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Assessing Agroforestry Impact on Household Income: A Study of the Bu'u Bei Community Forest Management Group in Tina Bani Village, Ende, Indonesia

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Agroforestry systems play a critical role in supporting livelihoods across East Nusa Tenggara, including in the Bu'u Bei Community Forest (HKm) in Tina Bani Village, Ende District, Ende Regency, Indonesia. This study investigates agroforestry patterns and evaluates their contribution to household income among the 47 HKm member households, surveyed through a census in April and May 2024. Employing both descriptive and quantitative analyses, our research reveals that the agrisilviculture system, characterised by a random mixed planting pattern, dominates agroforestry practices in the village. Path dependency, rooted in long-standing traditions, significantly shapes these practices. Agroforestry contributed significantly to household income in 2023, accounting for 98.87% of total income. However, poor infrastructure, particularly damaged roads, limits market access and reduces the economic potential of these systems. The study emphasises the need for integrated land management approaches that address infrastructure deficits while strengthening the resilience of agroforestry systems. This research provides critical insights into the socio-economic and environmental roles of agroforestry, offering a valuable reference for policymakers and stakeholders committed to promoting sustainable forest management and rural development in Indonesia

Keywords: agroforestry systems, socio-economic impact, forest ecosystem services, rural livelihoods, path dependency

1. Introduction

The community forest scheme, known as Community Forests in Indonesia, is one of the social forestry programmes promoted by the government. It involves communities in managing state forest areas, such as production and protected forests, that are not subject to ownership or licensing rights (Fauzi & Nahlunnisa, 2021). The agroforestry system and recognition of the local community are primary approaches within the social forestry scheme for managing cHKm(Bakri, 2021).

Agroforestry is a land-use system that integrates forestry crops with agricultural crops, plantation crops, or livestock within a single land area (Ayuniza et al., 2020). This system is designed to improve community welfare by providing opportunities for cultivating food crops, thereby increasing household income. Through agroforestry, communities benefit from the forest land without having to wait for timber

harvests. Agricultural yields can be obtained monthly or annually, depending on the crop type (Khadavi, 2021; Nurrani et al., 2015).

One significant economic benefit of the agroforestry system is its capacity to contribute to community income in both the short and long term (Hamid et al., 2023; Yonky et al., 2021). The diversity of crops in agroforestry systems not only meets daily consumption needs but also produces outputs for sale, thereby supporting short- and long-term economic stability. This study shows that income from agroforestry in Tanjung Beringin Village is higher than non-agroforestry income, with agroforestry yielding Rp. 98,906,000 per year compared to non-agroforestry income of Rp. 80,000,000 per year.

Based on the Decree of the Minister of Environment and Forestry of the Republic of Indonesia Number: SK.7043/MENLHKPSKL/PKPS/PSL.0/12/2017 concerning the Designation of the Bu'u Bei HKm Area, covering 90 hectares within a Production Forest Area. In the HKm, the agroforestry practice implemented is a mixed cropping system to optimise land use, allowing various plant species to be cultivated on that land. Generally, the HKm community in Tina Bani Village cultivates agroforestry crops such as Mahogany (*Swietenia macrophylla*), Gliricidia (*Gliricidia sepium*), Arabica coffee (*Coffea Arabica*), cocoa (*Theobroma cacao*), vanilla (*Vanilla planifolia*), Kepok banana (*Musa acuminata x balbisiana*), ginger (*Zingiber officinale*), and chayote (*Sechium edule*). These agroforestry crops have considerable potential; however, the arrangement of cropping patterns on HKm land has not been well-organised. This is because the land management patterns on HKm land were pre-established (inherited land), and the community continues existing management practices (Idris, 2019).

According to data obtained from the Tina Bani Village Office, there are 45 low-income households in Tina Bani Village (Tina Bani Village Profile, 2023). The implementation of agroforestry within HKm is expected to create job opportunities and increase community income. Therefore, this research is necessary to examine and understand the agroforestry system and the agroforestry contributed to the income of members of HKm members in Tina Bani Village, Ende Subdistrict, Ende Regency.

2. Method

This research was conducted in the Bu'u Bei HKm area, located in Tina Bani Village, Ende Subdistrict, Ende Regency. The study took place in April and May 2024. The tools used in this study included cameras, stationery, and laptops, while the materials comprised questionnaire sheets and Microsoft Excel.

1) Data Type

The data collected in this study consist of primary and secondary data. Primary data were obtained from informants through interviews conducted using questionnaires. These questionnaires included information on informant identity, agroforestry systems, household income, and household expenditure (Sitepu, 2014).

2) Data Collection

To support the analysis in this study, we collected data through in-depth interviews and documentation. In-depth interviews are a data collection method that involves direct questioning to obtain detailed information, with the researcher actively engaging in the informants' lives to gather the required data. Meanwhile, the documentation process involved gathering data in the form of images to support the research, including photographs of group members and images of the agroforestry land in Tina Bani Village.

The sampling method used in this study is the census method, which is appropriate when the population is relatively small and easily accessible. The informants selected for this study were 47 households from the Bu'u Bei HKm group who apply the agroforestry system to their land.

3) Data Analaysis

The data obtained from the study were analysed using descriptive and quantitative analysis. We used descriptive analysis to provide an overview of the agroforestry system, general information about the informants, and data on farmers' income and expenditure for 2023. This research also employed quantitative analysis to determine the income contribution for 2023, accounting for both agroforestry and non-agroforestry income and expenditure sources. The data were then categorised, calculated, and presented in tables according to the findings.

To determine farmers' income and the contribution of agroforestry, the following formulas are used, adapted from Rachmad (2011) in Rajagukguk et al. (2015):

Income from agroforestry

$$I_{af} = \sum \text{Farmer income from agroforestry (n)}$$

Where:

I_{af} = Total income from agroforestry per year (Rp)

Agroforestry products include revenue from the sale of timer, fruits and crops.

Income from non-agroforestry

$$I_{naf} = \sum \text{Farmer income from non-agroforestry (n)}$$

Where:

I_{naf} = Total income from non-agroforestry per year (Rp)

Non-agroforestry products include trade, livestock and other sources of income

Total Household income

$$I_{tot} = I_{af} + I_{naf} \quad \text{(n)}$$

Where:

I_{tot} = Total household income (Rp)

I_{af} = Total income from agroforestry

I_{naf} = Total income from non-agroforestry

Persentage contribution of agroforestry income

$$I_{af}\,\% = (I_{af}/I_{tot}) \times 100\% \quad \text{(n)}$$

where:

I_{af}% = Percentage of agroforestry income to total income
I_{af} = Total income from agroforestry
I_{tot} = Total household income

Total Household expenditures

$$Ctot=\sum C \quad (n)$$

Where:
C_{tot} = Total household expenditures over a one-year period (Rp)
C = Total expenses incurred to meet household needs

Percentage of total income to total expenditures

$$I_{tot}\ \% = (I_{tot}/C_{tot}) \times 100\% \quad (n)$$

Where:
I_{tot}% = Percentage of total household income to total household expenditures
I_{tot} = Total household income
C_{tot} = Total household expenditures

3. Result and Discussion

1) Pattern and Type of Plants

In general, the community managing Bu'u Bei HKm in Tina Bani Village engages in agroforestry land management using simple methods. The agroforestry practices in the village are characterised by a single system, namely the agrisilviculture system, which employs a random mixed planting pattern (Random Mixture) (Idris, 2019). Agrisilviculture refers to a land management system that integrates forestry and agricultural or plantation crops without incorporating livestock on the same land (Rante et al., 2022). The random mixed planting pattern used in agroforestry land management is illustrated in Figure 1.

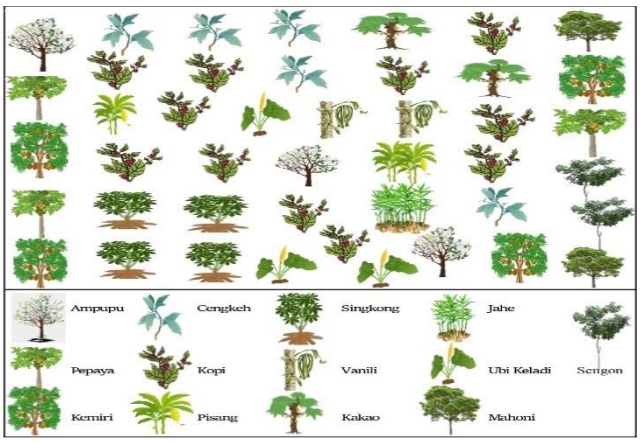

Figure 1. Random Mixture Pattern

Based on the interview results, the Random Mixture planting pattern has been practised for generations, and passed down from previous generations to the current farmers. This random mixed planting pattern is characterised by irregular planting arrangements that do not follow rows or lines typically associated with crop planting (Lewerissa et al., 2020).

On agroforestry land in Tina Bani Village, the community cultivates various plant species, including agricultural crops such as taro (*Xanthosoma sagittifolium*), ginger (*Zingiber officinale*), cassava (*Manihot esculenta*), kepok banana (*Musa paradisiaca*), papaya (*Carica papaya*), and chayote (*Sechium edule*). Plantation crops include Arabica coffee (*Coffea arabica*), Robusta coffee (*Coffea canephora*), vanilla (*Vanilla planifolia*), candlenut (*Aleurites moluccana*), cloves (*Syzygium aromaticum*), and cocoa (*Theobroma cacao*). Forestry crops include mahogany (*Swietenia macrophylla*), gamal (*Gliricidia sepium*), sengon (*Albizia chinensis*), and ampupu (*Eucalyptus urophylla*).

Forestry crops are typically used as shade trees and climbing supports for plantation crops. Gamal trees, for example, are commonly used as climbing supports for plants such as vanilla (Bahri et al., 2023).

2) Income from Agroforestry

Agroforestry income refers to the earnings derived from farmers' agroforestry lands. It is calculated over the past year based on the harvest yields of each commodity and is determined by the revenue generated from the sale of agricultural and plantation crops.

a) Respondents Revenue from Agroforestry

The revenue generated by respondents from agroforestry land in the past year, specifically in 2023, is presented in Table 1.

Table 1 shows that the total revenue of the Bu'u Bei HKm community from agroforestry land over one year amounted to Rp 531,194,000 per year, with an average income of Rp 11,380,799 per year. The largest revenue component came from plantation crops, totalling Rp 500,084,000 per year and an average income of Rp 10,640,085 per year. This is due to the higher selling prices and greater production volumes of crops such as Arabica coffee, Robusta coffee, cloves, vanilla, candlenut, and cocoa. These crops are cultivated primarily for commercial purposes and sold in large quantities, directly increasing farmers' incomes.

Tabel 1. Respondent Revenue from Agroforestry Land

No	Agroforestry component	Total Revenue (Rp)/Year	Average Revenue (Rp)/Year
1	Forestry crops	0	0
2	Agricultural crops	31.110.000	740.714
3	Plantation crops	500.084.000	10.640.085
	Total	531.194.000	11.380.799

Source: Primary data analysis, 2024

Conversely, the smallest revenue component was from agricultural crops, amounting to Rp 31,110,000 per year, with an average income of Rp 740,714 per year. This is attributed to the lower market price of ginger compared to plantation crops. Among agricultural crops, only ginger (Zingiber officinale) was sold, while crops such as cassava (Manihot esculenta), taro (Colocasia esculenta), banana (Musa paradisiaca), and papaya (Carica papaya) were primarily consumed by the farmers themselves. These crops serve as staple food sources for the farmers.

The plantation crops sold included Robusta coffee (*Coffea canephora*), Arabica coffee (*Coffea arabica*), candlenut (*Aleurites moluccana*), cocoa (*Theobroma cacao*), vanilla (*Vanilla planifolia*), and cloves (*Syzygium aromaticum*). Meanwhile, forestry crops such as mahogany (*Swietenia macrophylla*) and sengon (*Albizia chinensis*) were used for shade and for constructing farmers' private houses.

According to the research by Sanudin and Priambodo (2013) cited in Iqbal et al. (2021), income from timber is not only used for daily necessities but also for meeting temporary needs, such as school expenses, social events, house construction, and other urgent requirements.

b) Respondent Expenses for Agroforestry

The expenses incurred by respondents for agroforestry land management over the past year, specifically in 2023, are presented in Table 2.

Table 2 outlines the expenses incurred by the Bu'u Bei HKm community for agroforestry land management, which include agricultural tools such as machetes, sacks, sickles, hoes, and transportation. The total expenses for agroforestry activities over the past year amounted to Rp 29,870,500 per year, with an average expense of Rp 850,894 per year.

Tabel 2. Respondent's expenses for agroforestry

No	Expense component	Total expenses (Rp)/Year	Average Expense (Rp)/Year
1	Machete	6.185.000	237.885
2	Sack	1.630.500	38.035
3	Sickle	915.000	65.357
4	Hoe	2.940.000	122.500
5	Transportation	18.200.000	387.234
	Total	**29.870.500**	**850.894**

Source: Primary data analysis, 2024

The largest expense component was transportation, with a total of Rp 18,200,000 per year and an average expense of Rp 387,234 per year. This significant cost is attributed to the time and distance required to travel from the community's homes to Ende Market, which takes 2–3 hours over a distance of 27 km. The extended travel time is due to severely damaged roads, which slow down vehicle speeds and increase travel time. Poor road conditions also elevate transportation costs by necessitating more frequent vehicle maintenance and higher fuel consumption (Tarigan & Syumanjaya, 2018).

Conversely, the smallest expense was for sickles, with a total of Rp 915,000 per year and an average expense of Rp 65,357 per year. This is because sickles are relatively durable tools that do not require frequent replacement. Additionally, sickles are less expensive compared to tools like hoes and machetes. Agroforestry activities involving forestry, agriculture, and plantation crops require various tools to support daily farming operations. Tools such as machetes, sacks, sickles, and hoes are utilised for managing these activities. According to interviews conducted in Tina Bani Village, the community reuses the same tools annually to minimise expenses. For example, machetes are used for clearing weeds and branches, while hoes are used for soil preparation. Sacks are employed for transporting harvests, and sickles are used for cutting weeds and unwanted plants. Consequently, expenses for these tools are not itemised by activity.

A study by Jebaru (2022) found that the total expenses for agroforestry in Ranaka Village, Wae Ri'i Subdistrict, Manggarai Regency, amounted to Rp 101,443,000, with an average expense per farmer of Rp 2,254,288. This indicates that expenses in Ranaka Village are higher compared to Tina Bani Village due to differences in agroforestry needs. In Ranaka Village, expenses are dominated by labour and fertiliser costs, which are higher to support better agroforestry production. Meanwhile, in Tina Bani Village, transportation expenses constitute the largest proportion of costs.

c) Total Income of Respondents from Agroforestry

Table 3 indicates the total income of respondents from agroforestry land over the past year, specifically in 2023. The total income of the Bu'u Bei HKm community from agroforestry activities over one year amounted to Rp 501,323,500. Total expenses, representing all costs incurred by farmers during agroforestry production over the same period, reached Rp 29,870,500 per year.

Agroforestry crops provide a diverse range of income for the community due to variations in their economic value and production volume. There are two categories of farming: subsistence farming and commercial farming. Commercial farming focuses on cultivating crops primarily for sale rather than personal consumption, whereas subsistence farming involves producing crops mainly for the farmers' consumption (Aulia, 2021).

The commercial crops sold by the community include Arabica coffee, Robusta coffee, vanilla, cocoa, cloves, candlenut, and ginger. In contrast, subsistence crops such as cassava, taro, papaya, banana, and chayote are consumed by the farmers themselves as substitutes for staple foods, helping to reduce daily household food expenses.

Forestry crops such as sengon (*Albizia chinensis*), mahogany (*Swietenia macrophylla*), ampupu (*Eucalyptus urophylla*), and gamal (*Gliricidia sepium*) are also classified as subsistence crops. These are not sold but are used as shade trees, construction materials for private homes, and sources of firewood by the community.

Tabel 3. Finansial Summary of Agroforestry Activities

Income component	Total revenue (Rp)/Year	Total expense (Rp)/Year	Total income (Rp)/year
Agroforestry	531.194.000	29.870.500	501.323.500

Source: Primary data analysis, 2024

When constructing homes, two types of buildings were identified: semi-permanent and permanent houses. Semi-permanent houses require approximately 8 cubic metres of wood, while permanent houses require about 4 cubic metres. With the market price of mahogany wood at Rp 3,750,000 per cubic metre, the use of wood from agroforestry land helps farmers save on construction costs.

Gamal trees also serve dual purposes, providing support for vanilla plants to climb and supplying firewood. Thus, the outputs of agroforestry not only generate economic income through the sale of commercial crops but also fulfil basic needs such as food and construction materials, supporting the sustainability of farmers' livelihoods (Mulugeta, 2014; Perangin-Angin et al., 2024).

3) Respondent Income from Non-Agroforestry

a) Income from Supplementary Occupation

The income generated by respondents from supplementary occupation over the past year, specifically in 2023 is presented in Table 4.

Tabel 4. Income Supplementary Occupation

No	Type of work	Number of people	Total income (Rp)/Year	Average income (Rp)/Year
1	Motorcycle taxi	1	2.820.000	2.820.000
2	Small shops	3	10.400.000	3.466.667
3	Construction worker	1	5.000.000	5.000.00
	Total	5	18.620.000	11.286.667

Source: Primary data analysis, 2024

Table 4 shows that there are five farmers who have supplementary occupation. The total income from supplementary occupation for one year is IDR 18,620,000/year and the average income is IDR 11,286,667/year. From this side job, the largest income obtained by the community managing Bu'u Bei HKm is the kiosk business with a total income of IDR 10,400,000/year and an average income of IDR 3,466,667/year. This is because the kiosk business provides daily necessities that have continuous demand, thus providing a stable (continuous) income. Meanwhile, the smallest income is from motorcycle taxis with a total income of IDR 2,820,000/year and an average income that remains at IDR 2,820,000/year. This is because people who work as motorcycle taxis have fewer or non-full working hours.

b) Respondents Expenses for Supplementary Occupation

The expenses incurred by respondents for supplementary occupations over the past year, specifically in 2023. Table 5 shows that the total expenditure for supplementary occupation for one year is IDR 12,900,000/year and the average expenditure is IDR 7,460,000/year. The largest expenditure component of the HKm community for supplementary occupation is kiosk goods with a total expenditure of IDR 8,160,000/year and an average expenditure of IDR 2,720,000/year. Meanwhile, the smallest expenditure is gasoline with a total of IDR 1,800,000/year and an average expenditure of IDR 1,800,000/year.

Tabel 5. Finansial breakdown of supplementary occupation expenses

No	Expense component	Total expense (Rp)/Year	Average expense (Rp)/Year
1	Fuel	1.800.000	1.800.000
2	Shop supplies	8.160.000	2.720.000
3	Materials	2.940.000	2.940.000
	Total	12.900.000	7.460.000

Source: Primary data analysis, 2024

c) Total respondents' income from non-agroforestry

The total income of respondents from supplementary occupation over the past year, specifically in 2023.

Tabel 6. Net Income from Non-Agroforestry

Income component	Total revenue (Rp)/Year	Total Expense (Rp)/Year	Net Income (Rp)/Year
Non-Agroforestry	18.620.000	12.900.000	5.720.000

Source: Primary data analysis, 2024

Table 6 shows that the total income of the Bu'u Bei HKm community from non-agroforestry activities over one year amounted to Rp 5,720,000. This indicates that income generated outside of agroforestry land is minimal. These findings align with the study by Manurung et al. (2023), which reported that income from non-agroforestry activities is generally smaller than income from agroforestry. In their study, non-agroforestry income was Rp 184,800,000 per year, while agroforestry income reached Rp 856,385,000 yearly.

Similarly, research by Palihema et al. (2024) found that the total non-agroforestry income of farmers in Sayoang Village, Bacan Timur Subdistrict, South Halmahera Regency, was Rp 171,271,600 per year, with an average income of Rp 4,177,356 per year per household. These results indicate that non-agroforestry income in Sayoang Village is higher than in Tina Bani Village, likely due to the wider variety of job opportunities available in Sayoang. In contrast, supplementary occupation in Tina Bani are limited to small-scale kiosk businesses, construction work, and motorcycle taxi services, resulting in lower overall non-agroforestry income and a smaller contribution to total household income.

Most Bu'u Bei HKm community members do not engage in supplementary occupation. One key reason is the difficulty of allocating time, as farmers typically leave for their agroforestry fields early in the morning at around 06:10 and return in the evening at approximately 17:50. This routine leaves little opportunity to pursue additional work. Moreover, many community members believe that their income from agroforestry is sufficient to meet their daily needs (WS et al., 2019).

4) Overall Total Income of Respondents

The overall total income of respondents over the past year, specifically in 2023, is summarised in Table 7.

Tabel 7. Summary of Respondents Total Income

No	Income component	Total Income (Rp)/Year	Average Income (Rp)/Year
1	Agroforestry	501.323.500	10.666.458
2	Non Agroforestry	5.720.000	1.144.000
	Total	**507.043.500**	**11.810.458**

Source: Primary data analysis, 2024

Table 7 indicates that the total income of the Bu'u Bei HKm community from both agroforestry and non-agroforestry activities over one year amounted to Rp 507,043,500, with an average annual income of Rp 11,810,458. Overall, income from agroforestry significantly exceeds income from non-agroforestry. The primary source of income for the community comes from the sale of agricultural and plantation crops, which constitute the largest share of their earnings. This reliance is due to the fact that the majority of the Bu'u Bei HKm community depends heavily on agroforestry land to meet their household needs (Lewerissa et al., 2020).

5) Respondents Expenditures on Household Needs

The expenditures of respondets for household needs over the past year, specifically in 2023, are presented in Table 8.

Tabel 8. Household Expenditure Breakdown

No	Expense component	Total expense (Rp)/Year	Average expense (Rp)/Year
1	Food	391.395.200	8.327.557
2	Clothing	47.202.000	4.720.000
3	Education	136.880.000	4.562.667
	Total	**575.477.200**	**17.610.224**

Source: Primary data analysis, 2024

Table 8 shows that the total expenses of the Bu'u Bei HKm community over one year amounted to Rp 575,477,200, with an average annual expenditure of Rp 17,610,224. The largest expense component for non-agroforestry activities was food, totalling Rp 391,395,200 per year, with an average expenditure of Rp 8,327,557 per year. In contrast, the smallest expense was for clothing, amounting to Rp 47,202,000 per year, with an average expenditure of Rp 4,720,000 per year. This indicates that food consumption represents a significantly larger share of expenses compared to non-food items, as food is a fundamental necessity that must be prioritised. Food provides essential energy for human survival (Martina & Yuristia, 2021; Wati et al., 2024).

6) Overall Total Expenditures of Respondents

The overall total expenditures of respondets in 2023 are summarised in tabel 9.

Tabel 9. Total Respondents' Overall Expenditures

No	Expense component	Total Expense (Rp)/Year	Average Expense (Rp)/Year
1	Agroforestry	29.870.500	635.543
2	Non Agroforestry	12.900.000	2.580.000
3	Household needs	575.477.200	12.244.196
	Total	**618.247.700**	**15.459.739**

Source: Primary data analysis, 2024

Table 9 indicates that the total expenditures of the Bu'u Bei HKm community over one year amounted to Rp 618,247,700, with an average annual expenditure of Rp 15,459,739. The largest expenditure component was household needs, totalling Rp 575,477,200 per year, with an average expenditure of Rp 12,244,196 per year. In contrast, the smallest expenditure was for non-agroforestry activities, amounting to Rp 12,900,000 per year, with an average expenditure of Rp 2,580,000 per year.

The relatively high expenditures of the Bu'u Bei HKm community can be attributed to two main factors: household needs and agroforestry-related expenses. Household expenditures primarily consist of food, education, and clothing, with food being the top priority as it is a basic necessity required to support daily activities. Agroforestry expenditures, on the

other hand, are dominated by transportation costs due to poor road conditions, which increase transport-related expenses.

7) Comparasion of Total Income and Expenditures

The comparasion of overall total income and total expenditures of all respondents over the past year, specifically in 2023 is summarised in Tabel 10.

Tabel 10. Income vs Expenditure Comparasion

No	Indikator	Total (Rp)
1	Income	507.043.500
2	Expenditures	618.247.700

Source: Primary data analysis, 2024

Table 10 reveals that the expenditures of the Bu'u Bei HKm community exceed the income generated. Broadly speaking, income from agroforestry is used to cover both agroforestry-related and non-agroforestry expenses. However, the high household expenditures are disproportionate to the income received, resulting in agroforestry income being allocated to cover overall household expenses. The total household income accounts for 82.01% of total expenditures.

Despite overall household expenditures surpassing income, Table 10 shows that the Bu'u Bei HKm community can still meet their basic needs, thanks to the agroforestry land they manage. The produce from agroforestry helps offset daily necessities without complete reliance on market purchases. Agroforestry contributes to food and economic security for the community, directly reducing their financial burden even though total income remains lower than total expenditures.

8) Contribution of agroforestry to respondents' Income

The contribution of agroforestry refers to the income derived from agroforestry activities that support the livelihoods of the community. The contribution of agroforestry to the income of the Bu'u Bei HKm community can be determined by dividing the total income from agroforestry by the overall income of the community and multiplying the result by one hundred percent.

$$I_{af}\ \% = (I_{af}/I_{tot}) \times 100\%$$

$$I_{af}\ \% = (\frac{501.323.500}{507.043.500}) \times 100\%$$

$$= 98{,}87\%$$

Using the formula above, agroforestry contributes 98.87% per year to the income of the Bu'u Bei HKm management community.

See Figure 2, where agroforestry components make a significant contribution to the income of the Bu'u Bei HKm community, amounting to 98.87%, or approximately Rp 501,323,500 per year of the total household income. In contrast, non-agroforestry components contribute only 1.13% of the total household income, or around Rp 5,720,000 per year. This high dependency on agroforestry land means that the community prioritises agroforestry activities over supplementary occupation. The combination of crops on agroforestry land provides sustainable yields, supported by a variety of plants with different harvest periods (Sahureka & Wattimena, 2024).

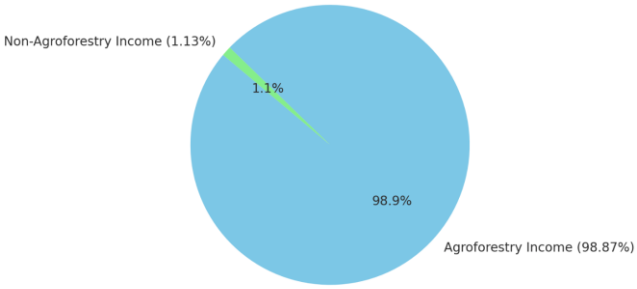

Figure 2. Persentage contribution of Agroforestry and Non-Agroforestry income (2023)

This combination enhances land productivity and reduces the risk of crop failure, resulting in long-term benefits. This finding aligns with the study by Yundari et al. (2022), which highlights that the diversity of crop species in agroforestry systems is highly advantageous for farmers. The varying harvest times of different commodities enable farmers to receive daily income from food and horticultural crops, as well as long-term income from annual plantation crops. Another benefit of agroforestry systems is the low risk of crop failure, as yields from other crops can offset potential losses in specific commodities (Yundari et al., 2022).

4. Conclusion

The research findings reveal that the agroforestry land management practices in Tina Bani Village are typified by a single agroforestry system, specifically the agrisilviculture system, which is structured with a randomly mixed planting pattern. Generations pass down this pattern, planting various crops randomly and without order (not necessarily following rows or lines as in monoculture systems). Past generations' innate knowledge and practices, reflected in the random mixture, highlight the significance of the path dependency that shapes current agricultural practices.

Furthermore, the agroforestry system made a substantial economic contribution, accounting for 98.87% of the income of the Bu'u Bei HKm management community, which equates to approximately Rp 501,323,500 per year of the total household income. This result highlights agroforestry's critical role in supporting HKm community livelihoods. The diverse and unstructured crop combination within the Random Mixture pattern enhances land productivity and provides a sustainable source of income, mitigating the risk of crop failure and ensuring economic resilience. These findings emphasise the potential of agroforestry to improve rural community welfare while preserving traditional agricultural practices and promoting environmental sustainability.

5. Author Contributions

The first author contributed to the writing, conceptualisation, and data analysis. The second and

third authors provided guidance and insights during the writing process. The fourth author was responsible for data curation and validating the analysis.

6. Completing Interests

The authors declare that there is no conflict of interest throughout the entire research process.

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