Multipurpose Trees Species-Based Agroforestry at Ogan Komering Ulu Selatan, South Sumatera

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Abstract. The practice of land cultivation with different plant species in the same land unit, known as agroforestry, has long been practiced by local communities in South Sumatra, including Ogan Komering Ulu Selatan. Coffee as the main crop is mixed with various multipurpose trees (MPTS) such as timber, fruit, animal feed and other products that have economic value and are used to meet livelihood needs. This practice provides a kind of safety net and a source of income for farmers destined for land optimization. The purpose of this paper is to highlight the role of multipurpose tree species in land management practices that are beneficial to farmers and the environment. Our preliminary results show that farmers in agroforestry have not practiced good land and crop management by selecting the type and number of MPTS plants planted considering the main crops grown. Farmers only see the empty space between plants or they do it without planning by using makeshift seeds, so the results are not optimal. Farmers only see the empty space between plants or do it without planning using makeshift seeds, so the results are not optimal. Capacity building and knowledge enhancement, as well as policy support, are needed to make MPTS-based agroforestry accessible to smallholder farmers.

Keyword: Multipurpose Trees, Species Based, Agroforestry, Ogan Komering Ulu

1. Introduction

Food production systems focused on production intensification usually lead to forest and land degradation and deforestation, thus impacting ecosystems and the environment [1],[2],[3] . Climate change, the spread of disease, poverty, and other ecological disasters are the result of the current production system. For this reason, a sustainable production system that does not cause a global environmental crisis by balancing social and economic ecological functions is needed. On the other hand, traditional communities in some places have their own way of meeting their daily needs while preserving the environment and biodiversity. They develop a production system based on the skills of individuals and families, still influenced by their culture and beliefs. They adhere to land use patterns that produce different products at different times to ensure food security for families. For this reason, it is necessary to understand that farmers

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grow different types of crops and maintain a family's source of income as part of a living culture that has been passed down from generation to generation.

Coffee is one of Indonesia's most important commodities and earns the country foreign exchange. The value of Indonesia's coffee exports was $883.12 million in 2019 [4]. The coffee cultivation area in Indonesia is 1,250,452 hectares, of which 20.65% is in South Sumatra province. In 2020, the coffee production of South Sumatra province reached 198,945 tons, making South Sumatra province one of the largest coffee producers in Indonesia [5]. Coffee productivity in South Sumatra reaches 903 kg per year. However, due to the influence of climate change, coffee productivity has decreased by more than 70% [6]. The coffee plants grown by the community are traditionally grown in an agroforestry pattern with multipurpose plants as shelter crops, both native woody plants such as bambang lanang, legumes, and fruit-bearing plants such as durian, jengkol, petai, avocado, and so on.

Different agroforestry and cropping patterns can support sustainable development goals [7]. Agroforestry as a contribution to rehabilitating degraded lands [8], reducing the impacts of climate change [9], contributing to food security and household nutrition [10], and increasing faunal biodiversity [11]. Farmers' livelihood strategies include migration, off-farm work, and diversification of plantation products [12]. However, the emphasis in the adoption and application of agroforestry practices in the community is on the economic factor compared to other factors such as environment/ecology [13]. The purpose of this paper is to examine the traditional agroforestry practices that exist among the people of South Sumatra, particularly those based on fruit and multipurpose crops, and the factors that may promote the success of land and forest rehabilitation activities using agroforestry patterns.

2. Research Methods

2.1 Research Location

This research was conducted in Ogan Komering Ulu Selatan (OKUS) Regency in four villages in Buay Sandang Aji Subdistrict

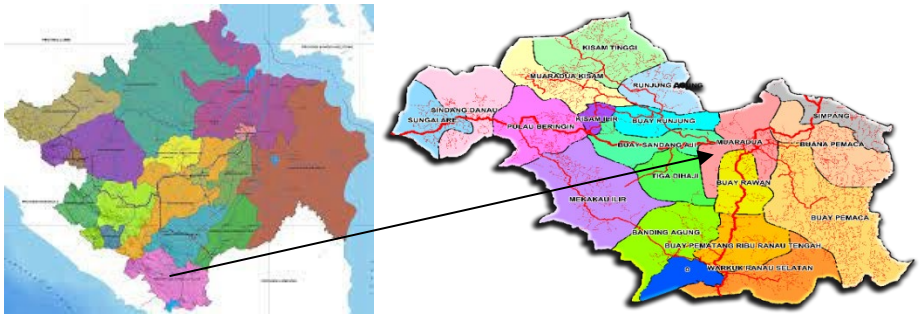

Figure 1. Research location

2.2 Data Collection and Analysis

The data used in this study are primary data and secondary data. Primary data were collected through field observations, household surveys, and in-depth interviews with households in four

villages in Buay Sendang Aji Subdistrict. The number of respondents selected was 70. Secondary data were obtained from BPS, reports and publications. In addition, data were analyzed descriptively and qualitatively to examine the choice of species of multipurpose trees and fruit trees in coffee agroforestry, the characteristics of farmers, and the constraining factors for agroforestry farmers in Ogan Komering Ulu Selatan Regency in South Sumatra Province.

3. Results and Discussion

3.1 Agroforestry traditional in South Sumatra

Traditional land use systems generally have high spatial and temporal plant diversity [14]. Cultivation of a variety of different crops attempts to improve the food situation and food security of farm households [15] and support the functionality of the entire production system [16]. Agroforestry, as an efficient use of crops to cope with diverse and often adverse conditions, is one form of strategy to minimize risk to farmers in order to ensure food production [17]; [18]. However, the current trend is for many farmers to abandon this farming method and focus on commercial forms of land use or a single crop type.

In South Sumatra, there are several land use patterns that have been managed by the community traditionally or for generations. One of them is coffee agroforestry based on multipurpose crops, especially fruit trees, in different ecosystem landscapes. The coffee plants serve as staple food and annual income for the community, while the fruit plants act as protective plants and provide additional income for the farmers. Protective plants used by farmers vary according to community preferences and socio-cultural conditions. Protective plants are used to reduce the intensity of light penetration on the land to maintain the microclimate. Protective trees are also used to increase soil fertility by planting crops that increase free nitrogen content, such as legumes.

Coffee cultivation with legumes is traditionally practiced by coffee farmers and maintained in some places in coffee growing centers of South Sumatra Province such as Muara Enim Regency, Lahat Regency, Empat Lawang Regency, Pagar Alam Town, and Ogan Komering Ulu Regency. Coffee farmers use species such as Gamal (*Gliricidia sepium*), Dadap (*Erythrina subumbrans*), Lamtoro (*Leucaena leucocephala*), Sengon (*Albizzia sp*) and so on as shade plants. In some locations, native trees such as Bambang Lanang (*Magnolia champaca*) are also used as shade plants.

The number, location, and spacing of cover crops vary and are different for each country because each farmer has different preferences regarding the benefits and use of cover crops. Farmers adhere to the use of cover crops for coffee plants because they do not affect the productivity of the coffee and some effort must be made to reduce costs when chemical fertilizers are used. The results of pruning are used as mulch on coffee plants. Legumes have rapid growth and easy propagation by cuttings, a lot of biomass, so they can be used as firewood, and the brew can be used as animal feed.

Trees are not only useful as shade plants, but also influence coffee growth and yields, as well as coffee quality [19]; [20]. On the other hand, shade plants and coffee plants compete for nutrients and light, so it is necessary to regulate spacing between plants, select shade plants, and prune plants [21]; [22]; [23]. The type of shade plant, i.e., legume or nitrogen-fixing tree, also improves soil fertility. Shade plant litter and pruners waste around coffee plants increase fertility and activity of microorganisms that are good for plants [24]. Soil fertility affects the quality and quantity of coffee cherries produced [25].

The communities also plant fruit trees to provide shade for the coffee plants, as a source of food, and also as garden markers. However, the number of trees is small and the location is not regulated. Fruit trees such as durian, avocado, jackfruit, petai, and jengkol were selected because they can provide supplemental income in addition to coffee and also do not interfere when there are not many of them (Table 1). Fruit crops have a higher economic value than other shade crops, often serving as savings for farmers. Fruit trees in coffee plantations such as duku and durian are more than 20-year-old plants planted by their parents, so their productivity has been reduced by the influence of climate change and pests and diseases. The rejuvenation of the plants was also carried out by searching for seeds of plantlets that are close to the mother plant by selecting the best fathers. Avocado, petai, jengkol and jackfruit are plants that are deliberately planted because they have good economic value and are in high demand.

Table 1. Priority fruit trees planted in the land

Ranking	Fruit tree	Latin name	Harvest time	Reason to plant
1	Durian	*Durio sp*	Once a year	Stable price and income the sale of crops can be as saving
2	Duku	*Lansium domesticum*	Once a year	Plants passed down from parents and the annual yield is quite a lot
3	Alvocado	*Alvocado sp*	2-3 times a year	Suitable for planting in this area and the production is good
4	Jack fruit	*Arthocarpus sp*	Almost all year around	The harvest is many times a year and the price is quite high
5	Petai	*Parkia sp*	Almost all year around	Easy to sell and the demand is quite a lot
6	Jengkol	*Archidendron sp*	Almost all year around	Demand a lot and the price is quite high

3.2 Respondent characteristics

The main source of income for the people of South Ogan Komering Ulu is coffee, along with other commodities such as rubber, palm oil, pepper, cocoa, coconut, sugar palm, and cloves (Figure 3). With an average productivity of 900 kg of coffee per year and a coffee price of about Rp. 20,000 per kilogram in the local market, farmers' income is estimated at about Rp. 18,000,000 per year.

From the research results, the average respondent is 40 years old and the majority has an elementary school degree. With an average monthly income from plantation products of about Rp. 1,653,952, this result is still below the minimum wage of OKUS Regency of Rp. 3,144,446 (in 2022). To meet their livelihood needs, the community is looking for other sources of income with wage labor as farm workers or other informal work outside the village.

Some farmers believe that diversifying their income from coffee is a long-term and risky endeavor, which is why many are still hesitant to plant other cover crops. In addition, market information about products other than coffee is still not well received by farmers, especially

when they can produce in large quantities. Extension agents and NGOs need to educate farmers about the business prospects of products other than coffee so that they can encourage farmers to diversify their products in coffee plantations.

Coffee gardens that are close to the house and easily accessible by foot or vehicle tend to have more protective plants, including more fruit producers, than gardens that are far from the house and more difficult to reach. Amare et al [26] found that the number or density of tree plants tended to be higher when they were close to home.

Table 2. Responden characteristics

Respondent characteristics	Criteria	Mean	Minimal	Maximal
Age	Year	40,30	19	70
Education	Elementary school	50		
	Junior high School	11		
	Senior high School	8		
	Bachelor	1		
Jobs	Farmer	69		
	Civil government	1		
Number of family		4,17	2	6
Number of family working		2,06	1	4
Income per month		1.653.952	533.333	5.304.167
Expence per month		1.129.855	400.000	2.920.000
Coffee area		1,65	0,3	8
Number of fruit trees per household (per Ha)		17	4	50

Source: Primary Data

3.3 Factors influencing farmers to plant fruit trees

Different farmers' knowledge, skills, and risk perceptions result in each farmer managing his land/garden differently. In addition, according to [27], it is very important to understand farmers' preferences for certain species with different uses and suitability for different locations, as this will determine the optimal combination and good management options for farmers.

Communities that have just established coffee plantations also plant other annual crops such as jackfruit, cloves, cinnamon, and seasonal crops such as bananas, eggplants, peanuts, and chilies that are used for household needs or given to relatives and neighbors. When the harvest is abundant, some of it is sold to increase household expenses. Planting mixed crops in coffee plantations usually depends on the availability of the farmers' own seed and support from government programs. When selecting mixed crops, preference is usually given to local varieties that have already been tested and are commonly found near other coffee plantations or in nearby forests. For new varieties, coffee farmers usually pay attention to plant growth and its effects on coffee plants first. The reason is that it would be risky for coffee farmers to reduce their income from coffee cultivation. The introduction of new varieties is done by farmers with large land and good profitability. Also [28] states that poor people prioritize food security rather than introducing something new that costs their time and energy and is different from that of rich people.

Planting by coffee growers often takes into account only the available free space in the garden, unlike coffee plants whose planting is planned from the beginning. The spacing between

coffee plants is generally 1.5-2 m x 1.5-2 m, resulting in 2500-4400 plants in a garden area. Timber plantations are planted between or within the boundaries of coffee plantations, while fruit trees are planted near huts or between coffee plants. Coffee farmers' knowledge of agroforestry is still limited, relying only on knowledge passed down from generation to generation or seeing the practices of others. From [29], farmers' perceptions based on local farmers' knowledge affect the management of the garden, including the choice of species, spacing, and soil and light conditions that affect the plants.

Coffee farmers tend to choose "safety first" despite low coffee yields in recent years because fluctuating yields pose a greater risk, especially since there is no real prospect of success. Farmers believe that increasing the number of plants on a limited area risks reducing coffee yields. This is confirmed by Salazar-Diaz and Tixier [30] in that plant diversity affects income, but depends on the type and composition of productive plants, as it is related to light and nutrient competition between plants. In addition, according to [31], household and land factors such as extension services, promotion of farmer groups, knowledge of regulations, species selection, number of plots, and higher on-farm and off-farm income influence the adoption decision process.

The availability of seed for fruit trees, farmers' low incomes that prevent them from buying high-quality seed for fruit trees, and planting distances that are too narrow are factors that discourage farmers from planting more fruit trees and other multipurpose trees, which increases the time required for plant maintenance and also increases concerns about lower coffee production (Figure 4). Land availability and poor growth when the number of plants on an area is large. Farmers have observed and studied in their own way to identify the right composition of agroforestry they use.

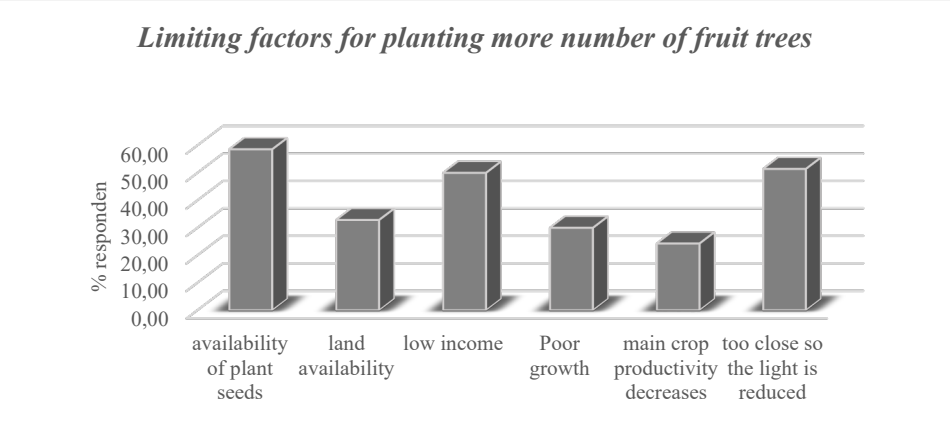

Figure 2. limiting factor for planting more number of tree

4. Conclusion

Access to assets (land ownership) may encourage or constrain coffee farmers to develop additional sources of income. Coffee is the main source of income for farmers because it is considered a more sustainable source of income and is resilient to several technical and non-technical factors of change. First, land availability is important for diversifying rural livelihoods. Narrow land tenure limits coffee farmers' ability to diversify the products on their land. Second, education, household size and composition are important determinants of diversification.

Educational attainment, the number of family members, and the number of family members who can work are related to the availability of labor in the household, which affects the allocation of human resources. A good level of education will encourage the allocation of labor to non-farm work. Third, changes in land use or cropping mix often involve investment (financial resources), which may be a constraint for resource-poor farmers, especially if access to financial capital is limited. In addition, farmers may be reluctant to take financial risks and pursue diversification if market access is uncertain or there is a lack of technical assistance to support new activities. Land tenure, household size and composition, income sources, and coffee production volume as constraining and/or facilitating factors/conditions for livelihood diversification

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