Available online at: http://proceeding.rsfpress.com/index.php/ ess/index
LPPM UPN "Veteran" Yogyakarta Conference Series
Proceeding on Engineering and Science Series (ESS)
Volume 1 Number 1 (2020): 528-536

Potential Land of Eucalyptus Industrial Forest for the Development of Sweet Sorghum in Player Gunungkidul Regency

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Abstract

The eucalyptus industrial forest in the District of Player Gunungkidul Regency was developed with a cropping pattern forming lines with a distance of 4-7 m. The corridor between plants is a space that can be synergized with farming communities around the forest for alley cropping with beneficial economically and land conservation. The purpose of this study was to analyze and plan a development system for and sweet sorghum mixed farming. This research was conducted using digital spatial data, the Player District Administrative Map based on the Indonesia Geoportal, geological maps, World_Imagery (MapServer) for coverage of Player district for 2017-2018. The image was then overlaid with polygons of villages that are included in the Player District area. Image interpretation is based on location, size, shape, shadow, color, texture, and pattern. Player District with an area of 10272.15 ha, has an area of eucalyptus industrial forest area of 4,277.68 ha (41.16%). The area of the alley space between eucalyptus lanes with a 4-7 m width of the alley is a potential for sorghum plant development.

Keywords: eucalyptus industrial forest, land, sweet sorghum

I. INTRODUCTION

Natural forest systems can be sustainable by themselves because they are closed harmoniously. However, for managed forests, certain types of commodities require human intervention. The form of intervention here is management. Eucalyptus industrial forest is managed by planting, maintaining, harvesting, and then replanting on the forest land. The surrounding forest is inhabited by rural communities. These communities can contribute as partners in industrial plantation forests. The form of partnership is the existence of synergy. Currently, the development of an integrated agricultural system is still slow and does not meet the principles of an integrated system. Farmers still apply a system that is partial or linear, namely the management of each component that is still separate or individually, for example only livestock or plants (Nurcholis & Supangkat, 2011). There needs to be an understanding in the community of seasonal plant commodities that are able to provide various benefits, namely: 1) economic competitiveness, 2) drought resistance, 3) multi-functional products,

4) products have a health value, 5) provide protection of soil and water, and 6) low crop cultivation costs. Sweet sorghum plants have these six superiorities than other seasonal crops. However, in Player Subdistrict, the community around the eucalyptus plantation forest is not yet known. With this research, it is expected to provide understanding and information to the community in this area. Based on this, the purpose of this study was to analyze and plan a development system for eucalyptus sweet sorghum mixed farming in the eucalyptus industrial forest.

II. LITERATURE REVIEW

Eucalyptus plant (Melaleuca cajuputi subsp. Cajuputi) or in old literature is often called Melaleuca Leucadendron. The eucalyptus factory (Melaleuca Leucadendron Linn.) Java Island has a capacity of 53,760 tons per year for eucalyptus leaves and the total production of eucalyptus oil produced in Java is 300 tons. The need for eucalyptus oil is currently increasing with the development of variations in the use of eucalyptus oil. The annual supply of eucalyptus oil that Indonesia needs is 1500 tons, while Indonesia itself is only able to supply 400 tons. Also, the production of eucalyptus oil in Indonesia has fluctuated and tends to decline based on data from the Directorate General of Forestry Production Development (Rimbawanto and Susanto, 2004, Muyassaroh 2016).

Eucalyptus plants can be classified into plants that can survive in less fertile land conditions, with long dry climates, and are resistant to high air temperatures. This plant can be found from the lowlands to an altitude of 400 m above sea level. It can grow near the coast behind the mangrove forest, from the texture of clayey clay to clayey clay, at pH 4-7. Eucalyptus plants are ideal for growing in dry climates, with a maximum rainfall of 2000 mm/year with a minimum temperature of 22^{o}C and a maximum temperature of 32^{o}C (Sudaryono, 2010). The design of the eucalyptus industrial forest is planted with very wide pathways between plants. This land space is managed by farmers on the surrounding forest for planting seasonal crops.

Sweet sorghum is one of the plants that have the potential to produce renewable energy, foodstuff, animal feed, and industrial products. Nurcholis et al. (2013) studied post-tin mining land in Bangka Belitung Province, showing that sorghum is able to grow and thrive in acid soils with a pH of about 4 or less, nutrient-poor with very shallow soil depth. The application of ameliorant with organic material together with clay in the tin ore mine site had a good effect on the growth of sorghum plants. Sorghum also has drought-resistant properties, which makes future prospects in accordance with the era of global climate change which tends to increase air temperatures, so that it can have an impact on drought on agricultural land. The development of sorghum plants to obtain sorghum varieties that are more resistant to drought is always done to face the era of global warming (Human et al, 2012).

Management of industrial forest by involving farmers around the forest is very important to improve environmental quality, management efficiency, and synergize the interests of forestry in the upstream sector with the interests of the community around the forest who are farmers. Forest management with agroforestry systems in semi-arid areas in China may increase the availability of soil moisture compared to monocultural forest management (Gao et al., 2018). The industrial forest also can be managed at low cost, continuously, and guaranteed safety. Farmers may use the area among industrial crops by cultivating valuable food crops. A review of the agroforestry system in Europe may provide benefits if it changes from a system that only uses it to produce forage crops to become food crop commodities that have high economic value (Moreno et al., 2018). So far, farmers around the industrial forest in Player District Gunungkidul only cultivate corn, cassava, and peanuts. With the advantages of sorghum plantations compared to some of these plant commodities, it is necessary to introduce sweet sorghum in the agroforestry system in the eucalyptus industrial forest.

III. RESEARCH METHODOLOGY

In carrying out the research, it was determined the area of the eucalyptus industrial forest which is located in the Player District. A study of the Player District administrative map was conducted based on the One Indonesia Data web, geological maps (Surono, 2009), World_Imagery (MapServer) for data for 2017-2018 (Figure 1). In the image from World_Imagery (MapServer) for Player District, it is overlaid with polygons for villages that are included in the Player District area. Image interpretation is based on location, size, shape, shadow, color, texture, and pattern. The results of the image interpretation are the type of land use. Field checks were carried out for the justification of the image analysis of the World Imagery in the research area.

The preliminary survey was carried out by conducting a field orientation to obtain an overview of the condition of the research area in the eucalyptus industrial forest area, including checking several land units related to the distribution of landform, morphological characteristics of soil, and land area boundaries for the development of sweet sorghum commodity. The field orientation was also intended for initial testing of maps of land use interpretation results and for designing map legends and taking inventory of the existing factors in the land.

The land survey aims to carry out: (a) Observation of land use resulting from image interpretation, (b) Observation of soil characteristics and distribution in the field, (c) Checking and determination of land unit boundaries by taking into account the boundaries of land units resulting from interpretation, (d) Compiling a land-use map legend. There were 2 times surveys of farmers in the eucalyptus industrial forest to (a) determine the motivation of farmers in relation to their interest in developing sweet sorghum and (b) coordination of sweet sorghum cultivation techniques.

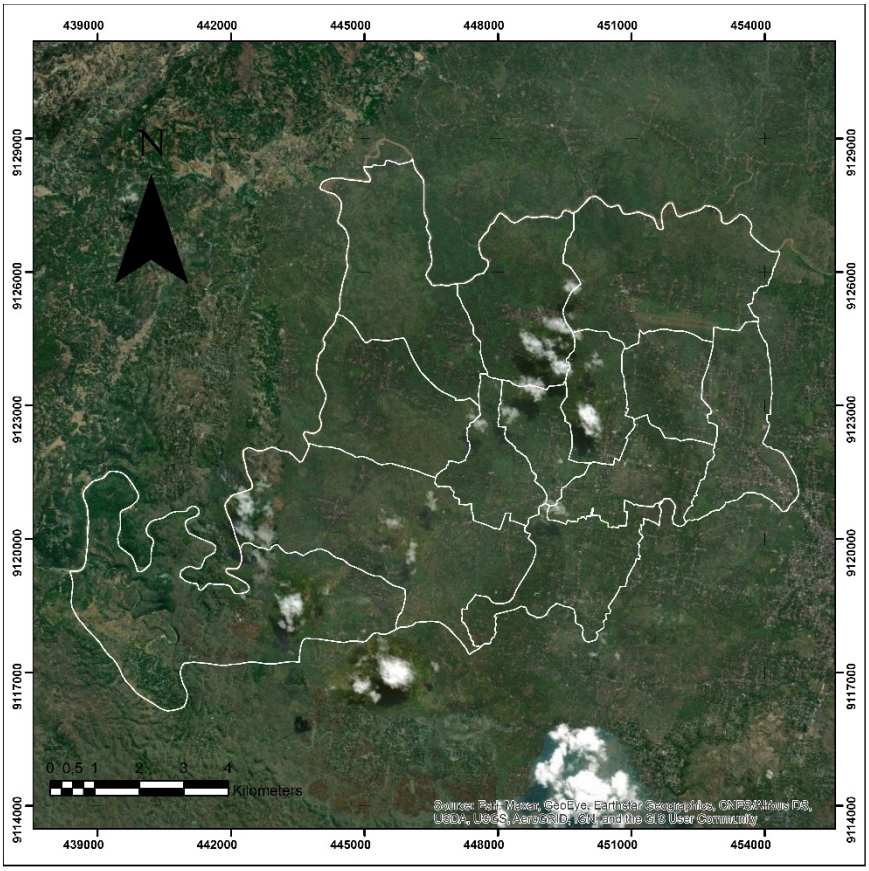

Figure 1. Image of World Imagery (Map Server) location covering Playen District 2017-2018) Sources: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

IV. FINDING AND DISCUSSION

IV.1. LAND RESOURCE

Administratively, the location study in Player District, which is included in the Yogyakarta Special Region Province. According to the geomorphological structure, the research area is included in a series of Southern Mountains, which extend from west to east. The land studied based on the Regional Geological map is included in the Kepek Formation (Figure 2). The Kopek Formation is the youngest rock arrangement in the southern mountains stratigraphic arrangement (Yogatama et al., 2017). This formation is composed of: marl with a few limestones deposited enjoy with the Wonosari formation (Surono, 2009). Kepek Formation develops from the age of Upper Miocene to Lower Pliocene (Surono, 2012).

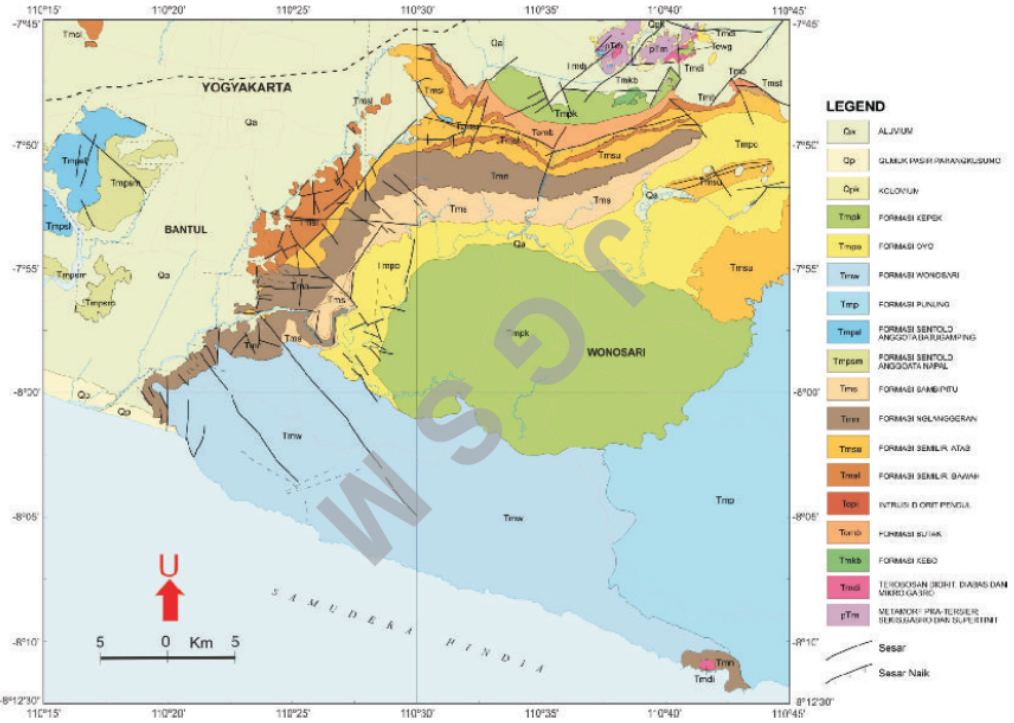

Figure 2. The geological map at the research location, taken from Surono (2009)

The landscape of the research area with a gently sloping topography with carbonate rock containing clay provides an opportunity to form parent material and then develop into the soil. Morphologically, the development of the soil in the area studied was relatively shallow. Identification using a hand auger shows that the soil depth ranges from 20 - 50 cm (Figure 3).

Figure 3. The soil profile of the studied area

IV.2.EXISTING CONDITION

The condition of the production forest area in the management area of the Yogyakarta Forest Management Unit or KPH in Player District, Gunungkidul Regency, Yogyakarta Special Region is an industrial land area with the main crop of eucalyptus commodity. The tenant farmers around the industrial plantation forest area who are members of the farmer groups in the Player District, Gunungkidul Regency are responsible for managing their cultivated land in the eucalyptus industrial forest. In order to coordinate the activities of the plant cultivation system undertaken by farmer groups assisted by local agricultural extension agents.

The analysis result of the overlay between Player District administrative map and the Image of World Imagery (Map Server) shows that the area of this District is 10,272.15 ha. By analyzing the field observation check, it was found that the types of land use in Player District, Gunungkidul Regency (Figure 4) consisted of 1. the most extensive industrial forest utilization, namely 4,277.68 Ha (41.16%), 2. residential area 2,293.63 Ha (22, 33%), 3. non-technical irrigation rice field area 2116.69 ha (20.61%), 4. dry area 981.86 ha (9.56%), 5. government building area covering 484.07 ha (4, 71%), and 6. non-industrial forest areas covering 168.21 hectares (1.64%).

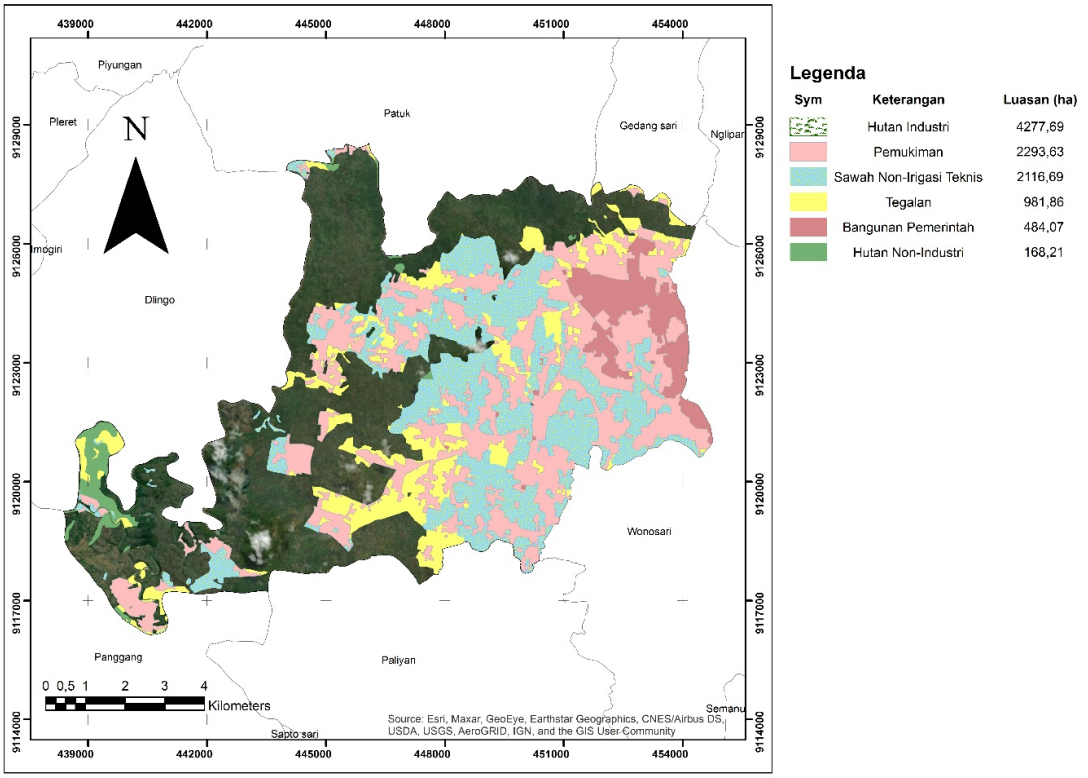

Figure 4. Map of land use types based on World_Imagery (MapServer) image analysis for 2017-2018

IV.3. DEVELOPMENT DESIGN

The main commodities cultivated in the area between eucalyptus plants in the Forest Management Resort area are peanuts, rice cassava, maize, or cassava which are planted intercropping. So far, the cultivation of intercrops, such as corn commodities using the BISI 2 variety, with 2 cobs per stem, produces an average of 23 tons/ha with 2 harvests. Apart from corn, rice plants are also cultivated in the intercrops. The sorghum development plan will be planted in planting season 1 with an intercropping system with corn and peanuts between eucalyptus plants, so with the assumption of eucalyptus plants, it can be taken care of.

Figure 5. Transport of Eucalyptus Leaf Harvest Products

Eucalyptus forests, which are widespread in several areas of the Yogyakarta Forest Management Unit, have the potential for the development of sweet sorghum with an intercropping model. The intercropping system of eucalyptus plants with sweet sorghum is expected to optimize land in: (a) more optimal land use as indicated by land equality ratio (LER), (b) diverse crop products, (c) reduce the risk of crop failure, due to reduced prices or other causes such as pests/diseases and climatic disturbances, (d) faster income (harvest sweet sorghum aged 90-110 days), (e) obtain additional yields from crops planted in the second season, (f) improve soil fertility due to the addition of organic matter fertilizers from sweet sorghum plant litter (g) to prevent erosion, and (h) to provide animal feed. Sorghum plants have evergreen properties, that is, when harvested they still have green leaves, so they have the potential to use livestock. Especially in the dry season, sorghum plants can grow back after being harvested, so that the soil surface in the hallway between eucalyptus plants is still covered by plants.

The design of the development of eucalyptus industrial forest areas planted on the land is 4 to 7 m wide between eucalyptus plantations so that there is still a large corridor space between lanes (Figure 6). Eucalyptus plants that are trimmed have a narrow canopy width. When after harvest, the soil is without cover. The land in this alley can be managed by farmers for planting seasonal crops, such as cassava, corn, and peanuts.

Eucalyptus forest areas should only be planted with food crops (sweet sorghum, maize, and beans). The problem is choosing the types of plants that provide economic and conservation benefits. Sweet sorghum crops with many advantages on the economy and environmental aspect can be intercropped in the alley between eucalyptus plants. Apart from providing benefits in the form of increased land productivity, this planting system can also provide financial benefits for managing farmers.

Figure 6. Design of Industrial Plantation Forest with Eucalyptus Plants Passage distance between lanes

V. CONCLUSION AND FURTHER RESEARCH

Eucalyptus industrial Forest developed in Player District Gunungkidul Regency has the potential for the development of sweet sorghum. Sweet sorghum plants have advantages over other types of plants by providing land cover in the alleys between eucalyptus plants. Farmers have an interest in cultivating sweet sorghum with the hope of benefiting from the stems, leaves, and seeds of sorghum.

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