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Survival Strategies of Fishermen in Bahodopi Amid Ecological Changes in Mining Areas

M. Junaidi[1], Hamka Naping[2], Pawennari Hijjang[2], Yahya[2]

[1]*Department of Anthropology, Tadulako University, Palu, Indonesia*
[2]*Department of Anthropology, Hasanuddin University, Makassar, Indonesia*

**Corresponding Author: M. Junaidi*
E-mail: junaidiuntad@untad.ac.id

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Abstract

This research explores the perspective of human adaptation as a cultural response to ecological change. Ecological and economic pressures drive humans to consciously choose and take advantage of opportunities in their ecological environment. The Bahodopi mining area is the context to explain human adaptation to these ecological changes. Nickel mining results in changes in the ecological environment that have an impact on people's lives. The destruction of the ecosystem affects the lives of people in mining areas such as fishermen in Bahodopi. Coastal fishermen in Bahodopi take advantage of the potential of marine resources by catching fish to meet their living needs before the mine. The marine and coastal environment as a habitat for fish is polluted by mining waste such as factory waste, other liquid waste, and mud materials due to the excavation of materials upstream damaging fish habitats. This condition is not favorable for fishermen because they cannot meet the economic needs of their families. Fishermen's economic activities have stopped because their catches have decreased along with the development of mining activities and the destruction of marine ecosystems. The Bahodopi mining area provides job opportunities for residents to become employees, entrepreneurs, service businesses, and the informal sector along with the number of mining workers. Utilization of natural resource potential such as being a stone breaker, wage labor in pepper gardens, and planting vegetables in the yard. Fishing families take advantage of the potential of other resources and economic opportunities as a form of adaptation to ecological changes.

Introduction

The Bahodopi mining area or Bahodopi block is located in East Bungku sub-district and Bahodopi sub-district, Morowali Regency. The topographic environment is in the form of mountains, hills, swamps, valleys (plains), and coastal areas. Before developing into a mining area, this area was inhabited by various ethnicities such as the Bungku, Mori, Tolaki, and Bajo people who were native settlers scattered in villages within the area; Toraja (Islamic) and Bugis, Tolaki people came to settle since 1958 because they were looking for shelter to settle in Dampala and Lele villages; as well as transmigrants from Java, Bali, and Lombok such as in Onepute Jaya village (UPT. Bahomtefe), transmigrants from Despot in Lele village, and in Bahomakmur village (UPT. Bahodopi). They take advantage of the potential of the natural environment to meet the needs of life by cultivating crops such as rice farming, plantation commodity crops such as cashews and cocoa. In addition to cultivation practices, they also concoct forest products in the form of wood, resin, and rattan as well as sago land as a food source. On the coast, local communities catch fish (fishermen) on the coast by Bajo fishermen and Bungku people.

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The government has made Bahodopi a mining industrial area because the potential for nickel minerals in the Morowali region, which is the largest in Indonesia, is 3 million tons and holds reserves of 40% of the world's lithium production (Tempo, 2023). The Morowali and North Morowali regions are included in the pillars of economic development in the eastern region of Indonesia in the industrial, energy, and mining sectors in the strategic planning policy masterplan (MP3EI) by the Indonesian government. The need for nickel is increasing due to the global agenda on reducing carbon emissions and the use of nickel in the automotive industry for lithium-ion batteries used by electric vehicles.

Nickel mining companies have been in Morowali since the New Order period when the contract of work (KK) permit was granted by the Indonesian government to PT. Inco (now PT. Vale Indonesia) and PT. Rio Tinto since 1968. PT. Inco operates until now while PT. Rio Tinto did not obtain an extension of the work contract permit. PT. Rio Tinto even had a conflict because of the overlap of IUP with a number of companies issued by the Morowali Regency Government in the early days of its expansion (Nutfa et al., 2023). PT. Bintang Eight Minerals (BDM) is one of the companies that has a mining business license (IUP) from the government based on Decree 540.3/SK.001/DESDM/IV/2010 with a concession area of 21,695 hectares covering 9 villages, namely; Bahomoahi, Bahomotefe, Lalampu, Lele, Dampala, Siumbatu, Bahodopi, Keurea, and Fatufia have started mining since 2010 (Taqiyaah & Hidayat, 2023).

PT. BDM collaborates with investors from China through PT. Shanghai Descent Investment (Group) Co.Ltd, and PT Bintang Eight Investama established PT Sulawesi Mining Investment (SMI) in Indonesia in 2009. PT. BDM carries out nickel mining activities in Morowali district on an area of 47,000 hectares. Regarding the hPT. BDM is supported by the Morowali local government initiating PT. Indonesia Morowali Industrial Park (IMIP) in 2013 built a processing industrial area (smelter) as well as an operator for the entry of a number of foreign investment companies (PMA) in the Bahodopi area. Currently, the number of companies that are members of the PT. IMIP as many as 52 companies (Public Relations of PT. IMIP, 2003). PT. This IMIP changed most of the face of the Bahodopi area which was originally an area located on the border, far from the center of government and economic growth turned into a city area with a nickel mining industry. Bahodopi is a destination for job seekers because jobs are opened by mining companies. The number of workers in existing conditions in 2018 at PT. IMIP as of August 2018 is 24,000 migrant workers and in the 2023 period there are more than 80,000 workers (PT. IMIP, 2023).

Activities to meet the needs of the people of Bahodopi began to be difficult as the mining area developed. The main livelihood activities that utilize the potential of natural resources such as agriculture become difficult because rice fields and plantations are damaged and infertile due to floods. In addition, land or land is acquired to build mining infrastructure. In a period of more than 20 years, paddy rice farming stopped because the need for irrigation water was insufficient and the water quality was not suitable for paddy rice farming. Floods often bring mud and sand materials to settle in the rice fields, causing the soil to be infertile. The same condition was experienced by coastal fishermen in Bahodopi who stopped their fishing activities due to water pollution that damaged fish habitats. This condition makes the lives of the local community in Bahodopi vulnerable and threatened because the main source of livelihood is lost due to mining activities (JATAM, 2015).

Bahodopi coastal fishermen stop their fishing activities because their catch is decreasing day by day, sometimes they even go home without results. This situation has been going on since the mining company began operating in the Bahodopi area. The community suspects that the loss of fish on the coast of Bahodopi is due to fish habitat being damaged by mining waste. The nickel processing plant (smelter) located around the residential environment of the

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community is suspected of dumping waste that ends up in the sea, polluting and damaging fish habitat due to the hot temperature of the waste. The destruction of fish habitat is also due to river water that empties into the coast carrying material from mineral extraction activities in the mountains. The river water is red when it reaches the coastal coast of Bahodopi, causing the sea water to be brownish-red.

Bahodopi fishermen are coastal fishermen who use small boats and outboard engines. They need to pay a lot of money if they want to continue their fishing activities by investing in boats and fishing equipment that are adequate to reach the wider sea to catch fish. Along with the ecological damage that occurs in the marine environment as a source of livelihood, fishermen are trying to adapt by choosing to take advantage of the potential in the surrounding environment for livelihoods or choosing the opportunities that exist in line with changes in the Bahodopi mining area.

The ecological changes that have occurred have caused fishing communities on the coast to adapt to these changes. Adaptation is understood not as a mere adjustment practice but through a process of understanding changes in the ecological environment, the knowledge tools possessed, understanding its economic, social, and cultural conditions so as to give birth to adaptive responses to these changes (Hardesty, 1977; Bennet, 1976; Poerwanto, 2000). Adaptation can be seen as an effort to maintain living conditions in the face of change (survive) and is a measure of the success rate of an organism can survive, to the extent that the subject adapts can be said to be successful or not. Adaptation is a cultural response or process that is open to the process of modification in which coping with the conditions for life by selective reproduction and developing it. Human adaptation behavior is a process that consciously and actively produces responses as a form of adaptation as happened in the coastal fishing community of Bahodopi (Donald Hardesty, 1977).

This study aims to analyze the adaptation of the Bahodopi coastal fishing community to ecological changes caused by nickel mining activities. The argument put forward is that drastic changes in the ecological environment are forcing coastal fishers to change their livelihood strategies, take advantage of new opportunities arising from the development of the mining industry, and adopt new forms of economic adaptation to sustain their survival.

Methods

The data of this paper was obtained through descriptive qualitative research (Creswell, 2017; Denzin & Lincoln, 2010). This study emphasizes ethnographic studies with an ecological adaptation perspective approach to look at ecological changes in the Bahodopi area which has developed into a mining area (Bennet, 1976; Moran, 1983; Hardesty, 1977; Bennet, 1983). Data collection was carried out in June - September 2021 through literature studies, secondary data collection, participatory observations, in-depth interviews, and focused discussions (FGD) with community leaders (Musoke et al., 2024; Sohel et al., 2022; Namanda et al., 2023). The selected informants were fishing families in Dampala village, Lalampu village, and Keurea village where coastal fishermen live in Bahodopi. These informants were chosen because they were directly affected by the ecological changes caused by mining activities.

The data analysis process involves several stages: organizing the data that has been collected, both from interviews, observations, and literature studies; selecting and focusing data relevant to the research objectives; identify key themes emerging from the data combining primary and secondary data; and triangulation to ensure the validity of the findings. Data updates through confirmation to a number of informants were carried out in 2022-2023 to ensure the accuracy and relevance of the data in the context of the changes that occurred. The adaptation of

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Bahodopi coastal fishermen to drastic ecological changes is an active response to economic, social, and cultural conditions that change along with the development of the mining industry.

Results and Discussion

Ecological Change: Mining Investment and Coastal Ecosystem Destruction

Massive mining investment in Bahodopi occurred after Morowali Regency was expanded from Poso Regency in 1999. The Morowali Regency Government issued mining business permits (IUP) for 177 foreign companies out of a total of 204 permits that control around 600,089 hectares of land. A total of 45 of these business licenses overlap with business licenses issued by the central government, such as 33 permits that overlap with PT Vale in the Bahodopi Block and Kolonodale Block (Afdalia et al., 2023). As a result, the Bahodopi area has become the main destination for nickel mining exploration, with many permits issued to overlap mining business licenses. Law No. 4 of 2009 on Mineral and Mineral Resources and Law No. 32 of 2004 on Regional Autonomy authorize local governments to issue mining business licenses, but the permits must be obtained from the central government if the location of the object crosses the administrative area of the province. PT Bintang Eight Mineral (BDM) is one of the large companies operating in Bahodopi with a mining business license covering 9 villages and production started in 2009. In addition to PT BDM, many small companies mine and export raw materials (ore) abroad. The development of downstream industries through PT Indonesia Morowali Industrial Park (IMIP) also transforms Bahodopi into a vast industrial estate with 52 companies in an area of 2000 hectares.

The Bahodopi area then became the most massive location to become a nickel mining exploration destination with the issuance of many permits until there was an overlap. One of the other crucial problems is if the location of the object issued by the permit crosses the administrative area of the province so that the permit must be issued by the respective local government. Observing this, the authority for mining business licenses is returned to the central government and local governments can only issue mining permits C. Law Number 3 of 2020 concerning Amendments to Law Number 4 of 2009 concerning Mineral and Coal Mining is a regulation that regulates mining governance along with a number of other technical government regulations. One of the important points in it is to increase added value through domestic processing and refining. This changes the way mining companies that invest not only take raw materials but also build factories (smelters) and produce finished materials or components for industrial needs (down streaming). The impact is the emergence of many mining industrial areas in mining potential areas such as in Bahodopi.

It can be felt from the beginning of the existence of the mine, the life of the people in Bahodopi has changed into an industrial society which is marked by the presence of PT. Bintang Eight Minerals (BDM) which has a mining business license (IUP) numbered: SK540.3/SK.001/BESDM/IV/2010, with a concession area of 21,695 hectares covering 9 villages, namely Bahomoahi, Bahomotefe, Lalampu, Lele, Dampala, Siumbatu, Bahodopi, Keurea, and Fatufia. Production of PT. BDM officially started in 2009 and is expected to end in 2025. Forms of processing such as the first batch of raw materials (*ore),* nickel ore processing to the production of iron and steel in the form of final products. In addition to PT. BDM, many small companies have mining permits and export raw materials (ore') to smelters abroad. The mandate of the Mineral and Mineral Law, which emphasizes increasing added value by processing domestic resources, makes mining companies invest more widely from upstream to downstream.

PT. BDM has turned the Bahodopi area into an industrial area through PT. Indonesia Morowali Industrial Park (IMIP). In the IMIP area, there are many companies that handle the nickel

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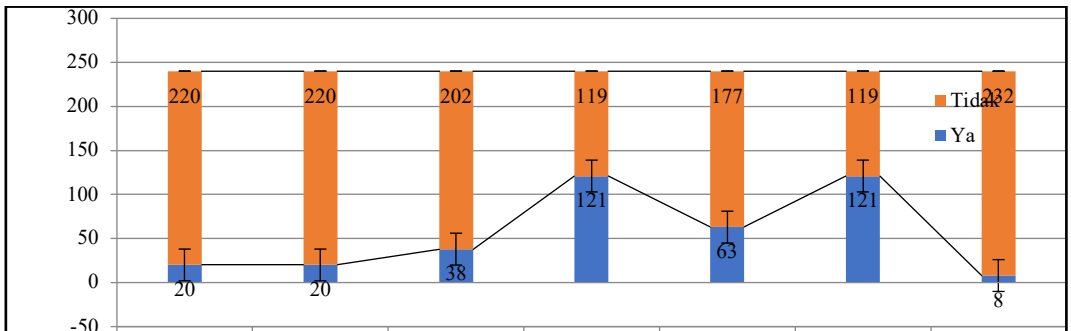
industry from upstream to downstream. The companies that are tenants in the IMIP area currently have 52 companies in an area of 2000 hectares. The development of PT. IMIP in the future, the Regent of Morowali has approved the proposal of PT. IMIP to free up forest land to expand the area by 2000 hectares as planned for the development of 4000 hectares. The expansion of the area is carried out in line with the number of investor companies that will enter for the development of the downstream industry.

PT. Vale (PT. Inco) PT Vale has controlled the Bahodopi Block since 1968 with an area of 22,699 hectares after a reduction from the initial area of 32,123.01 hectares. Other companies such as PT Wanxiang Nickel Indonesia also built a smelter in 2015 with an IUP land area of 20,000 hectares. The impact of this investment is the opening up of large areas of land for mining activities, resulting in reduced forest cover and increased potential for ecosystem damage. Open forests cause greater volumes of water during the rainy season and potentially flooding, damaging downstream and marine ecosystems. The people of Bahodopi have experienced significant changes in their lives, from an agricultural society to an industrial society, but with various negative impacts such as declining water quality, floods, and infrastructure damage. Regulations related to tailings disposal by mining companies also raise concerns about marine pollution and its impact on the livelihoods of local fishermen.

In addition to PT. IMIP and PT. Vale, a mining company operating in the Bahodopi area such as PT. Wanxiang Nickel Indonesia built a smelter in 2015 in the village of Bahomotefe due to the government's ban on the export of raw materials. PT. Wanxiang controls 20,000 hectares of IUP land. For the continuity of production, PT. Wanxiang also acquires land and joint ventures with local and national mining companies and also obtains small-scale material mining permits by freeing up land owned by local communities to be mined.

Diagram 1. Respondents Perception of the Impact of Mining Management



	Social Disparities	Damage to Cultural Norms	Pervasive Disease	Increasing Welfare	Shifting Community Lifestyles	Shifting Livelihoods	Others
No	220	220	202	119	177	119	232
Yes	20	20	38	121	63	121	8

Source: Data Processing Results

The perception of the people of Bahodopi shows that there is an increase in welfare due to mining activities in Bahodopi. Despite the changes in welfare, the community still feels the impact of mining activities. Their traditional livelihoods, such as farming, fishing, resin chasers, rattan gatherers, or hunting, turn into employees or feel the impact of mining by setting up boarding houses. The community feels the impact of mining companies through increased income. Despite the change in production patterns, some still maintain agricultural production by switching to crops such as pepper and cocoa, or by buying new land from land sales in Bahodopi or using the company's dormant land. The increase in income triggered an increase in living standards and a change in consumptive behavior. Significant investment in nickel

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mining and extensive land tenure means the potential for open land due to mining activities. This has an impact on the potential loss of forests that store water, increase the volume of water during the rainy season, and potentially cause flooding. Potential damage to forest ecosystems upstream impacts ecosystems downstream, including settlements and production land, as well as marine ecosystems. The ecology and natural functions from Bahomotefe to Bahodopi have undergone many changes. Forest cover that was once green and dense is now experiencing a large opening (Wellmann et al., 2020; Decuyper et al., 2022).

Along with the policy of the government of the Republic of Indonesia related to making the Morowali and North Morowali areas the center of the mining industry so that it becomes a vital object of the state. Priority is given to investment in the mineral mining sector such as nickel as an entry point for foreign companies (PMA) and national private companies for nickel production from upstream to downstream as regulated in Law Number 4 of 2009 (Mineral and Mineral Law). This means that the exploitation of mining areas (forests and land) will continue and its impact on ecosystem damage. People in mining areas in Bahodopi will be threatened by ecosystem damage such as the threat of flooding, loss of livelihoods, poverty risks, disease risks arising from mining activities and other social risks.

Ecological changes felt by the people of the Bahodopi area when agricultural land is converted into a mining area. Rice farming activities experience problems with water needs for agriculture. The quality and discharge of water are not suitable for agricultural activities because of open forest areas and are deforested due to the extraction of nickel (ore) materials. During the rainy season, the volume of water is more, causing floods to bring materials and mud to inundate rice fields. When the water recedes, it leaves a deposit of red mud and sand so that the rice fields are not fertile. The worst impact was when the 2019 floods that inundated villages in the Bahodopi area even damaged infrastructure such as bridges. This flood disaster is the most occurring, at least because the forest cover that serves as a water buffer in the upper part (mountains) has been deforested due to mining activities and drains water with a large amount of discharge, especially in the rainy season(Lahay, 2023). The same happens in coastal and marine environments as the destination of final disposal. Mining activities upstream bring materials from the mining site and the volume of materials will increase during the rainy season. The river water up to the estuary in the sea looks cloudy, brownish or red coming from the red soil at the ore excavation site. In addition to pollution from upstream, the sea is also a waste disposal site from treatment plants (smelters) and power generation machines in the area of PT. IMIP.

Ecological changes in Bahodopi are triggered by massive mining investment, especially after the expansion of Morowali Regency. This investment not only causes overlapping business licenses, but also converts agricultural land into mining areas. Agricultural activities are disrupted by unmet water needs due to forest clearing, while floods cause red mud deposits in rice fields, reducing their fertility. The expansion of the downstream industry also expands the mining industrial area, such as through PT IMIP which has 52 companies in an area of 2000 hectares. The development of mining supporting infrastructure such as special ports (jetties) changes the structure of the coast and blocks fishermen's access, as well as increasing the risk of marine accidents.

Regarding the disposal of mine residues or waste, according to Bahodopi residents, they do not know clearly about the disposal of tailings by PT. IMIP. The company has never socialized about waste disposal to the public whether it is stockpiled or thrown into the sea, residents are just guessing. According to a former employee of PT. IMIP tailings are piled up on a mountain, only the company knows where it is. According to residents, even though it is accommodated in a large dump, pollution into the sea will definitely occur because water flows from the

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mountain through rivers that drain into the sea. However, so far, many mining companies have dumped their waste in the sea. The sea is a waste disposal site by companies with deep-sea tailings disposal (DSTD) technology. The dumping of tailings in the sea adversely affects the ecosystem and threatens the livelihood of local fishermen. The DSTD method is a method that is quite widely used by mining companies in smelter waste disposal. In addition to land changes, marine pollution has also increased due to mining activities. Waste from smelters and power plants is dumped into the sea, causing damage to marine ecosystems and decreasing aquatic fertility. The disposal of marine tailings with DSTD technology also causes sedimentation that damages the seabed and threatens biodiversity. High barge activity adds to marine pollution, which adversely affects fishermen's livelihoods. The decline in fish catches has caused many fishermen to stop looking for fish, threatening the sustainability of their livelihoods.

The pipeline network releases tailings at a depth of 150-250 meters below sea level and is thought to sink to the seabed to a depth of one kilometer. DSTD is carried out by companies because it is cost-effective compared to building tailings dams or building waste treatment plants. The discharge of tailings waste into the sea causes sedimentation and siltation that alter the seabed landscape, decreasing the fertility of waters and the loss of biodiversity is marked by certain types of fish, and other marine life. PT. Cahaya Mining Service (one of the tenants in PT. IMIP) has conducted socialization to residents around the IMIP area, especially to the fishing community, related to the processing/disposal of tailings in the deep sea. PT. CMS offers a renewable technique for deep ocean waste disposal called (*High Pressure Acid Leaching*/HPAL). The attitude of the community is illustrated from the survey results of around 71% who disagree with the disposal of tailings into the sea (Laurence, 2021; Anindhita, 2024).

Steam power plants (*Power Plant*) in the mining area of PT. IMIP discharges water whose temperature is quite hot through a separate channel into the sea. According to Watson (2019) and Krzyżak & Korzeniewski (2021), the sea water feels hot when touched with hands and the affected area is hundreds of meters from the sewer. In the village of Fatufia, the hot water waste disposal site caused the fish in the disposal area to be further damaged, and the fishing net cages were disturbed and died. Marine pollution is also caused by barges that often experience fuel leaks during loading and unloading at ports (jetties). The high activity of loading and unloading ships of mining products and hundreds of barges operating along the coast in the Morowali sea area is indicated to cause pollution and environmental damage on the coast of Bahodopi. The results of the study show that mining investment in Bahodopi brings major changes to the terrestrial and marine ecosystems, resulting in environmental damage that has a direct impact on the lives of local communities. These changes include deterioration in water quality, flooding, and damage to infrastructure on land, as well as marine pollution and loss of fishermen's livelihoods. The transformation of society from agriculture to mining industry also creates economic uncertainty for many fishing families (Andrews et al., 2021; Rosyida et al., 2019).

Mining activities are a threat and even stop the activities of fishermen in Bahodopi. Ecological changes on land also bring changes in the ecosystem on the coast, especially in the places of fishermen's activities. Shipment floods affect water quality, especially in places of fishermen's activities. The place where the fish live becomes cloudy and even reddish-brown with an excess volume above normal so that the fish are no longer around the beach away from the place where the fishermen have been carrying out their fishing activities. Various conditions that cause changes in the coastal and marine ecosystem in Bahodopi as described above cause fishermen to choose to stop looking for fish due to uncertain results. They also avoid the risks of danger faced if fishing on the high seas by using only small boats and low-capacity engines. It indicates

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that the impact of mining investment in Bahodopi is part of a larger phenomenon related to the exploitation of natural resources in Indonesia. Ecosystem damage and the resulting social impacts illustrate the same pattern in many other mining areas, where short term economic gains often come at the expense of environmental sustainability and the well-being of local communities.

The condition of poverty and inability to meet the family's living needs threatens the fishing family in Bahodopi. Various problems expressed by fishermen that since the entry of the mine, the catch obtained is getting less and less, sometimes they even go down to the sea to just eat, they do not get fish at home. Like net fishermen in Dampala village, Keurea village and Lalampu village before the mining period was not so massive (before 2010), they could get a catch of up to 50 bunches of fish per day. They sell to the surrounding neighborhood for Rp. 5000 – Rp.7000 per bundle and a day they can earn Rp. 250,000 – Rp.350,000 per day with morning and afternoon working hours. Conditions in 2018, according to them, the catch along with the increasingly crowded mine is decreasing. Several times they go to sea but the production costs are covered by the results they get, even for household consumption they do not get fish at all. Considering the uncertainty of the results they obtained compared to their previous experience of obtaining results, they then stopped their activities as fishermen (Barz et al., 2020; Gundelund et al., 2022). When compared to 2023, the price of the fish in question is around Rp. 20,000 – Rp. 25,000 per bunch/place. The fish that are marketed are no longer the catch of Bahodopi fishermen but fish imported from outside the region such as from Poso, Parigi, Ampana, East Luwu, Palopo.

The existence of mining companies with all their activities creates a meaning for the community to the impact of mining, such as the presence of mining provides new jobs for farmers; mining damages agricultural land or environment, including marine environments; mining provides high selling value (economic value) to agricultural land. The presence of mining is a blessing (economic side) because their lives are now improving, but most farmers are not aware (do not know and/or understand) the long-term effects caused by mining (Adu-Baffour et al., 2021; Amoako et al., 2023). The implication of the results of this study is the need for stricter policies and better supervision of mining activities to reduce negative impacts on the environment and society. The government needs to ensure that mining investments are made with the sustainability of the ecosystem and the well-being of local communities in mind and that the negative impact of mining investments is due to the lack of effective oversight and regulation, as well as a greater priority on short-term economic gains compared to environmental sustainability. This reflects systemic problems in natural resource governance in Indonesia. Actions that need to be taken are tightening regulations related to mining activities, increasing supervision of the implementation of rules, and developing more holistic policies that integrate economic, environmental, and social aspects. The government also needs to increase the participation of local communities in decision-making related to mining investment to ensure that their interests are protected.

Adaptation Mechanisms and Work Options to Meet the Needs of Fishing Families

Ecological change with all its consequences is a pressure on the people in the mining area, including the coastal fishing community of Bahodopi. This condition is a threat to fishermen because of changes in the quality of the marine environment where economic activities are damaged by mining activities. Bahodopi fishermen are small-scale fishermen with a subsistence production orientation. They use relatively simple technological equipment such as ketinting boats, nets, trawls, bubu, and orbits to catch fish around the beach. They do not look for fish further away because they are afraid of the risks of accidents and failure to get a catch.

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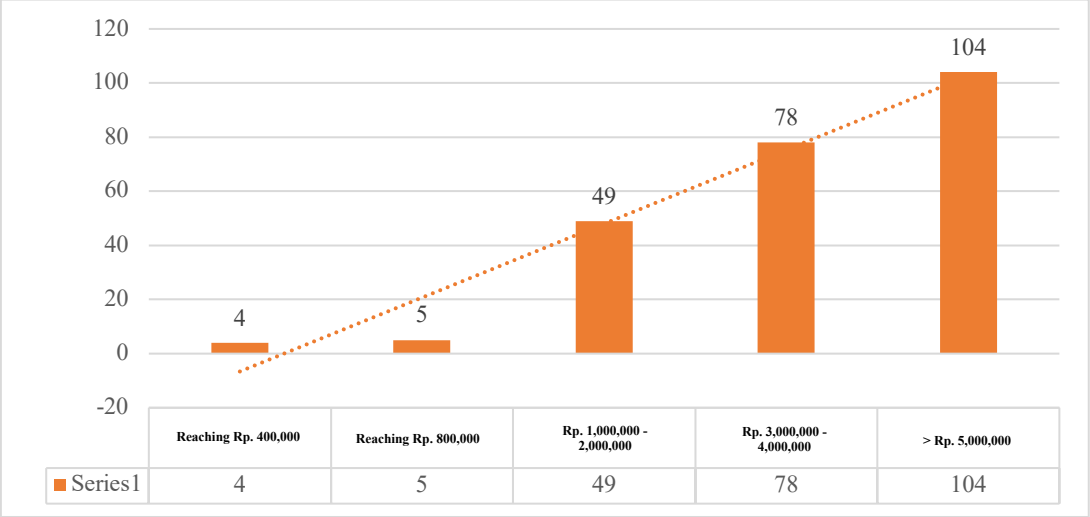
The rationality of Bahodopi fishermen in stopping their activities at sea is natural because they apply the moral principle of prioritizing safety *(safety first)* and unwillingness to take risks *(Risk averse)* such as the loss of production factors such as boats and fishing gear (Scott, 1983). The risk of accidents is also a possibility that can occur, especially with the crowded traffic of barges and the uncertainty of obtaining catches due to the damage to marine and coastal ecosystems. The destruction of fish habitat causes fish to migrate to unpolluted places so that for the continuation of their activities, they must move to fishing locations further away and have greater operational costs.

Fishermen in Lalamp have received fishermen empowerment assistance from the government in the form of large fishing boats and machines for fishermen groups but cannot be optimally used for production. The characteristics of fishermen who are used to being independent fishermen turned into fishermen groups do not become more sustainable because some fishermen have chosen to become company employees. The practical reason for fishermen is that the uncertain catch they get compared to being an employee of a company is more certain of the results they get without the risk of failure, including their safety at sea and the risk of greater operational costs incurred for fuel.

Faced with this stressful situation, fishing families in Bahodopi have chosen several options to find other sources of livelihood as an adaptation mechanism to ecological changes. Conscious-active behavior is a mechanism of adaptation or response to oppressive ecological changes, and simultaneously they make adjustments according to their capacity for knowledge, experience, culture, and relationships to take advantage of opportunities to ensure their existence. Loss of livelihoods due to damage to the ecological environment where their livelihoods are sourced.

Diagram 2. Total Monthly Income of Head of Household



Source: Data Processing Results

Income above Rp 5 million is 43% and in the range of Rp 3-4 million is 33% consisting of civil servants, self-employed, and company employees with average skills above Rp 5 million for those who work 3 shifts and Rp 7 million for 2 shifts, even higher. With the development of mining areas in Bahodopi, several opportunities have been created, such as working in companies, opening productive businesses in line with changes in the structure of the community and the number of immigrants working, as well as maximizing the potential of natural resources that have not been processed or are still controlled by the community. The stages of mining activities, such as exploration, construction, and production, provide

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opportunities for fishermen to transform their livelihoods. Previously, fishermen relied on hereditary knowledge and experience in farming or catching fish. However, when working in a mining company, the opportunity turns into a job that relies on manpower, such as being a crew member or helper, regardless of educational qualifications.

Adaptation is a key concept of biological, behavioral and social aspects in explaining human behavior. The basic assumption of adaptation develops from an evolutionary understanding that positions humans as subjects who seek to adapt to the surrounding natural environment, both biologically/genetically and culturally. The fundamental change is that the pattern of meeting family subsistence needs based on agriculture and fisheries has become a pattern of meeting needs based on the industrial sector. The fundamental change is that the pattern of meeting family subsistence needs based on agriculture and fisheries has become a pattern of meeting needs based on the industrial sector (Bennet, 1983).

A change from the practice of meeting needs whose production base is carried out privately (individuals and nuclear families) to a public sector that is accessible to others and becomes a collective responsibility. Bahodopi fishermen have to adapt in using new strategies in earning a living, strategies that have never been used before due to physical limitations (old age or declining health conditions) or social limitations (limited relationships with others). One of the strategies carried out is to become a worker in a mining company.

Relations also change in the process of economic production, which was previously a group of relatives changed to be more diverse with different structures. The economic production process of agriculture and fishermen only involves the nuclear family, helping each other in a group of relatives, extended families or working together freely. However, when working in a mining company, the structure and relationships change to a workforce/crew (labor) that is regulated and supervised by the *foreman*, inspected by supervisors and bound by working hours. These changes require adjustments from working individuals, especially local communities who were previously farmers or fishermen who have authority over themselves and their work in the production process. When working in a mining company, working under the orders of foremen and *supervisors,* must be responsible for completing the work given according to the targets individually and in groups, bound by the predetermined working time. The adaptation process for company employees here requires a collective attitude, working as a team with a number of people who have different backgrounds (ethnicity, race, religion, character, and expertise). An attitude of tolerance must be possessed by employees because of differences. In a crew group, sometimes in a higher structure is occupied by young people than the workers or people from outside so that the attitudes and behaviors of the individual must adjust to their attitude and work.

According to local people who work in mining companies, their time is very limited because they work in companies that are divided into several shifts (2-3 shifts) that alternate. Time for the nuclear family is limited, attending invitations from relatives or neighbors is very rare because the work rules have been set by the company, almost unable to participate in village activities and community harmony. Socializing with neighbors, relatives is very rare because they also work different shift times. Involvement in collective activities in the neighborhood and village is also limited in time and place.

It is different from the involvement of women in the economic production process. In the long production process, the involvement of other family members is limited, but when the mining company enters, the opportunity to work applies to all family members. Wives, children of working age (men and women) have the opportunity to work in the company. Women previously worked in the domestic sector (household) or were part of the production process

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such as selling fish caught by fishermen. But after mining companies entered, job opportunities for women who met the requirements were open as well as for male workers. The shift in the workspace for women is different from before because the involvement of women in the production team is in the same space and time as a work team. The involvement of women working in companies also places them as one of the main sources in meeting the economic needs of households, not only men. Likewise, children in families who have entered the age of the workforce, with only reading and writing skills can work who have dropped out of school can be accepted to work regardless of educational qualifications. It is not uncommon for 1-3 people to work in a mining company in one family and it can be said that the responsibility of meeting family needs no longer solely depends on the husband, father or man, because all family members have the opportunity to work in the company if they are eligible. The work involvement of some family members correlates with the level of family well-being. Kustiana Ayu (2016) sees that the existence of mining companies in Bahodopi correlates with the level of population welfare by looking at the aspects of job opportunities, income, food consumption and savings. According to him, there has been an increase in income for the community even though the job opportunities have not been maximized, they already have savings and the level of education is better and decent housing conditions show an increase in welfare after the mining (Korah et al., 2019; Cloete & Marais, 2021).

The stages of mining activities start from exploration, construction and production activities, where opportunities for fishermen to convert their livelihoods are very possible. If in previous economic activities relied on manpower and knowledge of farming or fishermen obtained from generation to generation and experience during work. When you become part of a mining company, the opportunity to work relying on manpower is to become a crew/helper (manual labor that relies on manpower), not paying attention to educational qualifications. The opportunity to work as a crew at the exploration and construction stage and the number of workers absorbed is large because what is needed is manual human labor with low skill abilities such as operating heavy equipment, and becoming a material transportation driver for exploration and construction. Workers in this category are recruited for a certain period of time according to the stage of work or contracted by a third party (*outsourcing*) so that they are vulnerable to the continuity of meeting their needs.

In contrast to the production stage, the labor received is more selective accordin to the needs of mining companies. Those who are accepted are workers who have skills that support production activities. Workforce that has basic knowledge obtained from vocational and engineering education received through campus recruitment. Employees in this category are contracted for a long period of time and usually occupy certain skill positions. Of course, they also have opportunities for a better position in the company. Local residents also have the same opportunities if they have the same qualifications as workers from outside because those who are accepted here generally have educational qualifications that suit the needs of the company. Therefore, the company still considers local labor for certain positions in the company that represent the local workforce. Personnel such as crew in the production process are still needed but in limited numbers while still paying attention to the skills of their employees to operate machines and equipment and vehicles, even to upgrade the ability of prospective employees will go through a training period before becoming permanent employees. The process of adaptation from the previous job when switching to a company employee who although uses more energy, there is a training period given to prospective new employees for adjustment/adaptation about work and patterns applied in the company such as working time at night (shift 2 or shift 3) where previously they only worked from morning to evening in the rice fields or gardens for farmers, at dawn until noon or afternoon until evening for fishermen.

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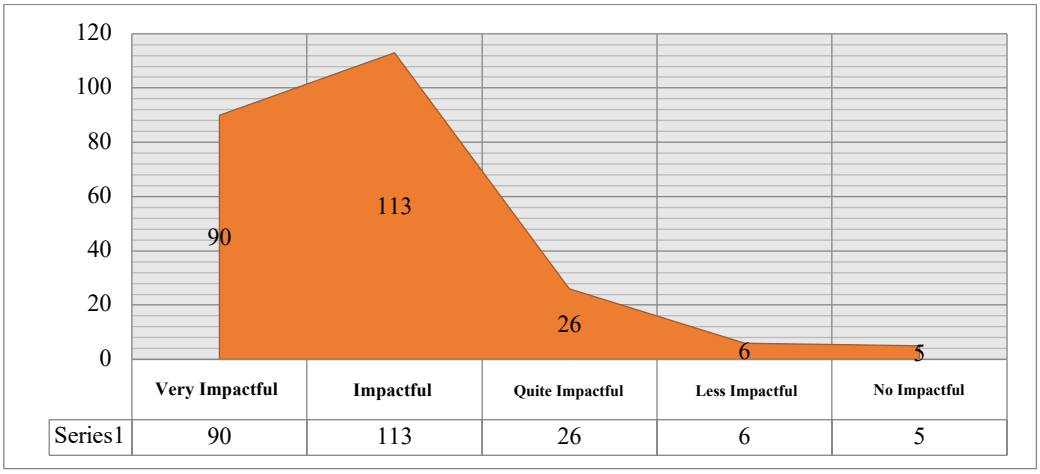
Of course, the adaptation of time using patterns that switch according to the time division of labor in the company.

Adaptation Strategies of Local Communities (Fishermen & Farmers) to Ecological Changes due to Mining

The company's employee recruitment pattern is quite vulnerable to the economic sustainability of local communities such as fishermen or farmers. Rules such as age restrictions for employees because the majority of local people who switch professions are adult working age groups, so their working period is only a few years before finally being dismissed by the company. Another thing is the recruitment model through outsourcing and the tenure depends on the project completion target. When the work stage is completed, the local people who become workers end according to the work contract, and if they want to work again, they must apply for a new job at another company.

The second option opportunity is to take advantage of the opportunities that arise along with the development of society with the number of immigrants working in the company. In this context, local communities such as farmers and fishermen continue to survive the ecological changes that occur. The rules of working within the company are restrictive, such as the age limit for working, the mechanism and rules for working with the company that depend on the duration of the employment contract, and the skills possessed limit their adaptability. Responding to this situation, those who work in companies maximize their working time. The results or salaries obtained are not for consumption, they try to save for business capital or investment in agricultural land and plantations elsewhere, or invest in their land by building boarding houses to rent to mining workers, or opening a home business such as laundry, selling finished food (stalls), selling cakes or other home businesses. In this context, the process of creativity accompanied by free time for housewives is not involved in the long economic production process, but when there are many mining workers, it becomes an opportunity with a home-based business with small capital they can earn a fixed income. For those who have large capital or a fixed income, they will create businesses with large capacities such as drinking water refill businesses (gallons), motorcycle repair shops, building plots of boarding houses for rent.

Diagram 3. Public Perception of the Impact on the Business Sector



Source: Data Processing Results

The choice to work to meet the economic needs of the local community, including fishing families in Bahodopi, after seeing the opportunities created by the flow of workers in the mining sector as well as workers in the informal sector. The development of the Bahodopi

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mining area certainly has an impact on changes in local social, cultural, and economic conditions. Changes in patterns and structures in societies that were originally relatively homogeneous became more heterogeneous. The attractiveness of mining companies triggers the flow of migrant workers and other economic opportunities (*multiplier effect*). The existence of migrant workers and economic actors makes public relations and their dynamics more complex. Likewise, the change in the value system (culture) that underlies social relations is depicted in social relations practices. Differences in values, beliefs, and traditions that form the cultural background of different people cause compromises on the values they understand and even tend to accept each other (*symbiosis*) in certain cultural practices.

Views have both objective and subjective value, although this will be able to describe a person's position or tendency regarding the situation that is the object of discussion. The impact obtained from the existence of the mine shows the high rate of community involvement in the mining mechanism and process. Changes in the economic structure with the existence of mining companies have caused a diversity of livelihood systems for the population. The most affected livelihoods are livelihoods based on the use of natural resources such as farmers and fishermen, but the service and trade sectors are actually stronger because of the high mobility of workers who live in Bahodopi and the number of tens of thousands of employees are consumers (target market) for businesses in the service and trade sectors. The growth of the Bahodopi mining area into an industrial area triggers mobility from areas outside the area to open various kinds of businesses.

The process of creativity and learning entrepreneurial culture by local people in immigrants who are trying especially the spirit of seeing profitable economic opportunities. The survival of a person or a group of people does not occur naturally in the face of certain environmental conditions, but there is a cultural process by individuals and groups to actively work to modify their behavior in order to maintain certain conditions, overcome certain risks in a new condition, or change existing conditions to survive. Adaptation is also an opportunity, an effect of social and cultural practices that unconsciously influence. An actual adaptive process may be a combination of all three of the above. For example, variations in cultural practices may increase due to opportunity/pressure on resources/groups, so adaptation can be said to be an active human strategy in dealing with their environment.

There are two types of adaptive behavior of humans as cultural creatures, namely idiosyncratic behavior or unique ways of individuals in overcoming environmental problems and cultural adaptations that are patterned into belonging to group members, and becoming traditions. According to him, adaptation is seen as a process of taking space for change, where the change exists in cultural behavior that is technological, organizational, and ideological. Cultural traits have a selection coefficient like natural selection, since there are elements of variation, differences in mortality and birth rates, and cultural traits that work through biological systems. Actual adaptive processes are as much a combination of some of the biological mechanisms and cultural commodification mentioned above. So that adaptation can be interpreted as an active human strategy (Hardesty, 1977).

The third option opportunity is to take advantage of the potential of available natural resources and the potential of natural resources that are still controlled by the local population. In practice to meet the needs of the community as the mining area develops, not all can be accommodated to work in a mining company due to the limitations of company rules and skills possessed. Those who are also unable to open a business due to limited capital, then another option is to look at the opportunities that exist in the surrounding nature. Several fishing families living in Dampala Village see the potential of stones and sand in the Dampala River. Fishing families in Dampala Village choose to become stone breakers in the river or collect sand to sell. The

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level of demand for sand and stone materials is quite high because many residents need to build houses or boarding houses for employees. The collected stones or sand are sold for Rp. 60,000 per cubic, in a month they can collect as much as 6-8 cubic. They also combine their work by becoming wage workers in the cocoa and pepper plantations owned by residents. They accept jobs fertilizing, spraying grass/weeds or plant pests from garden owners who work in companies, traders, or civil servants who do not have time to take care of their gardens and plants. As a result of working as a wage worker in their plantation, they are paid Rp. 50,000 – Rp. 75,000 per day with working hours from morning to evening. If the pepper harvest season, they are hired workers to pick pepper by working together with 2-4 people with a wage system of Rp. 100,000 per person or a wholesale system. This work is quite long because of the large area of pepper plantations owned by residents that must be harvested immediately so as not to pass the harvest period which results in a decrease in the quality of pepper seeds. This work is carried out by residents who are classified as economically weak because they do not have production land and their work has stopped due to the absence of fish caught in the sea. Hiring hired workers to take care of the plant garden for the owner is a common thing to do because they are busy working, and they only work in the garden during harvest and/or holidays.

Maximizing the use of controlled land is a form of adaptation to the cessation of farming activities due to damage to the ecological system. The use of yards and gardens owned by residents with short-term crops such as vegetables (beans, kale) and spice crops such as lombok, tomatoes, ginger, turmeric that do not require a large amount of water. This farming practice is carried out by farmers and fishermen along with the development of mining areas that were previously planted only for household consumption but then became a crop that is routinely grown for families. Land use and maximizing production on controlled land have a low adaptation rate because they do not require much adjustment. Basically, they are farmers, including fishing families, who live by their main activity as fishermen. However, he still has a garden land managed by his wife and children. The changes that occur are only in the commodities planted and the area of the crops.

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Adaptation can be seen as an effort to maintain living conditions in the face of change. The definition of adaptation refers to measurements that are linked to the success rate in order to survive. Adaptation should be seen as a cultural response or an open process to the process of modification in which coping with the conditions for life by selective reproduction and extending it. Adaptive dynamics refers to behaviors designed to achieve goals and satisfaction of needs and desires and consequences of behavior for individuals, communities, and the environment. At least the analytical model on this behavior is the actions of individuals designed to increase their productivity, and the modes created by the interactive behavior of individuals with other individuals in the group, which are usually constructed by rules of reciprocity. These interactive behaviors are also designed to meet the end goal and some

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become instrumental. Adaptation at the social level of the individual then becomes adaptive behavior, strategic action, and a synthesis of the two called adaptive strategies. Referring to the concept of adaptation Huy & Zott (2019) and Ackermann & Eden (2020) that the opportunities are converted into patterned actions, which are formed by the various adjustments that people use to acquire and use the resources available and solve the immediate and pressing problems they face.

Conclusion

In the conclusion of this study, it can be concluded that the local community, especially the fishermen in Bahodopi, are facing great pressure due to ecological changes caused by mining activities. They have developed various adaptation strategies to survive, including taking advantage of job opportunities in companies, adapting to complex social changes, and tapping into the potential of existing natural resources. This adaptation is not only individual, but also involves cooperation and mobilization of labor in collective work, as well as building new relationships in a changing work environment. Suggestions that can be made based on these findings are the need for further support and assistance for local communities in the face of ongoing ecological and social changes. Providing skills training and increased access to the job market outside the mining sector can help them adjust and improve their well-being. In addition, efforts are also needed to preserve local cultural values and maintain strong social relationships among community members, as part of their adaptation strategies that have proven effective in the face of change.

References

Ackermann, F., & Eden, C. (2020). Strategic options development and analysis. *Systems approaches to making change: A practical guide*, 139-199. https://doi.org/10.1007/978-1-4471-7472-1_4

Adu-Baffour, F., Daum, T., & Birner, R. (2021). Governance challenges of small-scale gold mining in Ghana: Insights from a process net-map study. *Land Use Policy*, *102*, 105271. https://doi.org/10.1016/j.landusepol.2020.105271

Afdalia, N., Kafrawi, M., & Nutfa, M. (2023). Modus operandi korupsi pada masa pertumbuhan pertambangan nikel di Sulawesi Tengah: Perspektif 'Elite Capture'. *Integritas: Jurnal Antikorupsi*, *9*(1), 55-70. https://doi.org/10.32697/integritas.v9i1.987

Amoako, K. O., Amoako, I. O., Tuffour, J., Naab, G. Z., & Owiredu-Ghorman, K. (2023). Challenges of Sustainability Practices: Evidence From a Gold Mining Multinational Enterprise in Ghana. In *Contextualising African Studies: Challenges and the Way Forward* (pp. 53-78). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80455-338-120231004

Andrews, N., Bennett, N. J., Le Billon, P., Green, S. J., Cisneros-Montemayor, A. M., Amongin, S., ... & Sumaila, U. R. (2021). Oil, fisheries and coastal communities: A review of impacts on the environment, livelihoods, space and governance. *Energy Research & Social Science*, *75*, 102009. https://doi.org/10.1016/j.erss.2021.102009

Anindhita, T. A., Zielinski, S., Milanes, C. B., & Ahn, Y. J. (2024). The Protection of Natural and Cultural Landscapes through Community-Based Tourism: The Case of the Indigenous Kamoro Tribe in West Papua, Indonesia. *Land*, *13*(8), 1237. https://doi.org/10.3390/land13081237

ISSN 2721-0960 (Print), ISSN 2721-0847 (online)

Barz, F., Eckardt, J., Meyer, S., Kraak, S. B., & Strehlow, H. V. (2020). Boats don't fish, people do′-how fishers′ agency can inform fisheries-management on bycatch mitigation of marine mammals and sea birds. *Marine Policy*, *122*, 104268. https://doi.org/10.1016/j.marpol.2020.104268

Cloete, J., & Marais, L. (2021). Mine housing in the South African coalfields: The unforeseen consequences of post-apartheid policy. *Housing Studies*, *36*(9), 1388-1406. https://doi.org/10.1080/02673037.2020.1769038

Decuyper, M., Chávez, R. O., Lohbeck, M., Lastra, J. A., Tsendbazar, N., Hackländer, J., ... & Vågen, T. G. (2022). Continuous monitoring of forest change dynamics with satellite time series. *Remote Sensing of Environment*, *269*, 112829. https://doi.org/10.1016/j.rse.2021.112829

Gundelund, C., Arlinghaus, R., Birdsong, M., Flávio, H., & Skov, C. (2022). Investigating angler satisfaction: the relevance of catch, motives and contextual conditions. *Fisheries Research*, *250*, 106294. https://doi.org/10.1016/j.fishres.2022.106294

Huy, Q., & Zott, C. (2019). Exploring the affective underpinnings of dynamic managerial capabilities: How managers' emotion regulation behaviors mobilize resources for their firms. *Strategic Management Journal*, *40*(1), 28-54. https://doi.org/10.1002/smj.2971

Korah, P. I., Nunbogu, A. M., Cobbinah, P. B., & Akanbang, B. A. A. (2019). Analysis of livelihood issues in resettlement mining communities in Ghana. *Resources Policy*, *63*, 101431. https://doi.org/10.1016/j.resourpol.2019.101431

Krzyżak, J., & Korzeniewski, K. (2021). Marine creatures dangerous for divers in tropical waters. *International maritime health*, *72*(4), 283-292. https://doi.org/10.5603/IMH.2021.0052

Laurence, D. (2021). The devolution of the social licence to operate in the Australian mining industry. *The Extractive Industries and Society*, *8*(2), 100742. https://doi.org/10.1016/j.exis.2020.05.021

Musoke, D., Lubega, G. B., Twesigye, B., Nakachwa, B., Brown, M. O., & Gibson, L. (2024). Enhancing the capacity of community health workers in prevention and control of epidemics and pandemics in Wakiso district, Uganda: evaluation of a pilot project. *BMC Primary Care*, *25*(1), 260. https://doi.org/10.1186/s12875-024-02522-1

Namanda, C., Atuyambe, L., Ssali, S., Mukose, A., Tumwesigye, N. M., Makumbi, F. E., ... & Ddungu, P. (2023). A qualitative study of influences on the uptake of contraceptive services among people of reproductive age in Uganda. *BMC Women's Health*, *23*(1), 130. https://doi.org/10.1186/s12905-023-02274-7

Nutfa, M., Roslinawati, R., Mascunra, A., Saleh, M., & Suriansah, S. (2023). Social Change and Threat to Agrarian Rights of the Tau Taa Wana Indigenous People in Central Sulawesi. *JSW (Jurnal Sosiologi Walisongo)*, *7*(2), 115-126. https://doi.org/10.21580/jsw.2023.7.2.13118

Rosyida, I., Ullah, W., Helmi, A., & Sasaoka, M. (2019). Adapting livelihoods to the impacts of tin mining in Indonesia: Options and constraints. *The Extractive Industries and Society*, *6*(4), 1302-1313. https://doi.org/10.1016/j.exis.2019.10.018

Sohel, M. S., Ehsan, S. M. A., Zaman, N. T., Hossain, B., Shi, G., Sarker, M. N. I., & Ali, H. M. (2022). Understanding rural local government response during COVID-19-

ISSN 2721-0960 (Print), ISSN 2721-0847 (online)

induced lockdown: Perspective from Bangladesh. *SN Social Sciences*, *2*(10), 216. https://doi.org/10.1007/s43545-022-00516-3

Taqiyaah, A., & Hidayat, A. (2023). Laws Concerning Mineral and Coal Mining on Community Welfare from an Environmental Ethics Perspective. *Indonesian Journal of Environmental Law and Sustainable Development*, *2*(2). https://doi.org/10.15294/ijel.v2i2.70333

Watson, S. (2019). *City water matters*. Singapore: Palgrave Macmillan. https://doi.org/10.1007/978-981-13-7892-8

Wellmann, T., Schug, F., Haase, D., Pflugmacher, D., & van der Linden, S. (2020). Green growth? On the relation between population density, land use and vegetation cover fractions in a city using a 30-years Landsat time series. *Landscape and Urban Planning*, *202*, 103857. https://doi.org/10.1016/j.landurbplan.2020.103857

ISSN 2721-0960 (Print), ISSN 2721-0847 (online)