

Combination of *Paraserianthes falcataria* and *Oriza sativa* at the Community Forest in Kapuas District, Indonesia

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Abstract—This research was aimed to compare the plant combination of *Paraserianthes falcataria* and *Oriza sativa* and monocultural plantation of *Paraserianthes falcataria* in order to increase land productivity in Kapuas District. This research consisted of two treatments and each treatment consisted of 17 plots. Data were analysed using homogeneity test and analysis of variance using SPSS 20.0. Research was conducted in the community forest project areas in Kapuas District, Central Kalimantan Province in 2017 to 2018. The result showed that at the first year, growth of dbh and height of *Paraserianthes falcataria* in plants combination system were 5.44 cm and 5.25 m respectively, whereas monocultural system were just 3.79 cm and 3.53 m respectively. Plants combination system also produced rice namely 3.05 ton ha⁻¹ in the first year. Thereby, the plants combination of *Paraserianthes falcataria* and *Oriza sativa* is better than monocultural plantation of *Paraserianthes falcataria*. This is the best system to increasing land productivity thereby it was give more added value for increasing income and prosperity of local peoples at Kapuas District, Central Kalimantan.

Keywords— Added value, *Oriza sativa*, *Paraserianthes falcataria*, plants combination

I. INTRODUCTION

A. Background

Borneo or Kalimantan island is the second largest island in the Indonesia archipelago.^{1,2,3} Kapuas District is one some regions located in Borneo, Indonesia that has experienced degraded forest caused illegal logging, wild forest fire etc. Plantation is one of Indonesia's Government Programs that is aimed in increasing degraded forest lands. Based on regulation of Indonesia Ministry of Forestry No.10.1/Kpts-II/2000 and regulation of Indonesia Government No.34/2002, forest plantation is directed in degraded forest areas such as shrubs, underbrush, grassland, and other critical land including poor timber potential caused by illegal logging. The development of Industrial Forest Plantation (IFP) has been started in 1980s, especially in Kalimantan and Sumatra. Unhappily, until 2000s the attainment of IFP is less

than 30%.⁵ Since year 2007, Indonesia Ministry of Forestry has launched the Community Forest Program duo to increase land productivity and also to create added value through local peoples.^{2,6,7}

Adverse result of Industrial Forest Plantation in Indonesia is caused by the adverse edaphic factor,^{9,10,11} less appropriate of silvicultural technique and technology^{8,12} and the socio-cultural factor.¹³ The adverse soil is caused by the marginal soil of podzolic red-yellow (ultisol)¹⁴ and also acidic characteristic with high content of Fe and Al caused the binding of Phosphor in the ground.^{12,14} Poor knowledge of silvicultural technique, heavy degradation, and poor forest management have caused poor growth of planted forest for some years.^{11,15,16} The lack of local society involvement in plantation forest activity often become serious problem, especially on the forest fire, illegal logging and land occupation.^{3,17,18} Some species which are recommended for forest plantation are *Paraserianthes falcataria*, *Dyera lowii*, *Hevea brasiliensis*, *Shorea balangeran*, *Paraserianthes falcataria*, *Swietenia mahagony*, *Eucalyptus* spp, *Peronema canescens*, *Gmelina arborea*, and others.⁴

Forestry development policy in Indonesia should have been directed to the integrated forest management, including plantation forest development using plants combination system involving local community.^{1,15} Plants combination system is able to be optimal for farming,⁸ creating better nutrient cycle,^{12,19} enhance biodiversity¹⁹ and also improve growth and yield.²⁰

Monocultural system had been applied in Industrial Forest Plantation and also Community forest since some years ago. Some forest concessionaries have applied the plants combination system as part of their plantation system, like Gunung Meranti, Daya Sakti 6, meanwhile community forest that successfully applied the plants combination system, called agroforestry, located at the Lawang Tamang, Tumbang Tihis, Manyarung etc. that is administratively located in Kapuas District, Central Kalimantan, Indonesia.

The community at the Kapuas District has developed the plants combination system on their farm. This effort is able to increase added value in the

form of minimizing the use of inorganic manure, minimizing of tending activity, improving growth and yield of plantation and also to create positive impact at local peoples in the form of improved production, better perception and also create care for natural resources and environment.

B. The Objectives of Research

The aim of this research was to analyze added value of agroforestry system, i.e. combination of *Paraserianthes falcataria* and *Oriza sativa* at the community forest in Kapuas District, Indonesia

II. METHOD

I. Research Site and Date

This research was conducted in the community forest at Lawang Tamang, Kapuas District, Central Kalimantan Province. Climate type of A (Schmidt and Ferguson, 1951) with precipitation of 2.650 mm year⁻¹. Initially vegetation was underbrush and grassland (*Imperata cylindrica*). Other species were *Macaranga macroptera*, *M. triloba*, *M. grandifolia*, *M. peltata*, *Melastoma malabathricum*, *Vitex sp*, *Hyptis capitata*, *Cyperus spp.*, etc. Soil type was ultisol and soil texture was sandy clay. Research has been done at November 2017 to December 2018.

II. Research Procedures

Land clearing was done by disc plow. The soil was treated with Calcium (CaCO₃) 500 kg ha⁻¹, at one week before plantation. *Paraserianthes falcataria* seedling was planted in October 2018 with spacing of 2.5 m x 2.5 m. All seedling of *Paraserianthes falcataria* were come from the nursery with uniform treatment.

Plot establishment. Plot 1 (as treatment 1) was plants combination system, i.e. the mixing of *Paraserianthes falcataria* and mount-paddy (*Oriza sativa*) with continued manuring, and plot 2 (as treatment 2) was intensive monocultural system (*Paraserianthes falcataria* plantation with continued manuring). Each treatment consisted of 17 plots as replication meanwhile size of each plot was 15 m x 10 m (= 150 m²) which was randomly placed. Continued manuring was used the composition of anorganic manure i.e. Urea mixed KCl namely 250 kg ha⁻¹. At the 2 to 3 weeks after *Paraserianthes falcataria* being planted, mount-paddy (*Oriza sativa*) was planted in plot 1 (t1) with dibble (that is wooden tool with a sharp end for making holes in the ground). Planting holes spacing was 25 cm x 25 cm and each hole was filled with 2 to 4 seeds of mount-paddy and then covered by topsoil.

Replanting seedling of *Paraserianthes falcataria* (replacement of dead seedling with a new one) was conducted on 2nd month after planting of trees. Data of diameter at breast height (dbh) and height of

Paraserianthes falcataria at 1 year after planting were collected Harvested mount-paddy (*Oriza sativa*) were done at 4.5 months after planting then result of paddy yield was recorded.

III. Data Analysis

Data were analyzed using analyse of varians (Anova) and LSD test, using SPSS 20.0.

III. RESULT AND DISCUSSION

A. Growth of *Paraserianthes falcataria*

Growth of diameter at breast height (dbh) and height of *Paraserianthes falcataria* in plants combination system (t1) and monoculte plantation system were showed at Table 1. The data indicated that in the first year, plants combination system showed the best growth with mean of dbh and height were 3.88 cm and 4.12 m respectively, meanwhile monoculture plantation showed lower growth namely 2.54 cm and 2.31 m respectively.

Table 1. Mean of dbh and height of *Paraserianthes falcataria* in the 2 treatments

No. Plot	Mean of dbh (cm)		Mean of height (m)	
	t1	t2	t1	t2
1	6.12	4.23	5.88	3.94
2	5.32	4.22	5.21	4.11
3	4.67	3.56	5.01	3.54
4	4.56	4.22	4.89	3.95
5	5.32	4.33	4.97	4.11
6	6.34	3.54	5.45	2.95
7	5.01	3.45	4.87	2.85
8	5.43	2.99	5.01	3.11
9	6.21	3.23	5.78	3.04
10	6.34	3.56	6.12	3.22
11	5.32	4.12	5.55	3.65
12	5.21	4.23	5.12	3.95
13	4.88	3.67	4.76	3.25
14	5.32	3.45	4.95	3.22
15	5.32	3.56	4.85	3.55
16	6.11	3.88	5.99	3.67
17	5.04	4.23	4.88	3.95
Average	5.44	3.79	5.25	3.53

Notes=

t1: plants combination system (*Paraserianthes falcataria* mix *Oriza sativa*), t2: monoculte plantation of *Paraserianthes falcataria*.

Based on the homogeneity test, the data of dbh and height of *Paraserianthes falcataria* were the significant value each equal to 0.31 and 0.79 respectively which were bigger than 0.05 so that all data were homogeneous and the next analysis can be

done. Based on analyse of variationin of dbh and height growth of *Paraserianthes falcataria*, they showed that significant value namely $0.00 < 0.05$, so there were significant different between the treatments. Thereby, dbh and also height growth of *Paraserianthes falcataria* in the plants combination system (t1) was better than the monocultural system (t2). Picture 1 showed a dbh growth and height growth of *Paraserianthes falcataria*.

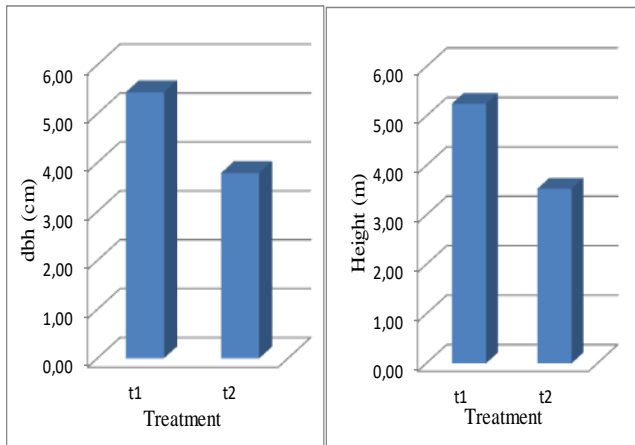


Figure 1. Comparison of dbh and height growth of *Paraserianthes falcataria* in

The data showed that there is positive correlation between dbh and height growth of *Paraserianthes falcataria* and both represent important parameters in tree growth²¹ and also as an indicator that *Paraserianthes falcataria* plant grow normally.²² The tree growth quality was represented by function of density which could be arranged through their spacing.^{23,24} The good wood quality was yielded from well-balanced and good tree growth since initial stage^{22,25} The 2.5 m x 2.5 m spacing at *Paraserianthes falcataria* plantation could result a good influence on the architecture of *Paraserianthes falcataria* because it produces well-balance effect of phototropism.

Plants combination system was the best system for the growth of dbh and height of *Paraserianthes falcataria* plantation (Table 1). This plant is a fast growing species that needs the availability of nutrient to balance its growth rate.^{24,26} Plantation area includes critical land and degradation land (regulation of Indonesia Government No.34/2002) and it has some limited factors⁷ that was marginal land, podzolic red-yellow soil, pH 4 to 5.5 - that has the character of acid soil was high of Fe and Al,^{11,14,27} but by giving base manure of calcium chloride (CaCO_3) equals to 750 kg ha^{-1} and also continuous manuring with fertilizer of urea: 250 kg ha^{-1} and KCl: 250 kg ha^{-1} could yield better growth of *Paraserianthes falcataria*. Fisher and Binkley expressed that growth of plant was influenced by soil tilage, site and species.¹² Soil tilage with plow could also give positive affect to mixed mineral soil above and underground. Waste and other organik

substance are the sources of soil nutrient therefore need to be retained. The marginal land has low potency for cultivation but with the technological treatment and correct processing system could become productive land.¹⁰ The use of basic manure and continued manuring is recommended and also suggested to promote growth on marginal farm.^{10,12,23,24}

B. Plants Combination System

Plots of plants combination system (t1) produced average yield of mount-paddy (*Oriza sativa*) of 3.05 ton ha^{-1} in the first year. This paddy yield was better than the result of mount-paddy from local people using shifting cultivation that less environmental friendly which is just 0,5 to $1,3 \text{ ton ha}^{-1}$.¹⁶ The *Paraserianthes falcataria* canopy was wide and big which progressively caused decreasing of light intensity which was distributed on the forest floor²³ and could reduce photosynthetic quality and quantity and also decreased the paddy productivity.²⁸



Figure 2. *Paraserianthes falcataria* mixed *Oriza sativa* in research plots of Kapuas District

Pursuant to this research result, the growth of *Paraserianthes falcataria* on the plants combination system is better than monoculture system. Based on evaluation of social aspect, economic and culture, the plants combination system was the best method compared to the monocultural system because they are able to employ more labour and to improve income of local peoples, creating cooperation among local peoples and management unit that could contribute to sustainability natural resources¹ and also could improve the positive perception to the forest development and plants combination system in the forest region.

The other uses on the plants combination system was security aspect to keep from forest fire. A lot of study expressed that most caused of forest fire was human factor.^{17,18,29} The local peoples tradition, especially on the surrounding forest region, was opening the farm by combustion and it was causing

forest fire.^{17,29} Plants combination system could reduce the number of forest fire because the local community could take care of their plant.

Plants combination system is believed to be able to depress the number of forest damage, because the local people in the settled cultivation are more productive with intensification pattern. The involvement of local peoples to manage natural resources using participatory rural appraisal (PRA) concept that had been adopted by some management unit in Indonesia. With this concept, the local peoples had a share to make the planning, managing, controlling and benefiting of natural resources in the surrounding habitation with sustained principal.²⁸ Plants combination system is the better solution to increase land productivity, thereby, it was give more added value for increasing income and prosperity of local peoples.

Constraint of plants combination system for wider scale is land accessibility and continued activity. Generally, the society prefers to establish plants combination activity on the land that nearby their habitation. They couldn't use the same location after two or three times of planting period so they have to look for a new farm afterward. The good planning in the plants combination management could create continued activity.

IV. CONCLUSION

Plants combination between *Paraserianthes falcataria* and *Oriza sativa* give the better dbh and height growth of *Paraserianthes falcataria*, namely 5.44 cm year⁻¹ and 5.25 m year⁻¹ respectively, and also mount-paddy (*Oriza sativa*) yield, namely 3.05 tonnes ha⁻¹. c This is the best system to increasing land productivity thereby it was give more added value for increasing income and prosperity of local peoples at Kapuas District, Central Kalimantan.

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