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Analysis the Productivity and Income of Candlenut Farmers in the HKm Nggahi Rawi Pahu KPHL Maria Donggo Massa in Bima Regency

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A B S T R A C T

This study aims to analyze the productivity and income of candlenut farmers in the Nggahi Rawi Pahu Community Forest (HKm), Maria Donggo Massa Forest Management Unit (KPHL), Bima Regency. Candlenut (*Aleurites moluccana*) is one of the Non-Timber Forest Products that has high economic value and has long been utilized by local communities around the forest. The research method was descriptive quantitative, with data collected through observation, interviews, and questionnaires involving 61 candlenut farmers. The results show that candlenut productivity varies according to land area, with the highest productivity reaching 1,884.30 kg/ha on land less than 0.5 hectares. The average net income of candlenut farmers is IDR 8,585,557.38 per year, with revenues amounting to IDR 9,796,733.61 and production costs of IDR 1,058,852.46 per year. Factors such as land area, number of trees, and cultivation techniques influence the productivity and income of farmers. The study concludes that more intensive land management on small plots yields higher productivity, while larger plots require better management to improve harvest outcomes. Recommendations include enhancing land management efficiency, providing cultivation training, and strengthening government support to improve the productivity and income of candlenut farmers

INTRODUCTION

Non-Timber Forest Products (NTFPs) are forest products other than timber that play an important role in supporting the lives of communities around the forest. (Permenhut No. 35 Tahun 2007) NTFPs is used both for consumption and sold as an additional source of income. This product includes consumable materials such as sago, fruits, vegetables, and traditional medicines, as well as commercial products like rattan, resin, agarwood, honey, and essential oils. The use of non-timber forest products continues to grow because the capital required is relatively small to medium, making it easily accessible to people with limited economic resources. (Pratiwi, 2022) Beside improving welfare, NTFPs also supports the principles of sustainable forest management and serves as a solution to tenure issues in forest areas. (Yanti et al., 2023)

One of the flagship NTFPs commodities widely cultivated by the community is candlenut (Aleurites moluccana), almost all parts of which have practical value, ranging from traditional medicine and kitchen spices to beauty products. (Makkarennu et al., 2020) Candlenut is also considered a fast-growing plant, making it easy for forest farmers to cultivate. (Anwar & Noor, 2014)

In Bima Regency, West Nusa Tenggara (NTB), candlenut is among the leading NTFPs commodities along with honey, tamarind, rattan, and turmeric. (Samsudin & Wanitaningsi, 2019) The local government has even designated candlenut as one of the strategic commodities with great potential to increase the income of communities living near the forest, most of whom live in poverty and have limited public access. (Markum et al., 2015) This plant plays an important role as a sustainable and high-value economic resource for communities around the forest. (Awaludin, 2024)

The Nggahi Rawi Pahu Community Forest (HKm), managed by the Maria Donggo Massa KPHL, is an area managed by the community since 2012 thru the social forestry program. It covers an area of 2,915 hectares, with over 200 households utilizing it for food crops, plantations, and conservation. In addition to forestry crops, farmers are developing productive commodities such as candlenut, coffee, vanilla, and cocoa thru agroforestry systems. Nevertheless, the development of candlenuts in this area still faces obstacles such as low productivity due to traditional technology, market price fluctuations, and limited supporting infrastructure.

Based on these conditions, this study aims to analyze the productivity and income of candlenut farmers in the Nggahi Rawi Pahu HKm area, Maria Donggo Massa KPHL, Bima Regency. The research results are expected to serve as an information source for the development of the candlenut business, while also providing input for efforts to improve the welfare of farmers in the region.

LITERATURE REVIEW

Non-Timber Forest Products (NTFPs) are forest products other than timber, encompassing various types of biological and non-biological products such as rattan, bamboo, sap, honey, forest fruits, and animal products like swiftlet nests. (Wibowo et al., 2023). Based on the Minister of Forestry Regulation Number P.35/Menhut-II/2007, HHBK includes both plant and animal forest products and their derivatives, excluding wood from forests. NTFPs has significant benefits in terms of economics, ecology, and society, as its utilization can be a source of income for the community, maintain ecosystem balance, and improve well-being thru the development of NTFPs-based industries. (Riki et al., 2023)

To optimize the utilization of Non-Timber Forest Products (NTFPs), the government issued the Minister of Environment and Forestry Regulation (KLHK) Number 77 of 2019, which regulates the utilization of NTFPs in production forests and their collection in state forests. This regulation provides a clear legal framework for managing NTFP with legal permits, appropriate procedures, and sustainability principles. With this regulation in place, it is hoped that the management of Non-Timber Forest Products (NTFPs) can be structured, sustainable, and provide maximum benefits for society and the environment. (Khaira, 2022)

The candlenut tree is a monoecious plant that can grow up to 25–40 m tall, with a trunk that lacks buttresses and has reddish-brown bark with deep grooves. The leaves are simple, arranged alternately with varying shapes from lanceolate to shallowly lobed 3–5 times, measuring 6–30 cm × 3–28 cm, with smooth or slightly serrated edges, and possessing glands that produce sweet sap at the end of the petiole. The inflorescence is in the form of conical or pyramidal thyrses, terminal, with fragrant unisexual flowers ranging in color from white to cream; male flowers are smaller with 17–26 stamens arranged in 4 circles, while female flowers are larger with nearly round, densely hairy ovaries. The fruit is a drupe, ovoid in shape with 4–6 longitudinal ribs, gray seeds with brown spots measuring 2–3.2 cm, and abundant endosperm. (Mustaqim & Yus, 2021)

Productivity is the ratio of output to input over a specific period, with efficiency being the ability to minimize resources for maximum results and effectiveness being the success in achieving goals (Vivi, 2018). In agriculture, productivity is influenced by soil fertility, crop type, fertilizer use, water availability, farming systems, technology, and access to agricultural services. Economically, productivity determines crop yields, income, and costs, where productive agribusiness is characterized by the optimal utilization of land, capital, and technology. Increased productivity demands business efficiency, sustainable innovation, and technological advancements to make production processes more effective and support sustainable development, while keeping labor costs down and adhering to an appropriate remuneration system. (Masnilam, 2020)

According to Decree No. 52/07/03/2014/KTH.075/2017 HKm Nggahi Rawi Pahu was established on January 1, 2018, located in North Maria Village, Wawo District, Bima Regency. The area managed by KTH Nggahi Rawi Pahu is 494 hectares. HKm Nggahi Rawi Pahu has a Farmers' Group Association

(Gapoktan) called Gapoktan Nggahi Rawi Pahu. The formation of Gapoktan is the first step in improving the skills of each farmers' group in carrying out their duties, expanding excellence in improving and empowering groups, and creating resilient and independent farmers.

METHODOLOGY

This research was conducted in the Nggahi Rawi Pahu Community Forest (HKm), Raba Village, Wawo District, Bima Regency. This location was chosen because it is one of the social forestry areas managed by the community, with the main commodity being candlenut. The tools used in the research consisted of stationery, a camera, a voice recorder, and a questionnaire to assist in the data collection process. The respondents in this study were farmers who are members of the Nggahi Rawi Pahu Forest Farmers Group (KTH), who also served as the research object.

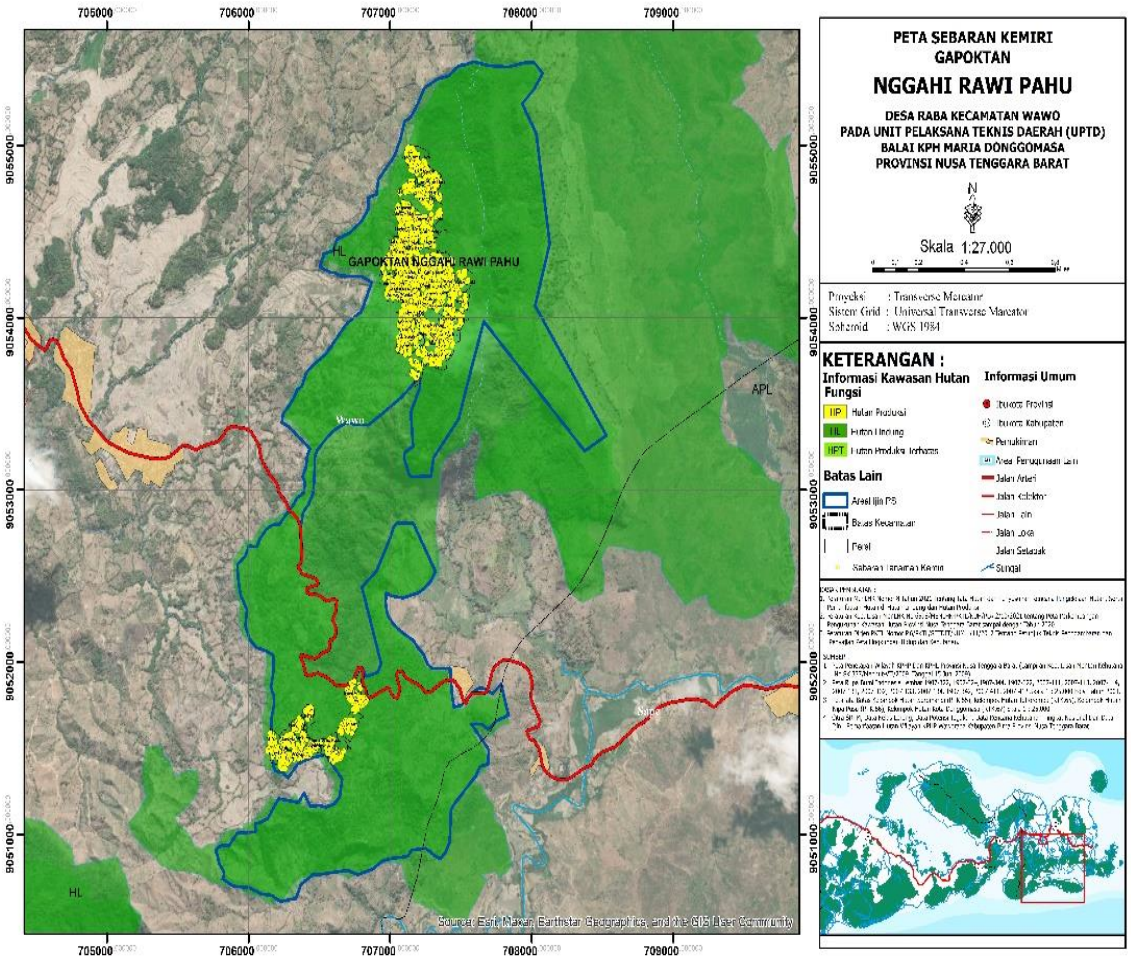

Figure 1. Research Location Map

The method used is descriptive with a quantitative approach. The descriptive method is used to systematically and accurately describe the conditions that occur in the field, while the quantitative approach is used to analyze the numerical data obtained from respondents. (Wajdi et al., 2024) The study population consists of all members of the Nggahi Rawi Pahu Forest Farmers Group, totaling 478 people. (Sugiyono, 2017) The sample size was determined using Slovin's formula at an error level of 15%, resulting in 61 respondents. The type of data used is qualitative data, which was then quantified for analysis purposes. Primary data was obtained thru in-depth interviews, observation, and questionnaires, while secondary data was obtained thru literature studies referring to documents, journals, books, and publications from relevant institutions. Data collection techniques include direct observation of farmers' conditions. (Sudarsono, 2016) literature review from various written sources (Mirzakon, 2017) interviews to gather more in-depth information, as well as the distribution of questionnaires (Sugiyono, 2017) The research variables include two main aspects: productivity and income. Productivity variables encompass land area, number of candlenut trees, productive age, planting distance, seed production, and harvest time. Income variables, on the other hand, include the number of trees, production, productive age, fixed costs, variable costs, and selling price.

Data analysis in this study focused on two main aspects: land productivity and farmer income. Land productivity is calculated to determine the potential yield of macadamia nuts per unit area. According to Sinungan (2003) Productivity is defined as the output obtained from a given input per unit area. The calculation uses the formula:

$$Productivity = \frac{Total\ production\ (kg)}{Land\ area\ (ha)} \quad (1)$$

where: productivity is the yield of cultivated land measured in kilograms per hectare, total production is the total amount of candlenut harvested by farmers in one year, and land area is the total area of cultivated land owned by farmers in hectares. The calculated productivity results were then grouped based on the age interval of the candlenut trees, namely 1–5 years old, over 5–10 years old, over 10–15 years old, and over 15 years old.

Farmers' income is analyzed by calculating the difference between total revenue and total cost. The formula used refers to (Septiadi & Yusuf (2023)

$$I = TR - TC \quad (2)$$

where: I is the farmer's net income in rupiah, TR is the total revenue from the sale of cashew nuts in rupiah per year, and TC is the total production cost in rupiah per year.

To calculate the total production cost, the following formula can be used:

$$TC = FC + VC \quad (3)$$

where: TC is the total cost of production, FC is the fixed cost including depreciation and land rent, and VC is the variable cost consisting of labor, fertilizer, and crop maintenance costs.

To calculate the amount of farm income, the following formula can be used:

$TR = P\ x\ Q$ ..... (4)

where: TR is the total revenue in rupiah per year, P is the selling price of nutmeg per kilogram, and Q is the production quantity in kilograms per year.

RESULTS AND DISCUSSION

Raba Village is one of nine villages in the eastern part of Wawo District, Bima Regency, with an area of 19.95 km² or 15.08% of the total district. This village is bordered by Kambilo Village to the north, Kalodu Village to the south, Kombo Village to the west, and Sari Village (Sape District) to the east. It is approximately 5.2 km from the district center and 40 km from the capital of Bima Regency. Most of the population of Raba Village works as farmers, gardeners, and ranchers. Agricultural traditions have been passed down thru generations and have become a social identity for the community. The main commodities cultivated are rice, both in paddy fields and mountainous areas, generally once a year. Some women also work as rice harvest laborers to supplement their family income. The population in 2023 was recorded at 2,753 people, consisting of 1,420 males and 1,333 females, with a sex ratio of 107 and a density of 138 people/km². Population growth is driving the expansion of settlements, causing some agricultural land, plantations, and community forests to be converted into residential areas and socio-economic facilities. Raba Village has a climate with two seasons: the dry season (July–October) and the rainy season (November–February). The average air temperature reaches 37°C with 30–33% humidity and annual rainfall of 35–36 mm. Although public awareness of forest sustainability is quite high, forest products are still being exploited, leading to a decrease in water sources. Economic mobility is quite smooth thanks to county road access and village infrastructure development thru PNPM, which supports the transportation of agricultural products (BPS, 2024).

Respondent Characteristics

The size of land owned by farmers is directly proportional to their income level. The larger the land area managed, the greater the potential harvest yield and income. Based on Table 1, the majority of candlenut farmers in HKm Nggahi Rawi Pahu have land with an average size of 0.94 hectares. This amount is still considered small compared to the provisions of the Minister of Environment and Forestry Regulation Number 09 of 2021 concerning Social Forestry Management, which allows ownership of up to 15 hectares per household.

Table 1. Area of Cashew Farmers' Land in the Nggahi Rawi Pahu HKm

No.	Interval (Ha)	Number of Responden (People)	Percentage (%)
1	< 0,5	3	4,92
2	0,5 - 1	33	54,10
3	1 - 2	25	40,98
Total		**61**	**100,00**

Experience in managing land also influences farmers' decisions and attitudes. The results in Table 2 show that the average cashew farmer has been cultivating their land for 20 years. Most (60.66%) have even been farming for over 20 years. This indicates that cashew farmers in HKm Nggahi Rawi Pahu have extensive experience and a close relationship with the forest as a source of livelihood, both for food and non-timber forest products. (Sasmita, 2021)

Table2. Long Time Working with Cashew Farmers in HKm Nggahi Rawi Pahu

No.	Interval (Ha)	Number of Responden (People)	Percentage (%)
1	10 - 20	24	39,34
2	> 20	37	60,66
Total		**61**	**100,00**

Production and Productivity of Pecan Plants

The number of candlenut trees owned by farmers directly affects production. Based on Table 3, the majority of farmers have 41–60 trees, with an average of 47 trees per respondent. Of this number, the average productivity reaches 21 kg of shelled beans per tree. The candlenut plant itself can grow well at an altitude of 0–800 meters above sea level with an annual rainfall of 1,500–2,400 mm and a temperature of 20–27°C, making it very suitable for the land ctondiions in HKm Nggahi Rawi Pahu. (Rosman dan Sudiman, 2002 dalam Ferry, 2019)

Table 3. Number of Farmers' Candlenut Trees in the Nggahi Rawi Pahu HKm

No.	Interval of Candlenut Quantity	Number of Responden (People)	Percentage (%)
1	20 - 40	15	24,59
2	41 - 60	44	72,13
3	61 - 80	2	3,28
Total		**61**	**100,00**

The productive age of the plant determines the yield level. Table 4 shows that the majority of betel nut trees are in the 20–25-year age group (49.18%), which is considered the optimal production phase. Meanwhile, the number of young trees is still limited, so regeneration is not yet maximized. The productive lifespan of coconuts generally reaches 25–40 years, and can even last up to 80 years, although rarely. (Ibrahim, 2019).

Table 4. Productive Age of Nutmeg Farmer's Plants in the Nggahi Rawi Pahu HKm

No.	Age Interval of Candlenut (Years)	Number of Responden (People)	Percentage (%)
1	10 - 15	23	37,70
2	15 - 20	8	13,11
3	20 - 25	30	49,18
Total		61	100,00

The production of betel nuts is influenced by land area, number of trees, plant age, and cultivation techniques. Based on Table 5, the majority of farmers (65.57%) are only able to produce 300–900 kg per year. High production, exceeding 2 tons per year, is only achieved by a small number of farmers. Average production reaches 999 kg per year, still far below optimal potential. According to Sunanto (1994) and Paimin (1997; dalam Sutejo, 2023) Nut production can reach 2 tons of nuts per hectare or about 200 kg of shelled nuts per tree. However, after the trees are over 50 years old, their productivity will decline.

Table 5. Production Volume of Farmers' Candlenuts in the Nggahi Rawi Pahu HKm

No.	Production Interval of Candlenuts (Kg/Year)	Number of Responden (People)	Percentage (%)
1	300 - 900	40	65,57
2	900 - 1500	15	24,59
3	1500 - 2100	2	3,28
4	2100 - 2700	1	1,64
5	2700 - 3300	1	1,64
6	3300 - 3900	0	0,00
7	3900 - 4500	2	3,28
Total		**61**	**100,00**

The productivity of cashew farmers can be influenced by various factors, one of which is the area of land they manage. Cashew land productivity is obtained by dividing the total production by the area of cultivated land owned by the farmers.

Table 6. Analysis of Cashew Farmer Productivity Based on Land Area and Production Yield

No.	Land Area (Ha)	Number of Farmers (People)	Total Land Area (Ha)	Production Volume (Kg)	Productivity (Kg/Ha)
1	< 0,5	3	1,30	2.930	2.253,85
2	0,5 - 1	33	23,79	34.450	1.448,09
3	> 1	25	32,51	23.560	724,70
Total			**57,60**	**60.940**	

Based on Table 6, it is known that farmers with land ownership of less than 0.5 hectares have higher production yields, while conversely, farmers with larger land areas achieve lower productivity. This can be attributed to the fact that more intensive land management on a small scale can result in better productivity compared to larger land areas that are managed less optimally. The area of agricultural land will affect the scale of the business, which will ultimately influence the efficiency of an agricultural enterprise. (Soetriono *et al*, 2006) On very large land areas, due to difficult access conditions, labor is not able to apply fertilizer freely, resulting in uneven distribution and concentration in only certain locations. Similarly, with the administration of medication and spraying. Efforts to increase productivity in agroforestry systems are made by implementing improvements in management so that the results obtained exceed previous practices. Additionally, environmental services that provide long-term benefits are also an important consideration. However, in some cases, short-term economic gains are often the determining factor for farmers in accepting and adopting new management methods. (Jarwinto, 2015)

Income of Cashew Farmers

Table 7. Analysis of Cashew Farmers' Income

No.	Description	Score
1	**Costs (TC)**	
	a. Fixed Costs (FC)	
	– Land Rent (Rp)	690.000,00
	– Worker Wages (Rp)	-
	– Equipment Depreciation (Rp/Year)	18.972,18
	Total Fixed Costs (Rp)	708.972,18
	b. Variable Costs (VC)	
	– Fertilizer (Rp)	-
	– Pesticides (Rp)	-
	– Maintenance (Rp)	150.000,00
	Total Variable Costs (Rp)	150.000,00
	c. Total Biaya (FC+VC) (Rp)	**858.972,18**
2	**Revenue (TR)**	
	– Average production (Kg/Ha/Thn)	1.058
	– Average price of candlenuts (Rp/Kg)	9.850
	Total Revenue (Rp)	**10.421.163,19**
3	**Income (I)**	**9.562.191,01**

Based on Table 7, the analysis of cashew farmers' income in HKm Nggahi Rawi Pahu shows that the average farmer's revenue (Total Revenue/TR) is Rp 10,421,163.19/year, with production costs (Total Cost/TC) of Rp 858,972.18/year. Therefore, the net income of cashew farmers (TR-TC) reaches Rp 9,562,191.01/year. This indicates that cashew farming in HKm Nggahi Rawi Pahu provides significant profits for farmers. The relatively high net income reflects that production costs are still within efficient limits compared to the results obtained. Farmers' income in the HKm system is often influenced by several key factors, namely land area, crop productivity, market access, and farmer institutions. The size of land owned by farmers directly affects the amount of production and total income earned. Research shows that farmers with larger landholdings tend to have higher incomes, although effectiveness in land management is also a determining factor. (Irawan et al., 2017)

In addition, commodity diversification is one of the important strategies for increasing the income of HKm farmers. Farmers who rely on a single type of crop often experience high income fluctuations due to changes in market prices and weather factors. Therefore, land management that combines several high-value economic commodities, such as cocoa and coffee, has proven to increase the stability of farmers' incomes. (Hutagaol & Tarigan, 2019) From a macroeconomic perspective, the income of HKm farmers is also influenced by market conditions and government policies. Farmers' dependence on fluctuating market prices is a major challenge in improving their welfare. Therefore, interventions in the form of more stable price policies, access to agricultural business credit, and business management training can be solutions to increase the income and welfare of HKm farmers. (Nurhayati, 2022)

CONCLUSIONS AND RECOMMENDATIONS

The research results show that the productivity of candlenut plants in the Nggahi Rawi Pahu HKm varies depending on land area. The highest productivity was found among farmers with land <0.5 ha, at 2,253.85 kg/ha, while the lowest productivity was on land >1 ha, at 724.70 kg/ha. This indicates that small landholdings tend to be managed more intensively, while large landholdings have low productivity due to limitations in management and labor. The average income of cashew farmers reached Rp 10,421,163.19 per year, with production costs of Rp 858,972.18, resulting in a net income of Rp 9,562,191.01 per year.

This income level is highly influenced by the number of plants, productivity per hectare, and the market selling price of candlenuts. For cashew farmers in the Nggahi Rawi Pahu HKm, there is a need to improve land management efficiency, especially for larger landowners, by implementing better land management techniques to optimize harvest yields. The government and policymakers are also expected to play an active role in supporting farmers' productivity and income thru technical assistance, efficient cultivation training, and the use of modern agricultural technology to make land management more sustainable and profitable.

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