



ANALYZING ECOLOGICAL MODERNIZATION PROCESS AND ITS EFFECTS ON THE COMMUNITY NEAR THE COMPANY: CASE STUDY VALE INDONESIA TBK.

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Abstract

Implementing ecological modernization in companies is very important in achieving community welfare. However, ecological modernization only impacts the community around the company's environment. This research explores the process of ecological modernization and its impact on the community surrounding the company. A qualitative research design was used, involving 16 participants from various professional backgrounds related to the company. We focus on PT. Vale Indonesia's activities as an object of research. Interviews, observations, and focus group discussions (FGD) were used to collect data. We analyze data by condensing, displaying, and drawing conclusions. The validity of the data was tested by extending observations, research accuracy, and triangulation of sources, techniques, and time. The research findings show that PT. Vale Indonesia is developing a green energy system as part of an ecological modernization effort to overcome expensive production and reduce the negative impact of the raw material crisis. Societies are also experiencing the effects of ecological modernization at the physical, emotional, and social levels.

Keywords: Ecological Modernization, Risk Society, Disaster, DAM, Renewable Energy.

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1. Introduction

It is possible to determine the essence of policy sustainability by identifying specific issues. Environmental issues are the most essential of all concerns. Initially, environmental issues were viewed as ad hoc or exposure issues requiring corrective action. At the end of the 1980s, the realisation that the environment is a structural problem led to the emergence of an environmental discourse known as "ecological modernisation" (Hajer, 1995; Murphy, 2000; Buttel). Ecological modernisation presupposes that extant environmental issues can be internalised by political, economic, and social institutions and that their sustainability can be maintained.

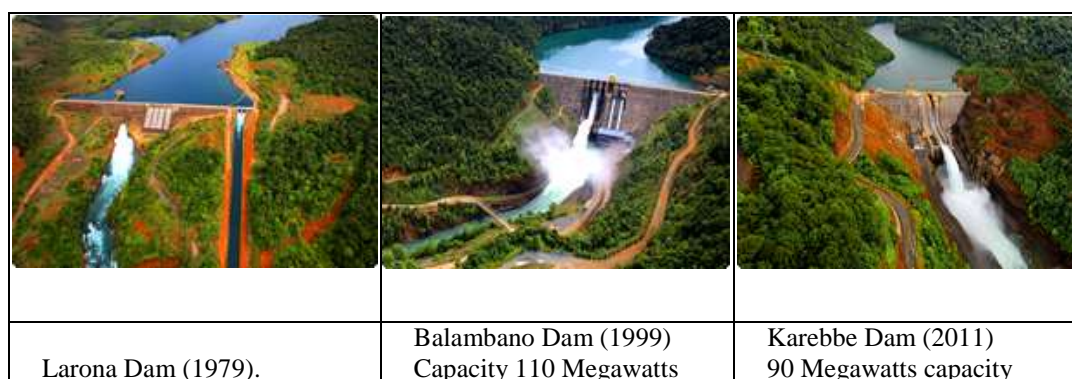
Ecological modernisation can be used to pursue a policy climate for environmental sustainability. This can result in a greater impact of science and a diminished impact of legislative and regulatory systems on policy climates (Murphy & Gouldson, 2000; Berger et al., 2001; Reiche, 2010). In management, understanding can replace coercion. Thus, environmental sustainability has specific policy climate dimensions that are essential to consider when transitioning to policy evaluation (Chang et al., 2016; Rogge et al., 2017; Rock et al., 2021).

Modernization that will continue to develop in companies worldwide will continue. One of the results of modernization is marked by the emergence of sophisticated technology to date. In the era of globalization, technology has emerged in many companies. Company modernization is crucial in achieving social welfare (Mol, 2002; Bidone, 2022; Xie et al., 2022). Modernization is developing and improving systems, technology, and production processes to increase efficiency, productivity, and product quality. Modernization focuses on the use of more sophisticated and innovative technologies, as well as more efficient and environmentally friendly practices (Howes et al., 2010; Curran, 2019; Liao et al., 2023).

Modernization also aims to mitigate energy resource problems. Technology that is more efficient in energy use can help companies reduce their energy

consumption, thereby reducing production costs and helping to mitigate the problem of shortage of energy resources. For example, by using production machines that are more energy efficient or by improving building insulation to reduce energy leakage (Siciliano et al., 2015; Allen & Vallee_Tourangeau, 2016; Mayeda & Boyd, 2020). PT Vale, a company operating in Indonesia, is working on modernizing its operations by adopting renewable energy sources, particularly Hydroelectric Power Plants (*PLTA*). Changes in energy sources especially encourage implementing modernization activities within a company. This study describes PT. Vale's efforts to modernize hydropower (Siciliano et al., 2015; Yu & Xu, 2016; Blake & Barney, 2018). The existence of a dam in the PT. Vale can increase the organization's annual nickel production output (Mettetal, 2019; Pan & Hong, 2022; Rullisa et al., 2022). In addition, hydropower can increase production cost-effectiveness by reducing carbon emissions that affect the surrounding ecosystem (Yu & Xu, 2016; Duru & Therond, 2015). However, hydropower can hurt local communities living around the dam (Von Sperling, 2012; Siciliano et al., 2015; Moran et al., 2018). Instances of dam failures leading to catastrophic flooding have been documented (Burrier & Hultquist, 2019; Ward et al., 2020; Yang et al., 2020). Therefore, it is essential to anticipate this risk in advance.

The potential hazards associated with hydroelectric dams are an essential component of ecological modernization. Corporations face unfavorable public opinion due to problems caused by dams (Curan, 2019; Sehnem et al., 2021; Agyabeng-Mensah et al., 2021). Inundation due to floods impacts the plantation, agriculture, and settlement sectors. The main concern arising from the disaster is the potential for disruption to the community's primary source of livelihood (Yang et al., 2019; Cheng et al., 2022; Huang et al., 2023). Despite this, the organization failed to provide a detailed explanation of mitigating risks and addressing potential harm from its operations. Figure 1 depicts hydroelectric dams in Indonesia that are under company management.



| | | |
|------------------------|--|--|
| Capacity 165 Megawatts | | |
|------------------------|--|--|

Figure 1. PT. Vale Hydroelectric Dam

The potential harm these dams pose has forced companies to reassess the consequences of their operations. In this regard, there appears to be a decrease in the consideration given to the impacts associated with dam construction (Blake & Barney, 2018; Yavaşoğlu et al., 2018; Konakoglu et al., 2020). Economic factors are often considered the standard for evaluating risk, resulting in reduced awareness of society's enduring issues (Burrier et al., 2019; Ward et al., 2020; Celik & Gul, 2021). The lack of public awareness about efforts to increase empowerment and welfare while mitigating the risks associated with company operations requires special attention.

Consequently, the challenges that arise from ecological modernization provide society with a framework for dealing with disaster hazards. Previous studies need a comprehensive record of the risk management strategies used in ecological modernization. Therefore, this study provides a new descriptive picture of the risk community in ecological modernization, especially those supervised by PT. Vale. This study describes the formulation of the problem as follows.

This study makes a scientific contribution to social construction, ecological modernization, and control strategies to address hydropower development's physical, social, and mental risks. In addition, the findings from this research can form the basis for assessing companies, government agencies, and community leaders, enabling them to ensure the provision of reliable solutions to the physical, social, and psychological risks facing society. The results of this investigation can serve as a vehicle for disseminating information to the public regarding the beneficial and unfavorable consequences of corporate ecological modernization efforts.

2. Methods

To answer the research questions, we use qualitative methods and a descriptive approach to describe the processes and impacts of ecological modernization on the communities around PT. Vale Indonesia. In this regard, we describe the empirical data obtained through fieldwork and explain the social phenomena associated with ecological modernization. The data in this study include primary data and secondary data. Primary data was obtained through interviews, observation, and Focus Group Discussion (FGD). We interviewed several community members, local government officials, and representatives from PT. Vale. This study examines community activities and phenomena, focusing on the process of ecological modernization and its impact on society. In addition, the discourse used by the company is also analyzed.

Research data is also obtained through the collection of documents that strengthen an understanding of the dangers of ecological modernization and its social implications. These documents may include emergency response plans, disaster compensation records, and population documentation. Data analysis is carried out while being collected and after a predetermined amount of time has passed, including data collection, reduction, display, and conclusions.

3. Results and Discussion

1. Ecological Modernization Process

PT Vale Indonesia's mission is to be a leading natural resources company in Indonesia, using global standards to create long-term value through superior performance and consideration for people and the environment. This vision is realized by transforming natural resources into community prosperity and sustainable growth.

The company continues to modernize processes and technologies based on sustainability for optimal results. As a result of the mining industry's operation, many workers are exposed to the hazards of significant environmental changes. In 1976, about 11,000 people participated in constructing the *Larona mine and dam*. Likewise, in 1999, many parties contributed to the construction of the *Balambano Dam*. All of them involve many individuals and inevitably affect the environment. AM, a civil engineer for hydro dams at PT. Vale Indonesia acknowledges as follows.

“For a long time, corporations have planned that future growth will be supported by hydroelectric power plants or dams. Since the dam was the primary source of electricity, factories were built beside the dam from the start. Likewise, the main objective of constructing the Balambano to Karebbe Dam is to increase nickel production in an economical and environmentally friendly way.

The interview explained that the dam had been under construction for a long time, starting in 1979. The Larona Dam was initially built, followed by the Balambano Dam in 1999 and the Karebbe Dam in 2011. The construction of this dam was mainly aimed at increasing nickel production and developing a sustainable energy source with an impact on minimal ecology. The previous efforts were strategic steps to strengthen the organization's vision and mission regarding sustainability. The company has optimized the use of renewable energy to ensure the sustainability of PT. Vale in the present and the future. AM further disclosed that:

“The organization is consistently improving its operations. The company continues to monitor

technological advances, domestic and global policies regarding nickel production, and the potential for the evolution of the company structure in the coming years. Another important aspect to consider is the need for cost-effectiveness in production while focusing on mitigating environmental damage. Achieving a balance between the production process and results is very important. Undoubtedly, technological advances occur every year, requiring increased sophistication.”

AM reports that the company continues to engage in sustainable innovation discourse by increasing its capacity and quality to address environmental issues. Additionally, the organization seeks to promote cost-effective mining operations while maximizing nickel production. Technology must be updated and comply with relevant policies, necessitating organization modernization.

The company's longevity of 53 years can be attributed to its adherence to sustainability principles, which include economic, environmental, and social dimensions. PT. Vale is dedicated to achieving sustainable development goals (SDGs) through implementing environmentally and socially responsible mining operations. The organization implements modernization initiatives to improve production systems and environmental sustainability. The modernization was carried out to overcome the shortcomings of the previous traditional system, which was considered financially unhealthy and environmentally unsustainable. Consistent with this, the informant, identified as S, articulated the following statement.

“With the emergence of this discourse, many interactions have taken place between the government and corporations, corporations and community leaders, communities and governments, and within society itself. The community shows advantages and disadvantages. However, a consensus was eventually reached through mutual agreement”.

The interview highlighted various dynamics in the community related to the construction of these dams. Interrelated concerns include interactions between government and companies, companies and local

communities, adversarial relations between communities and governments, and intra-community dynamics. However, according to information from informant S, all problems were resolved through mutually beneficial agreements. In particular, there is involvement from individuals who wield significant societal influence, including community leaders and political figures.

Furthermore, the informant's AM and S as employees of PT. Vale Indonesia provides additional information about the company's production:

“This company fulfills 5% of global nickel demand. Seventy-five thousand tons of nickel matte are produced annually. Despite having many goals, the company still maintains its commitment to preserving the environment. This commitment is in line with the director's message that the company must make every effort to avoid negative impacts inside and outside the operational location” (Interview, 09/2022).

PT Vale Indonesia personnel confirmed that their organization has a significant influence up to 5% on nickel supplies worldwide. The company produces 75,000 tons of matte nickel per year. This goal motivates corporations to continue boosting output and exploring new energy options to boost nickel production. According to the informant, despite this goal, the corporation continues to consider the impact of its operations. It makes measures to mitigate unfavorable effects within and outside its operational area.

Next, we conducted an in-depth Focus Group Discussion (FGD) with representatives from PT. Vale Indonesia. The discussion mainly relates to the ecological modernization process carried out by the company and the impact of this process on the company and the community around the dam construction site. The FGD findings show that dam construction has a significant adverse impact on business and the environment. Management of dams used to be traditional and far from human settlements. However, populations closer to dam conditions increase the risks and threats. Therefore, corporations use geotechnical monitoring systems to monitor dam activity.



Figure 4. Dam Geotechnology Monitoring System

Figure 4 illustrates the direct and indirect monitoring of dam activities. Continuous monitoring of PT Vale's three dams is carried out 24 hours using the latest technology system. The operation of this dam involves a series of procedures aimed at achieving sustainable nickel production using renewable energy sources.

The findings of this investigation indicate that the dam construction process was a deliberate strategy by PT. Vale implements to modernize energy infrastructure. The company built the *Larona Dam* in 1979 and rebuilt the *Balambano Dam* about two decades later in 1999. The company resumed *Karebbe Dam* construction in 2011 after a hiatus of 12 years. The description above demonstrates the company's ongoing efforts to apply ecological and technological advances to sustain its mining operations over time.

2. Ecological Modernization Impacts Companies and Society

Internal factors, such as company actions, and external factors, such as government policies and community dynamics, influence company operations. The parties involved acknowledge the ecological modernization carried out by PT. Vale has created unforeseen risks of unknown impact on the people of Laskap Village, the government, and the company. However, the organization has assessed the implications of its ecological modernization.

The process of ecological modernization, exemplified by the construction of the *Karebbe Dam*, is considered a safe endeavor by various community leaders, including at the village and district government levels. The community widely accepted and supported this information because the dam's construction was considered to have very positive results. Hence, individuals fail to consider the potential for adverse long-term outcomes and focus only on immediate benefits.

The focus group discussions (FGD) results explained that constructing a dam benefits youth, couples, and households in the nearest area because it provides jobs. However, after the implementation

of the dam, many new problems emerged that needed solving. Building the *Karebbe Dam* (ecological modernization) requires accountability from all parties involved regarding the well-being of the individuals affected by the project.

The discussion above strengthens the research findings that incidents have befallen the *Laskap Village community*. Most of these problems are new difficulties that have arisen after the operation of the *Karebbe dam*. Affected communities require resolution from relevant stakeholders. The events above have created problems that pose real dangers, including damage to river embankments, damage to agriculture/plantations due to flooding, and flooding of human settlements. In addition to physical events, social problems also cause disruption or loss of individual sources of livelihood, confiscation of arable land, the need for land compensation, stoppage of work, and disruption of routine activities. Individuals may also experience psychological stress, such as fear of river erosion, constant anxiety, and stress stemming from the loss of their means of livelihood. The next segment describes the physical, social, and physiological consequences caused by dam construction.

a. Physical Risk

In the early stages of the construction of the *Karebbe Dam*, the local people who owned the land around the dam site put up a fight. The refusal was related to the land acquisition that *Laskap Village residents* were working on without compensation. In the early stages of the construction of the *Karebbe Dam*, several arable lands belonging to the local community were identified as designated areas for dam construction. During that period, several circumstances arose whereby particular residents in *Laskap Village* demanded compensation for owning arable land. During that period, the community believed they had rights over the land they had used for a long time for fruit plantations, rattan cultivation, and serving as burial sites, including ancestral graves. PT. Vale Indonesia recognizes the problems mentioned above and faces challenges in

providing compensation for the area's designation as a protected forest area. In addition, the community still needs proof of land ownership. Many community members started cultivation activities

prior to the compensation process to receive compensation. Figure 5 depicts a map of the flood hazard and evacuation locations in Laskap Village.

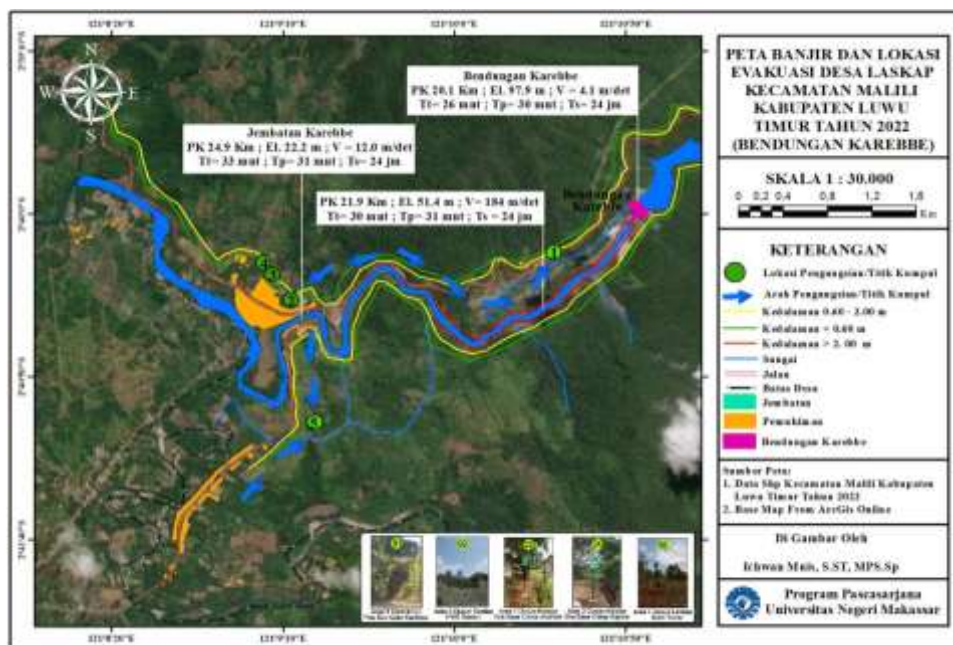


Figure 5. Map of Flood Hazard and Evacuation Locations

According to Figure 5, the existence of a dam creates a new hazard in the form of significant flooding due to potential damage to the dam. The emergence of this potential disaster is an urgent matter for the

community, authorities, and residents of *Laskap Village*. According to the flood map, certain conditions associated with the *Karebbe Dam* have been identified as a source of public concern.

Table 3. Time of Arrival of the Flood

| Number | Flood-affected Areas | | Flood Arrival Time | Population | | Flood Receding Time (hour) |
|--------|----------------------|--------------|--------------------|------------|------------------|----------------------------|
| | Village | Sub-District | | (life) | (Head of Family) | |
| 1 | Laskap Village | Malili | 30 minutes | 1.871 | 428 | 24 hours |
| 2 | Pongkeru Village | Malili | 35 minutes | 1.807 | 467 | 24 hours |
| 3 | Pasi pasi Village | Malili | 45 minutes | 1.189 | 285 | 24 hours |
| 4 | Puncak Indah Village | Malili | 50 minutes | 5.477 | 1.192 | 24 hours |
| 5 | Malili Village | Malili | 70 minutes | 4.390 | 1.071 | 24 hours |
| 6 | Baruga Village | Malili | 75 minutes | 3.257 | 1.862 | 24 hours |
| 7 | Wewangriu Village | Malili | 50 minutes | 3.038 | 745 | 24 hours |
| 8 | Balantang Village | Malili | 90 minutes | 2.234 | 602 | 24 hours |
| TOTAL | | | | 23.263 | 6.652 | |

Source: PT. Vale Indonesia, 2022

Even though it has not yet been breached, the dam remains a potential hazard for the surrounding community. The people wished this disaster would not happen in their lifetime, despite the endless possibility of the dam bursting. Even so, the community has felt a physical impact from the dam's existence. According to HZ,

“Currently, the community is constantly in trouble due to frequent small earthquakes and floods. In the past, floods were not as frequent as they are now. Previously, the inundation had receded within a few hours. However, current flooding is difficult to predict because it is usually caused by a sudden spill of water (the mouth of the dam opens), especially when heavy rainfall occurs upstream. In addition, the tides in the Karebbe and Pongkeru rivers caused

the inundation to recede within a week. The community has often felt small disasters like that. Homes, farm fields, and community gardens are often affected.”

Interviews with HZ revealed that historical examples of flooding depended on specific circumstances that contrasted sharply with current conditions. Historically, flooding events have been observed to coincide with periods of prolonged and

tidal rainfall in *the Karebbe and Southeast Rivers*. The floods that occurred during this period followed the natural water cycle. If the river water recedes, the flood water disappears by itself. Current conditions are different from the scenario above, where rainfall upstream can cause flooding in Laskap village. If the mouth of the dam opens, flooding can occur, which is an inevitable dam safety measure.



Figure 6. Flood in Laskap Village

Source: Laskap Village, 2022

PT. Vale Indonesia built an accountability system by building several water control gates to regulate water flow to the community's rice fields and plantations in response to previous physical incidents. Changes in river water can have beneficial and detrimental consequences, especially for the agricultural and rice cultivation industries. The failure of community agriculture can be attributed to flood conditions that appear unexpectedly as a result of the release of the dam. There may be more viable solutions than the production of water control gates to the problems faced by the community. According to informants, using the sluice system is a challenge for farmers engaged in agriculture and rice fields because the water regulation mechanism is still manual and relies on human power. This situation is very concerning and endangers the community's welfare, especially if PT. Vale and the government need help to manage it effectively.

b. Social Risk

To ensure corporate sustainability, the drive to modernize the industry has been identified as a contributing factor to the emergence of social risks. PT. Vale Indonesia seeks to overcome the problem of non-renewable energy by exploring the potential of renewable energy sources. On the other hand, PT. Vale has introduced a new danger previously unknown to the locals. According to MCNs: “Because of its location close to the dam, Laskap Village is one of the target villages to create a disaster preparedness village. Among all villages,

this village faces the greatest risk of natural disasters. In the past, we weren't worried because the water level was normal and it rarely flooded; the dam is far. But now, (we) have to be vigilant because floods have affected settlements and agriculture even though they were not caused by the dam breaking. We met with representatives from Vale many times and participated in various disaster mitigation activities. Due to its proximity to riverside settlements, Laskap village is likely to be badly affected. This threatening condition started when the dam started operating.”

In the early stages of dam construction planning, licensing dynamics were discovered. However, an agreement was eventually reached, which allowed the continuation of the dam's construction to its operation. The community faces the natural consequences of the dam, which has disrupted or potentially stopped individual livelihoods, especially in the agricultural and plantation industries. The results of the interviews and documentation revealed details of the community's losses which resulted in compensation made by PT. Vale Indonesia.

Repeated inundation conditions significantly hampered the livelihoods of the farmers. The above conditions significantly affect the income and livelihood of the farmers who live in *Laskap Village*. The cultivation of food crops in the village is experiencing uncertainty due to unpredictable floods, which constantly threaten rice fields. The remuneration provided by the organization in response to flood damage needed to be more

adequate than the resources expended. The community hopes that any floods that cause damage should be attributed to the company, considering that the rice fields serve as a primary source of livelihood for Mr. J and his family. One of the causes of the lack of public awareness is the frequent occurrence of similar incidents in *Laskap Village*. Communities often believe they bear responsibility for addressing their problems, given the significant lack of attention paid by government entities and companies to the well-being of those affected.

Agriculture is the main occupation of the locals who live near the dam built by PT Vale. Therefore, the construction of dams presents a new challenge because it is detrimental to local people's agricultural products. Initially, the farmers showed concern for this situation and worked together to solve the problem. However, the farmers no longer prioritize external matters due to the constant flooding as they are preoccupied with tending their gardens and residences. Meanwhile, the remuneration provided by the organization needs to be more sufficient to overcome the problems experienced by the farmers. Sure, farmers aspire to maintain the economic stability of their families. Thus, it is expected that PT. Vale Indonesia will be able to employ affected family members permanently. The local community can see this recruitment initiative as a solution to the difficulties faced by *Laskap Village* farmers who were affected by the floods caused by the construction of the company's dam, as well as a form of their responsibility.

Apart from livelihoods, another growing social problem is the obstruction of daily activities in the community. People must clean and maintain their homes longer because of the fast onset of floods and relatively slow receding. As a result, the community felt powerless for a very long time in dealing with floods because there was never a solution. FGD findings show that people's behavior during floods, especially women, is unusual. Slowly receding, sluggish water makes washing, cooking, and other tasks difficult. Even though families with stilt houses were not too affected by the flood, their mobilization and interactions were hampered by the flood. The community, especially mothers, hopes there will be a solution to the flood problem. If the flood cannot be stopped, the community asks for compensation by relocating houses or building to a safer place.

c. Physiological Risk

Implementation of ecological modernization by PT. Vale Indonesia has harmed the mental well-being of the local community, as they are exposed to various physical and social risks. Individuals are likely to experience positive mental health outcomes without a perceived threat. Conversely, the presence of such

threats can hinder the attainment of optimal mental well-being. Flood hazards and technological disruptions have created various conditions that impact the psychological well-being of the residents of *Laskap Village*.

The dam's construction in *Laskap Village* poses a physical risk that creates a sense of insecurity in the surrounding community. Therefore, all relevant stakeholders involved in advancing corporate sustainability must ensure that adequate safety guarantees are in place at any cost to safeguard the well-being of individuals in the areas of work, community, and family relationships. However, the individuals affected by their livelihoods may not feel completely secure. A farmer, J, admits that:

" If you want to harvest quickly, it will flood, it can be stressful. Our rice harvest is not very big, but enough to eat. We sell some of our crops to pay for our daily needs. If it floods during the day, we can monitor it and immediately turn off the water, but if it floods at night, we can't do anything about it. Most of the floods occur at night because companies usually open dams at night"

Community responses to the potential for a dam burst disaster are usually grouped according to their level of knowledge proficiency. Public awareness regarding the potential risks associated with dam failure still needs to be improved. A large part of the population needs to gain proper knowledge about the emergence of this threat. The presence of a dam in the community evokes fear and uncertain emotions about the results and actions that the community will take in the future. People are used to small floods. However, they cannot understand the potentially disastrous consequences of a dam bursting. Failure to provide adequate explanations to the general public can result in the emergence of individuals with mental health disorders and a lack of trust in government entities and companies. Several individuals in the *Laskap Village* community are concerned about the potential severity of a dam-bursting disaster, resulting in increased anxiety levels and potential negative impacts on mental well-being.

Both individuals and society need to adopt a pragmatic perspective from the current situation, which is shaped by the social constructions they have built. Therefore, they must be able to adapt to changing circumstances and the looming possibility of disastrous consequences for failure to be the inevitable outcome. Companies should aim to build collaborative partnerships that foster community acceptance and voluntary cooperation without creating a sense of coercion.

PT. Vale Indonesia has conducted a simulation to ease the anxiety of *Laskap Village residents* about the potential consequences of a dam bursting. Individual confidence in managing disasters is believed to increase as they gain the necessary skills

to deal effectively. However, according to S and AM's perspective, carrying out an emergency response only on one occasion is considered insufficient for a company. Increasing the number of simulation participants is suggested to increase the speed and scope of information dissemination. Even so, corporate business is not always liked by society. Indeed, specific individuals fear these simulations because they assume their implementation validates the possibility of a catastrophic event and exacerbates their anxiety.

The company and the government are trying to increase individual and community awareness in *Laskap Village* about the function of the dam and the potential positive and negative impacts associated with its construction. This improvement also fosters a sense of responsibility among community members so that they can evaluate their capacity

during a crisis and accept the situation without lingering regrets. It is expected that individuals in society can effectively fulfill and satisfy their physical desires through a reasonable level of knowledge.

Education is anticipated to enable individuals in a community to maintain composure during certain circumstances, such as earthquakes and heavy rains, while meeting their physiological needs, including consistent sleep, regular nutrition, and the ability to perform daily tasks. It is essential to manage individual mental health conditions effectively. To reduce public concern, the government continues to provide instructions and communication regarding indicators and confirmed hazard conditions through a prior notification system. Table 4 briefly describes the flood early warning system in the event of a dam burst.

Table 4. Dam Early Warning System

| | |
|---------------|--|
| Advisor | No sirens (only warning/alarm signs around the PLTA) |
| Watch | Intermittent loud siren sound, 1 second on and 5 seconds off, for 9 (nine) minutes |
| Warning | Continuous loud sound without stopping for 2 (two) minutes |
| under control | One long beep for 30 (thirty) seconds |

The village government has implemented an early warning system to detect the potential for a dam to burst and to disseminate information on determining

the dam's emergency status. Criteria for determining dam emergency status are presented in Table 5.

Table 5. Dam Emergency Status

| | |
|----------|--|
| Abnormal | <ul style="list-style-type: none"> Abnormal dam behavior Special inspections, intensive monitoring, and immediate physical and non-physical improvement efforts Prevent the situation from getting worse |
| Advisor | <ul style="list-style-type: none"> Threats are believed to be manageable. Technical and operational steps include increasing monitoring, observing the development of the situation, corrective repairs, or lowering the reservoir's water level if necessary. Increase the readiness of early warning systems. |
| Watch | <ul style="list-style-type: none"> The threat is believed to be getting worse, and it is not confident that it can be handled. Technical and operational steps include lowering the reservoir's water level, followed by monitoring the development of the situation. Be prepared to evacuate all residents in areas at risk of flooding. |
| Warning | <ul style="list-style-type: none"> Based on the assessment of dam experts, dam collapse is unavoidable. Evacuate the entire at-risk population. |

Dissemination of information to the public about the emergency status of dams aims to reduce the psychological hazard that continues to befall the community. This knowledge can help anticipate potential mental health risks that local communities may face. The capacity of communities to acquire knowledge and improve their disaster management skills is correlated with their ability to learn from their life experiences.

3. Ecological modernization for the sustainability of mining activities

PT. Vale Indonesia has implemented ecological modernization practices by constructing dams between 1976 and 2011 since the start of its production. For 53 years, the company has implemented ecological modernization initiatives by constructing hydroelectric power plants (*hydroelectric power plants*) on three separate occasions. Ecological modernization is a process that goes hand in hand with technological advances to address the challenges businesses face, particularly energy resources. PT. Vale Indonesia has implemented sustainable practices using renewable

energy sources in their nickel processing technology. Using sustainable energy sources allows companies to sustain their operations over the long term while finding viable energy substitutes over the long term. PT. Vale Indonesia is involved in the discourse of sustainable innovation by increasing its capacity and quality to manage the environment, especially regarding scarcity and rising raw materials and energy costs. The description above reinforces the view of contemporary society (Sehnem et al., 2021). This perspective is in line with research findings which show that companies operating in modern society tend to exhibit expansionist behavior towards the capacity of modern society.

PT. Vale Indonesia strives to improve its mining operations every year. The findings of this study indicate that companies consistently apply cost-saving measures in their production processes while maximizing nickel output. Therefore, companies operating in contemporary society continuously monitor environmental management and related issues. Companies apply contemporary production and environmental systems to enhance outdated conventional systems, which have proven suboptimal for the company and the ecosystem.

The findings of this study lead to the conclusion that the technology used by PT. Vale Indonesia has environmental implications during its operation, especially in substituting non-renewable fossil energy with renewable energy sourced from hydroelectric power plants (PLTA). This finding is consistent with the perspective (Burrier et al., 2019; Hanna et al., 2016), who is considered the pioneer of ecological modernization theory. According to his theory, technological advances can facilitate the transformation of industrial growth toward greater environmental sustainability. This perspective is closely related to the findings of the current investigation, whereby companies are seeking to update their ecological and technological practices to reduce the adverse effects of fossil fuel use and environmental degradation (in particular, air pollution) (Cugurullo, 2016; Sagala et al., 2019; Collins, 2022). Therefore, the company considers that the steps and efforts taken are appropriate. Despite the potential dangers, dam building is a promising way to produce environmentally friendly commodities rather than a bottleneck.

4. Effects of Ecological Modernization on Mining Activities and Associated Risks

The current study's findings shed light on the interrelationships between economics, innovation, and government policies that support the implementation of corporate discourse in facilitating ecological modernization. These findings align with the (Al-Saidi & Elagib, 2018; Rocchi et al., 2020; Novotny et al., 2021) modernization theory, which argues that modernity, as a theoretical framework,

describes the interaction between the economy, innovation, and state intervention in decision-making. by specific stakeholders.

PT. Vale Indonesia has initiated a discourse to transform the business sector towards a more sustainable and environmentally friendly approach to mitigating the ecological crisis. The current study indicates a shift towards environmentally conscious industrial systems, emphasizing "green" practices. The findings above indicate that PT. Vale Indonesia is actively seeking opportunities and strategies to facilitate the implementation of proposed ecological modernization initiatives. The company's compliance with Presidential Regulation No.51/M-IND/PER/6/2015 article 1, paragraph 2 concerning the green industry, is evaluated, including production processes emphasizing the optimal utilization of renewable energy efficiently and effectively. The definition of a green industry includes corporate goals to build a sustainable mining system while protecting the environment. While the benefits of dams to local communities are temporary, the potential harm will continue.

a. Physical Risk

The findings of this study regarding the physical hazards associated with ecological modernization are derived from an analysis of the physical risks faced by residents of *Laskap Village* and its surroundings. This research has identified the physical hazards associated with ecological modernization impacting local communities and several risks likely to persist in *Laskap Village* in the long term. The physical and ecological risks the *Laskap Village* community faces are described in great detail.

First, the function of the community's land has changed from the plantation and cemetery land to a dam area (PLTA) which the public cannot access unless the company obtains permission to visit the community's ancestral graves. Land conversion significantly impacts the livelihoods of individuals, especially those working in the plantation industry. The company has implemented measures to mitigate this risk by offering compensation to individuals who meet the criteria established through government approval.

Second, PT. Vale Indonesia has mathematically predicted and measured the direct threat of flash floods due to a dam burst. If a flood occurs, the *Laskap Village* community faces considerable risk because densely populated areas are at risk of being inundated, with an affected area of 7.10% of the total area of *Laskap Village*. Based on existing data, it is estimated that the flood height is anticipated to reach a height of 0.6 meters at the nadir. For comparison, the maximum elevation angle is 22 meters. The time lag between the dam breaking and the arrival of water in *Laskap Village* is approximately 30

minutes. It is estimated that the flood will recede within 24 hours.

Third, floods often result in submerging agricultural land, plantations, and settlements, causing adverse impacts on community crops and economic consequences on community incomes. The community often encounters flood events. The prolonged duration characterizes the recession of a flood event. The primary catalyst for this event was initiating a dam release mechanism, which was subject to fluctuating tidal conditions and rainfall patterns in *Laskap Village* and the headwaters, namely Lake *Towuti* and Lake *Matano*.

Fourth, the accelerated release of dam water can cause river erosion, posing a potential hazard to residential properties along the river banks. The dam's construction is suspected of causing the widening of the river channel caused by an increase in water discharge facilitated by the opening of the dam's floodgates. Foundation erosion in residential areas poses a significant risk of structural failure, potentially causing house collapse and endangering the safety of occupants. The above condition is a matter of great concern and has yet to be resolved due to the challenge of delineating the authority and responsibility of the parties involved. Responsibility for the condition of the people living along the river banks is often linked to the Pompegan and *Jenneberang* River Basin Offices (*BBWS*), which has led to accusations of irresponsibility from both the company and the government.

b. Social Risk

This section describes the social consequences experienced by the residents of *Laskap Village* as a result of the operation of PT. Vale Indonesia. The study findings show that the presence of the industry has produced many beneficial and unfavorable effects on society. The implementation of ecological modernization through the construction of dams has produced beneficial results for the welfare of the community. On the other hand, after the construction of the dam, the community faced social conditions that were previously unforeseen in terms of its impact on social welfare. This study reveals the social conditions of the people of *Laskap Village* after PT's construction of the dam. Vale.

First, the agricultural and plantation businesses of the *Laskap Village* community are hampered by repeated floods, which impact the prosperity of these activities, which are the livelihood of some of the community. The above phenomena can threaten the emergence of new social issues, such as poverty due to crop failure, decreased people's income, and the inability to meet daily needs.

Second, the people living around *Laskap village* have developed a sense of distrust and dissatisfaction with the hamlet, village, and district governments because there is no definite solution to

the flooding problem caused by the company's operations. *Laskap* villagers tend to see that the above groups have exploited them before. As a result, individuals show apathy and a lack of compassion because of their involvement and the resulting loss. Conversely, policymakers do not advocate for their welfare. As a result, the erosion of social solidarity gives rise to a state of indifference. *Third*, a feeling of apathy arises among fellow farmers due to their powerlessness and surrender to the challenges they continually face without concrete solutions from the relevant stakeholders. This disposition is considered capable of causing a more complex situation in the future if policymakers offer no substantive solutions.

Fourth, those affected experience discomfort and frustration, so they seek assistance from related parties to relocate their settlements to a more suitable location. However, advocates of ecological modernization have yet to consider the above aspirations sufficiently. Significant tensions will likely arise between communities, governments, and companies if no solution exists. Such friction has the potential to result in atypical behavior that is contrary to relevant statutory laws.

Fifth, new social issues can be linked to the ambiguous economic circumstances arising from crop failures and the expiration of contractual employee status. Precarious economic circumstances can make a society vulnerable to criminal activity without prompt government intervention. Communities often develop high expectations of government initiatives, including but not limited to basic needs, such as food, education, and health assistance. Dependence on government assistance is unavoidable due to its role as a viable measure in addressing the social risks faced by the residents of *Laskap Village*.

c. Physiological Risk

This section discusses the psychological condition of *Laskap Village* residents experiencing atypical growth due to internal and external factors. Dam construction as a means of ecological modernization is a significant external factor contributing to the development of an unhealthy mindset. This criticism aligns with various indications of mental health, which state that a person's mental well-being depends on a sense of security and adequate self-evaluation (Gupta, 2013).

The findings of the current study indicate that the residents of *Laskap Village* face mental health problems that arise from the aggregation of physical and social hazards caused by ecological modernization. After conducting a social assessment of the impact of ecological modernization, people began to see the negative aspects of this phenomenon. Individuals are likely to encounter positive mental health outcomes without perceived

threat. Conversely, the presence of such threats can hinder the attainment of optimal mental well-being. The results of an investigation into the psychological condition of the people in Laskap Village align with the notion of mental well-being (25). Mental health refers to the condition of individuals who experience psychological, emotional, and social well-being. Mental disorders can manifest in individuals experiencing stress, depression, and low self-esteem. In line with this, the flood hazard due to technological malfunctions is believed to have caused various conditions that have an impact on the psychological well-being of the people of *Laskap Village*. The mental dangers faced by the residents of *Laskap Village* are described as follows.

First, individuals feel insecure because of inadequate knowledge and education, causing prolonged anxiety. The lack of knowledge or explanation provided by the company or government resulted in a lack of sense of security felt by the *Laskap villagers*.

Second, a group of individuals who experience riverbank erosion due to excessive water discharge from dams is experiencing psychological pressure. The potential for the collapse of settlements along the *Karebbe River* has raised concerns among local communities who feel the flooding threatens their safety and well-being. The problems faced still need to be solved by local governments, district governments, river basin offices, and corporate entities.

Third, communities develop a distrust of the government and companies because they perceive that these two entities have yet to show a genuine commitment to dealing with the consequences of dam construction. Related parties still need to resolve the problem of inundation, which negatively impacts the agricultural and plantation sectors and threatens residents' settlements due to river bank erosion.

4. Conclusion

The research found that PT. Vale implemented a green energy system (ecological modernisation) to reduce production costs and the raw material crisis. The following reasons explain PT Vale's ecological modernisation. First, because fuel consumption accounts for 20-30% of the annual production budget, the corporation uses hydroelectric power facilities. Fuel prices are forcing corporations to use renewable energy. Second, annual electricity tariff increases will be capped at 5%. Organisations need power. Companies did not own electricity, therefore price swings by electricity owners made annual budget spending unpredictable. Thus, dam development is a crucial step in reducing corporate expenses, particularly electricity costs. Third, a hydroelectric power plant (PLTA) might reduce

carbon emissions by 500,000 metric tonnes per year. Hydropower development should reduce glasshouse gas emissions and enhance air quality near mines. PT. Vale Indonesia is Indonesia's lowest-carbon mining firm. East Luwu's district government has benefited from the dam's electricity generation. Power plant owner PT. Vale Indonesia supplied 50% of East Luwu Regency's power. The community needs 20 MW of electricity. PT. Vale Indonesia supplied 10.7 MW of electricity to PLN through the Hydroelectric Power Plant (PLTA). East Luwu Regency's annual budget is about 30 billion rupiahs from the sale of this electricity grant, which supports the local community's electrical needs. Fifth, PT. Vale Indonesia has worked to implement Presidential Decree No. 5 of 2006 on National Energy Policy and Law No. 30 of 2007 on Energy to suit company and government needs. Mining stakeholders should form an eco-friendly company. Our research also shows PT Vale Indonesia's ecological modernization's physical, social, and physiological risks.

5. References

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