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# Environmentally Friendly Post-Mining Land Reclamation Policy for Manganese in Sabu Raijua, East Nusa Tenggara, Indonesia

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**ABSTRACT**

Every mining business that is carried out will greatly affect the environment, either directly or gradually. Changes in natural ecology are also determined by human attitudes and protection of the environment. Restoration in accordance with the initial conditions is critical in mining industry to balance of the ecosystem, ecology, and avoid damage to environment. This study aims to investigate the post-mining reclamation of manganese in Sabu Raijua Regency, East Nusa Tenggara, Indonesia. The method used is empirical with some supporting data from respective agencies used as a basis for investigation. The results showed that the important position of Sabu Raijua in manganese production, and it has among the best quality of manganese in the world. However, as to avoid the detrimental effect of mining activities to cause environmental damage, strict supervision and the involvement of local institutions in environmentally friendly reclamation are highly needed. The findings underlined the core principle of reclamation of manganese mining with sustainability principle.

## 1. INTRODUCTION

Mining industry has a substantial contribution to economy in many developing countries [1]. However, its detrimental effect to the environment and ecosystem is unavoidable. On the other side, government has a need substantial income to its budget and to balance social and economic interest as well as the sustainability of environment. In Indonesia, this was stated in Article 65 paragraph (1) of Law No. 32 of 2009 concerning the protection and management of the environment, namely everyone has the right to a good and healthy environment as part of human rights. Sabu Raijua Regency, East Nusa Tenggara, Indonesia is the best manganese producing area. The reality on the ground that what is happening in Sabu Raijua Regency is that the protection of nature and the environment has not been implemented properly. The negligence of conservation is empirically proven to have detrimental effect in damage to the natural ecology [2, 3]. In Sabu Raijua Regency there are several mines which currently have not carried out reclamation until the implementation of postmining. This will greatly affect environmental sustainability and do not apply the principles of mining implementation. The damage to nature that is left unattended is proof of the neglect of the state in environmental management, namely the government as the regulator. Furthermore, so as not to have a worse impact, both on the natural environment and people's lives, both the community and the government must be able to act more decisively to restore the ecological functions of nature as intended. Previous research showed the important role of government and local institutions in conservation process [4-7].

The potential for mining and quarrying in Sabu Raijua Regency is related to manganese mining for its use as raw material for steel, manufacture of dry batteries for ceramic and glass production, raw material for welding rods, electrolysis of zinc and oxidizers in uranium production. All mining activities in Sabu Raijua Regency are carried out by PT. Cromindo Lestari and PT. Tiga Mas Nusantara. The manganese exploitation area is located in the Cultural Heritage area, namely Kolorae in Pedarro Village and traditional ceremonial areas in Mehona and Kolo Merabbu villages in Dainao Village. Manganese exploitation areas are also located in disaster-prone areas which include the villages of Aikare, Mehona, Loborui, Ledeke in Liae District and Paderro Village, Wadumeddi Village, Gurimonearu in Hawu Mahera District (Table 1). These areas have been designated as natural disaster-prone areas in the Regional Regulation (Perda) Sabu Raijua No. 03 of 2011. The problems caused by manganese mining activities in Sabu Raijua Regency, especially at the research study site, are basic physical conditions damaged by mining activities, such as loss of native soil nutrients and damage to ecosystems. Previous research argue that damaged ecosystem is ecosystem that can no longer carry out its functions optimally, such as soil protection, water management, weather control, and other functions in regulating environmental protection [8-10]. Some of the matters above underlie and become the background for conducting an academic study on the use of ex-manganese mining land in Sabu Raijua Regency. This study discusses the reality of the impact of manganese mining in Sabu Raijua Regency and post-Manganese reclamation policies in Sabu Raijua Regency.

**Table 1.** Mining and quarrying in Sabu Raijua

| Quarrying Goods | Quarching | Use | Location | Estimation Reserve Deposits (m) |
|---|---|---|---|---|
| Limestone | Phosphate rock mostly composed by the mineral calcium carbonate (CaCO3) in yellow brown | Raw material main manufacture cement, industry ceramics, etc. | Hawu Mehara, Sabu Liae and East Sabu | 35.360.000 |
| Clay | Contain $SiO_2$ that reaches 52%-54% with gray black clay and rich montmorillonite mineral | Raw material ceramics and raw material industry | West Sabu and Sabu Liane | 30.960.000 |
| Sirte | Alluvial deposits exposed in the valley river. Thickness between 0.5m-2m with fine sand size to boulder and the components consist of fractions of sedimentary rocks | Raw material profession construction | East Sabu, West Sabu and Hawu Mehari | 75.307 |
| Clay | Brown to reddish, characteristic fine sand arrived Rough | For materials cement Industry, ceramics, brick fire retardant, etc. Currently by Public local used for making earthenware | Haw Mehari | 16.380.000 |
| Manganese | Rocks with identical characteristics of blackish-gray, massive, uniform, botryoidal, stalactite and sometimes fibrous structures | Raw material for steel, manufacture of dry batteries, manufacture of ceramics and glass, raw material for welding rods, electrolysis of zinc and oxidizers in uranium production | Mesara dan Liae | 16.853.477.000 |

Source: Sabu Raijua ESDM Office, 2022

## 2. RESEARCH METHODS

The research method uses a sociological juridical legal research approach using a descriptive qualitative approach in the form of field research about sustainable reclamation of manganese in Sabu Raijua Regency, East Nusa Tenggara, Indonesia. The method used is empirical with some supporting data from respective agencies used as a basis for investigation.

In this study using the model of statutory regulations and patterns of behavior related to the applicable law in mining sector. Basically, this type of research examines the applicable legal provisions about reclamation and standard purification of minerals as the basis for sustainable post-mining reclamation of land and to balance social and economic interests. The consideration of sustainable spatial planning is also examined in this study to ensure the livelihood of local communities in agrarian domain. With the intention of analyzing the facts and data obtained from the field research, this study identified some steps. After the required data has been collected it then leads to problem identification which ultimately leads to problem solving and conclusions. The approach method in this study is a qualitative approach, namely by discussing and describing the analytical results obtained based on sustainability and legal principles that are relevant to the policy in mining industries of manganese.

## 3. RESULTS

### 3.1 World production and reserves of manganese

In terms of the quality of Indonesia's manganese, especially East Nusa Tenggara, it is the number one in the world, but in terms of the amount of resources when compared to other countries, the amount of Indonesia's manganese resources is very small when compared to South Africa and Ukraine, each of which is 78% and 10% of the world's total manganese resources. Meanwhile, the world's largest manganese reserves, apart from South Africa and Ukraine, are also found in Brazil, Australia, India and China (Table 2).

Reclamation is an activity carried out throughout the stages of the Mining Business to organize, restore and improve the quality of the environment and ecosystem so that it can function again according to its designation. A good and clean environment is the hope of all nations and countries. Therefore, reclamation activities are needed which are activities to restore former land. mining as it should be and in accordance with the planned Post-mining Reclamation plan, so that it can be used again as intended. As in Table 3, world manganese production in 2015-2016 was dominated by South Africa, China, Australia, Gabon and Brazil. In Table 4, it can be seen that the largest manganese mining companies in the world have dominated the world manganese market since 2019.

**Table 2.** World manganese reserves and production (million tonnes)

| Country | Mine production | | Reserves[11] |
|---|---|---|---|
| | 2015 | 2016 | |
| Australia | 2.400 | 2500 | 91.000 |
| Brazil | 1.090 | 1100 | 116.00 |
| China | 3.000 | 3000 | 43.000 |
| Gabon | 2.020 | 2000 | 22.000 |
| Ghana | 416 | 480 | 12.000 |
| India | 900 | 950 | 52.000 |
| Kazakhstan | 222 | 160 | 5000 |
| Malaysia | 201 | 200 | NA |
| Mexico | 220 | 220 | 500 |
| South Africa | 5.900 | 4700 | 200.000 |
| Ukraine | 410 | 320 | 140.000 |
| Other countries | 678 | 680 | Small |
| World total (rounded) | 17.500 | 16.000 | 690 |

Source: various sources modified by author, 2023

So far, Indonesia has not been able to optimize the economic value of manganese commodities. As can be illustrated in the export data for manganese ore and concentrate for 2012 of 19,000-tons, there is potential for an increase in the added value of manganese ores and concentrates if they are processed domestically. The potential added value can be calculated

from the difference between the import value of ferromanganese products and the export value of manganese ore and concentrate. Manganese oxide is more stable than iron oxide, so a higher energy is required to reduce manganese oxide, in the final reduction process of MnO to metal Mn will occur with solid carbon in the coke bed together with reduction of silica. This process is carried out to produce high carbon ferromanganese. To produce moderate carbon ferromanganese, a purification process with a ladle is required, in which the product from the electric furnace is blown out by oxygen and argon to oxidize the carbon in the molten metal. For low carbon ferromanganese use additional quartz and FeSi for reducing agents other than coking coal. The following types of ferromanganese products are produced and sold as an ingredient in making steel or manganese metal (Table 4).

In smelting with an electric furnace, a reduction reaction of manganese oxide and carbon will occur, which usually contains other metal oxides that interfere. To avoid these materials, especially those that are acidic, they can be neutralized by alkaline compounds such as lime but will produce more slag and can dissolve manganese so that metal recovery becomes lower. The resulting product is 65-68% manganese silicon, 16-21% silicon, 1.5-2% carbon. The following types of silicon manganese products are produced and sold as an ingredient for making steel or manganese metal (Table 5).

The production of chemical manganese dioxide (CMD) can be carried out by heating Mn salts such as $MnCO_3$ and Mn $(NO_3)_2$ under oxidative conditions through the carbonate process. The $MnO_2$ ore is reduced and leached in sulfuric acid solution. After removing the impurities, the $MnSO_4$ solution was reacted with $(NH4)_2CO_3$ to form $MnCO_3$ powder. The powder is heated in a reactor flowed with oxygen or air at a temperature of 500℃ to form $MnO_2$. The dissolution product is then washed and dried to produce CMD with a content of 90% $MnO_2$. Usually the preparation of CMD from manganese nitrate solution (Mn $(NO_3)_2$) produces CMD with higher purity (>99.5%).

### 3.2 Sustainable post-mining reclamation policy for manganese

Changes in land use patterns as a result of clearing mining sites (land clearing) and excavation can cause land use patterns where previously allotted for farming has shifted to mining land as well as construction of facilities and infrastructure for the mining project itself. There is a decrease in soil fertility as a result of changes in land use patterns as well as soil erosion and landslides from mining activities. There is a change in the aesthetic value of the environment as a result of mining activities with mining pits, scattered solid waste and causes an unattractive view of the surrounding environment.

**Table 3.** World manganese exploitation by company

| No | Company | Country | Manganese mine | Production 2019 (metepa) |
|---|---|---|---|---|
| 1 | BPH Billiton | South Africa Australia | Wessel makataan Groote Yeaning | 1.59<br>2.32 |
| 2 | Assuming | South Africa | Nchwaning | 2.32 |
| 3 | Vale | Brazil | Azul(para)<br>Urucum (mate Grosso) Others (mina Gerais) | 1.38<br>0.16<br>0.10 |
| 4 | Comlog | Gabon | Moanda | 2.00 |
| 5 | OM Holdings | Australia | Booto Creek | 0.64 |
| 6 | ENRC | Kazakhstan | | 0.90 |
| | | | Total | 11.45 |

Source: various sources modified by author, 2023

**Table 4.** Types of ferromanganese products

| Grade | | Mn (%) | Si (%) | C (%) | P (%) | S (%) |
|---|---|---|---|---|---|---|
| H. C ferro manganese | HC FeMn 65 | 65 Min | 1.5 Max | 6-8 | 0.85 | 1.03 |
| | HC FeMn 70 | 70 Min | 1.5 Max | 6-8 | 0.35 Max | 0.03 Max |
| | HC FeMn 75 | 75 Min | 1.5 Max | 6-8 | 0.35 Max | 0.03 Max |
| H. C ferro manganese (Low) phos | HC FeMn 70 (LP) | 70 Min | 1.5 Max | 6-8 | 0.15-0.20 | 0.03 Max |
| | HC FeMn 75 (LP) | 75 Min | 1.5 Max | 6-8 | 0.15-0.20 | 0.03 Max |
| M.C ferro manganeae | HC FeMn 65 | 70 Min | 1.5 Max | 1.5 Max | 0.35 Max | 0.03 Max |

Source: Tekmira Research and Development Center, 2017

**Table 5.** Types of silicon manganese products

| Grade | | Mn (%) | Si (%) | C (%) | P (%) | S (%) |
|---|---|---|---|---|---|---|
| H.C Silico Manganese | HC Si 15 Mn | 60 Min | 15 Min | .0 Max | 0.30 Max | 0.03 Max |
| | 60 HC Si 17 Mn 65 | 65 Min | 17 Min | .0 Max | 0.30 Max | 0.03 Max |
| H.C Silico Manganese (Low Phos) | HC Si 15 Mn 60 (LP) | 60 Min | 15 Min | .0 Max | 0.15-0.20 | 0.03 Max |
| | HC Si 17 Mn 65 (LP) | 65 Min | 17 Min | .0 Max | 0.15-0.20 | 0.03 Max |
| M.C Silico Manganese | Si 20 Mn 58 | 55-60 | 20 Min | 0.05 Max | 0.15 Max | 0.03 Max |
| L.C Silico Manganese | LC Si 24 Mn 53 | 50-55 | 24 Min | .10 Max | 0.10 Max | 0.03Max |

Source: Tekmira Research and Development Center, 2017

Land use for manganese mining business in Sabu Raijua by PT. Cromindo Lestari and PT. Tiga Mas Nusantara has never obtained approval from the holders of land rights and the settlement is based on Law No. 04 of 2009. The planned mining area will be implemented based on Sabu Raijua Regent's Decree No. 303 to 306 concerning environmental permits and production operations in 13 villages in Liae District and Hawu Mahera District. Meanwhile, based on regional regulations on spatial plans and regional plans, there are only 2 villages designated for manganese mining, namely Waduwalla Village and Wahumeddi Village. On the other hand, the two villages are included in areas prone to natural disasters and tsunami disasters. In determining the mining area of the Sabu Raijua government, it was not carried out in a transparent, participatory and responsible manner and did not pay attention to ecological, economic, socio-cultural and environmental aspects based on Law No. 3 of 2020 concerning amendments to Law No. 4 of 2009 concerning Mineral and Coal Mining (Table 6). This denotes the importance to place the livelihood of local communities in farming by considering agrarian reform as the subject of spatial planning and reclamation.

Mining activities are carried out in open pit mining. After mining activities are carried out, reclamation activities are carried out. Reclamation according to the Decree of the Minister of Energy and Mineral Resources of the Republic of Indonesia number 1827 K/30/MEM/2018 is an activity carried out throughout the stages of the mining business to organize, restore and improve the quality of the environment and ecosystem so that it can function again according to its designation. The manganese mining business that is developing in Sabu Raijua Regency, in addition to having a positive impact on the economic and social progress of the community, of course, also has a negative impact, especially the occurrence of natural damage if it is not managed in a good and correct way of mining.

Mining business activities, both mineral and manganese, are one of the spearheads of economic activity in supporting development in Sabu Raijua Regency. Manganese as an energy source has proven its role in encouraging the development of industrial activities, in accordance with government policies that are increasing the use of alternative energy sources. Sabu Raijua Regency has manganese mining resources which are quite potential to be developed (Table 7). As an alternative energy, manganese in Indonesia has considerable potential.

The Manggarai region has the most manganese resources and reserves in East Nusa Tenggara Province. Currently some of these reserves have been exploited, including PT Istindo Mitra Perdana which has a Production Operation covering an area of 736.3 hectares located in East Manggarai Regency, PT Indomineral Resources with an area of 1626.9 hectares and PT Sumber Jaya Asia with an area of 725.3 hectares in the Regency Manggarai, as well as PT Indomas Prima Mineral with an area of 192 hectares in West Manggarai Regency. The quality of manganese from NTT is among the best in the world, but mining activities cause environmental damage. In many places on the island of Timor, rocks function as catchments for rainwater which are then used to provide a source of clean water for residents. Manganese mining in the short-term increase's income, but the amount is not enough to meet the needs of life, and has a negative impact in the long term. The poverty rate in NTT remains high, and it is still the poorest or most underdeveloped province.

**Table 6.** Manganese mine data in Hawu Mehara District, Sabu Raijua District

| No | Village | Total resources (tons) | | Total reserves (tons) | |
|---|---|---|---|---|---|
| | | Ore | Metal | Ore | Metal |
| 1 | Daieko | 3.567.345 | 2.365.800 | 287.234 | 13.987 |
| 2 | Gurimonearu | 1.235.091 | 43.298.531 | 76.221 | 9.2340 |
| 3 | Ledeae | 63.443. 671 | 23.112.329 | 22. 900 | 1.564.023 |
| 4 | Lederaga | 23.675.000 | 11.764.096 | 25.987 | 23.032 |
| 5 | Lobohede | 13.267.850 | 9. 980.012 | 13.974 | 90.755 |
| 6 | Molie | 11.762.903 | 9.012.082 | 6.098 | 20.945 |
| 7 | Pedarro | 6.761.096 | 5.056.094 | 7.861 | 7.903 |
| 8 | Raemadia | - | - | - | - |
| 9 | Tanajawa | - | - | - | - |
| 10 | Wadumaddi | 12.894.853 | 8.813.763 | 112.530 | 287.014 |

Source: Sabu Raijua Regency ESDM Office, 2022

**Table 7.** Manganese mine data, Sabu Liae District, Sabu Raijua Regency

| No | Village | Total Resources (tons) | | Total Reserves (ton) | |
|---|---|---|---|---|---|
| | | Ore | Metal | Ore | Metal |
| 1 | Ledetalo | 7.117.345 | 3.305.801 | 423.234 | 23.081 |
| 2 | Halla Paji | 2.835.091 | 23.118.531 | 112.231 | 8.234 |
| 3 | Loborui | 83.443. 671 | 93.112.199 | 76.900 | 564.023 |
| 4 | Eikare | 3.675.000 | 1.764.096 | 2.987 | 2.032 |
| 5 | Dainao | 19.223.850 | 10.902.012 | 18.920 | 72.755 |
| 6 | Kotahawu | 11.762.903 | 9.012.082 | 6.098 | 20.945 |
| 7 | Deme | 9.721.016 | 8.016.094 | 7.822 | 7.988 |
| 8 | Eilogo | 5.610.273 | 6.201.239 | 9.830 | 9.230 |
| 9 | Ledeke | 8.982.102 | 2.981.256 | 9.923 | 8.541 |
| 10 | Waduwalla | 13.871.853 | 8.603.760 | 100.530 | 327.014 |
| 11 | Mehona | 6.567.345 | 3.365.800 | 23.569 | 201.762 |
| 12 | Raerobo | 1.235.091 | 43.298.531 | 234.900 | 234.933 |

Source: Sabu Raijua Regency ESDM Office, 2022

In the biological environment, there is a decrease in the diversity of flora and fauna. In the social, economic, cultural and public health environment, there are changes in social processes and social institutions, changes in people's attitudes and perceptions, changes in household/community income levels, changes in business opportunities/work opportunities, changes in cultural processes [11, 12]. In this regard, efforts that can be taken to preserve the environment and increase the benefits of natural resources in connection with mining activities are increasing supervision of mining activities and enforcing laws against polluters and environmental destroyers [13, 14]. It also needs consistency of all development stakeholders in their compliance with various legislative products in the field of protection and management of natural resources and the environment [15, 16], as well as increasing public awareness in efforts to manage and protect natural resources and the environment which are oriented towards the preservation and preservation of the environment [17-20]. Manganese rocks can endanger the lives of people who live side by side with manganese mines. Therefore, manganese should be exploited using various environmentally friendly approaches.

In general, the basis for regulations and policies for the management of mining or minerals is Article 33 paragraph (3) of the 1945 Constitution and Law Number 3 of 2020. Article 33 paragraph 3 of the 1945 Constitution states "earth, water and the natural resources contained therein are controlled by the state and used for the greatest prosperity of the people. The use of Article 33 paragraph 3 is carried out with the assumption that natural resources are controlled by the state and are common property, in this case national, and are used for welfare and as much as possible for the benefit of the prosperity of the people from one generation to the next in a sustainable manner.

Reclamation activities are a mandatory program that must be carried out by every mining company in Indonesia [21]. It is regulated in Article 39 paragraph 1 letter K of Law no. 3 of 2020 concerning Mineral and Manganese Mining. Management and monitoring of the mining environment including postmining reclamation activities must be carried out by the government at mining locations for the sake of implementing good mining techniques. Post-mining activities are planned, systematic and continuing activities after part or all of the Mining Business activities to restore the functions of the natural environment and social functions according to local conditions throughout the Mining area [22, 23].

The policy of the regional mining office with prevention of pollution is an act of preventing the entry or inclusion of living things, energy substances, and/or other components into the environment by human activities so that the quality does not decrease to a certain level which causes the environment to not be able to function according to its designation [24, 25]. In the first form, remediation, namely activities to clean up polluted soil surfaces [26]. There are two types of soil remediation, namely in-situ (or on-site) and ex-situ (or off-site). On-site cleaning is cleaning on site. This cleaning is cheaper and easier, consisting of cleaning, venting, and bioremediation. Off-site cleanup involves excavating the contaminated soil and then transporting it to a safe area. After that in a safe area, the land is cleaned of contaminants. The method is that the soil is stored in an impermeable tub/tank, then the cleaning agent is pumped into the tub/tank. Furthermore, contaminants are pumped out of the tub which are then treated by a wastewater treatment plant. This off-site cleanup is much more expensive and complicated. Second, bioremediation, namely the process of cleaning up soil contamination using microorganisms (fungi, bacteria). Bioremediation aims to break down or degrade pollutant substances into less toxic or non-toxic materials (carbon dioxide and water). Third, the use of tools (retort-amalgam) in melting gold needs to be done in order to reduce Hg contamination. Fourth, it is necessary to study Environmental Management Efforts and Environmental Monitoring Efforts or study Environmental Impact Analysis in formulating policies related to mining activities. Prior to implementation, mining activities can already be estimated in advance the impact on the environment. This study must be carried out, supervised and monitored properly and continuously implemented, not just a formality for administrative needs. Fifth, it is necessary to educate the public about the dangers of Hg and B3 in manganese mines. For health workers there needs to be training on public health risk surveillance due to B3 pollution in manganese mining areas.

Mining minerals are unrenewable natural resources and in managing and utilizing them requires a spatial planning which is handled holistically by paying attention to farming and agrarian aspect to ensure the rights of local communities. Moreover, four main issues were also influential in spatial planning, namely growth, equity, environment and conservation aspects to balance the interest between industry and local communities in agrarian domain. Sabu Raijua Regency Government general policy regarding mining. First, the Sabu Raijua Regency Government specifically revoked the operating licenses of Cromindo Lestari and PT. Three Mas Archipelago. Second, the Regency Government is reviewing the policy of granting permits to regional mining service which will conduct a general investigation in this area. Third, the Regency Government provided important notes relating to the operations of Cromindo Lestari and PT. Three Mas Archipelago. However, in the public domain, there remains distrust in the government's commitment to completely stop issuing permits for these companies in this area. Based on the Mineral and Coal Law Number 4 of 2009 and Government Regulation Number 1 of 2014 concerning the Second Amendment to Government Regulation Number 23 of 2010 concerning Implementation of Mineral and Coal Mining Business Activities and Minister of Energy and Mineral Resources Regulation Number 5 of 2017 concerning Increasing Mineral Added Value through Activities Processing and Refining of Minerals in the Country, it is hoped that processing and refining will be carried out domestically with products according to the requirements in Table 5 about Regulation of the Minister of Energy and Mineral Resources Number 5 of 2017 (Table 8).

**Table 8.** Standard of Purification of manganese as a basis for sustainable reclamation in manganese industry

| Processing | | Purification | |
|---|---|---|---|
| **Commodities** | **Quality** | **Product** | **Quality** |
| Manganese concentrate Ore: Mineral Manganese Pyrolusite psilomelan braunite manganite | ≥49% | Metals, alloys and chemistry of manganese | a. ferrous manganese (FeMn). mm≥60%<br>b. silica manganese (SiMn), ≥60%<br>c. manganese monoxide (MnO), mn ≥47.5% $MnO_2$≤ 4%<br>d. manganese sulfate ($MnSO_4$) ≥90%<br>e. manganese chloride ($MnCl_2$) ≥90%<br>f. synthetic manganese carbonate ($MnCO_3$) ≥90%<br>g. potassium permanganate ($KMnO_4$) ≥90%<br>h. manganese oxide ($Mn_3O_4$) ≥90%<br>i. synthetic manganese dioxide ($MnO_2$) ≥98%; and/or<br>j. manganese sponge (direct reduced manganese) Mn ≥ 49%, $MnO_2$ ≤ 4%<br>k. electrolytic manganese dioxide $MnO_2$ ≥ 90% and ≤ 250 ppm |

Source: Ministry of Energy and Mineral Resources, 2017

## 4. CONCLUSION

The finding showed that functioning land according to its designation through reclamation and postmining is important, and is not solely the responsibility of the mining company, but also the responsibility of the government. In this case, according to changes in Law No. 3 of 2020 on Law No. 4 of 2009 concerning Mineral and Manganese Mining, it is the Minister who is responsible, because they are the ones who carry out the assessment and approval of reclamation plans, post-mining plans, as well as supervise the implementation of reclamation by these mining companies. Law No. 3 of 2020 changes to Law No. 4 of 2009 concerning Mineral and Manganese Mining emphasizes the implementation of Post-mining Reclamation which is always related to environmental management as stated in the general elucidation of paragraph 3 of Law No. 3 of 2020 to strengthening policies related to environmental management in Mining business activities, including the implementation of reclamation and post-mining.

The findings highlighted the mining problems in Sabu Raijua Regency, NTT which has resulted in the emergence of the local institutions as the main actor of local resistance. Local institutions are primarily concerned with key principles such as sustainability, welfare, justice and pro-life. These principles go beyond the partial interests of the state, corporations, NGOs. As the recommendations, local institutions with social power should determine new patterns of tripolar relations. The position of the local institutions goes beyond the role that can be played by NGOs, the local press, or intellectual groups. Meanwhile, other elements outside the local institutions do not have a systematic pattern to form effective local resistance, especially forms of movement that do not prioritize violence. Moreover, the implications also suggest the core principle of reclamation of manganese mining is sustainability principle. As mining minerals are natural resources that unrenewable resources, managing and utilizing them requires a spatial planning which is handled integrally to paying attention to agrarian aspect in land function to farming of local communities while at the same time balance the functions of ecosystems as well as the social and economic interests.

There are some limitations in this study. This study did not empirically examine the governance process in post-mining reclamations. Moreover, Environmental Social Governance (ESG) was not properly examined in this study as this study only focus on local actors as the mediator in bridging the interest of tripolar relations (company, government and local communities) in post-mining reclamations. Thus, future research was expected to examine social and cultural perspectives in Environmental Social Governance (ESG) in broader perspective by using more samples in the research. Moreover, future research is expected to pay attention to governance aspects for the environmental conservation to ensure the rights of local communities in effective and equitable conservation.

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