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Study for Reclamation of Used Coal Mining Using Eucalyptus Plants

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ABSTRACT

The main purpose of this research is to make a study of reclamation of land used for coal mining for crop cultivation. The background of the research and identification of problems and the problem formulation were compiled. The discussion was focused on the following matters. Impact of coal mining activities, soil physical and chemical properties, loss of vegetation, reclamation and plants selection, and land suitability.
KEYWORDS: reclamation, coal mining, vegetation, eucalyptus plants

INTRODUCTION

According to Law Number 23 of 2014 concerning Regional Government, the authority to manage the mineral resource energy sector which was originally the authority of the Regency and City Governments is then transferred to the authority of the Provincial Government and the Central Government in accordance with their authority.

Based on Law No. 4 of 2009 concerning mineral and coal mining, the definition of mining is part or all of the stages in the framework of research, management and exploitation of minerals and coal which includes general investigation, exploration, feasibility studies, construction, mining, processing and refining, transportation and sales, and post-mining activities.

The problem of post-mining coal management through the reclamation of ex-mining land has become a national issue. One of the important things in the activities of the coal mining industry using the open pit method in Indonesia is how to do land reclamation and restore the preservation of the natural environment to be maintained [1].

Ex-mining mining land needs to be immediately reclaimed and replanted to restore the ecosystem and microclimate, soil fertility and water storage functions. Reclamation characteristics are open space, high light intensity, high temperature and extreme fluctuation, low pH and degradation of the number of species both flora, fauna and soil microorganisms. Such characteristics cause not all types of plants can live on the land [2].

One way to overcome this problem is by conducting a reclamation study of the former coal mining area using eucalyptus plants. Eucalyptus plants will be used as shrubs, selection of eucalyptus plants by considering ecological, economic and social aspects so that they can provide benefits to the economy of local communities and local governments in a sustainable manner. Ecologically the development of eucalyptus plants in degraded land is, among others, to support land conservation efforts and the use of marginal land into productive land. Economically the development of eucalyptus plants can be used as a household scale business up to a large scale and socially does not cause social complications.

Referring to the background of the research and identification of problems, the problem formulation was compiled, namely: How is the suitability of cultivated land on the former coal mining land?. The main purpose of this research is to make a study of reclamation of land used for coal mining for crop cultivation.

Impact of Coal Mining Activities

Coal mining systems in Indonesia are generally implemented by open pit mining with back filling methods which are adjusted to the reserve conditions and the quality of the existing geological structure of coal. The application of open mining method is adjusted with the calculation of coal reserves in layers with a certain slope, while the back filling method serves as an effort to minimize the area of open land because mining activities are still ongoing, so that landfilling activities are in line with the movement of active mines [3].

Open mining is more often done because the removal of land and overburden is cheaper compared to underground tunnels. Open pit mining is a type of track mine where minerals are deep in the ground as in coal mines and can occur in every excavation and construction activity there are also special impacts on coal mining activities [3]. The use of heavy equipment in coal mining activities is also known to result in large cavities that have a depth of up to 3 to 4 meters [3].

The stages of open pit mining activities include the stages of activities starting from clearing vegetation, stripping the top soil, and the disclosure of rocks that cover coal minerals and coal mining, these activities use

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heavy equipment. According to Rustam [4] An important impact that might result from coal mining in the pre-mining stage is land clearing due to land clearing. This will lead to further impacts such as a reduction in erosion resistance, changes in infiltration characteristics that will affect groundwater recharge, changes in water balance composition, changes in landscape and land use, and deterioration in land quality due to erosion. At the mining stage, an important impact that arises is the change in the landscape due to stripping or excavation of topsoil, overburden and coal. The possibility of acid mine drainage occurs if the runoff reacts with the overburden that has the potential to form acid, there may be landslides on the overburden in both outside the mine area and the former mine.

Visual appearance seen in the field on ex-mining land, the land becomes bare and looks arid because there is no vegetation that has a function as a cover (top soil). The most obvious change is the change in the shape of the earth's surface topography. Changes occur to the slope of the slope from the initial shape of 2 to 6% to 45 - 90%, surface appearance can be in the form of bumps or landfills and opening holes with a diameter of 300 - 700 m slope shape as described above, it will be difficult to withstand scour surface water (run off) as well as at the bottom of the sloping opening hole will occur puddles. If such conditions occur for a long time, it will result in soil damage [5].

According to Ahyar et al. [6], damage due to mining can occur during mining and post-mining activities. The environmental impact is closely related to the mining technology and techniques used. While mining technology and techniques depend on the type of mineral and the depth of mining material, coal mining is carried out by an open pit system, which is a dumping system (a way of mining coal by peeling the surface of the ground) the impact of coal mining activities is a decrease in physical and chemical properties of the soil, changes in land topography, loss of natural vegetation, loss of wildlife, besides the impact of causing damage to the ecosystem. Based on the explanation above, the most impacted coal mining activities such as the decrease in physical and chemical properties of the soil, changes in topography and loss of vegetation.

Decreased Soil Physical and Chemical Properties

Mining activities cause physical and chemical changes in the soil, thereby reducing the quality of the soil. In general, coal excavated soil is stacked on productive soil, with an inverted arrangement from the initial arrangement, top soil. In the first few years the area of the former coal mining is difficult to grow vegetation. This is caused by several factors, namely soil that is too dense, soil structure is not stable, bad aeration and drainage and soil is slow to absorb water. There are also chemical constraints such as extremely acidic pH and low soil fertility [7]. This phenomenon is in line with Hardjowigeno [8] changes in physical chemical properties of soil that occur such as changes in texture, structure consistency, boundaries between soil layers, while changes in soil chemical properties such as changes in nutrient content in the soil, C-organic, soil pH, conditions like this causing former mining land becomes difficult to grow a variety of plants including agricultural activities due to plant growth is hampered and soil productivity decreases.

According to Cooke and Johnson [9] shows that post-coal mining land is generally characterized by a very rough and varied physical texture, from clay to sandy loam. At some mining sites it appears rocky, and in very fine textiles it has no organic material content, is very compact, and the infiltration rate is very low. In general, mined land has very low macro-nutrient content, especially N, P, K, Na and Ca contents, as well as soil acidity pH and low Cation Exchange Capacity (CEC). In addition, soil microorganisms which are very helpful in stabilizing soil structure, the contribution of inorganic minerals, or their contribution in growth regulating substances, are also very low [3].

Loss of Vegetation

Qomariah research results [10] concluded that, land appearance in locations where there is a former coal mining land was not followed by land rehabilitation treatment until the tenth year, the condition of the ex-mining land showed that plant species would be difficult to live and there were almost no signs of a sign of vegetation can grow. In the process of land rehabilitation, the vegetation element is very necessary, because in addition to its function of securing the soil surface from erosion it also functions as a source of nutrients.

According to Barrow [11] in the natural ecosystem cycle one component is vegetation, including biotic components that have functions such as prevention and control of erosion such as protecting the surface of the ground from the destructive power of falling raindrops, and can control to hold surface water scour (run off). The function of vegetation can also improve the physical properties of soil through biological activities carried out by bacteria, fungi, fungi, insects and earthworms that can improve soil aggregate porosity and stability [12].

Ecologically revegetation is part of the mine land reclamation program. In the implementation of revegetation of mining areas often experience difficulties due to the physical and chemical nature of the soil. The absence of topsoil is a common feature in mining areas. Even if there is a nitrogen content that is so low that it does not meet the needs for plant growth. This situation is due to the absence of soil organic matter available by weathering dead plant material. In addition, the lack of soil microflora limits the decay of plant material.

Conditions are also exacerbated by rocky surface layers, which complicates the development of vegetation due to low infiltration rates and water retention [13].

Reclamation

Understanding reclamation according to Law No. 4 of 2009 concerning mineral and coal mining, it is stated that reclamation is an activity carried out throughout the stages of the mining business to organize, restore, and improve the quality of the environment and ecosystem so that it can function again in accordance with its designation.

Reclamation aims to improve or organize the use of disturbed land as a result of mining business activities, so that it can function and be efficient according to its purpose. Reclamation of ex-mining land in addition to an effort to improve post-mining environmental conditions, so as to produce a good ecosystem environment and also strived to be better than the initial baseline, is carried out by considering the potential of leftover minerals.

According to Sitorus [14] a strategic step to repair the damage caused by an open mining system is to return the remaining mining results into the holes in the mine opening (inpit filling). Re-vegetation by paying attention to the waste (tailings) that contain toxic materials. In post-coal mining land, land reclamation is an effort / effort to create so that the land surface can be stable, can sustain itself in a sustainable manner (self-sustaining). This former mining land can be used to produce again, starting from the relationship between land and vegetation, as a starting point for building new ecosystems. Reclamation of post-coal mining land which is associated with revegetation is basically to overcome the continued damage to land and create a process of nutrient formation through weathering falling leaf litter. These activities are expected to be sustainable and can form new ecosystems.

Reclamation activities are the end of mining activities which are expected to return the land to its original state, even if possible it can be better than the condition before mining. Reclamation activities include restoration of ex-mining land to repair ecologically disturbed land and prepare ex-mining land that has been ecologically improved for future use. The final goal of the reclamation is to improve the former mining land so that conditions are safe, stable and not easily eroded so that it can be reused.

Technically, the mining land reclamation business consists of recontouring / regrading / resloping ex-mining holes. Besides making drainage channels to obtain the shape of the region with a stable slope. Top soil spreading activities to meet the requirements as plant growth media, so as to improve the soil as a planting medium. Revegetation is carried out using fast-growing plants, local native plants and introduced forestry plants. It is also necessary to plan the development of food crops, estate crops and / or industrial forest plants, if land use planning is possible [15].

Plant Selection as Vegetation of Coal Mining Areas

Based on Minister of Energy and Mineral Resources Regulation number 18 of 2008 concerning Mine Reclamation and Closure. The definition of reclamation as an activity aimed at repairing or staking land that is disturbed as a result of mining business activities, so that it can function and be efficient in accordance with its designation. In accordance with its definition, the main purpose of reclamation is to make damaged areas better and more useful for humans. Reclamation aims at revegetation, which is replanting on ex-mining land so that it is beneficial for the ecology, economy and social, especially for the community around the mine.

According to Minister of Forestry and Plantation Decree number 146 of 1999, revegetation definition is a business or replanting activity on ex-mining land. Revegetation is carried out through the following stages of activity: the stages of the preparation of the plant's technical design, field supply, seedlings / nursery procurement, implementation of planting and maintenance of plants.

Revegetation is replanting activities on ex-mining land in an effort to avoid land erosion, build habitat for wildlife, biodiversity, improve soil productivity and stability and improve environmental conditions. Ecologically, plant species can adapt to the local climate but not soil conditions. For this reason, it is necessary to choose suitable species, with local conditions, especially for fast-growing species, which can change the microclimate on the former mining land. To support the success in restoring ex-mining land, steps such as improvement of pre-planting land, selection of suitable species, and use of fertilizer are carried out. To evaluate the success rate of plant growth on ex-mining land can be from the percentage of growth power, the percentage of canopy closure, growth of root growth, addition of species on the land, increased humus, reduced erosion and function as a natural filter. In this way it can be seen how far the level of success achieved in restoring ex-mining land [2].

Revegetation is a post-mining area planting activity with selected plants. Revegetation begins with planting cover crops and trees, and maintaining plants [3]. The success of revegetation on ex-mining land is very much determined by many things including aspects of landscape structuring, fertility of planting and planting media and crop maintenance. Landscape management is closely related to aspects of soil and water conservation and land use planning for mines.

Eucalyptus is a small trunked tree plant. Its branches hang down. The name eucalyptus refers to the white bark, layered with a peeling surface, taper leaf shape, with leaf bones parallel to like a spear, the flowers are white.

According to Brophy and Doran [16] mention that eucalyptus spread naturally in the Maluku islands, East Island, northern and southwestern Australia. This species grows at an altitude of 5 to 400 m above sea level, with an average rainfall of 1,300 to 1,750 mm per year. The forestry research and development agency in the introduction to eucalyptus cultivation states that in general eucalyptus is relatively easy to plant, coinciding with grumosol, latosol and regosol soils.

Eucalyptus is able to grow both on marginal lands and in areas of swamps and water puddles, able to adapt to soils with poor drainage, fire resistance and tolerance to soils with low to high salinity. Eucalyptus in a variety of site conditions, both in the highlands and lowlands bordering coastal forests and growing monoculture. In addition, eucalyptus is resistant to heat and fire. Eucalyptus can live and grow again in 1 year with the condition of the leaves that can be picked. Eucalyptus roots consist of taproots, lateral roots, and secondary roots. The roots are straight and grow downward, lateral roots grow in the neck of the roots at the beginning of growth. Secondary roots spread at a depth of about 20 cm below the surface of the soil [17].

The white wooden trunk is round and straight with a slight branching. With good growth conditions, eucalyptus can grow into trees with a height reaching 35 m and a diameter reaching 100 cm [17]. However, eucalyptus can grow into shrubs if the growth conditions are lacking, besides the growth of eucalyptus can be manipulated to get the shape of shrubs by picking the dau since the plant is still young. Eucalyptus bark white or brownish white consisting of thin sheets that are easily peeled off, the flaking, does not interfere with the growth of eucalyptus [17].

In the book introduction to eucalyptus plants explained that eucalyptus leaves are green with thick appearance, not shiny and hairy. The leaves are straight or curved with a length of between 5 to 10 cm and a width of between 1 to 4 cm and with 7 leaf bones with a length of between 3 to 11 cm on each leaf blade. The young shoots are covered by thick, soft feathers and spread out in lengths between 0.3 to 2 mm.

In the book introduction of eucalyptus plants also mentioned that eucalyptus plants are types of plants that have quite an important role, among others in the eucalyptus essential oil industry produce eucalyptus oil obtained by distilling . The main ingredient contained in eucalyptus oil is a sineol content that contains drugs. It is a potential plant for land rehabilitation activities from both ecological and economic aspects. Ecologically the development of eucalyptus plants in degraded land is, among others, to support land conservation efforts and the use of marginal land into productive land. Economically the development of eucalyptus plants can be used as a business / industry both for household scale up to large scale. Wood from eucalyptus plants can be used as building material. Eucalyptus includes strong grade wood with a durable class, in the area of South Kalimantan and South Sumatra the type of eucalyptus subspecies cumingiana is known as galam and the wood is widely used as building material.

Selection of eucalyptus species for post-mining revegetation activities refers to three (3) variables, namely analysis of land suitability of eucalyptus plants on ex-coal mining land, financial analysis of the feasibility of eucalyptus cultivation as well as an analysis of people's perceptions of the planting of eucalyptus on ex-coal mining land.

Land suitability

The issue of land suitability is something that needs attention in an effort to use more optimally. Land use is a direction of land use based on land capability. So that the reclamation activity can run well, it must know the suitability of the land to the allotment to be carried out, such as allotment for plantations, forestry, agriculture and so on. At pre-mining it is necessary to consider and make plans that show the post-mining land arrangements.

Sofyan [18] said that land characteristics are the characteristics of recognition or attributes of a plot of land. Land characteristics for land evaluation purposes, namely: topographic maps, soil maps, and climate and rainfall data.

Land evaluation is done by comparing or matching land characteristics with land use requirements / plant requirements. For example the suitability of plants to the height of the place, where tea and quinine plants are more suitable in cold regions (highlands), while rubber, palm and coconut are more suitable in lowland areas.

Important aspects of spatial planning, regional spatial planning is an effort to formulate efforts to use space optimally and efficiently and sustainably for human business activities in order to realize the level of community prosperity to be achieved within a certain period of time.

Suitability of land to plant species, selection of plant species (trees) is the main key in determining the success rate of revegetation. The selection of vegetation to achieve new ecosystem conditions with low erosion rates, optimal productivity and a sustainable environment needs to be done selectively with the right types of plants, so that ecosystem components as producers (flora), consumers (fauna), and decomposers can be formed immediately [19].

Conclusion

In an effort to plant can grow well, the soil conditions must be ideal according to the needs of plants so that land suitability needs to be done according to the type of plant. Evaluation can be done by distinguishing

between classes of land that are classified as suitable (S = Suitable) and land that is not suitable (N = Not - Suitable). To find out how the suitability of land using eucalyptus plants on ex-coal mining land, land suitability analysis is needed, the results can be used to support the main objective of the study, namely the study of reclamation of ex-coal mining land using eucalyptus plants.

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