Nickel Smelter on Social-Economics and Environmental Issues

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Abstract

As one of the countries in the world with large nickel reserves, Indonesia can use this wealth of mineral resources to accelerate development and improve people's welfare. However, like the management of mineral resources in other countries, mineral exploration has a side effect on the environment and people's lives, especially those who live around the mines. This study reveals the environmental and socio-economic impacts that occur at the smelter construction site in *Bahodopi* Sub-district, *Morowali* Regency Central Sulawesi Province of Indonesia. The existence of nickel plant has become a magnet for migrants, the drying up of several rivers, degradation of forest functions and sedimentation along the coast, has forced local residents to join migrants in pursuing new livelihoods in the trade and service sector, leaving their previous livelihoods as farmers and fisherman. It cannot be denied that there has been an increase in GDP from the mining sector, but it has not been used optimally to repair environmental damage and socio-economic impacts caused by mining activities.

I. Introduction

Indonesia is listed as the country with the largest nickel reserves in the world, having deposits of around 23,7% of the world's total reserves. The largest nickel content is distributed in three regions, namely Southeast Sulawesi at 32%, Central Sulawesi 26% and North Maluku 17% (Bhawono, Aryo, 2021). This situation has sparked the interest of investors, especially those from China (Devi, B dan Prayogo, D, 2013). Currently, there are two large smelters in the Provinces of Central Sulawesi and Southeast Sulawesi, located in the *Bahodopi* Sub-district, *Morowali* Regency, Central Sulawesi Province (IMIP/Indonesia *Morowali* Industrial Park) and in *Morosi* District, *Konawe* Regency, Southeast Sulawesi Province (VDNI/Virtue Dragon Nickel Industry). The development of each smelter is supported by the policy of the Indonesian government because until 2013 Indonesia's nickel export-import trade was always been in a disadvantageous position, because all nickel production was being exported in the form of raw materials, while nickel metal was being imported to meet the needs of the stainless steel, alloys, batteries and domestic nickel alloys (Haryadi dan Yunianto, 2016; Setiawan, A., dan Horman, JR., 2019).

Indonesia's mining regulations are currently still in transition, with continuous changes (Devi, B dan Prayogo, D, 2013). Based on several studies conducted, the government issued Government Regulation No. 1 of 2014 which states that mineral and coal mining is required to purify mining products domestically. This policy is expected to encourage new investment in the nickel concentrate processing and refining sector, thereby increasing the added value of domestic minerals. In addition, it can also increase the availability of industrial raw materials, infrastructure and energy availability, employment, increase household income, and increase state revenues, both central and regional (Supriadi, et al, 2015).

Indonesia *Morowali* Industrial Park/IMIP was founded in 2013, developing a nickel mine of nearly 47,000 hectares in *Morowali* Regency, Central Sulawesi. In less than five years IMIP has been able to change the map of the nickel industry in Indonesia. In 2014 nickel production was still controlled by PT. Vale with 77% share, followed by *Antam* 19% and the rest are other companies. However, in 2018 IMIP was able to

control 50% of the nickel industry production in Indonesia. As of early August 2018, IMIP was recorded as employing 25,447 Indonesian workers, and 3,121 foreign workers, shows the increasing speed of activity in the area https://www.ap3i.or.id/News/News-Update/perusahaan-nikel-terbesar-di-sulawesi-tengah-apa-itu-pt-imip-cek-penjelasannya.html (accessed June 26, 2022), and thousands of employees are still needed either by IMIP or companies that work directly or indirectly with the smelter activities in *Bahodopi* (www.imip.co.id).

The existence of mining companies and the operation of smelters have transformed the *Bahodopi* sub-district which was once an isolated area into a rural metropolis with several activities that are completely new for the local community, as has happened in other mining cities in the world. The opening of mining areas will create new community structures and landscapes (Marais, L., et al, 2018). As of September 2016, IMIP's investment has reached USD 2.5 billion. IMIP is currently building 2 smelters with a capacity of 300,000 tons per year and 900,000 tons per year, as well as 2 stainless steel factories with a capacity of 1 million tons per year and 2 million tons per year, respectively (www.imip.co.id, accessed June 26, 2022).

The World Bank in one of its reports emphasized the importance of doing Environmental Impact Assessment (EIA) dan Strategic Environmental Assessment (SEA), especially in countries in the region of East Asia and Pasific region (EAP). Environmental impacts include loss of natural resources, and deterioration of environmental quality in many areas and cities that threatens public health and quality of life, reduces economic productivity, and interferes with sustainable economic growth and poverty reduction (World Bank, 2006).

This paper discusses the impact of the construction of a nickel smelter in *Bahodopi* District, *Morowali* Regency and Central Sulawesi Province of Indonesia. This topic was chosen because since the construction of the smelter began, there have been very significant changes to the socio-economic, ecological and environmental situation in the Bahodopi sub-district area. This study focuses on the migration, shifts in livelihoods, environmental deterioration and social conflicts that have arisen since the IMIP smelter started operating. *Bahodopi*, which was previously an isolated area, has now turned into a rural metropolis, especially in the five villages that were the research sites. Competition with migrants who has come uncontrollable, changes in the landscape, causing a shift in people's livelihoods from depending on the agricultural sector, being forced to change or adapt to new activities in the form of trade and services.

Broadly speaking, the main activities of nickel mining companies include the construction of industrial estates in *Bahodopi* sub-district *of Morowali* Regency, including; the determination and transition of land tenure and compensation, development of supporting infrastructure for industrial areas that grow and develop as a consequence of the development of the IMIP area. Labor mobilization and population migration then occur due to the attractiveness of mining activities and job opportunities. The uncontrolled arrival of migrants encourages the opening of various new livelihood activities, especially in

the trade and services sector. On the other hand, the arrival of migrants also adds to the burden of the carrying capacity of the environment as well as competition with local residents.

Ii. Research Methods

This research was carried out in five villages in *Bahodopi* Sub-district of Morowali regency, namely *Lalampu, Bahodopi, Fatufia, Keurea* and *Labota* with the consideration that the five villages were the closest to the smelter location and experienced the most significant landscape changes compared to other villages in the *Bahodopi* sub-district. This research was conducted in the period between Januarys - August 2021. The research activity was started by preparing village profiles and maps as well as GPS. The survey was conducted with 835 respondents who were distributed respectively in *Lalampu* 224, *Bahodopi* 165, *Keurea* 199, *Fatufia* 171 and *Labota* 78.

The analysis was carried out by tabulating, classifying and calculating answers based on frequency data and presenting them based on answer categories. All data were processed by tabulating the frequency distribution using SPSS software and descriptive statistics to analyze the data by calculating the average and percentage. Some of the variables observed include the impact of the existence of mining on the GDP of *Morowali* Regency, population migration, and shifts in people's livelihoods and environmental changes that occur.

Iii. Result And Discussion

- **Impact of Mining on Macroeconomic Performance of** Morowali **Regency**

It is undeniable that the construction of a smelter in the IMIP area has had a positive impact on the GRDP of *Morowali* Regency. A very significant change in contribution occurred, where the mining and quarrying sector as well as the processing industry contributed very significantly to the GDP of Morowali district in the 2015–2019 periods (Fig. 1). Morowali Regency's GDP grew on average by 17.40% during that period.

The contribution of the mining and manufacturing sectors also continued to grow during the 2015–2019 period, with an average contribution of 62.57% annually to the total GDP of *Morowali* Regency (Fig. 2). This contribution is much higher than the agricultural sector, which before the existence of mining dominated *Morowali's* GDP. It is estimated that the contribution of the mining and manufacturing sectors will grow even greater in line with the addition of IMIP's smelter capacity.

The very large increase in the contribution of the mining and manufacturing sectors to the GDP of *Morowali* Regency does not seem to have been followed by improvements in infrastructure and public services for the community in *Bahodopi* District. Based on experience in many countries, it shows that the increase in GDP from mining and quarrying as well as the processing industry will also be followed by several problems in terms of health problems, social problems and some environmental impacts that occur as a result of these activities. Macroeconomic indicators are not only related to GDP, but also related to inflation rates, unemployment, the consumer price index, interest rates and energy consumption

levels (Chang, X., and Y.X Li, 2020; Jahanmiri, S., et al, 2021; Ramirez, KM., 2020; Mardone C., and R. Rio, 2019). Sustainability of mining activities is how much mining contributes to the community, not only the economic impact, but also the assessment of positive impacts in general including social and environmental (Mancini, L and Serenella Sala, 2018).

The road conditions in the five villages that were the research sites did not change much, while the volume of vehicles increased remarkably. Existing roads must accommodate mining vehicles and community vehicles that carry out various trading activities and daily activities.

Apart from transportation facilities, education and health facilities are also still very limited both in terms of physical facilities and human resource management, there are many complaints from the local community. The increase in population due to uncontrolled migration has resulted in the need for increasing the capacity of educational facilities, the emergence of a number of new diseases also requires completeness of health facilities and better health workers as stated by respondents in the five villages.

- **Migration and Social Conflicts**

A very large jump in population growth occurred in the 2019–2020 period in almost every village that became the research location. The increase in population growth has actually occurred since 2015, which was triggered by the operation of mining activities, as well as companies that are directly or indirectly related to the activities of mining companies, but because more accurate population data collection has only been carried out in between 2019–2020 (Tabel 1), it appears that migration growth is very high only in that period. Mining activities are concentrated in the five villages that are the research sites. The IMIP smelter is located right in the village of Fatufia, which borders the villages of *Labota, Keurea, Bahodopi* and *Lalampu*.

Table 1
Area and Population Growth in the study area

No	Villages	Area (Km2)	Population Growth				
			2016	2017	2018	2019	2020
1	Lalampu	103,32	237	241	246	249	6,289
2	Bahodopi	118,17	833	848	860	874	2,800
3	Keurea	102,87	718	731	742	754	5,233
4	Fatufia	119,79	789	802	815	827	4,059
5	Labota	162,17	444	452	458	466	6,285

Primary data, processed (2021)

The population growth figures above are only estimates. There is no definite data regarding the real population growth rate in the Bahodopi area due to: 1) no official data on the number of foreign workers working in IMIP and other companies; 2) not all migrant residents report their presence to the local government. The state should be there to solve problems that cannot be solved by local governments (Maher, Rajiv et al, 2019).

The increasing number of migrations is caused by the increasing number of manpower needs, both for smelter operational activities and by companies that are directly or indirectly related to mining activities, providing opportunities for migrants to be able to obtain better income opportunities (Bainton, NA., and Banks, G., 2018). The large increase in the number of migrants affects access to resources, environment, social and economy, including competition among job seekers (Bury, J., 2007; Mkodzongi, G., and S.J Spiegel, 2020).

The population in the five villages is dominated by migrants, so most of the population is of productive age, this is evidenced by the results of interviews with 835 respondents, of which 77.84% of them are in the productive age group between 17–40 years (Table 2). This situation further emphasizes the fierce competition between job seekers in the five research villages. The demands of the local population to obtain dispensation in obtaining employment, as well as the opportunity to become a supplier to the needs of mining companies were increasingly voiced during the research.

Tabel 2. Respondents Age Groups

Age Groups	Number of repondents	Percentage
17–40	650	77.84
41–60	167	20.00
> 60	18	2.16
Total Respondents	835	100

Primary data, processed (2021)

Migration of the population who moved in the five research villages came from various regions in Indonesia, *Sumatra, Kalimantan, Java, Bali, West Nusa Tenggara, Ambon* and all provinces on the island of Sulawesi (Table 3). More than 60% of migrants have no relatives in *Bahodopi*sub-district. They come bringing different cultures from those of their places of origin. One of the biggest disturbances to local communities in mining areas—along with the destruction of the landscape and environment as well as massive capitalist intrusion is the change in semi-subsistence lifestyles and it is the influx of migrants into areas surrounding mining operations (Bainton, NA., and G. Banks, 2018).

Table 3
Ethnic Groups and Province of Origin of Respondents

No	Ethnic Groups	Number of respondents	Province of Origin	No	Ethnic Gropus	Number of repondents	Province of Origin
1	Amori	1	Central Sulawesi	1	Jakarta	1	The Island of Java
2	Ampana	2		2	Jawa	35	
3	Bajo	10		3	Betawi	1	
4	Bungku	214		4	Sunda	10	
5	Bungku Eppe	5		5	Banten	1	
6	Kaili	8		**Sub Total**		**48**	
7	Luwuk	4		1	Padang	1	The Island of Sumatera
8	Menui	7		2	Batam	2	
9	More	2		**Sub Total**		**3**	
10	Mori	3			**Lombok**	**3**	West Nusa Tenggara
11	Mori Bungku	1					
12	Morowali	1			Bali	5	Bali
13	Palu	8			Dayak	1	The Island of Kalimantan
14	Poso	12					
15	Tomini	1			Ambon	1	Maluku
16	Toeppe	1					
17	Wana	2					
Sub Total		**282**					
1	Bugis	261	South Sulawesi				
2	Bugis Barru	1					
3	Bugis Palopo	2					
4	Bugis Pindarang	1					
5	Bulukumba	1					
6	Luwu	47					

No	Ethnic Groups	Number of respondents	Province of Origin	No	Ethnic Gropus	Number of repondents	Province of Origin
7	Makassar	13					
8	Mamuju	1					
9	Mandar	7					
10	Massamba	2					
11	Palopo	1					
12	Toraja	45					
Sub Total		**382**					
1	Buton	14	Southeast Sulawesi				
2	North Buton	1					
3	Muna	25					
4	Tolaki	65					
Sub Total		**105**					
1	Sangir	1	North Sulawesi and Gorontalo				
2	Gorontalo	4					
Sub Total		**5**					
Total Respondents						**835**	

Primary data, processed (2021)

Bahodopi sub-district has become the main destination for migration of people from various regions in Indonesia and China with the aim of working at IMIP or seeking other benefits. As a result, this area experienced unnatural population growth. According to some information collected during the study, it is estimated that the population will increase by tens of thousands people, over the next few years.

Population data collection is still a problem in every village because of limited human resources and supporting equipment to register migrants. Especially for migrants who come from abroad. According to government officials there, they have often asked for data on the number of workers at IMIP but not yet available. They addressed the request to the company's public relations and always answered that it would be immediately conveyed to the leadership. Unfortunately, the answer to this request has not yet been received. Likewise, not all of the domestic migrants reported their presence to the village government. Meanwhile, not all of those who reported their presence lived in the village where they reported their presence. For example, in *Fatufia* Village, there are more than 2,000 people who report and

are registered as temporary village residents, however, if traced, they do not live in the Fatufia area. They only need the domicile certificate only to complete the administrative requirements for working at IMIP.

The skill background and education level are almost the same as the local population (Table 4), making migrants (non-Chinese) and local residents generally work in lower management positions, manual labor, cleaning service staff and security guards, both in mining companies and other companies that are directly related or indirectly with mining activities. Others are involved in trading activities, opening food stalls, grocery stores or opening service businesses such as massage parlors and salons. Various new livelihoods, related to the opening of mines are closely related to changes in the economy, socio-culture, politics, and environmental conditions (Horsley, J., 2015).

This situation makes local residents have to face to face with migrants in the struggle for business land that has sprung up in *Bahodopi*. Mining opening activities, despite the positive benefits that can be obtained indirectly by local communities, mining often does not have a positive impact on communities who suffer from lack of education and poor access to markets and resources (Pokorny, B., et al, 2019).

Table 4
Respondent's Education Level

No	Level of Educations	Number of repondents	%
1	No School	82	9.82
2	Did not finish elementary school	89	10.66
3	Finished elementary school	82	9.82
4	Graduated Junior High School	78	9.34
5	Graduated Junior High School	415	49.7
6	Diploma, undergraduate, postgraduate	89	10.66
Total		**835**	**100.00**

Primary data, processed (2021)

The rapid rate of investment and population growth in *Bahodopi* not only provides positive benefits for development in the area, but also simultaneously creates the potential for horizontal conflicts that can occur at any time. Scarcity of economic opportunities is linked to livelihood issues, and distribution issues are often the start of conflict (Haslam, PA., and Nasser Ary Tanimoune, 2015). The conflict that occurred around 2019, between the *Toraja* tribe and the local population (*Bungku*), was suspected to be due to jealousy in the distribution of access and resources. In the future, it is not impossible that similar conflicts can occur again. A number of factors can trigger horizontal social conflict in the future: First, the current migrant population is estimated to have exceeded the local population in *Bahodopi* by a ratio of 60 percent of the migrant population and 40 percent of the local population. This situation can easily lead to major conflicts due to competition and unequal access. It is not only household poverty that has

the potential to increase the likelihood of conflict, but the combination of poor households in poor communities that are not served by the state (Maconachie, Roy and Tony Binns, 2007)

Second, the migrant population holds much greater economic opportunities than the local population. In addition to working at IMIP both as employees and as contractors, many migrant residents develop businesses including hotels, inns, boarding houses, basic food shops, building materials stores, convenience stores, selling food and transportation businesses (vehicle rental). Meanwhile, only small parts of the local population are engaged in such businesses. Socio-demographic and economic in the form of inequality are the main triggers of conflict in mining areas (Castellares and Fouche, 2017).

The development of rural areas in mining areas requires institutional changes, including the relationship between urban and rural economies, between jobs inside and outside agriculture, the relationship between economic transformation, institutional change and livelihoods and ensuring that the poor can participate in the process of economic growth that occurs (Bebbington et al, 2008). The dominance of the migrant population can be easily seen along the left and right of the main roads and local markets. It is estimated that around 70 percent of economic opportunities both related to IMIP and the informal sector are held by migrants and only 30 percent are held by local residents. Wage competition and feelings of injustice can be triggers for conflict. The socio-economic, political, cultural and environmental needs of the diverse community must be integrated into the company's business objectives for peace and security (Brata, NT, 2018; Issifu, A. K., 2016).

Third, population density that exceeds the limit, and a slum environment with a low level of comfort will very easily trigger social conflicts that can be initiated by small actions, such as jealousy, misunderstanding. One example is the irregular construction of boarding houses, so that one day some boarding houses will not have access roads because they are closed by other boarding houses. Small cases like this will easily become a trigger for conflict if it involves local residents and migrants. The creation of local businesses, strengthening human resources and strengthening local institutions appear to be the most successful strategies to promote local development and to reduce conflict in the long term (Javier Arellano, 2011).

Fourth, involves the lack of discourse surrounding village relocation, which appears as a deliberate strategy from the beginning of IMIP's entry into *Bahodopi.* The current situation which is chaotic, shabby, noisy, is strongly suspected to be a condition that was deliberately created and allowed by the authorities and IMIP with the aim of making the local population feel unwelcome in their homeland so they would choose to leave the village. The rumors circulating are that in the end the villages of *Labota, Fatufia, Keurea, Bahodopi* and *Lalampu* will be entirely controlled by IMIP and the original residents will be relocated to other places. Handling social issues cannot only be carried out or become the responsibility of the company alone, the active involvement of the state is very important, even if there are corporate social responsibility activities, it cannot be considered as a replacement for tax payments by companies, because it can result in companies replacing the role of the state (Javier Arellano, 2011).

Horizontal social conflict is one of the negative impacts that often occur in areas that are growing or experiencing rapid economic change, such as in Bahodopi. (Bebbington et al, 2008). The conflict is actually more caused by the unequal distribution of the benefits of resources between one another, both personally and in groups (Chong and Haslam, 2020; Haslam, PA., and Nasser Ary Tanimoune, 2015; Campisi and Caprioni, 2016). Conflict triggering factors like this are quite common in *Bahodopi Sub-district* and *Morowali* Regency in general. Investments in the mining sector often have adverse social, environmental and economic impacts for many, but provide significant benefits for only a few. (Bebbington et al, 2008; Jaskoski, Maiah, 2014). Furthermore, social conflicts can have a long-lasting impact on negative economic growth (Chong and Haslam, 2019). Limited understanding of local culture, is resulting in public relations with the company always fluctuating (Persson, S., et al, 2017; Nguyen, N., et al, 2018; Devi, B., dan Prayogo, D., 2013; Esteves, 2008).

Based on the 2022 BPS report, it is stated that the crime rate in *Morowali* Regency and *Bahodopi* District is quite high. In *Morowali* Regency the number of criminal acts in 2019 was 345 cases, in 2020 as many as 311 cases and in 2021 as many as 326 cases. Meanwhile, in *Bahodopi* District in 2019 there were 179 cases, in 2020 there were 111 cases and in 2021 there were 125 cases. *Bahodopi* Sub-district is the area with the highest crime rate in *Morowali* District. Broadly speaking, criminal cases in this area are theft, abuse and drugs. The socio-economic, political, cultural and environmental needs of the community must be integrated into the company's business objectives for peace and security (Issifu, A. K., 2016).

Despite the complexity of the work, there are some clear paths forward. Companies need to understand where and how they are making a difference in the lives of the most vulnerable, but comprehensive monitoring and evaluation is rarely done well. More effort should be put into outcome and impact evaluations so that companies, governments and communities are clearer about how local level mining practices can contribute to poverty reduction and human development (Kemp, D., 2009; Javier Arellano, 2011).

- **Environmental Impacts and Livelihood Shifts**

The growth of slum areas is one of the current points of concern in Bahodopi Sub-district, including the villages of *Labota, Fatufia, Keurea, Bahodopi* and *Lalampu*. The construction of boarding houses that are irregular and haphazard. There is no clear and firm spatial layout that separates residential areas, public facilities and factory facilities. All of them intertwine with each other. A number of stalls, people's houses and boarding houses were built very close to or adjacent to the highway or right beside the river.

Garbage is one of the indirect environmental impacts of the presence of migrants who are provoked by the presence of the IMIP industrial area. Borders of roads and small rivers become places for dumping and storing residents' waste. This condition worsens environmental sanitation (Aguilar-González et al, 2018). It is estimated that around 68 tons per day of waste are produced by thousands of residents currently living in Bahodopi and its surroundings. This garbage is piled up along the 15 kilometer highway from Labota Village to Lalampu. The absence of a garbage collection fleet from the local

government and IMIP further exacerbates the solid waste condition in this area. So far, waste has only been handled by the local village government with all the limited budget, facilities and human resources.

The severity of environmental pollution as described above is also reflected in the number and types of diseases that afflict the population in Morowali Regency, namely in 2021 as many as 2,304 cases of diarrhea and 271 cases of tuberculosis. Meanwhile in Bahodopi District there were 439 cases of diarrhea and 98 cases of tuberculosis. The two types of diseases that many people suffer from are directly related to the cleanliness of the residential environment and air pollution. This situation is by no means new; it happened at the smelter in Sorowako, just separate by Towuti Lake (T. Glynn, 2006).

The challenge of sustainable development is how to sustain economic growth and meet people's needs without destroying natural resources. The development of the mining industry requires a holistic approach by taking into account environmental sustainability, economic growth and social change. Strong cooperation between all stakeholders is needed, including international organizations to overcome complex problems that occur to create sustainable development (Lahiri-Dutt, K., 2011). It also needs stronger legislationby government agencies at all levels, with penalities of consequence when there are breaches.

The environmental damage that is happening at this time, can form a negative perception of the local community based on various sources of information, including the official news media, the internet, word of mouth, and the company itself. Negative perceptions may stem from anti-corporate or anti-capitalist sentiments. Furthermore, negative perceptions are more likely to arise due to the absence of regular information or communication from the company itself, leading to a partial understanding of the company and its business (Cesar and Ostos, 2020). Even the media should expect strong consequences for promulgating misleading information.

There are three main sources of environmental pollution in Bahodopi, namely air pollution from factory chimneys, the exhaust fumes of motorized vehicles (Table 5). The factory which operates 24 hours has produced thick smoke which is concentrated above the factory site and residential areas. Noise pollution from both two wheeled heeled and four-wheleed vehicles, including heavy vehicles belonging to IMIP, mobilization of this vehicle is deafening noise. Both the noise and the air pollution are exacerbated by the very close distance between people's houses and the highway. Residents waste that accumulates on the side of the roads and in river tributaries is a significant health hazard. The need for a new approach to development practice that combines social and technical know-how let alone the latest innovation is becoming increasingly pressing with the prevalence of preventable disease. It is evident that there has been a dearth of planning since the sustainable development (SD) paradigm first emerged on the global stage in the 1980s and 1990s. It is tragedy that could so easily have been predicted (Downs, TJ., et al, 2020; Dupuy, K.E., 2014; Dupuy et al, 2015).

Table 5
Air Pollution Conditions According to Respondents

No	The condition of Air	Number of respondents	%
1	Severely damaged (polluted)	438	52.46
2	Damaged	282	33.77
3	Not badly damaged	101	12.1
4	Do not know	14	1.68
Total		**835**	**100**

Primary data, processed (2021)

The growing development of mining activities as well as increasing environmental damage have an impact on shifting people's livelihoods. Prior to the outbreak of mining activities and all associated activities, the Bahodopi people depended for their livelihoods on the agricultural sector, especially cash crops such as coconut and nutmeg. Others worked as fishermen, because their village is located in a coastal area. But now the landscape of the Bahodopi Sub-district area has changed. The area that used to be a community plantation area has turned into a mining area, causing the land to become barren and rivers that were previously a source of water for residents' agricultural activities to dry up. The mining industry generally has a negative impact when viewed from the system of ownership and expropriation of land for agricultural production (Jung, S., 2018).

The forest area in *Bahodopi* Sub-district according to the Decree of the Minister of Forestry Number: SK.465/Menhut II/2011 is 81,853.73 hectares, consisting of limited production forest covering an area of 47,299.26 hectares; permanent production forest of 23,976.06 hectares and convertible production forest of 10,578.41 hectares. More than 33,960.76 hectares of the forest area has become a nickel mining business permit area. No less than 11 companies currently obtain mining business permits there. The results of aerial photos took in February 2022 show that around 40 percent of the total area of the Mining Business Permit has been exploited. The need for community consideration and development as a consequence of changing resource allocations is especially important in mining, where environmental and social costs are often borne by communities, while project benefits flow to national capital cities and global financial hubs, leading to conflict between local communities and miners. (O'Faircheallaigh, C., 2013; German, L., et al, 2014; Matlaba, FJ., 2021).

The construction of the IMIP industrial area of 3,000 hectares consisting of 2,500 hectares of forest area and 500 hectares of Other Designated Areas has directly resulted in the conversion of 2500 hectares of forest area and 500 hectares of community land into industrial areas. The forest areas that have been converted into industrial areas are located in *Fatufia* and *Labota* Villages, while community lands that have been converted into industrial areas are located in *Keurea* Village (location of IMIP airport), *Fatufia* and *Labota*. Developing countries that are centers of mineral extractive investment generally generate

negative externalities to local livelihoods (Hota, P., and Behera, B., 2016). Resource extraction should be configured as generating more job opportunities, providing better market access and increasing fiscal transfers to resource-producing regions. On the other hand, the mineral extractive industry also contributes to the marginalization of poor smallholders by encouraging land grabbing, environmental degradation and shifting labor markets (Wegenast, T., and J. Beck, 2020; Haslam, PA., and Nasser Ary Tanimoune, 2015).

Table 6
River Conditions according to respondents

No	Category of Rivers Condition	Number of respondents	%
1	Severely damaged (polluted)	**229**	**27.43**
2	Damaged	**333**	**39.88**
3	Not Badly damaged	**228**	**27.31**
4	Do not know	**45**	**5.39**
Total		**835**	**100.00**

Primary data, processed (2021)

There are 3 main rivers in the *Bahodopi* area, namely the *Padabaho* River, *Fatufia* River and *Lalampu* River. Prior to the arrival of IMIP, residents used these rivers as a source of clean water, bathing and washing. Changes in the landscape due to the development of mining areas by IMIP resulted in very large changes to the existing and have resulted in very large changes to previously river flows in the *Bahodopi* Sub-district area (Table 6). Currently, these rivers can no longer be used by residents as a source of clean water and other needs. *Padabaho* River water is only clear until 8 am after that the water will continue to be cloudy until at night. This is because there are many companies that operate heavy vehicles upstream, both by mining companies in IMIP, and by people who collect sand from the river. Passing sand transport vehicles always cross this river. The *Fatufia* River is used by IMIP as a waste water disposal channel from the factory. When viewed from a distance, the water flowing in this river appears to be very clear, but if look closely, the water is blackish in color and looks oily. The *Lalampu* River was dammed and flowed by IMIP to the industrial area. As a result, this river can only be used by residents to wash their vehicles. Environmental problems can be the initial trigger for conflicts between companies and local communities (Jaskoski, Maiah, 2014; Cesar, 2019).

Everywhere in the world, modern mining companies are very capital intensive which can create a lot of job openings, but they are changing the environment, processing thousands of tons of material, occupying large areas of land and using huge amounts of water (O'Faircheallaigh, C., 2014; Downs, TJ., et al, 2020; Fraser, G., 2018). The destruction of forest and river areas also affects the availability of clean water in *Bahodopi* Sub-district. During the rainy season, the availability of water there is very abundant, and water often floods residential areas. However, during the dry season, the availability of clean water

decreases drastically. As a result, when the dry season arrives, residents often experience a clean water crisis.

Meanwhile, sedimentation in coastal areas occurred massively, partly due to the construction of docks for transporting nickel ore, resulting in damage to fishing grounds, fishermen had to sail further, while the fishing fleet could not afford it (Sarianto, D., 2016). The ponds located along the coast of the five research villages can no longer be used for fish farming activities. Most of the respondents, around 67%, stated that the average coastal area had been damaged and could no longer be used for aquaculture or fishing activities.

Damage to the coastal area occurred along 13 kilometers, from *Labota* Village to *Lalampu* Village. This area was previously covered by mangroves and other coastal vegetation, but the current condition is that there are only a few mangrove plants left in the villages of Lalampu, *Bahodopi* and *Keurea*. The coastal areas in the five villages have now been stockpiled and used as areas for stockpiling nickel ore and coal, residential areas and jetties. Along with the damage to coastal areas, there is also pollution of the marine environment in the form of sedimentation, turbidity and decreased sea water quality. The main sources of this pollutant are nickel mining activities in mountainous areas, loading and unloading activities of ore, coal and other materials in coastal areas, wastewater discharge from factories as well as oil spills from large ships, tugboats and barges that many dock in the area around the coast. Small town development due to extractive industry activities needs to consider land conflicts, and environmental change (Agergaard, J., 2019).

Table 7
Soil Condition According to Respondents

No	Soil Conditions	Number of respondents	%
1	Severely damaged	224	26.83
2	Damaged	379	45.39
3	Not badly damaged	204	24.43
4	Do not know	28	3.34
Total		**835**	**100.00**

Primary data, processed (2021)

In addition to problematic river conditions, according to the majority of respondents (70%) the soil condition is also in a badly damaged condition, making it difficult to maintain their gardens or even open new ones (Table 7). Soil conditions in former nickel mining generally decline and inhibit plant growth (Prematury, R., 2020). Based on the things mentioned above, it can be said that the forest area and lands in the village which have been a kind of social security, which guarantees the fulfillment of household needs and the survival of the people in *Bahodopi* are now no longer reliable. The presence of nickel

mining companies, the development of industrial estates and industrial companies in Bahodopi, which later controlled land in forest areas and in rural areas have threatened the social security of the population.

So far, no steps or government programs have been taken to rectify this condition. As a result, most people then switch to other livelihoods (Table 8). Some of them change professions, work in mining companies or companies that are directly or indirectly related to mining activities, others build boarding houses which are currently the most popular business in Bahodopi.

Some who are less fortunate to have land to build boarding houses, try their luck as traders with the risk of having to compete with migrants. Local people expect mining companies to contribute more to improving their living conditions. The relationship between mining communities and mining companies is faced with various socio-economic challenges, some of the poor are forced to pursue new livelihoods that sometimes do not match their knowledge and skills (Hilson, G and Hu, Y., 2022; Heyns, A., 2019).

Table 8
Types of Livelihoods of Respondents in Bahodopi Sub-district

No	Types of Livelihoods	Number of Respondents	Percentage
1	Mining Employees	607	72,69
2	Village officials	1	0,12
3	Labour (farm labour, bricklayer, housemaid)	93	11,13
4	Driver	3	0,36
5	Mini mart employee	3	0,36
6	Fisherman	6	0,72
7	Trader / businessman	97	11,62
8	Pharmacist	1	0,12
9	Farmer	8	0,96
10	Pensionary	3	0,36
11	Vegetable seller	1	0,12
12	Mechanic	2	0,24
13	Land Broker	1	0,12
14	Mosque Administrator	1	0,12
15	Government Employees	8	0,96
Total		**835**	**100.00**

Primary data, processed (2021)

The presence of companies (corporations) also does presents new livelihood opportunities for people who previously relied on livelihoods from farming or utilizing agricultural and forest products. The income obtained from working in the company is felt to provide a more certain amount and timing of income receipts, so that the agricultural sector and local livelihood activities are neglected (Bebbington et al, 2008). This opens up opportunities for livelihood shifts. But on the other hand, most people don't realize are other demands that are also a prerequisite for the shift in livelihoods; new livelihoods in mining corporations require skills and behaviors that are completely different from their profession as farmers, for example fixed working hours. In addition to working as company employees, new opportunities arise from the presence of mining are professions in the trade and service sector. Such position often require educational levels not attained in a rural setting. Those who are most likely to benefit are immigrants. The social and cultural impacts of large-scale mining on surrounding communities can be serious, long-lasting and affect existing livelihoods (O'Faircheallaigh,C., 2014).

Iv. Conclusion

The presence of a nickel processing plant in *Bahodopi* Sub-district must be admitted to have had a positive impact on increasing the GDP of *Morowali* Regency, but the increase in GDP does not seem to have a positive correlation with real efforts to overcome various environmental and socio-economic problems that occurred in *Bahodopi* as a result of the smelter construction.

Uncontrolled migration has led to pressure on environmental resilience and competition for livelihoods between local residents and migrants. Until the time the research was carried out, indications of inter-ethnic social conflict had occurred but were still on a scale that could still be controlled. The increase in conflict escalation has the potential to increase along with the increase in the number of migrants, smelter activities and related activities.

Increased smelter activity has had an impact on changing the landscape of Bahodopi Sub-district marked by the drying of several main rivers, severe sedimentation along the coast, forcing local communities who previously depended on livelihoods as farmers and fishermen, to switch to participating in competition with migrants to become mining employees or work in the trade and service sector.

The presence of the state is urgently needed to control the situation as soon as possible before it gets out of control. The increasing environmental damage has an impact on the worsening of environmental sanitation, floods, local transportation facilities, settlement arrangement and loss of livelihoods of local residents, as well as potential conflicts between migrants and local residents, it seems that the necessary action is is beyond the control of the local government.

Declarations

Ethical Approval

Hereby, Yani Taufik consciously assure that for the manuscript **Nickel Smelter on Social-Economics and Environmental Issues (A case study of a nickel processing factory in Bahodopi Sub-district, Morowali Regency, Central Sulawesi Province, Indonesia)** the following is fulfilled:

1) This material is the authors' own original work, which has not been previously published elsewhere.

2) The paper is not currently being considered for publication elsewhere.

3) The paper reflects the authors' own research and analysis in a truthful and complete manner.

Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Authors' contributions

Sarlan participated in Focus Group discussions and the community social impact analysis, while Iskandar mostly participated in providing views regarding changes in environmental conditions due to the operation of the smelter in the last five years. Meanwhile, I am analyzing social changes, especially the impact on people's livelihoods and perfecting report writing as well as completing references with journals and some of the latest sources of information regarding the development of the smelter in Bahodopi.

The paper properly credits the meaningful contributions of co-authors and co-researchers. The two companion authors, Sarlan and Iskandar, participating starting from data collection, focus group discussions carried out in each village involve community leaders and village leaders, as well as in the preparation of this paper. All authors have been personally and actively involved in substantial work leading to the paper, and will take public responsibility for its content.

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Availability of data and materials

The authors confirm that the data supporting the findings of this study are available within the article

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Figures

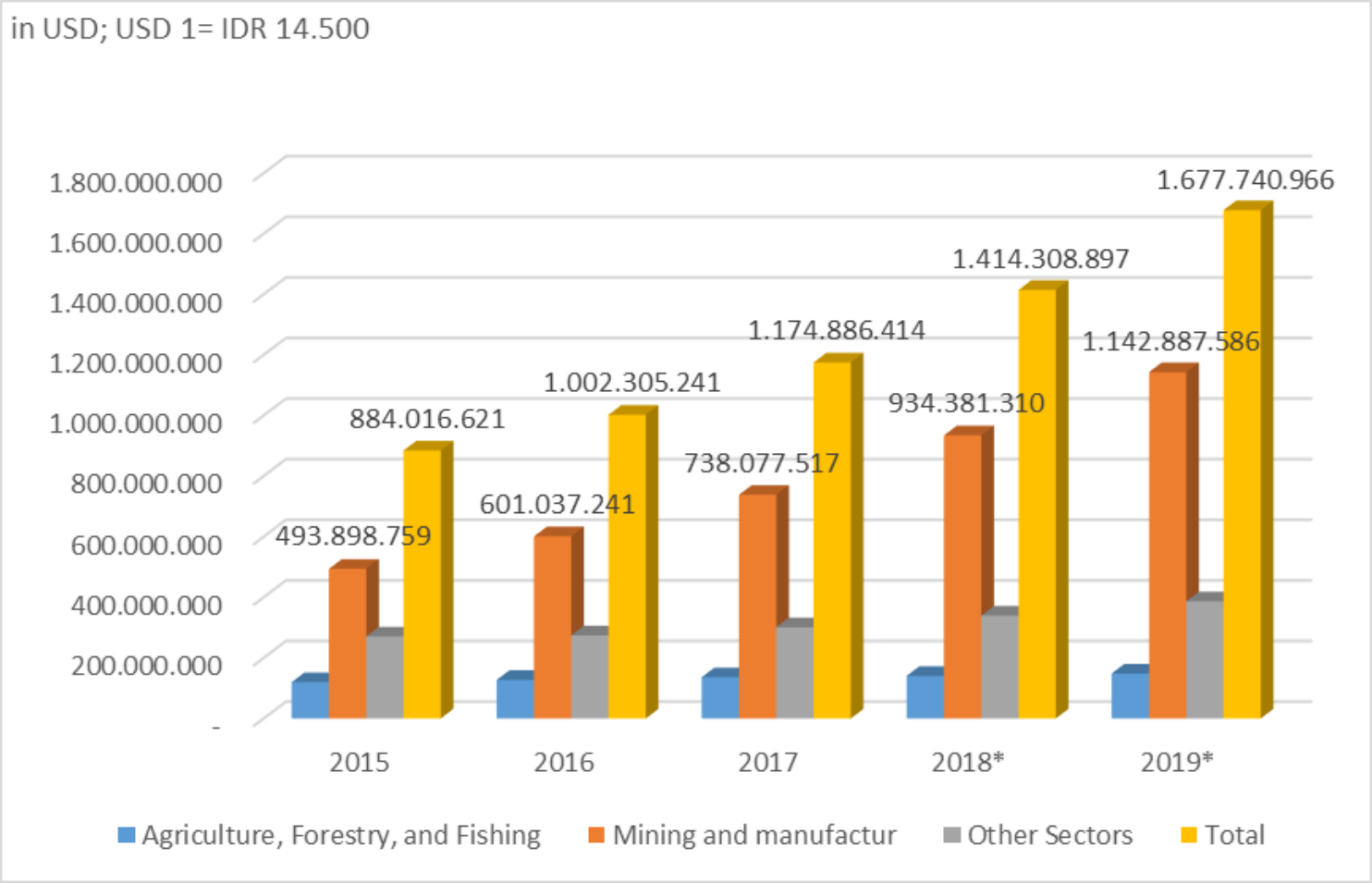

Figure 1

Mining and Manufactur Sectors to GDP of Morowali Regency (2015-2019)-Morowali Regency in figure, 2020

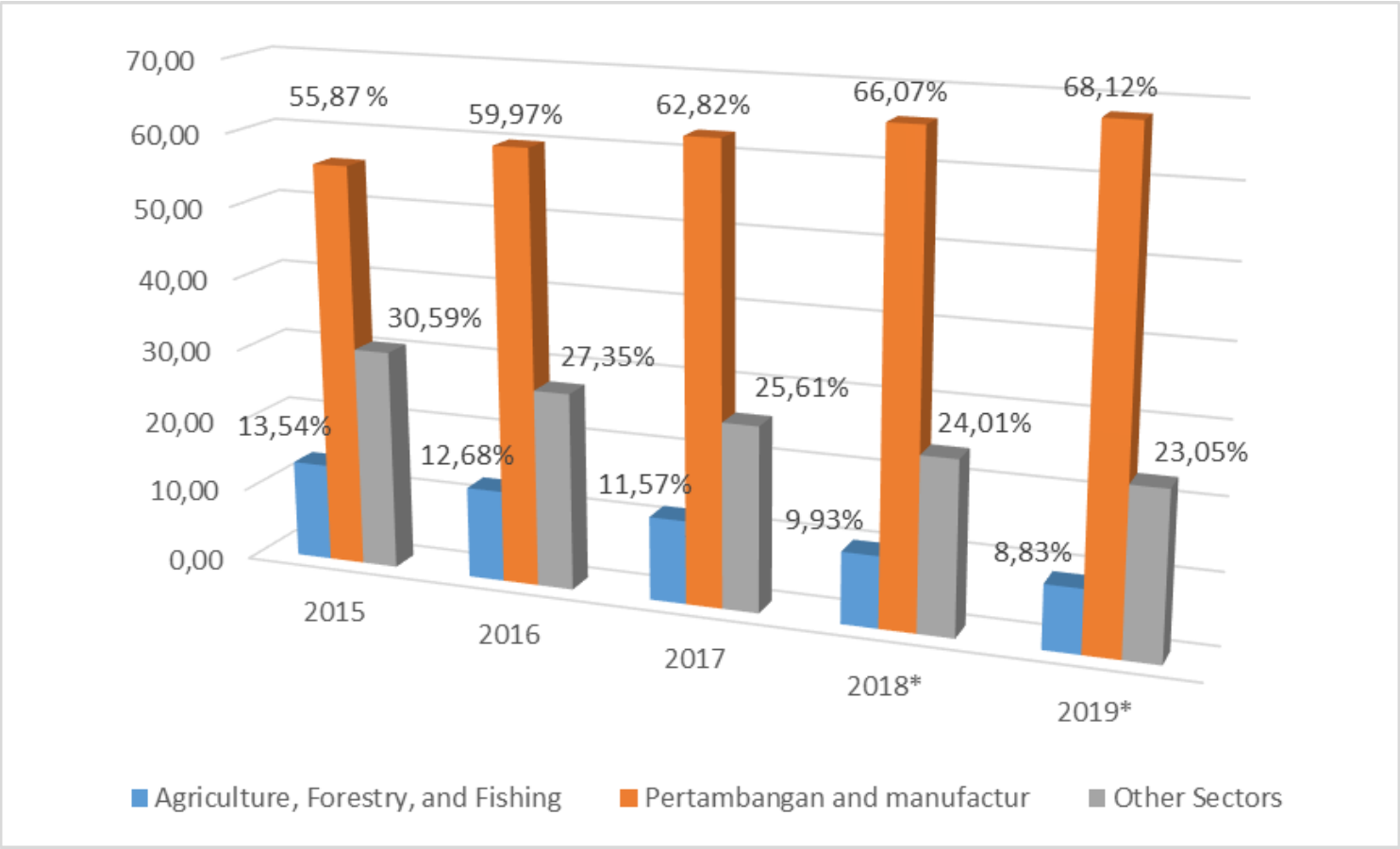

Figure 2

The Contribution (%) of the Mining and Manufactur Sectors to the Total GDP of Morowaly Regency (2015 – 2019)-Morowali regency in figure 2020, processed.