

COAL MINING CLOSURE COMPLIANCE ANALYSIS AT BANJAR REGENCY, SOUTH KALIMANTAN, INDONESIA

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ABSTRACT

Banjar regency is one of the areas in South Kalimantan province in Indonesia that has some coal mining activity in the area. The utilization of coal mining as natural resource has a positive impact on economic growth and community welfare but can also have a negative impact on the environment if not be managed properly. Land disturbance areas could be impacted on land erosion rate, air pollution, and wastewater discharge can be increased, also lower the soil fertility level. On the biological issue, the loss of some flora and fauna species and the social aspect, the activity affected social tradition, social conflict, and community wrong perception. To evaluate the sustainability of post-mining, the study was carried out to analyze the existing conditions, including final morphology and topography, erosion rate, soil fertility, water quality, the success rate of reclamation and revegetation. The results of this study indicated that the topography of some areas does not comply with the company's plans as stated in the post-mining documents approval with high erosion level, lower soil fertility rate, lower reclamation, and revegetation achievement, and lower improvement of community economy programs.

Keywords: Compliance, Community success parameter, Mine closure plan, Revegetation rate.

INTRODUCTION

Coal mining activities have a positive impact in terms of economic growth and community welfare but at the same time have a negative impact on the environment if not managed properly (Gunawan et al., 2014). Negative impacts on the environment can occur in (1) the physical environment, such as topography, erosion rate, low soil fertility rate, land capability, water pollution due to acid mine drainage, and air pollution (Noor et al., 2020a; Setiawan et al., 2018), (2) the biological environment such as the loss of various types of flora and fauna (Kleinmann, 2004), (3) the social environment, such as changes in culture and traditions, population migration, social conflicts, and community perceptions (Buchori et al., 2018).

Every coal mine in Indonesia is required to prepare a mine closure plan document before they start mining reference with Indonesia Regulation. PT Tanjung Jaya Alam (PT TAJ) and PT Putra Bara Mitra (PT PBM) are examples of two mining companies in Banjar Regency, South Kalimantan Province, that have carried out their obligations to have the mine closure approval document in 2013 (Kepmen ESDM 1827, 2018). Mine closure documents approval those have been prepared by PT TAJ and PT PBM cover the ecology, economy, and social aspects. PT TAJ has been supported the economic improvement programs that have been determined, such as the land transformation economic value of ex Pit-2 area for an ethanol process factory, ex Pit-4 for cow farming and freshwater fish cultivation. Area of ex Pit-5 for

mini golf course. For social aspects covering educational and social facilities such as scholarship programs for students and community health service assistance, how the community program can improve social empowerment.

The aim of this research is comparing the existing condition with the plan those have been approved in mine closure documents by investigating (1) the latest condition of morphology and topography, erosion rate, soil fertility rate, acid mine water quality and success rate of reclamation and revegetation, 2) economic program of community surrounding during post mining (Castro et al., 2011).

MATERIALS AND METHODS

Research Location

The research was conducted at coal mining companies of PT TAJ and PT PBM at Banjar District of South Kalimantan Province (Figure 1).

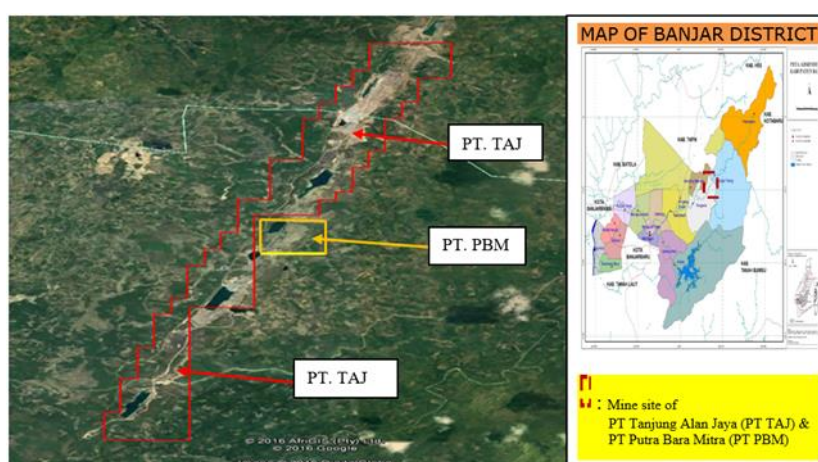


Figure 1. Map of PT TAJ concession of 1,621 Ha and PT PBM of 91 Ha

Data Collection

Data collected in this study are primary and secondary data. Primary data were compiled by field survey, direct interviews, and questionnaire on the surrounding community. A field test was carried out for soil, water, and revegetation area. Soil sampling at nine locations in ex pit (in-pit) and five locations in waste dump area (out-pit dump). For water quality analysis, water sampling was conducted on four ex pit locations of voids. Secondary data were compiled from literature related studies (Cherry et al., 2001; Noor et al., 2020a; PT PBM - AMDAL, 2005; PT TAJ - AMDAL, 2007; Paramita and Kristiana, 2013).

Reclamation Plan Implemented Analysis

Success criteria of mine closure process were analyzed by comparing the actual achievement at field with the plan in document. The comparison delivered some area is compliance or not compliance with statement in the document. (Cherry et al., 2001; Noor et al., 2020b; Soni et al., 2014).

Erosion Rate, Soil Fertility, and Water Quality Analysis

The erosion rate on the study location was quantified by Universal Soil Loss Equation (USLE) (Wischmeier and Smith, 1978). The erosion experiment done on 11 locations on ex mining area. Soil fertility parameter reference adopted from the Soil Research Center of Bogor Agricultural University guidelines. Soil samples from each location were taken at a

depth of 0-50 cm as the assumption of plant root area. All soil samples were composited and analyzed at Environmental Study Research Center, ULM. For waste water quality analysis result by water sampling on the area of compliance point of pH, Total Suspended Solid, Fe, Mn and Cd analyzed in the laboratory and referenced with the regulation of South Kalimantan Governor Decree Number 36 the year of 2008 (Doran, 1994; Larney and Angers, 2012; Noor et al., 2019; Noor et al., 2020c).

Revegetation Success Rate and Community Success Parameter Analysis

Revegetation Success rate of every location were evaluated with reference with success criteria of (1) land arrangement with a percentage value of 60%, including the arrangement of the land surface, spreading topsoil, control of acid mining water erosion; (2) revegetation with a value of 20% includes cover crop, fast growing, local crops; (3) acid mine drainage; (4) the success criteria with a value of 20% include transplanting and treatment (PT TAJ – AMDAL 2007; PT PBM – AMDAL 2005) references with Energy and Mineral Resources Ministry (ESDM) Regulation of Number 1827 year of 2018 concerning the Implementation of Reclamation and Post-Mining Plan for Non-Forestry Area. For Forestry area references with Forestry Ministry Decree of P.60 regarding revegetation success criteria for forestry area. Plot sampling in the reclamation area to identify the condition of the revegetation process, how many percent the area planted by local species and plant health condition. For economic aspect of community development was analyzed by compiling community information sharing. How many percent the community accepted the community empowerment program (Kepmen ESDM 1827, 2018; Noor et al., 2020b; Permenhut P.60, 2009; PT PBM - RPT, 2010; PT TAJ - RPT, 2012).

RESULT AND DISCUSSION

Every coal mining company has an obligation to prepare the approval mine closure documents covering a) post-mining objectives, b) consultation with stakeholders, c) environmental issue, d) final reclamation plans, asset facilities management, utilization of voids, community economic empowerment programs (Chaulya, 2004; Mahreda et al., 2020; Noor et al., 2020a).

Reclamation Plan Implementation Result

Mine Closure document is the basic reference for conducting the field survey on PT TAJ and PT PBM reclamation area. In the document has mentioned the detail of each area were identified condition in the year of 2010 and 2013. PT PBM reclamation area of waste dump area is 32.27 ha, revegetation area 29.41 ha, southern void area 3.32 ha. For PT TAJ condition are waste dump area is 25.74 ha, revegetation area 25.74 ha, and river diversion with 4 m wide and 500 m length (PT PBM - RPT, 2010; PT TAJ - RPT, 2012).

For geochemical study have been identified 80.0% of overburden was Non-Acid Forming (NAP) based on 16 samples and 7.5% of Potential Acid Forming (PAF) with category of low capacity, 10.0% was PAF high capacity, and 2.5% was PAF medium capacity. Reclamation will not meet the success rate of revegetation if the PAF material was not handled properly (Noor et al., 2019). Backfilling area on reclamation activity identified on level 80.5–103.5 msl (meter sea level) at the north area by in-pit dump methods and some area on level 70.5–90.0 msl at southern part by combining both in-pit dump and out pit dump as caused material balance effect to be void area (Noor et al., 2020a; PT PBM - RPT, 2010).

Total volume of overburden (OB) those return to reclamation of the southern area is 6,917,000 bank cubic meter (bcm) covering 848,000 bcm of in-pit dump area and 4,500,000 bcm of waste dump area. For the northern area, the reclamation was 2,170,325 bcm covering

2,455,000 bcm of in-pit dump and 1,284,325 bcm of waste dump area. The topography of Pit-1 is 35.0 ha of bumpy hilly area on level 55-80 m sea level (msl). Pit-2 are 39.4 ha of in-pit dump on level 30-80 msl, and 36.5 ha of bumpy hilly waste dump area on 30-70 msl. Pit-3 is a wavy hilly area of 22.83 ha on 30-70 msl. For Pit-4 is 25 ha on 25-85 msl as mentioned in document approval have been changed to be 32.89 ha on 25-60 msl. The plan of waste dump area is 37.12 ha of bumpy hilly references on 30-40 msl have been changed to be 45-70 msl. For Pit-5 where wavy hilly is 88.94 ha on 22-115 msl and waste dump area is 130.86 ha of undulating hills on elevation 45-60 msl to be 50-65 msl (PT PBM - RPT, 2010; PT TAJ - RPT, 2012).

Post-mining Land Erosion Rate Result

Result of land erosion rate analysis based on the USLE equation. All of the experiment locations found that the erosion level was at level five with a very heavy category (Table 1). Very high category of erosion level considers the area that is not covered well by the revegetation process in the area. The success of revegetation rate depends on fertility of the soil where the past vegetation grew.

Table 1. Erosion Category at Ex Mining Location

No.	Location	Soil Loss (ton ha ⁻¹ year ⁻¹)	Level	Category
1	Pit 1 AB	120.27	5	Very Heavy
2	Pit 2 A	57.17	5	Very Heavy
3	Pit 2 B	30.82	5	Very Heavy
4	Pit 5 BC	41.67	5	Very Heavy
5	Pit 5 AB	89.66	5	Very Heavy
6	Pit 5 AC	17.88	5	Very Heavy
7	Pit 1 AB	99.23	5	Very Heavy
8	Pit 2 AB	32.70	5	Very Heavy
9	Pit 3 AB	30.43	5	Very Heavy
10	Pit 5 D	15.70	5	Very Heavy
11	Pit 5 BC	28.25	5	Very Heavy

Soil Fertility Parameter Analysis Result

Soil fertility parameter have been sampling on covered and un-covered of reclamation area as detailed mention in Table 2. Some area covered by local tree species to comply with forestry regulation and another area is not. The soil fertility status of study is presented in Table 2.

Table 2. Soil Fertility Parameter Analysis

No	Location	pH	BS		C-organic		N-total		P ₂ O ₅		K ₂ O		Ca		Mg		CEC
			----- % -----		----- mg/100 g soil -----												
1	Pit 1 AB	6.14 N	44.35 H	2.07 M	0.53 H	41.95 H	25.12 M	6.77 M	4.44 H	26.54 H							
2	Pit 2 A	5.02 A	12.01 L	1.54 L	0.60 H	24.40 M	18.98 L	2.26 L	0.10 VL	23.59 M							
3	Pit 2 B	4.34 A	11.80 L	2.09 M	0.61 H	29.25 M	22.36 M	1.87 VL	0.42 L	24.04 M							
4	Pit 5 BC	3.92 A	21.96 M	0.93 VL	0.56 H	15.80 M	10.25 L	3.35 L	1.47 M	23.84 M							
5	Rec. 5 BC	4.37 A	11.05 L	0.89 VL	0.59 H	15.23 M	14.26 L	1.62 VL	0.20 VL	21.07 M							
6	Pit 5 BC	4.37 A	12.43 L	1.88 L	0.61 H	20.26 M	19.26 L	1.57 VL	0.21 VL	17.75 M							
7	North WD	4.37 A	12.43 L	1.88 L	0.61 H	20.26 M	19.26 L	1.57 VL	0.21 VL	17.75 M							
8	South WD	4.37 A	12.43 L	1.88 L	0.61 H	20.26 M	19.26 L	1.57 VL	0.21 VL	17.75 M							

Note: N: Netral A: Acid L: Low VL: Very Low M: Medium H: High

Revegetation Success Rate Result

PT TAJ and PT PBM have been implemented the reclamation plan and planted the area by past growing and local species. Result of the investigation as mentioned on Table 3. The highest achievement on the total reclamation quality is ex Pit 1AB with the score of 85% and the lowest is ex Pit 1E of 18.45%. The detail of result of revegetation success rate mentioned in Table 3.

Table 3. Result of revegetation success rate

No.	Location of ex Mining Pit	Planting Year	Extensive Contribution			Land Use Stewardship (60%)			Revegetation (20%)				Success Criteria (20%)		Score		
			Evaluation Result	Area of Reclamation Achievement	Contribution of Extensive achievements	Land Surface Arrangement	the spread of top soil	Water Management Erosion Control	Cover Crop	Fast Growing	Local Plants	Acid Mine water	Insertion / embroidery	Care	Success of Reclamation	Quality of Reclamation	Total Reclamation Quality Achievements
Weight (%)			[A]	40.0	10.0	10.0	2.5	7.5	5.0	5.0	10.0	10.0	%	[B]	[AxB]%		
1	Pit -1E	2006	23.6	11.6	49.2	20.0	5.0	5.0	1.0	4.0	0.0	2.5	0.0	0.0	37.5	0.38	18.45
2	Pit -1D	2005	6.6	6.6	100.0	40.0	7.5	7.5	2.5	5.0	5.0	5.0	5.0	5.0	82.5	0.83	82.50
3	Pit -1C	2006	45.0	20.5	45.6	30.0	5.0	7.5	0.0	5.0	0.0	4.0	0.0	0.0	51.0	0.51	23.26
4	Pit -1AB	2004	23.0	23.0	100.0	40.0	7.5	7.5	2.5	7.5	3.0	5.0	7.5	7.5	85.0	0.85	85.00
5	Pit -2	2005	32.8	32.8	100.0	40.0	5.0	7.5	2.0	5.0	2.0	3.0	4.0	5.0	72.5	0.73	72.50
6	Pit -2E	2007	6.6	6.6	100.0	40.0	5.0	5.0	2.0	4.0	1.0	2.0	2.0	2.0	58.0	0.58	58.00
7	Pit -3	2010	22.8	22.8	100.0	35.0	5.0	5.0	2.0	4.0	1.0	2.0	2.0	2.0	58.0	0.58	58.00
8	Pit -4	2012	27.4	27.4	100.0	35.0	5.0	7.5	2.5	2.5	0.0	5.0	0.0	5.0	67.5	0.68	67.50
9	Pit -4E	2012	5.4	5.4	100.0	40.0	5.0	7.5	2.5	2.5	0.0	5.0	2.0	2.0	67.5	0.66	65.50
10	Pit -5A	2011	17.8	17.8	100.0	40.0	7.5	7.5	2.5	4.0	2.0	5.0	2.0	2.0	72.5	0.73	72.50
11	Pit -5 BC	2012	32.1	32.1	100.0	40.0	5.0	5.0	1.0	4.0	1.0	2.0	1.0	2.0	61.0	0.61	61.00
12	Pit -5 D	2012	23.4	23.4	100.0	40.0	5.0	4.0	1.0	3.0	2.0	2.0	1.0	2.0	60.0	0.60	60.00
13	Pit -5DE	2014	15.6	15.6	100.0	40.0	0.0	3.0	1.0	2.0	1.0	2.0	1.0	2.0	52.0	0.52	52.00
14	North Pit	2008	1.5	1.5	100.0	40.0	10.0	10.0	2.5	5.0	3.0	5.0	5.0	5.0	83.0	0.83	83.00

Economic Community Program Evaluation Result

Community program implementation area shown in map of Figure 2 where the area of ex pit-4 area set for a center office of economic improvement for the community around the mining. The area ex Pit-3 is planned for the area to be bioethanol processing industry, beef, and fish industry. The area ex Pit-4 is planned for the area of tourism, agriculture, livestock, fisheries, nursery of reclamation revegetation project. The area of ex Pit-5 is planned for mini golf sport recreation and combined with natural tourism to improve the void ex mining area for water sport recreation (PT PBM - RPT, 2010; PT TAJ - RPT, 2012). Figure 2 illustrated the area for community program.

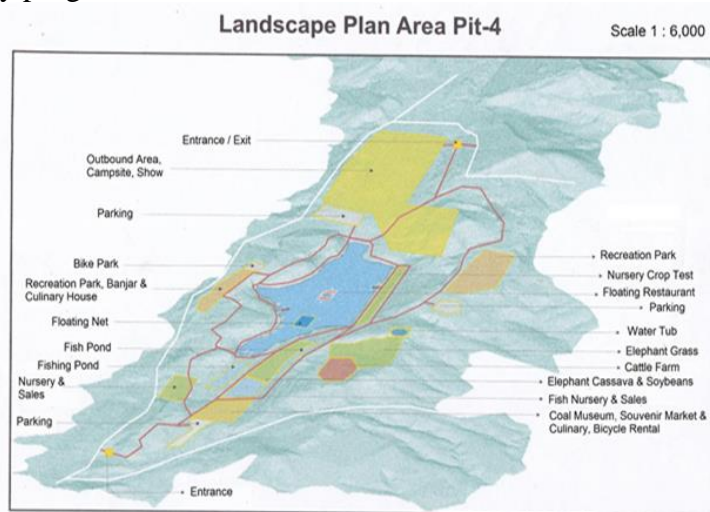


Figure 2. Community Economic Program of Mine Closure

Plan and Actual Mine Closure Document Discussion

Every coal mining company has an obligation to set the mine closure plan documents prior entering the closure stage. These two companies are examples of mining companies that have carried out their obligations in Banjar Regency. Both have been prepared the document approval before entering the mine closure stage but there are some finding in the lack of implementation referred with the document approval by stakeholder.

There are some incompliances implementations comparing the reclamation plan in the mine closure documents with the actual of existing condition. The success of mine closure stage of coal mining area very depends on the commitment of each company based on good mining practice guidance implementation reference with government regulation. Both companies have been following the standard of procedure how to prepare the document since 2003, then have an approval in 2005. The companies have been communicating and socialization to the people surround of Banjar Regency and the authority evaluator from Mining Provincial Office of South Kalimantan. Considering the transition period of the authority moved from provincial office to central office, there are some lacks evaluation (Mahreda et al., 2020; Noor et al., 2020c).

Some of area for reclamation program does not meet with the plan. The erosion rate mostly in very high level as affected by the implementation of activity does not follow the plan. Material handling during reclamation process specially for material of Potential Acid Forming classification was not handle properly and create not better condition for revegetation process because some area covering by cover crop and tree, but others are not. High erosion rates affect the level of soil fertility because nutrients become unavailable. Finally, the level of success criteria of reclamation also lower considering higher erosion and lower soil fertility.

To evaluate community program, in mine closure document was not clearly stated the parameter success criteria. Success parameter is the reference to evaluate the criteria as a basic reference the latest condition compared the last condition.

There are some weaknesses to measure the success criteria of mine closure implementation program are (a) some regional evaluators of mine closure document do not have qualified competencies (b) the low level of the company commitment to support \mine closure process during the discussion to related stakeholders, (c) the final mine closure document does not meet the expectation from all stakeholders. Some indicators that have been seen from the ecology aspects, economy and social dimensions are all less compliance (Blechman et al., 2017; Carrick and Krüger, 2007; Soni et al., 2014).

CONCLUSION

PT TAJ and PT PBM have been completed the mine closure document as their obligation. Some parameters in the mine closure stage condition are not compliance with the plan as mentioned in mine closure document approval. The level of some pit lower than the final baseline plan. Number of Pit Lake or void remaining is higher than the plan. Revegetation success criteria is low due to all areas in very heavy erosion rate level and low soil fertility. There are some community empowerment programs not implemented yet. All could be happened considering the low competency of evaluator is the significant issue and low commitment by coal mining company themselves.

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