

The economic adaptation pattern of seaweed cultivator community affected by nickel mine waste in North Konawe Regency, Indonesia

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Abstract. The impact of nickel mining activity in North Konawe Regency, Southeast Sulawesi Province is felt by the coastal community, especially by seaweed cultivators. This has caused the failure of the seaweed cultivation business, which significantly affected family income and welfare. Therefore, this study aimed to describe the existing conditions of seaweed cultivation in the mining area of North Konawe Regency and the economic adaptation pattern of farmers in fulfilling their daily needs. It was conducted using in-depth interviews, surveys, observations, and focus group discussions (FGD). The data obtained were analyzed using qualitative and quantitative descriptive analysis methods. The results showed that all seaweed farmers at the nickel mining area of North Konawe Regency experienced continuous failure, hence, they did not resume cultivation. Subsequently, the adaptation pattern of seaweed cultivators in fulfilling the family economic needs due to the cultivation failure is by taking debt from non-formal financial institutions, using savings, and selling business assets as a survival strategy. It also includes becoming a fisherman and an entrepreneur as well as the use of close relationships, kinship, and friendship as a social strategy.

Key Words: model, adaptation, economy, mining, nickel, seaweed.

Introduction. Economic development is a continuous effort and a manifestation of the state's responsibility to its community. However, it usually changes the life and economic pattern of the community. This condition exists in coastal areas in Southeast Sulawesi Province, especially for seaweed cultivators due to changes in aquatic ecosystems, which were caused by nickel mining activities in the excavation and shipping processes. This province is a center for seaweed cultivation and ranked 4th among other regions in Indonesia, with the largest production of 917,363 tons in 2013 (Indonesian Ministry of Marine and Fishery's Directorate of Fishery 2016).

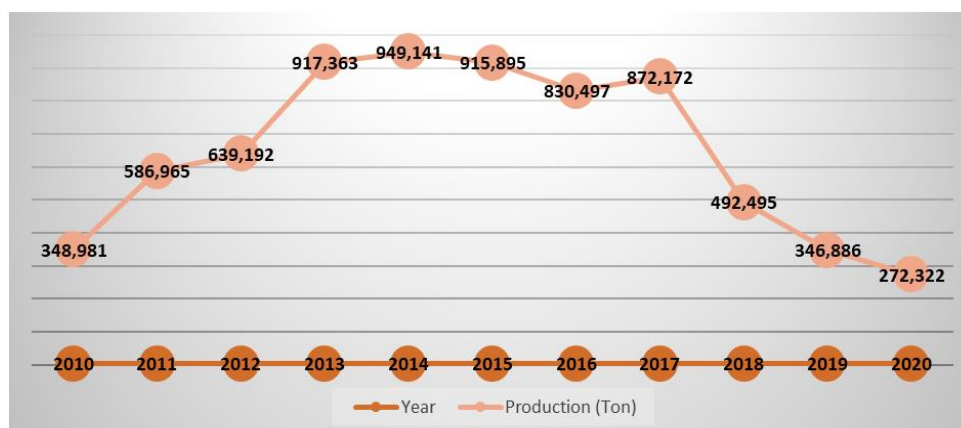


Figure 1. Production of seaweed in Southeast Sulawesi Province.

Figure 1 shows seaweed production in Southeast Sulawesi Province from 2010 to 2020, which was quite volatile with a decreasing trend in the last five years (2014-2018). This indicates the province's problems in the seaweed cultivation business. However, it was discovered that nickel production in the area experiences a continuous increase yearly as presented in Figure 2.

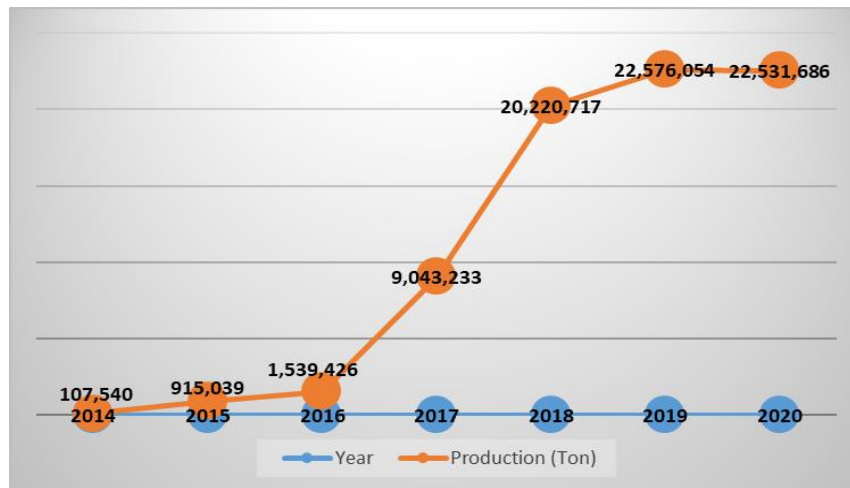


Figure 2. Nickel production in Southeast Sulawesi Province in 2014-2020.

The description of seaweed and nickel production, as shown in Figures 1 and 2, indicates the condition of the seaweed cultivator community in the coastal areas of Southeast Sulawesi Province. This also shows a shift in community livelihoods, especially in the replacement solutions applied by cultivators to maintain their family's economy, as a consequence of the failure of the cultivation business. Previous investigations have revealed that the mining sector plays an important role in accelerating the development, business opportunities, and employment. However, problems are usually encountered when mining activities negatively affect other sectors of the community economy. The presence of the mining industry has changed the economic structure and the local community has even become marginalized (Rasyida & Sasaoka 2018; Hatu 2011). According to the preliminary study, the seaweed cultivation business that has been carried out by coastal communities with very good results is no longer practiced.

Therefore, this study aims to assess the existing conditions and economic adaptation pattern of seaweed cultivators who do not engage in other related businesses in the mining areas of North Konawe Regency. This is because the development of a seaweed business is a very important activity, able to increase the region's productivity, people's income, and standard of living (Muthalib et al 2017). According to Nuryadi et al (2017), seaweed growers can make US\$ 458.71 ha⁻¹ at a selling price of US\$ 0.67 kg⁻¹ seaweed.

Material and Method

Study location. This study was carried out in Southeast Sulawesi Province using data on cultivators, obtained in North Konawe Regency. The data were collected from 3 villages that had been centers of seaweed affected by nickel mining waste, namely Barasanga, Lemobajo, and Tanjung Bunga.

Data collection technique. The data were obtained through a purposive sampling technique using qualitative and quantitative approaches. This was carried out through field surveys and interviews with cultivators, village, and local government (Marine and Fisheries Service). Field surveys were conducted by observing and visiting the cultivation activity sites, as well as the trading business units. In-depth surveys and interviews with affected local seaweed cultivators and groups, village government and elements of the local Maritime Affairs and Fisheries Service were also performed. Additionally, this study

uses structured and semi-structured questions through surveys, key informants, and FGD.

The data are related to the existing conditions of seaweed cultivation in mining areas and the pattern of family economic adaptation in fulfilling their economic needs. The indicators used in assessing economic adaptation patterns were selected as follows:

- a. The survival adaptation pattern is studied based on 11 indicators, namely selling land, vehicle assets, jewelry, electronic goods and business assets, reducing consumption, debt to financial and non-financial institutions (banks), as well as borrowing from family, neighbors, and using savings.
- b. The pattern of adaptation to alternative economic sources is based on 5 indicators, namely fishing, farming and gardening, working in the construction industry or as mining workers, as well as entrepreneurs.
- c. The pattern of adaptation based on social interaction is based on 5 indicators, namely using family relationships, neighborhood, friendship, social organizational networks, and government assistance.

Statistical analysis. This study was conducted using in-depth interviews, surveys, observations, and focus group discussions. The data obtained were analyzed using qualitative and quantitative descriptive analysis methods. This was carried out using an in-depth description to understand and interpret the meaning and relationships of the symptoms observed, to obtain a comprehensive, holistic, and integrated. Therefore, the principle in this analysis is a systematic search for causality and social explanation.

Results and Discussion

Seaweed production in areas affected by nickel mining. The general description related to the seaweed conditions in areas affected by nickel mining activities in North Konawe Regency is quite fluctuating, although there is no visible production in the last 2 years. The seaweed production of the regency as a center affected by nickel mining waste is shown below.

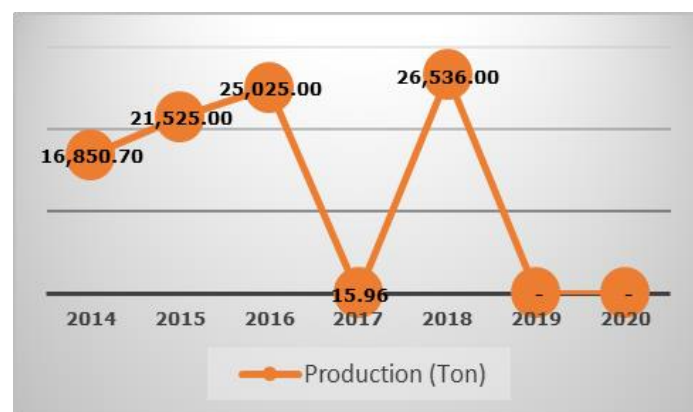


Figure 3. Seaweed production in North Konawe Regency in 2014-2020.

Figure 3 shows the significant impact of the mining business on seaweed cultivation. This is proven by the absence of seaweed production, especially in business centers. The results of field identification interviews with community seaweed cultivators in North Konawe Regency reveal a continuous decrease in cultivation due to declining water quality, though several attempts have been made to rebuild the business through cultivators' initiatives or assistance programs from the local District Fisheries Service. It was also reported that since the operation of mining companies began in coastal areas, there have been continuous business failures caused by the flow of mining land sediments into the sea, thereby polluting the cultivation area, especially when raining.

The shipping activity that passes through the area around the seaweed fields carrying mining soil material has also changed the color of the seawater, thereby polluting the waters of the cultivation area, which leads to the decay and death of

seaweed. According to Jonah & Adu-Boahen (2016), mining activity that produces sediment can further exacerbate the coastal erosion intensity and damage aquatic ecosystems. Prianto & Husnah (2009) also showed the negative impact of mining activities on aquatic ecosystems. These include sedimentation and changes in the landscape of coastal areas, decreased water fertility, increased turbidity, ecosystem damage as well as the destruction of aquatic biota, and heavy metal pollution.

The impact of mining activities will be felt by changes in the local economy, especially in places with low human resources and after mining operations are closed (Cobbinah & Amoako 2018). Therefore, the restoration of the ecological environment is a major factor that must be addressed for environmental sustainability and community activities. The issues that trigger conflicts in coastal areas are environmental, social, legal, and economic (Bidayani & Kurniawan 2020; Fuhong et al 2017).

Economic adaptation patterns. The economic adaptation pattern of seaweed cultivators affected by nickel mine waste in North Konawe Regency was analyzed through 3 approaches, namely survival, alternative economic sources, and social interaction adaptation patterns.

1. Survival adaptation patterns. The survival adaptation pattern of seaweed cultivators affected by nickel mine waste in North Konawe Regency is presented in Figure 4.

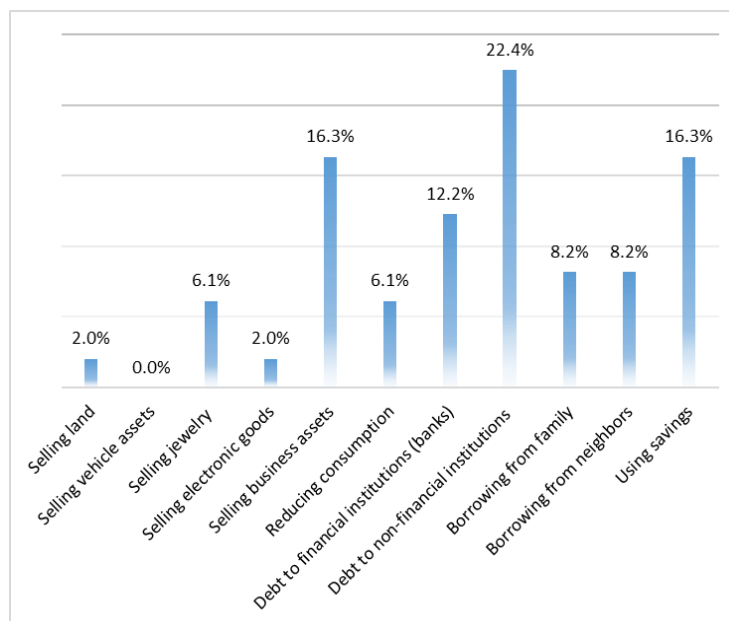


Figure 4. Survival adaptation patterns.

The survival effort of seaweed cultivator families affected by nickel mines in the regency is essentially oriented towards borrowing funds from non-formal institutions, because the funds are quickly and easily obtained, in terms of requirements. Subsequently, cultivators also take advantage of their savings and sell business assets. According to Scones (2001), an adaptation strategy is a combination of actions taken by households to achieve better welfare. Asset management can be used to make adjustments or develop certain strategies for maintaining survival (Suharto 2009). According to Suharto (2009), the strategy that can be used to survive is to borrow money from moneylenders or banks. This can help poor families when they need money urgently (Sugihardjo 2012). Staszynska et al (2010) also stated that the adaptation strategies adopted by farming households in Poland to overcome the challenges of deteriorating economic conditions are acquiring new skills for work, saving, borrowing, and selling assets.

2. Adaptation patterns based on alternative economic sources. Adaptation patterns based on alternative economic sources are presented in Figure 5.

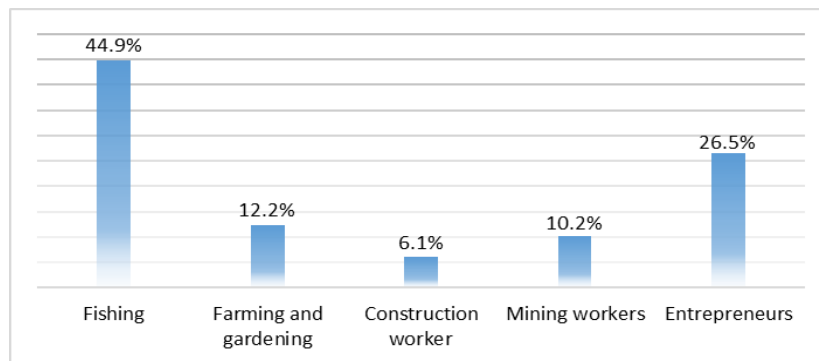


Figure 5. Adaptation patterns based on economic sources.

The assessment results of the adaptation pattern of the seaweed cultivator community affected by nickel mines are shown in Figure 4. It was discovered that the majority of cultivators returned to sea fishing activities, which was their initial job before the seaweed cultivation business. Another option is to become an entrepreneur as well as to practice farming and gardening. The community recognizes that there is a huge degradation of their income since they ceased being seaweed cultivators. Although there is a decrease in income, the community has no other alternatives due to its members' capabilities and available resources. Twigg (2001) and Ratna (2013) stated that a livelihood shift is a community reaction in dealing with changes to achieve a sustainable livelihood. Furthermore, Grigoryev & Berry (2017) reported that skills have a positive relationship with the ability to assimilate and adapt. This transition is not uniformly distributed across the community due to past habits. According to Nurhayati (2014), the conversion of agricultural land to non-agricultural causes problems for small farmers because they do not have other expertise outside of agriculture.

The economic source in Figure 4 shows that some people practice more than one occupation, which includes fishing, farming, and entrepreneurship, in order to fulfill the economic needs of the family and as a precaution, on case of failure in one business. This activity is performed by mobilizing all potential in the family, including the wife as well as children, and by their involvement in various jobs, even though the results obtained are sometimes modest (Kusnadi 2000). Meanwhile, the condition in Figure 4 illustrates the impossibility for the community to improve its economy, due to limited abilities and skills.

3. Adaptation pattern based on social interaction. The dominant pattern of economic adaptation, based on social interaction, as shown in Figure 6, include neighborhood, family, and friendship relations.

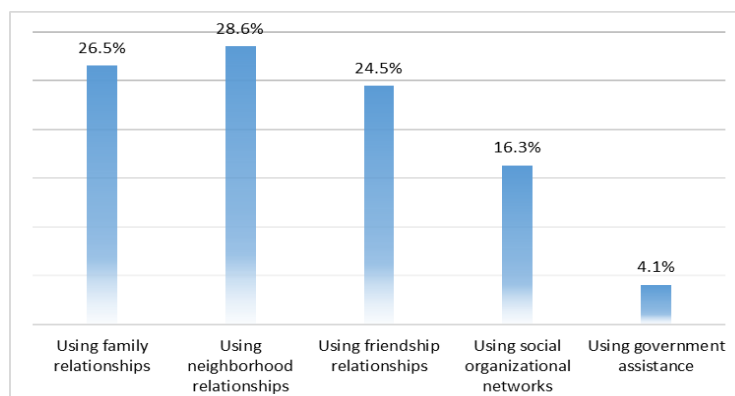


Figure 6. Patterns of economic adaptation based on social interaction.

The adaptation pattern of using kinship, neighbors, and friendship describes that in the community of seaweed cultivators there are already close solidarity relationships. This is referred to as an active socio-economic adaptation strategy to increase family income, by carrying out various actions (Suharto 2009). Society will always try to stabilize changing conditions, such as needs in the socio-economic field, therefore, the farming community applies 4 absolute prerequisites, namely adaptation, goal attainment, integration, and latency, in order to maintain the variation in the socio-economic field (Ritzer & Gouglas 2011).

According to Suharto (2009), the networking strategy can also be carried out by establishing relationships, both formal and with the social environment. Sugihardjo (2012) also stated that social networks are formed due to interactions in the community and can help poor families when they need money urgently. Moreover, a specific social variable that can be used as a benchmark for a sustainable aquaculture is the poverty rate (Petiana et al 2015). According to Ting et al (2015), a sustainable aquaculture must integrate environmental, social, institutional, and economic dimensions. When this is accomplished properly, aquaculture fisheries have bright prospects and can fulfill current as well as future food, social, economic, and employment needs.

Seaweed cultivation still susceptible to increase family economic resilience in the future. However, it must be developed from integrated planning and management between the government, the industrial sector and seaweed cultivators, by considering the economic, institutional and technological factors (Zainudin 2020; Ferdouse et al 2018; Benham 2016). In larger disasters, economic resilience is the responsibility of state institutions (Zhang 2022).

The development of the nickel industry also has several negative impacts on the community, namely a consumptive culture and lifestyle, a lack of motivation to develop a business and the tendency for people to get something instantly and easily (Nuraeni 2018). Therefore, changes in social and economic functions should be balanced with efforts to sustainably increase the community's economic resilience. The development strategy is directed towards economic resilience by creating the right business climate, using science and technology, supplying goods and services, maintaining the environmental functions and increasing the competitiveness in global markets (Carletto et al 2013). Environmental quality can also increase the community economic resilience due to its significant impact on the productivity and continuity of fishery activities. This economic resilience is the condition of the community with access to sufficient food for individuals and groups, as well as with the ability to maintain their provisions at all times, both physically and economically (Fisher 2001). This is also an effort to discover the best way of allocating various resources to fulfill the need for security (Yusgiantoro 2014). Similarly, in the blue economy context, increasing seaweed cultivation can boost economic growth, increase farmers' income, preserve the oceans, and enhance environmental sustainability (Freitas et al 2022).

The government must also ensure that the existence of the industry does not cause a decrease in environmental quality due to waste pollution. The higher the waste volume, the greater the potential for environmental pollution (Glavic & Lukman 2007; Ardebili & Boussabaine 2007; Halog & Chain 2006). According to Miller (2021), seaweed management requires policies that can ensure the realization of sustainable development, prioritizing economic benefits as well as the interests of local and rural communities. Harahap et al (2020) showed that natural resources and a good coastal environment will contribute to the productivity of fisheries. A high and continuous fisheries productivity can determine the restoration of the community's economy.

Conclusions. The results showed that all seaweed cultivation areas located in the nickel mining area in North Konawe Regency experienced continuous failure, therefore the community could no longer practice cultivation business. Subsequently, the adaptation pattern of seaweed cultivators in fulfilling the economic needs of families due to cultivation failure is by taking debt from non-formal financial institutions, using savings, and selling business assets as a survival strategy. The cultivators also engage in fishing

and entrepreneurship as an economic resource strategy and by using close relationships, kinship, as well as friendship as a social strategy.

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Conflict of interest. The authors declare no conflict of interest.

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