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Sustainability level of post coal mine management in Banjar, South Kalimantan-indonesia

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ABSTRACT

Open coal mining contributes to non-tax and tax state revenues, both the District and City, Province and Central Government in the form of royalties, employment and encouraging the growth and development of the economy of the community around the mine. Open coal mining in addition to having an impact on economic growth, also has a large impact on environmental damage. This study aims (1) to analyze the level of sustainability of post-mining management; (2) leverage attributes of the sustainability of post-mining management. The research method used a multidimensional scaling (MDS) approach, and Rap-PCMS (Rapfish modification). The results of the study showed that the level of sustainability of post-mining management was 47.66% (categorized as less sustainable), the sustainability of ecological dimensions was 49.17%, the economy was 44.29% and social was 47.48% which was categorized as less sustainable. There are 3 sensitive attributes that affect the sustainability index, namely: 1) plant percentage, 2) livelihood communities of post-mining, and 3) population migration.

***Key words**: Post coal mine, Sustainability index, Leverage attributes, MDS.*

Introduction

Coal mining can make a large contribution to non-tax state revenues (PNBP) and state revenues in the form of taxes from the central government, regional government (district/city), employment of communities around the mine site, open access roads from villages to cities, economic means grow and develop and encourage the growth and development of regional and national economies.Coal mining is conducted open pit system, in addition to providing economic benefits to the community, it also has a large impact on damage: a) physical environment such as land, water and air; b) biological environment such as the loss of various types of flora and fauna; c) social environment such as changes in customs, population migration, social conflict and community perception. Open coal mining can damage the environment because mining activities openly affect landscape changes (morphology/landscape), the formation of mine holes (voids), low walls and high walls with slope from slope (30o) to sharp (90o), the formation of new valleys and hills that are prone to landslides, changes in physical, chemical and biological properties of soil and water due to the mixing of top soil, sub soil and over burden (OB), exposure to Positive Acid Formimg (PAF) material, acid mine drainage, changes in structure layer of soil that results in land degradation with low fertility.

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To ensure the sustainability of post-mining, both ecologically, economically and socially, the government passed Law No. 04 of 2009 concerning Mineral and Coal Mining, in lieu of Law No.11 of 1967. Based on the new law, it was stated that each company is obliged to make reclamation plan documents and post-mining plan documents that have been approved by the government. Approval is given if it includes: a) post-mining objectives, b) consulting with stakeholders, c) initial environmental features, d) desired final environmental plans including morphology and topography, mine site reclamation program and outside mine and mining facilities, utilization of voids, community economic improvement programs and community social programs.

To assess the problem of the implementation of post-coal mining management in a sustainable manner in Banjar Regency, formulated research objectives are guidelines and research references, namely 1) how the level of sustainability of post-coal mining management in Banjar Regency is currently based on three dimensions of sustainable management (ecology, economics and social), and what variables are the leveraging factors for the sustainability of post-mining management.

Materials and Methods

Research Location: This research was conducted in the coal mining area in Banjar Regency, South Kalimantan Province. The research locations are in two sub-districts, Pengaron Subdistrict and Sambung Makmur Subdistrict, and are carried out at two companies, namely; PT. Tanjung Alam Jaya and PT. Putra Bara Mitra.

Data collecting method. This research was conducted with a survey approach with interview, observation and sampling techniques. For environmental physical ecology components include; soil, water and vegetation. Soil sampling was carried out at 9 points on the mine site, 5 points outside the mine site (outpit dump). Water sampling was carried out in 4 holes (voids). Whereas for the questionnaire selected 61 respondents selected by the prupposive sampling method. For expert respondents, there were 9 persons selected 2 persons from community leaders, 1 person from NGO, 1 person from the university, 1 person from the ESDM Office of Banjar Regency Government, 1 from the ESDM Office of the Government of South Kalimantan Province, 1 person from the Ministry of Energy and 2 person from componies.

Data Analysis Method : The data analysis method used is the method or technique used to obtain research data (Sugiyono, 2009). The research using method is multidimentional scaling approach (MDS) with the help of the software Rapid Appraisal for Post Coal Mine Sustainable (Rap-PCMS) which is a modification of Rapfish (Rapid Appraisal for Fisheries). Rapfish is a Multi-Disciplinary Rapid Appraisal Technique to evaluate the Sustainability of Fisheries. According to Pitcher (1999), Rapfish is a Non-Parametric Multidimentional Scaling approach (Kruskal and Wish 1978; Schiffman et al. 1981; Preisshot *et al.*, 1998) with ordination techniques (Clarke 1993) based on the Multi Criteria Analysis (MCA) principle) by relying on an algorithm called the MDS algorithm (Fauzi and Anna 2002).

According to Alder *et al.* (2000), there are several stages in Rapfish, namely: (1) determination of attributes for program sustainability; (2) assessment of each attribute in an ordinal scale based on the criteria of the level of sustainability of each dimension; (3) data analysis using Rapfish software; (4) the preparation of the index, sustainability status and sensitive attributes that have an effect on the sustainability of the program in each dimension; (5) examine the effect of errors in calculations with Monte Carlo analysis. The analysis phase refers to Yusuf (2016), consist of rapfish analysis process, leverage analysis and Monte Carlo analysis. Schematically in the following figure.

The preparation of the index and the sustainability status of the post-coal mining implementation management, from each of its dimensions and attributes follows the concept developed by Pitcher (1999). Scoring scores for each dimension are stated to be the worst scale (bad) of 0% to the best (good) of 100%. Assessment scores are based on

Table 1. Index values and sustainable status of post-coal mine

Value index	Sustainability status
0 – 25 %	Worse (unsustainable)
26 – 50 %	Less (less sustainable)
51 – 75 %	Sufficient (quite sustainable)
76 – 100 %	Good (Very sustainable)

Source : Pitcher (1999)

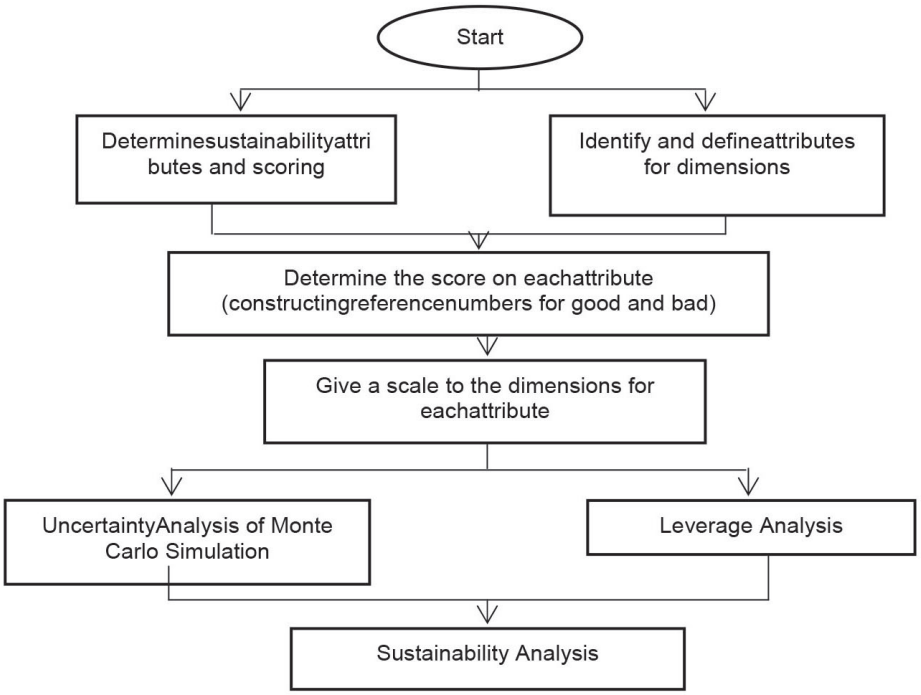

Fig. 1. Stages of sustainability analysis

the results of existing conditions and are based on secondary data obtained. Index value > 50% can be stated that the dimensions studied have been continuous, on the contrary <50% of these dimensions are not/unsustainable. Sustainability index category according to Pitcher (1999), as follows.

The results of the determination of the sustainability of each dimension, then made in a kite diagram, to find out the trade off of the continuity of post-coal mining implementation management.

Results and Discussion

Leverage Attribute.Based on the results of focus group discussion (FGD), the sustainability attributes of post-coal mining management in Banjar Regency were determined as many as 30 attributes; consists of 10 attributes of ecological dimensions, 10 attributes of economic dimension and 10 attributes of social dimension. More detailed as follows:

Sustainability index. Sustainability of management post-coal mining becomes very important, given the externalities of coal mining activities have an impact on the environment and surrounding communities. The results of MDS-RapPCMS analysis are carried out in 2 phases, namely partially covering 3 dimensions of management (ecological, economic, and social), and simultaneously (overall). More detailed results are obtained as follows:

The results show that the sustainability of post-coal mining management in Banjar Regency is categorized as less sustainable with a 47.66% multidimensional sustainability index, covering ecological dimensions is 49.37%, economic dimensions is44.29% and social dimensions is 47.59%. These results can be accepted keeping in mind the results of the validation test, where it was found that the difference in the value of monte carlo with the value of sustainability for all aspects of the study <5%, the value of R2 which all reached> 80%, and the stress value <20%.

Difference in Monte Carlo value with sustainability index (ordination value) ranges from 0.04 to 0.52% or <1%. Kavanagh (2001) states that the difference between the value of monte carlo and the ordination value is a maximum of 5%. This value indicates that the effect of an error, or the impact of a scoring error is relatively very small. Thus, the developed RapPCMS model is considered adequate as a predictor of sustainability index values. According to Kavanagh and Pitcher (2004), that Monte Carlo analysis can be used as a simulation method to evaluate the impact of random errors in

statistical analysis. The same thing was stated by Fauzi and Anna (2005) that Monte Carlo analysis can be an indicator of errors caused by scoring on each attribute, variations in scoring that are multidimensional because of different opinions, the process of data analysis that is done repeatedly, and error in inputting data or missing data.

Rsquare (Squared Correlation) or also known as the coefficient of determination is the square of the correlation coefficient which shows variance proportions of the optimization of data scaling contributed by multidimensional scaling procedures and is a measure of goodness of fit measurement. According to Ghozali (2009) that the coefficient of determination or R2 essentially measures how far the ability of a model can explain the variation of the dependent variable (dependent variable). R2 values range between 0 (zero) and 1 (one) which if expressed in percentages between 0% to 100%. A small R2 value means having a very limited dependent variation and a value close to 1 means that the independent variables can provide all the information needed to predict the dependent variable. In other words, the value close to 1 indicates that the model can be explained well from the existing data or the R-square value is getting closer to 1 meaning that the data is increasingly mapped perfectly. The output of R2 value is obtained from 94.73 to 95.72% which shows that this value is quite high, namely> 80%. Kavanagh (2001) states that Squared Correlation (R2) values of more than 80% indicate that the sustainability index estimation model is good and adequate to use.

Stress value is a measure of incompatibility (a lack of fit measurement) between the data and the measurement results or models produced. The smaller the stress value shows that the monotonous relationship that is formed between inequality and

Table 2. The dimensions and attributes of Rap-PCMS in the management of post-coal mining in Banjar Regency

Dimension	No.	Attribut
Ecology	1.	Final rona morphology
	2.	*Pushback*
	3.	*PAF and NAF materials*
	4.	Inpit dump
	5.	Erosion level
	6.	Soil fertility level
	7.	Land Capability
	8.	Plant percentage
	9.	Substitution plant growth
	10.	The success of reclamation and revegetation
Economy	1.	Cotribution of GRDP
	2.	Public transportation facilities and infrastructure
	3.	Economy activity nof post-mining
	4.	Livelihood communities of post-mining
	5.	Post revenue more than pre-mining
	6.	Locally-generated revenue
	7.	Distribution of income
	8.	CSR post-mining
	9.	Economic facilities
	10.	Land transformation of economic value
Social	1.	Respiratory diseases and diarrhea
	2.	Public perception of coal mine
	3.	Customs community behavior
	4.	Family dependent burden rate
	5.	Sex rasio
	6.	Population migration
	7.	Social conflict
	8.	Level of community participation
	9.	Education facilities
	10.	Level of employment

disparities is better and the map configuration criteria that are formed are more perfect. In other words, stress values are close to zero, so the output produced is more similar to the actual situation or the lower the stress value, the better / fit the model. Conversely, the higher the stress value, the less suitable the model is. The output in the form of stress values from the five aspects studied were obtained ranging from 13.85-15.33% which indicates that the criteria for nonconformity are categorized as quite appropriate. Kavanagh (2001) states that the value of stress that can be tolerated is <20%.

Sustainability of ecology - Ecological sustainability is a depcription of the level of sustainability of post-coal mining management related to environmental aspects, such as; morphology, pushback, PAF and NAF materials, dump, erosion, soil fertility, land capability, plant, reclamation and revegetation. Ecological dimension sustainability indicators consist of 10 attributes. The results of the analysis are as follows:

The results of the analysis showed that the index of sustainability of ecological dimensions was 49.17% or categorized as less sustainable. While the ecological dimension sustainability leverage attributes is plant percentage. Plant percentage is a description of the management of a new post-mining mine. The number of plants found in the ex-mining area shows that land handling activities have been carried out. In addition, the number of plants will help accelerate the return of nutrients to the soil. Pioneer plants that are tolerant of acidity, soil fertility and animals are formed in the early stages of reclamation (Iskandar, 2012). Furthermore, that the land in the reclamation location with the passage of time and the growth of pioneering plants, the quality of the land is increasing, with increasing levels of soil organic matter resulting from litter decomposition. Improving soil quality will also increase macro and micro flora-fauna populations. Furthermore, habitat for wild animals is formed and local non-pioneering types of wood can develop better.

Sustainability of economy - Economic sustainability is a description of the level of sustainability of post-coal mining management related to economic aspects, such as; GRDP, infrastructure, multiplayer economy, CSR funds and income of communities. Indicators of economic dimension sustainability consist of 10 attributes. The results of the analysis are as follows:

The results of the analysis show that the index of the sustainability of economic dimensions is 44.29% or categorized as less sustainable. While the leverage attributes for the sustainability of the economic

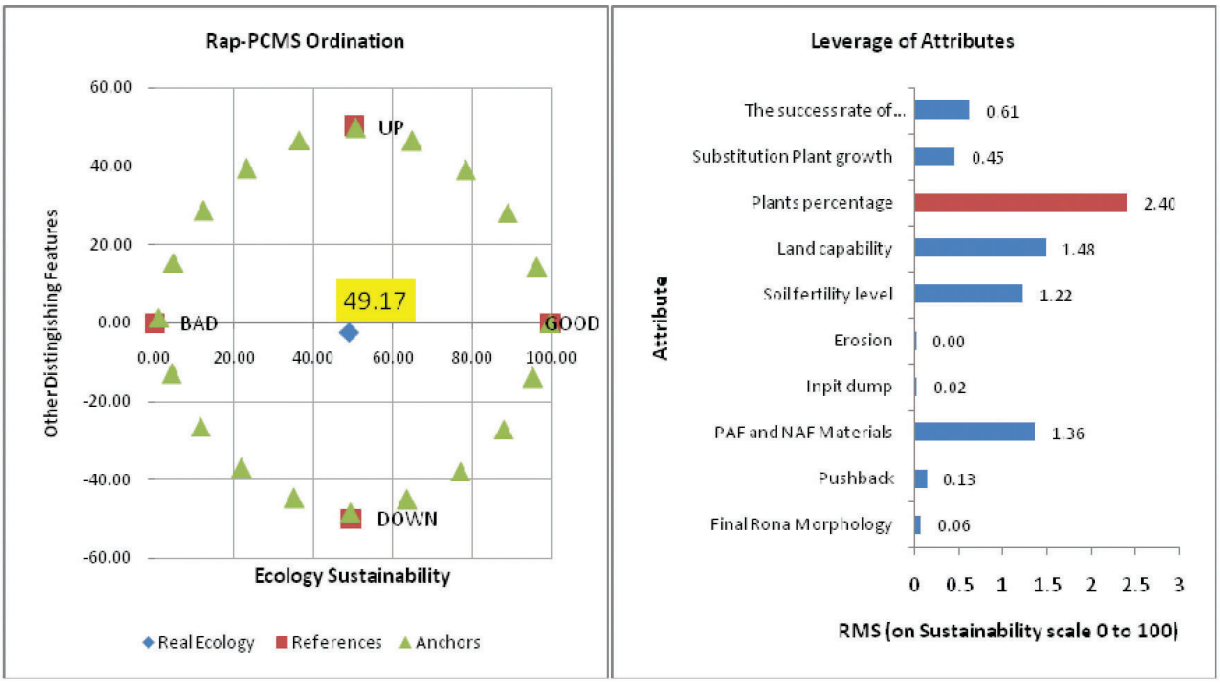

Fig. 2. Sustainability index and leverage attributes of ecological dimension.

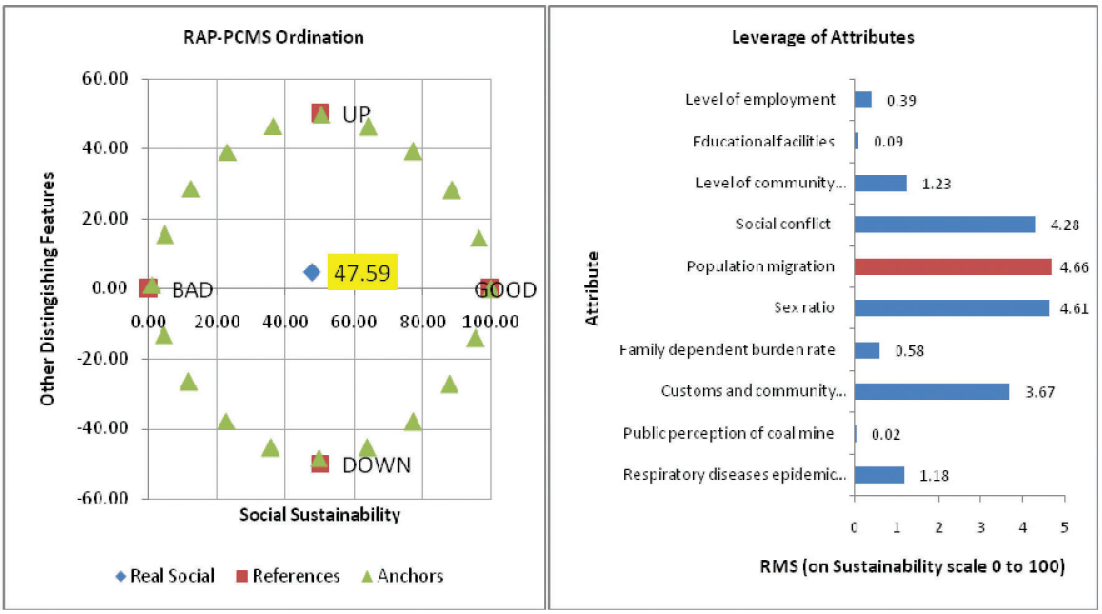

Fig. 3. Sustainability index and leverage attributes of economic dimension.

dimension is livelihood communities of post-mining. The livelihoods of post-mining communities are attributes of economic sustainability levers that have the highest sensitivity. Post-mining will be very influential on the lives of the people around the mine. Aspects of livelihoods and income are the factors most felt by the community, where mining operations have provided a decent livelihood and economic multiplayer highly (Wahyu and Waskito 2007). In addition to changing the livelihoods of communities around the mine, post-mining activities also change the culture of the community. The results of Prambudi's research (2010), that there is a mutually influential relationship between changes in livelihoods with socio-cultural values on mining land.

Sustainability of social - Social sustainability is a description of the level of sustainability of post-coal mining management related to social aspects, such as; diseases/healthy, public perception, customs community behavior, conflict, participation, and education level. Indicators of sustainability of social dimensions consist of 10 attributes. The results of the analysis are as follows:

The results of the analysis show that the index of ecological dimension sustainability is 47.57% or categorized as less sustainable. While the leverage attributes for the sustainability of the social dimension is population migration. Population migration is a sustainability lever attribute that has the highest sensitivity. The closure of the mining area will cause people to move outside the mining area to find new livelihoods. Mining activities that employ a lot of people give a post-mining social impact in the form of large population migration in a fast time.

Table 3. The results of the sustainability analysis of post-coal mining management

Dimensions	Sustainability Index	Monte Carlo Value (%)	R2 Value (%)	Stress Value (%)	Categories
Ecology	49.17	48.65	94.73	14.65	Less Sustainable
Economy	44.29	44.06	95.04	13,60	Less Sustainable
Social	47.59	47.55	95.05	13.68	Less Sustainable
Multidimentional	47.66	47.77	95.72	12.96	Less Sustainable

Sources: MDS-RapPCMS Analysis, 2018

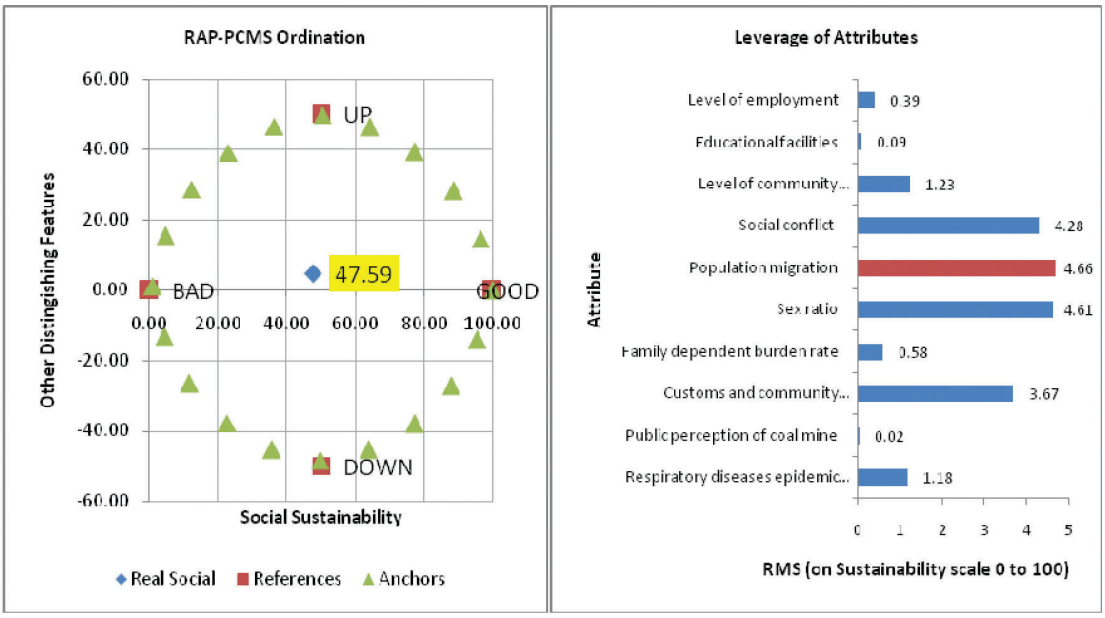

Fig. 4. Sustainability index and leverage attributes of social dimension.

Conclusion

The level of multidimensional sustainability is obtained by an index of 47.66% or categorized as less sustainable. This condition also appears in the sustainability trade off which shows the balance of the three management dimensions. It appears that the economic dimension is a dimension that has the lowest sustainability level of 44.29% while the ecological dimension is the management dimension that has the highest sustainability index. However, these three dimensions are categorized as less sustainable. The leverage attributes for the sustainability of post-coal mining management in Banjar Regency, consist of; 1) plant percentage, 2) livelihood communities of post-mining, and 3) population migration.

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