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REVEGETATION OF PEATLANDS IN WEST KALIMANTAN WITH SUPERIOR COMMODITIES

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Abstract

Efforts to improve peatland can be carried out through restoration activities. This study evaluates the growth of four types of plants used in revegetation activities on deep peatland in Kubu Raya District. The study of the combination pattern of woody species and non-timber producers on peatland was compiled using a completely randomized block design (RCBD) consisting of 12 plant plots, four replications, each plot consisting of 100 plants with a spacing of 4 m x 3 m. Plant seeds come from *cabutan* (pulled out seed), kept and maintained in the community's seedlings in Central Kalimantan Province. The planting hole is made with 30 cm x 30 cm x 30 cm, then given 3 kg of manure/hole and 200 gr of agricultural lime per planting hole. The parameters measured were plant height and diameter. Measurement data were analyzed using a diversity test (ANOVA) if there were significant differences and then continued with Duncan's post-test. The results of the study showed that: (1) The jelutong plant is the most suitable species to be developed on deep peatlands because it has the fastest growth, and (2) Growth of jengkol and petai still needs to be improved by improving the physical and chemical properties of peat soil.

Keywords: *peatlands, revegetation, superior commodities, West Kalimantan*

1. Introduction

West Kalimantan has a peatland area of 1,680,134 ha or 30% of the total area of West Kalimantan Province, which is divided into peat with a thickness of <3 m with an area of 1,240,157 ha (73.8%) with sapric-hemic maturity and thickness > 3m 439,977 ha (26.2%) with the level of fibric [1] The area of peat distribution in West Kalimantan includes Kapuas Hulu, Sambas, Pontianak, Kubu Raya and Ketapang [2]. The peat forest area in Kubu Raya District of West Kalimantan continues to shrink due to the conversion of peat forests into settlements and cultivated land. In 1991 vegetation cover reached 66.31% but in 2010 it increased to 57.45% [2].

In West Kalimantan, especially in Kubu Raya Regency, peatlands are partly used by the community for intensive agricultural land. The community generally burns peatland in preparation for land for annual crops [3]. Changing peat forests into intensive agricultural land causes ecological damage. Nusantara, Sudarmadji, Djohan and Haryono [2] report that aeration of soil surface temperature and groundwater depth changes causing anaerobic changes to aerobes, which further increases microbial activity, thereby increasing decomposition of organic matter and CO_2 release. As a result of the unwise use of peatland, it often causes peatland fires that result in ecological, economic, and social losses. Sawerah, Muljono and Tjitropranoto [4] stated that community participation in preventing peat fires is still low due to the low level of

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education and income of the community.

Efforts to improve peatland can be carried out through restoration activities. Ramdhan [5] stated that restoration activities could impact farmers' income who have been utilizing peatland so that the commodities to be developed in restoration activities should be based on input from the community. However, local species under the ecology and peat habitat typology must be considered while including native peatland species [6]. Some peat swamp plants have high economic value, but the population is currently declining due to increased damage to peat forests. Indonesia is the largest exporter of jelutong sap globally, but its potential is declining due to the conversion of peatland and logging of trees in the natural forest [7]. Jelutong has the potential to be developed on peatlands because of its high economic value. The economic value of jelutong cultivation will be higher if it is grown in a mixture compared to if planted in monoculture [8]. This study evaluates the growth of four types of plants used in revegetation activities on deep peatland in Kubu Raya District.

2. Methods

a. Location and Time

The study was conducted in Rasau Jaya Dua Village, Rasau District, Kubu Raya District, West Kalimantan. The research was carried out on community-owned peatlands that were previously used as seasonal crop farms. The peatland used has a depth of 3-4 m. The research was conducted from October 2017 - December 2018.

b. Materials and tools

The materials used are wood-producing plant seeds: gerunggang (*Cratoxylumarborescens* (Vahl.) Blume.), Jelutong (*Dyera polyphylla* (Miq.) Steenis), and pulai (*Alstonia pneumatophora* Backer ex Den Berger), and non-wood-producing plants: *Areca catechu* L. and jengkol (*Pithecellobium jiringa* (Jack) Prain), manure from chicken manure, agricultural lime, herbicides, push. The tools used are hoes, machetes, meter rollers, calipers, buckets and mines.

c. Experimental design

The study of the combination pattern of woody species and non-timber producers on peatland was compiled using a completely randomized block design (RCBD) consisting of 12 plant plots, four replications, each plot consisting of 100 plants with a spacing of 4 m x 3 m. Plant seeds come from *cabutan* (pulled out seed), kept and maintained in the community's seedlings in Central Kalimantan Province. The planting hole is made with 30 cm x 30 cm x 30 cm, then given 3 kg of manure/hole and 200 gr of agricultural lime per planting hole.

d. Peat soil characteristics measurement

Observation of peat characteristics was carried out at 9 points in the study location. Peat soil samples were taken using a peat drill at every depth interval of 0-50 cm, 100-150 cm, 200-250 cm, and 300-350 cm to the depth of the mineral soil. Parameters observed were peat depth, peat maturity, bulk density, organic C content. Chemical characteristics of the peat were also observed using the top layer sample. The chemical parameters observed were pH, N-Total (using Kjeldhal method), P_2O_5 (using Bray I method), K, and Cation Exchange Capacity (using NH_4OAC extraction method).

e. Data Analysis

The parameters measured were plant height and diameter. Measurement data were analyzed using a diversity test (ANOVA) if there were significant differences and then continued with Duncan's post-test.

3. Results and Discussion

a. Peat soil characteristic

The result showed that the study location's average peat depth was 2.99 m (2.5 - 3.25 m) and 1.53 m (1 - 1.7 m), respectively. Thus location-1 is categorized as deep peat (> 200 cm), and location-2 is shallow-medium peat (50 - 200 cm) according to Adhi, Nugroho, Ardi and Karama [9] classification. Different thicknesses of peat can affect peat fertility. Peat fertility decreases with increasing thickness of the peat layer, so the plants will find it difficult to reach the bottom layer's mineral layer [10].

Table 1. Characteristic of peat soil in the study location

Parameters	Value	
Peat depth (m)	2.99	(2.5 – 3.25)
Bulk density (gr/cm^3)	0.23	(0.15 – 0.39)
Organic C (%)	52.70	(44.6 – 57.2)
C stock (ton/ha)	3,466.90	(2,455.4 – 5,286.2)

Notes: Number in parentheses indicates ranges value

Average of bulk density value was 0.23 gr/cm^3 ranging from 0.15 to 0.39 gr/cm^3. This value seems to confirm the previous study in Rasau Jaya III (nearby this study location) by [10], which reported the range value of 0.1 – 3 gr/cm^3. Meanwhile, the C organic content in the study location was 52.7 % on average. This value is also confirmed with the previous study that the peat's organic C content ranged from 52.3 to 58.2 % for all forest types [11].

Table 2. Chemical characteristics of peat soils at the study site

Analysis Parameters				
pH H2O	Kjeldhal (%)	Bray I (ppm)	NH_4OAC Extraction 1N pH: 7 (cmol(+)kg^{-1})	
	N-Total	P_2O_5	K	KTK
2.55	1.91	253.85	0.55	123.04

b. Evaluation of Growth

Plants up to 12 months old have quite diverse growth between species. The results of the analysis of the variance of plant growth are presented in Table 2.

Table 3. Results of analysis of variance of plant growth

Parameter	Source of variation	Df	Mid square	F	p-value
Height	Species	4	83722,57	53,34	0,000*
	Block	3	14040,39	8,93	0,000*
Diameter	Species	4	12390,04	39,90	0,000*
	Block	3	1905,05	6,14	0,000*

Notes: *significance at 95%

The results of the analysis of variance show that the parameters of height and diameter show significant growth between plant types. The results of further tests to find out the best growth are presented in Table 3.

Table 4. Duncan's post test results influence the type of plant on growth

Parameter	Species	Average
Height (cm)	Jelutong	155,20 a
	Gerunggang	116,06 b
	Pulai	106,17 bc
	Jengkol	96,71 cd
	Pinang	93,64 d
Diameter (cm)	Jelutong	3,87 a
	Pulai	3,10 b
	Pinang	3,01 b
	Gerunggang	2,28 c
	Jengkol	1,58 d

Notes: The average value in the column followed by the same letter shows no significant difference in the level of confidence of 95%

Post-tests showed that the growth of the largest plant height and diameter was owned by jelutong plants (155.20 cm, 3.87 cm). The type of jelutong swamp is one type of plant with a natural distribution on peatland, so it has a better adaptation level than other types. Besides, jelutong can grow on peat conditions with 10-20 cm of the surface water table until submerged up to 1 cm [12]. The provision of manure and lime also supports jelutong plants' biggest growth at the beginning of planting. Septiyani, Yelianti and Murni [13] stated that jelutong plants gave a positive response to organic fertilizer's presence on peatlands increasing root shoot ratio as an increase in the results of photosynthesis. Organic fertilizers can act as ameliorants on peat to improve the physical and chemical properties of peat soil. Organic fertilizers can keep moisture around the root media, especially during the dry season.

Pulai plantation, which is native to peat swamps, has a slower growth rate than jelutong, which may be due to plant genetic factors. Besides, on peatland that has been damaged, it can cause changes in peat soils' physical and chemical properties, which can disrupt pulai plants' growth. Yuwita, Hakim, & Alimah [14] state that gerunggang generally has a slow life force and growth when planted in peatlands that have experienced fires. Besides, gerunggang plants have relatively more difficult cultivation technology than jelutong plants. This is evidenced by the low viability of gerunggang seeds and long germination times, even though they have been tried with various planting media types [15].

Jengkol and areca nut have slow growth when planted on peatland. This is because the two types are not native to peatlands. Nevertheless, based on the experience of the people who planted in the area of their land, jengkol and areca nut was able to grow and produce. Communities around peatland have a high interest in planting non-timber forest products. Yuniati, Nurrochmat, Anwar and Darwo [16] stated that jengkol and areca nut are types that have market demand and have high economic value. Efforts to increase this type of growth can be done by improving peat soil's physical and chemical fertility. Increasing peat soil pH can be done by giving soil enhancers such as lime and sea mud and inoculating beneficial soil microorganisms [17]

4. Conclusion

Based on the results and discussion above, it can be concluded: (1) the jelutong plant is the most suitable species to be developed on deep peatlands because it has the fastest growth, and (2) growth of jengkol and petai still needs to be improved by improving the physical and chemical properties of peat soil.

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