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Technical Review of Land Usage of Former Limestone Mine for Rubber Plantation in PT Semen Baturaja Tbk for Sustainable Mining Environment

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Abstract. Limestone mining activities at PT Semen Baturaja Tbk in Ogan Komering Ulu Regency of South Sumatera Province is conducted on an open quarry mining system. Limestone is the main raw material needed in the manufacture of cement in PT Semen Baturaja Tbk. Open-pit mining activities at the end of their activities will leave ex-mining land. The ex-mining land must be used for the mining environment remains sustainable. The ex-mining land can be used for various purposes such as rubber plantations, oil palm plantations, teak forests, pine forests, fruit orchards, and others. The former land of limestone mine of PT Semen Baturaja Tbk as stated in its post mine plan document, one of which is for rubber plantation. The research uses a survey method. The purpose of this research to assess the technical utilization of limestone mined land PT Semen Baturaja Tbk for rubber plantations for sustainable mining environment. The results are expected to benefit stakeholders, academics, researchers, practitioners and mining associations, and the environment.

1. Introduction

Indonesia as a country rich in natural resources such as limestone. Limestone is widely used as raw materials of cement, building materials, materials stability of roads, and so on. PT Semen Baturaja Tbk is one of cement producer in Indonesia in fulfilling limestone requirement as raw material of cement production doing its own mining activity. Limestone mining by PT Semen Baturaja Tbk is located in Baturaja, Ogan Komering Ulu Regency. Mining activities undertaken by PT Semen Baturaja Tbk are not denied having an impact on the environment around the mining area. Positive impacts arise from economic improvement of communities around mining, employment, development, and so on. Mining activities conducted on the other hand also cause harm to the environment [1].

The former mining environment will undergo chemical, biological, and physical changes. The effort to handle the negative impacts of this mining activity is to carry out planned reclamation activities [2]. Reclamation aims to prevent erosion or decrease the speed of running water flow, keep the land unstable and more productive, and hopefully can generate added value for the environment and create a much better state than the previous environment so that the mining environment is sustainable for the welfare present and future generations [3,4].

Limestone mining activities are not always possible because the activities that take place depend on the availability of reserves. Based on the feasibility study document of PT. Semen Baturaja (Persero)



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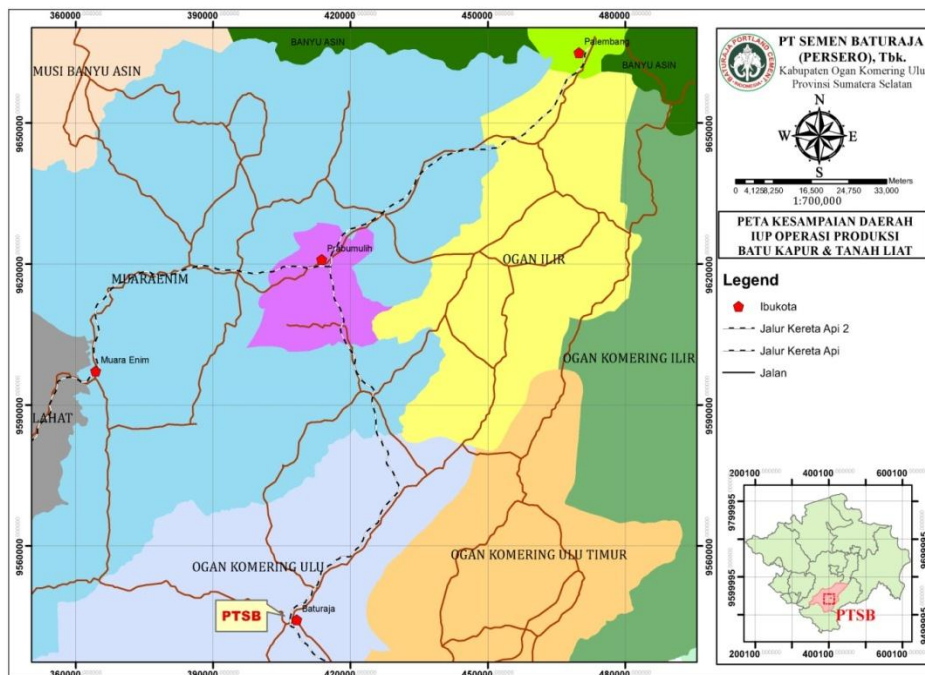
Tbk in 2018, limestone mining activities will end in 2026. Mining activities that have ended will certainly have an impact on the community as well as the surrounding environment. Therefore it is necessary to plan activities that will be done after the mining activities end so that people stay prosperous and the environment remains sustainable. PT Semen Baturaja Tbk as a company conducting mining activities is obliged to carry out reclamation and post-mining activities as regulated in Government Regulation number 78 of 2010 and Ministerial Regulation number 7 of 2014. Post-mining is an activity undertaken to restore the function of the natural environment and social function according to local conditions throughout the mining area in a planned, systematic and sustainable way when some mining activities will end or all mining activities expire [5].

Post-mining activities of PT Semen Baturaja Tbk through post-mining land allotment are expected to restore the function of the forest as an ecosystem so that the disturbed land due to mining activities (forest) as a natural resource remains sustainable and the mining environment of limestone remains sustainable. Based on this it becomes an important point and becomes a force in this research to study the technical aspects of PT Semen Baturaja Tbk's post-mining plan.

2. Materials and Methods

The research method is survey, by observing directly the condition of location of mining business license of PT Semen Baturaja Tbk. Descriptive analysis is used to describe the initial hue conditions at the study sites. This becomes the basic foundation in designing / planning the former land of limestone mine in PT Semen Baturaja Tbk is technically to keep the mining environment sustainable. Data collection was done primarily to obtain primary data conducted by direct observation, and secondary to secondary data by studying literature and institutional.

Administratively, the research location is included in West Baturaja Sub-district, Ogan Komering Ulu Regency, South Sumatera Province. The territory can be reached by land travel from Palembang City to Ogan Komering Ulu Regency using four-wheeled vehicles through provincial road with a travel time of about 6 hours. Then go to Pusar village through village road with travel time about 15 minutes. The location of the study is shown in figure 1.



Source: Document of Feasibility Study of PT. Semen Baturaja Tbk, 2018

Figure 1. Regional Accomplished Map

3. Results and Discussion

Technical aspects and important economic aspects are taken into account in determining the post-mining land allocation. Technical aspects serve as the basis for determining the economic planning of post-mining costs. The technical aspects discussed are as follows:

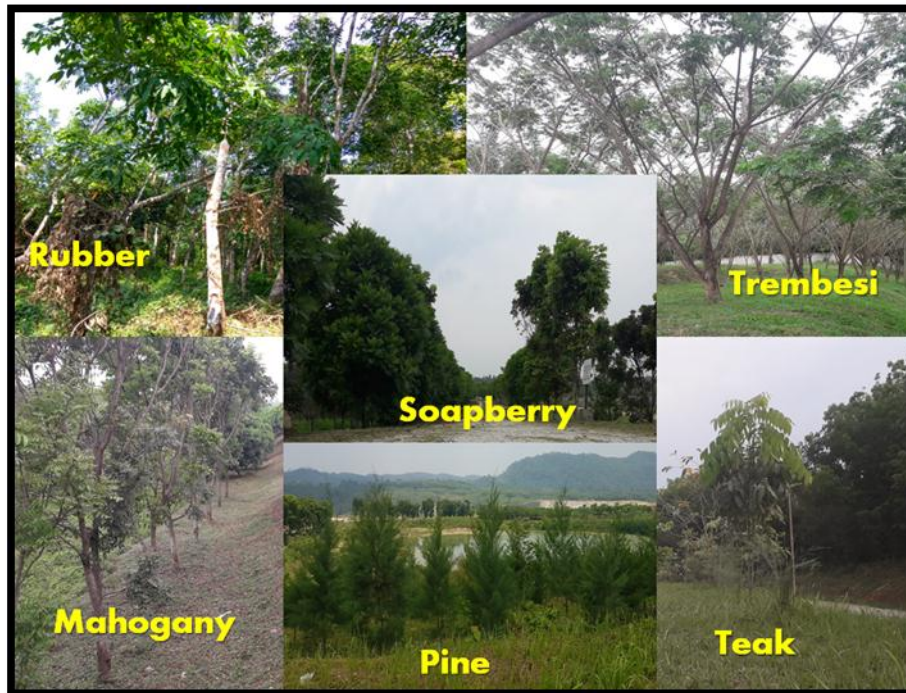
3.1. Initial condition

The initial environmental tile is a description of the environmental condition of the location of the mining cement mining activity of PT Semen Baturaja Tbk. This environmental condition is very important to examine to measure changes that will occur due to a series of activities that have been and will be done. The environmental tones studied include physics-chemical, biological, socio-economic, socio-cultural and public health hues.

The initial condition in this study focuses on the study of geophysical environmental ties associated with soil and biology with existing plants at the site of the project site. This is based on a journal article in [6] which states that changes in physical and chemical properties of the soil that occur due to mining include increased bulk density and soil moisture and decreased permeability and soil fertility. Technical aspects of soil analysis should be undertaken prior to reclamation and re-vegetation activities to determine the treatment to be provided for soil physical and chemical properties in good quality [7].

Reference [8] metions, the type of soil in the research area is a yellowish red podzolic type. In addition, also found alluvial and hydromorf soil type associations. Noting the case, basically at the study site and its surroundings encountered at least three types of soil covering, podzolic, alluvial and hydromorphic. According to field observations, the soil at the site of activity is classified as infertile soil for agriculture. The soil at the study site needs to be improved by the dominance of the sand and dust fraction which shows the composition of sand and dust present in the soil. The soils dominated by the sand fraction have a high composition so that the soils are very low in water retention. All soil types found in the study sites are in fact low in natural fertility. Generally the soil reaction is acid, the organic matter content and the total nitrogen content is moderate.

The quality of the soil in the research location is influenced by one of them by land cover vegetation. Vegetation (flora) based on the results of field surveys in the surrounding area of research in limestone mining at PT. Semen Baturaja is a rubber, pine, trembesi, soapberry, teak, rubber, mahogany plant. Vegetation of the PT Semen Baturaja limestone mining area as shown in figure 2.



Source: Survey of Unsri Competitive Grants Team, 2018

Figure 2.Vegetation Plant Around Existing Mine Sites

3.2. Mine design and mine age

Post-mining land acquisition planning is based on technical design of mining activities in the form of mining method, mining system, mining design, and mine age. Based on the shape and characteristics of layers of limestone and its cover layer, the mining method to be applied by PT Semen Baturaja Tbk is open pit method [9].

The limestone mine design of PT. Semen Baturaja Tbk is designed with the following criteria:

1. Based on the calculation from the Geotechnical consultant, we get the angle of slope that is 50° with the Security Factor of 1.387
2. Dumping of cover soil using a overall slope angle of 34° with $FK = 1.53$
3. The first year of limestone production amounted to 1,620,100 tons, increased to 1,970,000 tons in the eighth year and 1,412,297 tons in the ninth year.

Based on the amount of mining reserves worth 16,560,647 tons, the first limestone production was 1,620,100 tons, increasing to 1,970,000 tons in the eighth year and 1,412,297 tons in the ninth year.

3.3. Reclamation and allocation of post-mined land

3.3.1. Mine reclamation

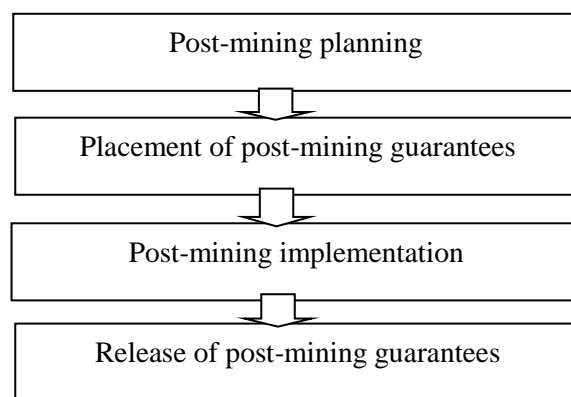
Mine closure planning should be integrated into three aspects, namely economic, social, and environmental. It aims to keep the mine closed after making a positive contribution to sustainable development.

The characteristics of limestone resources in Indonesia are mostly deposited near the surface of the earth. This causes the mining method that many do is open pit method. Mining activities will cause landscape changes such as topography, vegetation cover, hydrological patterns, soil structure damage, and others. This can be difficult in the process of recovering and restoring former mining land in accordance with the designation or known as reclamation.

Reclamation phases include top soil conservation, cover crop planting, pioneer planting, heavy metal countermeasures [10]. Reference [11] argued that reclamation activities require different approaches and technologies because the landscape changes that occur can be permanent (eg very deep soil, soil changes, and biodiversity loss) or temporary (eg residual pile excavation and tailings waste).

3.3.2. *Land allocation post-mine*

Natural resource management policies in sustainable development can use natural resource and environmental sustainability challenge approaches [12]. Post-mining planning for a sustainable mining environment represents the form of its implementation in the mining sector. Post-mining stages for mineral, coal, nonmetallic and rock mining are carried out as shown in the figure 3 below.



Source: Juniah, 2017

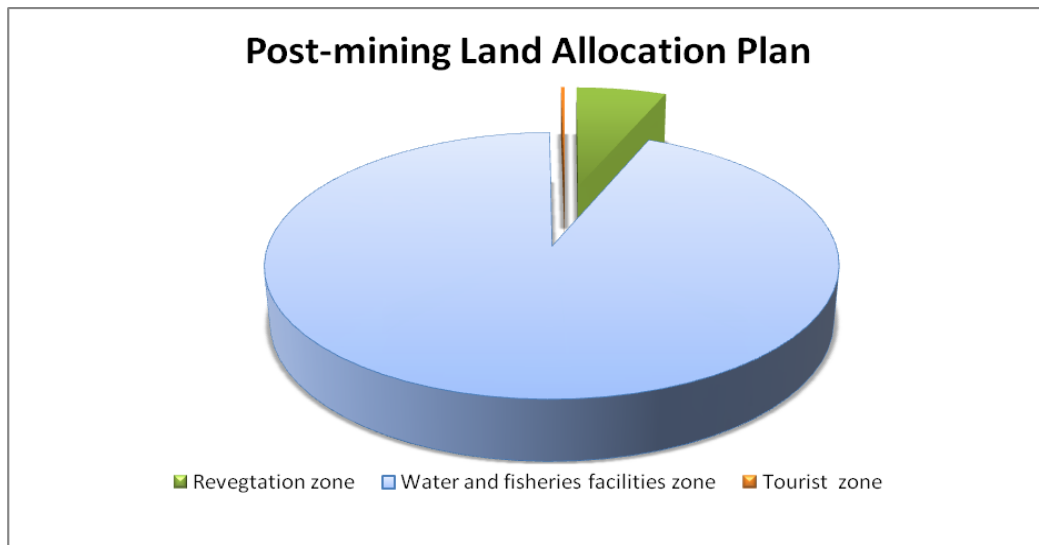
Figure 3. Post-mining Phase Diagram

Based on figure 3, it appears that post-mining planning is in the first stage. This means that post-mining land use planning is done first or earlier before mining activities are conducted. The preparation of the post-mining plan is contained in the post-mining plan document which aims to maintain a sustainable and sustainable environment.

PT Semen Baturaja Tbk is committed to implementing a post-mining plan that benefits communities who live around the mine and mining environment by maximizing the management of the mining environment for planned land use. Based on the post-mining plan prepared by PT Semen Baturaja Tbk, it is known that the post-mining land allotment plan will be utilized for the three designation zones as shown in Table 1 and figure 4 below.

Table 1. Plans for the Allocation of Post-Mining Land of PT Semen Baturaja Tbk.

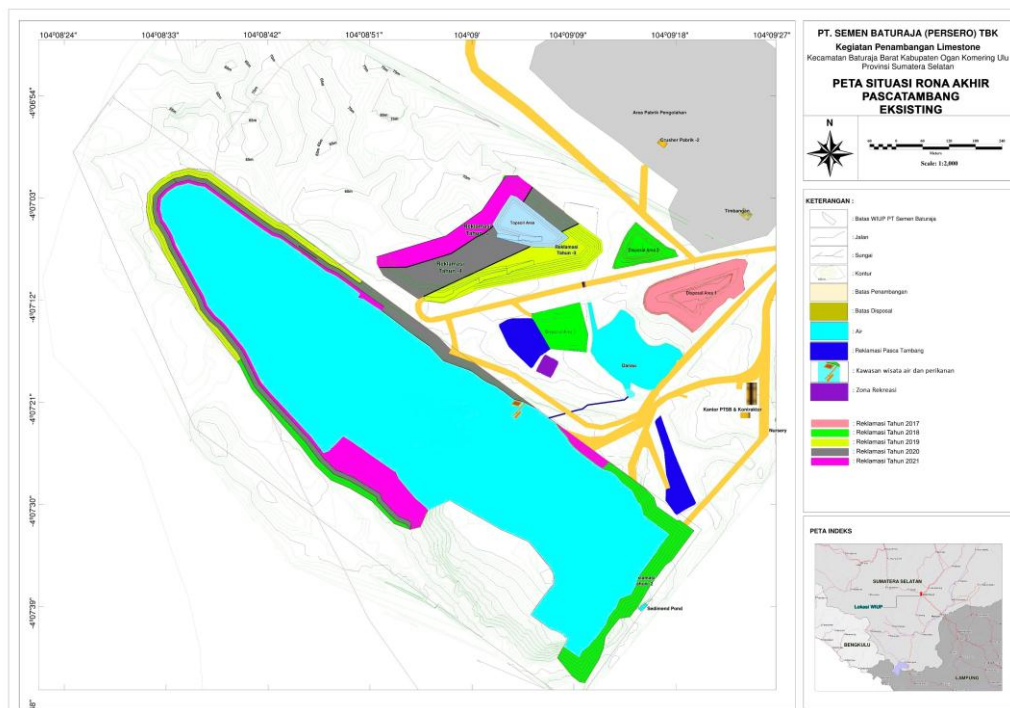
Allocation Plan	Extent (ha)	Percentage
Revegetation zone	3,58	6,21%
Water and fisheries facilities zone	53,94	93,53%
Tourist zone	0,15	0,26%
Total	57,67	



Source: Results Of Post-Mining Plan Document Data Processing, 2018

Figure 4. Plans for the Allocation of Post-Mining Land of PT Semen Baturaja Tbk.

Based on Table 1, it can be seen that the allotment of the former limestone quarry for the revegetation zone is 3.58 ha or 6.21%. This revegetation zone will be intended for rubber plants. This is considering that the initial environmental condition of the location of this research is community rubber plantations which are expected to provide benefits to the surrounding community by maintaining environmental sustainability. The seeds to be planted can be brought in from outside or seeds from surrounding communities. The land use plan (end mine condition) limestone mining PT. Semen Baturaja Tbk is shown in figure 5.



Source: Limestone Post-mining Plan Documents of PT Semen Baturaja Tbk, 2018

Figure 5. Land Use Plan (End Mine Condition) Limestone Mining PT. Semen Baturaja Tbk

4. Conclusions

Postponement of post-mining land of PT Semen Baturaja Tbk at the end of production operations is planned in order to restore environmental function and sustainable limestone mining is for the revegetation zone for rubber plantation with an area of 3,58 ha. This is based on technical studies such as initial hue conditions, mine design and mine life.

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