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BUSINESS FEASIBILITY OF AGROFORESTRY IN SILEUTU VILLAGE, SIBAGANDING NAGORI, SIMALUNGUN REGENCY

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ABSTRACT

This study aims to analyze the feasibility of agroforestry practices in Sileutu Village, Sibaganding Sub-village, Girsang Sipangan Bolon Subdistrict, Simalungun Regency, using observation and interviews. The total income from coffee agroforestry in Sileutu Nagori Sibaganding Village, Girsang Sipangan Bolon Subdistrict, Simalungun Regency, averaged IDR 1,498,940 per month and IDR 17,987,280 per year. Based on the R/C ratio analysis, which yielded a value of 9.20, it can be concluded that the coffee agroforestry business in Sileutu Village, Sibaganding Nagori, Girsang Sipangan Bolon Subdistrict, Simalungun Regency, is profitable and viable for further development.

Keywords: Business Feasibility, Agroforestry Practices, Total Income, R/C Ratio Analysis, Coffee Agroforestry

ABSTRAK

Penelitian ini bertujuan untuk menganalisis kelayakan usaha agroforestri yang dipraktikkan di Desa Sileutu Nagori Sibaganding Kecamatan Girsang Sipangan Bolon Kabupaten Simalungun dengan menggunakan metode observasi dan wawancara. Jumlah pendapatan usahatani agroforestri kopi di Desa Sileutu Nagori Sibaganding Kecamatan Girsang Sipangan Bolon Kabupaten Simalungun mendapatkan hasil rata-rata per bulan sebesar Rp. 1.498.940, dan rata-rata per tahun mendapatkan hasil sebesar Rp. 17.987.280. Dari hasil analisis R/C Ratio yaitu sebesar 9,20 dan dapat disimpulkan bahwa usahatani agroforestri kopi di Desa Sileutu Nagori Sibaganding Kecamatan Girsang Sipangan Bolon Kabupaten Simalungun menguntungkan dan layak untuk dikembangkan

Kata Kunci: Kelayakan Usaha, Praktik Agroforestry, Total Pendapatan, Analisis Ratio R/C, Agroforestry Kopi

I. INTRODUCTION

Simply put, agroforestry refers to the combination of agriculture and forestry. It is a system that seeks to integrate agricultural and forestry practices. This approach aims to cultivate various agricultural crops alongside or in combination with forestry species, and potentially with livestock or aquaculture. Agroforestry is a pattern that is new to farmers, yet it has actually long been practiced alongside human civilization (Supawarta, 2018).

Agroforestry has long been practiced in Indonesia. As a sustainable land-use practice (Dhakal & Rai, 2020), It boosts total agricultural output by integrating woody perennials with food crops, along with livestock on the same land. When the concept is practiced appropriately, it can provide economic, ecological, social, and cultural benefits. The crop diversity in intercropping can provide a good income on a daily, monthly, and yearly basis. However, it depends on the agroforestry pattern adopted (Achmad et al., 2022). Agroforestry techniques emerged as a response by farmers to land constraints, in an effort to secure periodic and sustainable yields. This concept has long been practiced by farmers due to its

numerous advantages; beyond providing economic benefits, agroforestry also offers significant and far-reaching environmental benefits (Guardison & Wojtyla, 2023).

Agroforestry is generally practiced with the goal of establishing a more sustainable approach to landuse that boosts agricultural productivity and enhances the living standards of rural residents. The various agroforestry practies can be seen as steps in the development of a productive agroecosystem, akin to the natural processes found in ecosystem. Over time, the increasing integration of trees into land management strategies through agroforestry indicates a shift towards a mature agroforest characterized by improved ecological vitality. Similarly, on a broader scale, combining various agroforestry practices within a landscape is comparable to forming a rich mosaic in an ecosystem, where each segment contains distinct niches. In this ecological framework, farmers can tend to and utilize their trees to harness the benefits offered by ecosystem services or products, either by halting agrarian evolution at any phase or by allowing the growth of a fully developed agroforest. For example, methods like fallowing and relay cropping take advantage of the benefits present in the initial phases of ecosystem development, while complex multi-tiered systems mirror established flora (Leakey, 2017).

Agroforestry encompasses many different practices and techniques depending on resource availability and environmental condition. Better assessment into their independent performance with respect to different environmental, socio-cultural and political situations is of paramount importance to determine factors underlying agroforestry adoption and establishment. Perhaps, the trade-off upon a farmer's choice on different land management (including non-agroforestry approaches) might be worth investigating to determine the rationale underlying the selection process. These aforementioned factors might vary across spatial and temporal scales, generating a niche for further research, particularly on the development of tools for agroforestry intervention (Mukhlis et al., 2022).

The application of agroforestry is one of the land management systems that can be used to address problems arising from land use changes and simultaneously tackle food issues. When managing and using land resources, issues can happen if development efforts and the outcomes they aim to achieve do not match the goals set for managing those resources. The main goal is to use the existing resources in the best possible way, in a way that lasts over time (Rozalina et al., 2025).

As noted by Mokoginta (2016), agroforestry is developed to benefit humanity and enhance community welfare; it is also expected to address often-urgent rural development challenges (Zahro et al., 2017). To assess the extent of agroforestry development and its success particularly regarding the profits gained by the community and improvements in their well-being an analytical approach is required. A financial-based project analysis is suitable for this purpose. Since agroforestry systems yield diverse products with varying harvest cycles (ranging from a minimum of one year), such analysis is essential to evaluate the profitability of the agroforestry venture.

This integration of agriculture and forestry is often viewed as an option capable of ensuring food security while delivering various environmental benefits. Consequently, agroforestry systems can be implemented to support the development of national food security programs or new food production hubs. Agroforestry practices characterized by optimal diversity and productivity can yield balanced returns throughout the land-use cycle, thereby ensuring stable (and sustainable) income for farmers. Forest-adjacent communities facing poverty and food insecurity can derive direct benefits such as forest products and indirect benefits through livelihood systems (agroforestry, agrosilvopasture, and agrosilvofishery), ultimately improving their well-being through the sustainable and enduring utilization of natural resources (Guardison & Wojtyla, 2023). Based on the foregoing, the author is interested in examining the business feasibility of coffee agroforestry in Sileutu Village, Girsang Sipangan Bolon District, Simalungun Regency.

II. LITERATURE REVIEW

A study conducted by (Megayani et al., 2019), titled "Feasibility Study of Coffee Farming and Characteristics of Coffee-Farming Households in South Ogan Komering Ulu Regency," aimed to identify the characteristics of coffee farmers and analyze coffee farming operations and their level of

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feasibility in OKUS. The research methods used were descriptive and quantitative to describe the conditions or characteristics of farmers and to analyze the profitability and feasibility of coffee farming. A total of 728 households were sampled. The analytical tool used in this study was the R/C ratio analysis.

A study conducted by (Pahlevi et al., 2014) titled "Feasibility Analysis of the Luwak Coffee Agroindustry in Balik Bukit Subdistrict, West Lampung Regency." The objective of this study was to determine the feasibility of the Luwak coffee agroindustry at both the small-scale and micro-scale levels. The methods used were quantitative and qualitative, and the study area was selected using a purposive sampling method. The data analysis methods employed were NPV, IRR, B/C Ratio, and sensitivity analysis. The results of this study indicate that Luwak coffee businesses whether small-scale or micro-scale are viable for development. The NPV values for small-scale and micro-scale agroindustries are 0.75 and 0.89, respectively; the IRR values are 1.03% and 0.90%, respectively; and the Net B/C and Gross B/C ratios are 1.01 and 1.06, 0.50 and 0.32, respectively, and the payback period (PP) is 0.32 and 0.33 (years). The results of the sensitivity analysis indicate that an increase in production costs and a decrease in the selling price of the product can have an impact. This study differs from previous research in terms of the study location, as this study was conducted in Kayumas Village, Arjasa Subdistrict, Situbondo Regency. The variables used in this study are fixed costs, variable costs, and revenue. The sampling method used was simple random sampling, while the study location was selected using purposive sampling.

A report on a farming business analysis by (Rifka Alkhilyatul Ma'rifat, I Made Suraharta, 2024), conducted across various stages of agroforestry development at the Pujon Kidul Forest Police Resort (RPH), Pujon Forest Management Unit (BKPH), and Malang Forest Management Unit (KPH)—indicates that: (i) at the initial agroforestry stage, the effective area cultivated by farmers was quite large (96.9%); farmers tended to grow vegetables and secondary food crops (*palawija*), generating an annual income of IDR 6,728,928.00 and a B/C ratio of 1.51; (ii) at the intermediate stage, the effective cultivated area was 31.0%; farmers tended to grow grass beneath the primary tree crops, generating an annual profit of IDR 27,160,650.00 and a B/C ratio of 1.66; and (iii) at the advanced agroforestry stage, the effective cultivated area decreased to approximately 12.6%; annual profit reached IDR 21,442,350.00 with a B/C ratio of 1.65.

The R/C ratio is a metric used to assess the viability of a project or business venture. The R/C ratio calculated from the 90 agroforestry farmer respondents was 2.98 (Triwanto et al., 2022). An R/C ratio greater than 1 indicates that all coffee agroforestry operations in Tulungrejo Village are profitable and viable for future continuation; none of the operations incurred a loss, nor did any fall at the break-even point (where there is neither profit nor loss) (Zakaria et al., 2017).

III. RESEARCH METHOD

Data Collection Techniques

The research was conducted using observation and interviews. To achieve the research objectives, both primary and secondary data were collected. Primary data were obtained through direct field observations and interviews with farmers using a questionnaire. The sample size for this study consisted of 30 respondents selected using purposive sampling specifically, coffee agroforestry farmers in Sileutu Village

Data Analysis

All data were obtained through field data collection using observation and interviews. To determine the income levels of farmers engaged in agroforestry, the following formula (Hadisapoetro, 1973) was used:

1. Costs
   Hadisapoetro (1973) states that external costs include all expenses incurred to generate gross income, excluding wages for family labor and interest on all assets used for personal purposes. The total costs incurred by agroforestry farmers are calculated using the following formula:
   Total Costs (TC) = production input costs + external labor costs
2. Revenue (gross income)

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The amount of revenue earned by agroforestry farmers is calculated using the following formula:

TR = Q x P

Where:
TR = Total Revenue (IDR)
Q = Quantity (Kg)
P = Price (IDR)

3. Income

The income of agroforestry farmers is calculated using the following formula:

I = TR – TC

Where:
I = Income (IDR)
TR = Total Revenue (IDR)
TC =Total Costs (IDR)

The income analysis is then followed by a feasibility analysis, or Cost-to-Revenue Ratio (R/C) analysis, which compares business revenue with total production costs. This analysis uses the following equation:

A = TR / TC

R/C = ((P.Q) / (FC + VC))

Where:
A = Farming Viability Index
R/C = Ratio of total revenue to total production costs
FC = Fixed Costs
VC = Variable Costs

Based on the following criteria:
If R/C = 1, the farming practice is not very viable and does not generate a profit
If R/C < 1, the farming practice is not viable and incurs a loss
If R/C > 1, the farming practice is viable and generates a profit

IV. RESULTS AND DISCUSSION

Characteristics of Respondent

The characteristics of forest farmers are distinguishing features possessed by each respondent (Ramadhan, J, 2013). Based on the data collected through interviews with 30 respondents, information regarding respondent characteristics can be presented, including:

Tabel 1. Characteristics of Respondents

No.	Description	Number of People	Percentage (%)
Characteristics based on gender			
1	Man	8	26,67
2	Woman	22	73,33
	Total	30	100,00
Characteristics based on education			
1	No school	2	6,67
2	Finished elementary school	6	20
3	Finished junior high school	13	43,33
4	Finished from high school or equivalent	7	23,33
5	Diploma-Bachelor	2	6,67
	Total	30	100,00
Characteristics based on age			
1	20 – 29 years old	1	3,33
2	30 – 39 years old	5	16,67
3	40 – 49 years old	7	23,33
4	50 – 59 years old	14	46,67

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5	≥ 60 years old	3	10,00
	Total	30	100,00
Characteristics based on place of residence			
1	Around the garden	22	73,33
2	Outside the garden	8	26,67
	Total	30	100,00
Characteristics based on land area			
1	<0.50 Ha	8	26,67
2	0.50 – 1,00 Ha	22	73,33
	Total	30	100,00
Characteristics based on occupation			
1	Farmer	24	80,00
2	Self-employed	6	20,00
	Total	30	100,00
Characteristics based on the number of dependents			
1	0-1 person	5	16,67
2	2-3 person	16	53,33
3	≥ 3 person	9	30,00
	Total	30	100,00

Source: Primary Data, 2022

The majority of respondents were women (73.33%), with the remainder being men (26.67%). This indicates that agroforestry farming in Sileutu Village is managed by women, as the men in the village predominantly work as sap tappers a role that requires greater physical strength.

It was found that the majority of respondents had a junior high school education (43.33%), with nearly equal proportions having completed elementary and senior high school; thus, it can be concluded that, generally speaking, the respondents possessed adequate agricultural knowledge albeit knowledge inherited from parents who managed agroforestry land. Notably, respondents with a bachelor's degree (6.67%) did not automatically possess superior agricultural knowledge compared to those with lower levels of education, although the bachelor's degree holders were better able to adapt to agricultural knowledge.

The higher a farmer's level of formal education, the more positive their perception of community forest management using agroforestry systems tends to be. Farmers with higher levels of formal education possess broader perspectives than their counterparts; this breadth of insight makes them more open to innovation. Non-formal education can enhance farmers' forest management skills, leading to better outcomes. Through proper cultivation techniques, both woody and seasonal crops will grow optimally and command higher market prices. This can increase farmers' household income, allowing them to experience tangible economic benefits (Ramadhan, J, 2013).

It was found that the majority of respondents managing agroforestry systems fell within the 40–49 age group (46.67%). Based on this, it can be concluded that land management is more productive, as the respondents managing agroforestry plots in Sileutu Village do not face labor constraints. This is due to the fact that younger farmers are not as focused on agroforestry, as it is viewed as an additional livelihood that makes the land become unproductive. The younger farmers earn their main income from other livelihood options such as daily laborers and hawkers (Desmiwati et al., 2021).

There are several respondents (73.33%) reside in the vicinity of their plantations, implying that a small proportion live elsewhere. Table 4 suggests that variations in the distance between a respondent's residence and their land may lead to differences in land management practices; those living away from the plantation face time constraints and logistical challenges regarding the travel required for farm management. Data obtained from the respondents indicate that the agroforestry plots they manage were inherited from their parents. Furthermore, current limitations in land management can be linked to the scarcity of younger generations continuing agroforestry operations, as many migrate to other regions.

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The majority of respondents (26.67%) possess agroforestry land classified as small-scale, resulting in low income levels. Meanwhile, 73.33% of respondents fall into the medium-sized land category. According to the data, the final category large landholdings consists of inherited land that has not yet been subdivided among siblings living away from the area. Consequently, even large landholdings fail to generate significant income if not managed intensively.

The vast majority of respondents (80.00%) are full-time farmers, whereas only 20.00% are self-employed entrepreneurs. These data indicate that the respondents' income is generally derived from farming activities, such as wet-rice cultivation and other agricultural pursuits.

The data indicates that the majority of respondents (53.33%) have 2–3 dependents, while 30.00% have three or more dependents; the remaining 16.67% have no dependents a group largely comprised of individuals over the age of 50. Furthermore, the data shows that an average of three dependents per family necessitates a certain level of income to meet economic needs. Consequently, land in Sileutu Village plays an increasingly important role in supplementing income, particularly for respondents with limited agricultural land outside of mixed gardens or those who possess no land other than agroforestry plots.

In summary, the data regarding respondent characteristics reveals that the study participants are predominantly women with a junior high school education, aged 50–59, residing near the land, owning 0.5–1.0 hectares of land, and supporting 2–3 family members.

Plant Species Composition

Based on the field inventory, data on the composition of agroforestry plant species in Sileutu Village were obtained, as presented in Table 2 below:

Table 2. Composition of agroforestry plant species in Sileutu Village based on their uses

No.	Commodity	Plant Status	Total
A	**Fruit-Bearing Plants**		
1	*Coffea canephora*	Horticulture	7,50 Ha
2	*Aleurites mollucana*	Annuals	27 stems
3	*Durio zibethinus*	Annuals	15 stems
4	*Mangifera indica*	Horticulture	12 stems
5	*Persea americana*	Annuals	35 stems
6	*Musa paradisiaca*	Annuals	10 stems
7	*Passiflora edulis*	Horticulture	0,09 Ha
8	*Gnetum gnemon*	Annuals	16 stems
9	*Syzygium aromaticum*	Annuals	11 stems
10	*Archidendron pauciflorum*	Annuals	18 stems
B	**Plants that produce wood/trunks**		
1	*Toona Sureni*	Annuals	22 stems
2	*Pinus merkusii*	Annuals	14 stems
3	*Areca catechu*	Horticulture	20 stems
C	**Agricultural/Plantation Crops**		
1	*Zea mays*	Horticulture	0,12 Ha
2	*Manihot esculenta*	Horticulture	0.02 Ha
3	Capsicum annum L.	Horticulture	0,25 Ha
4	*Capsicum frutescens*	Horticulture	0,08 Ha
5	*Theobroma cacao L.*	Horticulture	0,50 Ha
D	**Spice Plants**		
1	*Zingiber officianale*	Horticulture	0,60 Ha
2	*Cymbopogon citratus*	Horticulture	0,40 Ha
E	**Others**		
1	*Arenga piñata*	Horticulture	7 stems

Source: Primary Data, 2022

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Based on the table above, it is evident that the crops commonly cultivated by agroforestry farmers are horticultural crops such as coffee, bananas, cassava, corn, chili peppers, and ginger. This is because horticultural crops have a short life cycle and produce yields relatively quickly, so farmers grow them to supplement their income and meet their basic needs.

There are 10 fruit bearing plants on agroforestry farmers, shows that the three fruit tree species mentioned above were the most recorded ones in comparison to the other fruit tree species. The possible reason is that most of the time households prefer high value fruit tree species and good marketability (Adane et al., 2019).

Forestry crops do not generate income because farmers plant them in their gardens primarily for shade or as living fences. Farmers who cut down these trees do not do so for sale, but rather to meet their own needs such as constructing houses, building livestock enclosures, and fulfilling other requirements (Olivi et al., 2015). The concept of cultivating fruit-bearing plants within an agroforestry system can be implemented by studying methods already applied in various regions. These types of fruit plants hold potential for development, as they are considered easy to maintain and market. Developing agroforestry by combining fruit plants with various agricultural crops on farmland is believed to have a positive effect on the physical and chemical properties of the soil (Ardini et al., 2020).

Figure 1. Agroforestry Land
Source: Primary Data, 2022

Horticultural plants have various functions, including sources of income, additional food sources, aesthetic/beauty functions, and producers of spices/medicinal plants. Many plantation crops include hardwood plants, which are perennial and woody plants. The term hardwood refers to plants that, when cultivated for a long time, provide yields, have a long life cycle, help conserve soil, and do not require intensive management. There is a lot of strong evidence showing that when you increase the variety of plants in an area, it helps raise the amount of crops and animal food produced, as well as the amount of wood made. It also makes the harvest more reliable, supports more pollinators like bees, and helps control weeds and pests. However, how this variety affects the soil's nutrients and carbon levels is not yet clearly understood (Isbell et al., 2017).

The results of the crop inventory in Sileutu Village indicate that farmers have not yet fully adopted agroforestry principles on their land; this is evident from the limited application of agroforestry crop combinations and the insufficient number of such crops currently cultivated by farmers in Sileutu Village. It is also known that the reason the community grows fruit-bearing plants is that they gain two benefits: an economic benefit, as fruit-bearing plants provide income from the sale of fruit; and a benefit in terms of soil and water conservation (environmental services).

The application of agroforestry is one of the land management systems that can be used to address problems arising from land use changes and simultaneously tackle food issues. When managing and using land resources, issues can happen if development efforts and the outcomes they aim to achieve do not match the goals set for managing those resources. The main goal is to use the existing resources

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in the best possible way, in a way that lasts over time. This means that the well-being of the community can improve without harming or worsening the natural environment. If this is not done properly, it could harm the environment and put future generations at risk (Maruapey, 2013)

Farmers' Income by Crop Type

Income is the farmer's total revenue minus production costs in the agroforestry enterprise (Olivi et al., 2015). Based on direct interviews with respondents, data on income by crop type in Sileutu Village was obtained, as presented in Table 3 below:

Table 3. Farmers' Income by Crop Type

No Respondent	Types of Plants	Total Income (IDR/month)
1	*Coffea canephora*	31.808.000
2	*Aleurites mollucana*	3.924.000
3	*Durio zibethinus*	-
4	*Mangifera indica*	-
5	*Persea americana*	4.140.000
6	*Musa paradisiaca*	1.290.000
7	*Passiflora edulis*	135.000
8	*Gnetum gnemon*	-
9	*Arenga piñata*	400.000
10	*Syzygium aromaticum*	1.950.000
11	*Toona Sureni*	-
12	*Pinus merkusii*	-
13	*Archidendron pauciflorum*	2.415.000
14	*Zea mays*	440.000
15	*Manihot esculenta*	-
16	*Capsicum annum* L.	1.855.000
17	*Capsicum frutescens*	320.000
18	*Zingiber officianale*	600.000
19	*Theobroma cacao L.*	540.000
20	*Cymbopogon citratus*	255.000
21	*Areca catechu*	380.000
Total		**50.452.000**

Source: Primary Data, 2022

Based on the table above, it can be seen that not all of the 21 plant species found in agroforestry areas generate income for farmers. Of the 21 species, farmers derive their largest source of income from coffee, amounting to IDR 31,808,000 per month. The lowest source of income for farmers comes from passion fruit, amounting to IDR 135,000. Some plants do not generate income for farmers due to low market prices for their produce, while others are not harvested or suffer crop failure caused by insects or pests.

Agroforestry is primarily expected to help optimize sustainable land use in order to secure and improve community livelihoods, as well as enhance human ecological carrying capacity, particularly in rural areas. The objective of this agroforestry practice is to improve the well-being of communities living near forests by providing villagers or farmers with opportunities to cultivate food crops, thereby increasing their income (Syahputra, 2021).

Income by Number of Respondents

Farmers' monthly income by number of respondents in Sileutu Village is presented in Table 4 below:

Table 4. Income by Number of Respondents

No Respondent	Land Area (Ha)	Total Income (IDR/year)
1	0,50	17.061.600
2	0,45	16.996.800
3	0,37	15.576.000

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No Respondent	Land Area (Ha)	Total Income (IDR/year)
4	0,34	18.331.200
5	0,90	20.220.000
6	0,48	20.176.800
7	0,60	19.490.400
8	0,56	19.456.800
9	0,63	17.570.400
10	0,49	18.528.000
11	0,31	15.355.200
12	0,50	15.760.800
13	0,43	17.280.000
14	0,95	16.908.000
15	1,20	24.093.600
16	0,40	16.944.000
17	0,52	19.545.600
18	0,39	16.128.000
19	0,33	13.543.200
20	0,59	17.870.400
21	0,30	14.035.200
22	1,05	19.692.000
23	0,70	19.999.200
24	0,82	19.344.000
25	0,64	20.282.400
26	0,55	20.680.800
27	0,97	19.617.600
28	0,95	18.441.600
29	0,27	12.391.200
30	0,88	18.297.600
Total	18,07	539.618.400
Mean	0,60	17987280

Sumber: Data Primer 2022

Based on Table 4 above, it is evident that all 30 selected respondents derived income from agroforestry management; among them, the highest revenue was IDR 24,093,600 (earned by respondent number 15), while the lowest was IDR 12,391,200 (earned by respondent number 29). The data in Table 10 indicates that the average revenue obtained by the agroforestry farmers was IDR 17,987,280. It is established that land area influences the income of agroforestry farmers in Sileutu Village, Nagori Sibaganding, Girsang Sipangan Bolong District, Simalungun Regency.

The significant contribution of agroforestry items results from individuals managing and using their land to grow a variety of plant species. Such land cultivation techniques are traditions that are inherited through the ages. Implementing agroforestry can enhance the earnings of farmers if they are able to sustain land productivity by choosing appropriate plants, caring for those plants, selling available products, and establishing robust farming organizations. As farmers' earnings rise, the economic status of the village will also advance, fostering development.

Farmers' Production Costs in Sileutu Village

According to (Suryanto et al., 2012), farming costs represent the total value of inputs and resources utilized to conduct farming activities in order to generate a certain volume of produce within a specific period. The production costs for farmers in Sileutu Village include expenses for fertilizers, pesticides, and labor (measured in *HOK* or daily labor units), as detailed in Table 5 below.

Table 5. Farmers' production costs in Sileutu Village

No	Description	Total Cost (IDR/month)
1	Fertilizer Costs	1.808.000

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2	Pesticide Costs	1.085.000
3	Labor Costs (HOK)	2.590.000
	Total	5.483.000

Sumber: Data Primer 2022

Table 5 shows that the monthly production cost for farmers in Sileutu Village reaches IDR 5,483,000. These high costs are driven by the scarcity and high market prices of the fertilizers and pesticides needed to support crop productivity, leaving farmers struggling to manage their crops.

High production costs are also attributed to labor expenses specifically the cost of hired daily labor as farmers must employ workers to maintain their agroforestry plots; this is particularly true for farmers with landholdings exceeding 0.50 hectares, who require more hired help.

Production costs, including those for fertilizers and pesticides, are generally incurred for horticultural crops. Forestry crops such as durian and *jengkol* do not receive fertilizer applications; consequently, production costs are primarily associated with horticultural crops.

Farmers' Income in Sileutu Village

Based on the revenue and production costs associated with agroforestry land derived from sources such as agricultural and orchard produce (e.g., harvests of coffee, bananas, corn, etc.) the net income for each agroforestry farmer was calculated.

The net income and average income of farmers in Sileutu Village (shown in Table 6) were determined by deducting production costs from the farmers' total monthly revenue. Data obtained from field interviews with 30 respondents provided the information on agroforestry farmers' net income presented in Table 6 below.

Table 6. Farmers' Income in Sileutu Village

No Respondent	Land Area	Total Revenue (IDR/month)	Total Production Cost (IDR/month)	Total Income (IDR/month)
1	0,50	1.580.000	158.200	1.421.800
2	0,45	1.560.000	143.600	1.416.400
3	0,37	1.434.000	136.000	1.298.000
4	0,34	1.656.000	128.400	1.527.600
5	0,90	2.002.000	317.000	1.685.000
6	0,48	1.825.000	143.600	1.681.400
7	0,60	1.790.000	165.800	1.624.200
8	0,56	1.765.000	143.600	1.621.400
9	0,63	1.630.000	165.800	1.464.200
10	0,49	1.680.000	136.000	1.544.000
11	0,31	1.408.000	128.400	1.279.600
12	0,50	1.457.000	143.600	1.313.400
13	0,43	1.576.000	136.000	1.440.000
14	0,95	1.719.000	310.000	1.409.000
15	1,20	2.340.000	332.200	2.007.800
16	0,40	1.548.000	136.000	1.412.000
17	0,52	1.787.000	158.200	1.628.800
18	0,39	1.480.000	136.000	1.344.000
19	0,33	1.250.000	121.400	1.128.600
20	0,59	1.655.000	165.800	1.489.200
21	0,30	1.291.000	121.400	1.169.600
22	1,05	1.944.000	303.000	1.641.000
23	0,70	1.840.000	173.400	1.666.600
24	0,82	1.807.000	195.000	1.612.000
25	0,64	1.856.000	165.800	1.690.200

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26	0,55	1.867.000	143.600	1.723.400
27	0,97	1.922.000	287.200	1.634.800
28	0,95	1.824.000	287.200	1.536.800
29	0,27	1.154.000	121.400	1.032.600
30	0,88	1.805.000	280.200	1.524.800
Total	**18,07**	**50.452.000**	**5.483.800**	**44.968.200**
Mean	**0,60**	**1681733,333**	**182793,33**	**1.498.940**

Sumber: Data Primer 2022

Based on Table 5 above, among the 30 respondents, the highest monthly net income was IDR 2,007,800, earned by respondent number 15; this is because the agroforestry farmer cultivated coffee, *suren*, durian, *jengkol*, ginger, bird's eye chili, and sugar palm crops that, particularly coffee, command very high market prices. Conversely, the lowest monthly income was IDR 1,032,600, earned by respondent number 29, as this farmer cultivated only coffee, candlenut, and sugar palm. Data from Table 5 also indicates that the average monthly income earned by the agroforestry farmers was IDR 1,498,940.

Agroforestry systems with a timber or commercial focus typically prioritized income generation, whereas those centered on traditional and non-timber products tended to emphasize the benefits for dietary diversity. Across both groups, almost all studies indicated that agroforestry systems support stability through environmental advantages, although these benefits were seldom quantified. Additionally, while many of the identified studies examine income within a food security framework, studies addressing traditional agroforestry systems often lacked rigorous financial analyses. The household ability to capture off-farm income, enabled by the use of agroforestry systems, may have a more favorable effect on nutritional outcomes than greater crop diversity, provided that such income strengthens household capacity to buy nutritious foods through market mechanisms. Lastly, as Indonesia continues to urbanize, the contrasting roles of homegardens and other agroforestry practices in rural settings (as distinct from urban or peri-urban areas) will need to be addressed in a systematic manner (Duffy et al., 2021).

Income Frequency Distribution of Agroforestry Farmers

Based on the data above, the total number of respondents is 30. To clarify information regarding the distribution of income derived from the study, the farmers' income data were grouped into three classes. Based on this grouping method, information regarding the distribution of farmers' income is presented in Table 7 below:

Table 7. Frequency Distribution of Farmers' Income

No	Class	Intervals (IDR)	F	%
1	Substandard	< 1.498.940	14	46,6667
2	Adequate	1.489.940-1.701.428	14	46,6667
3	Highly adequate	< 1.701.428	2	6,66667
Total			30	100

Based on the data in the table above, the income levels of farmers in classes 1 and 2 are comparable. This situation has led agroforestry farmers in Sileutu Village (Nagori Sibaganding, Simalungun Regency) to seek additional income by working outside their agroforestry plots for instance, as entrepreneurs, drivers, or pine resin tappers.

Farmers who adopt agroforestry achieve better outcomes than those who do not. They earn higher incomes, which may enable them to address many of their everyday socioeconomic challenges and, as a result, contribute more to reducing household income and poverty than farmers who do not practice agroforestry.

R/C Ratio Analysis

Agroforestry can also result in a higher benefit-to-cost ratio. Certain practices involve growing woody plants that need minimal inputs (chemical fertilizers, pesticides, etc.), which can lower production costs and enhance the income earned by farmers. Nonetheless, such a result may largely rely

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on the farmers' understanding of the practice, especially regarding optimal plant/tree selection for their system. Certain trees can thrive more effectively when grown alongside their companion crops. In contrast, selecting inappropriate tree or crop components can lead to nutrient competition, ultimately resulting in decreased yields and, thus, lower profits for farmers.

The amount of production, fertilizer, labor costs, and selling prices greatly affect the income received by farmers. The lower the costs incurred and the increased revenue, the higher the income received by farmers (Ningtyas et al., 2022). The R/C ratio analysis or Return and Cost ratio (R/C ratio) is a comparison between the value of the output to the value of the input or the comparison between farm income and expenses. The goal is to determine profit or not the farm is feasible (Dk et al., 2023).

Table 8 above shows an R/C ratio of 9.20. This figure is derived by dividing the average total revenue of IDR 1,681,733.33 by the average total cost of IDR 182,793.33. Consequently, the farming activities undertaken by agroforestry farmers in Sileutu Village, Girsang Sipangan Bolon District, Simalungun Regency, are profitable and viable for further development.

Table 8. Comparison of Total Revenue and Total Costs

No	Data Type	Total
1	Revenue	1.681.733,33
2	Cost	182.793,33
3	R/C	9,20

Observations regarding agroforestry practices in the village revealed that while not every farmer employs this method, the majority do utilize agroforestry systems; the lack of adoption among some farmers stems from a lack of information and knowledge regarding the practice. The agroforestry systems in Sileutu Village are dominated by fruit-bearing crops specifically coffee which are classified as long-term crops and can be harvested within a two-week period.

Aside from land constraints, the intercropping practices implemented by farmers offer numerous benefits, such as generally achieving higher productivity per unit area compared to a monoculture planted on the same plot, while also facing fewer issues with weed, pest, and disease management. This approach reduces peak labor demands, enhances farm revenues, boosts the nutritional status of farming households, and lowers risks associated with crop failures and market fluctuations, particularly concerning by-product pricing and production input costs. By adopting intercropping methods, farmers can increase their earnings, as these practices allow for more efficient use of production resources, thereby resulting in lower production expenses compared to traditional monoculture systems. Intercropping system could improve the livelihood of smallholder farmers through increased productivity in certain land areas, and it contributes to national food security. The benefits of intercropping are increased the cropping intensity and productivity of various plant constituents, yield stability, economic return, social benefits, pest control, and effective fertilizer use. It also reduces the economic risk and market fluctuation resulting from growing a single crop that is more prone to natural hazards and helps the farmer's efficient land utilization by having more than one crop produced per unit area (Widiyanto et al., 2022).

Land use is closely related to the social conditions of local communities to meet their needs. Land use is any form of human intervention, either permanent or temporary, to a natural resource and artificial resource, collectively referred to as land, with the aim of meeting both material and spiritual needs in the present. The choice of cropping systems and specific management strategies van help determine the pool of non-crop species present in each field. Furthermore, the maintenance of higher crop diversity can help prevent the development of single, problematic weed species in the long term (Alignier et al., 2020). The importance of urban society plays a key role in the eco nomic and social development of rural areas, encouraging farmers to implement better management practices and diversify their activities (Silva et al., 2017).

Similar to commercial homegardens, agri-silviculture systems that are predominantly focused on timber typically had lower levels of dietary diversity, yet higher income levels. Most such studies on agri-silviculture systems involved financial analyses. In such analyses, management effects on

profitability were easier to identify than in other more complex agroforestry systems. Such timber-focused systems were not necessarily lacking in other elements, as the diversity considerations work on different timescales. For example, silvopastoral and environmental benefits were certainly identified in such studies, as was the ability to earn greater off-farm income due to the lower maintenance and long cycles of such systems. Future research on timber focused agri-silviculture systems should consider greater integration of food security factors and outcomes into financial analyses (Duffy et al., 2021).

According to (Brown et al., 2018), there are two important factors as a precondition for success in adopting an agroforestry system before making further interventions namely, successful mobilization and engagement of farmers and facilitating farmer capacity development and/or access to qualified tree/agriculture seeds. Several interventions are needed after the precondition phases have been met, include providing incentives, facilitating market networks, and institutional and policy change.

Program sustainability can be defined as a state in which the program's effects continue to be experienced over time. Such sustainability is crucial for observing the long-term impact experienced by the communities affected by the program. Similarly, in the context of agroforestry, community perspectives are shaped by the impacts and benefits derived from agroforestry development (Supawarta, 2018). Managing planting patterns in agroforestry is crucial, as it influences the growth of plantation, agricultural, and forestry crops alike. Agricultural crops typically grown as understory plants are affected by forest tree stands, particularly regarding sunlight interception. Optimal space utilization can be achieved by managing planting distances, canopy layer development, and plant layout. Establishing an effective agroforestry pattern in this way not only minimizes competition among components but is also expected to prevent pest and disease outbreaks, ultimately leading to increased crop production (Triwanto et al., 2022).

V. CONCLUSION

Coffee agroforestry in Sileutu Nagori Village, Sibaganding Subdistrict, Girsang Sipangan Bolon District, Simalungun Regency, generate an average monthly income of IDR 1,498,940 and an average annual income of IDR 17,987,280. The R/C Ratio analysis shows a value of 9.20, indicating that coffee agroforestry is profitable and worth developing.

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