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The Relationship of Land Cover to Stands Density and Biomass Production in Tropical Rainforest South Kalimantan

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Abstract Tropical rainforests have high structures and variations, Forest diversity used as a result of forest exploitation for plantation or mining activities. Circle change is a fast way to change the structure and species diversity. This study aims to analyze the relationship of land cover to stand density and production of litter biomass. The research location is located in forest area with special purpose (KHDTK) University of Lambung Mangkurat. Research method by conducting Landsat 8 satellite image analysis of Year 2017 to analyze land cover. Measurements and number of types, basal measurements by Simon method (1993), litter biomass measurements with 50x50cm wire quadratic and laboratory analysis. The results show that there are five land cover that is old grove, young grove, shrubs, mixed garden and open field. The result of the measurement of the density of the stands shows that the difference in the land gives a very significant difference to the species and size of individual trees and basal areas per hectare ($P < 0.001$), the cover of old grove has the presence species, the number of individuals per hectare and the high basal area by displaying the main density with the land cover of young grove, shrubs, mixed gardens or open fields. Land cover gives a very real difference to litter biomass production ($P < 0.001$). The characteristics of the oldest grove of land with the highest density gave the highest amount of litter biomass and decreased at the closure of young grove, mixed gardens, shrubs and open fields. The old grove have the highest density as they approach secondary forest vegetation. Land cover with high density will produce litter of the forest floor in large quantities.

Keywords Land Cover, Tropical Rainforest, Stand Density, Litter Biomass

1. Background

Tropical rainforest in Indonesia naturally has a high biodiversity (Laumonier, 1997), South Kalimantan is one that has tropical rainforest areas with high diversity, even in logged-over areas (Susilawati, 2008). Tropical rainforests in South Kalimantan are dominated by dipterocarpaceae species (Suyanto, 2015). The diversity of tropical rainforests is reduced as a result of plantation activities such as rubber, oil palm and mining (Nugroho, 2010). Tropical rainforests are generally dominated by ultisol, incepticol and entisol soils with relatively low soil fertility so that the restoration of forest stands is strongly influenced by the supply of organic matter from the above vegetation (Hardjowigeno, 2003), this causes the succession of plants to run more slowly (Suyanto, 2015).

Changes in the structure and species diversity of tropical rainforests as a result of activities outside of forestry or uncontrolled logging of forestry license holders led to significant land cover changes (Sunderlin and Resosudarmo, 1997). Any change in land cover causes changes in the structure and diversity of tropical rainforest species, there are species of fast growing species that grow on an open field cover that is different from the original species of diptercarpaceae which has slower growth (Hidayatullah, 2017, Krisnawati, 2003).

Changes in land cover causing structural changes and species diversity are expected to cause changes to the density of stands of tropical rainforests in South Kalimantan. The stand density is a group of stands that occupy the area and the space of a certain species and number so that it can regulate to the light entering the floor of the forest stand (Oudum, 1993; Suhendang (1985).

Changes in land cover will have an impact on the production of ground litter biomass, this biomass is very important for plants that provide nutrients for growth (Indriyanto, 2006). Different types and standing structures will cause differences in the quantity and type of litter produced. Therefore, it is necessary to investigate the effect of tropical rainforest cover on changes in density and production of litter biomass produced. This study aims to analyze the relationship of land cover to stand density and production of litter biomass.

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2. Research Methods

This study was conducted in Tropical rainforest located in Forest Area with Special Purpose (KHDTK) University of Lambung Mangkurat South Kalimantan. The location is located at coordinates 126°54 '- 127025' E and 3°21 '- 3°48' S, located in Banjar Regency of South Kalimantan Province (Anonymous, 2016). The soil type is dominated by the type of soil Ultisol has an average rainfall between 1,800 mm to 3,000 mm per year, has a climate type B with moisture Between 70-83% and temperatures between 20° -35°C (Anonymous, 2009).

The data retrieval procedure was done by direct measurement in field and laboratory analysis at Soil Science Laboratory Faculty Forestry of Lambung Mangkurat University. How to take data is done with the following stages:

1. Conducting land cover analysis by analyzing Landsat 8 satellite image of 2017 on tropical rainforest located in forest area with Special Purpose (KHDTK) University of Lambung Mangkurat South Kalimantan
2. Determine the observation points on each land cover with replication as much as 3 repetitions for each land cover.
3. Measure density of stands at observation points that have been made using square plot measuring with plot size 20 x 20 as much as 5 plot of measure at each point of observation. The stand density is determined by measuring the stand density based on the number of individual plants and the stand density based on the basal area according to Simon (1993) as follows:
   Basal area = ¼ π.d^2
   d = diameter
   π = constants (22/7)
4. Measuring litter biomass:
   The litter biomass is measured with 50 cm x 50 cm quadratic wire placed on the forest floor. All the litter in the quadratic wire are grouped into liters L (liter) is the new falling litter, still intact, the color greenish and brownish, still a bit fresh. F1 Litter is litter that begins to decompose (not complete, original shape still visible, still litter single / not attached). Separate parts of leaves, stems / branches, flowers / fruit. Litter F2 is a litter that has been decomposed further, litter already attached to each other. Litter H (Humus) is litter decomposed completely, shaped like compost, blackish color, crumb structure. Determining moisture content and calculating biomass in the laboratory with drying reaches 80°C for 2x24 hours to absolute dry weight according to the formula (Hairiah and Rahayu, 2007).
   % Water content = (Sample of Wet weight - Sample of Dry weight) / Sample of Dry weight x 100%, while Calculation Biomass = wet weight / (1 + (% moisture content / 100))

The data were analyzed using variance analysis according to Yitnosumitro, 1993, with sigma plot version 12 software analysis tool.

3. Results and Discussion

1. Landcover

Landcover is a biophysical object that occupies space above the surface of the earth where most of the land cover character is formed by vegetation (Suyanto, 2015). Based on the results of Landsat 8 imagery analysis, there were 5 classifications of land cover, namely old grove (27.13%), young grove (26.17%), shrubs (28.76%), mixed garden (5.46%) and open field (12.48%). Based on the results of land cover analysis, the tropical rainforest in KHDTK area has been under pressure on the closure which resulted in wide open field and mostly young grove and shrubs.

The activity of the residents to utilize the land into a mixed garden, because the area is because the area is bordered by residential areas. While a rather wide open field caused by the occurrence of land fires that may occur every dry season. The basis of land cover is the basis for conducting analysis on the density and biomass of litter.

2. Solid Density Based on Number of Individual Trees

Table 1. Tables of the Number and Type of Individuals per hectare

No	Land Cover	Number of Types Found	Number of Individuals per hectare (Indv/ha)
1	Old grove	50^{d}	1686^{e}
2	Young grove	31^{c}	1334^{d}
3	Mixed Garden	26^{b}	1115^{c}
4	Shrubs	15^{a}	954^{b}
5	Open field	8^{a}	183^{a}
	Description: *Lsd = least significant different; Notations a, b, c, d, e are distinctive markers, in the same notation has no value difference*	Mean: 24 Standard deviation: 2,59 LSD: 5,29	Mean: 1054 Standard deviation: 42,85 LSD: 99

The number of species is the number of plant species that comprise a community forest area. More and more species attendance shows the level of plant diversity that makes up a region. While the density of trees is a number of trees in a certain area, generally measured in tree density per hectare (Suhendang, 1985). Under Table 1 shows that the difference in land cover makes a very real difference to the number of species found per hectare and the number of individuals trees per hectare ($P < 0.001$), at the old grove land cover having the highest individual presence and number of individuals per hectare compared to the young grove, land cover, shrubs, mixed or open field.

According to Jayanthi and Arico (2017) divides the density of the individual number into three classes: the number of individuals above 1,000 per hectare shows high

density, the density between 700-1000 indicates medium density and densities below 700 indicates low density. Density of stands in the highest tropical rainforest at the land cover of old groves, young groves and mixed gardens. Despite the high incidence of mixed gardens but the presence of the species is not high, this is because mixed gardens only limit the types favored by farmers who are kept alive, such as fruit and some useful wood.

The number of species presence is directly proportional to the number of individual plants per hectare ($P < 0.001$), with the regression equation is $y = 23.87 + 491x$, ($r = 0.82$), increasing the presence of the species will be followed by the increasing number of plant individuals. Changes to the structure and diversity of tropical rainforest species will quickly change the number of species and the number of individual trees that need attention so as to avoid greater damage (Hidayatullah, 2017; Yamani, 2011).

The species dominating the cover of the old grove are Litsea trima, Palaquiium desyphillum, Macaranga motleyana and Tristiropsis sp. The species dominating the cover of the young grove are Litsia sp, Macaranga motleyana, Buchanania arborescens, Cryptocaria fania and Cratoxylon tormosum. The species dominating the cover of the shrubs are Vitex pubescens, Litsea trima, Tristiropsis sp, Buchanannia arborescens and Strombosia javanica.. The species dominating the cover of the mixed gardens are Hevea brazilensis, Nephelium sp, Nephellium sp, Durio zibethinus and Artocarpus integra. Open field is generally dominated by Vitex pubescens. The types that appear in tropical rainforests are dominated by fast growing species, this is the result of exploitation so that emerging fast-growing new species such as Macaranga motleyana, Vitex pubescens etc.

3. Density of Stand Based on Basic Field Area (Basal Area)

Table 2. Density of stands based on basal area

No	Land Cover	Basal Area (m^2/ha)
1	Old grove	$0{,}845^{d}$
2	Young grove	$0{,}673^{c}$
3	Mixed garden	$0{,}574^{c}$
4	Shrub	$0{,}148^{b}$
5	Open field	$0{,}0138^{a}$
Description: Mean: 0.45; Standard deviation: 0.05; Least Significant Different: 0.12; Notations a, b, c, d are distinctive markers, in the same notation has no value difference		

Density of trees according to Sahid (2009) can be determined by the interpretation of the basal value of the area, the basal area per hectare is the sum of the basal area of individual trees within 1 hectare. Based on Table 2 shows that the difference in land cover gives a very significant difference to basal area size ($P < 0.001$), at the cover of the old groves having the highest basal area per hectare compared to the cover of the young groves, shrubs, mixed or open field. The higher the basal area then the density of the stand is more tightly (Hardjana, 2015, sahid, 2006).

The cover of the old groves is almost similar to the cover of secondary forest land, especially the structures and types of stands that compose it (Suyanto, 2015). The cover of the old groves and young groves and shrubs indicates that the land has been exploited against the diversity of the area. The old groves will undergo continuous succession to be secondary forest if no disturbance is done (Gunawan, 2015), the process of transforming old grove into secondary forest is slow, let alone soil fertility in the tropics is influenced by the supply of oragnik material from the constituent vegetation (Hardjowigeno, 2003).

Succession of the forest from the young grove to the old grove or the old grove to the secondary forest requires a time factor, according to Gundrson (2000). Natural ecosystems have resilience, the ability to survive and recover when disturbed to return to equilibrium conditions. However, the succession process can be done by human intervention on existing stand density by enrichment and cultivation of plants, while for open fields and shrubs can be done by planting with 100% intensity (Gunawan et al., 2011; Gunawan, 2014).

The density of the stands found in the old groves and the young groves and shrubs is potential for various efforts to increase the density with the enrichment of species and the arrangement of crop spatial patterns so that the distressed lands can be immediately recovered. The old and young groves are treated by secondary succession approaches that are community changes occurring in previously vegetated areas but suffered disruptions or damage such as fire (Woodland and Trust, 1998).

4. Litter Biomass

Litter production in tropical forests is higher than temperate forests, this is due to the ever-green tropical rainforest (Wiharto, 2010). Forest litter is important for the growth of tropical rainforests, high rainfall causes the rapid decomposition process of litter in tropical rainforests (Nugroho, 2015).

Table 3. Biomass Production Litter on Each Land Cover

No	Land cover	Basal area (m^2/ha)
1	Old grove	$0{,}333^{d}$
2	Young grove	$0{,}266^{c}$
3	Mixed garden	$0{,}130^{b}$
4	Shrub	$0{,}001^{a}$
5	Open field	$0{,}001^{a}$
Description: Mean 0.15; Standard deviation: 0.02; Little Different Significant: 0.06; Notations a, b, c are distinguishing marks, in the same notation have no values		

The production of litter is strongly influenced by the amount of stand density, high density leads to large litter production, while the different species that compile the tropical rainforest have no effect on biomass production (Riyanto et al, 2013). Based on Table 3 demonstrating that

the difference in land cover makes a very real difference to litter biomass production (P <0.001). The cover of the oldest grove with the highest density gave the highest amount of litter biomass and decreased on the cover of young groves, mixed gardens, shrubs and open fields.

According to Sinaga (2015) states that even the relatively high distribution of trees and tree density will result in large volumes of litter drops. According to Sadono and Umroni (2012) states that the tight land cover is characterized by high density of stand, this causes the sun does not easily get into the forest floor and cause undeveloped plants are not growing well, consequently the forest floor is dominated by litter of trees on it. Nasib (2017) states, high biomass is also influenced by the growing places, sunlight and vegetation types that shed leaves.

The high production of litter determines the tropical landscape of the tropics, so that the acceleration of succession from young groves, groves into old groves or secondary forests should be done with enrichment and maintenance techniques. This is done to form a closed nutrient cycle that characterizes the tropical rainforest (Nugroho, 2015; Hardjowigeno, 2003).

4. Conclusions

The tight land cover is produced from high stand density, with high number of individual plants, old groves having the highest density due to the approaching climax vegetation ie secondary forest. Land Cover of high-density land will produce litter on the forest floor in large quantities. Land cover that less density should be done enrichment and maintenance to accelerate the succession, so that biomass productivity on the floor faster.

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