance. Residents living around the mining site experience a decrease in income, difficulties accessing clean water, and an increase in health issues, especially respiratory diseases. In addition, the living space of indigenous communities is increasingly constricted, and the weak accountability of the company is exacerbated by the existence of new legal policies that make it difficult for residents to prove environmental pollution.

Based on the background above, this research aims to analyze the trade-off between the economic benefits generated from nickel exports and the environmental impacts occurring in Weda Bay. Several previous studies have either emphasized the economic contributions from nickel exports or highlighted environmental impacts, but have not explicitly analyzed the balance between the two in specific scenarios, particularly in IWIP. Through this study, it is hoped to provide a more comprehensive picture regarding the role and issues faced by the nickel sector in Indonesia, while also presenting policy recommendations that support the creation of a balance between economic development and environmental conservation efforts in the future.

2. METHODS

The research method employed in this study is a qualitative approach with a descriptive orientation. Qualitative research is a method used to understand meanings, experiences, or social phenomena that occur. The purpose of this research is to thoroughly

examine the dynamics of nickel exports and their impacts on social and environmental aspects, with a focus on the Teluk Weda area in Maluku. The data collection process was conducted through a literature review and secondary data searches from various credible sources. The information was obtained from reports and publications from institutions such as the World Bank, the Geological Agency of the Ministry of Energy and Mineral Resources, the United States Geological Survey (USGS), the Central Statistics Agency (BPS), as well as research reports from the Centre for Research on Energy and Clean Air (CREA) and the Center of Economic and Law Studies (CELIOS). These sources provide accurate and comprehensive information regarding the magnitude of nickel exports in Indonesia, its contribution to the economy, and the environmental and social impacts arising from mining activities, particularly in the Weda Bay region, Maluku.

The use of secondary data was chosen for several reasons. First, it allows for greater efficiency in terms of time and resources, as the data is already available and accessible. Second, the data comes from trusted and official institutions, which ensures a high level of validity and reliability. Third, due to the limited accessibility of mining sites like Weda Bay, whether because of geographic, security, or regulatory factors, secondary data becomes the most practical option. Finally, because this study aims to assess the broader policy impacts and macro-level dynamics of industrialization, secondary data is more appropriate than localized primary data. Through the analysis of secondary data, the researchers aim to compile a comprehensive picture of the trade-off between economic interests and nickel exports, as well as the associated risks of environmental degradation and social pressures. This study not only highlights the economic aspects of export activities but also examines the ecological and social consequences that arise as part of the industrialization dynamics in mining areas..

3. RESULTS AND DISCUSSIONS

3.1 Transformation of Weda Bay as the National Nickel Export Center

In the mining sector, Indonesia is one of the countries with the world's highest mineral reserves. This is evidenced by Indonesia's significant contributions to various global mining commodities, including gold, tin, copper, and nickel. This situation has placed Indonesia among the world's top 10 largest exporters of mining products. One of the mining commodities that contributes the most to Indonesia's export balance is nickel (Tangkudung & Kaseger, 2024).

North Maluku has the largest nickel resources in Indonesia. One of the areas continually promoted for nickel production in Central Halmahera is the Weda Bay region (Maharani et al., 2025). Weda Bay in Central Halmahera, North Maluku, has evolved into one of the primary nickel export centers in Indonesia since nickel reserves were discovered in the area in 1996 by Weda Bay Minerals, in collaboration with PT Antam (Mining Technology, 2023). After experiencing delays for several years, the project resumed activity in 2018 through a collaboration between Indonesian and Chinese companies, specifically PT Indonesia Weda Bay Industrial Park (IWIP). Mining activities began in October 2019, while

the refining facility (smelter) officially commenced operations in April 2020 (PT IWIP, 2023).

The Indonesia Weda Bay Industrial Park (IWIP) is the primary location for nickel mining and processing activities in Indonesia. This area is an integrated mineral industrial zone funded by three Chinese companies: Tsingshan Holding Group, Huayou Cobalt, and Zhenshi Holding Group. Within IWIP, there are at least four to five companies, including Weda Bay Nickel (WBN), that operate mining and nickel processing (smelter) facilities. Additionally, various subcontractor companies and service providers also play a role in supporting these industrial activities (Maharani et al., 2025). K This mining area covers an area of 45,065 hectares, and the shareholding structure of PT Weda Bay Nickel consists of four companies, namely Tsingshan with a share of 57%, Eramet S.A. with 43%, Strand Mineral Pte Ltd with 90%, and PT Aneka Tambang Tbk with 10% (Drakel, 2023).

Based on the analysis results, CELIOS indicates that the construction of nickel smelters along with supporting facilities contributes to the national GDP by IDR 83.17 trillion (equivalent to USD 5.36 billion) during the construction phase. At this initial stage, the project draws labor from various regions to support the development of industrial infrastructure (CREA & CELIOS, 2024). This contribution reflects the significant economic impact of initial investments in the downstream nickel industry. In addition to generating direct economic value from the industrial sector, this phase also stimulates economic activities in related sectors such as construction services, transportation, and material supply. The development also increases the demand for labor from various regions to work on industrial infrastructure projects, including smelters, power networks, and logistics facilities. The impact is not only felt in the formal sector but also boosts the local economy through increased income for the surrounding community.

The increase in downstream activities is also reflected in the national export performance. According to data from the Central Statistics Agency (BPS), Indonesia's nickel commodity exports have experienced a significant upward trend over the past decade. In 2015, nickel exports were valued at IDR 806.08 billion and have continued to show a positive trend, particularly after the acceleration of downstream activities began in 2021. The export value surged significantly to IDR 5.94 trillion in 2022, increased again to IDR 6.82 trillion in 2023, and reached IDR 7.99 trillion in 2024. This trend indicates that investment in the nickel industry sector not only contributes to national economic growth and job creation but also strengthens Indonesia's position in global trade through an increase in the exports of value-added products.

However, behind the seemingly promising economic achievements, it is essential to highlight and evaluate the long-term impacts of nickel mining activities, particularly in relation to environmental sustainability, social stability in the communities surrounding the mining areas, and the risks of excessive dependence on the extractive sector within the national economic structure.

3.2 Trade-Off Analysis and Sustainable Management Strategies

3.2.1 Trade-off analysis

In the context of industrial activities, particularly in the nickel mining industry, there will undoubtedly be a trade-off between economic interests and environmental sustainability. This is due to nickel being a strategic global commodity, particularly with the increasing production of electric vehicle (EV) batteries and clean technology. On the other hand, this acceleration of industrialization leads to various ecological and social impacts. The presence of the nickel industry in Weda Bay, particularly in industrial areas such as IWIP (Indonesia Weda Industrial Park), undoubtedly contributes to the economic growth of North Maluku.

The IWIP area is a mining area as well as a nickel processing industry integrated where, according to data from the Central Statistics Agency, the Regional Gross Domestic Product (PDRB) growth in North Maluku is 13.73% in 2024, which is mainly supported by the processing industry at 24.69% of the total PDRB of North Maluku. The economic contribution of PT IWIP is not only in terms of PDRB, but there are 13 types of obligations, either in the form of taxes or royalties, that PT. Indonesia Weda Bay Industrial Park (IWIP) must fulfill the government's requirements each year, where the royalty rate charged is 1% of total sales. It is recorded that the contribution of PT. Indonesia Weda Bay Industrial Park (IWIP) to the Indonesian government in 2022 was US\$3 billion or around Rp. 30 trillion (Drakel, 2023). In addition, the contribution to the economic aspect is also felt by the surrounding community, where the people can build businesses such as boarding houses or businesses in the culinary field. The community can also obtain jobs where the IWIP area has contributed to the local labor market's absorption. Approximately 80% of the 82,000 workforce consists of local workers who help the surrounding community meet its daily needs. Another positive impact is the expansion of access roads that have been built, making it easier to distribute goods, which will result in greater equity. Additionally, the construction of bridges, places of worship, and schools greatly assists the local community. On the other hand, the presence of the nickel industry does have negative impacts, such as the threat of environmental degradation that occurs over a specific period. One of the concerns is that the threat of environmental degradation will reduce GDP in certain years if the nickel industry continues to rely on coal energy and fails to implement additional pollution controls, such as water filters or tailings processing. Additionally, GDP will also decrease if there is no in-depth strengthening of CSR (Corporate Social Responsibility). This aligns with the research conducted by CREA & CELIOS (2024), which analyzed the BAU (Business As Usual) scenario as follows.

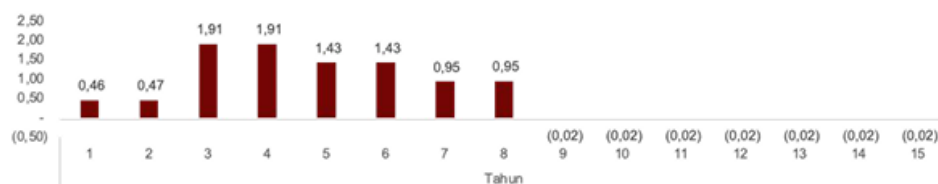


Figure 1. The impact of nickel industry GDP in North Maluku under the BAU scenario

Source: CREA&CELIOS, 2024

According to the CELIOS and CREA report (2024), when analyzed under a BAU scenario, the nickel mining region in North Maluku will make a significant positive contribution to North Maluku's GDP in the early operational phase, particularly in the first 5 years up to the 8th year. The nickel processing industry recorded an addition of GDP of up to IDR 3.6 trillion, while the mining and excavation sector contributed more than IDR 12 trillion. However, this report also shows that this contribution is temporary. In the 9th year and beyond, the contribution of the nickel industry becomes negative due to environmental impacts that reduce output in other sectors, such as agriculture and fisheries. Several environmental impacts have occurred, including deforestation that resulted in the loss of 26,100 hectares of primary forest due to nickel mining. The damage to the forest also led to the largest flood in Central Halmahera in 2024, with approximately 1,726 evacuees (BPS, 2024). Seas have undergone dimensional changes due to mining and smelter activities, water pollution, and decreasing fish catches by fishermen in coastal areas, especially around Weda Bay, which has also been affected by mining activities. Another negative impact is the increase in health issues among communities around the mines due to pollution, dust, and industrial activities. In other words, although the contribution of IWIP to early economic growth is quite significant, the long-term socio-ecological costs it generates are very substantial and could hinder sustainable development. However, if the nickel industry utilizes renewable energy, as depicted in the RE (Renewable Energy) and APC (Air Pollution Control) scenarios, then the economic growth from the nickel industry could remain sustainable, considering several aspects.

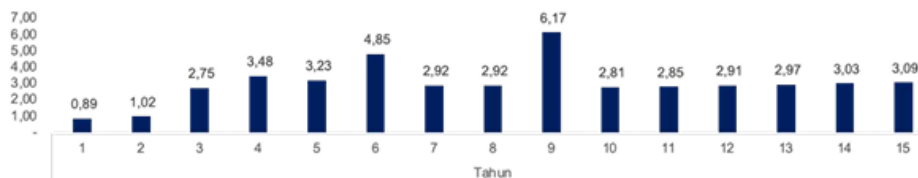


Figure 2. The impact of the GDP of the nickel industry in North Maluku in the RE and APC scenarios

Source: CREA&CELIOS, 2024

According to a report from CREA & CELIOS (2024) in the RE and APC scenarios, it is stated that the contribution of the nickel industry to GDP will remain stable and may even increase for up to 15 years due to the mitigation of negative impacts occurring in other sectors. Furthermore, the RE and APC scenarios also reflect sustainable industrial growth that does not compromise the environment or the well-being of surrounding communities. This is certainly in stark contrast to the BAU scenario, which experiences a sharp decline in the 9th year due to unresolved environmental and social damages.

3.2.2 Sustainable management strategy

As one of the largest nickel industrial areas in Indonesia, PT Indonesia Weda Bay Industrial Park (IWIP) in Weda Bay has indeed implemented various sustainable management strategies in response to environmental and social pressures from its industrial activities. One of the measures taken is to implement the RE and APC scenarios by utilizing New and Renewable Energy (EBT) in its industrial activities. The utilization of EBT encompasses the development of green energy projects, specifically a Solar Power Plant (PLTS) with a capacity of 2 gigawatts (GW) and a Wind Power Plant (PLTB) of 500 megawatts (MW), aimed at promoting sustainable development in line with national carbon emission reduction targets. IWIP also utilizes waste heat technology commonly employed in the High Pressure Acid Leaching (HPAL) industry, which converts industrial processes into electrical energy, aiming to significantly reduce carbon emissions with a target of 4 million tons per year. Additionally, IWIP is developing a co-firing method at the Coal-Fired Power Plant (PLTU) that utilizes biomass to generate electricity and reduce carbon emissions. Through various efforts, IWIP is demonstrating concrete steps towards RE and APC scenarios.

Sustainable management strategies are not only applicable in the RE and APC scenarios but also involve the implementation of CSR programs aimed at mitigating negative externalities and improving the quality of life for local communities surrounding industrial areas. One of the CSR programs being carried out is the Weda Bay Project, which coincides with the celebration of World Environment Day 2024, aimed at fulfilling a commitment to protecting the environment by starting to plant 1 million mangroves. The Weda Bay project not only involves planting mangroves but also begins with simple practices, such as waste sorting and recycling, as well as cleaning riverbanks and beach areas. In addition, they are also undertaking reclamation of mining areas, mangrove rehabilitation, and coral transplantation, as well as building High-Density systems used to manage rainwater into clean water that can be reused. This is done to ensure the company's sustainability by continuously prioritizing the balance, conservation, and protection of the environment.

The CSR activities carried out are not only aimed at maintaining environmental balance but also to improve the quality of life in the community, such as supporting the construction of the Lelief Inpatient Health Center, valued at Rp. 14 billion, built on an area of 100x100 meters, and its operations, including the provision of 10 oxygen tanks. Additionally, IWIP constructed staff housing for health workers, which is expected to balance the availability of health infrastructure with the number of health personnel. In terms of the economy, PT IWIP continues to play a role in sustainable economic development in North Maluku by empowering MSME actors since 2021 in various sectors such as the procurement of food supplies, work clothes and equipment, fuel oil (BBM), industrial gas, wood processing, transportation and accommodation, maintenance and repair services, as well as the distribution of medications. The cooperation has reached the amount of Rp. 3.5 trillion in accordance with the Regulation of the Minister of Investment/Head of BPKM No. 1 of 2022 concerning the Procedures for the Implementation of Partnerships in the Field of Investment between Large Enterprises and MSMEs in the region. This can lead to a multiplier effect, encouraging economic growth in the area. In terms of culture, IWIP has also established cooperation with the Faisa Cultural Studio to preserve the traditional Bamboo

Tada musical instrument. However, it is essential to note that despite implementing various sustainable management strategies, nickel industrial activities continue to cause environmental, health, and social harm. In this case, cooperation from multiple parties is necessary to continuously mitigate these negative externalities. With various efforts underway, IWIP will demonstrate a strategic and balanced approach that balances economic growth with environmental sustainability, aligning with the direction of national development towards a green and low-carbon economy.

3.3 Government Intervention in Regulation and Policy

The Indonesian government shows active involvement in the nickel mining sector through national policies focused on industrialization processes and increasing export value. The Weda Bay area in North Maluku is a priority region for implementing the national nickel downstream program. The implementation of this policy is reflected in the development of the Indonesia Weda Bay Industrial Park (IWIP), which is listed as a National Strategic Project (PSN). Regulatory support for the acceleration of smelter development and the increase of refined nickel product exports is provided through regulations such as the Minister of Energy and Mineral Resources Regulation Number 17 of 2020 and Presidential Regulation Number 18 of 2020, which directly facilitate corporate interests in this sector (Yudhoprakoso & Fristikawati, 2023).

Government intervention in the mining sector continues, but this step has not been accompanied by strengthening the environmental oversight system or protecting local communities. The implementation of regulations, such as Law Number 32 of 2009 on Environmental Protection and Management and the regulations on Environmental Impact Assessment (AMDAL), still shows weaknesses at the implementation level. Mining activities in the Teluk Weda area have had negative impacts, including river pollution, limited access to land for communities, and rising social tensions. Moreover, indigenous communities and fishing groups have lost their living space due to the expansion of industrial areas carried out without an inclusive, fair, and transparent public consultation process (Bidul & Widowaty, 2023).

Article 28H paragraph (1) of the 1945 Constitution emphasizes the right of every citizen to obtain a healthy environment as part of their physical and spiritual well-being. This provision includes the right to a decent life, to participate in a clean and safe environment, and to have access to health services. In this context, the state and all stakeholders must preserve and protect the quality of the environment as an essential element supporting the life of humans and other living beings in Indonesia (Ananda, 2025).

The enactment of Law Number 6 of 2023 has changed the legal approach to liability for environmental damage, particularly through the abolition of the principle of strict liability. This change exacerbates the community's increasing difficulty in obtaining justice, as they are now required to prove the company's fault in cases of pollution. This situation arises amid the increasing intensity of environmental damage in Weda Bay, including marine pollution, deforestation, and degradation of coastal ecosystems. In this situation, the government tends

to focus more on facilitating investment rather than ensuring environmental responsibility and accountability from industrial actors (Ananda, 2025).

Meanwhile, although the authority for licensing has been centralized to the central government through Government Regulation No. 96 of 2021, the role of local governments (Pemda) in monitoring and enforcing environmental violations remains vital. However, overlapping permits, weak inter-agency coordination, and minimal public participation hinder effective environmental monitoring. The imbalance between the principles of good environmental governance and economic interests exacerbates environmental damage and weakens the position of local communities in facing the negative impacts of mining activities (Yudhoprakoso & Fristikawati, 2023).

The government is also working to establish a platform among stakeholders, including companies, local governments, civil society organizations, and local communities. This aims to outline mitigating measures against environmental impacts, strengthen monitoring systems, and ensure active community participation in the decision-making process. On the other hand, the government also establishes mining prohibition areas in regions with high ecological vulnerability, such as watersheds, protected forests, and coastal areas, to prevent irreversible environmental damage and to maintain the sustainability of ecosystems in the Weda Bay. At the national level, the formation of the Task Force for Accelerating Downstreaming and Energy Resilience aims to integrate strategies across ministries, while also aligning industrial investments with environmental protection policies. However, the implementation of monitoring for the Environmental Impact Analysis (AMDAL) and the fulfillment of post-mining reclamation obligations still face several obstacles and are considered not optimal.

The downstream policy and government interventions regarding nickel have not yet fully adhered to the principles of sustainable development. The primary focus of the government is solely directed towards increasing foreign exchange and export volumes, which tends to ignore the long-term ecological and social impacts. Various issues such as deforestation, marine and air pollution, land disputes, and the increasing vulnerability of indigenous communities continue to occur without precise handling of these problems. In this regard, the role of the state should not merely be that of a facilitator of industrial interests, but also as a protector of the environment and the fulfillment of community rights.

The policies and regulations implemented by the government regarding nickel management in the Weda Bay area demonstrate a dominance of economic orientation and national industrialization that have not been fully balanced with environmental protection and the fulfillment of local community rights. The primary objective of the downstream program is to enhance the added value of resources and bolster the independence of the domestic industrial sector; however, its implementation continues to face various challenges. Among them are weak oversight mechanisms, disharmony in coordination between the central and local governments, and a low level of transparency and accountability in the decision-making process. In this condition, the importance of policy reformulation, strengthening the oversight system, and increasing public participation is crucial so that mining activities in Weda Bay can occur fairly and sustainably.

4. CONCLUSION

Based on the analysis results, nickel exports have had a significant positive impact on national and regional economic growth, particularly through increases in Gross Regional Domestic Product (GRDP), job creation, and strengthening of the industrial supply chain. The presence of PT Indonesia Weda Bay Industrial Park (IWIP) serves as a real example of the implementation of resource-based downstream strategies. However, this economic achievement is also accompanied by serious consequences, including environmental damage and social disruption, such as deforestation, environmental pollution, declining land quality, and the displacement of local social structures. If this activity is not balanced with sustainable management, such as in the Business As Usual (BAU) scenario, the environmental impact caused by nickel mining activities is at risk of reducing the contribution of this sector in the long term, as well as having severe effects on other sectors such as agriculture and fisheries.

In this regard, it is expected that the government will play a crucial role in mitigating the negative impacts of nickel mining activities in Teluk Weda, Maluku. Strategic steps that can be taken include strengthening environmental regulations and policies, encouraging the use of environmentally friendly technologies, and actively involving the community in the process of monitoring and managing natural resources. PT IWIP has begun to implement a more sustainable approach through the integration of Renewable Energy (RE) and Air Pollution Control (APC) scenarios, accompanied by the implementation of Corporate Social Responsibility (CSR) programs in various areas, including the environment, health, the economy, and cultural preservation. With the strategic and sustainable implementation, the mining area in Teluk Weda has the potential to become a national nickel export center while preserving environmental sustainability and promoting the welfare of society fairly and comprehensively.

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