

Agribusiness of Cocoa Based on Post-Harvest Processing in Intercropping Farming Systems

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Abstrak: Cocoa is a leading plantation commodity that plays a vital role in supporting the national economy, serving as the primary income source for smallholder farmers and as the essential raw material for the chocolate processing industry. This study aims to analyze the feasibility of cocoa agribusiness based on post-harvest processing through cocoa bean fermentation within an intercropping system in Mundeh Village, West Selamadeg District, Tabanan Regency. Primary data were collected through field observations, interviews, and production cost recording, while secondary data were obtained from literature and relevant documentation. Qualitative descriptive analysis was used to describe post-harvest processing activities, while cost, revenue, profit, and R/C Ratio analyses were employed to assess business feasibility. The results indicate that the total production cost per cocoa bean fermentation cycle is IDR 6,721,500, with variable costs being the dominant component. Total revenue reached IDR 8,400,000, resulting in a profit of IDR 1,678,500 per production cycle. The R/C Ratio value of 1.25 indicates that the business is economically feasible. The implementation of an intercropping system positively affects farmers' income stability and operational efficiency, although effective management of time and labor is required. This study confirms that post-harvest processing through fermentation can enhance the quality, added value, and welfare of cocoa farmers.

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1. Introduction

Cocoa is a leading plantation commodity that plays a vital role in supporting the national economy, primarily serving as a significant income source for smallholder farmers and the essential raw material for the chocolate processing industry. As one of the world's largest cocoa producers, Indonesia demonstrates that the majority of cocoa production originates from small-scale farmers characterized by limited landholdings and diverse cultivation techniques, including the implementation of intercropping systems as a crop diversification strategy [1] the intercropping system is frequently adopted by farmers as it optimizes land utilization, enhances resource efficiency, and contributes supplementary income from other commodities—such as coffee, nutmeg, and other catch crops—thereby bolstering the economic stability of the farmers [1]

Cocoa bean fermentation is a critical post-harvest stage in determining the final quality of the beans, as this process develops the characteristic chocolate aroma and flavor that dictate its market value internationally [2]. Proper fermentation enhances the quality of cocoa beans to meet market standards, resulting in a higher selling price compared to unfermented beans. This process facilitates the formation of aroma compounds and distinctive chocolate flavors, which serve as key determinants of price in both domestic and international markets [3]. From an agribusiness perspective, the implementation of fermentation not only improves product quality but also contributes to increased value-added, business efficiency, and farmers' income. Fermented cocoa beans tend to command higher prices due to their superior quality over non-fermented counterparts, thereby providing greater economic value-added for farmers. Research in East Lampung indicates

that the application of fermentation techniques increases the selling price of cocoa beans by approximately 52.17% and significantly boosts the income of smallholder farming operations [4]

Intercropping is an agricultural cultivation system involving the simultaneous planting of two or more crop species on the same plot of land within a single growing season. This system is implemented through the strategic arrangement of plant spacing, planting schedules, and specific crop combinations to minimize inter-plant competition and enhance the efficiency of environmental resource utilization [5] the application of intercropping provides production diversification, which stabilizes farmers' income by reducing dependence on a single commodity [6] In addition to improving land-use efficiency, intercropping can mitigate the risk of harvest failure caused by pests, diseases, and drought. Furthermore, intercropping systems can utilize shade trees to create optimal environmental conditions for cocoa plant growth while potentially increasing the diversification of agricultural yields [7]

Nevertheless, challenges in implementing fermentation within intercropping systems persist, including constraints such as limited time and labor, disparate harvesting schedules across commodities, and a lack of adequate post-harvest facilities [8]. These factors often lead farmers to prefer selling cocoa beans in wet or unfermented forms due to faster turnover and lower operational costs, despite the relatively lower income generated. However, if managed effectively through coordinated harvesting schedules, enhanced technical skills, and improved market access, intercropping systems can actually support the development of fermented cocoa agribusiness. This approach enables efficient resource utilization and provides more stable income for farmers.

2. Methodology

2.1 Research Location

This research was conducted at the Taman Sari Cocoa Farmers Group, located in Mundeh Village, West Selemadeg District, Tabanan Regency. The site selection was determined through purposive sampling, a technique for deliberate sample selection based on specific criteria or considerations. The primary considerations were that the Taman Sari Cocoa Farmers Group implements intercropping systems within their cocoa agribusiness and actively engages in post-harvest processing practices, such as cocoa bean fermentation.

2.2 Data Collection Methods

The data collection methods in this study were carried out to obtain primary and secondary data relevant to the research objectives [9]. Primary data were collected directly from cocoa farmers through field observations, interviews, and recording of the costs associated with fermented cocoa bean processing. Observations were conducted to directly examine the cocoa post-harvest processing activities, particularly the fermentation stages of cocoa beans, the facilities and infrastructure used, and the intercropping farming patterns applied by farmers.

Meanwhile, secondary data were obtained through literature review and documentation sourced from farmer group reports, scientific publications, books, journals, and supporting data from related institutions concerning cocoa agribusiness and post-harvest processing. These secondary data were used to strengthen the analysis and provide a theoretical foundation for the discussion of the research findings.

2.3 Respondents

The respondents in this study were cocoa farmers who are members of the Taman Sari Cocoa Farmer Group in Mundeh Village, West Selemadeg District, Tabanan Regency. Respondents were selected using purposive sampling, which is a sampling technique based on specific considerations aligned with the research objectives. The selected respondents met the criteria of being cocoa farmers who apply an intercropping farming system and have conducted or previously conducted post-harvest processing in the form of cocoa bean fermentation.

2.4 Qualitative Descriptive Analysis

Qualitative descriptive analysis is an analytical method used to describe and explain research conditions based on non-numerical data, such as interview results, observations, and documentation [10]. This method aims to gain an in-depth understanding of actual field conditions through narrative

explanations. It is appropriate for research that emphasizes understanding processes and real conditions that cannot be measured quantitatively but can be described through respondents' experiences and information.

In this study, qualitative descriptive analysis was used to explain the post-harvest cocoa processing activities carried out by farmers in Mundeh Village, West Selemadeg District, Tabanan Regency, particularly in the production of fermented cocoa beans. The analysis focused on the fermentation techniques applied, the duration of fermentation, the facilities used, and the constraints faced by farmers, thereby providing a comprehensive overview of cocoa agribusiness practices based on post-harvest processing.

2.5 Cost Analysis

Cost analysis is used to calculate all cost components incurred in the fermentation process of cocoa beans by cocoa farmers in Mundeh Village, West Selemadeg District, Tabanan Regency. This analysis includes fixed costs (TFC) and variable costs (TVC), so that the total production cost (TC) can be comprehensively calculated[11]. The purpose of this cost analysis is to determine the total expenditure required in the production process so that it can be compared with the output value and the value added generated [12].

Basic Formula:

$$TC = TFC + TVC$$

Explanation:

TC = *Total Cost*

TFC = *Total fix cost*

TVC = *Total Variable Cost*

1. Fixed Cost

Fixed cost is a cost that does not change even when the level of production changes [13]. In the cocoa bean fermentation process, the fixed cost components include: depreciation of fermentation equipment (wooden boxes, tarpaulins, mixing tools), depreciation of drying equipment (drying racks, tarpaulins), and depreciation of other supporting equipment such as containers and other auxiliary tools.

2. Variable Cost

Variable cost is a cost that changes according to the amount of raw materials processed. The TVC components in the cocoa bean fermentation process include the price of wet cocoa beans (Rp/kg) [9], fermentation labor wages (daily operational work)[11], the cost of supporting materials such as banana leaves, jute sacks, and plastic.

2.6 Income Analysis.

The data obtained from the cost analysis were further analyzed using revenue analysis and profit analysis [14]

Adapun analisis penerimaan dan analisis pendapatan sebagai berikut:

Revenue

The revenue and income analyses are described as follows:

$$R = P \times Q$$

Explanation:

R = Revenue

P = Price

Q = Quantity

Income

The amount of income earned is calculated using the following formula:

$$\Pi = TR - TC$$

Explanation:

Π = Profit

TR = Total Revenue

TC = Total Cost

2.8 Business Feasibility Analysis

The feasibility analysis of cocoa agribusiness based on post-harvest processing is conducted to assess whether the fermented cocoa bean business is economically viable for development. Business feasibility is analyzed using the following feasibility indicator:

Basic formula:

$$R/C \text{ Ratio} = TR/TC$$

TR = Total Revenue

TC = Total Cost

If the result is greater than one, the net benefits obtained exceed the costs incurred; therefore, the business is considered feasible to operate. [15]

3. Results and Discussion

3.1 Total Cost of Cocoa Bean Fermentation Business

The cost components in the cocoa bean fermentation business are classified into fixed costs and variable costs. Fixed costs represent expenditures that remain relatively unchanged in each production period, such as depreciation of fermentation equipment and other supporting tools. Meanwhile, variable costs are costs whose magnitude is influenced by production volume, such as raw material costs, production inputs, and labor. This cost structure classification is important to evaluate business efficiency and the potential for production cost control. The following table presents the total fixed costs of cocoa bean fermentation:

Table 1. Total Depreciation Cost of Equipment (FC) for Cocoa Bean Fermentation

No	Type of Equipment	Quantity	Purchase Price (Rp)	total	Economic Life (Months)	Depreciation Value (Rp)
1	Fermentation box	4	530.000,00	2.120.000,00	60	35.333
2	Bamboo basket	3	30.000,00	90.000,00	36	2.500
3	Plastic basket	2	30.000,00	60.000,00	36	1.666
4	Jute sack	7	16.000,00	112.000,00	36	3.111
5	Sack	2	2.000,00	4.000,00	36	111
6	Tarpaulin	5	100.000,00	500.000,00	36	13.888
8	Scissors	2	30.000,00	60.000,00	36	1.666
9	Machete	2	40.000,00	80.000,00	36	2.222
Total						60.500

Table 1 shows that fixed costs in the cocoa bean fermentation business originate from the use of various equipment supporting the fermentation and drying processes. These include fermentation boxes, bamboo baskets, plastic baskets, jute sacks, tarpaulins, and other supporting tools that are repeatedly used in each production cycle. The depreciation value of each piece of equipment is calculated based on the purchase price, number of units, and the economic life of the equipment.

The analysis results indicate that the total equipment depreciation cost incurred in one production cycle is IDR 60,500. This value reflects the amount of fixed cost that must be borne by farmers even when production volume changes. However, the proportion of this fixed cost is relatively small compared to the total business cost, and therefore it does not constitute a dominant cost component in the cocoa bean fermentation business.

Table 2. Data Tabulation of Cocoa Bean Fermentation Business per Production Cycle

No	Cost Type	Unit	Quantity (Unit)	Price (Rp)	Total (Rp)
A	Biaya Variabel				
1	Sarana Produksi				
	a. Wet Cocoa Beans	(Kg)	220	30.000,00	6.600.000
	b. Banana Leaves	(stalks)	4	1.000,00	4.000
	c. Plastic Inner	(pcs)	1	2.000,00	2.000
	d. Sack	(pcs)	1	5.000,00	5.000
	Total Production Inputs	(Rp)			6.611.000
2	Labor				
	a. Family labor	(work-day)	1	50.000,00	50.000
	b. Hired labor	(work-day)			
	Total Tenaga Kerja	(Rp)			50.000
	Total Variabel Cost				6.661.000
B	Fixed Cost				
1	Equipment Depreciation	(Rp)			60.500
	Total Fixed Cost	(Rp)			60.500
	Total Cost Production				
	TC = TFC + TVC	(Rp)			6.721.500

Based on the tabulated data of the cocoa bean fermentation business with a single production cycle, the total production cost incurred by farmers amounts to IDR 6,721,500. This cost consists of variable costs and fixed costs. Variable costs are the largest component in this business, primarily due to production inputs, especially the purchase of wet cocoa beans amounting to IDR 6,600,000, which reflects the high contribution of raw materials to the total production cost. In addition, variable costs also include the use of banana leaves, inner plastic, sacks, as well as labor costs amounting to IDR 50,000.

3.2 Revenue of Cocoa Bean Fermentation Business in Mundeh Village

The revenue of the cocoa bean agribusiness is calculated by multiplying the selling price by the production quantity. The total revenue of the cocoa agribusiness in Mundeh Village, West Selamadeg District, Tabanan Regency, is presented in Table 3.

Table 3. Revenue of Cocoa Bean Fermentation Business

Output Quantity	Price	Total (P x Q)
70kg	Rp 120.000	Rp 8.400.000

Based on the table above, from a single production cycle, the output obtained is 70 kg of fermented cocoa beans sold at IDR 120,000 per kilogram, resulting in a total revenue of IDR 8,400,000 for the farmers.

3.3 Income of Cocoa Bean Fermentation Business in Mundeh Village

The income of the cocoa bean fermentation business in Mundeh Village is calculated as the difference between total revenue and total cost. Total revenue is the income received from the sale of dried fermented cocoa beans, while total cost represents all expenses incurred in the production of fermented cocoa beans. The following table presents the data for the cocoa bean fermentation business:

Table 4. Income of Cocoa Bean Fermentation Business

Revenue	Total cost	Total (TR-TC)
Rp 8.400.000	Rp 6.721.500	Rp 1.678.500

Based on Table 4 above, the revenue from the cocoa bean fermentation business in Mundeh Village is IDR 8,400,000, and the total cost amounts to IDR 6,721,500. Thus, the Taman Sari Cocoa Farmer Group in Mundeh Village earns an income of IDR 1,678,500 per production cycle from the cocoa bean fermentation business.

3.4 Feasibility of Cocoa Bean Fermentation Business

The feasibility of the cocoa bean fermentation business was analyzed using the Revenue-Cost Ratio (R/C Ratio) method to determine the financial viability of the business. The R/C Ratio of the cocoa bean fermentation business is presented in Table 5:

Tabel 5 R/C Ratio usaha fermentasi biji kakao

Revenue	Total cost	Total (TR/TC)
Rp 8.400.000	Rp 6.721.500	Rp 1,25

Based on the calculation, the R/C Ratio was found to be 1.25, which means that every IDR 1.00 spent generates IDR 1.25 in revenue.

An R/C Ratio greater than one indicates that the cocoa bean fermentation business is economically feasible and profitable to operate and develop[15]. This result suggests that the application of post-harvest processing through fermentation can increase the selling price of cocoa beans and provide additional income for farmers. Therefore, cocoa agribusiness based on post-harvest processing has strong potential to be developed as a strategy for increasing the income and welfare of cocoa farmers, particularly in Mundeh Village, West Selamadeg District, Tabanan Regency.

3.5 The Influence of Cocoa Agribusiness Based on Post-Harvest Processing on the Intercropping System

The Taman Sari cocoa farmer group in Mundeh Village applies an intercropping system with crops such as coffee, banana, porang, and other plants while maintaining cocoa as the main commodity on their land. This is because cocoa generally has a stable market price, especially fermented cocoa beans. Farmers can sell fermented cocoa beans at prices up to IDR 120,000 per kilogram to companies and partner cooperatives. Moreover, the maintenance and post-harvest management of cocoa are relatively easy to perform. Based on interviews, farmers often do not apply fertilizer to cocoa; they only conduct weeding to remove competing weeds that consume nutrients from cocoa trees and carry out regular pruning to prevent excessive tree growth. This practice helps protect cocoa trees from pests and diseases, improves air circulation, and supports optimal growth and productivity.

However, implementing an intercropping system also presents challenges in developing cocoa agribusiness based on post-harvest processing. Differences in harvest times between crops and the high labor demand during certain periods can limit farmers' ability to perform cocoa bean fermentation optimally. Therefore, effective management of time and labor is required to ensure that cultivation and post-harvest processing activities run in a balanced manner.

Overall, the intercropping system has a positive influence on cocoa agribusiness, particularly in enhancing farmers' income stability and operational efficiency. When supported by proper post-harvest processing, especially cocoa bean fermentation, the intercropping system has the potential to serve as a sustainable cocoa agribusiness model that can increase value added and improve the welfare of cocoa farmers.

4. Conclusion

Based on the results of the research and discussion, the following conclusions can be drawn:

1. Cocoa agribusiness based on post-harvest processing through cocoa bean fermentation within an intercropping system in Mundeh Village has good potential for development, as it can improve the quality and selling price of cocoa beans compared to non-fermented products.
2. The cost analysis shows that the total production cost of cocoa bean fermentation is IDR 6,721,500 per production cycle, with a cost structure dominated by variable costs, while fixed costs are relatively small and do not constitute a major burden for the business.
3. The cocoa bean fermentation business generates revenue of IDR 8,400,000 and a profit of IDR 1,678,500 per production cycle.
4. The business feasibility analysis using the R/C Ratio method yields a value of 1.25, indicating that the cocoa bean fermentation business is economically feasible and profitable to operate and develop.
5. The intercropping system has a positive impact on cocoa agribusiness by increasing farmers' income stability through enterprise diversification, although effective management of time and labor is required to ensure that post-harvest processing activities run optimally.

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