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Use of Biochar to Improve the Quality of Post-Coal Mining Land at Pt. Puspa Juwita Flat Land Muara Village Badak District

Yuanita , Roby, F.Silvi Dwi Mentari, Haryatie Sarie
Politeknik Pertanian Negeri Samarinda
Kampus Gunung Panjang Jl. Samratulangi Samarinda 75131

Abstrat:- Efforts that can be made so that the productivity and fertility of ex-coal mining soil can survive or allow it to be further improved include efforts to add organic material by providing biochar so that soil that is critical or lacking nutrients can add nutrients. The aim of this research is to obtain ex-coal mining land that can be used for agricultural land and plantation land by reclamating ex-coal mining land with the provision of biochar so that it is hoped that the land can be improved properly. This research was carried out in two places, namely (1) the former coal location of PT. Puspa Juwita, Tanah Datar Village, Muara Badak District, East Kalimantan and (2) nutrient testing was carried out at the Soil Laboratory of the Samarinda State Agricultural Polytechnic. It can be seen from the results of the soil analysis that by administering 75 kg/bed biochar (Sampel 3) there was an increase in the chemical properties of the soil on ex-mining land owned by PT Puspa Juwita, Tanah Datar Village, Muara Badak District, Kutai Kertanegara Regency, where the P element = 0.2560% , K = 0.73151 %, N = 0.2949, organic C = 2.949 %, Mg 0.4675 %, Fe = 21083 ppm, Al = 4736, CEC = 12.30 me/100 g and pH = 7.16

Keywords*: Biochar, Soil, Coal Mine.*

I. INTRODUCTION

One of the critical lands that has the potential to be converted into agricultural land is former coal mining land. Ex-coal mining land usually has a high level of density and is less fertile due to the presence of embankment materials originating from underground layers, both the C horizon and parent soil materials (Murjianto, 2011).

In the critical condition of used coal land, most food plants are unable to grow well because of limited root penetration into the soil to obtain water and nutrients. Infiltration such as rainfall and irrigation becomes difficult to penetrate the soil surface due to the closure of these pores (Whitemore et al, 2011).

Coal mining using the open mining method causes land degradation, with damage to the physical and chemical properties of the soil. For this reason, efforts are needed to ensure that the land is not further degraded, by means of revegetation activities which is one of the technologies for rehabilitating damaged land caused by human activities (Singh et al, 2002)

Reclamation activities are the expected end of mining activities and return the land to its original condition, even if possible, it can be better than the condition before mining. Reclamation activities to improve ex-mining land to repair land whose ecology has been disturbed and prepare ex-mining land whose ecology has been improved for further use (Murjanto, 20211).

Efforts to accelerate the restoration of the quality of land former open-pit mining can be done by adding biochar to increase soil fertility and improve the quality of soil that has been degraded (Atkison et al, 2010).

Biochar is a solid material formed through the process of burning materials without oxygen (pyrolysis) at a temperature of 250-500^{o}C, and has been proven to survive in the soil for >1000 years and sequesters carbon in the soil (Lehmann, 2007). Biochar is not a fertilizer but functions as a soil conditioner. The raw material source for biochar is organic waste, especially agricultural waste which is difficult to decompose or with high C/N (Steiner et al, 2007).

Biochar is very useful for agriculture, especially for improving land quality (physical, chemical and biological properties of soil), restoring gradated and wet acid dry land, increasing nutrient availability, retaining nutrients and water, increasing pH and CEC on acid dry land, and lasting a long time in the soil (< 400 years because it is difficult to decompose). Providing biochar as a soil conditioner, either directly or formulated in advance with other ingredients, is expected to accelerate the improvement of the quality of soil properties (Prasetyo and Suriadikarta, 2006)

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This research aims to obtain ex-coal mining land that can be used for agricultural land and plantation land by reclamating ex-coal mining land with the provision of biochar so that it is hoped that the land can be improved properly.

II. RESEARCH METHODS

A. Time and Place

➢ *Research Time*

This research was carried out for 4 months, namely from August 2021 to December 2021

➢ *Research Place*

This research was carried out in two places, namely:

- The former coal location of PT. Puspa Juwita, Tanah Datar Village, Muara Badak District, East Kalimantan
- Nutrient testing was carried out at the Samarinda State Agricultural Polytechnic Soil Laboratory.

B. Tools and Materials

The tools used are hoes, machetes, earth drills and writing utensils.

The materials used are clean water, coal land, biochar and raffia rope

C. Research Procedure

- *Preparation of Biochar.*

Biochar was prepared in the amount of 500 kg and was finely ground using a grinding machine at the Agricultural Polytechnic Production Laboratory

- *Survey and Land Preparation*

The results of the field survey, the location of the post-coal mining area belonging to PT. Puspa Juwita is located in Tanah Datar Village, Muara Badak District

- *Initial Soil Sampling and Analysis*

Samples were taken using a soil drill and then the soil samples were taken to the Samarinda Polytani Soil and Water Laboratory as initial data. The soil analysis taken is P, K, N, C, M, Fe, Al, CEC and pH.

- *Make Beds*

The land used is former coal mining land. The land was measured according to research needs, namely 2 m x 3 m for 10 beds. The land that has been measured is cleaned and cultivated by hoeing until it is loose. After that, the soil is given manure

- *Application of Biochar in Research Beds*

The finely ground biochar was sown evenly on the research beds in quantities corresponding to random plots, the amount sown was 0 kg (control), 25 kg, 50 kg, 75 kg and 100 kg.

- *Final Soil Sampling and Analysis (after biochar application).*

After applying biochar and leaving it for approximately 3 months, soil samples were taken and analyzed again in the laboratory.

D. Data Processing

The research data takes chemical data at the beginning and end of the research by observing P (Phosphorus), N (Nitrogen), K (Potassium), C (Carbon), Mg (Magnesium), Al (Aluminum), soil CEC and pH

III. RESULTS AND DISCUSSION

A. Results

➢ *Soil Analysis Results (initial)*

Results of soil analysis observations (initial) on post-coal mining land at PT. Puspa Juwita Tanah Datar Village without treatment can be seen in Table 1 below:

Tabel 1. Table 1. Soil analysis (initial)

Parameters	Units	Mark
P Total	%	0,0056
K Total	%	0,66997
N Total	%	0,0524
C Organik	%	0,0026
Mg Total	%	0,4597
Fe Total	ppm	2780,00
Al Total	ppm	17826,0
KTK	me/100g	6,50
pH	-	6,0

From table 1, the parameters observed in the soil analysis (initial) show that Total Fe and Total Al are high, while the lowest are P. K, N, Organic C, CEC, Mg and slightly acidic pH.

➢ *Soil Analysis Results (final)*

Results of soil analysis observations (final) on post-coal mining land with the provision of biockar at PT. Puspa Juwita Tanah Datar Village without treatment can be seen in Table 2 below:

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Table 2 the parameters observed in the soil analysis (final) show the highest values

Parameters	Units	Sample 1	Sample 2	Sample 3	Sample 4
P Total	%	0,1110	0,0981	0,2560	0,1031
K Total	%	0,6911	0,6768	0,73151	0,6899
N Total	%	0,230	0,210	0,289	0,220
C Organik	%	1,963	1,336	2,949	1,816
Mg Total	%	0,4490	0,4074	0,4675	0,4286
Fe Total	ppm	22246	23760	24083	22654
Al Total	ppm	2520	4648	4736	3520
KTK	me/100g	7,20	6,80	12,30	10,60
pH	-	7,02	6,85	7,16	6,98

From table 2, the parameters observed in the soil analysis (final) show the highest values in sample 3, namely for the elements P, K, N, Organic C, Mg, Fe, Al, CEC and pH.

B. Discussion

➢ *Soil Analysis Results (Preliminary)*

The soil used as a sample in this study was obtained from former coal mining land of PT. Puspa Juwita, Tanah Datar Village, Muara Badak District, East Kalimantan.

From the results of the soil analysis test, the nutrients present are low when seen in table 1, this is suspected because there is no addition of nutrients and this can have an impact on reducing the level of fertility around the area, there has been no treatment around the coal mining area, there are lots of remains abandoned mining in the area (Hidayat et al, 2019).

It can be seen that the elements P, K, N, Mg have the lowest values, low levels of Organic C can be caused because the CEC value of the soil is not too large, and the Al element plays a role in reducing the CEC when it is in large quantities, the Fe element is a macro element that is needed in small quantities. on soil fertility. If the CEC is low then the pH will also be low (sour state).

According to Cooke and Johnson (2002), post-coal mining land is generally characterized by a very rough and varied physical texture, from clay to sandy loam. In some mining locations it appears rocky, and has a very fine texture that does not contain organic material, is very compact, and has a very low water infiltration rate. In general, ex-mining land has very low macro nutrient content, especially N, P, K, N and C, as well as low soil acidity pH and Cation Exchange Capacity (CEC).

Apart from that, soil microorganisms which are very helpful in stabilizing soil structure, the contribution of inorganic minerals, or their contribution to growth regulating substances, are also very low (Adman B., 2012). In order to minimize damage to land from former coal mining and the ongoing process of land degradation, soil conservation efforts on former coal mining land need to be supported by information data, including the status of the soil fertility level.

Soil excavated in coal changes the physical and chemical properties of the soil which can reduce the quality of the soil. In general. In general, coal excavated soil is piled on top of productive soil, in the reverse arrangement from the initial arrangement, topsoil. In the first few years, the former coal mining area was difficult to grow vegetation. This is caused by several factors, namely soil that is too dense, poor soil structure, poor aeration and drainage and soil that is slow to absorb water. There are also chemical obstacles such as very acidic pH and low soil fertility.

Changes in the physical properties of the soil that occur include changes in texture, structural consistency, boundaries between soil layers, while changes in the chemical properties of the soil include changes in the nutrient content in the soil, P, K, N, C-organic, Mg. Fe, Al and soil pH can cause ex-mining land to become difficult for various plants to grow, including for agricultural activities, because plant growth is hampered and soil productivity decreases (Hardjowigeno, 2003)

➢ *Soil analysis results (final)*

Observation results of soil analysis (final) on post-coal mining land with biockar application at PT. Puspa Juwita, Tanah Datar Village, in table 2, shows the highest value in sample 3, namely for the elements P, K, N, C Organic, Mg, Fe and Al, the highest value in sample 2, the nutrient elements P, K, N, CEC value and pH . This is due to the addition of nutrients with 75 kg of biochar in each bed. Where the elements P = 0.2560 %, K = 0.73151 %, N = 0.2949, organic C = 2.949 %, Mg 0.4675 %, Fe = 21083 ppm, Al = 4736, CEC = 12.30 me/ 100 g and pH = 7.16.

It is suspected that by administering 75 kg of biochar, it can add directional elements to coal mine soil, which is quickly processed and there are microorganisms that can increase fertility in coal mine soil. Coal mining soil that is less fertile if given biochar or fertilizer containing nutrients can accelerate its breakdown by microorganisms, so the decomposition process will speed up soil fertility. The addition of appropriate biochar can increase soil fertility and restore the quality of degraded soil (Atkinson et al. 2010; Glaser et al. 2022).

In accordance with the opinion of Foth and Ellis (1997) in Hutapea and Apriliya (2020), soil has different fertility depending on a number of soil-forming factors that dominate

the location, namely parent material, climate, relief, organisms, or time. Soil as a medium for plant growth is the main focus in discussing soil fertility management, while plant performance is the main indicator of the quality of soil fertility. Thus soil fertility cannot be separated from the balance of biological, physical and chemical properties of the soil. These three soil properties interact with each other and greatly determine the level of soil fertility (Kusumawati, 2021).

Utilizing biochar made from agricultural waste which is difficult to decompose is one effective way that can be taken to restore degraded dry land. Providing biochar as an additional nutrient can be done by adding other materials to accelerate the breakdown of decomposition by microorganisms and can improve the quality of the physical properties of coal mine soil (Prasetyo and Suriadikarta, 2006).

IV. CONCLUSION AND SUGGESTION

- *Conclusion*

It can be seen that through the application of biochar there has been an increase in the improvement of soil chemical properties on ex-mining land belonging to PT Puspa Juwita, Tanah Datar Village, Muara Badak District, Kutai Kertanegara Regency.

- *Suggestions*

Land reclamation needs to be carried out by applying biochar combined with organic material or planting cover crops, so that the land can be better managed.

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