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Tree-crop diversification by smallholder farmers in Southern Sumatra to diversify sources of income

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Abstract. Tree crop diversification becomes a common component of farmers strategies to diversify their sources of income, to deal with price fluctuation and also to adapt to a changing environment. This study examined farmers activity in tree-crop diversification and factors that encourage rural households in tree planting. A combination of household interviews and participatory field surveys was conducted to collect primary data. Data was analyzed descriptively and quantitatively. The results show that farmers mainly engaged in planting trees with agroforestry system, even there were also some people who develop trees with monocultures system. The tree species most developed in the research area are *Magnolia champaca*, *Azadirachta excelsa*, and *Anthocephalus cadamba*. The diversification decisions of communities depends on age, education level, the number of family members, expenses, and assets. Farmers who have wider landholdings and relatively have high incomes will be more interested in doing tree crop diversification on their land. Of the households surveyed, the respondents have the main job as a farmer in which the average age was 50 years old and the majority had education level up to elementary school and junior high school. The average expense of the respondents was 1.437 million rupiah per month in which the average of land holding is 2.68 hectares. In southern Sumatra, farmers try to mix some tree-crop in their land in order to increase their income, to get cash income in different time (maintaining food security), and reduce some risks because the changes of environment, market and policy. Therefore, this practice can provide economic resilience for farm households.

Keywords: Farmers, source of income, Southern Sumatra, tree-crop diversification

1. Introduction

The practice of land use with various types of plants on land owned by farmers has long been carried out by farm households in the Southern Sumatra region such as in Bengkulu and South Sumatra. This practice provides a variety of products that can sustain the livelihoods of farmer households to be more resilient to economic and environmental changes, especially for the poor [1] and provide increasing value over time, but to meet the requirements of market needs in terms of quantity and quality will be not easy to achieve [2]. This practice is also better than the practice of planting with one type of plant/monoculture or specialized agriculture, because specialized agricultural practices are very easily affected by the market and trade-offs often occur between economic functions and ecological functions [3]. The practice of planting by relying on one type of plants, is determined



by the choice of farmers, besides that it is also influenced by various motivating actors, including stakeholders such as large companies, international investors and policy makers. [3].

The main crops on community land area are generally commodities that have economic value such as rubber, chocolate, coffee, palm oil and also other food-producing crops trees. Commercial commodities will be more market-oriented so that the price of the commodity will depend on the demand and supply for those commodity. On the other hand, the commodities cultivated by farmers on their own land are very vulnerable due to changes in prices, pests and diseases attack and also a decrease in harvest due to climate change. For this reason, diversification of various crops in private land is a strategy that carried out by farmers. [4], revealed that diversification of a variety of plants or agroforestry system is an effort for food security and mitigation of climate change by farmers.

For most farmers, commodities which are annual crops are used as a source of cash income to fulfil their daily needs. In addition, farmers also plant timber-producing trees to meet long-term needs that are used as investments or savings for farmer households. Their decision to apply this pattern/model is a strategy to meet their life needs or adaptation efforts of farmer households from uncertainty. In reality on the field, variations in socio-economic and ecological conditions will influence decision making by the community [5]. This study aims to determine the practice of land use by the community and factors that affect farmers' households in land use with a variety of crops including planting trees.

2. Research Method

This research was conducted in 3 locations in the Southern Sumatra region where the community practices land use with various types of plants with annual crops and wood-working plants. The combination of household surveys, interviews and participatory field observations is carried out to collect primary data and deepen the information that has been obtained. Secondary data is obtained from literature studies and BPS (Central Agency on Statistic of Indonesia) data collection. To answer the research objectives, the data were analysed quantitatively and descriptively.

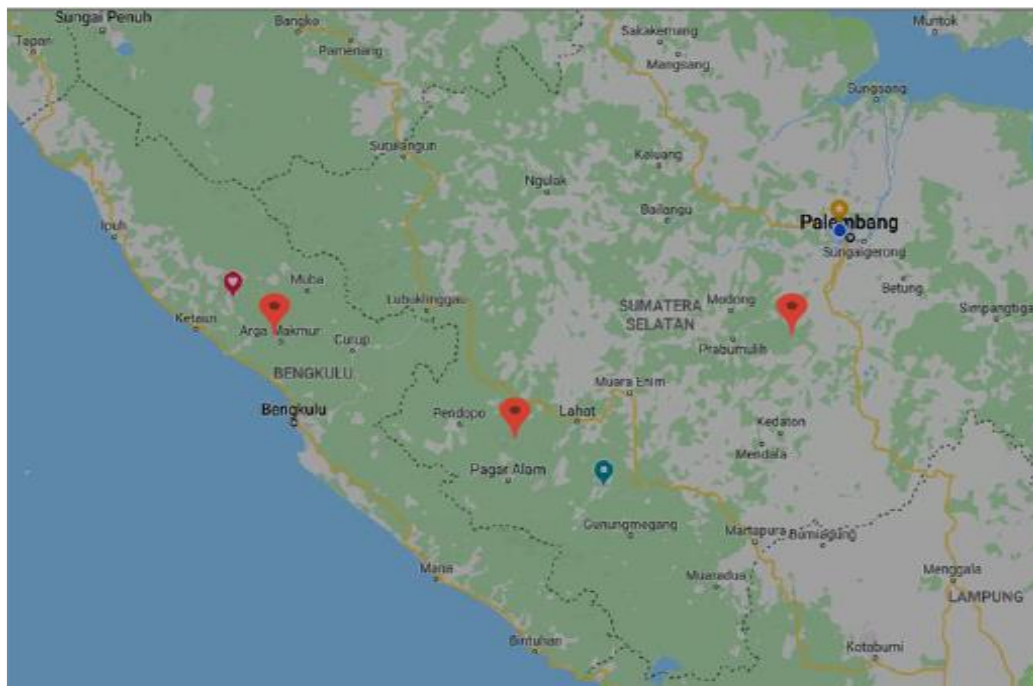


Figure 1. Research location

Source: <https://www.google.com/maps>

3. Results and Discussion

3.1. Cultivation practices and various commodities as the main component of the land

Land farmers is a limited resource and asset so it must be used optimally. Therefore, it can increase income and reduce expenditures that will be fulfilled from the plant production from land. The practice of land use with various types of plants including annual crops and wood-based crops that are mixed by using agroforestry system has provided many benefits for farmer households and the environment. Only a few households use their land with one type of crop, which is partly due to limited workforce.

Annual crops which are the main component of land are generally commodities that have economic and commercial value such as coffee, rubber, oil palm, fruit plants and other crops. These commodities are very vulnerable to changes in prices and yields that are influenced by markets, policies and climate. However, when the price of one type of annual crop falls, the landowner farmer cannot immediately replace this plant with another plant [6].

Timber-producing plants grown by farmers in each landscape will differ depending on biophysical conditions (soil conditions, climate and altitude). Timber-producing plants that are planted are local types that have been hereditary/culture for a long time and are considered to be the most suitable for growing. Planting activities are carried out independently by farmers and also encouraged by the government through reforestation and forest and land rehabilitation programs.

Local wood species of *Azadirachta excelsa* are planted by farmers in lowland areas in North and Central Bengkulu Regencies, Bengkulu Province [7] (Figure 2 and 3). This plant has good quality of wood, is widely used for woodworking, for the household needs and also for sale. Furthermore, another species is *Magnolia champaca* that are cultivated by farmers in the highlands such as in Lahat, Empat lawang and some areas in Pagaralam Regencies (Figure 4). The spread of this species was very wide in almost all regions of South Sumatra. This type is very good for woodworking because it has a strong class and durable class number II [8]. Technical planting of these types of plants can be done with a mixed pattern because it has a relatively light canopy, self pruning, and relatively fast growth.



Figure 2. Agroforestry of *Azadirachta excelsa* and Cacao



Figure 3. Agroforestry of *Azadirachta excelsa* and Agricultural crops

In addition to *Azadirachta excelsa* and *Magnolia champaca*, other short-cycled plants namely *Anthocephalus cadamba*, was widely distributed naturally and planted on farmers' land that has slightly wetter land conditions such as in Ogan Komering Ilir and Ogan Ilir Regencies. This plant has a cycle of 5-6 years with a volume per tree approximately 0.38 m³. *Anthocephalus cadamba* wood is used for building materials and other uses. The growth of this plant will be good if it is planted on the land as a boundary crop and is very suitable to grow on land that tends to be wet (Figure 5). *Anthocephalus cadamba* can also be cultivated in a monoculture system.



Figure 4. Agroforestry of *Magnolia, champaca*, coffee and coconut tree



Figure 5. Agroforestry of *Anthocephalus cadamba* and bananas

Planting activities of various types of plants carried out by the farming community are mostly carried out not by planning and prior arrangement. Farming activities are carried out spontaneously, only based on experience, seeing other people and the experience of past people by seeing the availability of empty space in the land. Arrangement of plant spacing is carried out on commercial annual crops. Plants that produce wood are planted on the edge of the land as land boundaries and between land that is still empty and are considered not disturbing the main crops. Farmers also have not implemented good farming practices in fertilization, pest and disease control and spacing so that the results obtained are less than optimal. This condition is adjusted to their own experience and knowledge.

The household's decision to plant various types of crops in one cultivated land is usually with consideration to diversify the yields, which is a household strategy to deal with uncertainty and to fulfil life's needs. Plant diversity can be an option to adapt to the changes that might occur. The diversity of types of plants on the land for farmers is intended to get more income from the annual crops and timber crops. Timber products can provide a proportion of income around 34.82% of the total income generated from farming activity.

3.2. Farmers Characteristics

For farmers with limited capital, knowledge, labor and resources, land becomes an important production factor that is their source of livelihood. Land as a source of food, building materials and energy that is always available to farmer households. The results from the land can reduce household

expenses because some of the results can be consumed directly such as firewood, seasonal crops such as vegetables, and fruit trees. Due to limited land ownership, farmers will cultivate land with the aim of meeting their living needs and trying to increase the income from the land they are working on. In their research, [9] explained that planting with various types of crops or agroforestry can be an economically efficient diversification strategy, but only if the design allows for economic scope, there were beneficial interactions between trees and crops and also had higher income.

Socio economic conditions and farmer characteristics are factors that will encourage farmers to apply various types of planting patterns in addition to other driving factors that come from outside such as markets and policies. Job characteristics, age, education, number of family members, number of family members who work, level of expenditure and assets affect the decision of farmers to diversify crop types and yields. According to [10], These individual characteristics will also affect the knowledge and behavior of the community in sustainable development activity so that it can ultimately improve the standard of living and welfare of the community. Furthermore, [11], revealed that understanding of the socio-economic characteristics of farmer households plays an important role in the successful implementation of policies relating to the diversification of production from various types of crops on land.

In the case of Southern Sumatra, the characteristics of farmers who grow various types of crops on land that is based on timber-producing plants varied widely from work, education, age, household expenses, number of family members, number of family members who can work, distance of house to garden and the extent of land ownership (Figure 6,7 and 8). The main work of the head of the household that practices planting with various types of plants is farmers that was as much as 84.44%, because they have a dependency on productivity from their managed land. The yield from the land is the main source of income. In contrast to landowners who have a main job other than farmers, they have other sources of income that are the source of livelihood and their existing workforce has been devoted to off-farm activities. Farmers who rely heavily on yields from the production of the land are very vulnerable to the ups and downs of the prices of the commodities being cultivated.

Farmer education is mostly elementary school and junior high school level (Figure 6). Education can influence the ease of acceptance of something new in the adoption process and the level of knowledge of farmers regarding cultivation techniques[12]. Revealed that farmers with low education level will also adopt various types of plants on their land to meet the needs of life and maintain their social status. On the other hand, [13], explained that the level of education and training will affect the management and practice of cultivation by farmers so that farmers tend to have mature calculations in decision making, more likely to avoid risk, especially those related to the adoption process. Planting practices with agroforestry system were carried out by farmers with an average age of 47.96 years because of their experience that this practice is considered to provide more security for households (Figure 8). Meanwhile, [14] stated that young farmers tend to take risks to try different planting patterns even though the experience that they have in cultivation is still inferior to farmers of old age.

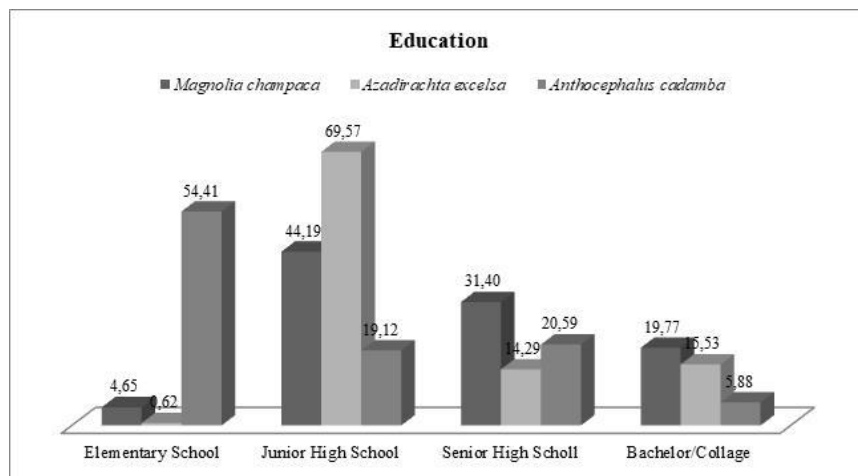


Figure 6. Farmers Education

The level of expenditure by farmers of *Azadirachta excelsa*, *Magnolia champaca*, dan *Anthocephalus cadamba* is relatively similar that was around 359 thousand rupiahs per week or 1.437 million rupiahs per month (Figure 7). This expenditure is generally for food needs, and children's school fees.

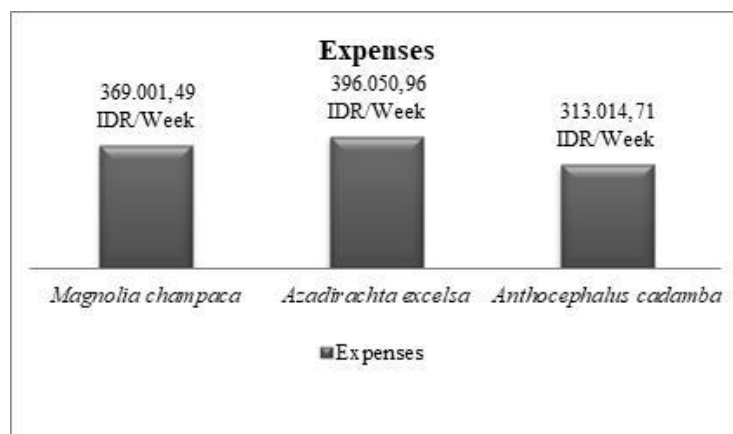


Figure 7. Farmer Expenses

Figure 8 explained that the average land holding by the community was 2.68 Ha and the distance between the settlement and their land was 2.28 km. The wider the land owned by farmers, the greater their chances for planting various types of plants. In addition, the average age of the farmers who plant timber was 50 years old. At this age farmers already have good considerations to choose the types of plants that are considered beneficial based on their experiences and needs.

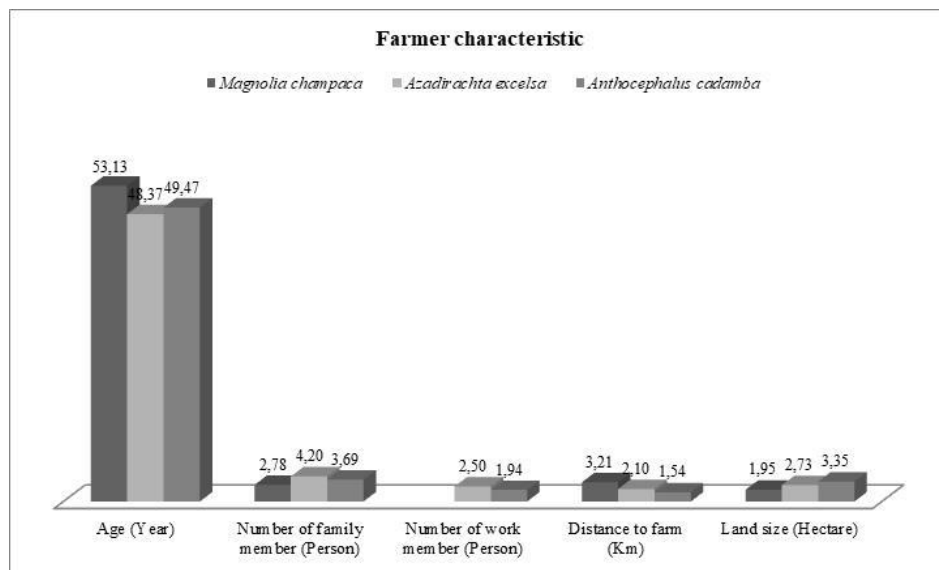


Figure 8. Farmer characteristics

4. Conclusion and Recommendation

Economic resilience of households in farming communities in Southern Sumatra is done by varying the yield of the land with some types of plants. This behavior is aimed to meet the needs and increase the earnings for households. Timber trees are an important component in farmer's land that contributes to income. Land can be a source of food, a source of building materials and also fuel that is always available for the households. This behavior is an attempt to reduce household expenses. Age, education level, the number of family members, expenses, and assets, affect the decision of farmers to diversify products from their land. Barriers that are often faced by farmers who plant various types of crops to meet their needs were the management of land that has not been planned properly. Planning for harvesting yields, especially for timber-producing trees, has not been done so that the results are not optimal. The advantages in the practice of planting with diverse types of crops were low input and effective use of labor so that the costs of farming are low. We suggest that farmer knowledge regarding cultivation system should be increase and their access to high qualify planting material is also facilitated

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