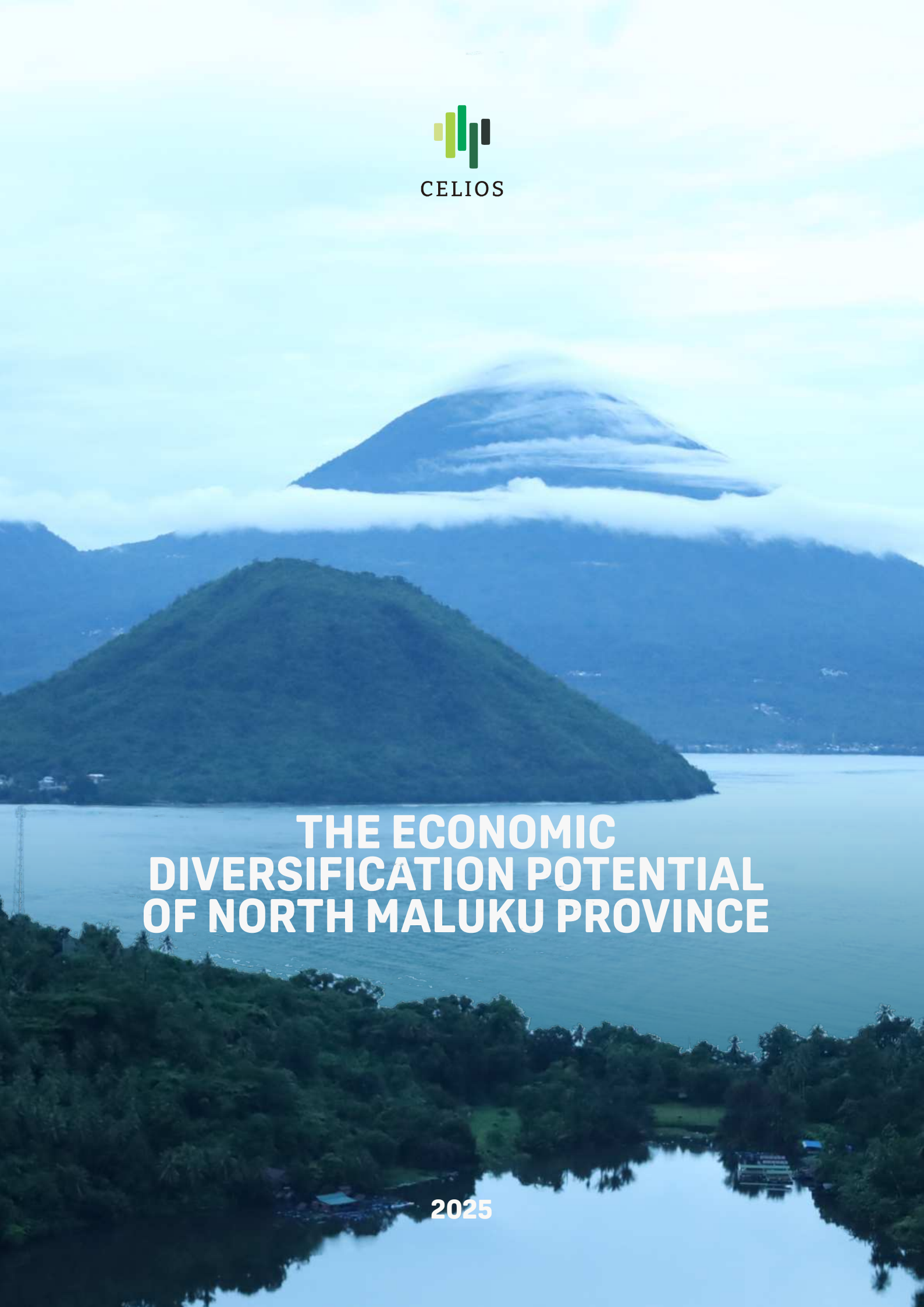

CELIOS

THE ECONOMIC DIVERSIFICATION POTENTIAL OF NORTH MALUKU PROVINCE

2025

THE ECONOMIC DIVERSIFICATION POTENTIAL OF NORTH MALUKU PROVINCE

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Publisher
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Background

The Indonesian government has taken the initiative to downstream nickel. This step began with the declaration of a moratorium on nickel ore exports in 2020, which has created a fertile climate for the development of the nickel industry in Indonesia. From 2020 to December 2024, there were 54 nickel smelters in Indonesia[1] still under construction and 16 smelters in the planning stage. Of the 54 smelters that were already in operation, 18 of them were located in North Maluku Province[2]. Nickel processing activities in North Maluku are concentrated in two locations: Central Halmahera Regency, centered in the Weda Bay area, and South Halmahera Regency, centered on Obi Island.

As shown in the appendix, there are more than 20 companies in North Maluku Province engaged in the nickel processing sector. The majority of these companies have capital from foreign sources, with only about 3 companies obtaining capital from domestic sources. Furthermore, the majority of these foreign investors come from China. In terms of location, most nickel processing entities in North Maluku Province are based in the Weda Bay Industrial Area, Central Halmahera. This is followed by South Halmahera, which is centered on Obi Island.

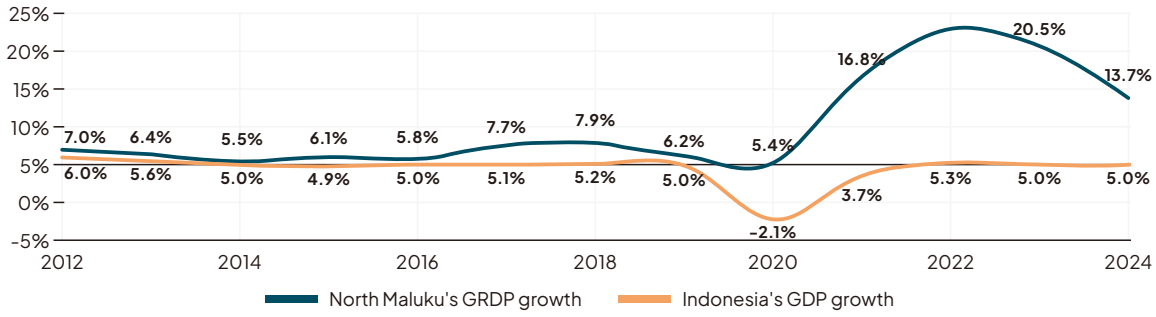
Economically, this nickel boom has boosted North Maluku's growth on paper to fantastic figures. As can be seen in **Figure 1-1** below, in the period from 2020 to 2024, North Maluku Province recorded an average economic growth of more than 18% per year. During the period from 2022 to 2023, when the global economy was still sluggish due to the COVID-19 pandemic, North Maluku Province recorded the highest GRDP growth in the world. This figure reached 22.94% in 2022 and 20.49% in 2023.

1 Fransiska Dewi, "ESDM: Indonesia's Nickel Downstream Industry is Unrivaled, 50 Smelters Built in 5 Years," *Indonesia Mining Association*, n.d., accessed July 23, 2025, https://ima-api.org/detail/news/mining/esdm-hilirisasi-nikel-ri-tak-tersaingi-5-tahun-bikin-50-smelter.

2 Lili Handayani, "Directorate General of Mineral and Coal: 44 Nickel Smelters Operating in Indonesia," March 2024, *Media Nikel Indonesia*, March 20, 2024, https://nikel.co.id/2024/03/20/ditjen-ilmate-44-smelter-nikel-beroperasi-di-indonesia/.

As can be seen from the graph below, since 2012, even before the nickel boom, North Maluku Province has consistently exceeded Indonesia's overall economic growth rate. From 2012 to 2016, North Maluku Province's economic growth was always higher than Indonesia's average, although the difference was not significant. The deviation between the two began in 2017, at the start of the nickel boom, and widened in the following years. North Maluku's GRDP broke through double digits in 2021 and exceeded 20% in 2022. Despite a slight decline, North Maluku has still recorded double-digit economic growth to date.

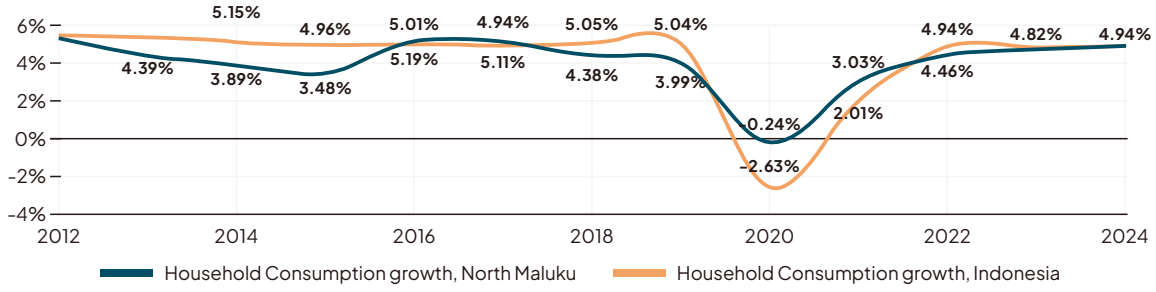
Figure 1-1. **North Maluku Province GRDP Growth and Indonesia GDP Growth**



Source: Processed from BPS data

Upon closer examination, this fantastic GRDP growth has another side that is not as beautiful as it seems. When looking at economic growth from an expenditure approach, it can be seen in Figure 1-2 below that the growth of household consumption in North Maluku Province during the 2012 to 2024 period is not much different from that of Indonesia. In general, the growth of household consumption in North Maluku is mostly below that of Indonesia, even though the difference in economic growth between North Maluku and Indonesia is far above.

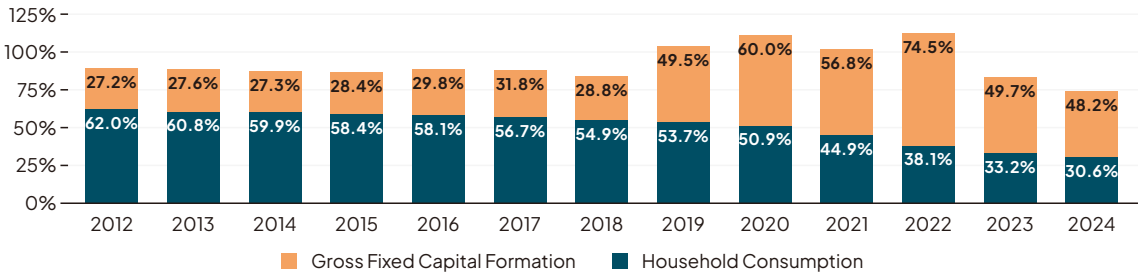
Figure 1-2. **Growth in Household Consumption in North Maluku and Growth in Household Consumption in Indonesia**



Source: Processed from BPS data

As shown in **Figure 1-3** below, during the same period there was a significant reduction in the proportion of household consumption in North Maluku's GRDP. The share of North Maluku's gross fixed capital formation began to creep up in 2017 when the nickel industry there began to take shape. In 2020, the Gross Capital Formation component dominated North Maluku's GRDP and exceeded the Household Consumption component, and this condition continues to this day. This reflects the lack of *a trickle-down* effect from the nickel industry to local consumption, where the economic benefits do not trickle down.

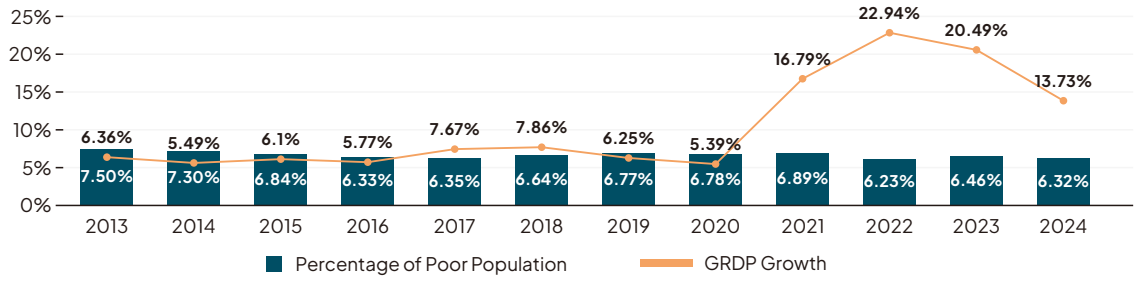
Figure 1-3. **Proportion of Gross Fixed Capital Formation and Household Expenditure to North Maluku Province's GRDP**



Source: Processed from BPS data

BPS data also shows the same thing, where in the period 2012 to 2024, the percentage of poor people in North Maluku Province did not decrease significantly. Both before and after nickel downstreaming, the percentage of poor people remained steady at around 6.5%. **Figure 1-4** shows that this steady poverty rate contrasts sharply with the economic growth of North Maluku Province, especially after the moratorium on nickel ore exports was imposed in 2020.

Figure 1-4. **Percentage of Poor Population VS Economic Growth of North Maluku Province**



Source: Processed from BPS data

The above illustration does not fully capture the poverty conditions in North Maluku Province. The figures shown in **Figure 1-4** are limited to the percentage of the poor population compared to the total population of North Maluku. Furthermore, this does not reflect the reduction in poverty in absolute terms. As shown in **Table 1-1** below, when calculated from 2016, the number of poor people in North Maluku increased by 3,190. This indicates that economic growth from the nickel industry does not have a sufficient trickle-down effect to overcome the problem of poverty in North Maluku.

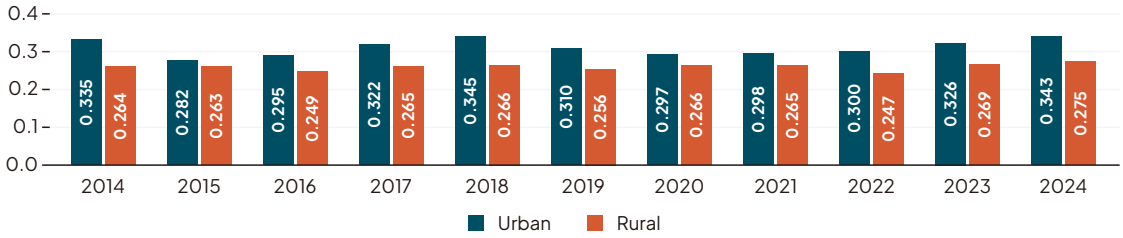
Table 1-1. **Changes in The Number of Poor People in North Maluku Province**

Year	Change in Number of Poor People
2016	-5,220
2017	1,790
2018	4,990
2019	3,140
2020	1,770
2021	790
2022	-7,290
2023	3,930
2024	-710
Total	**3,190**

Source: North Maluku Provincial Statistics Agency

The issue of poverty in North Maluku has also been raised by the Central Halmahera Regency Government. They revealed that there is still a significant problem of poverty in Central Halmahera, even though it has become a center for the nickel processing industry since the construction of the Indonesia Weda Bay Industrial Park (IWIP) in the regency. Theoretically, even since the construction phase of the IWIP area, there should have been job opportunities and cash flow into Central Halmahera to alleviate the majority of poverty in the region. When this did not happen, there was a disconnect in the nickel industry's economic chain to the community.

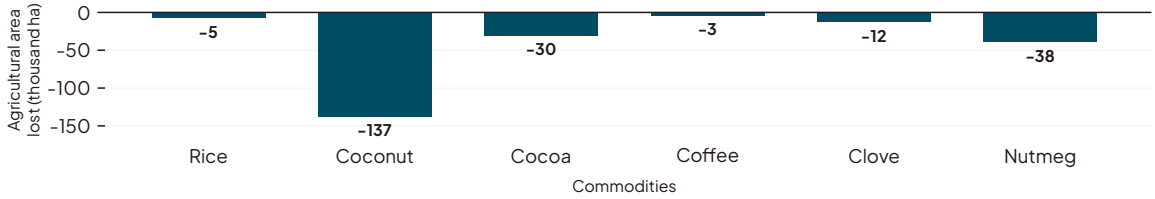
Figure 1-5. **Gini Ratio for Semester 1 in North Maluku Province, 2014—2024**



Source: Processed from BPS data

This enormous economic growth has also come at a substantial environmental and social cost. The data in **Figure 1-5** shows a significant reduction in the area of land planted with various agricultural and plantation commodities. According to BPS data, since 2012, 5,051 hectares of rice fields, 136,882 hectares of coconut plantations, 37,852 hectares of nutmeg plantations, and 12,085 hectares of clove plantations have been lost or converted to other uses.

Figure 1-6. **Total Decline in Agricultural and Plantation Land Area from 2012 to 2024**



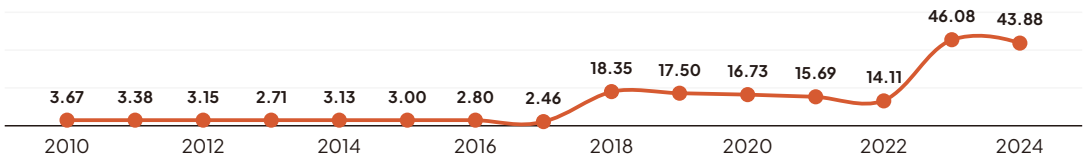
Source: Processed from BPS data

In addition to agricultural areas, forest areas have also been greatly reduced. Approximately 26,100 hectares of forest have been deforested. Deforestation has also occurred in several watersheds (DAS), reaching 2,612 hectares due to nickel industry activities, resulting in flooding disasters[3] in villages around the Indonesia IWIP area. Both of these indicate a massive shift in land use, both from the agricultural sector and from environmental buffer areas. This area has then been converted into a nickel mining and industrial area, as well as a buffer area for both sectors.

Pollution is also an important factor to consider. The use of captive coal-fired power plants also threatens air quality and the health of the surrounding community, which in turn will incur health costs. Research by CELIOS and CREA indicates that 55,000 premature deaths due to air pollution could be caused by the nickel industry in Sulawesi and Maluku, with total community losses estimated to reach Rp53 trillion by 2030.

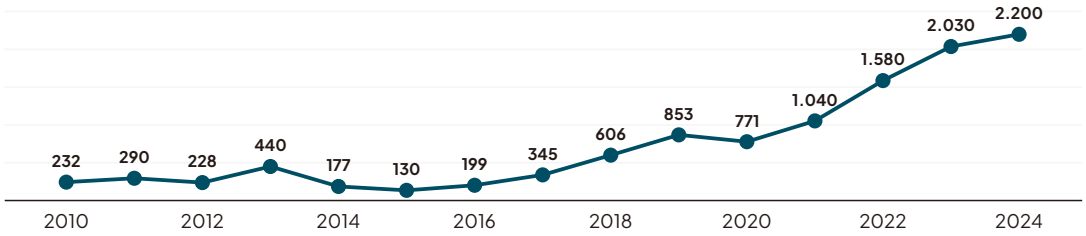
This environmental damage can result in social losses. For example, marine pollution from IWIP can force fishermen to go further out to sea[4][5] and incur higher costs. The experience of the nickel industry in Central Sulawesi also indicates that soil pollution can cause social change through changes in the professions of local residents. This occurs because agricultural land has been polluted, causing many farmers to sell their land and switch professions to become workers in the nickel industry.

Figure 1-7. **Indonesia's Nickel Reserves Reduced by Nickel Mine Production**



Source: compiled from BPS (2025) and USGS (2025) data[6]

Figure 1-8. **Nickel Mine Production in Indonesia**



Source: compiled from BPS (2025) and USGS (2025) data

3 Advocacy Team for Gunung Tanah, "Covering Up Environmental Damage in North Maluku by Criminalizing Students," Environment Defender, *JATAM*, September 13, 2024, https://jatam.org/tebet/lengkap.php?slug=Menutupi-Kerusakan-Lingkungan-di-Maluku-Utara-Dengan-Kriminalisasi-Mahasiswa.

4 Rabul Sawal, "The Fate of North Maluku Fishermen When the Bay Is Polluted with Nickel Waste [2]," Environmental News, *Mongabay.co.id*, July 31, 2024, https://mongabay.co.id/2024/07/31/nasib-nelayan-maluku-utara-kala-teluk-tercemar-limbah-nikel-2/.

5 Mahmud Ichi, "East Halmahera Sea Severely Polluted by Nickel Waste," Environmental News, Mongabay.co.id, January 2, 2024, https://mongabay.co.id/2024/01/02/laut-halmahera-timur-tercemar-parah-limbah-nikel/.

6 U.S. Geological Survey, "Nickel Statistics and Information," U.S. Geological Survey, 2025, https://www.usgs.gov/centers/national-minerals-information-center/nickel-statistics-and-information.

Ultimately, the nickel boom cannot last forever. BPS data shows that Indonesia has approximately 55 million tonnes of nickel reserves. However, as seen in **Figure 1-7** above, there were spikes in nickel reserves in 2014, 2018, and 2023, amounting to 600,000, 16.5 million, and 34 million tonnes, respectively. In addition, nickel mining has also skyrocketed. Meanwhile, **Figure 1-8** shows that the tonnenage of nickel ore mined in Indonesia per year will reach 2.2 million tonnes in 2024. At this rate of mining, it is estimated that nickel reserves in North Maluku will be depleted in the next 15 to 20 years.

Beyond the issue of depletion, fluctuations in global nickel prices and demand could end this nickel boom even before reserves are exhausted. Once the profits from nickel are gone, all that will remain is an area that has suffered environmental and social degradation. Without large-scale and time-consuming mine reclamation and environmental restoration, it will be very difficult for the area to return to its previous agriculture-based economy.

An economic diversification strategy needs to be pursued immediately to support the livelihoods of the people of North Maluku even after the nickel boom ends. In order to achieve long-term economic certainty, this diversification strategy should ideally be sustainable. This would avoid the boom and bust cycle that is often experienced by mining regions. Furthermore, there is an urgency for this economic diversification study to be carried out as early as possible in order to identify and save the potential for sustainable economic growth before it is eroded by nickel industry activities.

Economic Diversification Potential

The first step in implementing this economic diversification is to identify the opportunities that exist in North Maluku Province. Before conducting a more in-depth analysis of the economic potential that exists in North Maluku, it is necessary to first establish the criteria for selecting the potential for economic diversification that can be used.

Not mining and quarrying industries

It is important to avoid the boom and bust cycle that is characteristic of the mining industry, so the economic potential to be developed cannot be finite, or limited in reserves. Therefore, the mining and quarrying industries for non-metallic minerals such as sand, gypsum, and limestone will not be considered for diversification.

Not dependent on the sustainability of the nickel industry

Economic diversification is pursued to ensure the economic sustainability and source of income for the people of North Maluku after the nickel industry. Therefore, industries that depend on the sustainability of the nickel industry itself, such as the property industry for nickel industry workers' housing and the construction sector that depends on nickel projects, need to be set aside.

Has sustainable characteristics

This economic diversification is expected to become a reliable source of livelihood for the people of North Maluku in any condition. Therefore, the selected potential must be long-lasting and sustainable. Thus, industries that do not meet the sustainability criteria, such as the palm oil plantation industry or the logging industry, will not be included in this study.

The three points above are the requirements for a sector or industry to be considered as a potential industry for further development for the purpose of economic diversification. This chapter will specifically examine which industries have the potential for further development using secondary data analysis, field observation results, and input from the North Maluku Regional Government itself. The details of the program elaboration required for the development of this potential will be discussed further in the next chapter.

2.1. Potential of the Agriculture, Forestry, and Fisheries Sectors

North Maluku Province has great development potential in this sector, especially in the plantation and fisheries subsectors. According to the results of the North Maluku BPS agricultural survey[7] there are three plantation commodities in the plantation sector that have great potential for further development in North Maluku Province. These three crops are coconut, nutmeg, and cloves. Meanwhile, discussions with the Central Halmahera Regency Government have revealed the potential for revitalizing rice farming. In the fisheries sector, North Maluku has marine fisheries potential that needs to be maintained and further strengthened.

2.1.1. Potential for Coconut Downstream Industry Development

By integrating the coconut downstreaming initiative[8][9] planned by the central government, North Maluku Province can further capitalize on one of its leading commodities. Although it has a relatively small land area, North Maluku Province is the fourth largest producer of coconuts and copra in Indonesia, behind Riau, North Sulawesi, and East Java provinces.

Table 2-1. **Coconut Production, Harvested Area, and Agricultural Productivity in North Maluku Province (2019–2024)**

Year	Production (tonnes)	Production Delta (tonnes)	Harvest Area (ha)	Harvest Area Change (ha)	Productivity (tonnes/ha)
2019	210,946	4,491	202,796	-14,335	1.04
2020	211,757	811	202,683	-113	1.04
2021	211,065	524	203,707	1,024	1.04
2022	199,961	-7,208	203,997	290	0.98
2023	204,041	4,093	159,050	-44,947	1.28
2024	204,271	230	159,492	442	1.28

Source: North Maluku Provincial Statistics Agency

7 North Maluku Provincial Statistics Agency, *Agricultural Potential of North Maluku Province: Analysis of Coconut, Nutmeg, and Clove Plantations*, Statistical Report 82000.24032, 2023 Agricultural Census (North Maluku Provincial Statistics Agency, 2024).

8 *Launch of the Coconut Downstreaming Roadmap*, directed by Bappenas RI, 2024, 04:13:35, https://www.youtube.com/watch?v=Jemegdghkz8.

9 Expert Staff for Leading Sector Development and Infrastructure, BAPPENAS, *Coconut Downstreaming Roadmap 2025-2045* (Ministry of National Development Planning, 2024).

Potential

- The downstreaming program for the coconut industry is in line with the central government's intentions, so that the implementation of the development of this sector can be carried out more quickly and effectively because there is support from the central government.
- The total value of coconut and copra production in North Maluku is high, ranking fourth in Indonesia.
- The productivity per hectare of coconut plantations in North Maluku shows a positive trend. Data from 2024 shows that coconut production productivity reached 1.28 tonnes of coconuts per hectare. This is an increase from the worst figure in 2022, which was around 0.98 tonnes per hectare.
- North Maluku Province has many coconut farmers, but the majority of these farmers are still struggling with poverty.
- The coconut production methods used by these farmers are still very traditional, and there is room for mechanization of production so that output can be further increased.
- Despite the large production of coconuts and copra, there are still few facilities in North Maluku for processing coconuts into products with higher industrial added value, such as crude coconut oil (CCO) and virgin coconut oil (VCO).

Challenges

- There has been a significant conversion of coconut plantation land between 2012 and 2024. In 2023 alone, the area of coconut harvests decreased by 2,600 hectares compared to the previous year.
- The selling price of copra is still low. Although the production process can be mechanized and made more efficient, without good logistical support and industrial integration, coconut farmers will still not be able to reap the benefits of downstreaming.
- Road and port infrastructure support is urgently needed for the integration of the coconut downstream industry, especially in *the last mile* of the supply chain. Adequate transportation infrastructure development is required to facilitate this industry.

2.1.2. Potential for Nutmeg Plantation Development

During the colonial period, the Maluku Islands were famous for their spices, and these commodities remain Maluku's mainstay to this day. More specifically, according to the 2023 farmer survey, North Maluku Province has significant environmental capital in nutmeg production. BPS data from the same year also shows that around 16% of Indonesia's total nutmeg production comes from North Maluku Province.

Potential

- North Maluku already has a high nutmeg production base. More than 16% of total domestic nutmeg production comes from North Maluku Province.
- The number of agricultural businesses, both individual and household, that cultivate nutmeg in North Maluku is relatively large. As a result, the development of this sector has the potential to have a large *multiplier* effect.
- North Maluku already has many superior nutmeg varieties. This could greatly facilitate the development of the nutmeg plantation sector in the future.

Challenges

- Like other plantation commodities, nutmeg plantations in North Maluku have also experienced land degradation. In 2023, the harvest area for nutmeg commodities plummeted from 68,000 ha in 2022 to 21,000 ha in 2023.
- Unlike coconut, whose oil can be widely used in various industries, nutmeg has limited industrial applications.
- Nutmeg also has limited downstream potential. There are not many products that require large quantities of nutmeg, and even as a cooking spice, the use of nutmeg is limited in terms of quantity.

2.1.3. Potential for Clove Plantation Development

Another spice that can be relied upon for economic diversification in North Maluku Province is cloves. Although North Maluku's clove production tonnage is small compared to other clove-producing provinces, the soil conditions in North Maluku are very suitable for clove cultivation. The potential for clove development in North Maluku is quite large, but the challenges faced are also relatively large.

Potential

- The relatively acidic soil conditions in North Maluku are suitable for clove plantations.
- Clove is a high-value commodity, with a market price that can reach US$7,000 per ton.
- With a high price-*to*-*bulk* ratio, it is easy to transport plantation products.
- The number of agricultural businesses, both individual and household, that grow cloves in North Maluku is quite large. Like nutmeg, the development of this sector has the potential for a large multiplier effect.

Challenges

- Like coconut and nutmeg, clove plantations in North Maluku have also experienced land shrinkage. In 2023, the harvest area for cloves decreased by more than 50%, from 26,000 ha in 2022 to 12,000 ha in 2023.
- Cloves are used in large-scale industries, especially in the kretek cigarette industry, but competition with other clove-producing regions is very strong.
- The current production capacity of cloves in North Maluku is relatively small when compared to major clove-producing regions such as East Java. Transportation infrastructure issues also make North Maluku cloves less attractive than cloves from closer producing regions.
- Pests and diseases are a significant problem. More modern cultivation techniques using pesticides are needed.

2.1.4. Potential for Rice Farming Development

Rice production in North Maluku fluctuated during the 2011-2024 period, but showed a downward trend. BPS data shows that in 2024, total rice production in North Maluku Province will reach 38 thousand tonnes. This figure is far below the rice production figures before the nickel industry existed. As can be seen from **Table 2-2** below, North Maluku's rice production peaked in 2015 with a production figure of 75 thousand tonnes. After reaching its peak in 2015, there were two years for which rice data was not available. In the following year, 2018, rice production fell sharply to 35,000 tonnes, and in subsequent years, rice production fluctuated up and down, but never exceeded 45,000 tonnes.

Looking at the rice yield figures, it can be seen that the rice yield in North Maluku did not experience a significant decline. Rice yields from 2011 to 2024 were in the range of 35 quintals per hectare. In fact, in 2020, North Maluku's rice yield reached 42 quintals per hectare. This indicates that the problem lies elsewhere, namely in the figure for rice harvest area.

As can be seen in **Table 2-2**, the effect of agricultural land conversion due to the nickel industry is clearly visible. After peaking in 2015, the rice harvest area in North Maluku decreased by more than 50%. In 2018, the rice harvest area was only 10,000 hectares, and in the period from 2021 to 2023, the rice harvest area fell below 10,000 hectares. Although there have been ups and downs, in general it can be said that the rice harvest area in North Maluku has declined significantly compared to the pre-nickel years.

Table 2-2. **Rice Farming Statistics in North Maluku**

Year	Rice Production (tonnes)	Harvest Area (ha)	Yield (kg/ha)
2011	61,429	16,783	36.6
2012	65,686	17,794	36.9
2013	72,444	18,675	38.8
2014	72,073	21,192	34.0
2015	75,265	21,438	35.1
2016	N/A	N/A	N/A
2017	N/A	N/A	N/A
2018	35,360	10,343	34.2
2019	37,946	11,701	32.4
2020	43,383	10,302	42.1
2021	28,051	7,782	36.0
2022	24,486	6,416	38.2
2023	26,663	7,709	34.6
2024	38,113	11,733	32.5

Source: Compiled from BPS data

If we only look at the data on paper, it will be very difficult to see the potential for rice development in North Maluku. However, based on information obtained from the Central Halmahera Regency Government, this decline in harvest area is not solely due to land conversion for residential or nickel mining purposes. Findings in the field show that there are many idle rice fields, which have contributed to the decline in rice harvest area in North Maluku.

The reasons for the abandonment of rice fields vary, ranging from unfavorable weather conditions and declining water quality to farmers switching professions to work in the nickel industry. However, this means that there is still potential for development, or more precisely, potential for revitalization of the rice farming sector, which can be used as an option for economic diversification in North Maluku.

Potential

- Revitalizing the rice farming sector helps strengthen food security.
- There is still agricultural land that can be reused.

Challenges

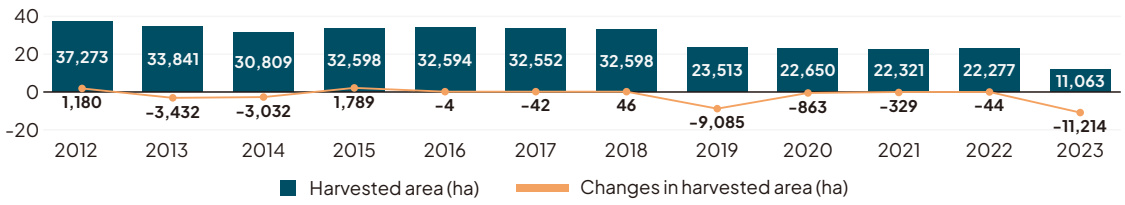
- Significant land conversion accompanied by farmers switching professions can hinder efforts to revitalize rice farming for economic diversification.
- Environmental issues, including weather anomalies and the negative effects of the nickel industry. Both of these increase *uncertainty* in agricultural production.

2.1.5. Potential for Cocoa Plantation Development

In addition to coconut, nutmeg, cloves, and rice, cocoa is another plantation commodity with potential for further development. Although nationally, North Maluku Province's cocoa production is insignificant compared to Indonesian cocoa giants such as Central Sulawesi and Southeast Sulawesi, cocoa accounts for a significant portion of North Maluku Province's plantation sector. In addition, cocoa has much greater downstream potential. Cocoa can be processed into various types of semi-finished commodities such as *cocoa butter* and *cocoa powder*, which in turn can be used as raw materials for the processed food industry. This is unlike spices such as nutmeg and cloves, which have limited downstream potential.

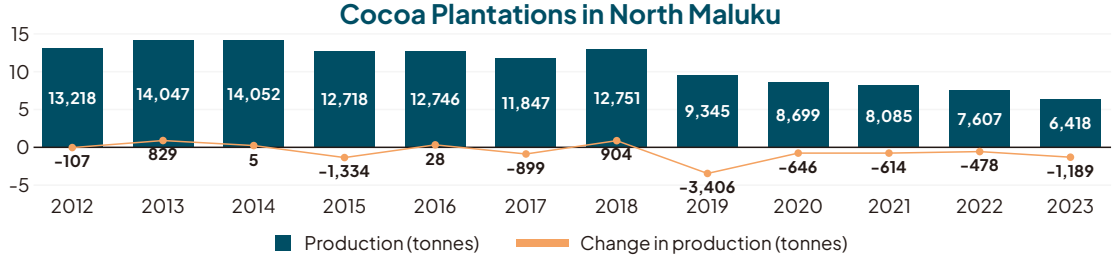
Agricultural commodities such as rice, nutmeg, and cloves have market demand characteristics that are limited. This is because the consumption of staple foods such as rice and spices such as nutmeg and cloves does not increase proportionally to household income and consumption levels. Someone who experiences an increase in purchasing power will not suddenly start eating rice five times a day or use twice as much nutmeg and cloves in their cooking. An increase in purchasing power and income of an individual will manifest in increased consumption of tertiary foods and beverages such as ice cream and coffee. There is also the potential for that individual to improve the quality of their consumption by consuming higher quality food ingredients. For these reasons, the scalability of cocoa commodities is greater than that of staple foods and spices.

Figure 2-1. **Harvest Area (ha) and Change in Harvest Area (ha) of Cocoa Plantations in North Maluku**



Source: Compiled from BPS and CEIC data

Figure 2-2. **Production (tonnes) and Changes in Production (tonnes) of Cocoa Plantations in North Maluku**



Source: Compiled from BPS and CEIC data

Similar to other agricultural sectors, the cocoa plantation industry in North Maluku Province is not in good condition. There is a downward trend in the cocoa plantation industry in North Maluku. This can be seen in Figure 2-1 and 2-2 above. Furthermore, as shown in table 3 below, this decline applies to both harvest area and production volume, with the sharpest decline occurring in 2023 and 2019.

Table 2-3. **Condition of Cocoa Plantations in North Maluku**

Year	Harvested Area (ha)	Production (tonnes)	Productivity (kg/ha)	Change in Harvested Area (ha)	Change in Production (tonnes)
2012	37,273	13,218	3.55	1,180	-107
2013	33,841	14,047	4.15	-3,432	829
2014	30,809	14,052	4.56	-3,032	5
2015	32,598	12,718	3.90	1,789	-1,334
2016	32,594	12,746	3.91	-4	28
2017	32,552	11,847	3.64	-42	-899
2018	32,598	12,751	3.91	46	904
2019	23,513	9,345	3.97	-9,085	-3,406
2020	22,650	8,699	3.84	-863	-646
2021	22,321	8,085	3.62	-329	-614
2022	22,277	7,607	3.41	-44	-478
2023	11,063	6,418	5.80	-11,214	-1,189

Considering the various conditions above, cocoa plantations in North Maluku still have hope. As can be seen in **Table 2-3** above. Although there has been a general decline in production, productivity per hectare in 2023 has increased dramatically. This indicates the efficiency of production methods that will need to be maintained in the future.

Potential

- Large downstream industry. There are many types and forms of cocoa derivative products, from upstream to downstream, from semi-finished materials such as cocoa butter to chocolate retail businesses.
- Final products that use cocoa as a raw material are not staple foods such as rice, so market demand can continue to rise in line with increased purchasing power.
- Unlike spices, the use of processed cocoa products in food and beverages is not particularly restrictive or limited in quantity.
- Potential export opportunities for sustainable cocoa. Many countries that are major cocoa producers in West Africa employ underage workers, so many cocoa products from these regions are rejected by companies that prioritize human rights and sustainability issues.

Challenges

- Land conversion and significant fluctuations in cocoa plantation production can hamper the downstream cocoa processing industry supply chain.
- Significant pest and disease problems. There is a trade-off dilemma between the use of pesticides and non-organic fertilizers and the international market, which has a high demand for organic cocoa products.
- Quality control of diverse cocoa bean production and its implications for competition in the export market and further processing. This can complicate diversification and downstreaming efforts.
- Competition with cocoa-producing regions such as Central Sulawesi. Although cocoa downstreaming is possible, local plantations may not be able to meet the demand for raw materials in terms of both quality and quantity.
- Relatively low yield per hectare of cocoa compared to other crops such as coffee and tea.

2.1.6. Potential for Development of Capture Fisheries

North Maluku has a fairly capable capture fisheries sector. In 2023, the total value of North Maluku's marine fisheries catch was close to Rp8 trillion with a tonnage of 350 thousand tonnes. According to BPS data, the condition of marine capture fisheries in North Maluku shows fluctuations from year to year. However, when viewed from historical figures since 2017, the condition of marine capture fisheries in North Maluku has shown a positive trend. From 2017 to 2023, the average tonnage of marine fish catches grew by 5.8% per year. Meanwhile, the CAGR of the value of catches in the same period reached 10.8%.

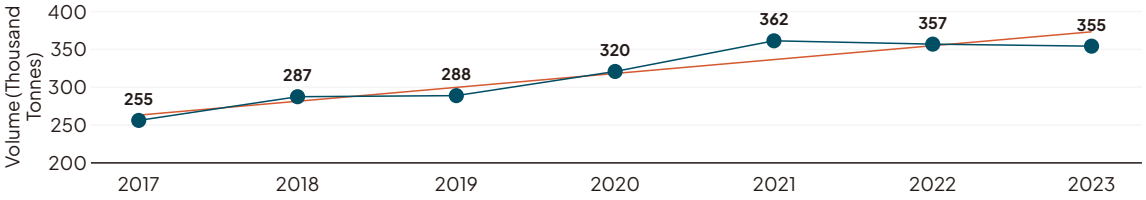
Table 2-4. **Volume and Value of North Maluku Fisheries Production VS Indonesia and Their Percentages**

	North Maluku		Indonesia		Percentage of North Maluku to Indonesia	
Year	Volume (tonnes)	Value (Thousand IDR)	Volume (tonnes)	Value (Thousand IDR)	Volume	Value
2019	288,187	6,392,772,533	7,164,302	187,492,765,544	4.02%	3.41%
2020	319,925	6,893,706,854	6,493,258	171,475,693,528	4.93%	4.02%
2021	361,501	8,151,120,398	6,767,572	179,580,858,954	5.34%	4.54%
2022	356,982	7,787,193,797	7,026,425	192,222,345,315	5.08%	4.05%
2023	354,650	7,960,506,144	7,373,516	206,315,672,278	4.81%	3.86

In terms of tonnage, North Maluku only contributed around 5% to the total national catch in 2023. When compared to other Indonesian provinces in the same year, North Maluku ranked 7th below East Java, Maluku, South Sulawesi, Central Sulawesi, North Sumatra, and Central Java. Unlike most of the provinces above it, even though North Maluku's marine products are not the largest, North Maluku has access to the *pelagic* zone, which provides access to high-value fish commodities. According to BPS statistics, in 2023 North Maluku was the second largest tuna producer in Indonesia, below the province of Maluku. In addition, North Maluku is also a significant producer of tongkol and cakalang fish.

As can be seen in the Figure 2-3 below, when viewed from the macro conditions of capture fisheries since 2017, the trend in North Maluku's capture fisheries remains positive (red line). It can also be seen from the real value (blue line) that the volume of catches fluctuates significantly each year. This indicates that the marine fisheries sector in North Maluku lacks stability. This low stability can have an effect on the uncertain welfare of fishermen and open the door for middlemen and collectors.

Figure 2-3. **North Maluku Province Marine Fish Catch Volume (Thousand Tonnes) with Trend**



Source: Compiled from BPS data

Although the long-term potential trend looks quite promising, the condition of the marine fisheries sector in North Maluku in the last 2 years cannot be said to be good. In 2022 and 2023, this sector recorded negative growth with a decrease in catch tonnage of up to 6,850 tonnes. It cannot be denied that the nickel industry has played a role in the decline in marine catch. Not to mention, there are many facts in the field that are not captured in the data, such as the effects of coastal damage caused by the nickel industry, which can force fishermen in North Maluku to sail further from the coast to obtain sufficient catches.

Despite facing various problems, the North Maluku capture fisheries sector can still be relied upon as a sector for economic diversification. Although there has been a decline in production in recent years, the fisheries sector is still large enough to support diversification efforts. Moreover, this sector also has many gaps that can be improved, both in terms of technology and governance. Technically, there are still opportunities to improve fish production and transportation methods; in addition, there are still many opportunities for downstream industries based on capture fisheries, such as canning and drying industries. Added to this is the issue of availability.

Data related to the capture fisheries sector available at BPS, both at the national and provincial levels, is not yet reliable. There are still many values that are repetitive or repeated from the previous year. This indicates that data collection is not consistently carried out properly each year. There are also issues with gaps in statistics on fish species and their sale values. Details on the types of fish caught and the dynamics of their production from year to year are very important for analyzing the condition of the capture fisheries sector in North Maluku Province.

Potential

- Leading fishery products such as tuna originate from North Maluku. These leading products have a high selling value compared to their volume.
- The growth trend of this sector is still positive. Despite ups and downs, the trend of this sector in North Maluku is still positive and growing.
- Great potential for downstreaming. Fishery products have great potential for downstreaming and derivative industries. Products such as canned and dried fish are relatively easy to produce.
- There is still room for improvement in distribution and transportation. Even before entering the downstream narrative, this sector can still be optimized by improving logistics and governance.

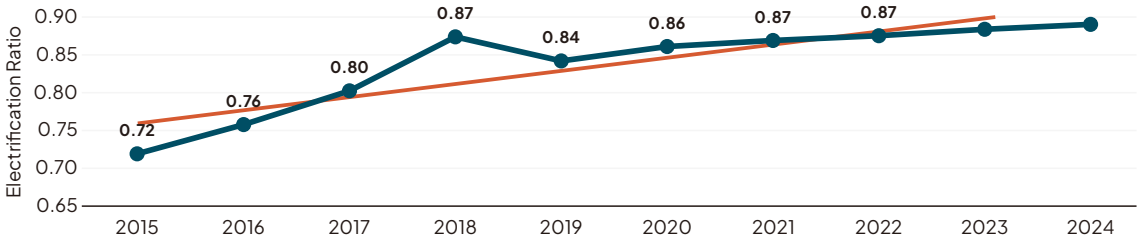
Challenges

- Significant annual fluctuations. This indicates high uncertainty in this sector.
- The problem of marine pollution caused by the nickel industry. It is not yet clear from data analysis to what extent this nickel pollution has affected the marine fisheries sector, so further observation is needed.
- Poor and unreliable data. The data available at BPS is unreliable and far from the actual conditions in the field.

2.2. Potential of the Electricity Supply Sector

According to the 2024 PLN Statistical Report, North Maluku has an electrification ratio of 88.92%. This figure is the 5th lowest in Indonesia. Only the provinces of Papua have lower electrification ratios. A total of 342,344 households out of 385,020 households in North Maluku have access to electricity, leaving 42,676 households without electricity.

Figure 2-4. **Electrification Ratio and Electricity Electrification Growth Trend in North Maluku**



Source: compiled from PLN Statistical Report

From the graph above, we can see the development of the electrification ratio in North Maluku from 2015 to 2024. It can be seen that the electrification ratio has an upward trend (yellow line), but we can also see that in some years there are irregularities when the electrification ratio decreases or stagnates. When these irregularities are examined more closely, historical data shows that there was a reduction in the number of households connected to electricity in 2019. The number was quite large, reaching almost 14,000 households. After that, from 2021 to 2024, the data shows that the change in the number of households connected to electricity was minimal, ranging in the single digits from zero.

If this data is accurate and truly illustrates the changes that have occurred in the field, then it can be suggested that there are problems or obstacles in the electricity sector in North Maluku. One hypothesis that could explain this phenomenon is the division of electricity capacity with the nickel processing industry area. Another hypothesis is a decrease in power from PLN, causing many households to lose electricity. These two hypotheses are not mutually exclusive, and further observation in the field is needed to determine the actual conditions.

Table 2-5. **Electrification Ratio and Additional Households Connected to Electricity**

Year	Electrification Ratio	Additional households connected to electricity
2015	0.72	11,064
2016	0.76	8,301
2017	0.80	9,471
2018	0.87	17,623
2019	0.84	-13,988
2020	0.86	3,656
2021	0.87	-4
2022	0.87	0
2023	0.88	-2
2024	0.89	-2

Source: PLN Statistical Report

In addition to household needs, there is also the potential for electricity supply to small and medium-sized industries, which are projected to emerge in large numbers with the economic diversification program. The processing industry, which will be promoted as an effort to downstream other sectors, will require electricity to operate. Although not large, this power requirement is quite significant. Not to mention that as an industrial power supply, it requires high reliability to minimize power disruptions.

This power supply should also use clean and renewable energy. The use of clean and renewable energy or EBT is chosen to meet the sustainability targets set out in the 2045 RPJMN. In addition, the use of EBT is not limited by capital constraints as it can be implemented on a micro and small scale. Ultimately, households and business units can be more independent in terms of electricity supply and not completely dependent on PLN.

2.2.1. Potential for Community-Based EBT Development

Electricity supply in Indonesia is still dominated by PLN and large-scale private electricity providers, most of which use fossil fuel-powered generators. If the economic diversification of North Maluku is powered by these fossil fuel generators, it will be less than ideal. This is because the use of fossil fuel-based electricity is far from the sustainable economic aspirations outlined in the RPJMN 2045. Therefore, in order to meet current and future electricity needs after the initiation of more environmentally friendly and sustainable diversification, a community-based Renewable Energy (EBT) approach can be used.

The concept of community-based renewable energy (EBT) can be a breakthrough for the North Maluku Regional Government to develop this electricity supply sector. EBT can consist of a combination of Solar Power Plants (PLTS), Wind Power Plants (PLTBa), Micro-Hydro Power Plants (PLTMH), and Ocean Wave Power Plants (PLTGL). In the community-based EBT concept, these power plants are managed by community groups through cooperatives. The local government, in turn, can act as a facilitator and mentor for these communities.

In community-based EBT, local governments can act as facilitators of facilities, technical assistance, and guidance for community groups that have the potential to become EBT managers. Local governments, together with community groups in need, can plan the construction of PLTMH, PLTBa, and PLTS according to the potential in the community environment.

Local governments and PLN can then build smart electricity transmission networks connected to the nearest Pumped Storage Hydroelectricity (PSH) to stabilize the electricity supply. These smart electricity transmission networks can be decentralized off-grid from the existing PLN network, or on-grid or connected to the existing PLN network. The community can work together in the construction process, carry out maintenance, and even collect fees that can be used to cover the operational costs and depreciation of the PLTMH, PLTBa, and PLTS that are built.

The clearest advantage of renewable energy compared to coal-fired power plants lies in its environmental friendliness and sustainability. In addition, the use of micro and small-scale EBT also has advantages in terms of independence. By using micro-scale PLTS and PLTMH located in a village, for example, it will reduce the village's dependence on PLN's electricity supply. Furthermore, for the same power, EBT scale utilization has lower initial investment costs than conventional PLTU. According to a study conducted by 350.org and CELIOS, coal-fired power plants require an investment cost of up to Rp25.6 million per kilowatt. Meanwhile, the installation cost of micro-scale solar panels is only around Rp12.2 million per kilowatt (350.org & CELIOS, 2024).

These renewable energy sources also have several disadvantages that need to be addressed. One of them is the disparity between peak electricity supply and peak electricity demand. In solar power plants, peak electricity supply occurs during the day, but peak electricity demand occurs in the evening and at night. The same thing happens with wind power plants, which depend on wind speed, and hydroelectric power plants, which depend on water flow. Therefore, energy storage technology is needed to store excess energy produced during peak production so that it can be used during peak energy demand, which usually occurs between 5:00 p.m. and 10:00 p.m.

In general, this energy disparity is overcome by the use of batteries. However, batteries have many disadvantages, from their high price, storage capacity that continues to decline sharply with use, the risk of explosion and fire, to battery waste leaks that pollute the environment. The battery production process also requires massive mining of various metals and minerals, which can damage the environment. In addition to these shortcomings, there are also limitations in battery supply, making it impossible to meet demand as more and more people switch to renewable energy. Therefore, an alternative energy storage mechanism other than batteries is needed.

PSH can be a cheap and flexible energy storage solution. Simply put, PSH can be created by building two reservoirs/dams in two locations that are close to each other but have a significant difference in elevation. During peak production, the excess supply of renewable energy available from solar power plants, biomass power plants, and hydroelectric power plants is used to pump water from the lower reservoir/dam to the upper reservoir/dam. During peak electricity demand, water from the upper reservoir is released into the lower reservoir, thereby utilizing the force of the water flow to turn the hydroelectric/micro-hydroelectric power plant turbines, generating additional electricity when electricity demand surges.

PSH technology is very easy to build and has been in use for over 100 years. In Indonesia, PSH will only be implemented in a giant 1400 MWh hydroelectric power plant in Cisokan[10] (The World Bank Group, 2021), West Java, in 2025. This amount is very small compared to Indonesia's potential of 800 TWh in more than 26,000 locations[11]. By using PSH, one of the biggest weaknesses of EBT can be minimized. An EBT network based on PLTS, PLTBa, and PLTMH supported by PSH can be a viable solution for electricity supply.

North Maluku itself has significant PSH potential. The PSH-based EBT potential of the total area of North Maluku Province reaches 145.1 MW[12], with the majority located in the Halmahera river basin. Geographically, Halmahera has many rivers that can be used to build dams capable of generating electricity and storing excess electrical energy in a community-based EBT scheme. In addition to supporting independent electricity availability from clean and renewable sources, the construction of these dams can also be utilized for daily community needs such as irrigation, fisheries, and clean water supply.

10 World Bank, "Indonesia's First Pumped Storage Hydropower Plant to Support Energy Transition," worldbank.org, Press Release, 2021, https://www.worldbank.org/in/news/press-release/2021/09/10/indonesia-s-first-pumped-storage-hydropower-plant-to-support-energy-transition.

11 David Firnando Silalahi et al., "Indonesia's Vast Off-River Pumped Hydro Energy Storage Potential," *Energies* 15, No. 9 (2022): 3457, https://doi.org/10.3390/en15093457.

12 Riyan Tri Nurharyanto and Iwan Gunawan, "Technical Feasibility Study of Renewable Energy Potential for Mini Hydro in Goal Village, East Sahu District, West Halmahera Regency," *IRA Journal of Mechanical Engineering and Its Applications (IRAJTMA)* 2, no. 3 (2023): 44–54, https://doi.org/10.56862/irajtma.v2i3.85.

Community-based EBT schemes can ultimately become a relatively inexpensive energy procurement solution that does not rely on complex, cutting-edge technology. In the construction process, community-based renewable energy is fairly simple to build, has relatively low technical complexity, and does not require intensive mechanization, so it can be built using existing community resources. This low level of technical complexity in the planning process is also expected to enable community-based renewable energy to be planned and managed independently by local governments.

Potential

- An environmentally friendly energy source. There is almost no disruption to the local ecosystem, and the traditional livelihoods of the community are not significantly affected.
- Low technical complexity. This allows the community to participate in building and operating this community-based EBT system.
- The cost of building the system is relatively cheap compared to conventional coal-fired power plants. Large and capital-intensive investments with high levels of mechanization and technology are not required.
- High level of community independence and self-sustainability. Because they do not depend on coal-fired power plants, or at least not 100% dependent, communities that use this renewable energy scheme are not too vulnerable to power outages.
- Community-based EBT infrastructure can be used for other purposes. PSH reservoirs and dams can be utilized for various community needs, from irrigation to water flow control.

Challenges

- Continuity of electricity supply. EBT depends on variable factors. Solar power plants depend on sunny weather, wind power plants depend on weather, and micro-hydro power plants are vulnerable to drought.
- Organizational challenges. In terms of planning and operations, there are challenges in organizing community-based EBT development efforts with the community.
- There is a need for equipment, spare parts, and maintenance related to the EBT power plant itself. Although the technical complexity of community-based EBT is much lower than that of conventional coal-fired power plants, equipment and spare parts for solar panels and turbines are still required.

Research Method

In order to answer how the potential for diversification will impact the economy of North Maluku, a more in-depth economic analysis is needed. This study will use a Computable General Equilibrium (CGE) model (using Input-Output or IO tables) to simulate an economic diversification program in North Maluku and its effects on the economy over a 20-year period.

To simulate realistic economic diversification, several economic diversification program scenarios are needed, which in turn will be translated into "shocks" to be simulated in the model. These scenarios will be divided based on the main industrial sectors that are developed and receive *the* main *shocks*. Based on the discussion of North Maluku's economic potential above, the diversification development scenarios and their discussion will be divided into three categories according to their main sectors. The three sectors are: agriculture and fisheries; manufacturing; and electricity supply.

3.1. Input-Output (IO) Analysis Method and General Assumptions Used

3.1.1. Input-Output (IO) Analysis Method

This study uses the Input-Output (IO) approach to analyze the impact of economic diversification. The IO method is part of the Computable General Equilibrium (CGE) Model, which models the economy by describing the production chain between sectors and the level of interconnection between sectors in a geographical area. By processing and analyzing this interconnection system, the effects of external shocks on the economy can be determined.

To better understand the IO method, we can use the example of canned fish production. This processed fish product is produced by the food and beverage industry and is an output generated from inputs from various sectors. First, there are labor and skill factors used by fishermen to catch fish. Then, the fish enters the distribution process until it reaches the food processing industry. Not to mention that during the production process, from catching fish to producing canned processed fish, there are also inputs such as electricity, building rent, machinery, motor vehicles, etc.

In this example of canned fish production, production factors that are innate and not the result of production from other sectors, such as labor and skills of workers in this sector, are referred to as primary inputs. Meanwhile, other inputs that come from the added value of other goods—such as processing raw fish into fish that is ready to enter the factory—are called intermediate inputs. This input-output method traces the entire production process and the interrelationships between sectors to produce goods in an economy so that it can ultimately describe the production structure of all final output in an economy.

In practice, IO calculations use a matrix form. This matrix was developed by economist Wassily Leontief[13] and can be calculated using data collected by statistical institutions such as the Bureau of Labor and Statistics in the United States or BPS in Indonesia. A simple illustration of this IO matrix can be seen in the example in **Table 3-1**. This table describes an economy divided into three sectors—agriculture, industry, and services—and the interactions between these sectors and their final production values.

Table 3-1. **Illustration of a 3-Sector Input-Output Table**

Sector		Agriculture	Industry	Services	Final Consumption	Total Output
	Code	1	2	3	C	Y
Agriculture	1	Z11	Z12	Z13	C1	Y1
Industry	2	Z21	Z22	Z23	C2	Y2
Services	3	Z31	Z32	Z33	C3	Y3
Gross Value Added	A	A1	A2	A3		
Total Input	Y	Y1	Y2	Y3		

In the table, the relationship between sectors is illustrated in the elements within the cells. For example, Z12 represents the output of the agricultural sector that is used as intermediate input by the industrial sector. Meanwhile, Z33 represents the output of the service sector that is used as input for the sector itself. Of course, not all of the output from a sector is always used as input for another sector; there is also output from that sector that is directly consumed by the community, which is represented in the final consumption column. The sum of the output values between sectors (Z11, Z12, Z13) and for direct consumption (C1) is in the total output column, where Y1 is the total output of the agricultural sector.

Similar to output, not all inputs come from other sectors. There are primary input factors such as labor and capital in the production input of a sector, which in the table above are included in the Gross Value Added category. The sum of the input values from other sectors in the form of intermediate inputs with Gross Value Added results in Total Input, which has the same value as Total Output (Y1 = Y1) because in an economy, the value of output should be equal to the value of input.

13 Wassily W. Leontief, "Input-Output Economics," *Scientific American* 185, no. 4 (1951): 15–21.

Using IO table analysis, the effects of a policy on an economy can be determined. This analysis can examine the effects of the policy by looking at changes in sectoral and overall output after incorporating the shock figures from the policy. In addition to output analysis, IO tables can also be used to determine the impact of the policy on wages and employment.

The input-output calculations in this study use IO table data for 17 sectors in North Maluku Province based on producer prices. The use of this provincial IO table was preferred over the IRIO table because the analysis to be conducted is limited in scope to the North Maluku Province area. For the output estimation time range, a value of 20 years was used to align with the 2045 RPJPN and RPJPD targets.

3.1.2. General Assumptions in IO Simulation

Before moving on to the discussion of shocks per program, there are several assumptions used as the basis for calculating the IO simulation. These assumptions are general and apply to all shock simulations that will be carried out. As explained in the previous section, the economic impact of the simulated diversification program will be analyzed using the Computable General Equilibrium or CGE model. In this case, the type of CGE model used is the 2016 Input-Output (IO) table for North Maluku Province according to the applicable base price. This IO table was chosen because it is the most recent IO table available at the provincial level.

The next assumption relates to the time frame of the diversification program and IO modeling. The simulation will cover a 20-year period from 2026 to 2045. The modeling begins in the first year of the economic diversification program's implementation. In this case, it is assumed that the entire diversification program will begin in the first year and be implemented in stages over a period of 5 years. For the following years, it is assumed that the same program will be repeated every 5-year period.

Next is the assumption regarding labor. In order to simulate the effects of shocks on employment, appropriate employment data is needed. All IO shock simulations will use Sakernas data from August 2016 in their calculations. The Sakernas data for the August 2016 period was chosen over more recent data, such as the Sakernas data for August 2025, because the IO table used is the 2016 IO table. If the simulation is based on the 2025 Sakernas data, there will be a potential underestimation in the wage simulation and an overestimation in the employment simulation. Therefore, the August 2016 Sakernas data was chosen as the basis for the IO simulation assumptions.

The next assumption relates to the natural economic growth projection (or long-term economic growth rate) of North Maluku Province and the national inflation rate. In order to simulate the effects of the economic diversification program over a 20-year period, assumptions on economic growth and inflation projections are needed. Currently, North Maluku's economic growth is reaching double digits, but this performance is derived from limited and unsustainable extractive industries. Therefore, the economic growth assumption will use a smaller value that better reflects the long-term growth of North Maluku's economy, namely 6.5%. For the inflation rate, an assumption of 3.5% per annum is used.

Furthermore, in relation to economic growth assumptions and the objective of this study as an alternative for economic diversification, the IO simulation assumes that there will be no new nickel mines or processing industries opened in North Maluku. The IO simulation will not include the growth factor of the nickel industry in North Maluku and assumes that this sector is stagnant or not growing. The final assumption relates to the value of the shock used. In this case, each shock in the IO simulation will be assumed to use the 2024 applicable price. Meanwhile, the results of the IO simulation will also use the applicable price assumption. This is because the inflation projection factor has been included in the IO simulation calculation.

3.2. Diversification Scenario in the Agriculture and Fisheries Sectors

Table 3-2. **Summary of The Diversification Program in The Agriculture and Fisheries Sectors**

Sub-sector	Program	Target Achievement
Nutmeg Plantations	• Expansion of nutmeg plantation harvest area • Intensification of nutmeg plantations	• Harvest Area: 68,000 ha • Yield: 320 kg per ha
Clove Plantations	• Return of clove tree productivity not yet harvested • Incentives for clove plantation workers • Extensification of clove plantations	• Harvest area: 26,000 ha • Yield: 420 kg per ha
Cocoa Plantations	• Certification of disease-resistant local cocoa varieties • Use of superior local cocoa seedlings • Expansion of cocoa plantation area • Expansion of dry cocoa bean processing businesses	• Annual harvest: 14,000 tonnes • Yield: 420 kg per hectare
Rice Farming	• New rice field development program • Revitalization of abandoned rice fields • Rice farming intensification program • Irrigation system renewal	• Harvest area: 11,000 ha • Yield: 4,210 kg per ha
Capture Fisheries	• Construction of solar-powered cold storage facilities • Expansion and construction of fishing ports • Procurement of 10 GT and 30 GT fishing vessels	• Cold storage capacity: 10,000 tonnes • Expansion of 2 fishing ports • 50 10 GT vessels and 10 30 GT vessels

3.2.1. Nutmeg Plantation Revitalization Program

Nutmeg is a leading commodity in North Maluku with the highest selling price per kilogram. The selling price of this commodity can reach Rp215,000 per kilogram. The nutmeg plantation revitalization program has the potential to dramatically increase the productivity of the agricultural sector in North Maluku. BPS data shows that nutmeg plantations peaked in 2022, when the nutmeg harvest area exceeded 68,000 hectares. In the following year, in 2023, nutmeg productivity peaked, with a harvest value of 320 kg per hectare. However, the harvest area has decreased from the previous year. This indicates that there is still potential to be achieved again. Assuming that the nutmeg plantation recovery program can achieve this productivity figure again, there is the potential for an increase in nutmeg production of more than 15,000 tonnes. With the commodity price reaching Rp215,000 per kilogram, this program has the potential to provide a positive shock to the North Maluku economy of Rp3.3 trillion.

On the other hand, there are not many downstream options for nutmeg commodities. The majority of nutmeg sold on the market is used directly as food ingredients. There are several obstacles and limitations in the utilization of nutmeg derivative products. The first is the type of derivative product itself. The simplest nutmeg derivative products are beverages and snacks made from nutmeg. These food and beverage products can be produced and distributed by small-scale industries that do not require a lot of fixed capital. However, these two products have a niche market and are limited in scale, so the valuation of the industry is too small to have a visible impact in the IO simulation.

There is also the option of downstreaming nutmeg as a raw material for pharmaceuticals, especially as a raw material for herbal medicines. However, this option was removed from the diversification program due to economies of scale. There are indeed pharmaceutical products that use nutmeg as a raw material, but nutmeg is only one of many raw materials used in the manufacture of these products. Many other ingredients must be sourced from various locations. In addition, the production machinery and equipment are not exclusively for manufacturing products made from nutmeg; a single pharmaceutical factory complex can produce various types of products with different raw materials.

Therefore, the shock from the IO simulation was only based on the assumption of a nutmeg plantation revitalization program and did not include a commodity-based downstream industry development program. This nutmeg plantation revitalization program will include plantation extensification and intensification, with a target harvest area of 68,000 ha and a productivity of 320 kg per hectare. The estimated total production is 22,000 tonnes per year.

3.2.2. Clove Plantation Revitalization Program

Similar to nutmeg, cloves are a leading commodity in North Maluku province with a high selling price per kilogram, around Rp102,000 at the farmer level. The clove harvest area in North Maluku reached its highest value in 2022, with an area of just under 26,000 hectares. Unfortunately, in just two years, the clove harvest area in North Maluku plummeted to 12,500 hectares, or less than half of the harvest area in 2022. This reduction in harvest area can be partly attributed to land conversion due to the growth of the nickel industry in North Maluku, but there are other factors that have contributed to the decline in harvest area.

Based on the results of a Focus Group Discussion (FGD) with North Maluku Provincial Government officials, particularly from the Agriculture Office, it was found that there is a shortage of labor in the clove plantation industry. Cloves have a narrow harvest period and require a large number of workers during the harvest season. The characteristics of clove trees, which have tall branches and numerous small flowers, require manual harvesting methods. This is exacerbated by the large size and height of clove trees, which require relatively young workers with sufficient physical strength to harvest them.

The rapid development of the nickel industry in North Maluku has absorbed the labor needed to harvest cloves. Clove farmers complain about the difficulty of finding enough strong and sufficient labor for the harvest period because the majority of young workers prefer to work in the nickel industry and other related industries. This has resulted in many clove plants not being harvested on time.

From the above facts, it can be concluded that the drastic decline in clove harvest area does not necessarily mean that 13,500 hectares of clove plantations in North Maluku have been destroyed. Similar to what happened to coconut plantations, this means that there are several plantation areas that still have clove plants but are not productive due to a lack of labor for the harvest period. This means that the revitalization of clove plantations can be done by increasing the supply of labor. Programs that provide incentives for seasonal clove workers can help with this. In addition, programs that provide transportation assistance for workers will also help the migration of seasonal workers from mining areas to clove plantation areas.

In addition to utilizing existing clove plantation land, programs that help with the extensification of clove plantation cultivation also need to be implemented. The target harvest area is at the 2022 level, or 26,000 ha. Meanwhile, intensification programs must also be carried out. The productivity or yield per hectare of clove commodities in North Maluku will reach 420 kg per hectare in 2024, which is the highest in the 2011-2024 period. This productivity must be maintained in line with the expansion of clove plantations.

Based on these two assumptions, it is possible to estimate the potential yield of clove plantations in North Maluku if a revitalization program is carried out to restore the area of clove plantations to what it was before without reducing the productivity achieved in 2024. With a target harvest area of 26,000 ha and productivity of 420 kg per ha, the estimated total clove production from this program is 10,892 tonnes per year. The shock value of this estimated production in the IO simulation is around Rp579 billion.

3.2.3. Cocoa Plantation Revitalization Program

In addition to these two plantation subsectors, the cocoa industry is also worthy of development. In this study, the majority of cocoa industry development will be explained in the discussion of the cocoa downstreaming program, but some of these development efforts are in the agricultural sector. Similar to nutmeg and cloves, cocoa offers a high selling price per kilogram, with dry cocoa beans reaching Rp100,000 per kilogram.

Unlike nutmeg and cloves, which can be sold after being harvested and dried, cocoa beans require quite a complicated processing before they can be sold on the market in the form of dry beans. Therefore, it is assumed that the simulation of cocoa plantation revitalization will also be automatically followed by an increase in the processing of cocoa beans into dry beans. This processing business is also considered part of the Agriculture, Plantation, and Fisheries sector—and not the Processing Industry sector—because this process is integral to the production of cocoa beans.

The simulation of the cocoa plantation revitalization program here will target the production of dry cocoa beans in North Maluku to a level of 14,052 tonnes per year. This figure is more than double the cocoa production in North Maluku in 2024. This harvest value was achieved by North Maluku in the period from 2013 to 2014. The harvest area at that time reached more than 30,000 ha with a yield or productivity of 4.2 quintals per ha.

The yield in 2014 was below the cocoa yield in 2024, which is recorded at 5.8 quintals per hectare. By maintaining this yield, in order to achieve the cocoa harvest target of 14,052 tonnes per year, an additional 13,161 hectares of land is needed. These two assumptions will be used as shock scenarios for the cocoa plantation sector in the IO model simulation.

3.2.4. Rice Farming Revitalization Program

Rice farming in North Maluku peaked in 2015, with a rice harvest area of 21,438 hectares and a rice production of 75,265 tonnes. In terms of productivity, or yield, the rice farming sector in North Maluku in 2020 could record the highest yield during the 2011 to 2024 period, with a value of 42.1 quintals per hectare. However, the current condition of rice farming in North Maluku is below that figure, with a harvest area of only 11,733 hectares, a total production of 38,113 tonnes, and a yield of 32.5 quintals per hectare. In order to revitalize the rice farming sector, it is necessary to increase productivity to the level that was previously achieved and to create new rice fields.

Based on information obtained from primary sources, namely direct discussions with the North Maluku Provincial Government and the Central Halmahera Regency Government, it is known that both local governments are aware of and have plans to create new rice fields and reclaim abandoned rice fields. Various primary sources indicate that there are approximately 4,789 hectares of land ready to be used for rice farming or returned to rice farming.

In addition to rice farming extensification, intensification efforts are also necessary. Various programs, such as subsidies and the provision of cheap fertilizers or high-quality seeds suitable for the acidic soil conditions of North Maluku, can be implemented to increase the productivity of rice fields. Referring to the peak yield of rice farming in North Maluku in 2020, it is realistic to assume that these programs can increase the productivity of rice farming in North Maluku to 42.1 quintals per hectare.

In addition to creating new rice fields, replanting abandoned rice fields, and intensifying rice farming, it is necessary to pay attention to the supporting infrastructure for rice farming. One important supporting factor that needs to be developed is rice field irrigation infrastructure. From discussions with the North Maluku Agriculture Office and the North Maluku Regional Development Planning Agency (BAPPEDA), it was learned that there are several irrigation facilities that have been abandoned and are no longer maintained. This is because the irrigation infrastructure is no longer used since the land that was once rice fields has now been abandoned. To facilitate the expansion of rice farming, it is necessary to rebuild the irrigation infrastructure network.

Based on these factors, it can be assumed that the rice farming revitalization program in North Maluku will increase the land area by 11,733 hectares and productivity by 42.1 quintals per hectare. The additional rice production based on this assumption will be used as the shock value in the IO simulation.

3.2.5. Fisheries Infrastructure Development Program

Offshore fishing is one of North Maluku's leading sectors. Unfortunately, infrastructure constraints often hamper this sector. One of these obstacles is the lack of fish storage and cooling facilities, commonly known as cold storage. These facilities are used to store fish catches on land so that the quality and freshness of the catch does not deteriorate quickly. In addition, there is also a shortage of adequate ice factories. Similar to cold storage, ice blocks are used to maintain the freshness of the catch. By carrying sufficient ice blocks on their boats, fishermen can stay at sea longer and do not need to rush to port to sell their catch.

The lack of these two facilities makes it difficult for fishermen to store seasonal catches. Many fish catches rot due to the lack of refrigeration facilities. This also causes the selling price of fish at the fisherman level to be low due to the oversupply of seasonal fish that must be sold quickly. With cold storage facilities and sufficient ice availability, fishermen do not need to rush to sell their catch and can sell it at a later date at a better price.

A program to build adequate cold storage and ice factories is urgently needed. However, it should be noted that these cold storage facilities require a stable power supply. Learning from the experience of building cold storage in Morowali Regency, Central Sulawesi. It is not enough to simply build the physical facilities for cold storage. Many cold storage facilities in Morowali were built but eventually abandoned and left unused due to insufficient electricity supply. Therefore, along with the construction of cold storage facilities, it is necessary to build adequate power generation facilities.

Unfortunately, the construction of additional coal-fired power plants to supply the needs of cold storage is contrary to the spirit of sustainable economics. One solution that can be used is to install solar panels on the cold storage facilities themselves, as discussed in the research by Setiawan, Thalib & Maarif (2021). Given the sunny weather in North Maluku, this solution can result in a relatively self-sufficient cold storage network that is not too dependent on the smooth supply of electricity from PLN.

The construction of this PV (Photovoltaic) Cold Storage is estimated to cost around Rp3.63 billion for one facility with a capacity of 100 tonnes and a total power of 30 kW. It should be noted that this amount only covers the construction costs of the PV Cold Storage and does not include land acquisition costs. The total cold storage requirement for North Maluku is estimated to reach 10,000 tonnes, and the total cost required to meet this requirement with PV cold storage is around Rp363 billion.

In addition to the need for cold storage and ice, there is also a need for adequate fishing ports. With the availability of cold storage facilities and an adequate supply of ice, it can be assumed that there will be an increase in fish trade transactions in North Maluku throughout the year. To meet these needs, it is necessary to build new fishing ports and expand existing ones. The estimated funding requirement is Rp79 billion per port. This amount does not include the PV Cold Storage facilities at the port, which have been calculated separately.

With sufficient ice supply and a large enough port, this will facilitate fishermen to go to sea longer, further, and using larger fishing boats. The cost of procuring one 10 GT fishing vessel complete with fishing equipment can reach Rp700 million, while a 30 GT vessel complete with all equipment can reach Rp2 billion. Based on these values, the estimated cost of the fishing vessel procurement program can be calculated. Assuming that the program procures 50 10 GT vessels and 10 30 GT vessels, the total estimated cost or shock reaches Rp70 billion.

3.3. Diversification Scenario in the Processing Industry Sector

Table 3-3. **Summary of The Diversification Program in The Processing Industry Sector**

Sub-sector	Program	Target Achievement
Crude Coconut Oil (CCO) Industry	• Development of the CCO manufacturing industry • Development of renewable energy-based supporting energy infrastructure	• Total production capacity of the CCO industry: 124,400 tonnes of CCO per year • Total supporting electricity demand: 16,600 kW
Cocoa Processing Industry	• Construction of cocoa powder and cocoa butter manufacturing plants • Development of renewable energy-based supporting energy infrastructure	• Total input capacity of the cocoa industry: 14,000 tonnes of dry beans per year • Total supporting power requirements: 15,500 kW
Fish Canning Industry	• Construction of a tuna canning industry • Development of renewable energy-based supporting energy infrastructure	• Total production capacity of the tuna canning industry: 20 tonnes of canned fish per day • Total supporting power requirements: 337 kW

3.3.1. Coconut Downstream Program: Crude Coconut Oil (CCO) Industry

North Maluku has a relatively large coconut plantation area. The recorded coconut harvest area in North Maluku in 2022 reached 204 thousand hectares. Although the annual harvest area of coconut plantations in North Maluku varies each year, BPS data shows that from 2011 to 2022, the coconut harvest area in North Maluku province has almost never been below 200 thousand hectares each year. Although there was an anomaly in 2015 when the coconut harvest area fell to 147 thousand hectares, in the following year the harvest value recovered to a level above 200 thousand hectares.

Unfortunately, this performance ended in 2023. The harvested area in 2023 and 2024 fell to 159,000 hectares. However, in terms of total production, the coconut plantation sector in North Maluku remained stable with an annual production of 204,000 tonnes in 2024. Between 2011 and 2024, North Maluku's coconut production never fell below 200,000 tonnes (except in 2022, when coconut production "only" reached 199,961 tonnes). Even when the harvest area decreased dramatically in 2023–2024, North Maluku was still able to produce more than 200 thousand tonnes of coconuts.

Discussions with the North Maluku Provincial Agriculture Office revealed that, in addition to land conversion, the decline in coconut harvest area in North Maluku was also caused by low selling prices for coconuts and copra. North Maluku Agriculture Office staff also stated that this decline in harvest area did not necessarily mean the physical loss of coconut plantations, but rather that coconut farmers were not harvesting their coconuts due to low prices. Therefore, there is still potential for greater coconut production in the future if the prices of coconut and copra commodities can be stabilized.

One of the factors causing low fluctuations in coconut commodity prices is the lack of stable demand. The North Maluku Provincial Agriculture Office revealed that there is fairly stable demand for fresh coconuts from a soft drink company and from direct consumers, but this demand is insignificant compared to production in North Maluku. Furthermore, the quality of coconuts required for this market must be high, which cannot be met by all coconut farmers in North Maluku.

To create reliable, stable, and massive demand for coconut commodities, an industrial-scale solution is needed. Therefore, the development of a downstream coconut industry can be a solution to create a steady and stable source of demand for coconut commodities. For this reason, this study will use a scenario of downstreaming coconut and copra commodities in an IO model simulation.

The simulated coconut downstreaming scenario will be built from several assumptions. The first assumption is the type of downstream industry to be built. In general, there are several coconut derivative products that are widely used in the chemical industry, two of which are Virgin Coconut Oil (VCO) and Crude Coconut Oil (CCO). These two products are copra derivatives that have significant demand in the chemical and pharmaceutical industries.

Of the two products, VCO has higher purity and a higher price per ton on the market. The VCO production process is also more complex and requires large-scale factory facilities. Meanwhile, although the price per ton of CCO is lower than VCO, the CCO production process is much simpler than VCO. Unlike VCO, which requires large capital to establish VCO factory facilities, the CCO production process requires machines and tools that are simple enough to be used in small and medium industries.

Based on these characteristics, the simulated downstreaming program will use CCO manufacturing assumptions. In this case, the CCO processing industry was chosen due to three main factors. First, CCO production is not capital intensive and can be produced on a small scale. Second, this industry can be run by small and medium industries with several units of relatively simple machinery and equipment that can be operated by workers with minimal skills. Third, each business unit does not consume a lot of electricity so that it can be powered by alternative electricity sources such as renewable energy.

The simulated scenario will assume the development of coconut downstreaming in the form of CCO within a period of 5 years. It is also assumed that the capacity that needs to be achieved by the CCO processing industry is the same as the copra production in North Maluku in 2024, or around 204,000 tonnes. Based on the business plan document reviewed by researchers, this capacity requires an investment of Rp346 billion and can produce 124,400 tonnes of CCO per year, assuming that 1 ton of copra can produce 610 kg of CCO.

This investment value does not include investment in the energy sector, which is certainly needed for the operation of this CCO processing industry. If we know that a CCO plant with a capacity of 90 tonnes per year requires 12 kW of electricity, then the power requirement for processing 124,000 tonnes of CCO per year is 16.6 MW. Based on a CELIOS study, if this power requirement is met by a micro-scale solar power plant, it will cost Rp202.3 billion.

In addition, there are assumptions regarding the prices of copra and CCO. Using the prices reported by BPS, the market price of copra is Rp6 million per ton and the price of CCO is Rp19.7 million per ton. Using these price assumptions and the above assumptions regarding copra production and CCO production potential, this industry will generate an added value of Rp1.22 trillion annually.

3.3.2. Cocoa Downstreaming Program: Cocoa Bean Processing Industry

Indonesia is the third largest cocoa producer in the world and North Maluku is one of the largest cocoa producers in Indonesia. Unfortunately, the majority of cocoa in North Maluku is only sold to the market in the form of dried beans, without any further value-added processing. This is a huge missed opportunity considering the many derivative products that can be produced from dried cocoa beans.

The potential of the cocoa industry spans from upstream to downstream, from cocoa plantations to consumer products such as chocolate bars. Based on discussions with the North Maluku Provincial Development Planning Agency (BAPPEDA) and field surveys, it is known that there is already an upstream to downstream cocoa industry in North Maluku, albeit on a very small scale. There is only one cocoa processing company in North Maluku that processes cocoa from upstream to downstream, with limited production volume.

Based on this foundation, the economic diversification program will project the development of the cocoa industry. To simulate the effects of this cocoa industry development on the North Maluku economy, it is necessary to develop a simple and realistic, yet feasible program scenario. In this case, the IO model will simulate the development of the cocoa grinding and processing industry from dry beans to intermediate goods in the form of cocoa powder and cocoa butter. Simulating the development of the cocoa industry to the retail level cannot be done due to the complexity of the assumptions.

Based on a study of a cocoa processing plant business plan in Nigeria, the estimated cost of a cocoa processing plant with a capacity of 400 tonnes per year is around US$184,000. With an exchange rate of Rp16,000 per US$1, the plant would cost Rp2.95 billion. Based on this assumption, a total of Rp103.5 billion is needed to build a processing facility with a capacity that can cover the entire cocoa harvest of North Maluku.

In addition to investments in machinery and factory equipment, the electricity needs of these factories must also be taken into account. The energy required to process 1 ton of dry cocoa beans in the plant reaches 2232 MJ or 620 kWh. Based on this assumption, it can be calculated that the total electricity demand for the entire cocoa industry downstream program reaches 15,500 kW.

Generating that much electricity requires a coal-fired power plant (PLTU) of sufficient scale. Based on the results of studies by CELIOS and 305.org, the cost of building a coal-fired power plant to meet the 15,500 kW demand requires an investment of Rp396.7 billion. This amount can be reduced by using more sustainable alternative energy sources. It is estimated that to produce the same amount of power, an industrial-scale solar power plant would only require an investment of Rp283 billion.

3.3.3. Fisheries Downstreaming Program: Fish Canning Industry

This study will also simulate the development of a fish canning industry as part of a program to develop downstream industries for agricultural and fishery commodities. Based on a literature review and field data collection, it was found that tuna is the most suitable commodity for this canning industry.

The first reason for choosing tuna is that canned tuna has an established and well-established market. Second, the price of tuna is the highest compared to other fishery commodities. Therefore, the potential losses incurred if there is an excess catch and the fish is not sold will also be greater. With this fish canning industry, it is hoped that the excess supply of tuna can be absorbed and reduce losses for fishermen.

The calculation of investment cost assumptions in this program simulation is based on research by Montaner et al (1995) and Kartikasari (2021). From these two journal articles, it was found that the investment cost assumption required for a tuna canning factory with a capacity of 1 ton per day in 1995 was US$120,000. Adjusted for inflation, this value in 2025 will be US$253,000 or equivalent to Rp4.05 billion.

Assuming 260 working days per year, the canning capacity needed to absorb *the excess supply* from North Maluku's marine catches is around 20 tonnes per day. The investment cost required to build a fish canning industry with this capacity is around Rp81 billion. As with the coconut and cocoa processing industries, this figure does not include the costs required to build the necessary electricity infrastructure.

Still based on Montaner et al (1995) and Kartikasari (2021), the estimated electricity consumption required for a canning factory with a capacity of 1 ton per day is around 16.8 kW. For an industry with a capacity of 20 tonnes per day, the power required reaches 337 kW. This power requirement can be met by the construction of an industrial-scale solar power plant worth Rp6.2 billion.

3.4. Diversification Scenarios in the Electricity Supply Sector

Table 3-4. **Summary of The Diversification Program in The Electricity Supply Sector**

Sub-sector	Program	Target Achievement
Community-based renewable energy development	• Procurement of utility-scale solar power plants for households	• Total electricity capacity: 10,000 kW
Construction of Pumped Storage Hydro (PSH)	• Construction of PSH and supporting infrastructure	• Total storage capacity: 10,000 kW

3.4.1. Community-Based Renewable Energy Development Program

As explained in the previous chapter on the electricity supply sector, the 2024 PLN Statistical Report shows that there are around 42,676 households that are not yet connected to PLN electricity. The same report also shows that there are around 10,000 households that are 'lost' from the PLN electricity network. The diversification scenario in this sector will simulate the use of EBT to meet these needs.

The first assumption that needs to be made in creating this scenario is the electricity needs per household. One simple housing unit has an average electricity capacity of 900 VA or 900 watts. By including a transmission loss factor of 10%, the electricity needs per household are in the range of 1 kW. These needs are assumed to be met by EBT-based electricity sources such as wind power, solar power, and micro-hydro power.

The next step is to select renewable energy sources that are suitable for the geographical conditions of North Maluku. Topographically, North Maluku does not have the right contours for large-scale micro-hydro power. In terms of climate and weather, solar power plants (PLTS) and wind power plants (PLTB) are suitable for implementation in North Maluku. Sunlight is available throughout the year in North Maluku, and the relatively long coastline means that many areas are affected by sea winds.

Unfortunately, the investment cost per kW of wind power plants, especially in coastal areas, is still high. Therefore, it will be assumed that all of the above-mentioned electricity needs will be met by solar power plants (PLTS). The procurement scenario scheme to be used is a community-based renewable energy scheme using utility-scale solar power plants with an assumed investment cost of Rp12.2 million per kW. The cost per kW of these utility-scale solar power plants is the lowest compared to other renewable energy sources and is also lower than conventional coal-fired power plants.

3.4.2. PSH Development Program

Unlike conventional power plants, EBT-based electricity cannot provide a consistent power supply at all times. Wind power plants cannot supply electricity when there is no wind, solar power plants cannot produce electricity at night, and micro-hydro power plants are prone to drought problems. This consistency issue is even more pronounced in community-based EBT schemes, which are technically unsophisticated and small in scale.

To fill this energy gap, the EBT program simulation will also include a pumped storage hydro (PSH) component. Physically, PSH consists of a water reservoir, water pumps, and power generation units. During the day, when there is excess electricity supply from EBT sources, water will be pumped into the reservoir. At night, the floodgates will be opened to run the power generation units.

Compared to the use of batteries to store electrical energy during the day, the PSH scheme has advantages in terms of simplicity and ruggedness. The technology used in PSH is simple enough to be maintained, operated, and repaired by local residents. The PSH scheme can also utilize existing water reservoirs such as ponds, irrigation channels, and floodgates. In addition, the use of PSH also creates more jobs and has a positive effect on the local economy with various public works required for the construction and maintenance of the PSH system.

Still based on the CELIOS and 350.org study[14], the construction of PSH is assumed to require funds of around Rp13.3 million per kW. The total requirement for the entire EBT program reaches Rp133 billion, assuming that there is no need for massive construction of water infrastructure such as reservoirs and floodgates. This figure assumes that the majority of PSH can use existing reservoirs and water channels in North Maluku.

14 350.org CELIOS, *Opportunities and Challenges in Community-Based Renewable Energy Financing*, Research Report (CELIOS & 350.org, 2024), https://celios.co.id/wp-content/uploads/2024/12/Peluang_dan_Tantangan_Pendanaan_energi_terbarukan_Berbasis_Komunitas_compressed_aa222bb374.pdf

Findings

Table 4-1. **IO Simulation Results of The North Maluku Economic Diversification Program**

Program Sector	Additional GRP (Trillion IDR)	Additional Wages (Trillion IDR)	Additional Employment (Thousands)	Additional Output (Trillion IDR)
Agriculture and Fisheries	58.79	21.95	1,430	83.7
Processing Industry	8.13	2.56	204	39.9
Electricity Supply	8.99	3.82	201	75.9
Total	**75.91**	**28.33**	**1,835**	**199.50**

Based on the results of the IO simulation, the economic diversification programs described above are estimated to generate a total additional GRDP of Rp75.9 trillion. This figure is not the total GRDP that North Maluku Province will achieve if it implements economic diversification, but rather the ADDITIONAL GRDP obtained above the natural GRDP growth of North Maluku Province. The figure of Rp75.9 trillion is the aggregate additional GRDP over 20 years, with an average additional GRDP per year of Rp3.8 trillion.

When calculated from the GRDP of North Maluku in 2024, these economic diversification programs in various sectors will increase the average economic growth of North Maluku by 2.96% each year. Of course, this figure is an additional value on top of the existing economy. For example, assuming that the GRDP of North Maluku without economic diversification will grow at a constant average rate of 6%, with economic diversification, the growth achieved will be 9%.

Figure 4-1. **Additional GRDP Per Year from Diversification Programs Across All Sectors**

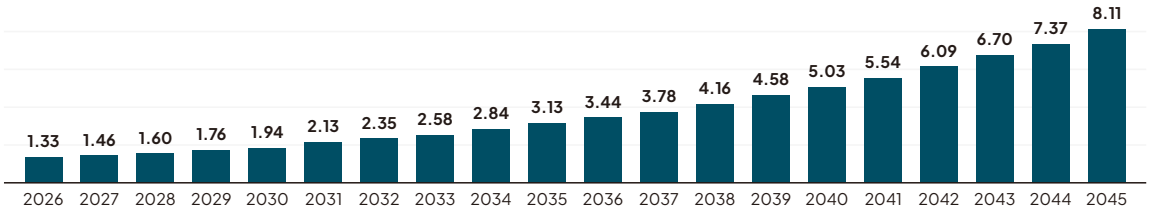


Figure 4-1 above shows the annual GRDP growth over 20 years since the implementation of the economic diversification program. On average, the simulated 5-year economic diversification program will increase GRDP by Rp3.8 trillion per year. Using North Maluku's GRDP in 2025 as a reference, this diversification program will boost annual economic growth by an average of around 2.96% per year.

Figure 4-2. **Total Additional Wages or Compensation Per Year from The Diversification Program Across All Sectors**

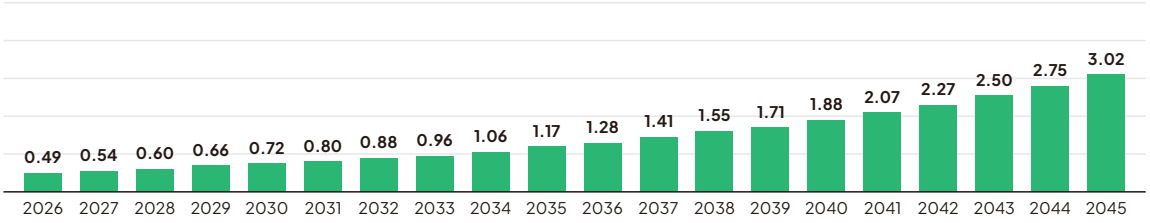


Figure 4-2 above shows the annual increase in wages from economic diversification efforts. The additional wages for workers reached Rp28.33 trillion. Keep in mind that this amount is the total additional wages over 20 years for all workers in North Maluku Province. To calculate the additional wages per worker, this value must be divided again by the number of workers in North Maluku in the 20th year.

Using the assumption of the number of workers in North Maluku according to the February 2025 Sakernas survey, if this additional wage is divided among all workers in North Maluku, then in the 20th year, each worker in North Maluku will receive an average additional wage of Rp2.1 million per year, or Rp177,885 per month. This figure is obtained based on the assumption that the number of workers in North Maluku remains unchanged from the February 2025 Sakernas data.

Assuming that the North Maluku workforce grows by 2% per year, the additional wage earned by workers per year in 2045 will reach Rp1.4 million, with a monthly wage increase of around Rp119,681. As with the GRDP above, this increase is above the natural wage increase from North Maluku's natural economic growth, so the final value will be even greater.

Figure 4-3. **Total Additional Jobs Per Year from The Diversification Program Across All Sectors**

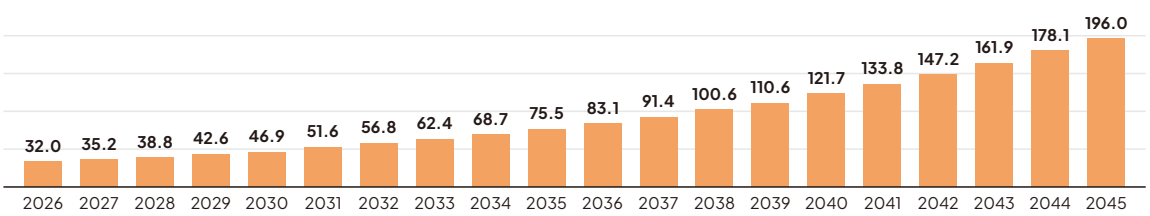
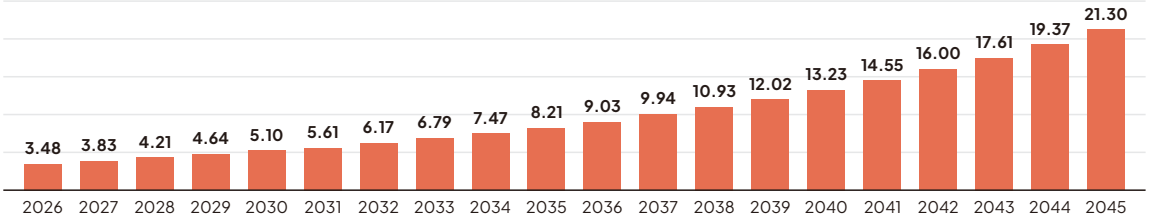


Figure 4-3 illustrates the additional employment obtained from year to year from the IO simulation results. From these IO simulation results, it is also known that the number of additional jobs created by the launch of this economic diversification program will reach 1.8 million jobs in the 20th year. Similar to GRDP and wages, this value is the aggregate of additional jobs over 20 years. When calculated on average, there will be an additional 91,000 jobs each year.

It should be noted that this number is in addition to the natural job growth currently experienced by North Maluku, and therefore the actual job growth that will occur could be even greater. It should also be noted that these results are theoretical jobs that will be created, and in reality, they will not necessarily all be filled. In theory, there is nothing to prevent an individual from holding only one open job. Moreover, this value does not include changes in management efficiency or productivity improvements through mechanization. Therefore, in practice, the number of jobs created will tend to be smaller than the value on paper.

Figure 4-4. **Total Additional Output Per Year from The Diversification Program Across All Sectors**



The entire economic diversification program is estimated to generate a total additional output for all sectors of Rp199.5 trillion over a period of 20 years. In this case, output per sector refers to the gross production value for each sector. Unlike GRDP, this output value is not reduced by the value added from the inputs used by the sector. This results in a total value that is greater than the GRDP.

This additional output does not only come from sectors directly affected by the diversification program, but also from other sectors that are affected by the economic domino effect of the increase in directly affected sectors. For example, a cold storage development program in the fisheries sector will increase the availability of fish and other seafood products that were previously seasonal. This increased availability will also have a positive effect on the output of the Accommodation and Food Service sectors.

The above explanation describes the results of the IO simulation if all programs are implemented. However, in order to analyze in more depth the effects of the programs in each sector on the economy, the next sub-chapter will explain the simulation of the impact of the programs in each sector on the IO simulation results. Table 4-2 below illustrates the contribution of each sector's program to the total economic impact of diversification.

Table 4-2. **Contribution of Diversification Programs in Three Sectors to The Total Economic Impact**

Program Sector	Contribution to Total Additional GRDP	Contribution to Total Additional Wages	Contribution to Total Additional Employment	Contribution to Total Additional Output
Agriculture and Fisheries	77.45%	77.48%	77.94%	41.95%
Processing Industry	10.71%	9.03%	11.10%	19.98%
Electricity Supply	11.84%	13.49%	10.96%	38.07%

4.1. Agriculture, Forestry, and Fisheries Sector

Table 4-3. **Summary of The Impact of Diversification Programs in The Agriculture and Fisheries Sectors**

Impact	Additional GRDP (Billion IDR)	Additional Wages (Billion IDR)	Additional Employment (Thousands)	Additional Output (Billion IDR)
Nominal Increase	58,793	21,949	1,430	83,695
Percentage of Total	77.45%	77.48%	77.94%	41.95%

As shown in Table 4-3 and Figure 4-5, diversification programs in the agriculture and fisheries sectors contributed the most to the increase in GRDP. Programs in these sectors do not include downstream agricultural product programs such as cocoa bean processing and fish canning programs, which will later be included in the manufacturing sector category. These results were achieved solely through the revitalization of the agricultural sector and the development of fisheries infrastructure in the form of cold storage and fish ports.

The additional GRDP obtained from this sector alone was recorded at Rp58.8 trillion, or around 77.5% of the total additional GRDP. The significant effect of this sector reflects the potential of North Maluku province in the fields of agriculture and marine fisheries, with premium commodities that have high selling prices, such as nutmeg, cloves, and tuna.

In terms of wages, an additional Rp22 trillion in wages was also generated as a result of programs in this sector, or 77.5% of the total additional wages from all programs. This high percentage is due to the proportion of labor or workforce for each unit of output from the agriculture and fisheries sectors being relatively large compared to the capital required. In other words, the proportion of wages in gross value added in this sector is relatively higher than rent.

The diversification program in the agriculture and fisheries sectors also created 1.4 million jobs across all sectors over 20 years, or around 78% of the total jobs generated from the overall economic diversification simulation. The dynamics of job creation resulting from the development of this sector can be seen in Figure 4-7 below. It should also be noted that although the simulated shock is in the agriculture, forestry, and fisheries sectors, not all or most of the 1.4 thousand additional jobs are necessarily in these sectors. The multiplier effect of a positive shock in the agriculture, forestry, and fisheries sectors will also result in additional jobs in other sectors.

In terms of output growth, the diversification program in the agriculture and fisheries sectors has a smaller proportion compared to its effect on GRDP, wages, and employment. The total economic output increase due to the shock in this sector reached Rp83.7 trillion. Although this figure is the highest when compared to the next two sectors, it only represents 42% of the total output obtained from the shock in the three sectors. This is due to the value of inter-sectoral linkages in the agriculture, forestry, and fisheries sectors, which is relatively small compared to the value of inter-sectoral linkages in the manufacturing and electricity and gas supply sectors. These relatively small linkages indicate that shocks in this sector have a relatively small effect on other sectors, so the effects of diversification in this sector will not have much impact on other sectors.

Figure 4-5. **Additional GRDP from The Diversification Program in The Agriculture and Fisheries Sectors**

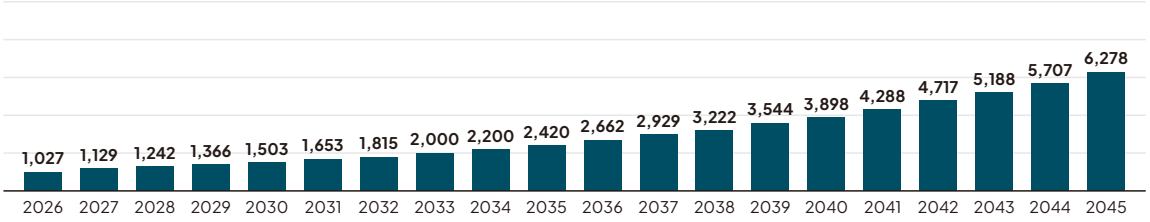


Figure 4-6. **Additional Wages from Diversification Programs in The Agriculture and Fisheries Sectors**

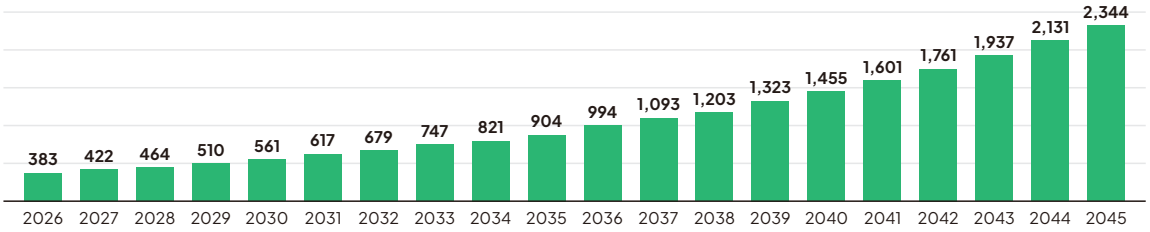


Figure 4-7. **Additional Employment from The Diversification Program in The Agriculture and Fisheries Sectors**

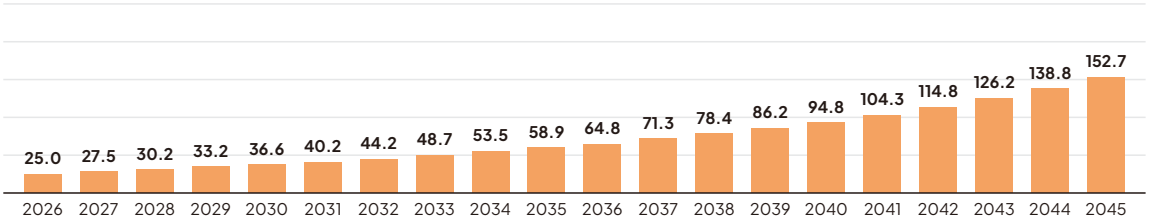
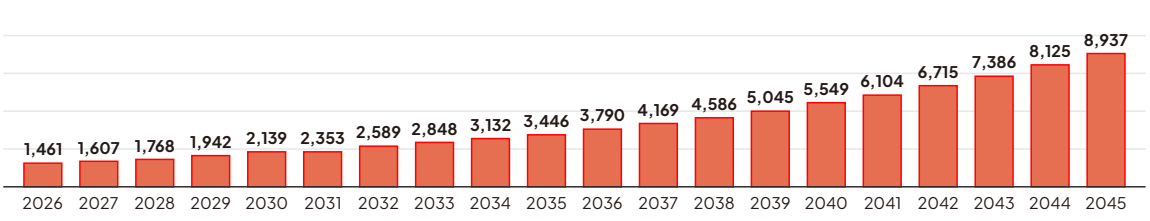


Figure 4-8. **Additional Output from The Diversification Program in The Agriculture and Fisheries Sectors**



4.2. Manufacturing Sector

Table 4-4. **Summary of The Impact of Diversification Programs in The Manufacturing Sector**

Impact	Additional GRP (Billion IDR)	Additional Wages (Billion IDR)	Additional Employment (Thousands)	Additional Output (Billion IDR)
Nominal Increase	8,130	2,557	204	39,861
Percentage of Total	10.71%	9.03%	11.10%	19.98%

Diversification in the processing sector ranks last in terms of its contribution to North Maluku's GRDP. According to the IO simulation conducted, the development of downstream industries for coconut, cocoa, and fish canning will generate an additional Rp8.13 trillion in GRDP over the next 20 years, or around 10.7% of the total additional revenue generated from the economic diversification program. Although the contribution from this sector is far below that of the agriculture and fisheries sectors, the downstreaming program for agricultural and fishery products is important in order to increase *the value added* of these primary sector products. In addition, there are also significant economic multiplier and linkage aspects from the processing industry sector. This will be explained further in the following explanation.

A total of Rp2.55 trillion, or around 9.03% of the total additional wages obtained from this diversification program, came from programs in the manufacturing sector. The percentage contribution of wages from this sector is smaller than its contribution to the GRDP. This is due to the characteristics of the manufacturing sector, which requires relatively more capital than labor per unit of output. Therefore, the proportion of wages in gross value added in this downstream industry is smaller than the proportion of wages in gross value added in the agriculture and fisheries sectors, which explains why the proportion of wages from this sector is smaller than its proportion of GRDP.

Furthermore, in terms of job creation, programs in this sector are estimated to create more than 204 thousand new jobs over 20 years, or around 11.1% of the total effect of economic diversification on employment. The proportion that is slightly larger than the GRDP and 2% larger than the proportion of the same sector to wages is due to the linkage factor of the manufacturing sector, which is larger than the agriculture and fisheries sectors. This causes shocks in the manufacturing sector to have a greater impact on other sectors than similar shocks in the agriculture, forestry, and fisheries sectors. Therefore, an increase in the manufacturing sector will encourage more job creation in other sectors.

The linkage factor from the manufacturing sector also resulted in a proportionally larger increase in output from shocks in this sector compared to the agriculture, forestry, and fisheries sectors. Approximately Rp38 trillion, or 20% of the total simulated increase in output, came from programs in the manufacturing sector.

Figure 4-9. **Additional GRDP from Diversification Programs in The Manufacturing Sector**

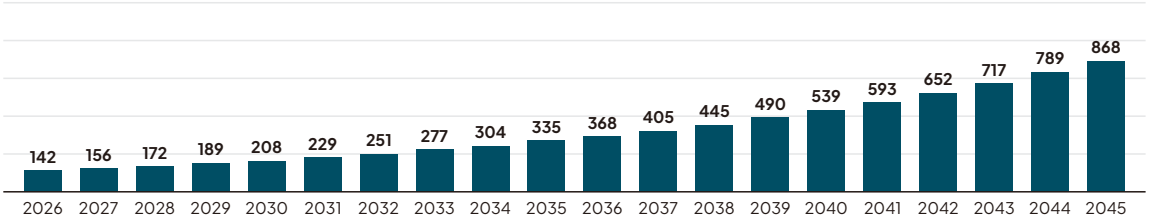


Figure 4-10. **Additional Wages from Diversification Programs in The Manufacturing Sector**

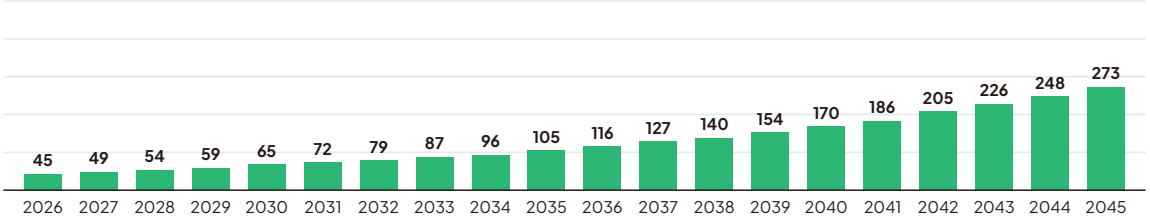


Figure 4-11. **Additional Employment from Diversification Programs in The Manufacturing Sector**

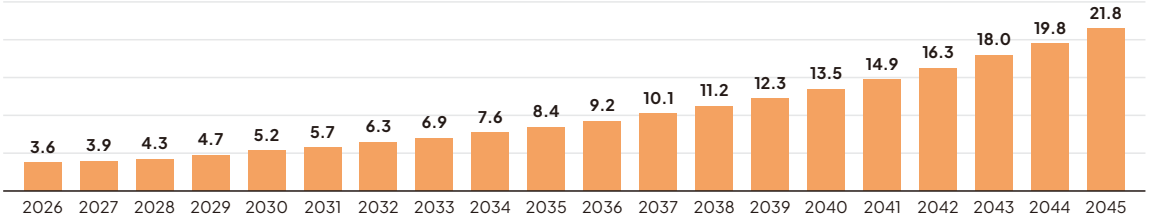
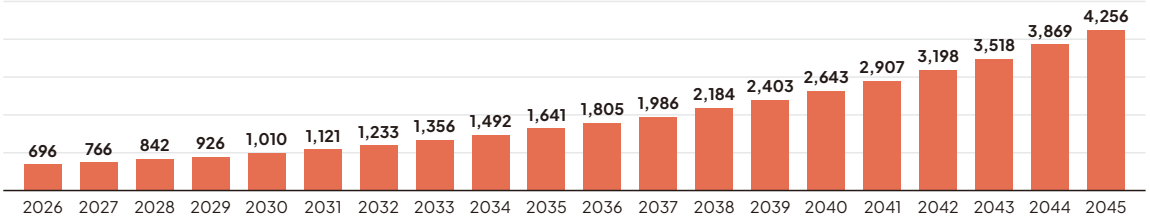


Figure 4-12. **Additional Output from Diversification Programs in The Manufacturing Sector**



4.3. Electricity Supply Sector

Table 4-5. **Summary of The Impact of The Diversification Program in The Electricity Supply Sector**

Impact	Additional GRP (Billion IDR)	Additional Wages (Billion IDR)	Additional Employment (Thousands)	Additional Output (Billion IDR)
Nominal Increase	8,987	3,821	201	75,940
Percentage of Total	11.84%	13.49%	10.96%	38.07%

The effect of the shock in the electricity procurement sector on North Maluku's GRDP is the second largest when compared to the other two sectors. In total, the EBT procurement program for more than 50 thousand houses in North Maluku is estimated to generate an additional GRDP of nearly Rp9 trillion in 20 years. This value is only equivalent to 11.8% of the total additional GRDP generated by the overall economic diversification program.

This result is reasonable considering the significant capital input and shock from this program. In addition, the multiplier from the electricity procurement sector is one of the largest. The intrinsic value of the forward and backward linkages of this sector is very large. This is because electrical energy is used in almost all industries. The use of EBT will mainly help the micro-industry sector and household consumption.

The effect of this program on wages is proportionally higher than on GRDP. The IO simulation results indicate that around 13.5% or Rp3.8 trillion of the total additional wages came from programs in this sector. As a comparison, this figure is also proportionally higher than the manufacturing sector. This is mainly because the effect of wage increases in the manufacturing sector is relatively small, thereby increasing the share of the electricity supply sector.

Furthermore, in terms of job creation, the EBT procurement program only contributes to an additional 201 thousand new jobs over a period of 20 years. This figure is around 11% of the total job creation generated by the overall economic diversification program. Similar to the manufacturing sector, the low number of new jobs created can be attributed to the nature of the electricity supply sector, which is much more capital intensive when compared to the agriculture and fisheries sectors.

Although the effect of the EBT program on GRDP, wages, and employment is relatively small in proportion, its effect on output is proportionally very significant. Approximately Rp76 trillion in additional output was generated from this program over 20 years, or 38.1% of the total increase in output generated by the economic diversification program. This high proportion is due to the high *linkage* of the electricity supply sector; the availability of adequate electricity supply will drive an increase in output in other sectors.

Figure 4-13. **Additional GRDP from The Diversification Program in The Electricity Supply Sector**

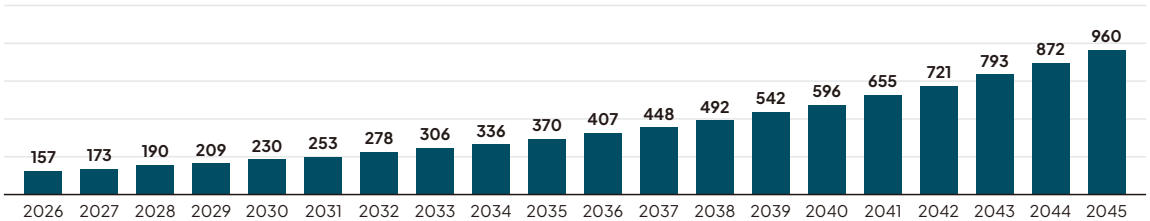


Figure 4-14. **Additional Wages from The Diversification Program in The Electricity Supply Sector**

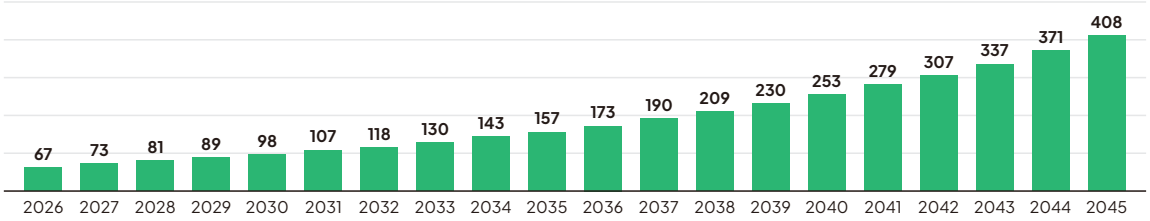


Figure 4-15. **Additional Employment from The Diversification Program in The Electricity Supply Sector**

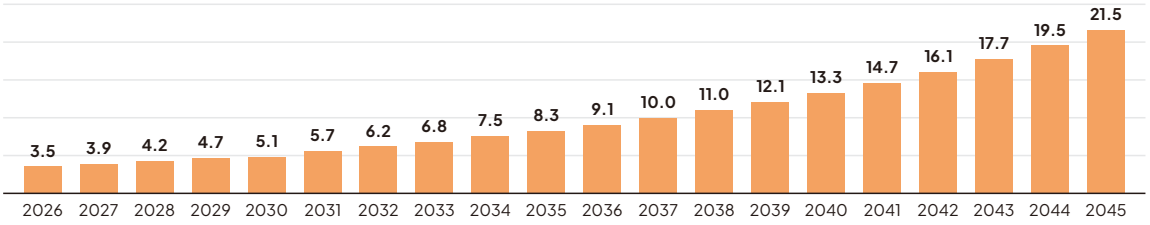
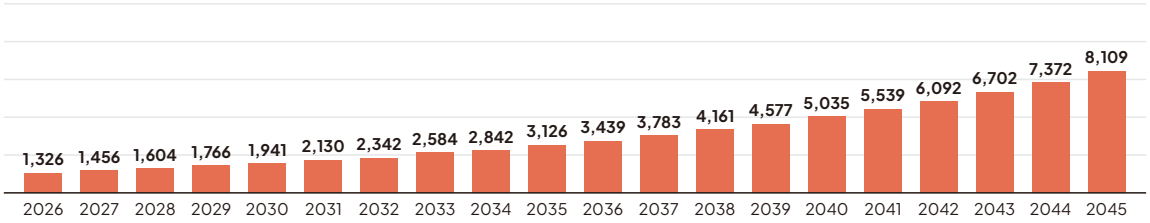


Figure 4-16. **Additional Output from The Diversification Program in The Electricity Supply Sector**



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Appendix

Table A-1. **List of Nickel Mining and Manufacturing Companies in North Maluku Province**

No	Province	Company	Location	Capital
1	North Maluku	PT Indonesia Weda Bay Industrial Park	Central Halmahera	PMA
2	North Maluku	PT Teka Mining Resources	Central Halmahera	PMA
3	North Maluku	PT Lipe Metal Industry	Central Halmahera	PMA
4	North Maluku	PT Perkasa Metal Industry	Central Halmahera	PMA
5	North Maluku	PT Westrong Metal Industry	Central Halmahera	PMDN
6	North Maluku	PT Kao Rahai Smelters	Central Halmahera	PMA
7	North Maluku	PT Jade Bay Metal Industry	Central Halmahera	PMA
8	North Maluku	PT Debonair Nickel Indonesia	Central Halmahera	PMA
9	North Maluku	PT Andalan Metal Industry	Central Halmahera	PMA
10	North Maluku	PT Sunny Metal Industry	Central Halmahera	PMA
11	North Maluku	PT Angel Nickel Industry	Central Halmahera	PMA
12	North Maluku	PT Huake Nickel Indonesia	Central Halmahera	PMA
13	North Maluku	PT Jiu Long Metal Industry	Central Halmahera	PMA
14	North Maluku	PT Lin Victor Metal Industry	Central Halmahera	PMA
15	North Maluku	PT Maluku Utara Metal Industry	Central Halmahera	PMDN
16	North Maluku	PT Infei Metal Industry	Central Halmahera	PMA
17	North Maluku	PT Youshan Nickel Indonesia	Central Halmahera	PMA
18	North Maluku	PT Halmahera Jaya Feronikel	South Halmahera	PMA
19	North Maluku	PT Feni Haltim	East Halmahera	PMDN
20	North Maluku	PT Alchemist Metal Industry	North Halmahera	PMA
21	North Maluku	PT Halmahera Persada Lygend	South Halmahera	PMA
22	North Maluku	PT Wanatiara Persada	South Halmahera	PMA
23	North Maluku	PT Megah Surya Pertiwi	South Halmahera	PMA

Source: Data of the North Maluku Regional Government[15]

15 Dinas Komunikasi Informatika dan Persandian Provinsi Maluku Utara, "Daftar Perusahaan Industri Provinsi Maluku Utara," Open Data Maluku Utara, accessed 23 July 2025, https://opendata.malutprov.go.id/dataset/daftar-perusahaan-industri-provinsi-maluku-utara

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