E-ISSN 2599-2872; P-ISSN 2549-8150

J-PEN Borneo: Jurnal Ilmu Pertanian

journal homepage: https://jurnal.ubt.ac.id/index.php/jpen

Research Paper 8 (2) (2025) 1-7

Factors affecting cocoa farming income in Metun Sajau Village, Tanjung Palas Timur District, Bulungan Regency

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Submitted/Received: 19 April 2025 ; Accepted: 29 June 2025

ARTICLE INFO

Keywords:

Cocoa

Farm income

Land area

Production

Production cost

ABSTRACT

Cocoa is a strategic plantation commodity that has the potential to improve farmers' income, including in Metun Sajau Village, Tanjung Palas Timur District, Bulungan Regency. This study aimed to analyze production costs, revenue, net income, and the effects of land area, production cost, and production quantity on cocoa farming income. A quantitative survey approach was used. Thirty active cocoa farmers were purposively selected as respondents. Primary data were collected through interviews and structured questionnaires, while secondary data were obtained from supporting documents and relevant literature. Data were analyzed using multiple linear regression after classical assumption testing. The results showed that dried cocoa bean production reached 836.68 kg with a selling price of IDR 90,000/kg, generating total revenue of IDR 75,301,200. Total production cost was IDR 8,770,333, resulting in net income of IDR 66,530,867. Regression analysis indicated that land area had a positive and significant effect on income with a coefficient of 2.166 and a significance value of 0.001. Production cost also had a positive and significant effect with a coefficient of 2.766 and a significance value of 0.002. Production quantity had a positive and significant effect with a coefficient of 2.633 and a significance value of 0.005. Simultaneously, the three variables had a significant effect cocoa farming income. These findings suggest that income improvement can be pursued through land optimization, efficient allocation of production costs, and increased production.

INTRODUCTION

Cocoa (*Theobroma cacao* L.) is one of Indonesia's strategic plantation commodities with high economic value. It serves as a raw material for food and beverage industries, a source of foreign exchange, a provider of employment, and an important source of income for smallholder farmers. Most cocoa farming in Indonesia is still managed by smallholders; therefore, the development of this commodity is closely related to farmers' ability to manage land, increase production, control production costs, and obtain a reasonable income. Cocoa has been widely recognized as an important plantation commodity because it has economic potential, stable market demand, and contributes to regional income [1].

Despite its potential, Indonesian cocoa faces persistent problems. Common constraints include low productivity, inconsistent bean quality, aging trees, pest and disease attacks, limited adoption of cultivation technology, and weak postharvest handling. Previous studies have emphasized that Indonesian cocoa development requires strategies to increase production and improve quality because the sector continues to face declining production, poor bean quality, inadequate crop maintenance, and plant pest problems [2]. Cocoa is also considered an economically important plantation commodity for farmer income and agroindustrial development; therefore, its development should be directed toward more efficient and sustainable production systems [3].

The income problem in cocoa farming is also related to the balance between production costs and output value. Production costs in cocoa farming consist of fixed and variable costs, while farmers' income is calculated as revenue minus total costs [4]. Differences in postharvest treatment, such as fermented and non-fermented cocoa beans, can also affect production, selling price, revenue, and income. These conditions indicate that cocoa development should not rely solely on area expansion, but should also consider productivity, cost efficiency, cultivation technology, output quality, and marketing

systems. The sustainability of smallholder cocoa farming is influenced by relationships among farmers, value chains, institutions, and farm economic performance [5].

Statistical data show that cocoa still has development potential in North Kalimantan Province, although production has declined. Cocoa production reached 821.1 tons in 2022 with an area of 2,464 ha, while in 2023 the area increased to 2,488.2 ha but production decreased to 810.7 tons. This indicates that land expansion was not followed by productivity improvement. Cocoa production in North Kalimantan is concentrated in Nunukan, Bulungan, and Malinau. Nunukan was the largest producer, while Bulungan experienced a decline in production from 80.7 tons to 63.0 tons and a decrease in area from 646 ha to 634 ha [6]. Therefore, Bulungan has potential as a cocoa-producing region but still faces productivity, land management, and farmer income constraints.

Metun Sajau Village, Tanjung Palas Timur District, Bulungan Regency, is one of the areas with opportunities for smallholder cocoa development. This potential is supported by farmers who cultivate cocoa as one source of household income. However, income from cocoa farming may be affected by several production factors. Land area is assumed to influence income because it represents the scale of farming. Larger cultivated land may provide more productive trees and higher production, although land area alone does not guarantee higher income if it is not supported by proper maintenance, input use, and farm management [1].

The second important factor is production cost. Production costs include all expenditures in cocoa farming activities, such as fertilizers, pesticides, labor, equipment depreciation, crop maintenance, harvesting, postharvest handling, and marketing. Production cost becomes a determinant of net income because income is obtained from the difference between total revenue and total cost [4]. The third factor is production quantity. Production quantity is directly related to farmers' revenue because revenue is calculated by multiplying output quantity by selling price. Thus, production is an important variable in increasing farmers' income when the selling price and production costs are favorable [7].

Several studies have discussed the relationship between land area, production cost, production quantity, and cocoa farming income. Income is formed by the interaction between land capacity, production potential, revenue from harvest, and costs incurred during farming [8]. Other studies have examined cocoa farming income, financial feasibility, technology adoption, and development systems [1], [9], [10]. However, previous research has generally focused on major cocoa-producing regions such as Sulawesi, Nusa Tenggara, Lampung, and other areas. The local context of North Kalimantan, particularly Bulungan Regency, has received limited attention. Each region has distinct land characteristics, farm scale, input access, labor costs, productivity levels, and marketing channels. Therefore, this study analyzed the effects of land area, production cost, and production quantity, both partially and simultaneously, on cocoa farming income in Metun Sajau Village. The results are expected to contribute to farm-income studies and provide information for farmers and local governments in improving smallholder cocoa development policies.

MATERIALS AND METHODS

Research Site and Time

The study was conducted in Metun Sajau Village, Tanjung Palas Timur District, Bulungan Regency, North Kalimantan Province. The location was selected purposively because Metun Sajau is one of the cocoa development and production areas in Bulungan Regency. The research was carried out from March to April 2025.

Research Approach and Respondents

This study used a quantitative approach with a descriptive survey method. The quantitative approach was applied because the study analyzed relationships between independent and dependent variables using numerical data obtained from respondents. The independent variables were land area, production cost, and production quantity, while the dependent variable was cocoa farming income. The population consisted of cocoa partner farmers in Metun Sajau Village. Field data indicated that there were 43 partner farmers, of whom 30 were still actively engaged in cocoa farming. Respondents were selected using purposive sampling based on the criteria that they actively managed cocoa farms and were registered as partner farmers. Therefore, the total number of respondents was 30 farmers.

Data Collection and Variables

The data consisted of primary and secondary data. Primary data were obtained directly from respondents through interviews and structured questionnaires. The primary data included information on land area, production cost, production quantity, revenue, and cocoa farming income. Secondary data were obtained from supporting documents, farmer group records, scientific publications, books, journals, government reports, and other sources relevant to the study. Data collection was carried out through interviews, questionnaires, and documentation. Interviews were conducted directly with cocoa farmers to obtain information on farming activities, input use, production results, costs incurred, and income received. The questionnaire was used as the main instrument to collect systematic data, while documentation was used to collect supporting records, reports, and images related to cocoa farming in the study area.

The variables consisted of independent and dependent variables. Land area was defined as the total land used by farmers for cocoa farming. Production cost included all costs incurred in cocoa farming, both fixed and

variable costs. Production quantity refers to the total dried cocoa beans produced by farmers in one production period. Cocoa farming income was defined as the difference between total revenue and total production cost.

Data Analysis

Data were analyzed quantitatively using SPSS. The analysis included classical assumption tests, multiple linear regression analysis, and hypothesis testing. Classical assumption testing consisted of normality, multicollinearity, and heteroskedasticity tests to ensure that the regression model met statistical requirements. The effect of land area, production cost, and production quantity on cocoa farming income was analyzed using the following multiple linear regression equation:

$$Y = a + \beta 1X1 + \beta 2X2 + \beta 3X3 + e$$

where Y is cocoa farming income, a is the constant, β1-β3 are regression coefficients, X1 is land area, X2 is production cost, X3 is production quantity, and e is the error term. The F-test was used to examine the simultaneous effect of the independent variables, the t-test was used to examine the partial effect of each independent variable, and the coefficient of determination was used to measure the ability of the model to explain variation in income. The decision criterion was based on a significance level of 0.05.

RESULTS

Study Site

Metun Sajau Village is located in Tanjung Palas Timur District, Bulungan Regency, North Kalimantan Province. Administratively, it borders Tanjung Agung Village to the north, Sajau Hilir Village to the south, Sajau Pura Village to the east, and Tanah Kuning Village to the west. The village has diverse topographical characteristics, including hills, valleys, mountainous areas in the west, and swamp areas in the north. These physical conditions influence land-use patterns and agricultural activities, including plantation crops such as cocoa. The study site has potential as a smallholder cocoa development area in Bulungan Regency.

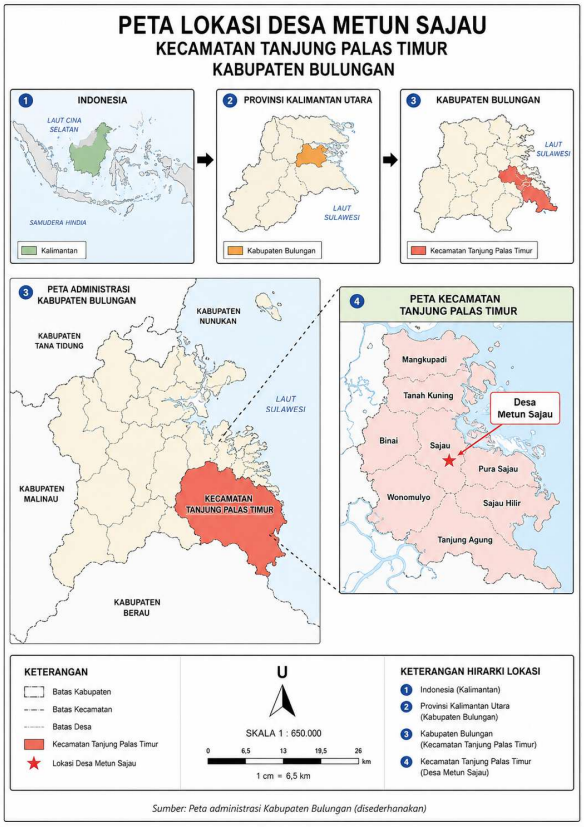


Figure 1. Location map of Metun Sajau Village, Tanjung Palas Timur District, Bulungan Regency.

Respondent Characteristics

Respondent characteristics included age, education, farming experience, and land area. Based on age, respondents were dominated by non-productive age farmers, namely 18 people or 60%, while productive age farmers accounted for 12 people or 40%. This indicates that cocoa farming in Metun Sajau Village is mostly managed by older farmers. This condition reflects considerable practical experience but may also limit the acceptance of innovation and technological adaptation. Farmer age has been associated with knowledge, information acceptance, and response to agricultural innovation [11].

In terms of education, most respondents had a low level of formal education: 36.7% did not attend school, 26.7% completed elementary school, 20% completed junior high school, and 16.7% completed senior high school. This may influence farmers' ability to access information, record costs, and make farm-management decisions. Education has been linked to farm-management ability and farmer income [12]. Most respondents had 1-5 years of cocoa farming experience (56.7%), followed by 6-10 years (36.7%), and more than 10 years (6.7%). Farming experience can affect farming skills and production decisions [13]. In terms of land area, most farmers cultivated 1-3 ha (96.6%), indicating that cocoa farming was generally small to medium scale. Land ownership is an important factor in determining the contribution of cocoa farming to household income [14].

Table 1. Characteristics of cocoa farmer respondents in Metun Sajau Village.

Characteristic	Number of farmers	Frequency (%)
Age		
Productive age (>15-65 years)	12	40.0
Non-productive age (>64 years)	18	60.0
Education		
No formal education	11	36.7
Elementary school	8	26.7
Junior high school	6	20.0
Senior high school	5	16.7
Farming experience (years)		
1-5	17	56.7
6-10	11	36.7
>10	2	6.7
Land area		
0-1 ha	1	3.3
1-3 ha	29	96.6
>3 ha	0	0.0

Source: Processed primary data, 2026.

Production Cost, Production, Revenue, and Income

Production cost is an important component in cocoa farming income analysis because it represents all expenditures incurred by farmers during one production period. Cocoa production costs in Metun Sajau Village consisted of variable and fixed costs. Variable costs included production inputs such as fertilizers and pesticides, while fixed costs included depreciation of agricultural tools used in cultivation. This classification is important because farm income is obtained from revenue minus total production cost. More efficient cost allocation increases the opportunity for farmers to obtain higher net income. Production cost, revenue, and income analysis is a basic tool for assessing the economic performance of cocoa farming [4].

The cocoa seedlings used by farmers in Metun Sajau Village were superior Sulawesi 01 and Sulawesi 02 varieties obtained through support from PT Pesona Khatulistiwa Nusantara. This support indicates a partnership pattern that helps reduce farmers' initial capital burden. In this system, harvested cocoa is generally sold to the partner company in the form of dried cocoa beans. Thus, the partnership supports not only input provision but also market access. Variable costs were mainly used for fertilization and pest control. Fertilizers included NPK Mutiara, Phonska, compost, and rice husk, while pesticides included herbicides, insecticides, and fungicides. Variable costs in cocoa farming generally include seedlings, fertilizers, pesticides, and labor [15]. Fixed costs in this study included depreciation of tools such as grass cutters, sprayers, pruning shears, hoes, shovels, and grafting knives. Production cost has also been shown to affect the feasibility and income of cocoa farming [16].

Table 2. Production, revenue, production cost, and income of cocoa farming.

Component	Value (IDR/Kg)
Dried cocoa bean production	836,68
Selling price of dried cocoa beans	90,000
Total revenue	75,301,200
Total production cost	8,770,333
Total income	66,530,867

Source: Processed primary data, 2026.

Table 2 shows that dried cocoa bean production reached 836.68 kg. At a selling price of IDR 90,000/kg, total cocoa farming revenue was IDR 75,301,200. After deducting the total production costs of IDR 8,770,333, net income was IDR 66,530,867. The production costs consisted of variable costs for fertilizers and pesticides and fixed costs in the form of agricultural tool depreciation.

Classical Assumption Tests

The normality test was conducted using 30 observations. The test statistic was 0.108, and the Asymp. Sig. (2-tailed) value was 0.200, which was greater than 0.05. This indicates that the residuals in the regression model were normally distributed. Therefore, the regression model met the normality assumption and was suitable for multiple linear regression analysis.

Table 3. Normality test result.

Description	Value
N	30
Test statistic	0.108
Asymp. Sig. (2-tailed)	0.200

Source: Processed primary data, 2026.

The multicollinearity test showed that all independent variables had tolerance values greater than 0.10 and VIF values lower than 10. Land area had a tolerance value of 0.958 and a VIF of 1.043, production cost had a tolerance value of 0.950 and a VIF of 1.053, and production quantity had a tolerance value of 0.990 and a VIF of 1.010. These results indicate that the independent variables did not have excessively high correlations with one another. Thus, the regression model did not experience multicollinearity.

Table 4. Multicollinearity test result.

Variable	Tolerance	VIF	Conclusion
Land area	0.958	1.043	No multicollinearity
Production cost	0.950	1.053	No multicollinearity
Production quantity	0.990	1.010	No multicollinearity

Source: Processed primary data, 2026.

Heteroskedasticity was examined using a residual scatterplot. The residual points were distributed randomly above and below the zero line and did not form a clear pattern such as a funnel, widening, or wave pattern. Therefore, the model did not show heteroskedasticity symptoms. This means that the residual variance was relatively constant and that the regression model was appropriate for analyzing the effects of land area, production cost, and production quantity on cocoa farming income.

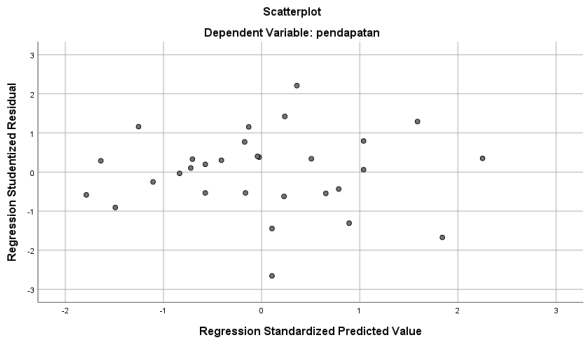


Figure 2. Scatterplot of regression standardized predicted values and studentized residuals.

Factors Affecting Cocoa Farmer Income

Multiple linear regression analysis showed that land area, production cost, and production quantity each had a significant partial effect on cocoa farmer income. The regression equation obtained was as follows:

$$Y = -65.444 + 2.166X1 + 2.766X2 + 2.633X3$$

The constant value of -65.444 with a significance value of 0.001 indicates that if land area, production cost, and production quantity were considered constant or zero, income would be negative. In practical terms, this constant is not interpreted directly because cocoa farming cannot take place without land, production costs, and production output.

Table 5. Partial t-test result of factors affecting cocoa farming income.

Variable	Regression coefficient	t-value	Sig.	Conclusion
Constant	-65.444	-3.959	0.001	Significant
Land area	2.166	3.703	0.001	Significant
Production cost	2.766	3.406	0.002	Significant
Production quantity	2.633	3.006	0.005	Significant

Source: Processed primary data, 2026.

Land area had a regression coefficient of 2.166, a t-value of 3.703, and a significance value of 0.001. This indicates that land area had a positive and significant effect on cocoa farming income. In other words, the larger the cocoa land managed by farmers, the greater the opportunity to obtain higher income, assuming other variables remain constant. Theoretically, land is a key production factor because it determines planting capacity, the number of productive trees, and harvest potential. This finding is consistent with previous research showing that land area is an important variable related to cocoa farmer income [17].

Production cost had a regression coefficient of 2.766, a t-value of 3.406, and a significance value of 0.002. This result indicates that production cost had a positive and significant effect on cocoa farming income. Production cost can increase income when it is allocated productively to inputs that support cultivation activities, such as fertilizers, pesticides, crop maintenance, and production tools [4]. Thus, production cost should not be viewed only as expenditure but also as a farm investment when used efficiently to improve productivity and cocoa bean quality.

Production quantity had a regression coefficient of 2.633, a t-value of 3.006, and a significance value of 0.005. This indicates that production quantity had a positive and significant effect on cocoa farmers' income. Economically, production is the basis of revenue formation because revenue is obtained by multiplying production quantity by selling price. Higher dried cocoa bean production increases revenue and creates opportunities for higher income, particularly when cocoa bean quality is good and the selling prices are stable [7].

Table 6. Simultaneous F-test result.

Model	df	F-table	F-value	Sig.
Regression	3	2.98	8.916	0.000
Residual	26			
Total	29			

Source: Processed primary data, 2026.

The simultaneous F-test showed an F-value of 8.916, which was higher than the F-table value of 2.98, with a significance value of 0.000. This result indicates that land area, production cost, and production quantity jointly had a significant effect on cocoa farmers' income. Therefore, changes in cocoa farming income are not determined by one factor alone but by the combined effects of land management, input cost allocation, and production quantity.

Table 7. Coefficient of determination test result.

R	R Square	Adjusted R Square	df2	Sig.
0.712	0.507	0.450	26	0.000

Source: Processed primary data, 2026.

The R value of 0.712 indicates a strong relationship between the independent variables and cocoa farmer income. The R Square value of 0.507 means that 50.7% of the variation in cocoa farmer income was explained by land area, production cost, and production quantity. The remaining 49.3% was influenced by factors outside the model, such as selling price, bean quality, farmer experience, cultivation technology, market access, and climate conditions. The Adjusted R Square value of 0.450 indicates that after adjustment for the number of variables and sample size, the model still explained 45.0% of the income variation. The significance value of 0.000 confirms that the regression model was appropriate for explaining cocoa farming income.

DISCUSSION

The findings demonstrate that land area, production cost, and production quantity are important determinants of cocoa farming income in Metun Sajau Village. The positive effect of land area indicates that farm scale remains a major factor in smallholder cocoa farming. Larger landholdings provide opportunities for more productive trees and higher output, but their effect on income depends on the quality of management, crop maintenance, and input allocation. Therefore, land expansion alone may not be sufficient if it is not followed by improvement in cultivation practices and

plant productivity. This is relevant to the situation in Bulungan Regency, where the decline in cocoa production shows that land availability has not necessarily resulted in increased productivity.

The positive effect of production cost suggests that production expenditure in this study functioned as productive investment rather than merely as a cost burden. When expenses are allocated to essential inputs such as fertilizers, pesticides, maintenance tools, and crop management, they can support higher yields and better output quality. However, this finding should be interpreted carefully because higher costs only increase income when they are efficient and directly contribute to production performance. Inefficient spending may reduce net income. Therefore, farmers need guidance in input allocation, cost recording, and farm budgeting to ensure that each production cost contributes to increased output and income.

Production quantity also had a positive and significant effect on income, confirming the basic economic principle that higher output increases revenue when market price remains stable. The selling price of dried cocoa beans in this study was IDR 90,000/kg, which generated total revenue of IDR 75,301,200 from 836.68 kg of production. This indicates that improving productivity and maintaining bean quality are central strategies for increasing farmer income. Production improvement can be achieved through better crop maintenance, pruning, fertilization, pest and disease control, and postharvest handling. In addition, quality improvement may strengthen farmers' bargaining position and increase access to better market prices.

The simultaneous significance of the three variables confirms that cocoa farming income is shaped by a combination of farm scale, cost allocation, and production performance. The R Square value of 50.7% shows that the model explains a substantial proportion of income variation, although almost half of the variation is still influenced by other factors. These may include cocoa selling price, bean quality, farmer experience, technology adoption, market access, climate variability, labor availability, and institutional support. Future research should include these variables to provide a more comprehensive explanation of cocoa income dynamics. From a practical perspective, farmer income improvement in Metun Sajau Village should focus on optimizing existing land, improving input efficiency, increasing production, strengthening postharvest practices, and supporting farmer partnerships with market actors.

CONCLUSION

Land area, production cost, and production quantity had positive and significant effects on cocoa farming income in Metun Sajau Village, Tanjung Palas Timur District, Bulungan Regency. A larger land area increased the opportunity for farmers to obtain higher income because it allowed greater production capacity. Production cost also had a positive effect when allocated efficiently to support cultivation activities and improve productivity. Production quantity was an important determinant because higher dried cocoa bean output increased revenue and net income. Simultaneously, the three variables significantly affected cocoa farming income, with the model explaining 50.7% of income variation. Therefore, farmer income improvement should be directed toward optimizing land use, allocating production costs efficiently, increasing productivity, and strengthening postharvest and market support for smallholder cocoa farming.

ACKNOWLEDGMENT

The authors would like to thank the cocoa farmers in Metun Sajau Village who participated in this study and provided the necessary information. Appreciation is also extended to the Agribusiness Study Program, Faculty of Agriculture, Universitas Borneo Tarakan, for academic support during the preparation of this manuscript.

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