Evaluation of the Result Rate of Reclamation with 5 Years-Old Revegetation on Post-Coal Mining Land in Lati Site Pt.Berau Coal

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Abstract— *Mining activities with open mining system give changes in the landscape and generate other negative impacts on the environment. Therefore, the post-mining land treatment is necessary taken to restore the condition of the mine site. One of the efforts that can be done is reclamation and revegetation. The purpose of this study was to assess and evaluate the success rate of reclamation and revegetation in coal post-mining fields at PT. Berau Coal. This study was carried out on PT Berau Coal revegetation land in Lati Site, Sembakungan Village, Gunung Tabur District, Berau Regency, East Kalimantan. This field work was conducted for two months. This study adopted survey, sampling and scoring methods. Revegetation plants used are revegetation with planting age 5 years old. Assessment of revegetation criteria was accomplished by a sampling system using sample plots. The first sample plot was obtained by random sampling, then the next plot was systematically determined with a zig-zag pattern. The results of the study showed that the land management criteria had a score of 30, erosion and sedimentation control was 13 and revegetation was 47.3. The success rate value of reclamation with revegetation is included in the good and successful category with an evaluation value of 90.33%.*

Keywords— *Evaluation, post-coal mine land, reclamation, revegetation.*

I. Introduction

Mining carried out by PT. Berau Coal uses an open pit mining system which in its implementation will certainly result in forest and environmental disturbances. Mining activities carried out have a negative impact and cause environmental degradation such as land destruction, making the soil less fertile for planting media and the reduced diversity of flora and fauna around the mined environment.

PT. Berau Coal is committed to handling post-mining land in the form of reclamation as a form of responsibility for the disturbed environment for mining purposes, one form of reclamation activity carried out by Berau Coal is revegetation. The selection of revegetation plant types is adjusted to the ability of plants that are adaptive to the post-mining environment, considering the condition of the ex-mining land that has been damaged and is less fertile. Some of the plants that have been used for revegetation include eucalyptus, sea sengon, longan, kahoi and lime.

In fact, the reclamation activities carried out in the field do not always run well if you look at the condition of the land damaged by mining. Damaged land conditions can cause disruption of revegetation plant growth and can even cause plant death. Monitoring of revegetation plants is routinely carried out to anticipate this and determine the growth and condition of the planted vegetation. The research location is in the post-coal mining area of Site Lati, especially the former In Pit Dump Other South (IPD OS) mining area located in Sammbakungan Village, Gunung Tabur District, Berau, East Kalimantan.

Research on the success rate is carried out by assessing several indicators of reclamation activities such as land management, revegetation plants as well as erosion and sedimentation. Research evaluating the success rate of reclamation aims to find out how big the success rate of reclamation with revegetation planting year 2013 or 5 years old is carried out on reclaimed land at Lati Site, especially the IPD OS area, so that appropriate directions or recommendations can be determined to increase the success of reclamation in the area. Research evaluating the success rate of reclamation with revegetation is guided by using the Minister of Forestry Regulation Number 60 of 2009 concerning Guidelines for Forest Reclamation (Kementrian Kehutanan. 2009). Efforts to reduce the area of land that is open due to mining activities, so that stockpiling activities are in line with the movement of active mines [2]. [3] states that open pit mining activities also affect the balance of the soil surface ecosystem, reducing soil productivity and environmental quality. [2] mentions environmental impacts due to mining can be in the form of decreased soil productivity, soil compaction, erosion and sedimentation, Forest and land rehabilitation is an effort to restore, maintain and improve forest and land functions so that their carrying capacity, productivity and role in maintaining life support systems remain stable. awake [4]. Reclamation includes securing ex-mining land, land scaping, setting low economic value mining materials (low grade), top soil management, erosion control, and revegetation [5]. The short-term goal of reclamation is to form a landscape that is stable against erosion, returning the mine site to be used as productive land [6].

II. Research Methodology

The research was conducted in the post-mining revegetation area of PT Berau Coal East Kalimantan at Site Lati, especially in the reclamation area of the IPD OS block located in Sambakungan Village, Gunung Tabur District, Berau Regency. The research activity was carried out in July 2018 – September 2022. The tools and materials used in the research were stationery, GPS, camera, laptop, tape measure, raffia, scissors,

ruler, tally sheet, measuring tape and 5-year-old revegetation stands (year of planting). 2013).

III. RESULTS AND DISCUSSION

The parameters on the land management criteria consist of refilling ex-mining holes, the area laid out, slope stability and top soil sowing. Coal mining with an open-pit mining system causes serious impacts on the environment, one of which is the formation of former mining pits. Therefore, it is necessary to do handling is refilling ex-mining pits. The filling of ex-mining pits is done by filling the pits using material that was originally taken during mining. It is necessary to pay attention to the composition of the filling of ex-mining holes, namely the overburden is at the bottom, then the subsoil and topsoil are placed at the top. Assessment of filling ex-mining pits is carried out by looking at the actual conditions at the research location. The filling of ex-mining holes at the IPD OS location has been carried out in its entirety, this is because no remaining holes were found that were still left open at the reclamation site studied, so that it had a value of 5.

TABLE 1. Criteria for Land Arrangement at the Research Site

Parameter	Evaluation	Score	Calculation Score
a. Replenishment of ex-mining pits	Replenishment of ex-mining pits ≥ 90%	5	
b. Size of the area laid out	Area arranged ≥ 90%	5	$= \dfrac{5+5+5+5}{20}$
c. Slope stability	There is no landslide until the landslide is very light (<5%)	5	$\times\,30$
d. Top soil sowing	Top soil sowing ≥ 90%	5	$= 30$

The parameter of the area that is laid out is the size of the post-mining area to be reclaimed. The area of the reclamation area under study was 6.48 ha from the planned 6.25 ha. Changes in area occur due to changes in the area of land opening to be mined, the area being laid out has a value of 5.

Slope stability parameter assessment is carried out to determine the stability of the land that has been laid out. The assessment is carried out by observing the presence or absence of landslides in the reclamation area. The results of observations show that at the IPD OS reclamation location there are no landslide events, this proves that the land that is laid out has a stable slope stability so it has a value of 5.

Top soil or topsoil is a very important component in revegetation activities, because topsoil contains many nutrients and minerals which are good growing media for plants. The assessment of topsoil sowing is carried out by looking at the reclamation documents belonging to the company, this is because at the location studied reclamation activities have been running for a long time. Topsoil sowing in the IPD OS block is carried out thoroughly on an area of 6.48 ha so that it has a score of 5. Topsoil is sown by placing overburden at the bottom and then subsoil on top and the top layer is topsoil.

Erosion and sedimentation control is one of the things that companies must do during and after mining activities. Erosion can result in soil loss, mud deposits and sedimentation in

grooves and drainage. Erosion control needs to be done one of them by making soil conservation buildings. Erosion and sedimentation criteria are divided into

number of conservation buildings, building benefits, area of cover crop planting, erosion and sedimentation.

The types of conservation buildings that exist in the reclamation area studied are drop structures and drainage channels. Waterfall buildings are made at a certain distance from the drainage channel, while drainage canals are made to surround the reclamation area. The construction of conservation buildings has a value of 1, because the construction of the number of waterfall buildings is not in accordance with what it should be on an area of 6.48 ha. The assessment of the benefits of the building is carried out by observing the presence of erosion and sedimentation, the presence or absence of puddles and the color of the water in the building. Observations show that there are puddles of yellow or cloudy water in the drainage channels originating from runoff water, this situation indicates that the conservation building is less useful so it has a value of 2.

TABLE 2. Erosion and Sedimentation Control at the Research Site

Parameter	Evaluation	Score	Calculation Score
a. Number of Buildings	Number of Buildings ≤60%	1	
b. Building Benefits	Less useful	2	$= \dfrac{1+2+5+5}{20}$
c. Cover Crop Planting Area	cover crop planted ≥ 90%	5	$\times\,20$
d. Erosion and Sedimentation	erosion event <5%	5	$= 13$

Cover crop planting area is carried out evenly parallel to the contours of the entire revegetation area. Cover crop planting is carried out at the beginning of reclamation activities, so that at the research location the assessment is carried out by looking at the reclamation documentation for selecting companies. Based on the documentation that cover crop planting has been carried out thoroughly on reclamation land covering an area of 6.48 ha with a spacing of 20 cm x 20 cm, so it has a value of 5. The types of cover crops used by the company are Centrosoma pubecens and Centrosoma mucunoides.

Erosion and sedimentation assessment is carried out by looking at the presence or absence of erosion at the study site. Observations showed that there were groove erosion at several points of the reclamation area with an area of 11 m2 (0.015% of the land area) at several points that were not covered by cover crops. The assessment of erosion and sedimentation is 5, because the area of erosion that occurs is <5% of the reclamation area. Several factors that can affect erosion are soil type, climate, topography and vegetation. The type of soil in the study area is dominated by ultisol soil which has a high level of erosion sensitivity and high rainfall in the study area can cause high erosion possibilities.

The revegetation parameter assessment was carried out by making a measuring plot measuring 40 m x 25 m. Making the number of measuring plots is determined by a sampling intensity of 5% of the reclamation land area, so that the number

25

of measuring plots made is 3 plots of a land area of 6.48 ha. The selection of measuring plot points is done using a systematic sampling technique with a random start (systematic sampling with random start), namely by mapping the reclamation area to be studied then the first plot is determined randomly, in this case the researcher chooses a point that is close to the road in order to facilitate access. The second and third plots were carried out systematically with a zig-zag pattern drawn from the location of the first measuring plot point. Several parameters were observed, namely planting area, growth percentage, number of plants per hectare, plant composition and plant health (Table 3).

TABLE 3. Revegetation at the Research Site

Plot	Parameter	Evaluationn Evaluation	Score	Calculation Score
I	Size of planting area	Planting realization ≥90%	5	
	Percentage grow	Percentage grow ≥90%	5	$\frac{5+5+5+5+4}{25} \times 50$
	Number of plants per hectare	Number of plants ≥625 ph/ha	5	=48
	Composition of plant species	Local type >40%	5	
	Plant health	Healthy plant 80%-90%	4	
II	Size of planting area	Planting realization ≥90%	5	
	Percentage grow	Percentage grow ≥90%	5	$\frac{5+5+5+5+4}{25} \times 50$
	Number of plants per hectare	Number of plants ≥625 ph/ha	5	=48
	Composition of plant species	Local type >40%	5	
	Plant health	Healthy plant 80%-90%	4	
III	Size of planting area	Planting realization ≥90%	5	
	Percentage grow	Percentage grow ≥90%	5	$\frac{5+5+5+5+3}{25} \times 50$
	Number of plants per hectare	Number of plants ≥625 ph/ha	5	=46
	Composition of plant species	Local type >40%	5	
	Plant health	Healthy plant 60%-79%	3	

The revegetation parameter assessment was carried out by making a measuring plot measuring 40 m x 25 m. Making the number of measuring plots is determined by a sampling intensity of 5% of the reclamation land area, so that the number of measuring plots made is 3 plots of a land area of 6.48 ha. The selection of measuring plot points is done using a systematic sampling technique with a random start (systematic sampling with random start), namely by mapping the reclamation area to be studied then the first plot is determined randomly, in this case the researcher chooses a point that is close to the road in order to facilitate access. . The second and third plots were carried out systematically with a zig-zag pattern drawn from the location of the first measuring plot point. Several parameters were observed, namely planting area, growth percentage, number of plants per hectare, plant composition and plant health (Table 3).

Plant growth in the three plots had an average of 100%, due to the overall growth of revegetation plants in each plot of 62 trees with a spacing of 4 m x 4 m. Assessment of plant growth is done by counting the number of pioneer plants that grow in the observation plot. The assessment of plant growth parameters is worth 5. The types of pioneer plants used by the company are eucalyptus and sea sengon.

The number of plants per hectare is determined from the measuring plot area, which is 1000 m2 divided by the spacing used, which is 4 m x 4 m for pioneer plants, so that the number of trees per hectare is 625 trees. The assessment is carried out directly in the field. The assessment of the number of plants per hectare at the research site is worth 5, because the number of plants planted is 625/ha, overall in the research area there are a total of 4050 trees consisting of eucalyptus and sea sengon.

The composition of plant species is local plant species grown in the revegetation area. The types of local plants used by PT Berau Coal are kahoi, longan and lime. Local plant planting is carried out after succession when the pioneer plants have grown large, this is because local plant growth requires shade. The assessment was carried out by counting the number of local plants in each measuring plot. The composition of plant species is worth 5, because the planting of local plants is carried out thoroughly with a spacing of 4 m x 8 m.

Plant health parameters were carried out directly on the plants in the measuring plot. The assessment of plant species is divided into 2 categories, namely healthy plants and unhealthy plants. Healthy plants are plants that have straight stems, densely titled, minimum height according to standards and free of pests and diseases, while unhealthy plants are plants that grow abnormally, are attacked by pests, yellow leaves and bent stems. The revegetation area of IPD OS shows an average of 83.87% healthy plants, so it has a value of 5. Some of the unhealthy plants encountered were pioneer plants that were entangled by ground cover plants and experienced leaf loss.

Evaluation Results of Each Parameter

The results of the evaluation of the success rate of reclamation at the research site, namely the IPD OS Site Lati block, showed success. The value of the reclamation rate that has been carried out is 90.33% belonging to the good category, so that the reclamation can be accepted and is said to be successful.

Several factors caused the reclamation activity to not reach the perfect value because in the reclamation area it was found that there was groove erosion at several points and the presence of revegetation plants that had unhealthy conditions due to entanglement of ground cover plants and leaf loss.

Things that companies can do to improve or anticipate this include reorganizing land and planting cover crops in areas where erosion occurs, normalizing drainage so that runoff water can be channeled into settling ponds, weeding or changing plants can be done on entangled plants. ground cover with plant species whose growth is not coiled like grass. Types of grass that can be used such as elephant grass or bede grass.

IV. CONCLUSION

The criteria for land management have a score of 30, the criteria for controlling erosion and sedimentation are 13 and revegetation are 47.3. The results of the evaluation of the success of reclamation in the IPD OS area have a value of 90.33. These results are included in the good category (>80%), the implementation of the reclamation can be accepted and is said to be successful.

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