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EVALUATION OF THE EFFECTIVENESS OF GREEN ECONOMY POLICIES IN SMELTER FACTORY AREA: QUADRUPLE HELIX PRESPECTIVE

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Abstract:

The high demand for mining products and the need to increase economic value have led the government to build mineral processing plants (smelters) so that local residents can have opportunities to work and increase government revenue from the tax sector. However, few studies discuss the impact of smelter construction in Indonesia, especially from the perspectives of the government, society, employees, and academics. This aligns with the 2019-2024 Indonesia's government national research priorities (PRN), Sustainable Development Goals (SDGs), and the Ministry of Education and Culture's vision, which includes the flagship concept of independent learning (MBKM) and the Green Economy program. The urgency of this research stems from the conflicting interests of stakeholders, which can result in suboptimal implementation of the green economy. This can lead to issues such as economic disparities between employees and local communities, environmental damage, and uneven welfare levels. The aim of this study is to examine the effectiveness of the green economy model in the smelter areas from a quadruple helix perspective. The study employs a qualitative research method. The stages of this research are as follows: (i) observation and identification of potential respondents; (ii) preparing participant criteria and research indicators; (iii) data collection; (iv) identification and collection of qualitative data using an ethnographic approach; (v) compiling research results; (vi) compiling research outputs; (vii) reporting and monitoring and evaluation. The results show that the presence of PT Bumi Mineral Sulawesi has had a positive impact on creating jobs and reducing unemployment, as well as improving the local economy and the welfare of the community. However, to achieve inclusive sustainable development, we must address the challenges of equitable welfare distribution and environmental impacts.

Keywords:

Green Economy; Quadruple Helix, SDGS, Smelter; Sustainability.

Introduction

An industrial facility known as a smelter factory processes mineral ore into pure metals or alloys through smelting and refining processes. The government anticipates that the industrial development process will serve as a means to boost output, catering to both local and global demands while also enhancing the well-being of the surrounding community (Ferrannini et al., 2021). This will not only boost economic growth but also transform the economic structure by fostering greater community involvement, and also, equal employment opportunities for local people (Mehmood et al., 2024). The Indonesia's central government is taking steps to develop industrial areas, as outlined in Presidential Decree Number 41 of 1996, to encourage increased investment in the mining product processing industry sector and to provide legal certainty to mining companies. In the metal mineral mining industry, smelters are part of the production process. The new mining law, which requires mining companies to purify and process raw minerals before selling them abroad, coincided with the implementation of the smelter policy. Article 103 and Article 170 make it clear that anyone with a mining business permit (IUP) or a special business permit (including work contracts) must build a smelter (mineral processing and refining) factory in Indonesia within five years of the Minerba Law 2009 going into effect on January 12, 2009.

Various companies in Indonesia currently produce nickel, one of the primary metals listed in the Minister of Mining Regulation Number 7 of 2012, in the form of matte nickel, ferro-nickel, and nickel metal. Three companies in Indonesia, including PT. Bumi Mineral Sulawesi in Luwu Regency, South Sulawesi, have constructed smelters to transform raw nickel from their mining operations into semi-finished. Most mining and mineral company processing activities have a simultaneous impact on communities, as many of these communities depend on mining and smelting for their livelihood (Pradip et al., 2019). Mining production is an economic sector that has a significant impact on the environment, including deforestation, land damage, water and air pollution, and loss of biodiversity. However, no study has examined the effects of constructing smelter factories in Indonesia, particularly those that are in the early stages of operation. Therefore, many parties, including academics, are concerned about the potential positive impact of constructing a smelter factory on society as well as its potential impact on government revenues and environmental issues.

Literature Review

The resulting impact, whether it affects society or the environment, needs to be evaluated further so that it does not become an externality that is detrimental to the affected parties. The economic, social, and environmental impacts resulting from the presence of nickel processing smelters necessitate the use of an analytical tool, such as the quadruple helix model, to inform decisions and policies that align with the philosophy of sustainable development (Bartzas et al., 2021; Hanafi, 2024). In efforts to overcome the environmental challenges faced by the mining industry, the concept of the green economy becomes relevant and strategic. Green economy refers to an economic system that aims to reduce environmental risks and ecological scarcity (Gyimah et al., 2024). This transition to the newest energy sources, along with the

application of environmentally friendly technology and resource efficiency, aims to reduce negative impacts on the environment and improve overall socio-economic welfare. This research focuses on formulating a green economy policy model in the smelter factory area, employing qualitative methods and conducting interviews to supplement primary data.

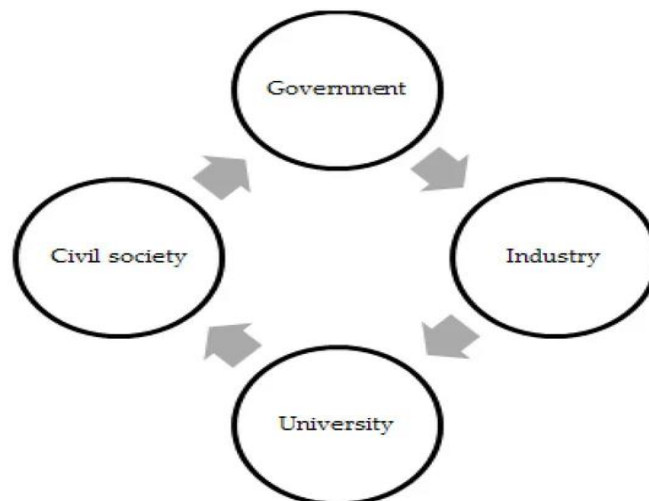


Figure 1 Quadruple Helix Models

Problem Solving Strategy:

1. Search for information about the impact of the existence of smelter companies and the role of local governments, especially the economic, social, and economic impacts, as well as environment through questionnaires and structured interviews using semi-open questionnaires.
2. Conduct in-depth information regarding the impact of the existence of smelter companies, especially those related to economic and social impacts, through observations and visits to company locations as well as focused discussions (FGD) with local communities, regional governments, village governments, academics, and factory employees.
3. Review the steps taken by the smelter company in dealing with economic, social, and environmental issues.
4. Formulate an adaptation strategy for the smelter company to have a positive impact on all parties.

State Of The Art And Novelty

The fundamental problem in several countries, including Indonesia, is how to build mining factories that are environmentally friendly and have a positive impact on the government, workers, and surrounding communities (Umar Mai et al., 2024). By focusing on the role of central government regulations in implementing green economy policy models in mining concession areas that are inclusive and sustainable, research makes a significant contribution in the era of transition toward a sustainable and environmentally friendly economy (Bhattacharyya & Shah, 2022). Regulations moderate the four main components of the quadruple helix models involved in this effort. Many previous studies have focused on developing the green economy concept, but there has been no research that specifically

highlights the collaboration of the 4 (four) main components in making the green economy a success in the smelter factory area. An overview of the research model and the novelty of this state-of-the-art research is presented below.

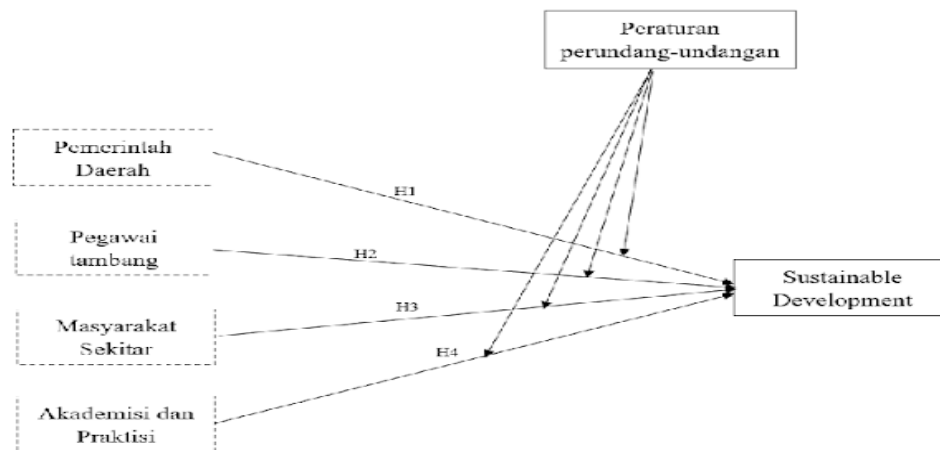


Figure 2. Basic Research Framework

Stakeholders will use the research results, both in theory and practice, to formulate policies regarding corporate sustainability. This research also offers a solution by providing a realistic picture of the field conditions related to the impact of a company's existence, both economically and socially.

The quadruple helix model describes the interaction among four main actors in innovation and economic development: government, industry, academia, and civil society ((Hutchings & Deegan, 2022; Marimuthu et al., 2022). This model evolved from the Triple Helix concept, which only involved the first three actors. The Quadruple Helix is a natural evolution of the Triple Helix concept, reflecting changes in global innovation dynamics (Carayannis et al., 2022; Mishra et al., 2023). They argue that the inclusion of civil society introduces a crucial new perspective, ensuring that innovation not only benefits the economy but also addresses social and ethical aspects. The addition of civil society in the quadruple helix expands the innovation perspective by incorporating the needs, aspirations, and participation of the public in the innovation process. Carayannis & Campbell (2009) highlight that the Quadruple Helix offers a more inclusive and democratic approach to innovation development. They assert that integrating civil society can produce more diverse and relevant solutions to societal needs, thereby creating more positive social impacts. The quadruple helix provides a more holistic framework for understanding and managing the innovation process. In the context of economic and social development, the involvement of civil society helps ensure that innovations that are developed truly benefit the broader community. This model also supports an inclusive and participatory approach to decision-making. Carayannis et al. (2020) argue that the quadruple helix opens new opportunities for broader collaboration between various sectors in addressing the complexities of today's global issues. They believe that involving civil society as an active partner in the innovation process can strengthen collective responses to social, economic, and environmental challenges.

Methods

This research was conducted in Luwu district (where the nickel ore processing factory is located) by PT. Sulawesi Mineral Earth. The data sources in this research are the government, communities around the factory, employees, and academics. The current study randomly selected 15 (fifteen) informants based on predetermined criteria, which included 10 (ten) local residents, 2 (two) government employees, 2 (two) employees, and 1 (one) academic who understood the concept of sustainable development for interviews (Cresswell & Cresswell, 2022).

Researchers prepare a research design so they can find answers to their research questions. (Junaidi, 2022; Podsakoff et al., 2003). This research uses a qualitative descriptive research design. Zabelina et al. (2023) states that qualitative descriptive research aims to describe and illustrate existing phenomena, both natural and human-engineered, with a focus on characteristics, quality, and interrelationships between activities. This research employs Miles and Huberman's interactive data analysis methodology. The population of this research includes the community surrounding the factory, the local government, and factory employees, totaling 150 individuals. However, the sample size is limited to 15 individuals who meet these criteria. The objectives of this research align with specific criteria for informants, which include the community, local government, and employees in the smelter factory area.

Data Analysis Techniques Researchers carry out data analysis techniques in three stages (Hair Jr et al., 2019), starting with data reduction, a selection process that focuses on simplifying, abstracting, and transforming raw data or rough data from written notes and field interviews. Researchers continuously carry out the data reduction process during research to generate the maximum amount of data possible. The second stage involves presenting the complex information in a systematic manner, making it more selective and simpler, and enabling researchers to draw conclusions and take action based on the data. This data presentation process equips researchers with simplified data and generates systematic information. The conclusion is the final step in the data analysis process. In this section, the researcher expresses conclusions from the data obtained from observations, interviews, and documentation. With the researcher's conclusions, it will feel perfect because the data produced is truly valid and optimal. This data checking technique was carried out in an effort to prove the suitability of research findings with reality in the field (Hutchings & Deegan, 2022). The researchers in this study employed triangulation techniques, which involve examining the accuracy of specific information using a variety of methods and data acquisition sources. We hope that by combining these various methods, we can produce knowledge that leads to accurate truth.

Research Results

Improving the Economy of Communities Around the Factory

Founded on October 27, 2014, PT Bumi Mineral Sulawesi is a private company specializing in mineral processing. This company is implementing a sustainable development plan in accordance with government policy to increase the added value of national mining export products. The company's commitment includes technology transfer and encouraging innovation in mineral processing technology, both in the upstream and downstream sectors. This is a career opportunity for people in Luwu Regency, especially in Bukit Harapan Village. An informant was interviewed about the number of residents who work at the company.

Previously, the majority of residents from Pasampang Hamlet and Bukit Indah Hamlet relied on farming as their primary source of income, leading to a high unemployment rate. However, following the establishment of PT BMS, approximately 95% of these residents now work for the company. On the other hand, in hamlets such as Minanga and Malenggang, the majority of residents continue to work as farmers, with a ratio of approximately 50:50 between workers in companies and those in plantations. This indicates a notable change in the local employment structure following the establishment of PT BMS.

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The interview results align with Marimuthu et al. (2022) research, which indicates that the village's smelter factory has positively impacted job creation for certain individuals. This has indirectly reduced the number of unemployed, improved local economic conditions, and increased the welfare of local communities. PT. Bumi Mineral Sulawesi, part of the KALLA business unit, focuses on nickel processing with two main smelters in Luwu Regency, South Sulawesi. The Ferro Nickel smelter is planned to start operating in Semester 1 of 2024 with a production target of 33,000 metric tonnes of nickel per year. Meanwhile, the Nickel Sulphate Battery Grade Smelter will commence operations in Semester 2 of 2024, aiming to produce 31,400 metric tonnes of nickel annually. An informant expressed that the presence of PT BMS is the main driver for improving the community's economy.

After the establishment of BMS, the community's economic life has improved, with a more stable income than before." The economy of the community around PT BMS has experienced a significant improvement. Many residents are able to build houses and open small businesses. The large number of residents employed at PT BMS contributes to the increased speed of money circulation in the community surrounding the factory. This has a positive impact on the local economy, opening up jobs and generating MSMEs around the factory. Research by Vanpoucke and Klassen (2024) shows that the construction of a smelter factory has a significant positive impact on the local economy. This development not only improves the regional economy but also creates thousands of new jobs. Increasing the purchasing power of local communities shows that investment in mineral processing infrastructure can bring broad economic benefits to surrounding communities. Overall, the presence of PT BMS not only brings direct economic benefits through job creation and increased income but also influences local communities positively through the development of economic and social infrastructure around the factory.

Corporate Governance and Social Responsibility towards Human Resources

In its production process, PT Bumi Mineral Sulawesi applies the Eco-Green process by using a hydroelectric power plant from Malea Energy to produce green energy with minimal pollution. Almost 80% of PT Bumi Mineral Sulawesi uses local workers. PT BMS actively recruits workers from the surrounding area, with the majority of workers coming from the local

area. This aims to improve the welfare of local communities and reduce unemployment levels. The informant provided us with the following information:

"PT BMS is highly transparent in disseminating information about employment opportunities to the village government." The village government places a high priority on employment opportunities for local residents." PT BMS's commitment to corporate social responsibility is evident in the various programs and initiatives it implements to support local communities. Based on information from sources:

"PT BMS has contributed to the construction of public facilities such as mosques, sports fields, and road repairs. This helps improve the quality of life in local communities and supports their daily activities. The company also provides assistance when disasters occur, such as landslides, as well as contributions in the form of tools—tools and facilities needed by the community. This assistance shows PT BMS's concern for the welfare of the surrounding community."

PT BMS also strives to minimize negative impacts on the environment through collaboration with the Environmental Service and the application of environmentally friendly technologies in company operations. Liu et al. (2024) conducted research, emphasizing the importance of revitalizing the environment sustainability (AMDAL) mechanism to enhance its effectiveness and comprehensiveness in environmental management. Thus, to achieve successful environmental management, Indonesia needs to update and strengthen its AMDAL process to better address complex environmental challenges. The following are the results of an interview with one of the informants:

"Until now, the company has not had any negative environmental impact because it is still in the productivity stage and consistently collaborates with the Environmental Service to monitor environmental impacts." Since PT BMS does not generate B3 waste, it can utilize the waste from nickel production to manufacture concrete pavers, a process that is currently underway. Analysis and experimentation will also contribute to future innovation in this field. The AMDAL does not seem to have a significant environmental impact due to its non-mining operations. Minimal environmental damage will undoubtedly follow economic improvements." However, some individuals persist in their belief that the BMS's CSR program is not optimal. Junaidi et al. (2020) conducted research that identifies three primary environmental pollution issues: air pollution from factories and vehicles, vehicle noise, and waste accumulation on roadsides and rivers. Mining activities also cause marine pollution, such as sedimentation and decreased water quality.

"BMS's CSR program remains minimal and lacks direct improvements, yet it makes several contributions, including providing aid for tools and constructing public facilities like mosques and sports fields." The village government better manages the CSR program to ensure its benefits for the local community. Thus, while PT BMS has achieved a number of achievements in governance and corporate social responsibility, there is still room for further improvement and development in their efforts to support sustainable development and the welfare of local communities.

Level of Welfare and Social Equality in the Area Around the Factory

In Luwu Regency, South Sulawesi, the presence of PT BMS has brought significant changes in the level of welfare and social equality of the local community. As part of the KALLA

business unit, PT BMS is committed to not only operating in the nickel processing industry but also paying attention to the social and economic impacts it has on the communities around its factories. The industrial sector plays an important role in the national economy by increasing state income and creating business opportunities that contribute positively to efforts to equalize society's welfare. The nickel smelter industry, with its presence, is a driver of regional growth and development as well as economic activity for local residents. This reflects the increase in community welfare in line with the development of the smelter industry (Marimuthu et al., 2022). Information obtained from informants is as follows:

"PT BMS is a professional organization that fulfills employee rights, including salaries, protections, and insurance guarantees." There are no delays in the payment of employee rights. PT BMS also pays attention to employee welfare by providing salaries in accordance with government regulations. PT BMS consistently upholds employee rights, providing insurance guarantees and other forms of protection to ensure their safety while working.

However, challenges to equalizing welfare and social equality are still a major concern. Classically, Zabel et al. (2024) has noted that when there is a large increase in trade and production, there is often also a large increase in the level of human suffering. This shows that economic growth does not always guarantee equal social justice. An informant expressed the following opinion:

"The presence of PT BMS has reduced the unemployment rate in Bukit Harapan, with 90% of residents already working for the company. However, people perceive an uneven increase in community welfare. Family prosperity is still uneven, and some households have multiple BMS workers while others do not. Farmers' lives have not significantly changed since the establishment of BMS, with farming continuing as usual and unaffected by BMS activities.

Thus, while PT BMS has made a positive contribution to economic prosperity and social equality around its factories, there are still challenges that need to be overcome to ensure that all levels of society can benefit fairly and sustainably from the presence of this company.

Positive Impact for Government from Companies

Maintaining a positive relationship between the village government and PT BMS is crucial for the community to equally benefit from the company's positive impact. De Klerk and Swart (2023) conducted research that demonstrates the success of nickel mining companies in creating new jobs and absorbing labor from local communities. In addition, the presence of a nickel mining company enhances the welfare of the local community, particularly for its employees. We have gathered the following information from sources:

"The relationship between the village government and PT BMS has so far been very good. The two parties maintain open coordination, particularly when it comes to BMS's assistance to the local community. The village government consistently participates in various activities and considers the village head's views when making decisions that affect the public.

The presence of PT Bumi Mineral Sulawesi in Bukit Harapan Village, Luwu Regency, has also encouraged many families to send their children to college. Junaidi et al. (2020) emphasized that education is very important in human life, especially getting a job. The higher a person's education, the greater the opportunity to get a higher salary and a better position in the

company. Other research by Liu et al. (2024) and Obeidat et al. (2023) concluded that education helps increase society's positive view of environmental projects and programs. People who are more educated tend to be more aware and competent in understanding environmental problems. One informant stated:

"Make sure to pursue education now so that you are ready to join and meet the requirements to work at PT Bumi Mineral Sulawesi (BMS) after completing your education later. People strive to send their children to school.

Overall, the presence of PT BMS not only provides economic benefits through job creation and increased income but also improves the quality of education and strengthens partnerships with local governments. This proves that collaboration between the private sector and local government can have a significant positive impact on social and economic development in local communities.

Conclusion

PT Bumi Mineral Sulawesi (BMS), as a private mineral processing company operating in Luwu Regency, South Sulawesi, has a significant positive impact on the economy and welfare of the surrounding community. The establishment of PT BMS has created significant new jobs for local residents, reduced the unemployment rate, and increased the income and economic conditions of the community. Local residents directly witness this, with the majority transitioning from farming to working for this company. The factory's improved economic and social infrastructure, such as the construction of public facilities and support for education, demonstrates this positive impact. However, we still need to address challenges like inequality in the absorption of economic and social benefits to ensure that all communities benefit equally. Polanyi's classical theory aligns with the finding that economic growth does not always lead to fair social equality. In addition, the positive relationship between PT BMS and the village government, along with the company's dedication to social and environmental responsibility, play a crucial role in guaranteeing the ongoing benefits of this company. Support for employee education and welfare is also part of the company's efforts to improve local social and economic conditions. Overall, the presence of PT BMS in Luwu Regency not only reflects regional economic growth through the nickel smelter industry but also provides an example of successful collaboration between the private sector and local government for sustainable and inclusive development.

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