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Impact of Nickel Downstreaming in North Maluku: Input-Output Analysis

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Abstract: *This study aims to determine and analyze the impact of downstream nickel commodity policies on the economy in North Maluku Province. Secondary data in this study also uses data on mining companies and industrial processing in North Maluku Province from the Mining and Energy Service of North Maluku Province, as data on nickel commodity resources and reserves in Indonesia. The analytical tools used are backward and forward linkage analysis; analysis of the I-O table, and the RAS method then iterates over the I-O table. Furthermore, four scenarios are used to view. the dynamic atmosphere of policy. Based on the results of this analysis, the results of scenario four, namely 10 percent of nickel reserves into an electric car downstream ecosystem and 20 percent produced into EV Batteries, are policy scenarios that the Government can see because they have a positive impact on the regional economy in North Maluku Province.*

Keywords: Downstream; I-O Table; Iteration; Regional economy; North Maluku

1. Introduction

During the era of imperialism, the Indonesian nation experienced many forms of slavery with various policies made by the colonialists in the form of "forced labor" and "forced cultivation". As a nation, Indonesia does not have the right to be able to determine political, social, economic, cultural, scientific, and technological attitudes and even plant commodities to be planted must follow orders from the master. After the Indonesian nation achieved independence, all policies regarding economic democratization in Indonesia were regulated by the Founding Fathers in "Article 33 of UUD 1945.

Based on the article's explanation, we reject all forms of colonialism against the national economy and are aware of the various resources that are Indonesia's main commodities. In the G20 series in Glasgow some time ago, Indonesia refused to sign a supply chain agreement where this agreement failed to be followed by 16 other countries because this agenda was a "west-driven" agenda that targeted Indonesia which is rich in natural resources (Ramalan, 2021). Therefore, we must guard our wealth in natural resources, especially the wealth in mineral commodities that can make Indonesia get out of the middle-income trap. Presidential Regulation Number 55 of 2019 concerning the Battery Electric Vehicle Acceleration Program for Road Transportation where in 2025 it is targeted to be able to produce electric cars and in 2035 (Fitriyani, 2022). Maluku's economy is primarily driven by agriculture, fisheries, and forestry, which serve as the main livelihood sources for the local population. However, the region faces challenges such as limited industrial diversification and dependence on traditional sectors (BPS, 2022b). Mining has become increasingly important in supporting economic development, contributing significantly through job creation, infrastructure development, and government revenue (Smith et al., 2021).

Maluku possesses rich mineral resources, including nickel and manganese, which, if sustainably managed, can boost economic growth and reduce poverty (Ministry of Energy and Mineral Resources, 2023). It is hoped that all Indonesian people can enjoy the downstream momentum following the mandate of the Republic of Indonesia Constitution Article 33, the Government establishes the Indonesian Mining Industry which is a holding consortium for the Indonesian BUMN Mining industry in which PT Antam Tbk, PT. Bukit Asam Tbk, PT. Freeport Indonesia, PT Inalum (Persero), and PT Timah Tbk which aims to process various Indonesian mineral commodities, one of which is nickel assess that it is necessary to research to determine the impact of downstream nickel on the regional economy of North Maluku Province to prepare nickel downstream policies in nickel ore-producing areas such as what happened in North Maluku Province which experienced significant economic growth due to downstream nickel commodities. This research examines the mining sector's role in strengthening Maluku's economy, focusing on its potential to balance economic benefits with environmental sustainability.

2. Literature Review

2.1. Natural Resource and Environmental Economics

Natural resource and environmental economics explore the balance between resource utilization and extinction. The interaction between economic development and environmental conservation is a central theme in the literature. In developing countries, balancing resource exploitation with environmental protection remains a challenge, requiring strong governance, investment in environmentally friendly technologies, and public awareness campaigns (Bowles & Gintis, 2000).

According to Perman et al. (2011), efficient resource management is essential to ensure long-term economic growth while minimizing environmental degradation. Renewable resources, such as forests and fisheries, require sustainable harvesting practices, while non-renewable resources, such as minerals and fossil fuels, require strategies to optimize extraction and encourage value-added activities (Pearce & Turner, 1990). Additionally, an integrated approach combining market-based incentives and regulatory frameworks can improve resource efficiency (OECD, 2022). Dasgupta (2021) outlines that economic policies must internalize environmental impacts, such as pollution and loss of biodiversity, to achieve sustainable development.

2.2. Mining Economics

The mining sector is important to economic development, especially in resource-rich areas. In developing countries, it often catalyzes industrialization by attracting foreign investment and stimulating related industries. Mining provides significant economic benefits such as job creation, infrastructure development, and government revenue through taxes and royalties (Smith et al., 2021). However, its success depends on effective resource management and policies that prioritize environmental sustainability and community welfare (Andrews & McCarthy, 2020). Various studies highlight the dual role of mining in driving economic growth and addressing socio-economic disparities.

Despite its potential, mining has challenges, including environmental degradation and social conflict (Gunningham, 2022). For example, a report emphasizes that transparent governance and fair revenue distribution are critical to maximizing the benefits of mining (World Bank, 2019). In Indonesia, regions with sustainable mining practices show significant GDP growth compared to regions with unmanaged resource extraction (Ministry of Energy and Mineral Resources, 2023). Sustainable practices, such as using renewable energy in operations and involving local communities, are critical to minimizing these impacts. Overall, the literature underscores the need for an integrated approach that balances economic, environmental, and social objectives.

2.3. Downstreaming in the Mining Sector

Downstreaming, or the development process that adds value to raw materials, has received attention as a strategy to increase the economic benefits of the mining sector. Downstream policies in the mining sector, especially nickel and bauxite processing, have shown significant economic potential (Nugroho 2022). However, effective downstreaming requires integrated policies, investment in infrastructure, and international partnerships to overcome obstacles and maximize economic benefits. According to Hilson and McQuilken (2020), downstreaming encourages industrial diversification by creating new industries, increasing export revenues and creating jobs. For resource-rich countries, this reduces dependence on raw material exports and mitigates the risk of selling off commodity prices. A study highlights that value-added delivery contributes to higher GDP growth and strengthens domestic industry (Widodo et al., 2021).

2.4. Research Framework

According to Halsmayer & Hoover (2016) a growth model an economy that focuses on production factors, especially input factors such as capital and labor. At the national level, gross national product can be used to describe production factors and at the company level, abstractions can be used to increase output in production factors (Mansur & Syaifullah, 2019).

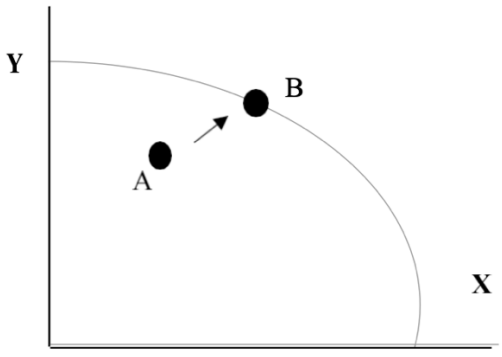

Figure 1. Production Possibilities Curve

There are times when the condition of people's savings (S) in a country experiences a fairly high increase, which will have an impact on increasing investment (I) which will also have implications for other economic indicators. Several countries whose economies are driven by manufacturing activities as a basis for economic growth have proven to be able to

enable these countries to become advanced countries and accumulate capital stock to facilitate the stages of creating a production process using an investment approach. In the production possibilities curve above, point A is the point that shows that the economy is not running efficiently because input factors are not running optimally, therefore specialization is needed by the country to produce goods or services that become output. Structural reform of institutions so that they run efficiently will be an alternative solution to create low transaction costs by ensuring "law enforcement" and strengthening enforcement against moral hazard actions that may occur in institutional processes.

The dynamic system model is a supporting tool in practical policy-making and also allows for many choices of policy formula scenarios. Changes and policy behavior to provide feedback that contains information to design more complex policy formulations. What must be anticipated in changes and policy behavior is to make an analysis that is used to anticipate the worst risks of policy failure (Howlett, 2004). According to Groff (1963) dynamic systems in research can carry out policies that can be used for policy design. Therefore, the application of dynamic systems can be seen from behavior in policymaking with the following flight simulator management model:

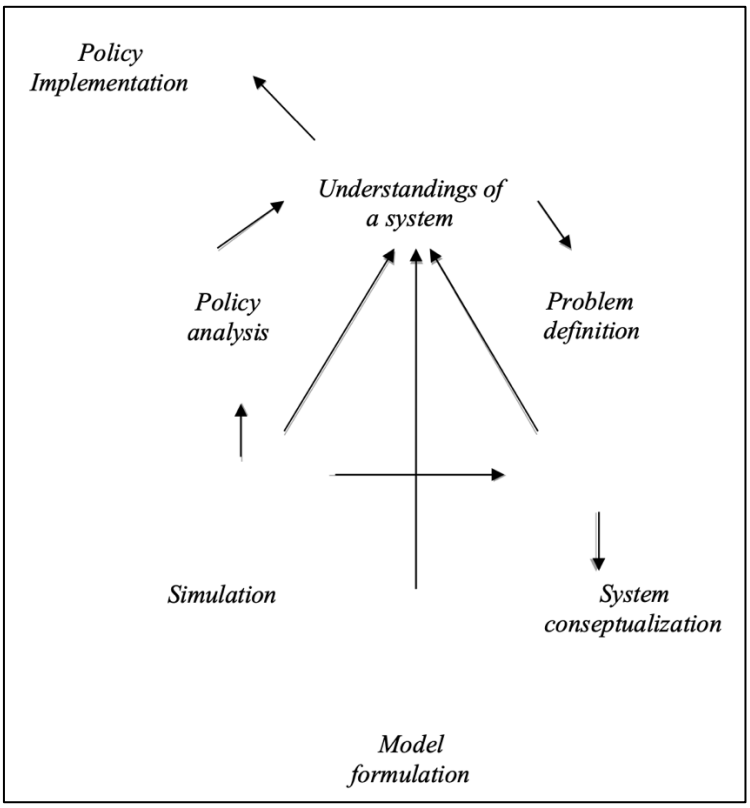

Figure 2. Dynamic Models Approach
Source: Richardson and Pugh (1997)

In the picture above, it can be seen that the dynamic systems approach is used to solve complex problems and has a focus on getting feedback and going through seven stages in solving the policy problem approach that will be created. In many policy formulations, developing countries usually use dynamic models to find out the policy options that can be

implemented by developed countries and see the causality of several possible variables that can influence these policies.

3. Research Method

In this study, the data used were secondary, namely, the 2016 Input-Output table data obtained from the Central Bureau of Statistics of North Maluku Province and data on the realization of the North Maluku Province APBD. Static and dynamic economic impacts according to Presidential Regulation No. 55 of 2019 concerning the Acceleration of the Battery-Based Electric Motorized Vehicle (EV Battery) Program. The 2016 Input-Output table analysis method is iterated into the 2021 Input-output table to produce an updated Input-Output table (Dietzenbacher & Lahr, 2004).

I-O analysis which is also used to analyze planning, especially with the implementation of Presidential Regulation Number 55 of 2019 (Regulation of the President of the Republic of Indonesia, 2019) will certainly change good relations in the economy between industries in the North Maluku Province and between regions in Indonesia. This study uses an analysis of the I-O table and is formulated as follows (Luenberger & Ye, 2015):

$Zi = Mi + Xi = . . Wi + Yi$……..…… (1)
(marketing) (demand) (I =1,2,3,.)
The second equation will be derived in Table I:
$Xj = .. Xij + Vj = Uj + Vj$.....…… (2)
(j =1,2,3,….)

Information:
a. Equation (1) = balance of supply and demand.
b. Equation (2) = balance quantity of each factor of production with input prices added up with the added value of the related sector.

In this analysis stage, we will calculate the 3 types of impact as follows (BPS, 2016), namely backward impact, forward impact, and total impact. This study looks at static and dynamic economic impacts, whereas for static economic analysis, this analysis does not consider aspects of time so that it only takes a single variable and everything happens in a single time interval and there are 2 scenarios namely before the nickel downstream policy and after the nickel downstream policy scenario.

The amount of nickel reserves in North Maluku Province is 1.4 billion tons and according to Mckanzie (Zaidan, 2021), by 2030 nickel consumption will increase by 30 percent, therefore until 2030 nickel reserves in North Maluku Province which will be purified by 30% of the existing reserves. In the static economic impact analysis, there are 4 (four) dynamic economic impact analysis scenarios, where the first scenario is in the downstream policy to become an EV Battery, namely 10 percent of nickel consumption is made into an EV Battery product and 20 percent is still exported to other provinces, in the second scenario it is 20 percent of nickel consumption is downstreamed into EV battery products and 10 percent is exported to other provinces. In the third scenario, 30 percent of nickel consumption will be used as an EV battery product, and in the fourth scenario, 10

percent of the EV battery output will be downstreamed to the electric car ecosystem and 20 percent of the proceeds will be exported.

The scenario above was carried out based on several references according to the Directorate General of Mineral and Coal (2023), the reference price for nickel minerals in May 2023 is $23,278.57, and for an EV battery price of $13,500 which is marketed in the United States (Zaidan, 2021). The reference price for electric cars used in this study is the market price for electric cars that have entered Indonesia with the most affordable price for the public, namely IDR 243,000,000 with the Air EV type.

4. Result

The EV Battery sector has the same FLER and BLER numbers in scenarios one through three, namely for FLER of 1.02 and BLER of 18.50. A FLER result that is greater than 1 means that the EV Battery sector can add to the output of other sectors in an increase in the final demand of all sectors of 1.02 units and a BLER result that is greater than 1 means that the EV Battery sector has a high deployment power than the EV Battery sector. other economies which amounted to 18.50 (Ahuja et al., 2021). The results of scenario 4 show that downstream nickel commodities are used as two downstream product outputs, namely EV batteries and electric cars, indicating that these two commodities produce a FLER of 1.00, which means that the EV battery sector and electric vehicles do not affect output for an increase in demand for one unit in all economic sectors. In the BLER analysis, a result of 1.00 was also obtained in the EV battery and electric car sectors, which means that the distribution of these two commodities to the economic sector has the same average distribution.

Table 1. FLER and BLER Result Analysis

Sector	Scenario	FLER	BLER
Processing Industry	Scenario 1	5,22	1,39
	Scenario 2	5,04	1,39
	Scenario 3	5,04	1,39
	Scenario 4	2,65	1,13
EV Battery	Scenario 1	1,02	18,5
	Scenario 2	1,02	18,5
	Scenario 3	1,02	18,5
	Scenario 4	1,00	1,00
Wholesale and Retail Trade; Car and Motorcycle Repair	Scenario 1	14,45	4,65
	Scenario 2	14,29	4,65
	Scenario 3	14,29	4,65
	Scenario 4	9,11	1,15
Electric Vehicle	Scenario 1	-	-
	Scenario 2	-	-
	Scenario 3	-	-
	Scenario 4	1,00	1,00

When viewed from the backward linkage analysis, scenarios one to three have better backward linkage than the fourth scenario and the results of this analysis also occur in the forward linkage analysis where forward linkage occurs best in scenarios one to three. In the fourth scenario, it can be seen that downstream nickel commodities into electric cars should

not be carried out in North Maluku Province because it has little forward and backward linkages to the economic sector in North Maluku Province, so it can be concluded that North Maluku Province is better off focusing on downstream nickel commodity into EV Battery products.

Wikarya (2023) also explains that in the 3 scenarios that are made the economic benefits of downstream nickel products carried out domestically provide significant benefits to the economy and letting all or part of the raw materials abroad will result in losses of income and job loss in the country.

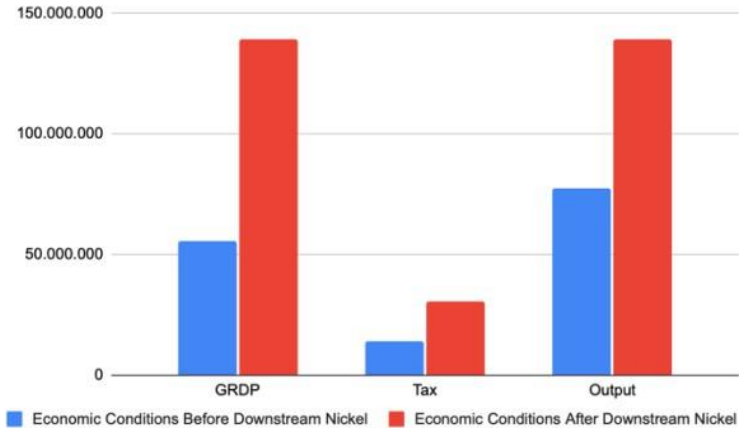

Figure 3. Static Economic Impact Analysis (million rupiah)

Analysis using the RAS was carried out to update the North Maluku Province input-output table for 2021 to describe the current economic situation of North Maluku Province. Based on the results of the analysis in (Table 2) it can be seen that the North Maluku Province's GRDP, Taxes, and Output experienced a significant increase. North Maluku Province's Gross Regional Domestic Product has experienced significant growth from 2016-2021, namely by 151 percent (BPS 2022a). in aggregate, the average economic growth for North Maluku Province grew by 25.17 percent and this was in line with North Maluku Province's growth in Q-2 2022 of 27.74 percent.

The tax revenue also shows that the increase in North Maluku Province's GRDP has also had a positive impact, with tax revenue growing by 139 percent in the last six years. The output generated from various economic sectors of North Maluku Province has also experienced a significant increase, although not in triple digits such as GRDP and tax growth, it has been noted that due to nickel mineral downstream activities, there has been an increase in output of 80 percent in the last six years.

Table 2. Dynamic Economic Impact Analysis (million rupiah)

Scenario	GRDP	Tax	Output
Scenario 1	-8.299.386,00	-3.214.268,00	-8.299.386,00
Scenario 2	0	-1.388.403,00	77.846,00
Scenario 3	-8.224.663,00	-3.197.829,00	-8.221.455,00
Scenario 4	66.385.651,00	13.216.440,00	66.385.651,00

In the analysis of the dynamic economic impact of the fourth scenario, results are obtained that have a good impact on the economy of North Maluku Province, because it has an impact on an increase in GRDP of IDR 6,638,5651,000, an increase in tax revenue of

IDR 13,216,440,000, and an increase in output of IDR 6,385,651,000. Therefore, the fourth scenario is the main option that must be implemented by the North Maluku Provincial Government because it has a significant impact on the economy in North Maluku Province, namely 10 percent of nickel reserves can be downstreamed into an electric car ecosystem and 20 percent used as an EV Battery.

Table 3. Results of Analysis of Output Multiplier and Income Multiplier

Sector	2022		Scenario 1		Scenario 2	
	Income Multiplier	**Output Multiplier**	**Income Multiplier**	**Output Multiplier**	**Income Multiplier**	**Output Multiplier**
Mining and Excavation	1,15	2,30	1,15	0,67	1,15	0,73
Processing Industry	28,76	57,33	37,34	0,67	32,99	0,73
Wholesale and Retail Trade; Car; and Motorcycle Repair	4,27	8,51	1,61	0,84	4,28	8,52

Sector	Scenario 3		Scenario 4	
	Income Multiplier	**Output Multiplier**	**Income Multiplier**	**Output Multiplier**
Mining and Excavation	1,15	0,91	1,15	0,91
Processing Industry	28,76	0,91	28,76	0,91
Wholesale and Retail Trade; Car; and Motorcycle Repair	4,27	8,50	4,27	8,50

Source: data processed

The income multiplier in this study is best in scenario four, namely for the processing industry and wholesale and retail trade; car and motorcycle repairs will have a significant impact on the regional economy of North Maluku Province but will not have a positive impact on the mining and quarrying sector. In terms of output multiplier, the best results for the downstream stage have a good impact on scenario 3, even better without a downstream policy scheme.

5. Discussion

Based on the results of the backward linkage and forward linkage analysis, scenarios one through three are the best scenarios that can be implemented in nickel downstream policies in North Maluku Province. The results of the static economic analysis showed a significant increase in the economy of North Maluku Province after the downstream nickel policy was implemented in Indonesia, namely from 2016 to 2021 after updating the I-O table data for North Maluku Province in 2016 to the I-O table in 2021 using the RAS method then GRDP managed to grow by 151 percent, tax revenues grew by 139 percent, and output grew by 80 percent.

In the results of the dynamic economic analysis, it can be concluded that the fourth scenario, namely 10 percent of North Maluku Province's nickel reserves, is used to

downstream the electric car ecosystem and 20 percent to become an EV Battery is the best scenario that the Government can implement. The significant impact on the regional economy of North Maluku Province can be proven by the increase in GRDP of IDR 6,638,5651,000, an increase in tax revenues of IDR 13,216,440,000, and an increase in output of IDR 6,385,651,000. The results of this economic and dynamic analysis follow research (BPS, 2016) where downstream also impacts North Maluku Province's regional economy. In income multiplier analysis, the fourth scenario is the best scenario to increase people's income and the third scenario output multiplier is the best scenario that can be implemented so that an output multiplier occurs.

5. Conclusion and Recommendation

Based on the results of this analysis, the results of scenario four, namely 10 percent of nickel reserves into an electric car downstream ecosystem and 20 percent produced into EV Batteries, are policy scenarios that the Government can see because they have a positive impact on the regional economy in North Maluku ProvinceBased on the results of this study, there are theoretical and practical implications as follows: 1) In theory, initially, the downstream policy was considered to provide an economic surplus in all scenarios but this was not proven in the scenario with small downstream nickel ore commodities because it offered little added value, and in the downstream scenario with large nickel ore commodities due to the influence of factors from negative externalities on economic activity. 2) Practically, the results of this research become policy recommendations for the North Maluku Provincial Government to encourage downstream nickel commodity activities to form an electric vehicle ecosystem to obtain maximum GRDP, taxes, and output.

References

Ahuja, J., Dawson, L., & Lee, R. (2020). A circular economy for electric vehicle batteries: driving the change. *Journal of Property, Planning and Environmental Law*, *12*(3), 235–250. https://doi.org/10.1108/JPPEL-02-2020-0011

Andrews, T., & McCarthy, D. (2020). Resource management and sustainable mining. *Journal of Environmental Policy*, 18 (4), 123-135. https://doi.org/10.1016/j.jenvpol.2020.04.001

Halsmayer, V., & Hoover, K. D. (2016). Solow's Harrod: Transforming macroeconomic dynamics into a model of long-run growth. *European Journal of the History of Economic Thought*, *23*(4), 561–596. https://doi.org/10.1080/09672567.2014.1001763.

Badan Pusat Statistik. (2016). *Tabel Input-Output Indonesia 2016.*

Badan Pusat Statistik. (2022a). *Laju Pertumbuhan Produk Domestik Regional Bruto Provinsi Maluku Utara Menurut Pengeluaran Atas Dasar Harga Konstan 2010.*

Badan Pusat Statistik. (2022b). *Volume Ekspor*. Badan Pusat Statistik.

Bowles, S., & Gintis, H. (2000). Walrasian economics in retrospect. *Quarterly Journal of Economics*, *115*(4), 1411–1439. https://doi.org/10.1162/003355300555006 55

Dasgupta, P. (2021). *The economics of biodiversity*: The Dasgupta review. London: HM Treasury.

Dietzenbacher, E., & Lahr, M. (2004). *Wassily Leontief and Input-Output Economics*.

Cambridge University Press. https://doi.org/10.1017/CBO97805114935 22

Directorate General of Mineral and Coal (2023)

Fitriyani, A. D. (2022). *Hilirisasi Bahan Tambang: Sebuah Upaya Peningkatan Kesejahteraan Masyarakat*. Sekretariat Kabinet Republik Indonesia. https://setkab.go.id/hilirisasi-bahan-tambang-sebuah-upaya-peningkatan-kesejahteraan-masyarakat/

Groff, P.C. (1963). *Papers, ARL221, Blair-Caldwell African American Research Library Collection*, The Denver Public Library.

Gunningham, N. (2022). The social and environmental dimensions of mining. *Resource Economics Review*, 25 (1), 67-89. https://doi.org/10.1080/12345678.2022.1234567

Hilson, G., & McQuilken, J. (2020). Value addition in resource-dependent economies: Challenges and opportunities. *Resources Policy*, 65, 101-112. https://doi.org/10.1016/j.respol.2020.101112

Howlett, A. W. (2004). Review beyond good and evil in policy implementation: instrument mixes, implementation styles, and second generation theories of policy instrument choice. *Policy and Society*, 23(2):1-17. https://doi.org/10.1016/S1449-4035(04)70030-2

Luenberger, D. G., & Ye, Y. (2015). Linear and nonlinear programming international series in operations research & management science. *International Series in Operations Research & Management Science, 228.* https://doi.org/10.1007/978-3-319-18842-3

Mansur, A., & Syaifullah. (2019). Memantau risiko makro dan finansial di dalam perekonomian Indonesia. *Kajian Ekonomi Dan Keuangan, 2*(2),120–148. https://doi.org/10.31685/ kek.v2i2.302

Ministry of Energy and Mineral Resources. (2023). National mineral resource management report. Jakarta: Government of Indonesia. Retrieved from https://www.esdm.go.id

Ministry of Industry. (2023). Indonesia's mineral downstreaming roadmap. Jakarta: Government of Indonesia. Retrieved from https://www.kemenperin.go.id

Nugroho, A. S. (2022). Pembatasan sebagai solusi pelarangan ekspor bahan baku nikel: Studi kasus ekspor bahan baku nikel Indonesia. *Jurnal Perspetif dan Cukai*, 6(1), 98-113. https://doi.org/10.31092/jpbc.v6i1.1563

OECD. (2022). Natural resource management for sustainable development. Paris: OECD Publishing. Retrieved from https://www.oecd.org

Pearce, D. W., & Turner, R. K. (1990). *Economics of natural resources and the environment*. Baltimore: Johns Hopkins University Press.

Perman, R., Ma, Y., McGilvray, J., & Common, M. (2011). *Natural resource and environmental economics* (4th ed.). Harlow: Pearson Education.

Ramalan, S. (2021). Erick Thohir: Presiden Tolak Tandatangani Kesepakatan Supply Chain Tambang Negara G20. *IDX Channel*. https://www.idxchannel.com/ economics/erick-thohir-presiden-tolak-tandatangani-kesepakatan-supply-chain-tambang-negara-g20

Regulation of the President of the Republic of Indonesia (2019)

Richardson, G.P. & Pugh, A. (1997). Introduction to system dynamics modeling with DYNAMO. *Journal of the Operational Research Society*, 48(11), 1146. https://doi.org/10.1057/palgrave.jors.2600961

Smith, J., Brown, L., & Johnson, P. (2021). Sustainable mining practices in developing regions: Case studies from Southeast Asia. *Journal of Economic Development and Sustainability*, 15 (3), 45-62. https://doi.org/10.1016/j.jeds.2021.03.005

Widodo, T., Santoso, H., & Riyadi, B. (2021). The impact of mineral downstreaming on Indonesia's economic growth. *Journal of Southeast Asian Economics*, 28 (2), 85-98. https://doi.org/10.1016/j.jsae.2021.02.003.

Wikarya, U. (2019). *Efektifitas kebijakan hilirisasi minerba, dan transparansi tatakelola*. LPEM FEB UI. 15- 18. https://ekon.go.id/source/publikasi/14.03.2019-lpem-ui.pdf

World Bank. (2019). Managing mining revenues for economic growth. Washington, DC: World Bank. Retrieved from https://www.worldbank.org

Zaidan, M. (2021). Kajian bahan baku mineral nikel untuk baterai listrik di daerah Sulawesi Tenggara. *Jurnal Rekayasa ..... Pertambangan,*1(1), 132-135

https://maluku.bps.go.id