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Original Article

Analysis of the Impact of Mining on the Economy and Environmental Degradation in Morowali Regency (A Case Study of PT IMIP)

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Abstract

Morowali Regency in Central Sulawesi has emerged as Indonesia's leading nickel hub through the Indonesia Morowali Industrial Park (PT IMIP), a joint venture with China's Tsingshan Steel Group. Since 2013, PT IMIP has attracted billions in investment and developed advanced smelters to meet global demand for electric vehicle batteries. While this expansion has boosted economic growth and employment, it has also raised serious environmental concerns. This study analyses the dual impact of nickel mining in Morowali Regency, using 2010–2024 data from the Central Statistics Agency and supporting literature. The objective is to measure the mining sector's contribution to Gross Regional Domestic Product (GRDP) and evaluate its environmental consequences. A descriptive quantitative approach was applied to examine the relationship between GRDP and the mining sector, while qualitative analysis was used to assess environmental degradation. Results show that GRDP rose sharply from Rp4.10 billion in 2011 to Rp98.79 billion in 2024. Although the mining sector's share declined from 41.67% to 18.18%, its absolute value increased, driving employment, socio-economic transformation, and business diversification. However, mining activities caused severe environmental damage, including 5,501 hectares of deforestation, marine ecosystem disruption, water and air pollution, and a surge in acute respiratory disease cases to 55,527 in 2024. Waste generation in Bahodopi District reached 40 tonnes per day, with inadequate management infrastructure. The study concludes that sustainable resource management policies are urgently needed to balance economic growth with environmental conservation, recommending stronger regulations, adoption of eco-friendly technologies, and community empowerment.

Keywords: Economic Impact, Environmental Degradation, GRDP, Mining and Quarrying, PT IMIP.

1. Introduction

Morowali Regency is one of several nickel-producing regions in Indonesia and has a nickel and steel-based industrial area, also operating in the Central Sulawesi region. Tin, white gold (solder) managed by PT Indonesia Morowali Industrial Park (IMIP) is located in Bahodopi District and has its own port and airport. It is a collaboration between Bintang Delapan Group and Tsingshan Steel Group from China (Yayasan Tanah Merdeka, 2020). The PT IMIP Industrial Area is a collaboration between Indonesia's Bintang Delapan Group and China's Tsingshan Steel Group. PT IMIP is a company established on September 19, 2013, with the legal form of a limited liability company (PT). The company began operating in 2014 with main investors Shanghai Decent Investment Ltd, PT Sulawesi Mining Investment, and PT Bintang Delapan Mineral. This company manages an industrial area with 25 companies within it and has developed rapidly in less than six years.

There has been much news about foreign direct investment plans for electric vehicle battery manufacturing in Indonesia. In the PT IMIP area, two companies have begun construction of their production facilities, such as the construction of nickel processing facilities with high-pressure acid leaching (HPAL) technology that has already begun, because with the global trend of using environmentally friendly vehicles such as electric cars, it will impact the demand for nickel raw materials as raw materials for making electric car batteries. In the PT IMIP area, various types of factories have been established, including smelters for nickel pig iron (NPI). These smelters apply rotary kiln-electric furnace (RKEF) and blast furnace (BF) technologies. Additionally, this industrial area also has ferrochrome and ferrosilicon smelters, as well as factories that produce electrolytic manganese, stainless steel, carbon steel, and others. This includes factories that produce various other supporting materials.

The nickel-based industry in Morowali is growing rapidly. This has transformed Morowali's face over the past five years. Morowali's economy has grown rapidly. The smelter facilities are located in IMIP, which is the result of collaboration between PT BDM, PT SMI, and a subsidiary of Tsingshan Group. Five years after the construction of the first smelter, IMIP has developed into an integrated industrial area. The smelter facilities at PT IMIP are the result of collaboration between PT BDM, PT SMI, and a subsidiary of Tsingshan Group. Within five years since the construction of the first smelter, PT IMIP has developed into a world-class integrated nickel-based industrial area. As of January 2019, the total investment value that has entered the industrial area reached US$ 5 billion, or approximately Rp 69 trillion (Yayasan Tanah Merdeka, 2020).

PT IMIP is the largest nickel industry company in Southeast Asia, controlling 50 percent of the market share in downstream production in Indonesia. The main products produced by PT IMIP are nickel, followed by stainless steel and carbon steel. The presence of PT IMIP has a significant impact on the economy in Morowali Regency, but the presence of PT IMIP still draws criticism from various community groups. Although this company can contribute to reducing unemployment and poverty rates, as well as being a source of state revenue, the mining industry also brings negative impacts in the form of river pollution and forest destruction around the mine site, with damage reaching thousands of hectares (Nadya, 2023). The positive impacts brought by PT IMIP can be seen from the improvement in human resource quality through education programs, skills training, health services, and economic development for the local community. However, the negative impacts on the physical environment are very concerning, including soil, air, and water pollution, as well as forest destruction (Rifay, 2024).

Nickel mining in Morowali Regency, particularly through PT IMIP's operational activities, has become one of the main pillars in driving regional and national economic growth. PT IMIP, as one of the largest industrial areas in Southeast Asia, plays a significant role in increasing the Gross Regional Domestic Product (GRDP) of Morowali Regency, which shows rapid economic development in a relatively short period since beginning operations in 2014. The contribution of this industry can be seen from the increase in investment up to US$ 5 billion and the development of innovative processing and production facilities, such as HPAL technology and high-tech smelters that support global demand, especially from the trend of using electric vehicles based on batteries that require nickel raw materials. However, behind these economic achievements, serious challenges have emerged regarding environmental pollution impacts and declining community health quality. The massive nickel mining and processing activities in the IMIP area have caused air and water pollution, forest ecosystem damage, and critical natural resource degradation. The increase in cases of acute respiratory

infections (ARI), as well as natural habitat destruction, shows that development sustainability does not only depend on economic growth alone, but must also consider environmental conservation and community health aspects.

Therefore, this research has high urgency to comprehensively examine the reciprocal relationship between economic growth driven by mining activities at PT IMIP and the negative impacts that arise on the environment. A deep understanding of this aspect is important as a basis for making policies that can balance economic benefits and environmental protection. In addition, this study is also relevant in the context of accelerating sustainable development, especially considering the high industrial dynamics that continue to develop and the potential for increasingly complex environmental problems.

Furthermore, the results of this research are expected to provide scientific contributions in enriching studies on the balance between economic growth and environmental sustainability in major mining areas. Through empirical analysis related to the influence of mining activities on GRDP and environmental and community health indicators, this research can become a foundation in formulating natural resource management policies that are not only oriented toward short-term economic growth, but also consider ecosystem sustainability and community quality of life in the future. Thus, the findings from this study are expected to help the government, industry, and communities in establishing sustainable, adaptive, and responsible development strategies, to ensure that economic benefits align with environmental conservation and protection of the rights of communities around mining areas.

2. Literature Review

International cooperation has now become an important part of international life, where every action taken by a country aims to achieve their respective national interests. One real example of this cooperation is the relationship between Indonesia and China, particularly in the field of nickel investment through smelter construction projects. To date, Indonesia has 26 nickel smelters, and this number is expected to continue increasing in the coming years. Cooperation in this nickel investment project provides positive impacts for the economic growth of both countries. For Indonesia, this investment increases state revenue through the downstreaming process, creates jobs that contribute to reducing unemployment rates, and increases the amount of foreign investment entering. On the other hand, China also benefits from this project, with increased investment in Indonesia and maintained nickel supply chain for manufacturing needs in their country. Thus, this cooperation creates sustainable interdependence, where Indonesia needs investment from China for smelter construction, while China needs nickel from Indonesia for their industrial interests (Fauziyyah & Paksi, 2023)

The mining sector is a capital-intensive activity that requires substantial investment. Investment in general will impact both the community and economic growth in the region because it can provide extensive employment opportunities, increase economic activity, national income, and improve community welfare standards. The positive impact of investment in the metal mining sector is the increase in Papua Province's total GRDP, mining and agricultural sector GRDP, as well as added value in terms of labor in the mining sector. (Rosyid, 2020). The government as a policy stakeholder should make decisions based on public interest. Referring to Law No. 4 of 2009 on Minerals and Coal, which opens space for local governments to issue mining permits, this is highly vulnerable to abuse of authority. The overly easy granting of investment permits is feared to override protection rights in mining areas and trigger social conflicts in the community. When viewed from a prospective aspect,

mining activities are more detrimental to communities around the mine, such as floods, air pollution, water and soil contamination. Meanwhile, company owners will not experience such impacts because after mine resources are depleted they will return to their respective places with various wealth they possess. While in former mining areas, mud floods, loss of local residents' livelihoods, and environmental damage will become shadows that ultimately drag the community into the poverty trap (Risal et al., 2013)

Externalities for the community can be in the form of benefits or cost burdens due to production and consumption activities. These benefits or burdens are not only felt by people directly interested in the company as owners, consumers, workers, government or community, but also felt by other communities not directly related to the company's activities and presence (Mariyana, 2017). Externality is the cost or benefit of market transactions not reflected in price. Production and consumption activities of one party that affect other parties and no compensation is given by the party conducting the production activity. When externalities occur, there are parties affected by these consumption and production activities. Third parties are those who bear the burden such as polluted water or air and damaged land (Rinawati & Dewi, 2014)

Positive externalities occur in community income and education. Community income and education experience differences before and after mining. After gold mining, community income increased and with increasing income, community education also increased because the community has the ability to finance the education costs of their children or family members to complete high school and even reach university level. Negative externalities occur in health, security, and the surrounding natural environment. As a result of mining waste such as mercury commonly used by the community, river water becomes contaminated and causes surrounding communities to suffer from illnesses caused by this mining activity, both by gold miners and surrounding communities (Anisa, 2023).

Central Sulawesi Province, which has high GRDP, will also show significant GRDP per capita, for example in Morowali Regency and Banggai Regency. The mining sector in Morowali Regency contributes to increasing Central Sulawesi's GRDP thanks to the existence of nickel mines, which are resources with great potential in the region. On the other hand, the regency with the lowest GRDP per capita in Central Sulawesi Province is Banggai Laut Regency, which is caused by Banggai Regency's relatively low GRDP and population that is also not high. (Pende & Ali, 2023). Morowali in Central Sulawesi is a successful example of nickel processing policy. PT IMIP is an industrial area that supports global investment expansion from China. In the past four years, since nickel processing facilities began operating, IMIP has become the main producer of nickel pig iron (NPI) in Indonesia. In fact, IMIP has also become a center for stainless steel production, which is a processed nickel product (Yayasan Tanah Merdeka, 2020).

The copper mining sector makes a substantial contribution to economic development in Papua Province. To maximize the positive impact of the copper mining sector's presence in Papua can be done in two ways: pragmatic approach and systematic approach. With the presence of the copper mining sector in Papua Province has provided many benefits in the economic field. These impacts include creating employment opportunities both directly and indirectly through inter-industrial linkage systems and income induction effects (Suciyanti et al., 2018). Nickel mining activities in coastal areas of Sulawesi and North Maluku have had major social impacts on local residents. One of the main consequences observed is the marginalization of local communities. Coastal communities, who largely depend on marine natural resources, must face various challenges due to water pollution caused by mining waste. For example, in Pomalaa, Southeast Sulawesi, the Bajo community has lost access to marine

ecosystems that were once the main source of their livelihood, such as fishing and seaweed cultivation. Damage to coral reefs and marine water pollution have reduced fish populations and damaged the ecosystem that is the foundation of their social and economic life (Gunarto & Mokodompit, 2024)

The impact of nickel mining companies in North Konawe Regency, Tinanggea District, has created business opportunities for the local community, which can be understood as opportunities to achieve profits. Nickel mining activities in this area encourage the community to take advantage of these opportunities by establishing micro-businesses, such as small kiosks (grocery stalls, roadside food stalls, mobile credit counters), small industries (tempeh making, tofu, chips, and screen printing), and service businesses (barbers, tire repair, motorcycle workshops, and tailors). In addition, the community is also involved in craft businesses (souvenirs, woodwork, and weaving), as well as agriculture and livestock sectors (secondary crops, native chickens, ducks, catfish, fish ponds, and shrimp). The opening of these small businesses provides economic benefits for both parties; micro traders can increase income to meet daily needs, while mining employees have easier access to shop at nearby kiosks without having to travel far. These findings show that the presence of mining companies not only impacts the economic sector, but also contributes to improving local community welfare through the creation of new business fields (Suriyani, 2019).

Marine pollution from nickel mining waste in North Konawe has the potential to cause serious impacts on marine ecosystems, including decreased water and sediment quality, as well as coral reef damage that serves as habitat for various species. Waste containing heavy metals such as nickel, cobalt, and cadmium can damage ecosystem balance and enter the food chain, which is detrimental to fishery resources vital to local communities, especially fishermen. This negative economic impact includes decreased catch yields and value of the fisheries sector, which directly impacts the livelihoods of coastal communities. In addition, health risks for communities consuming fishery products from polluted waters become a serious concern. Therefore, holistic and coordinated handling efforts are needed, including strict regulations, investment in clean technology, and active community participation in environmental monitoring (Saputro et al., 2024).

Economic growth in Morowali Regency shows consistent development, and the sectors contributing most are mining and exploration as well as the processing industry sector. This occurs in line with the entry of investment for the construction of nickel processing plants in the form of smelter factories in Bahodopi District, which produces investment in the form of capital goods with quite significant value (Nuraeni, 2018). The presence of the mining industry has changed the community's perspective in generating income to meet basic needs, where many individuals leave jobs in agriculture, plantations, and fisheries sectors. This change is caused by unproductive agricultural land and pollution that disturbs fish habitat, as well as damage to mangrove ecosystems and coral reefs due to mining activities. Although companies provide compensation, this cannot fully cover the long-term losses experienced by the community, such as loss of livelihood. Now, communities are increasingly dependent on the mining industry, which forces them to face changes and shift from agricultural land to work as laborers in the sector. This transformation shows a mutually influential relationship between the community and the mining business (Sumardin, 2025).

The impact of nickel mining in Fatufia Village, Bahodopi District, Morowali Regency, provides significant influence on the community's economy, both positive and negative. Positive impacts include the formation of employment opportunities, reduction of unemployment, and increased population and education levels. However, negative impacts that emerge include dense population, increased consumption of alcoholic beverages

(alcohol), social conflicts, air pollution, noise, and traffic congestion due to many employees. Changes in community income are also visible, where many sell agricultural land to build boarding houses. In addition, many communities open BRILink outlets, showing high money circulation in the mining area. Overall, nickel mining activities in Fatufia Village create economic opportunities while challenges that need to be managed to achieve sustainable welfare (Nurhayat et al., 2023).

The impact of PT IMIP mining in Fatufia Village, Bahodopi District, Morowali Regency, shows significant social and economic impacts. Social impacts include increased community education levels, but health problems also emerge due to water pollution and air pollution. Community social relationships change, with focus on individual businesses and financial contributions in social activities. Economically, mining opens new business opportunities, encouraging communities to shift from agriculture and fisheries to trading businesses. Communities now better understand the importance of saving for the future and children's education, with more stable income and no longer dependent on uncertain agricultural yields. (Suriansa, 2022). Before Bahodopi became an industrial area, the majority of the community earned income as fishermen. A small portion worked as farmers and civil servants. The community's standard of living at that time was below average. After large investments entered the area, job choices became increasingly diverse. Not only as fishermen, farmers, or civil servants, now they can trade fish or become fish suppliers to meet the needs of around 38 thousand employees. They can also supply staple materials such as rice, vegetables, cooking spices, and so on to the company. Most of the community also become boarding house providers with profits ranging from Rp5-10 million per month. In addition, local sons and daughters are also recruited as factory employees (Kurniawan, 2020).

Morowali located in Central Sulawesi experiences quite severe environmental impacts due to nickel processing activities from Indonesia Morowali Industrial Park (IMIP), especially in coastal and marine areas. Tailing disposal causes coral reef damage. The most felt impact is by fishermen, because fish are becoming increasingly difficult to catch on Morowali's coast. Deforestation also occurs extensively in land areas. Meanwhile, the ocean bears an additional burden due to waste disposal. Sea water pollution causes fishermen to lose their source of livelihood. Dumped waste causes sediment accumulation in the sea, which ultimately damages coral reefs (Syarifuddin, 2022). Environmental pollution in marine areas is not only caused by nickel mining and processing industry activities. In mid-June 2020, a barge carrying nickel ore leaked and sank in waters near Bete-Bete Village, Bahodopi District, Morowali Regency. The ore spill caused pollution and damage to the marine environment and coral reefs. In addition, coal burning in the IMIP area is also a very serious environmental issue. Dust from coal burning is carried by wind to residential areas adjacent to the factory. Fatufia, the village where IMIP operates, is the area most affected by coal smoke (Candra, 2021).

PT IMIP's mining activities in Morowali Regency, Central Sulawesi (Sulteng), have become a disaster for fishermen. Their livelihood from marine products can no longer be relied upon because it is polluted by waste disposal from the company's Steam Power Plant (PLTU), which results in decreased catches for fishermen (Aidil, 2024). Nickel mining activities produce various particles, especially dust divided into two main types, namely $PM_{2.5}$ and PM_{10}. These particulates can negatively impact the health of the community and workers around the mining area. In addition, the nickel mining industry also has the potential to produce sulfur dioxide (SO_2) gas emissions originating from pyrometallurgical or smelting processes, namely mineral processing at high temperatures using coal-fired furnaces (coke). This coal combustion process triggers the release of particulate and gas emissions that increase the risk of air pollution, especially $PM_{2.5}$, PM_{10}, and SO_2. All three types of pollutants

contain hazardous materials that can cause respiratory tract disorders, such as Acute Respiratory Infections (ARI), lung cancer, cardiovascular disease, chronic obstructive pulmonary disease (COPD), to increasing the risk of premature death (Sanjaya et al., 2024)

Nickel ore mining activities in Bahodopi District, Morowali Regency, have caused significant environmental damage. Changes in landscape from hilly to flat and pitted result in loss of vegetation and terrestrial fauna habitat. Decreased surface water quality, both in rivers and seas, occurs due to pollution from mining activities that impact the reduction of aquatic biota populations, such as fish. Analysis of environmental damage levels shows that abiotic and biotic components are in the category of severe damage, which reflects serious impacts on soil physical conditions and biodiversity. Meanwhile, the cultural component experiences moderate damage, indicating complex social and economic impacts for local communities dependent on natural resources. Therefore, rehabilitation efforts and sustainable environmental management are needed to minimize negative impacts from these mining activities and protect ecosystems and community welfare (Subekti et al., 2023). In the mining and quarrying industry, the Green Industry concept can be applied where the production process considers efficient use of resources. The goal is to minimize negative impacts of industrial activities on the environment, increase resource use efficiency, and create sustainable jobs. Green industry is also known as sustainable industry (Suparman et al., 2023).

3. Methods

This study utilises quantitative analysis methods using secondary data from the Central Statistics Agency (BPS) of Central Sulawesi Province for the years 2011–2024, as well as additional data from the internet, articles, and journals. The analysis focuses on the economic impact, namely the Gross Regional Domestic Product (GRDP), and the environmental impact in Morowali Regency. This study uses a descriptive quantitative approach. The variables in this study use two variables, namely variable (X) is the Mining and Quarrying Sector, while variable (Y) is the Total GRDP of Morowali Regency. The relationship between variable (X) and variable (Y) is analysed to measure the extent to which the mining and quarrying sector contributes to the increase in the GRDP of Morowali Regency. The method of analysis of the contribution of the mining and quarrying sector to the GRDP uses the following formula:

$$\text{Contribution} = \frac{\text{Value of Mining and Quarrying Sector}}{\text{Total GRDP}} \times 100\%$$

While a quantitative approach is used to examine the impact of mining and quarrying activities on environmental degradation in Morowali Regency through literature study, which includes scientific publications, environmental reports from government agencies, and media institutions focusing on environmental and conservation issues.

4. Results and Discussion

It can be seen from the beginning of PT IMIP's (Indonesia Morowali Industrial Park) operations in the Morowali area, specifically in Bahodopi District, significantly impacted the local community's economy. Nickel ore mining in the upstream and nickel ore processing in the downstream make Morowali a region with the most vibrant economic activity in Central Sulawesi. The industrial area in Morowali has become one of the world's most important nickel

producers. IMIP has also become one of the stainless-steel industry centers with the lowest production costs. This is because the location of stainless-steel production is combined with the location of NPI and ferrochrome. The main raw materials for making stainless steel are ferrochrome and NPI. IMIP's semi-stainless-steel products can be sold at lower prices in the global market due to their integrated production location.

Table 1. GRDP Income ADHK Morowali Regency 2011-2024

Year	Mining and Quarrying (Million Rupiah)	Total GRDP (Million Rupiah)
2011	1,709,158.00	4,101,979.00
2012	2,445,212.00	5,011,999.00
2013	3,334,690.00	6,203,582.00
2014	1,494,684.00	6,208,893.00
2015	3,153,027.00	10,419,752.00
2016	3,655,288.00	11,714,403.00
2017	4,237,418.00	13,363,839.00
2018	6,408,961.50	28,358,401.60
2019	7,676,333.50	34,102,749.30
2020	10,315,559.60	43.902.249,40
2021	12,701,490.40	55.004.426,40
2022	14,888,973.60	70.621.654,60
2023	16,985,391.50	84.987.244,40
2024	17,961,629.00	98,791,650.90

Source: Morowali Central Statistics Agency 2011-2024

Based on GRDP data of Morowali Regency by business field at 2010 constant prices during 2011 to 2024, Based on Gross Regional Domestic Product (GRDP) data of Morowali Regency from 2011 to 2024, the development of the mining and quarrying sector value shows diverse patterns with increases and decreases throughout the period. At the beginning of the period, this sector's value increased from 1,709,158 billion in 2011 to 3,334,690 billion in 2013. However, in 2014 there was a sharp decline to 1,494,684 billion, reflecting obstacles or factors affecting the sector. After 2014, the mining and quarrying sector again showed a stable and significant upward trend, reaching 17,961,629 billion in 2024. This upward trend indicates improvement in production and exploration conditions in the sector, which positively impacts the regional economy.

Total GRDP of Morowali Regency during 2011 to 2024 experienced a quite significant upward trend, although there were years of stagnation in the early-mid period. Starting from a total of 4,101,979 billion in 2011, Total GRDP continued to develop until reaching 98,791,630 billion in 2024. Quite significant acceleration occurred especially from 2017 to 2024, with a large jump in 2018 reaching 28,358,401 billion and continuing to increase until the last year of data. This increase in Total GRDP shows strong and consistent long-term county economic growth.

The relationship between the mining and quarrying sector and Total GRDP growth in Morowali Regency is very close. Data shows that increases in mining sector value directly contribute to increases in Total GRDP. This is clearly seen from the pattern of increase in both variables running parallel since 2015, showing that the mining sector is one of the main drivers of economic growth in this region. Thus, the mining and quarrying sector not only plays a role as a contributor of economic value, but also as an economic development engine that drives improvement in community welfare. Years showing significant increases in the mining sector and Total GRDP are 2018, 2019, and 2020 to 2024. Conversely, 2014 is a year with significant decline in mining sector value which also impacted Total GRDP stagnation. This decline

indicates specific conditions affecting the sector's performance, thus impacting overall county economic growth.

In conclusion, the mining and quarrying sector has a very large contribution to Morowali Regency's economic growth during 2011 to 2024. This sector's contribution has proven capable of driving significant Total GRDP increases, so the mining sector can be considered a leading sector that is the backbone of the regional economy. Therefore, sustainable management and optimization of mining sector potential are very important to maintain stable and inclusive economic growth rates in Morowali Regency, showing significant increases in regional economic performance. GRDP value increased rapidly from Rp34.10 Billion in 2019 to Rp84.98 Billion in 2023. This growth is mainly supported by the dominance of the processing industry sector and the mining and quarrying sector which continues to develop. The presence of nickel industrial areas such as PT IMIP is one of the main factors driving economic growth in this area.

The processing industry sector recorded the largest contribution, with a value reaching Rp72.12 billion in 2024, increasing sharply compared to Rp21.30 billion in 2019. This sector developed rapidly due to nickel downstreaming activities. On the other hand, the mining and quarrying sector also shows a consistent upward trend, from Rp7.67 billion to Rp16.98 billion in five years, indicating the important role of the upstream sector in supporting industrial activities in Morowali.

Growth also occurred in the construction sector, which increased from Rp2.24 billion in 2019 to Rp4.54 billion in 2024, indicating acceleration in infrastructure development. In addition, the trade, transportation, and communication sectors also show improved performance, reflecting increased overall economic activity. Meanwhile, sectors such as government, education, and health experienced slower but still positive growth. This increase indicates adjustment to public service needs due to economic and population growth. Overall, Morowali's economy is strongly supported by exploitation and processing of natural resources, especially nickel, which has broad impacts on other sectors.

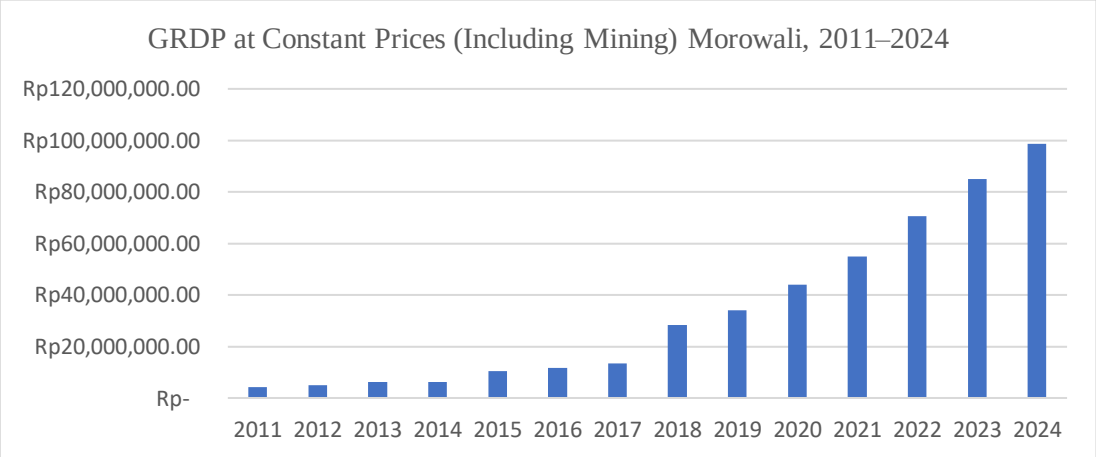

Figure 1. Morowali GRDP 2011-2024
Source: Morowali Central Statistics Agency Data

Based on data in Figure 1, it can be seen that the Gross Regional Domestic Product (GRDP) at Constant Prices (ADHK) of Morowali Regency shows a significant upward trend throughout 2011 to 2024. During that period, the development of ADHK GRDP value experienced a relatively stable journey in the early years before entering a period of sharp growth acceleration starting from 2017 to 2024. Quantitatively, this GRDP value increase can

be observed from a very drastic increase in the bar chart, where GRDP value increased from a relatively low level in 2010 to approaching Rp100 billion in 2024.

Data trends show a positive growth direction with increasingly rapid GRDP value advancement in recent years. From 2011 to 2016, value development was stable with relatively slow and moderate increases. However, after 2017, significant acceleration occurred with GRDP value soaring high every year, forming an exponential increase pattern on the graph. This trend indicates that Morowali Regency's economy experienced strong and sustainable expansion during that period.

Analysis of the significant increase in the period 2017 to 2024 indicates strong driving factors for regional economic growth. One possible cause of this sharp surge is increased mining and quarrying sector activity, known as one of the main sectors in Morowali. Increased mine industry investment, supporting infrastructure development, and economic policies supporting natural resource management also contributed to this growth. In addition, global dynamics such as higher commodity demand have the potential to significantly affect GRDP value during that period.

The economic meaning of this GRDP growth trend is increased production capacity and economic added value generated by Morowali Regency. Significant growth shows that this region is able to drive higher economic development, open job opportunities, and increase community income. Thus, the upward trend in GRDP value reflects sustainable regional economic progress, and shows Morowali's potential as a region capable of optimally utilizing its natural resources for local community welfare and national economic contribution. Thus, it can be concluded that the development trend of Morowali Regency's ADHK GRDP from 2011 to 2024 describes strong and sustainable economic growth, especially driven by strategic sectors such as mining. This provides an important picture of regional economic dynamics that must continue to be optimized through effective resource management and supportive development policies.

Morowali Regency has experienced significant economic transformation by relying on the mining and processing industry sectors as the backbone of its economy. Based on data from the Central Statistics Agency (BPS) of Morowali Regency in 2023, the mining and quarrying sector contributed Rp16 billion to the Gross Regional Domestic Product (GRDP). However, more notably, the processing industry sector shows a much larger contribution, reaching Rp59 billion, reflecting the success of industrial downstreaming development, especially in nickel processing. (Fauziyyah & Paksi, 2023)

Table 2. Contribution of Mining and Quarrying Sector to Morowali Regency GRDP 2011-2024

Year	Total GRDP (Million Rupiah)	Mining & Quarrying (Million Rupiah)	Contribution of Mining & Quarrying Sector to GRDP (%)	GRDP Growth Rate (%)	Mining & Quarrying Sector Growth Rate (%)
2011	4,101,979.00	1,709,158.00	41.67	21.69	51.17
2012	5,011,999.00	2,445,212.00	59.61	22.18	43.07
2013	6,203,582.00	3,334,690.00	53.75	23.77	36.38
2014	6,208,893.00	1,494,684.00	24.07	0.09	-55.18
2015	10,419,752.00	3,153,027.00	30.26	67.82	110.95
2016	11,714,403.00	3,655,288.00	31.20	12.42	15.93
2017	13,363,839.00	4,237,418.00	31.71	14.08	15.93
2018	28,358,401.60	6,408,961.50	22.60	112.20	51.25
2019	34,102,749.30	7,676,333.50	22.51	20.26	19.77
2020	43.902.249,40	10.315.559,60	23,50	28,74	34.38
2021	55.004.416,40	12.701.490,40	23,09	25,29	23.13

Year	Total GRDP (Million Rupiah)	Mining & Quarrying (Million Rupiah)	Contribution of Mining & Quarrying Sector to GRDP (%)	GRDP Growth Rate (%)	Mining & Quarrying Sector Growth Rate (%)
2022	70.621.654,60	14.888.973,60	21,85	23,86	17.22
2023	84.987.244,40	16.985.391,50	19,99	24,75	14.08
2024	98,791,650.90	17,961,629.00	18.18	16.24	5.75

Source: Processed Secondary Data

Based on data from 2011 to 2024, Based on data in the table regarding the contribution of the mining and quarrying sector to Morowali Regency GRDP in 2011 to 2024, comprehensive analysis can be conducted to understand regional economic growth dynamics and the role of that sector. Generally, Morowali Regency's GRDP shows a very significant upward trend, from Rp4,101,979 billion in 2011 to Rp98,791,630.9 billion in 2024. The displayed GRDP growth rate also fluctuates with certain years recording very high growth, for example in 2015 at 67.82 percent and 2018 reaching 112.20 percent. However, there are also years with nearly stagnant growth, such as in 2014 at 0.09 percent.

The trend of mining and quarrying sector contribution to GRDP shows a declining tendency in terms of percentage contribution to total GRDP. In 2011, this sector's contribution reached 41.67 percent, then rose sharply to 59.61 percent in 2012, and gradually declined again to 18.18 percent in 2024. Although the contribution proportion decreased, the absolute value of the mining and quarrying sector continued to increase significantly, from Rp1,709,158 billion in 2011 to Rp17,961,629 billion in 2024. This condition describes rapid industry growth, but balanced by growth in other sectors, making the mining sector's portion relatively decline proportionally to the overall regional economy.

Analysis of the mining and quarrying sector growth rate shows high volatility, with significant changes affecting total regional economic growth. 2014 became a very prominent point, where a sharp decline in mining sector growth rate of -55.18 percent occurred, causing nearly stagnant total GRDP growth rate of 0.09 percent. This can be indicated as a year of contraction or major challenges in the mining sector that impacted regional economic slowdown. Conversely, the decrease in Morowali's GRDP income from the mining and quarrying sector in 2014 can be linked to PT IMIP's smelter construction which changed the regional economic structure. Smelter construction caused a shift in activities from direct raw material mining to downstream nickel processing domestically, so the volume and value of raw mining production decreased.

This transformation impacted the reduced contribution of the mining and quarrying sector to Morowali's GRDP, although overall Morowali's economy experienced growth driven by the processing industry sector. The policy of prohibiting nickel raw material exports that came into effect in early 2014 also forced industrial activity diversification in Morowali, strengthening the smelter's role as the main economic driver.

This transformation has resulted in a decline in the contribution of the mining and quarrying sector to Morowali's GRDP. In 2014, the contribution of the mining and quarrying sector to Morowali's GRDP ADHK declined compared to 2013, with a growth rate of around 29.68 per cent, due to fluctuations in production during the construction of the PT IMIP smelter, which began in 2013. This process reduced raw mining activities because the ore was diverted to domestic processing facilities, in accordance with the initial mandate of Articles 102-112 of the Mineral and Coal Law, which requires refining to increase the overall added value of Morowali's economy, which experienced growth driven by the processing industry sector. The policy banning the export of raw nickel, which came into effect in early 2014, also

forced the diversification of industrial activities in Morowali, strengthening the role of smelters as the main drivers of the economy.

The contribution of the mining sector to Morowali's GRDP has fluctuated significantly, with a decline in 2014 due to the construction of the PT IMIP smelter, which shifted the focus from raw extraction to processing, and an increase after 2015 in line with full operations and the downstreaming push from the Minerba Law. This analysis is closely related to the regulations of Law No. 4 of 2009 on mineral and coal, which requires domestic processing and restricts the export of raw ore.

Therefore, the decline in mining sector GRDP that year was not merely an indication of economic decline, but rather a reflection of economic structural change toward sustainable industrial downstreaming. In 2015 the mining sector again showed recovery with a growth rate reaching 110.95 percent, which then also drove GRDP growth rate acceleration of 67.82 percent. 2018 also recorded a slowdown in mining contribution at 22.60 percent but with GRDP growth that soared to 112.20 percent, indicating the role of other sectors beginning to contribute as economic drivers.

Comparison between mining and quarrying sector growth rate and total GRDP growth rate shows that this sector tends to be less stable and has a major impact on regional economic growth fluctuations. In years where mining sector growth experienced large surges such as in 2015, overall GRDP growth was also driven high. Conversely, when this sector experienced decline such as in 2014, regional economic growth also slowed drastically. This indicates that the mining and quarrying sector is still a main driver of Morowali Regency's economic growth, although its relative role decreases due to development of other sectors.

The year with the highest mining sector contribution in proportion to GRDP is 2012, at 59.61 percent. Conversely, the lowest contribution occurred in 2024, at 18.18 percent. This comparison confirms that although the absolute value of the mining sector increased, increased contribution from other sectors caused a decrease in this sector's proportional percentage. In this context, regional economic composition experienced diversification, although the mining sector still holds a central role.

The contribution of the mining and quarrying sector to GRDP shows a relatively stable trend, although slight fluctuations occurred. In 2019, this sector contributed 22.51 percent to total GRDP. That contribution increased to 23.50 percent in 2020, reflecting this sector's important role in supporting the regional economy. However, starting in 2021, its contribution began to gradually decline to 23.09 percent, then to 21.85 percent in 2022, and finally dropped drastically to 19.99 percent in 2024. In 2024, the mining sector in Morowali Regency experienced an increase in nominal added value, compared to the previous year. However, although its value increased in absolute terms, its contribution to GRDP actually decreased. This occurs because in measuring sector contribution to GRDP, the main focus is the relative contribution percentage to total GRDP from all economic sectors, not just nominal value alone.

Economically, this percentage contribution decrease is caused by the fact that total GRDP of Morowali Regency in 2024 grew faster overall compared to the mining sector's growth itself. In other words, although the mining sector increased in value, its increase was not proportional to the surge in total added value generated by other sectors. When other sectors such as processing industry, construction, trade, and services grew more significantly, they contributed a larger proportion in the GRDP structure. This causes the relative contribution of the mining sector to become smaller in percentage, although its value increased.

This phenomenon also describes changes in regional economic structure, where dependence on the mining sector is beginning to decrease, and other sectors are beginning to take more dominant roles in driving economic growth. In addition, the base effect also influences, because the larger the total GRDP, the smaller the impact of small additions in one sector if not accompanied by proportional increases. Thus, the decrease in mining sector contribution in percentage in 2024 does not indicate performance decline, but rather the impact of other sectors' faster overall growth.

During 2010 to 2024, Morowali Regency's GRDP growth experienced quite significant changes, reflecting economic dynamics strongly influenced by the mining and quarrying sector. Over the past five years, Morowali Regency's GRDP growth rate shows relatively high and stable figures, reflecting rapid regional economic growth. In addition to impacting increased Morowali Regency GRDP, the nickel mining and quarrying industry also provides significant influence on the community's economy in mining areas, especially communities in the PT IMIP mining area. Villages in the industrial area are no less busy. A small portion of the community become providers of goods and services officially to PT IMIP. From Dampala to Labota, thousands of boarding rooms are rented for PT IMIP workers. Grocery stores, various kiosks, laundry services, motor vehicle workshops, refilled water depots, fuel retailers, restaurants, and street food stalls are everywhere.

Villages in the area experienced major changes as a result of PT IMIP's presence. Small villages such as Bahodopi, Bahomakmur, Keurea, Fatufia, and Labota have experienced rapid development. Cars and motorcycles pass 24 hours a day. Agricultural activities that were previously significant are now almost nonexistent. The majority of agricultural land has shifted function to become boarding house construction areas.

Agricultural land in the area has largely shifted function, mostly built into boarding houses. Communities assess that the boarding house business is more promising than farming. Although boarding house construction requires substantial initial capital, they still choose it because it is considered to provide greater long-term economic benefits. Companies also buy community-owned land to build various facilities supporting their operations. One example is agricultural land that was previously rice fields owned by Kaurea and Bahomakmur Village residents, which have now been converted by PT IMIP into an airport area. Since PT IMIP's establishment in Bahodopi District, the surrounding community's economy has increased. This can be seen from changes in community livelihoods. Before mining exploration and exploitation permits were issued, the community in Fatufia Village was very dependent on forest natural resources such as damar, rattan, agricultural products, and activities as fishermen.

With PT IMIP's presence, job opportunities opened for communities around the mining area. In addition, this company also opens business opportunities for local communities. Business opportunities can be interpreted as an opportunity that can be utilized as part of efforts to obtain profits. This is proven by nickel mining activities in the area, where many communities are able to see and utilize these opportunities to establish small businesses, such as grocery kiosks, roadside food stalls, mobile credit counters, small industries (such as tempeh making, tofu, chips, and screen printing), and service businesses (such as haircuts, tire repair, motorcycle workshops, and tailors).

The emergence of various small businesses provides benefits for both parties, namely the community and mining workers. Traders or small entrepreneurs can increase their income so daily needs can be met. Meanwhile, for the company, the presence of nearest kiosks facilitates mining employees to meet their needs without having to go far to get needed goods. Income is compensation in the form of money obtained by someone from work or business

results, both in formal and informal sectors, in a certain period of time. Community income increased along with nickel mining activities compared to conditions before the mining. Communities that previously relied on daily income from agricultural and plantation products that sometimes experienced crop failure have now been transformed after job opportunities opened in the mining sector. Many residents around the mining area who got jobs in companies, and some of them also started opening new businesses.

Livelihood transformation or commonly called work transformation is a change in how humans carry out tasks and work to sustain life. This change includes shifts in main tasks and utilization of available resources to form a more decent life and improve living standards. In Fatufia Village, this livelihood source transformation appears from changes in community orientation that previously depended on agriculture and marine products to the trade sector and other small businesses. This situation provides great opportunities for culinary business actors to expand their business, add menu varieties, enlarge eating place capacity, and recruit more workers. With the increasing number of restaurants also opens job opportunities. With this increase in employment also impacts the increase in population in the PT IMIP mining and quarrying area in Bahodopi District.

With population increase also affects the increase in basic needs such as rice supply, vegetables, fish, and various basic needs for these basic needs come from surrounding districts, such as rice needs come from Bumi Raya and Wita Ponda Districts as one of the largest rice suppliers in Morowali Regency, and also vegetables because these two districts are famous for their agricultural products. Even for vegetable needs, sometimes must be brought from Napu highlands, Poso Regency. Behind positive impacts, the mining and quarrying industry also has negative impacts. Based on environmental damage data caused by PT IMIP shows serious violations found by the Ministry of Environment and Environmental Control Agency (KLH/BPLH) of the Republic of Indonesia. These violations include:

1) PT IMIP does not have a communal Wastewater Treatment Plant (IPAL), so wastewater pollutes the surrounding environment.
2) There is hoarding of nickel slag waste (B3) and tailings without permit covering 10 hectares with volume estimated at more than 12 million tons, which has the potential to pollute soil and water.
3) In fact, land covering 179 hectares and factory construction covering approximately 1,800 hectares are not listed in the Environmental Impact Analysis (Amdal) document.
4) Air quality in the IMIP industrial area is poor with dust parameters (TSP) and PM10 particles exceeding standards, due to 24 emission sources that do not install continuous emission monitoring devices (CEMS).
5) Coal PLTU use causes increased ARI (Acute Respiratory Infection) disease in surrounding communities.
6) Marine ecosystem damage due to air and sea pollution, disturbing fishermen's livelihoods due to mud pollution and coral reef closure.
7) The integrated waste management facility (TPST) in Bahomakmur also does not yet have environmental approval, with poor leachate management that could pollute the surrounding environment.

In addition, B3 (hazardous and toxic) waste generated reaches approximately 10 million tons every year since the smelter operated, where only 10 percent can be utilized while the remaining 9 million tons accumulate without adequate management. One of them is environmental damage such as environmental pollution, one of which is due to haphazard tailing disposal (mud residue from nickel extraction) causing widespread sedimentation. As a

result, heavy metal pollution still present in nickel extraction residue, this heavy metal contamination accumulates in marine biota and triggers biomagnification in the marine ecosystem food chain. The real impact of waste disposal is coastal sedimentation in Morowali, especially the PT IMIP mining area. Mangrove forests and Morowali coastal seas that are home to fishery resources are damaged and result in fishermen experiencing decreased income. What should be known, Morowali waters are one of the threatened coral biodiversity triangle areas. Coral reefs are home to fish and also other marine biota because coral reefs are underwater ecosystems that become places for various marine resources that have economic value.

Based on analysis by Yayasan Kompas Peduli Hutan (KOMIU), until 2022 about 5,501 hectares of forest in Morowali have turned into mine pits due to nickel mining activities by PT IMIP. Morowali also became the region with the largest forest loss in Central Sulawesi, with deforestation reaching 2,073 hectares throughout 2024. In the years 2017 to 2024, deforestation in Morowali was always more than 1,000 hectares per year, with peak deforestation of 2,884 hectares occurring in 2016, one year after PT IMIP's first smelter was inaugurated. Mining activities and mining area expansion covering more than 118 thousand hectares have swept away most of the natural forest in this regency. This damage is not only forest clearing, but also includes land degradation due to heavy metal pollution, which makes forest recovery in former mines difficult. Hot water waste disposal from PLTU activities used for one of the most striking effects is hot water disposal from PLTU that generates electricity for mining industries in the surrounding area. Water temperatures in the waters around Fatufia Village are increased by hot water waste that flows into the sea. This phenomenon affects marine biota life, especially fish, which are the main source of coastal community income. Many fishermen complain about drastic decreases in fish catches and disrupted floating net cage businesses, which have functioned as local economic sources.

Changes in sea water temperature are not the only thing with negative impact. In addition, back-and-forth activities of barges and heavy mining cargo ships create ecological pressure on Morowali's coastal areas. The movement of these large ships can damage coral reef ecosystems and cause coastal erosion as a result. In fact, there have been several barge leaks and nickel ore spills into the sea causing significant pollution. Nickel ore spills damage seabed habitats. The impact of PLTU's presence was felt by a number of fishermen in areas around the mine, precisely in Kurisa Village, Bahodopi District, which is directly adjacent to PLTU. One of the impacts is on fishermen's cage businesses. PLTU waste disposal mixed with chemicals causes fish in cages to die. Previously communities could still cultivate fish in cages from their catches, but now they can no longer because sea water has been polluted by waste.

Before PLTU's presence, marine environmental conditions in Kurisa were very supportive of fishermen's lives. Sea water was still clean, rich in fish, shellfish, and other abundant marine resources that could be relied upon as main livelihoods. Communities also conducted fish and lobster cultivation activities in cages, even catching marine products directly from around the location. However, conditions changed drastically over time. Waste from PLTU waste disposal and industrial activities conducted without adequate environmental management caused sea water in the area to be polluted. Water color that was previously clear became turbid, mixed with mud and chemicals, even changing color to brown and blood red. This situation caused mass death of fish and lobsters in their cages, resulting in large economic losses for fishermen. Some of them lost catches worth tens of millions of rupiah, and natural fishing activities had to stop.

This situation not only brought material losses, but also threatened the sustainability of their livelihoods. Fishermen had to go to sea farther to the middle of the sea, even up to 7 miles

from home, with additional costs and danger risks at sea. Catches became increasingly few, and many of them were forced to change professions, those who were previously fishermen, now become factory workers or traders. In addition to impacting sea water pollution, the presence of mining and quarrying industry by PT IMIP also impacts air pollution. This air pollution is caused by 24 emission sources from PT IMIP tenants who do not install Continuous Emission Monitoring System (CEMS) equipment. In addition, coal use in captive PLTU is also mentioned as the main cause of high SO_2 levels in the air.

Coal use at quite high temperatures also causes increased SO_2 levels in the air, which has serious impacts on environmental quality of life and health of surrounding communities. This is among other things a finding from research conducted by Transformasi untuk Keadilan Indonesia (TuK Indonesia), in research conducted in Fatufia, Bahomakmur, and Labota Villages. This research uses environmental health risk analysis methods. In Morowali itself there is a large nickel industrial area, namely PT IMIP. Coal use in captive PLTU is mentioned as the main cause of high SO_2 levels in the air. Coal burning at high temperatures releases sulfur dioxide (SO_2) gas emissions in significant amounts, which negatively impacts air quality and health of surrounding communities.

Poor air quality around PT IMIP's mining area directly impacts community health. Air pollution has caused increased cases of respiratory diseases, one of which is Acute Respiratory Infection (ARI). Based on data from Bahodopi Health Center, the graph of ARI case achievements in Bahodopi Health Center work area during 2020 to 2024 shows significant fluctuations from year to year. In 2020, the number of ARI cases was recorded at 10,273 cases, which can be considered as the starting point of case trends in that period. Furthermore, in 2021 a sharp increase occurred with the number of cases reaching 20,508, or almost double the previous year. This increase can be linked to various factors, such as increased population mobility, decreased air quality, or lack of preventive efforts at the community level. However, in 2022, ARI cases experienced a decrease to 13,081 cases, indicating improvement or effectiveness of public health interventions implemented at that time. The most striking phenomenon occurred in 2024, where the number of cases increased drastically to 55,527 cases. This surge reflects potential serious public health crisis, and can be caused by various factors such as increased industrial activity, high air pollution due to mining and heavy transportation, and potential decrease in environmental quality of life in Bahodopi area.

In addition to decreasing air quality due to particle and gas emissions such as PM10, PM2.5, and SO_2, the presence of nickel mining and processing industry by PT IMIP in Bahodopi District has also provided significant impacts on land ecosystems, especially in the form of loss of forest cover and damage to ecological structure. Massive land clearing from year to year by mining companies causes conversion of natural forests into open land, which not only eliminates vegetation, but also damages fauna habitat. Changes in landscape from hilly areas to pitted flatlands due to mine exploitation activities cause disruption of area ecological functions, such as forest ability to absorb rainwater and hold erosion.

Further impacts from forest degradation in Bahodopi, Morowali area, significantly increase hydrometeorological disaster risks, especially floods. This phenomenon was proven in early May 2024, when heavy rain for 3-4 hours caused Dampala River to overflow, thus flooding residential areas in Bahodopi. Based on data from Morowali Regional Disaster Management Agency (BPBD), the flood was caused by high rainfall intensity that could not be accommodated by existing drainage systems, so about 200 people were affected and forced to evacuate to evacuation centers or to relatives' places. Floods that now occur almost every rainy season confirm that loss of forest cover due to nickel mining activities has directly contributed to decreased carrying capacity and environmental absorption capacity in the area (Gunawan,

Head of Emergency and Logistics Division BPBD Morowali, 2025; Data Yayasan Kompas Peduli Hutan, 2019-2022). Research and observations by Walhi Sulteng also highlight that massive nickel mining activities since 2015 caused significant environmental damage, increased sedimentation, river pollution, and increased flood frequency that harms local communities and surrounding ecosystems.

The National Disaster Risk Index (IRBN) data from the Central Sulawesi Provincial Disaster Management Agency (BNPB Sulteng) for the period 2015-2024 ranks Morowali Regency as the second most disaster-prone area in Central Sulawesi Province. North Morowali Regency is the area with the highest disaster risk, This is because both areas are mining industry zones in Central Sulawesi Province. These two regencies were once a single area, namely Morowali Regency, before being divided into two regencies, namely Morowali Regency and North Morowali Regency, in 2013. The impact of the mining industry itself has resulted in environmental damage, leading to natural disasters such as floods and landslides due to deforestation for the mining industry zone, which has an impact on disaster risk. This can be seen from data from the National Disaster Management Agency (BNPB), which shows that the two regencies with the highest disaster risk index in Central Sulawesi Province are the two regencies that are mining industry areas. The two regencies with the highest disaster risk index can be seen from the Central Sulawesi Province risk data from 2015-2024.

Table 3. Central Sulawesi Province Risk Index Values from 2015-2024

No	Regency/City	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Risk Class 2024
1	Morowali Utara							174.82	174.82	174.82	174.82	High
2	Morowali	177.20	177.20	177.20	177.20	173.80	173.80	174.82	174.82	173.25	171.17	High
3	Donggala	189.20	189.20	172.27	157.13	157.13	157.13	166.75	166.75	166.75	165.14	High
4	Banggai Laut							163.20	163.20	163.20	163.20	High
5	Banggai Kepulauan	163.20	163.20	163.20	163.20	163.20	163.20	163.20	163.20	163.20	159.41	High
6	Banggai	163.20	163.20	163.20	163.20	163.20	163.20	163.20	163.20	162.03	156.37	High
7	Buol	149.60	149.60	149.60	149.60	149.60	149.60	149.60	149.60	149.60	149.60	High
8	Tojo Una Una	137.60	137.60	137.60	137.60	137.60	137.60	137.60	137.60	137.60	137.60	Medium
9	Toli Toli	159.20	159.20	159.20	159.20	159.20	159.20	159.20	147.71	136.39	127.32	Medium
10	Poso	172.40	127.52	125.00	132.24	121.14	121.14	118.85	120.44	121.60	120.90	Medium
11	Kota Palu	181.20	181.20	162.70	162.70	162.70	162.70	168.25	151.43	132.30	116.55	Medium
12	Parigi Moutong	173.60	118.70	116.48	108.39	108.39	108.39	108.39	102.67	97.72	93.53	Medium
13	Sigi	72.00	50.22	49.79	52.16	48.13	48.13	51.00	49.27	48.85	48.71	Medium

Source: National Disaster Management Agency data

The risk index value has not changed due to the constant capacity value. The Disaster Risk Index for North Morowali and Banggai Laut Regencies began to be calculated in 2021, whereas in previous years it still followed the Disaster Risk Index values of their parent regencies.

Based on the Disaster Risk Index (IRB) data for regencies/cities in Central Sulawesi Province for the period 2015–2024, Morowali Regency has consistently been classified as

having a high disaster risk. In the 2015–2018 period, the DRIs for Morowali District remained stable at 177.20, reflecting a high level of risk due to a combination of threats, vulnerability and capacity in the region. Subsequently, in 2019–2020, there was a decrease in the DRIs value to 173.80, indicating an increase in disaster management capacity or a temporary decrease in the threat and vulnerability components. However, from 2021 to 2022, it remained relatively stagnant at around 174.82 in 2023 to 2024, experiencing a decline in value from 173.25 to 171.17. In 2014, Morowali Regency remained in the high disaster risk category despite a decline in the IRB value.

This condition shows that despite fluctuations in the index value, disaster risk reduction efforts in Morowali Regency have not been able to significantly and sustainably reduce the level of risk. Therefore, it is necessary to strengthen disaster mitigation strategies, increase response capacity, and implement more comprehensive regional risk management.

Based on the above data, it can be concluded that the existence of the PT IMIP mining industrial area has an impact on environmental damage, which results in natural disasters. This is reinforced by data from BPBN, namely the IRB data for Central Sulawesi Province, where Morowali Regency has a relatively high IRB. In addition, the existence of the mining industry has led to an increase in population and development activities. As this area is an industrial zone, population growth has also led to an increase in the volume of waste, as can be seen from the piles of waste along the Trans Sulawesi road. The large amount of waste piles in this area has a negative impact on the environment, public health and the beauty of the city. Waste piles are found along the Trans Sulawesi road, such as in the villages of Keurea, Fatufia, Labota and other villages in Bahodopi Subdistrict. This is very concerning, as can be seen from the volume of waste data (DLH) in Bahodopi Subdistrict, which has increased every year.

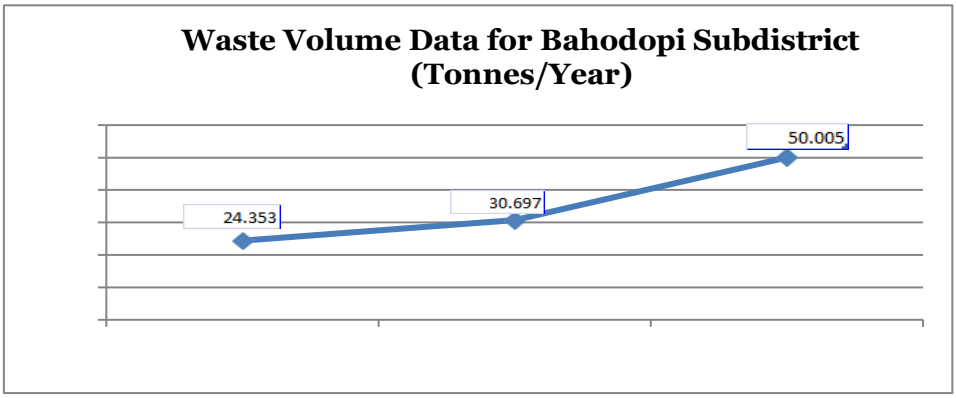

Figure 2. Waste Volume Data for Bahodopi Subdistrict
Source: Waste accumulation data (DLH)

Waste management in this area has encountered difficulties due to a number of issues. The first issue is the limited reach of the government agency, the Environmental Agency. Currently, the Morowali Regency Environmental Agency is still focused on waste management in the Bungku Tengah sub-district because the waste transport fleet is still minimal and there are also limitations in the number of waste transporters. As a result, the waste transport schedule in the Bahodopi sub-district is often unpredictable. In addition, there is also a perception that the government is not serious about addressing waste issues, as waste management efforts are only visible during 'Environment' celebrations or when the government is in the spotlight or criticised for its waste management.

The second problem is the impact of waste accumulation in Bahodopi Subdistrict. Public health is disrupted by the large amount of waste accumulated along the Trans Sulawesi route,

which causes unpleasant odours, especially as there are many food vendors on the side of the road. In addition, waste accumulation also has an impact on environmental pollution. Waste accumulation can pollute water and soil, especially if it contains hazardous materials. This can affect the quality of groundwater and water sources used by the community. Another impact is that waste piles can damage the landscape and reduce the aesthetic appeal of an area, which has an impact on community social activities.

To overcome this problem, the Morowali Regency Government, through the Environment Agency (DLH), has distributed waste management facilities to Bahodopi Subdistrict in the form of nine arm roll (amrol) units, eight waste trucks, twenty-six three-wheeled vehicles, and thirty-four containers on 30 June 2024, as well as budget support for the salaries of cleaning staff and fuel oil (BBM) requirements. In addition, the government also plans to build eleven Reduce, Reuse, and Recycle (3R) Waste Management Facilities and one Integrated Waste Management Facility (TPST).

However, the construction of these facilities is still facing various obstacles. The construction of TPS 3R is hampered by limited land availability at the village level, where only Keurea Village has prepared a location, while Labota Village has not. On the other hand, the construction of a ±20-hectare TPST, which is a collaboration between the Morowali Regency DLH and PT IMIP, has not yet been realised because the land status is still classified as Production Forest for Conversion (HPK), requiring a change in status to Land Management Rights (HPL). These administrative and inter-agency coordination constraints are the main factors hindering the acceleration of the construction of integrated waste management facilities in Bahodopi Sub-district.

In Labota Village and Keurea Village, the village governments have sought to act as facilitators in waste management by operating one waste collection truck each and collaborating with PT IMIP to transport waste along the Trans Sulawesi road. However, the limited number of vehicles and personnel means that waste transportation is not yet optimal. With the volume of waste continuing to increase, one truck per village is unable to cover the entire residential area, especially narrow alleys, so that transportation frequency in each hamlet can only be carried out two to three times per week. This condition results in the accumulation of waste, causing unpleasant odours and potentially reducing the quality of the environment and public health.

These problems have actually been addressed through the provision of waste management facilities by the local government, which the village government considers sufficient to solve the waste problem. However, the facilities that have been provided are not yet operational in Labota Village and Keurea Village because they are still in the planning and internal discussion stages. The delay in operating these facilities has caused the volume of waste to continue to increase and worsen environmental conditions. Therefore, accelerating decision-making and optimising the use of available facilities are urgent steps to ensure that waste management can be carried out more effectively and sustainably in both villages.

This situation is evident from the level of waste management, which is not commensurate with the volume of waste produced every day. The volume of waste produced in Bahodopi sub-district reaches 40 tonnes/day. This waste problem has a negative impact on the community; the smell of waste makes the community uncomfortable and can also affect their health.

5. Conclusion

From the results of research on the economic impact and environmental degradation of nickel mining activities in Morowali Regency, particularly those managed by PT IMIP. The research results show that the existence of the mining industry and nickel downstreaming significantly drives regional economic growth, as reflected in the increase in the Gross Regional Domestic Product (GRDP) of Morowali Regency from 2011 to 2024. In 2014, the mining and quarrying sector experienced a decline in production, which had an impact on the GRDP of Morowali Regency. The mining and quarrying sector plays a role as one of the economic development sectors with a continuously increasing absolute value contribution, even though its proportion of the total GRDP has declined due to economic diversification. The mining and quarrying sector has a significant impact on the economy of the community in the mining area, especially the community in the PT IMIP mining area, particularly in the MSME sector in the mining area.

The mining and nickel processing activities of PT Indonesia Morowali Industrial Park (IMIP) in Morowali Regency have a significant economic impact, but at the same time cause serious pressure on the environment. The results of the study show environmental degradation, including water, air and sea pollution, suboptimal management of hazardous waste, damage to coastal ecosystems, and large-scale deforestation. These conditions directly contribute to a decline in environmental carrying capacity and an increased risk of hydrometeorological disasters, particularly flooding, as reflected in the Morowali Regency Disaster Risk Index (IRB), which has consistently been in the high-risk category during the 2015–2024 period.

The environmental impacts also have implications for the health and socio-economic aspects of the community. Poor air quality due to industrial emissions and coal-fired power plants correlates with an increase in cases of acute respiratory infections (ARI), while coastal water pollution has an impact on declining catches and the loss of livelihoods for fishermen. On the other hand, industrial and population growth has led to an increase in waste generation to around 40 tonnes per day in Bahodopi District, which has not been matched by adequate waste management capacity, resulting in waste accumulation and a decline in the quality of the residential environment. Overall, this study confirms that environmental management in the Morowali mining industrial area has not been optimal or sustainable. Therefore, it is necessary to strengthen environmental supervision and law enforcement, optimise the utilisation of waste management infrastructure, and integrate industrial development policies with the principles of sustainable development and disaster risk reduction in order to minimise environmental impacts and improve community welfare.

Companies must implement effective waste management and environmentally friendly technology to reduce pollution. Then, economic diversification needs to be done by developing agriculture and tourism sectors to reduce dependence on the mining sector. Furthermore, training programs need to be provided for communities to improve their skills. Regular community health monitoring is also important to address problems arising from pollution. In addition, environmental restoration programs must be implemented to restore affected areas. Community involvement in decision-making is also very important, and there is a need to strengthen regulations and law enforcement against environmental violations. With these steps, it is hoped to achieve balance between economic growth and environmental conservation in Morowali.

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