Copping Pattern in Agroforestry and Biodiversity in Sarolangun Area Jambi

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Abstract
The agroforestry pattern implemented has yielded very good results for the local village community. Local villages get economic resources as well as staples for their daily meals. This research finds out how to choose good plants for agroforestry and how the agroforestry planting pattern is in accordance with the tree planting scheme in the forest, starting from the bushes first and then the big trees. The method used is the observation method, namely the researcher will first observe the cropping pattern of the agroforestry found. The researcher will carry out the method of making a floor plan, namely, the researcher will create a floor plan to find out the layout of the planting of agroforestry plants. Then carry out a survey method to determine the types of plants and how to plant them on agroforestry land. The interview method was carried out to determine how farmers choose plant species, the factors underlying the selection of plant species, and how to plant them on agroforestry land.

Keywords: Agroforestry, Observation, Method of Planting, Tree Planting, Floor Plans

1. Introduction

Agroforestry is a cropping pattern that combines agriculture with forests. According to Brandt et al (2019) and Nguyen et al (2019), agroforestry combines agricultural crops and forest plants on the same land area. Not infrequently, agroforestry also includes raising livestock on the land. Thus, there are several types of plants in the same land.

People in Indonesia have long practiced agroforestry. It can be said that agroforestry has been born since humans switched traditions from hunting to farming. According to records, the use of land for farming has been known since 7000 BC which basically can be categorized as agroforestry. (BPDAS Pemali Jratun, 2010). The definition of agroforestry is a processing system offered to overcome problems arising from land use change to address food problems. in general, it includes mixed gardens, tree-lined fields, loading, fallow land (grove), yard gardens, and wider community plantation forests which are richer in species (Hadi, 2013). According to Hairiah, et al. 2003, the definition of agroforestry is a system of using land with the aim of maintaining or increasing total yields with the principle of sustainability by implementing a combination of food crops and tree crops on one plot of land which is carried out simultaneously or alternately by applying several management practices based on ecological, economic and social conditions and culture in the local area. Meanwhile, according to (Bidura, 2017). Agroforestry is a system of integrated land use for marginal areas by implementing farming or low investment based on biological and socio-economic factors. Agroforestry is a combination of forestry science and

agronomy, which combines forestry business with rural development to create harmony between agricultural intensification and forest preservation (Bene, 1977; King 1978; King, 1979).

Agroforestry itself is well known in Indonesia with various models and local names, such as "parak" in Maninjau, West Sumatra; "obviously" in Kerinci, Jambi; "repong damar" in the Krui area, Lampung; “tembawang” in West Kalimantan; “simpukng” and “garden” in East Kalimantan; "talun" or "sat" in West Java; "wono" and "kitren" in Central Java; “tenganan” in Bali and “amarasi” in the East Nusa Tenggara region (de Foresta et al. 2000; Sardjono et al. 2003).

Based on its composition, agroforestry can be divided into several types, namely agroforestry on dry land (agro silviculture), agroforestry (silvofishery), greenery for animal feed (silvopasture), beekeeping (apiculture), natural silk cultivation (sericulture), and medicinal plant cultivation under forest stands (wanafarma). (Rohadi D et al. 2013). Agroforestry provides many benefits apart from the forestry side, but can also be used for animal husbandry, agricultural development, plantations, fisheries, maritime affairs, and health.

Agroforestry systems also have a positive impact on conservation. This agroforestry system is proven to be able to maintain soil fertility, protect water catchment areas, contribute to efforts to sequester carbon and support efforts to conserve biodiversity. In addition, agroforestry can also benefit plants by increasing root density (root length density). In coffee plantations that were shaded with lamtoro and gamal, the RLD level was higher than in coffee grown without shade. This shows that the agroforestry system provides benefits to production plants. From an environmental point of view, agroforestry can prevent erosion, increase the amount of litter that can be decomposed into soil organic matter, improve soil structure and increase biodiversity and biodiversity balance. The diversity of plants cultivated between annual crops and agricultural crops allows for a longer food and energy chain. This condition will further support the creation of high biodiversity (biodiversity). In summary, (Sabarnurdin, 2004) mentions several environmental benefits that can be obtained from agroforestry systems.

- Reducing pressure on forests, so that the function of forest areas is not disturbed (water management, biodiversity etc.)
- More efficient in nutrient recycling through deep rooted trees in the location.
- Better protection of the upstream watershed ecological system
- Reducing runoff, nutrient leaching and soil erosion
- Improving the microclimate, reducing soil surface temperature, reducing evapotranspiration due to a combination of mulch from annuals and tree shading
- Increase soil nutrients and soil structure through continuous addition of organic matter decomposition processes

One of Indonesia's economic development strategies is through a populist economic approach which can be the key to national economic resilience in realizing equitable prosperity and welfare (Rusli, 2005). Agroforestry can be interpreted as an agent of community-based economic development. Law No. 41 of 1999 concerning Forestry states that forest management is sustainable and has good character.

There are several advantages of an agroforestry system. The first is maintaining soil fertility. Agroforestry reduces erosion. In addition, agroforestry can also maintain soil fertility. (Wangpapattanawong, et al, 2017). At this time, there is a tendency to increase agricultural intensification. Agricultural intensification, especially in the form of monoculture farming, can reduce biodiversity. The expansion of oil palm plantations is an example of monoculture farming which reduces biodiversity.

Since agroforestry combines agriculture and forest, agroforestry can reduce the damage to biodiversity due to monoculture farming. Even so, it is necessary to understand the community's importance of agroforestry and that agroforestry can be carried out on various types of agricultural land. One of the weaknesses of agroforestry is the lack of research in this area. According to Jacobson (2013), there is a lack of research on agroforestry in the United States. Therefore, it is necessary to carry out research on patterns of agroforestry land management.

2. Research Method

The research was conducted at Ujung Tanjung Village, Sarolangun District. This research start from February. Field data is taken in 4 stages, such as:

- Observation Method

  According to Abdurrahman Fatoni, the observation method (Observation) is a data collection technique that is carried out through an observation, accompanied by records of the state or behavior of the target object. In a broad sense, actual observation is not limited to direct or indirect observations.

- Methods of Making Plans

  The method of making plans is done to find out the types and locations of plants in agroforestry land.

- Survey Method

  The survey method was carried out to find out the types of plants and how to plant them on agroforestry land.

- Interview Method

  Methods Interviews were conducted to find out how farmers choose plant species, the factors that underlie the selection of plant species, and how to plant them on agroforestry land.

- Data collection

  The primary data was obtained from interviews and observations of agroforestry lands at that time.

3. Results and Discussions

General Location Description

Located near a lake that was originally a river. The research location is composed of vegetation which is dominated from the level of shrubs to tall trees. The varieties that grow are durian, duku, papaya, banana, coconut, jengkol, jackfruit, areca nut trees. There are also palawija and oil palm plants. Some plants grow alone, such as palm trees, teak and other wild trees. Seasonal crops such as rice.

Figure 1. Location 1

Located by the river. The observation was taken on February 12, 2023. Farmers planted tall rice and black sticky rice between banana trees. There are durian, duku, teak, sap, coconut and areca palm trees. There are also secondary crops and other wild plants. Furthermore, farmers increased banana trees and planted cassava.

Figure 2. Location 2

Farmers grow short grain rice. There are durian, duku, sap, coconut, banana and jackfruit trees on the border of the land. Some land is left for planting turmeric, secondary crops and cassava. Furthermore, the second observation was taken on February 7 2023, farmers replacing the land that has been planted with rice with honey papaya.

Figure 3. Location 3

The land is divided into several parts, namely for planting tall rice and partly for planting sweet potatoes. There are duku, jengkol, papaya, and coconut trees. There are tomato and cayenne plants. Furthermore, the second observation was taken on February 7 2023, farmers replaced the land planted with rice with honey papaya while the land planted with sweet potatoes was replaced with green bean plants. The rest is planted with cassava.

Figure 4. Location 4

Farmers cultivate honey papaya which is planted near the lake. There are several types of palawija plants. Furthermore, the second observation was taken on February 7, 2023; farmers added papaya plants with intercropping of red chilies, cayenne peppers, and eggplant.

Figure 5. Location 5

Farmers plant tall rice planted in the gaps between tall trees. The tall trees on the land are banana, duku, papaya, durian and coconut. There are also growing sweet potatoes. The second observation was taken on February 7 2023, farmers replaced crops with oil palm.

Reason Planting The Plant

Agroforestry systems can play an important role in the conservation of biodiversity within deforested, fragmented landscapes by providing habitats and resources for plant and animal species, maintaining landscape connectivity (and thereby facilitating movement of animals, seeds and pollen), making the landscape less harsh for forestdwelling species by reducing the frequency and intensity of fires, potentially decreasing edge effects on remaining forest fragments and

providing buffer zones to protected areas (Schroth et al., 2004). From this table we can know that from location 1-5 there are some same plants.

Table 1. Type of plant

LOCATION	1	2	3	4	5
PLANT TYPE	Rice, black sticky rice, coconut, papaya, cassava, duku, durian, areca nut, teak, porang, banana	Rice, coconut, papaya, cassava, duku, durian, banana, porang, sweet potato, corn, sap, turmeric, jengkol, jackfruit.	coconut, papaya, cassava, duku, durian, banana, porang, sweet potato, sap, turmeric, jengkol, tomato, katuk	Papaya, long beans, durian, bananas, cayenne pepper, turmeric, tomatoes, katuk, kale, green beans, pumpkin, Sweet potato, cassava	Rice, banana, sweet potato, duku, papaya, durian, coconut
INFORMATION	Rice is planted and sticky rice during the rainy season. Farmers plant tall rice and black sticky rice between banana trees	Rice is planted in the rainy season. Durian, duku, sap, coconut, banana and jackfruit trees are planted along the borders of the land.	The land is divided into several parts, namely for planting tall rice and partly for planting sweet potatoes.	Papaya is planted in land close to the lake. The rest of the land is planted with various crops.	Rice is planted between tall trees that are rarely spaced apart.
NEXT OBSERVATION	Rice is planted in the rainy season. After harvest, it is replaced by increasing banana	Rice is planted in the rainy season. After harvest, it is replaced by planting honey papaya.	Farmers replaced land planted with rice with honey papaya while land planted with sweet potatoes was replaced with green beans.	Farmers are increasing honey papaya plants and intercropping with red chilies, cayenne peppers and eggplant.	Rice is planted in the rainy season. After harvest, it is replaced by planting oil palm

In location 1, 2, and 5 we can see that there's rice plant that farmers use to pick. The farmers said that they choose that plants because they can eat the products and sold it either. The rice that they plant is in rainy season, while other plants such as duku, coconut, cassava, durian, areca nut, teak, porang, banana, sweet potato, corn, etc are planted after or in the same season with the rice plant. The farmers said it more efficient while you wait for the rice to make the income and have another plant to sell or eat. They use agroforesty to saves space too. According to some farmers, they won't use the monoculture type because they think it'll be inefficient and takes more time and also incure some losses. There are tall trees too in the farm the farmers choose not to cut it because they gives a fresh air to people around there and gives a a shady place to rest when finished farming.

The Similarity Between The Location

To have a similarity of some area we can use this formula :

Similarity Index Formula

IS = 2W/(A+B) x 100%

Information :

w = species present in the two locations

A = number of species in location A

B = number of species in location B

Criteria: 75%-100% (Very similar); 50%-74.9% (similar); 25%-49.9% (not similar); < 25% (very dissimilar).

Table 2. Type of plant in location 1 and 2

1	2
Rice, black sticky rice, **coconut, papaya, cassava, duku, durian**, areca nut, teak, **porang, banana**	**Rice, coconut, papaya, cassava, duku, durian, banana, porang**, sweet potato, corn, sap, turmeric, jengkol, jackfruit.

In this table we can see there's rice, coconut, papaya, cassava, duku, durian, banana, and porang which is same between land 1 and 2. As we can see here, we can use the formula and we have the index similarity between location 1 and 2 is about 64% similar, which means the location 1 and 2 is similar to the others.

Table 3. Type of plant in location 1 and 3

1	4
Rice, black sticky rice, coconut, **papaya, cassava,** duku, **durian**, areca nut, teak, porang, **banana**	**Papaya,** long beans, **durian**, **bananas**, cayenne pepper, turmeric, tomatoes, katuk, kale, green beans, pumpkin, Sweet potato, **cassava**
1	**3**
Rice, black sticky rice, **coconut, papaya, cassava, duku, durian**, areca nut, teak**, porang, banana**	**coconut, papaya, cassava, duku, durian, banana, porang**, sweet potato, sap, turmeric, jengkol, tomato, katuk

In this table we can see there'coconut, papaya, cassava, duku, durian, banana, and porang which is same between land 1 and 3. As we can see here, we can use the formula and we have the index similarity between location 1 and 3 is about 56% similar which means the location 1 and 3 is similar too like the result before.

Table 4. Type of plant location 1 and 4

According to this table, we can see the plant is not much similar. Just papaya, cassava, durian and banana. So, we can use index similiarity and have the result by 33% similar. In other word, they not similar to others.

Table 5. Type of plants location 1 and 5

1	5
Rice, black sticky rice, **coconut, papaya, cassava, duku, durian**, areca nut, teak, porang, **banana**	**Rice, banana**, sweet potato, **duku, papaya, durian, coconut**

As we can see to the table, almost all of the plants are similar. We can use the index of similarity and have the number that is 67% similar in other word they similar to other.

Table 6. Type of plants location 2 and 3

Location 2	Location 3
Rice, **coconut, papaya, cassava, duku, durian, banana, porang, sweet potato,** corn, **sap, turmeric, jengkol,** jackfruit.	**Coconut, papaya, cassava, duku, durian, banana, porang, sweet potato, sap, turmeric**, jengkol, tomato, katuk

There's coconut, papaya, cassava, duku, durian, banana, porang, sweet potato, sap, turmeric, and jengkol that same in location 2 and 3, according to this, the similarity will be 81% which mean this locations are very similar to others.

Table 7. Type of plants location 2 and 4

2	4
Rice, coconut, **papaya, cassava,** duku, **durian, banana**, porang, **sweet potato**, corn, sap, **turmeric**, jengkol, jackfruit.	**Papaya, long beans, durian, bananas, cayenne pepper, turmeric, tomatoes, katuk, kale, green beans, pumpkin, Sweet potato, cassava**

In this area just 42% similar to others because there's just few plants that are same which is just papaya, cassava, durian, banana, sweet potato, and turmeric.

Table 8. Type of plants in location 2 and 5

2	5
Rice, coconut, papaya, cassava, duku, durian, banana, porang, **sweet potato**, corn, sap, turmeric, jengkol, jackfruit.	**Rice, banana, sweet potato, duku, papaya, durian, coconut**

As we can see to the table, almost all of the plants are similar. We can use the index of similarity and have the number that is 72% similar in other word they very similar to other.

Table 9. Type of plants in location 3 and 4

3	4
Coconut, **papaya, cassava**, duku, **durian, banana**, porang, **sweet potato,** sap, t**urmeric**, jengkol, **tomato, katuk**	**Papaya**, long beans, **durian, bananas**, cayenne pepper, **turmeric, tomatoes, katuk**, kale, green beans, pumpkin, **Sweet potato, cassava**

According to this table, we can see the plant is not much similar. Just papaya, cassava, durian and banana. So, we can use index similiarity and have the result by 59% similar. In other word, they similar to others.

Table 10. Type of plants in location 3 and 5

3	4
Coconut, papaya, cassava, **duku**, **durian**, **banana**, porang, **sweet potato,** sap, turmeric, jengkol, tomato, katuk	**Rice, banana, sweet potato, duku, papaya, durian, coconut**

In this table we can see there’re coconut, papaya, duku, durian, banana, and sweet potato which is same between land 3 and 5. As we can see here, we can use the formula and we have the

index similarity between location 3 and 5 is about 63% similar which means the location 3 and 5 is similar too like the result before.

Table 11. Type of plants in location 4 and 5

3	4
Papaya, long beans, **durian, bananas**, cayenne pepper, turmeric, tomatoes, katuk, kale, green beans, pumpkin, **Sweet potato,** cassava	Rice, **banana, sweet potato**, duku, **papaya, durian,** coconut

There's just few plants in location 4 that similar with location 5. In other words, the similarity between location 4 and 5 just 40% or its not similar between location 4 and 5.

4. Conclusions

As we can see here, there's much similarity between one location to another location. In here we can conclude that the farmers in Jambi or Sarolangun district mostly like to plant papaya, coconut, sweet potato, banana, durian, duku and rice in their area. They pick this plant is because is more easy to plant and more easy to take the products to sell and to eat. And if there's any tall tree they won't cut it because it usefull to the farmers. But according to this data, there's not much biodiversity that we can see, because one farmers to another use to planting the same plant on their farm lands. It brings up to 30% of similarity from one to the another sites.

Agroforestry creates consensus for both biodiversity and people. These provide critical habitat for biodiversity, ecologically sustainable buffer zones in protected areas, high quality matrices that facilitate movement between forest fragments, and ecosystem services such as pest control, pollination, and erosion control. Additionally, agroforestry provides an important source of income for local residents. It is also possible to see agriculture as a diverse system, an extension of natural habitats that can be controlled to enhance our needs.

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