



Review of Sustainable Land Management Model Practices by Agroforestry-Based Communities

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Abstract. Agroforestry is a land management scheme that becomes a middle ground between improving production functions and ecological functions of agricultural-based land resource management. However, there are still some pros and cons related to agricultural resource-based land management. This research aims to analyze sustainable land management models by agroforestry-based communities. The data used in this study is primary data and secondary data. Primary data is data collected directly from smallholders who practice agroforestry-based agriculture and a group of smallholders who do not practice agroforestry. At the same time, secondary data is data obtained from relevant sources such as research results, related agencies. To determine the contribution and trade-off of each production function, socio-economic function, and ecological function on agroforestry-based land management models used income analysis. The analysis results showed seven agroforestry business patterns that smallholders strive for. The most contributing income is pattern III, namely agroforestry business of oil palm, rubber, pond, and horticultural. The most income is an average monthly income of IDR. 25,639,363- The findings of this enrichment pattern will provide conflict resolution in many lands and forest areas that experience sustainable community participation with palm oil. In addition, the findings of this study are also useful for smallholders oil palm plantations to get a multiplier effect from the field of land business in the form of short-term crops and long-term crops.

Keywords: Agroforestry · Land Management · Sustainable Land Management

1 Introduction

Land-use changes into agricultural businesses, plantations, and industrial plantations resulted in decreased ecosystem function and loss of tropical forest species diversity [1, 2]. For example, changes in tropical forest ecosystems into oil palm plantations result in decreased ecosystem functions. It includes carbon storage capabilities, abiotic stability; Diversity of type, and naturalness (naturalness).

Cultivated crops have provided a source of livelihood and community welfare characterized by an increased expenditure of consumption, household income, and nutrition [3–7]. In addition, plantation cultivation crops, especially oil palm, are a major commodity in national economic development [8].

Synchronization of production functions and ecological functions in the management of agricultural-based land resources has been widely carried out by the community [9–11]. For example, [12] reported that the community integrates palm oil plants with other crops to increase the diversity of income sources and increase family economic resilience. Further, [12, 13] report that agroforestry is one of the land management schemes that can be a middle ground between improving production functions and ecological functions of agricultural-based land resource management. Meanwhile, the results of other studies also show that agroforestry patterns can be a middle ground for sustainable agricultural-based land management.

The Center for Excellence in Higher Education Science (PUIPT) Biodiversity and Biodiversity and Landuse Transformation System (BLasTS) was established at Jambi University with the main mandate of formulating a middle ground and reconciliation between maintaining the ecological function of an ecosystem and increasing production from land resource management and contributing to the social functioning of the community. This establishment is determined based on the Decree of the Rector of Jambi University No.1263 of 2018. PUIPT BLasTS has compiled a roadmap for the development of PUIPT both from institutional, research, work, and dissemination aspects. The Research Study of Practice and Development Of Sustainable Land Management Model Test by Agroforestry-Based Communities not only describes agroforestry-based land management practices but will also sustainably test agroforestry-based land models. This study analyzes sustainable land management models by agroforestry-based communities based on the above description.

2 Research Methods

The research was conducted in the Ladang Ladang Peris area in Batanghari Regency, Jambi Province. The data used in this study is primary data and secondary data. Primary data is data collected directly from smallholders who practice agroforestry-based agriculture and a group of smallholders who do not practice agroforestry. At the same time, secondary data is data obtained from relevant sources such as research results, related agencies. The observational variable in this study is the practice of agroforestry-based land management techniques covering crop types, agroforestry patterns, and economic aspects.

The data collection method is obtained through direct observation for primary data by planning observations and knowing the research object directly in the field. The objective is to discover what will be studied and use direct interview techniques on research objects by asking researchers questions. While secondary data through literature studies (desk study) and scientific research results of previous research related to research topics, document searches, and reports from related agencies.

The data analysis methods used in this study are qualitative descriptive analysis and quantitative analysis. First, the research is explained descriptively, mapping the economic potential in commodity diversity in the Ladang Peris area of Bajubang District of

Batanghari Regency. Furthermore, economic analysis analyzes the economic conditions of smallholders who initiate agroforestry-based agriculture using income analysis.

The income analysis of the value of agroforestry smallholders at the research site is calculated utilizing receipts minus the total cost. The difference between production (receipts) and costs incurred is agricultural income. Mathematically writeable [14]:

$$TC = FC + VC \quad (1)$$

Description:

TC = Total Cost of Palm Oil Farming (IDR/Year)

FC = Fixed Costs (equipment costs and equipment depreciation) (IDR/Year)

VC = No Fixed Costs (fertilization costs, medicines, and labor) (IDR/Year)

$$Prt = P_{on-farm} + P_{off-farm} + P_{non-farm} \quad (2)$$

Description:

Prt = Farmer's Income Per Year (IDR/Year)

$P_{on-farm}$ = Income from agroforestry farming (IDR/Year)

$P_{off-farm}$ = Income from Outside agroforestry farming (IDR/Year)

$P_{non-farm}$ = Income from Outside Agriculture (IDR/Year).

3 Results and Discussions

Agroforestry income is the acceptance of agricultural cultivation obtained by smallholders after deducting the costs of farming that need to be done by smallholders. It happens during the farming process when the crop has not been produced. The revenue of smallholders from smallholders is obtained from the sale of agricultural crop products cultivated by smallholders. While the cost of farming is the cost needed by smallholders to care for crops so that the farmed plants can produce as they should.

1. Agroforestry Acceptance

Agroforestry smallholders' acceptance is several costs that smallholders receive after selling the agricultural products that are cultivated. Sample smallholders in the research area farmed several farm crops that smallholders worked on. To find out how the acceptance received by smallholders can be considered in Table 1.

Table 1 shows the annual acceptance of smallholders in the research area based on each crop cultivated. The plants that contribute the most to smallholders' receipts are rubber, agarwood, and *dog fruit* plants. Each receipt, namely rubber amounting to IDR. 70,748,122, agarwood amounting to IDR. 35,999,640, and *dog fruit* of IDR. 18,000,000.

2. Agroforestry Farm Costs

Agricultural costs are costs incurred for production processes that aim to increase production output in a given period. In this study, the production costs incurred by smallholders within one year. Cultivation costs are, namely fixed costs and variable costs.

According to [14], fixed costs are relatively fixed costs that continue to be incurred even though production is obtained much or little. This fixed cost does not depend on

Table 1. Farmer's Acceptance of Each Crop Per Year in The Research Area in 2021

No	Types of Farming	Number of smallholders	Hasil Produksi (Kg/Ha/Tahun)	Total Receipts (IDR/Year)	Per farmer's Acceptance (IDR/Year)
1	Oil palm	16	107.244	245.021.400	15.313.838
2	Rubber	17	100.944	1.202.718.071	70.748.122
3	Papaya	1	1.440	2.880.000	2.880.000
4	Rambutan	1	1.680	8.400.000	8.400.000
5	Jackfruit	1	192	3.840.000	3.840.000
6	Pinang	1	3.204	6.408.000	6.408.000
7	Agarwood	2	2.160	71.999.280	35.999.640
8	Horticulture	1	4.404	8.808.000	8.808.000
9	Dog fruit	1	3.600	18.000.000	18.000.000
10	Banana	1	1.200	12.000.000	12.000.000
11	Cassava	1	3.600	7.200.000	7.200.000
12	Sengon	1	792	5.478.000	5.478.000

Source: Primary Data Processed, 2021

Table 2. Depreciation Costs of Agroforestry Business Tools in The Research Area in 2021

No	Types of Tools	Average Depreciation Expense (IDR/Year)
1	Dodos	13.026
2	Lori	10.307
3	Hoes	26.316
4	Cut Knife	13.389
5	Machete	14.561
6	Kap Sprayer	134.211
7	Sickle + Fiber	172.222
8	Others	62.697
	Sum	446.730

Source: Primary Data Processed, 2021

the small amount of product obtained. The fixed cost in this study is the depreciation cost of the tool. Depreciation of the tool is the capital issued by smallholders based on the length of use of the tool. The equipment used by smallholders in the research area can be seen in Table 2.

Table 2 shows that fixed costs in agroforestry farming include depreciation costs of agricultural tools. Agricultural tools used include dodos, lorries, hoes, cutting knives,

Table 3. Cost of Using Agroforestry Agricultural Fertilizer in Research Area in 2021

No	Types of Fertilizer	Price (IDR/Kg)	Total Cost (IDR/Kg/Year)
1	Urea	5.600	1.353.333
2	TSP	12.000	1.800.000
3	MOP	12.000	2.520.000
4	KCL	8.800	1.848.000
5	Phonska	2.300	483.000
6	NPK	11.000	3.208.333
7	Dolomite	3.000	787.500
8	Manure	500	1.600.000
	Sum	55.200	13.600.167

Source: Primary Data Processed, 2021

machetes, sprayer hoods, *sickles*, fiber, etc. The average fixed cost incurred by smallholders amounting to IDR. 446,730 Ha/Year. Variable cost is the cost that runs out in a single production process. In this study, variable costs are calculated in one year. The small variable costs calculated in one production process will affect the high or low amount of product produced. The variable costs in the study were purchasing fertilizer, purchasing medicines, and the cost of labor outside the family. The description of the use of production factor costs in the research area is as follows:

a. Fertilizer Cost

The cost of using fertilizer in this study is a sum of money smallholders spend to buy fertilizer used in their agricultural activities within one year. Fertilizers with optimal doses to help increase oil palm’ production. Sample smallholders who used fertilizers in the study were TSP, MOP, Phonska, NPK, Urea, KCL, Dolomite, and Manure. The use of fertilizer aims to obtain maximum production to obtain a high income—details of the cost of using fertilizer incurred by smallholders in Table 3.

Table 3 shows the corresponding total cost of using fertilizers per year by smallholders in research areas. Each of the required fertilizer costs is Urea amounting to IDR. 1,353,333, TSP of IDR. 1,800,000, MOP amounted to IDR. 2,520,000, KCL amounted to IDR. 1,848,000, Phonska amounted to IDR. 483,000, NPK amounted to IDR. 3,208,333, Dolomite amounted to IDR. 787,500. Manure amounted to IDR. 1,600,000 so that the total cost used for fertilizer costs was IDR. 13,600,167.

b. Cost of Medicines

The cost of using the drugs referred to in this study is a sum of money smallholders spend to buy drugs used in their agricultural activities within one year. The use of drugs with optimal doses is expected to help maintain the cleanliness of the land so that it is easier for smallholders to take care of crops and crop harvests and help stimulate crops to produce crops. The sample smallholders who used pesticides and herbicides in the study

Table 4. Cost of Using Agroforestry Agricultural Medicines in Research Area 2021

No	Kind	Price (IDR/Liter)	Total Cost (IDR/Ha/Year)
1	Gramaxone	103.167	631.333
2	Round Up	113.333	493.333
3	Ethrel	45.000	11.250
	Sum	261.500	1.135.917

Source: Primary Data Processed, 2021

Table 5. Cost of Agroforestry Agricultural Labor Wages in Research Areas in 2021

No	Kind	Wages (IDR)	Total Wages (IDR/Year)
1	Fertilization (IDR/Kg)	2.000	1.404.000
2	Spraying (IDR/L)	80.000	112.000
3	Maintenance (IDR/Hari)	80.000	933.333
4	Harvesting (IDR/Kg)	200	216.762
	Sum	162.200	2.666.095

were Gramaxon, Roundup, and Ethrel. The breakdown of the cost of using medicines incurred by smallholders is as in Table 4.

Table 4 shows the cost of medicines per year used by smallholders in the research area, namely Gramaxon with a total cost of IDR. 631,333, Roundup with a total cost of IDR. 493,333, and Ethrel with a total cost of IDR. 11,250 so that the total cost required for medicines per year is IDR. 1,135,917.

c. Labor Costs

Using labor is the cost incurred to pay labor wages carried out in agricultural activities. In this study, the labor costs paid are out-of-family (TKLK) because out-of-family labor costs are included in variable costs. The cost of labor outside the family in this study aims to calculate the income of smallholders. The following details show the cost of using out-of-family labor in agroforestry farming in Table 5.

Based on Table 5, it can be known that the cost of out-of-family labor incurred by smallholders in the research area is IDR. 2,666,095 Ha/Year. Based on the data, the largest fertilization labor wages are issued by smallholders from other wages, which amount to IDR. 1,404,000.

2. Livestock Revenue and Income

Buffalo cattle farming income is the difference between the receipt of buffalo cattle and the total costs incurred. The costs incurred are the cost of feed and depreciation of the tool. Based on the study results, of the 18 smallholders, there was only one farmer who farmed buffalo cattle in addition to their income. The details of smallholders' income incomes on buffalo cattle farming in the research area can be seen in Table 6.

Table 6. Smallholders' Income in Buffalo Cattle Farming in Research Area 2021

Description	IDR/Farmer
A. Acceptance	
Number (Tail)	6
Price (IDR)	18.000.000
Acceptance for 2 Years (IDR)	108.000.000
Total Receipts (IDR/Year)	56.000.000
B. Cost (IDR)	
Feed Cost	16.260.000
Tool Shrinkage	900.000
Total Cost (IDR)	17.160.000
Income (A-B) (IDR)	36.840.000

Source: Primary Data Processed, 2021

Based on Table 6, smallholders' average acceptance of buffalo cattle farming amounted to IDR. 56,000,000/Year, while the income received by smallholders amounted to IDR. 35,840,000/Year. The income earned by smallholders for each buffalo is IDR. 6,140,000. Buffalo sold by smallholders in the research area has entered the age of more than three years.

b. Fish Livestock Income

The business income of fish cattle is the difference between the receipt of catfish and tilapia cattle with the total costs incurred. The costs incurred are the cost of feed and depreciation of the tool. Based on the study results, of 18 smallholders, one farmer does a fish farming business as additional income. The details of smallholders' income on fish farming in the research area can be seen in Table 7.

Based on Table 7, it can be known that the receipt of catfish and tilapia farming business obtained by smallholders amounted to IDR. 118,500,000/Harvest, in 1-year, smallholders can harvest fish up to 3 times the harvest so that the revenue obtained by smallholders amounted to IDR. 355,500,000/Year, while the income received by smallholders amounted to IDR. 260,222,500/Year.

3. Agroforestry Smallholders' Income Per Pattern

The income of a pattern farmer is the income earned by smallholders that are adjusted based on the pattern of business carried out by smallholders. There are seven patterns that smallholders strive for in the research area. To see how smallholders' incomes fit into the business patterns that smallholders strive for can be seen in Table 8.

Table 7. Smallholders' Income in Catfish and Tilapia Livestock Business in Research Area 2021

Uraian	IDR/Petani
A. Acceptance	
Number (Catfish Tail)	6.300
Jumlah (Ekor Nila)	3.700
Harga Lele (IDR)	10.000
Harga Nila (IDR)	15.000
Total Receipts (IDR/Harvest)	118.500.000
Total Receipts (IDR/Year)	355.500.000
B. Cost (IDR)	
Feed Cost	92.000.000
Tool Shrinkage	3.277.500
Total Cost (IDR)	95.277.500
Income (A-B) (IDR)	260.222.500

Source: Primary Data Processed, 2021

Table 8. Total Income of Agroforestry Smallholders

Business Patterns	Type of business/ business	Number of smallholders	Farm Income (IDR/Year)	Farmer's Income (IDR/Month)
I	Palm Oil + Rubber	12	89.628.390	7.469.032
II	Palm Oil + Rubber + Buffalo	1	112.168.700	9.347.392
III	Palm Oil + Rubber + Pond + Horticulture	1	307.672.358	25.639.363
IV	Oil palm + Dog fruit	1	24.799.500	2.066.625
V	Palm Oil + Rubber + Sweet potatoes + Bananas	1	70.276.833	5.856.403
VI	Rubber + Betel nut + Agarwood	1	82.159.468	6.846.622
VII	Rubber + Wood Plants (Agarwood, Sengon) + Fruits	1	93.973.750	7.831.146

Source: Primary Data Processed, 2021

Based on Business Regulation in Research Area 2021. Table 8 shows that there are seven agroforestry patterns cultivated by smallholders in The Ladang Peris Village of Bajubang District:

1. The pattern I (Palm Oil + Rubber)

Most smallholders in Ladang Peris Village cultivate the pattern I (one); in this pattern, smallholders work on two crops in one land, namely palm oil and rubber. The dominating plant in this pattern is rubber plants because rubber is a crop that smallholders in Ladang Peris Village first cultivated. In its business, a pattern I (one) is more intended to transfer land functions from rubber plants originally cultivated into oil palm plants, so pattern I/one is the most widely found pattern in the research area. Many smallholders who work on the pattern I/one are 12 smallholders. The average income of smallholders who work under pattern 1 is \$ 7,469,032 / month or 89,628,390/year.

2. Pattern II (Palm Oil + Rubber + Buffalo)

Pattern II is the same as pattern I (one), where palm oil and rubber crops are planted in one land, smallholders add buffalo cattle for side businesses. The addition of buffalo as a side business provides additional income for smallholders. Pattern II is the pattern that has the most potential to have the most income after the pattern of business with the pool. A total of 1 farmer who seeks business pattern II, with income earned by smallholders is IDR. 9,347,392/month or IDR. 112,168,700/year.

3. Pattern III (Palm Oil + Rubber + Pond + Horticulture)

Pattern III applies an integration system between plantation subsectors, fisheries, and horticulture in one land. For crops cultivated by smallholders are oil palm and rubber, from fisheries subsector, smallholders make ponds for fish cultivation, and horticultural agricultural activities carried out by smallholders is the cultivation of vegetable crops. The application of this pattern provides many sources of income for smallholders, but the main income of smallholders remains from oil palm and rubber crops. Pattern III is the most favorable pattern compared to other patterns; one farmer seeks pattern III, with income earned amounting to IDR. 25,639,363/month or IDR. 307,672,358/year.

4. Pattern IV (Palm Oil + Dog fruit)

Pattern IV is one of the patterns cultivated by smallholders in Ladang Peris Village; palm oil becomes the main crop, and Dog fruit plants become additional crops grown in one land. The dominating crop is the palm oil crop and becomes the main income of smallholders. The total number of smallholders who seek Pattern IV is one farmer, with income earned amounting to IDR. 2,066,625/month or IDR. 24,799,500/year.

5. Pattern V (Palm Oil + Rubber + Yam + Banana)

Pattern V is a pattern carried out by smallholders by planting several plants, namely palm oil, rubber, yam, and bananas. Rubber plants became the dominating crop because first cultivated by smallholders, then palm oil was added as the main source of additional income. Finally, sweet potatoes and bananas become sideline crops as an additional source of smallholders' income. Smallholders striving for pattern V are one person, with income earned amounting to IDR. 5,856,403/month or IDR. 70,276,833/year.

6. **Pattern VI (Rubber + Betel nut + Agarwood)**

Pattern VI is a pattern of farming carried out by combining rubber, betel nut, and agarwood plants in one land, where rubber plants become the main crop in the house and as the main source of income. Banana and agarwood crops cultivated by smallholders are done as a source of additional income. One farmer attempts pattern VI with an IDR. 6,846,622/month income or IDR. 82,159,468/year.

7. **Pattern VII (Rubber + Wood Plants (Agarwood, Silk Tree,) + Fruits)**

Pattern VII is a pattern that smallholders cultivate by doing rubber farming as the main business and the main source of income, then agarwood, Silk tree, and fruits as additional efforts. This pattern provides many sources of income for smallholders, where fruit crops become an additional source of income that can be obtained quickly for smallholders. Smallholders who strive for pattern VII have one person, with IDR. 7,831,146/month or IDR. 93,973,146.

4 Conclusions and Suggestions

Smallholders managed agroforestry farming patterns in The Ladang Peris Village of Bajubang District have seven patterns. The pattern that shows the highest profit is pattern 3 (Palm Oil + Rubber + Pool + Horticulture), with an average monthly income of IDR. 25,639,363/month.

Agroforestry farming business cultivated by smallholders in Ladang Peris Village still needs direction from parties or agencies to provide input and innovation in managing their smallholders. In addition, one of the best agroforestry patterns is needed that is completely acceptable and applied by the community. The win-win solution can raise the economically and ecologically beneficial.

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