Agroforestry Models in Riau Main Island Indonesia: Kampar Regency Context

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Abstract: This paper focused on the identification of species composition dan standing stock of agroforestry model in District XIII Koto Kampar in Riau Main Island. The study aimed to show kinds of agroforestry model and estimate the standing stock. Data were collected from 12 sample plots with 60 sub sample plots. The research found that plants of agroforestry have three models that are agroforestry based rubber-durian-gaharu (*Hevea brasiliensis-Durio zibethinus-Aquilaria* sp,), agroforestry based rubber-durian and agroforestry based rubber-gaharu. Agroforestry based rubber-durian-gaharu has 4 sample plots with average potential standing stock 108,93 m^3/ha. Average the number of tree species per ha is 657 rubber, 214 gaharu, durian 15 and another tree 20. Agroforestry based rubber-durian has 2 sample plot with average potential standing stock 81,35 m^3/ha. Average the number of tree species per ha is 316 rubber, 41 durians, and another tree 71. Agroforestry based rubber-gaharu has 6 sample plot with average potential standing stock 59,48 m^3/ha. Average the number of tree species per ha is 545 rubber, 124 gaharu, and another trees 8.

Keywords: agroforestry model, species composition, standing stock

1. Introduction

Agroforestry is one of the options taken by upstream farmers for their land management. The principle of agroforestry that implements a land management system by combining different types of seasonal crops (food, vegetables, medicines), and annual crops (wood, fruits), has in many cases proven to have positive implications for farmer welfare and environmental conservation (Sambas, 2004; P3P Unram, 2003). The successful application of agroforestry is influenced by various factors, generally dependent on local characteristics, namely the biophysical, social, institutional, and external factors that support it. According to ICRAF (2000), there are many agroforestry patterns found in Indonesia, so each region in Indonesia has a distinctive agroforestry application pattern. Therefore, successful implementation of agroforestry in one area may not be generalized as an excuse to be applied in other areas.

These variations can be seen, among others, the variety and variety of vegetation, planting systems, patterns of individual, family, and group work relationships, as well as local institutional and policy support factors. The diversity of models of agroforestry application is a fact that needs to be explored more deeply. Of the various models that exist, of course, each has its advantages. In District XIII Koto Kampar which is one of the District in Kampar district found much agroforestry-based rubber planted with other plants such as trees and fruit trees. Plants that many become farmers' choice is gaharu planted with rubber. These agroforestry activities are undertaken by the community to gain benefits to improve the welfare of communities in and around the forest while maintaining the condition of the forest. According to De Foresta (1997) that complex agroforestry is a sedentary farming system that contains many types of plants with (tree-based) planted and treated with cropping patterns and forest-like ecosystems. Agroforestry activities carried out with a combination of crop types will provide by choice of farmers with various considerations such as conformity of the place of growth, economic factors, and others. The type composition of the constituent components of the agroforestry stand will make a difference to the pattern and model of agroforestry in each place.

The stand potential of each agroforestry model is based on the density and type that dominates a stand. High-density stands with large tree diameters will provide a larger value for the standing potential. The aims of this study to determine the potential of existing agroforestry model in Kecamatan XIII Koto Kampar.

2. Research Methods

The research was carried out agroforestry land in Desa Gadang Village, Koto Masjid Village and Tanjung Alai Village, XIII Koto Kampar District, Kampar Regency, Riau Province. The research was conducted in February - June 2017. The method of the research was survey method by taking agroforestry biophysical data, namely: composition of agroforestry, plant density, planting pattern, diameter, height, topography, soil type, rainfall. Also, interviews with agroforestry owners and measurements were made in the sample plots. In measuring the potential of agroforestry system that has wide plant spacing, plot 20 m x 100 m = 2000 m^2 where the total plot is 12 plots with 5 sub plots measuring 20 m x 20 m = 400 m^2 so that there are 60 sub plots with total sampling area is 2.4 ha.

Measurement standing stock are calculated by the formula

V = ¼ x 3.14 x d x t x cf
V = volume
d = diameter
t = high
cf = correction factor

3. Result and Discussion

The topography is flat and hilly. Soil type is yellow-red podzolic or commonly called FMD. Climatic conditions in the category of tropical climate with six months dry months while the number of wet months six months. The average rainfall in 2016 is about 2420 mm, and the average amount of rain in 2016 is about 15 days. The temperature of this research location temperature ranges from 20.2^0C - 22.8^0C. For air humidity in this study, location ranges between 97% - 99%. Geographically located in the lowlands. These three villages are located on the edge of Koto Panjang hydropower reservoir so that this village can be categorized into a tourist area. This area is dominated by rubber plantations and fish ponds

The agroforestry system located in Kecamatan XIII Koto Kampar is an agroforestry based rubber that is combined / intercropped with forest plants (Meranti, Sengon, teak, Tampui, etc.) or fruits (Durian, Petai, Jengkol, cocoa, mangosteen and others) other). The advantage of agroforestry system is diversification of plants so that it resembles the condition of the forest, it can be a house of millions of fauna and flora, and can prevent the occurrence of landslides and floods. Also, the most important is a very suitable agroforestry system selected to suppress and prevent global warming is becoming the hottest issue in the world. Agroforestry type composition grouped based on 12 agroforestry land located in XIII Koto Kampar based on observation and interview with land owner obtained three models of rubber based agroforestry based on the dominant tree species found in the field. These three models consist of 3 dominant tree species, ie, rubber, gaharu and durian are presented in Table 1

Table 1. Agroforestry model based on tree species composition

Agroforestry Model	Species composition	∑ Plot	N/ha	Vol/ha
Model 1 Rubber-Gaharu-Durian	Rubber,gaharu, meranti,bamboo,durian,jengkol, tampui, mangosteen, oil palm	4	907	108,93
Model 2 Rubber -Durian	Rubber, Durian, mangosteen, cocoa	2	429	81,35
Model 3 Rubber -Gaharu	Rubber, gaharu, jackfruit, sengon, candlenut, meranti, cocoa, teak, rambutan	6	678	59,48

Based on Table 1 it can be seen that the most dominant species that exist in each field are rubber, durian, and gaharu. Rubber plants grown initially is a government assistance activity in the form of rubber plants grown at plant spacing 3 x4, but over time some plants have died. The regeneration is only a natural regeneration of the scattered rubber seeds. The farmers also plant other crops among the rubber plants of durian, jengkol, petai, cocoa and others. The plants are planted with irregular patterns among the rubber plants with different times so that there are various structures and compositions. In general, fruit tree seedlings grown in rubber gardens are local seeds. There is no spacing or pattern, and even tillers are allowed to grow naturally by themselves. Seeds are dispersed on existing land and left without treatment such as treatment, thinning and even fertilization. This is done by farmers because it is considered to provide additional income other than rubber sap. Rubber based agroforestry has a variety of composition or plant composition and can be utilized by the owner (farmer) at any time by the wishes of the owner.

Durian one of the many plants found among rubber plants because durian tree has a high economic value of durian fruit. With the diameter of large and high trees then the durian becomes dominant among other plants. Wood from durian trees also has good quality to be used as raw materials for construction timber. The interest of landowners to grow gaharu arises when gaharu is considered beneficial because the price of gaharu has a very high value coupled with the existence of farmers groups who received help from gaharu seeds from the government. Gaharu plant is an intolerant plant which means need shade for its growth so that planted under rubber will give good growth. The composition of the type of each model is presented in Graph 1

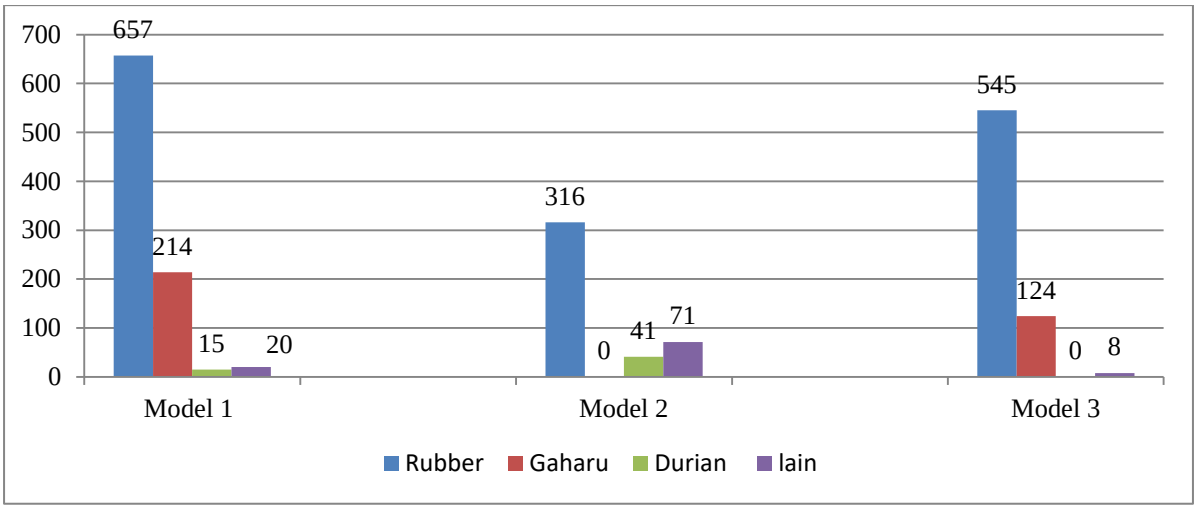

Figure 1. The composition of species and Number of trees/ha (N/ha) of Agroforestry models

Based on Figure 1 it can be seen that model 1 has some species dominated by rubber, then gaharu and durian. Other types that are encountered are jengkol, tamui, bamboo, meranti. Although regarding the number of durians is not too much but found in every observation plot and has the largest diameter of 64 cm. While on the 2nd model is not found gaharu species only durian and other plants. Other plants include mangosteen and cocoa. In model 3 the dominant plants are rubber and gaharu and also there are other plants that are jackfruit, sengon, candlenut, meranti cocoa, teak, rambutan. In terms of density or number of trees per ha (N/ha) model 1 has a larger number of trees than these two models because it has many tree species and gaharu planted is also young with a diameter between 4 cm- 9 cm while model 2 has N/ ha at least with only 429 trees this is due to the planted tree already has a large diameter and no additional of gaharu trees among the rubber plants.

The results of 12 plots of 20 mx 50 m in XIII Koto Kampar were recorded in 15 species of trees obtained in plots such as rubber (*Hevea brasiliensis*), gaharu (*Aquilaria sp*), durian (*Durio zibethinus*), cocoa (*Theobroma cacao*) Mangosteen (*Garcinia mangostana L*) and palm oil (*Elais guinensiss* Jacq). The staple crop is the rubber which is then between the oil palm planted another tree by planting applied by the farmer is a random system with irregular spacing.

In the research plot, rubber is found almost throughout the plot with the diameter range is 24-30 cm because the rubber plant is a staple crop. For gaharu plants are planted around the year so that the age of the plant is still young with diameter 5-10 cm. Gaharu plant aims to produce gaharu either naturally or through the treatment by introducing microorganisms after > 5 years old or diameter has reached 15 cm. Diameter range of durian is 31-64 cm, it shows that rubber plant and durian are superior plant species and old age and the average diameter of large stems in the research location, can be seen in Table 2

Table. 2 Description of plots

Plot	The number of trees.	Average diameter	Average height	Volume
1	49	26,7	14,2	103,88
2	32	34,9	17,8	116,40
3	56	27,8	16,2	167,86
4	52	25,5	14,8	99,82
5	37	26,2	11,1	62,89
6	43	25,1	12,6	25,44
7	26	23,4	13,9	38,25
8	27	24,6	14,8	47,58
9	22	22,0	12,4	29,54
10	53	22,5	14,0	83,76
11	38	29,1	14,6	95,77
12	38	27,5	14,2	84,14
average	39,42	26,275	14,22	79,61

The number of trees per observation plot varies between 22-56 stems with a plot area of 0.1 ha. Diameter tree ranges between 22.1 cm - 34.9 cm and 11.1 m high up to 17.8 m. This condition indicates that each plot of observation has a good diversity in the number of trees, diameter, and height. Agroforestry as one form of land utilization that has characteristics of diversity both regarding the number of plants, types of plants, diameter, and height.

The structure of rubber agroforests resembles secondary forests so that ecologically agroforests provide a good hydrological function and can prevent erosion. The composition becomes protective in the upstream area as it can serve as a buffer of the litter layer on the soil surface through the leaves of rubber and other fallen trees and prevent the formation of ditches due to erosion. Agroforestry is a multifunctional system of the landscape that is as a source of income for farmers, protection of the surrounding soil and water (Young, 1989), protection of biodiversity, controlling carbon emissions, and maintaining the aesthetic value of the landscape (Hairiah et al., 2001; Nair 2012)

4. Conclusion

Agroforestry based rubber models encountered are three forms: Rubber-Gaharu-Durian model, Durian-Rubber model and Rubber-Gaharu model with agroforestry plant composition comprise looking for rubber-gaharu-durian mixture and other varied plants in each plot. The number of trees per ha of the model Rubber-gaharu-durian is 657 rubber, 214 gaharu, 15 durian and 20 other species. For Durian, rubber model is 316 rubber, 41 durians, another type 71 while the model of Rubber-new species of plant is 545 Rubber, 124 gaharu, and 8 other Type. The average diameter of rubber is 25,5 cm durian 46,5 cm and gaharu 6.6 cm. Standing stock model Rubber-gaharu-durian is 108,93 m^3/ha, model Rubber-durian is 81,35 /ha and Rubber –gaharu is 59,48 m^3/ha

5. Acknowledgments

Many thanks to Kementerian Riset dan Teknologi Pendidikan Tinggi Republic of Indonesia, which has funded this research activities under the Penelitian Produk Terapan(PPT) scheme “Models of agroforestry as climate change mitigation efforts in District XIII Koto Kampar, Kampar Regency, Riau”.

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