

## Post-mining Land of Limestone Quarries for Sengon Plants in PT Semen Baturaja (Persero) Tbk

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### Abstract

Limestone mining in PT Semen Baturaja mine mining materials in the form of limestone. Limestone is the material needed to make cement. Open mining activities at the final stage will leave ex-mining land. Ex-mine land in the PT Semen Baturaja reclamation area has been planned for revegetation of sengon seedlings. The research was conducted to examine economically post-mining land of limestone mines for sengon plantations. The initial baseline studied in the study area includes climate, space and geological conditions, and vegetation. Some plants in the study area include sengon, cypress, and guava. The results showed that the use of limestone quarry land for sengon plants had met economically. The results of the study are expected to be utilized by stakeholders, academics, practitioners, researchers, mining associations and the environment.

### Keywords

Limestone, Limestone Mining, Ex-mining land, Sengon seedlings

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## 1. INTRODUCTION

Limestone mining at PT Semen Baturaja uses open-pit mining methods with Quarry mining systems. The limestone mine at PT Semen Baturaja produces limestone that is needed in the manufacture of cement. Lime or carbonate is a rock consisting of salt carbonate minerals formed chemically in the form of a solution, where the organism's water participates in the formation of carbonate rocks. Carbonate rocks are formed cretically (through deposition mechanization) or the process of chemical concentration of carbonate salts originating from marine animals including foraminifera plankton or mollusc which will form reefs through diagenesis (cementation, micritization (by organic)), compaction, neomorphism (the process of replacing minerals similar or polymorphic (Badirun et al., 2017)). Cement is the material needed for buildings, especially in Indonesia. The final stage of limestone mining left the land of ex-mining and mine pit. Limestone mining has positive and negative impacts. The positive impact of limestone mining is an increase in the economy around the mining area. Negative impacts of limestone mining in the form of losses to the environment, both directly and indirectly (Juniah, 2017).

An important requirement for countries that want natural resource conservation is environmentally friendly development. Natural resources need to be maintained and maintained for human survival in the present, and for the next generation. The

value of forest benefits has been reduced due to forest damage (Juniah et al., 2016). Limestone is a sedimentary rock which has three main components, including carbonate grains, mud (lime mud / micrite), and cement (cement). Sedimentary rocks are generally characterized by stratification, specific minerals from sedimentary origin (for example, glauconite, chamosite), sedimentary structures on the bed surface and inside beds, fossils and grains or gravels that have been transported (ie clusters) (Tucker, 2003). Limestone is a mineral belonging to carbonate minerals which are formed from organic remains of living things (Hamimu, 2012).

Limestone mining has a mining period in accordance with available reserves. The limestone mining plan will end in 2026 based on the feasibility study document. After mining ends, efforts are needed in reclamation to restore land functions. Post-mining is an activity to restore the function of nature and social conditions according to local conditions (ESDM, 2014). One of the activities in mining is stripping the cover layer. The cover can be in the form of topsoil, limestone or soft / weathered rock which covers the excavated material. Stripping is done by a mechanical excavator. The mechanical device planned for stripping the cover is 1 unit of class 30 T excavator for overburden and class 20 T excavators for top soil and 1 unit of Bulldozer to push material and top soil. Cover layer in the form of top soil is dug up and piled separately to the bank's top soil location. The top soil deposits are maintained in such a way as to minimize

erosion so that they can be redistributed to land that is ready to be rehabilitated and reclaimed. Likewise, the overburden in the form of weathered rock, the material will be excavated and piled in the location of the waste dump that has been determined with the geometry of the embankment slope does not pass the maximum geometry recommended based on geotechnical analysis (PT.SemenBaturaja).

Mining is a mineral and coal business activity which consists of stages of activities. The stages of limestone mining activities consist of activities of general investigation, exploration, feasibility study, preparation / construction, mining, processing and refining, sales, and post-mining (Mineral and CoalMining, 2009). One type of sengan plant is sea sengan. Sea Sengan has a specific gravity of 0.33 which is durable in its class. Sengan wood is widely used by the community as building materials, making veneers, pulp, and so on (Martawidjaya et al., 1989). Quality seeds are needed to produce quality sengan. One of the things that affects the quality of seeded seedlings is growing media. Growing media has a function as a provider of nutrients, oxygen, and the place where roots grow (Nursyamsi and Tikupadang, 2014).

## 2. EXPERIMENTAL SECTION

The method that will be carried out in retrieving the data needed for the purpose of completing this final report writing is:

### 1. Study of literature

Performed by studying literature materials in the form of books and various references to research reports related to this research.

### 2. Data Collection

The data collected by the author are:

- Primary Field Data, namely data collected by observing directly in the field such as questionnaire data (direct field interviews), data on land area (length and width), soil quality test data (soil pH and metal content), and others.
- Secondary Field Data, namely data collected based on references from companies such as baseline data, economic data, cost benefit analysis, mapping, literature and journal studies.

### 3. Data Processing

The data obtained, processed using a mathematical formula, are then presented in table form, drawings and completion calculations. Data processing includes calculating data on extended cost benefits or extended NPV and analyzing data on soil laboratory test results in accordance with soil composition.

### 4. Data Analysis

The processed data is then analyzed based on the literature related to the problem.

### 5. Research location

Administratively the study location is included in the West Baturaja District, Ogan Komering Ulu District, South Sumatra Province. The accomplishment of the area can be reached by road from the City of Palembang to the

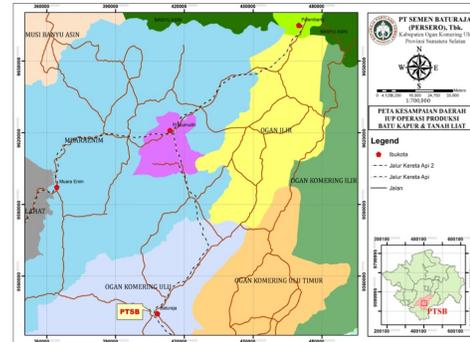


Figure 1. Map of Regional Accomplishments (PT. Semen Baturaja Tbk, 2018)

Ogan Komering Ulu District using four-wheeled vehicles through provincial roads with a travel time of around  $\pm$  5 hours. Then go to Pusar village through the village road with a travel time of about  $\pm$  15 minutes. Research location as shown in Figure 1.

## 3. RESULTS AND DISCUSSION

Technical aspects and economic aspects are important to consider in determining the designation of post-mining land. Technical aspects are used as a basis in determining the economic planning of post-mining costs. The economic aspects discussed are as follows:

### 3.1 Regional Achievement

The area of the Mining Business License ("IUP") of PT Semen Baturaja (Persero) Tbk is geographically located in Pusar Village which is included in the administrative area of West Baturaja District, OKU Regency, South Sumatra Province. The area of Production Operation IUP PT Semen Baturaja (Persero) Tbk is 103.4 Ha.

### 3.2 Initial Hue

Initial hue is an object that describes the conditions of an area. Some of the things discussed in the baseline are as follows.

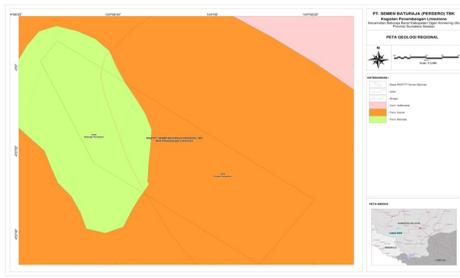
#### 3.2.1 Climate

The location of the limestone mine development activities of PT Semen Baturaja (Persero) Tbk in OKU Regency is administratively located in OKU Regency, South Sumatra Province. Based on the type of climate in South Sumatra in general and in particular districts, this region is included in tropical regions.

#### 3.2.2 Space and geological conditions

##### 1. Space Conditions

Pusar Village and its surroundings are mostly production forests that are not too dense, others are coffee, rubber, pepper and smallholder plantations. The area of investigation is in the area of the Saka, Lungkuk, and Sangur River flows. The average air temperature ranges from 21.73°C to 32.39°C, with relatively high rainfall.



**Figure 2.** Geological Map of Limestone Mine in PT. Semen Baturaja (Persero) Tbk



**Figure 3.** Rubber Trees as Natural Vegetation

## 2. Geological Conditions

Geological conditions in the study area can be viewed from various things, one of which is lithology. Lithological interpretation is made from drilling data when conducting exploration activities. Drilling is carried out by PT Supindo in the area of the Exploration Mining Business Permit (IUPK) of limestone and clay PT Semen Baturaja (Persero), Tbk. Geology of the Baturaja formation in general according to Van Bemmelen belongs to the Palembang group which has the formation of Tma, Qtk, and Tmpm. The limestone formation is a facies from the lowest collection from the Telisa side with a thickness of 1,000-1,200 m which develops as a pasir sediment and is an oily area (Talang Akar, Pendopo, Benakat). The limestone IUP area in the Puser area of PT Semen Baturaja (Persero) Tbk covering an area of  $\pm$  103.5 hectares, is located in the West Baturaja District of Ogan Komering Ulu District, South Sumatra Province. The topography of the limestone mining area in the Puser area is marked by Karst topography which has an average height of 45 meters above sea level. Navel mining is limited by the land of the population in the Southwest located  $\pm$  210 meters from the highway with Azimut 2150 49', while from the train station  $\pm$  620 meters northwest. The Batukapur mining area is surrounded by the Ogan river, with a distance of  $\pm$  320 meters to the mining site. The water level of the Ogan river is 30 m from the sea level. The geological map of the study area is shown in Figure 2. The location of the study area included a slope of 0 - 8% in Old Meosin, with a maximum area of more than 300 meters in that area. Geological map of limestone mine in PT. Semen Baturaja (Persero) Tbk can be seen in the Figure 2.

## 3. Topographic conditions

Topographic conditions in the study area are medium wavy plains. Morphology in the study area consists of plain terrain and sloping area.

### 3.2.3 Vegetation

Vegetation around the study area has various types. Vegetation is divided into natural vegetation and cultivation vegetation. The area of the planned expansion area at the PT. Semen Baturaja (Persero) Tbk in Puser Village, West Baturaja District, OKU

Regency in the form of shrubs, rubber gardens, sengon and mixed gardens. Most of the area that will be used as the location for the development of the coking mine in PT Semen Baturaja (Persero) Tbk is community-owned land, both for rubber plantations and bushes. The vegetation structure of shrubs is also various levels, namely the level of herbs, saplings, poles, and trees. In general, the vegetation at the Navel location with an observation area of 103.4 Ha has the highest diversity value between the vegetation levels is the tree level with a diversity index value of 2.940, then followed by the stake level with a diversity index of 2.441, pole level of 1.930 and herbaceous levels of 1,721. Planting distance on sengon plants planted in the research area between one plant and another measuring 4 x 4 m. The natural vegetation found in the research area includes rubber trees. Rubber trees as natural vegetation can be seen in the Figure 3.

### 3.3 Post-mining Land Use for Sengon Plantation

Post-mining land in the research location is used to restore land functions as before. The aspects carried out in post-mining land use include mining techniques, post-mining plans, and soil quality testing. Post-mining land use can be done in several ways, one of which is tree planting. Trees planted in the reclamation research area are sengon trees

#### 3.3.1 Technical of mine

##### 1. Mining Preparations

The first mining activity carried out is land clearing. Activities after clearing land are carrying out construction activities. Supporting facilities from construction that are constructed such as haul roads, limestone processing plants, 'stockpile', limestone loading ports, offices, explosives warehouse settlements, fuel warehouses, and others.

##### 2. Mining Operations

Mining operations consist of land clearing, stripping overburden, followed by mining consisting of excavation, loading and hauling.

###### (a) Land Clearing

Shrub cleaning, making pioneer roads, and making waterways included in land clearing activities.

###### (b) Stripping Overburden



**Figure 4.** Stripping Cover Ground Layer Using 30 T Excavator

Excavator load digging tools are used in stripping the cover layer. The cover layer that covers the excavated material is topsoil, limestone and soft stone. Land clearing activities in the research area are carried out with bulldozer heavy equipment. The working principle of bulldozers is leveling the land covered with trees and shrubs, making roads, and making drains. Subsequent activities after land clearing activities are stripping activities. The overburden to be peeled can come from limestone or soft rock that covers the excavated material. Mechanical devices planned for stripping top soil are class 30 T excavators and bulldozers. Stripping the overburden used excavators. Stripping Cover Ground Layer Using 30 T Excavator can be seen in Figure 4.

(c) Demolition

The demolition method planned by PT Semen Batara (Persero) Tbk at the Pular Village mine site consists of two methods, namely a method without blasting with a surface miner mechanical digging tool and blasting with a mechanical excavator class 30T excavator.

(d) Loading

The excavator used was a class 20 T excavator unit to dig and load top soil, 1 class 30 T excavator to dig and load overburden and limestone, and 1 wheel loader unit to collect the delivery material by Surface Miner class 500 Q.

(e) Transportation

The transport equipment used is a class 30 T dumptruck. The results of the limestone mining are transported using dumptruck to the crusher. The distance of the mine and crusher is estimated to be between 0.5 km to 1.5 km.

### 3.3.2 Post-mining plan

Post-mining land use can be done by planting sengon. The sengon trees planted in the study area have a close distance, which is around 4 m. Other plants planted in the post-mining reclamation area are fir and guava. The types of plants that are



**Figure 5.** Sengon trees in the post-mining reclamation



**Figure 6.** The initial hue soil sampling

planted cannot be done with sceneries due to adjusting to soil conditions, climate, and so on. Sengon trees in the post-mining reclamation area can be seen in Figure 5.

### 3.3.3 Soil quality test

Soil quality tests based on soil sampling in the study area are carried out in the laboratory. The collection of soil samples is carried out in areas that have not been mined around the mine area or the initial hue area and in the reclamation area or embankment area. The collection of soil samples in the study area is carried out individually. The initial hue soil sampling can be seen at Figure 6.

Soil sampling is also carried out in the post-mining reclamation area. The principle of taking soil samples is also the same as taking initial soil samples. The collection of soil samples is to determine the differences in the content of soil embankments and initial hues. The collection of soil samples must use hand protectors that limit the touch between skin and soil so that contamination of the soil does not occur. Sampling of embankment soil can be seen in Figure 7.

Soil samples that have been taken in the study area will then be tested for the quality of the soil samples. Testing of soil samples is carried out in the Environmental Biotechnology laboratory of PT. Indonesian Biotechnology Biodiversity. Soil test results for embankment and initial hue soil indicate differences in soil quality. The results of the soil quality test are in accordance with procedures and have met the quality standards set by the government. Soil test results can be seen in the Table 1.

**Table 1.** Soil Test Results

No	Parameter	Method	Unit	Identification Number		
				Landfill 1810.0398	Early Soil Land 1810.0398	
1	C-Organic	Walkley & Black / Gravimetri	%	0.72	9.29	
2	N-Total	Kjeldahl	%	0.14	0.45	
3	C/N Ratio	Calculation	-	5	21	
4	P <sub>2</sub> O <sub>5</sub> Available	Bray / Olsen	ppm	7	16	
5	P <sub>2</sub> O <sub>5</sub> Potential	HCl 25%	mg/100g	40	116	
6	K <sub>2</sub> O Potential	HCl 25%	mg/100g	30	51	
7	Cations can be exchanged	K <sup>+</sup> Na <sup>+</sup> Ca <sup>2+</sup> Mg <sup>2+</sup> N NH <sub>4</sub> OAc	cmol(+)/kg	0.56	0.62	
				0.15	0.18	
				17.1	33.94	
				0.82	1.86	
8	Acidity Exchangeable	Al-dd N KCl	cmol(+)/kg	21.57	0.21	
9	Cation Exchange Capacity	H-dd N NH <sub>4</sub> OAc	cmol(+)/kg	2.14	0.22	
				49.84	52.61	
10	Base saturation	Calculation	%	37.37	69.58	
11	Water Content	Gravimetri	%	10.7	8.9	
12	pH	H <sub>2</sub> O	Potensiometri	-	6.2	5.2
		N KCl		4.5	3.6	
13	Texture of 3 fractions	Sand	Pipette	%	41	-*
		Dust			18	-*
		Clay			42	-*



**Figure 7.** Sampling of embankment soil

### 3.3.4 Technical study on the use of the batukapur mine post-mining land for sengon plantation

Changes in soil quality physically and chemically can occur along with the development of limestone mining activities. The collection of soil samples in the study area includes taking samples of embankment and initial soil. The pH level on the sample results showed a difference, where the pH level of the embankment soil was 4.5-6.2, while the pH level of the soil in the baseline soil was 3.6-5.2. The content of soil elements such as C-Organic, N-Total and so on is still below the maximum permissible level. The test results of the soil samples show that the physical and chemical properties are still in accordance with the land quality standard set by the government.

The soil pH tested showed an increase in alkaline properties in the soil, where there was an increase from pH 3.6-5.2 to pH 4.5-6.2. The level of base saturation in embankment soil is 37.37, while in the baseline soil is 69.58. Some plants that have been tested on the previous landfill are sengon, cypress, and guava plants. Activities planned to be carried out on landfill are planting sengon seeds. Planting sengon seeds can provide benefits in the future.

## 4. CONCLUSIONS

1. The initial hue includes geophysical and geochemical components consisting of climate, geological conditions, and vegetation that have met the requirements in relation to the use of sengon plants. Some of the things obtained from the research include:
  - (a) Planting distance on sengon plants planted in the research area between one plant and another measuring 4 x 4 m.
  - (b) Most of the area that will be used as the location for the development of the coking mine in PT Semen Baturaja (Persero) Tbk is community-owned land, both for rubber plantations and bushes.

(c) In general, the vegetation at the Navel location with an observation area of 103.4 Ha has the highest diversity value between the vegetation levels is the tree level with a diversity index value of 2.940, then followed by the stake level with a diversity index of 2.441, pole level amounting to 1,930 and herbaceous levels of 1,721.

2. Soil quality in the study area is suitable for planting sengon plant seeds. The soil pH quality for initial soil is 5.2 for H<sub>2</sub>O and 3.6 for NKCL. The pH quality of soil for landfill is 6.2 for H<sub>2</sub>O and 4.5 for NKCL. This shows the change in soil pH becomes alkaline.

## 5. ACKNOWLEDGMENT

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