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ANALYSIS OF FACTOR AFFECTING COCOA FARMERS' INCOME IN NAGORI PINANGRATUS, JORLANG HATARAN DISTRICT, SIMALUNGUN REGENCY

[1*]Sry Artawati Manik, Universitas Simalungun
Email: sryartawatimanik@gmail.com
[2]Roeskani Sinaga, Universitas Simalungun
Email: roeskani@gmail.com
[3]Jhonson A Marbun, Universitas Simalungun
Email: jhonsonmarbun2112@gmail.com
[4]Febriani Issula Ningtias, Universitas Simalungun

*Correspondence Author: sryartawatimanik@gmail.com

ABSTRACT

This study aims to evaluate the economic feasibility of cocoa farming and identify the factors influencing cocoa farmers' income in Nagori Pinangratus, Jorlang Hataran District, Simalungun Regency. The study was conducted from September to November 2024 and involved 45 cocoa farmers selected using purposive sampling. The data were analyzed using farm income analysis, the Revenue–Cost Ratio (R/C Ratio), and multiple linear regression. The results indicate that the average annual income of cocoa farmers was IDR 11,046,662.60, with an R/C Ratio of 4.71, indicating that cocoa farming in the study area is economically feasible. The regression results further demonstrate that land area and production volume have positive and statistically significant effects on farmers' income, whereas production costs have a negative and statistically significant effect. Simultaneously, the three independent variables significantly affect farmers' income, as indicated by an F-statistic of 50.939 with a significance level of 0.000. The coefficient of determination (R^2) of 0.867 indicates that 86.7% of the variation in farmers' income can be explained by land area, production costs, and production volume, while the remaining 13.3% is attributable to other factors not incorporated into the model. These findings suggest that strategies to enhance cocoa farmers' income should focus on optimizing land utilization, improving the efficiency of production-cost management, and increasing farm productivity
Keywords: Production Costs, Cocoa, Farm Feasibility, Land Area, Farmers' Income, Production

ABSTRAK

Penelitian ini bertujuan mengevaluasi kelayakan usahatani kakao sekaligus mengidentifikasi faktor-faktor yang memengaruhi pendapatan petani kakao di Nagori Pinangratus, Kecamatan Jorlang Hataran, Kabupaten Simalungun. Penelitian dilaksanakan pada September–November 2024 dengan melibatkan 45 petani kakao sebagai responden yang ditetapkan melalui teknik purposive sampling. Data penelitian dianalisis menggunakan analisis pendapatan, Revenue Cost Ratio (R/C Ratio), dan regresi linier berganda. Hasil penelitian menunjukkan bahwa rata-rata pendapatan petani kakao mencapai Rp. 11.046.662,60 per tahun dengan nilai R/C Ratio sebesar 4,71. Nilai tersebut menunjukkan bahwa usahatani kakao di wilayah penelitian layak secara ekonomi untuk dijalankan. Hasil regresi memperlihatkan bahwa luas lahan dan jumlah produksi berpengaruh positif dan signifikan terhadap pendapatan petani, sedangkan biaya produksi menunjukkan pengaruh negatif dan signifikan. Secara simultan, ketiga variabel tersebut berpengaruh signifikan terhadap pendapatan dengan nilai F sebesar 50,939 dan tingkat signifikansi 0,000. Nilai koefisien determinasi (R^2) sebesar 0,867 menunjukkan bahwa 86,7% variasi pendapatan petani dapat dijelaskan oleh luas lahan, biaya produksi, dan jumlah produksi, sedangkan 13,3% sisanya berkaitan dengan faktor lain yang tidak dimasukkan ke dalam model penelitian. Temuan tersebut menunjukkan bahwa peningkatan pendapatan petani kakao dapat diarahkan melalui optimalisasi pemanfaatan lahan, pengendalian biaya produksi secara efisien, dan peningkatan

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produktivitas.

Kata Kunci: Biaya Produksi, Kakao, Kelayakan Usahatani, Luas Lahan, Pendapatan Petani, Produksi

I. INTRODUCTION

Cocoa (*Theobroma cacao* L.) is an economically important plantation commodity due to its integration into global trade and value chains and its role as a source of livelihood for many smallholder farming households in producing countries (Parra-Paitan et al., 2023). The economic significance of this commodity is determined not only by production activities at the farm level but also by its linkages with trading, processing, and marketing systems that collectively constitute the cocoa value chain (Prazeres et al., 2021). In the context of rural development, a well-coordinated cocoa supply chain can broaden market access, improve income stability, and simultaneously create incentives for more sustainable land management practices (Obiri-Yeboah et al., 2026). Therefore, cocoa development has economic relevance that extends beyond increasing production, as it is also closely associated with the sustainability of farmers' incomes and livelihoods throughout the cocoa agribusiness value chain.

In Indonesia, cocoa development occupies an important position within the plantation agribusiness sector because the commodity is export-oriented and continues to offer opportunities for market expansion through regional trade, although improvements in quality, production, and productivity remain necessary to strengthen its competitiveness (Dermoredjo et al., 2021). The structure of national cocoa production is also highly dependent on smallholder plantations; consequently, the sustainability of the commodity is closely related to the capacity of smallholder farmers to manage cultivation activities and derive economic benefits from their farming operations (Sa'adah et al., 2024). Nevertheless, smallholder cocoa farming continues to face several constraints, including limited knowledge and technology, inadequate institutional support, and crop management challenges, all of which may have implications for farm productivity and farmers' welfare (Rizal et al., 2024). These conditions are also relevant to the development of cocoa agribusiness in Sumatra, as research on smallholder cocoa plantations indicates that farm management practices play an important role in maintaining the sustainability of agroecosystems that support production activities (Rosalia et al., 2022). Therefore, cocoa as a smallholder plantation commodity should be viewed not only in terms of its production potential but also in terms of the capacity of cocoa farming to generate sustainable economic benefits for farmers.

At the farm level, cocoa farmers' income is essentially determined by the ability of the farming enterprise to generate revenue after accounting for the various costs incurred throughout the production process. Consequently, the management of production factors is particularly important because inefficient input use can increase production costs and reduce the economic benefits received by farmers. Research on cocoa farming in Indonesia indicates that the use of production factors, including land, fertilizers, pesticides, and labor, is associated with production levels and technical efficiency, making their effective management important for achieving farm profitability (Rouf et al., 2021). From a financial perspective, farm sustainability is also determined by farmers' ability to control cost components while maintaining production levels that generate adequate revenue; moreover, diversification within cocoa farming systems has been reported to have the potential to increase household income compared with cocoa monoculture systems (Pereira et al., 2021). Accordingly, an analysis of farm size, production costs, and production volume is necessary to provide a more measurable understanding of the factors associated with the formation of cocoa farmers' income.

The income earned by cocoa farmers reflects not only the amount of revenue generated from crop sales but also their ability to allocate resources and meet the expenditures required throughout the production process. Studies of cocoa farmers indicate that productivity, production costs, gross income, and net income are associated with farmers' capacity to finance farming activities, making financial considerations an important determinant of the economic benefits obtained from cocoa farming (Boansi et al., 2024). Conversely, limited farm size may constrain the ability of some plantation-farming

households to achieve an adequate level of income, particularly when their investment capacity and opportunities to diversify their livelihoods are also limited (Waarts et al., 2021). Production and economic risks may also place pressure on farm profitability, as production disruptions, changing market conditions, and price uncertainty can affect the income received by cocoa farmers (Ogunkunle et al., 2022). These relationships indicate that an assessment of the economic conditions of cocoa farming should simultaneously consider the interrelationships among the scale of land under cultivation, production expenditures, output generated, and farmers' income.

Nagori Pinangratus, located in Jorlang Hataran District, Simalungun Regency, is one of the areas where cocoa farming forms part of household economic activities. In practice, the ability of cocoa farming to generate income depends not merely on the cultivation of the commodity itself but also on how production resources are managed to generate economically valuable output. Studies of smallholder farming indicate that optimizing the allocation of land and agricultural resources can result in different levels of income depending on the combination and utilization of production factors applied (Sukanteri et al., 2022). In the cocoa sector, income is particularly relevant because economic success at the farm level extends beyond increasing crop yields and also involves the ability to create economic value from the products generated; further processing has even been reported to generate added value and profits for small-scale cocoa processing units (Hartatri et al., 2021). In addition, recent studies of smallholder cocoa farming in Indonesia indicate that the actual profits received by farmers may differ from their potential economic benefits, making input-use efficiency an important consideration in assessing the competitiveness of cocoa farming (Sukanteri et al., 2024). Although previous studies have examined cocoa productivity, efficiency, value addition, and profitability across different regions, the economic conditions of farming operations remain specific to local characteristics and farmers' resource-management practices. On this basis, an empirical assessment of farm feasibility and the relationships between farm size, production costs, production volume, and cocoa farmers' income in Nagori Pinangratus is required to provide evidence that reflects the specific conditions of the study area..

Research on the economics of cocoa farming has evolved to address various dimensions, ranging from production efficiency and resource management to strategies for increasing farmers' income. Recent studies indicate that the economic efficiency of cocoa farming may be influenced by farmer and farm characteristics, including farm size, labor use, access to finance, and extension support (Inkoom et al., 2022). In the Indonesian context, the characteristics of farming systems and the role of economic institutions have also been found to be associated with the level of commercialization of cocoa farming (Zachra & Kusnadi, 2024). Furthermore, different cropping systems may produce different economic outcomes for farmers because the organization of production activities is associated with operating costs and the income generated (Akhsan et al., 2022). Unlike these previous studies, the present study specifically integrates an assessment of financial feasibility with an examination of the effects of farm size, production costs, and production volume on cocoa farmers' income at the local level in Nagori Pinangratus. This study aims to analyze the feasibility of cocoa farming and examine the effects of these three production factors, both individually and simultaneously, on farmers' income. The findings are expected to provide empirical evidence that can serve as a basis for identifying production and cost-management aspects that should be prioritized to strengthen the economic performance of cocoa farming in the study area.

II. LITERATURE REVIEW

Cocoa Farming

Farming is an economic activity that combines various production resources to generate agricultural products while providing economic benefits to those engaged in the activity. In practice, the economic performance of a farming enterprise should not be assessed solely on the basis of production output but should also take into account the revenue generated and the total expenditures incurred throughout the production process. Agricultural economics studies indicate that changes in production costs can determine the level of profitability because increases in costs that are not accompanied by

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corresponding growth in revenue may reduce the financial returns of farming operations (Samociuk et al., 2025). Other empirical evidence demonstrates that input costs may constrain farm profitability, whereas increases in production output and selling prices have a positive effect on the profits earned by farmers (Yigezu et al., 2025). Therefore, farm income can be understood as an economic outcome resulting from the relationship between revenue generated from production activities and the costs incurred by farmers in operating their farms.

Concept of Farm Income and Economic Feasibility

Farm revenue represents the economic value generated from marketed agricultural output and can operationally be calculated by multiplying the quantity of products produced by the selling price received by farmers. This approach has been applied in various farm economic analyses to determine total revenue before production expenditures are deducted (Firdaus et al., 2022). Meanwhile, production costs comprise the economic expenditures required to carry out farming activities and, in financial analysis, can be classified into fixed and variable costs (Adigun & Adeniyi-Oso, 2023). Net farm income is subsequently calculated by subtracting total production costs incurred during a given farming period from total revenue; therefore, changes in either revenue or costs directly affect the amount of income earned by farmers (Alabı et al., 2025). Accordingly, the relationship among production output, selling prices, revenue, and costs provides the fundamental basis for measuring the economic returns generated by farming activities.

The economic feasibility of a farming enterprise reflects its ability to generate adequate revenue relative to the financial resources expended during the production process. One approach used to evaluate this condition is the *Revenue–Cost Ratio* (R/C Ratio), which represents the ratio of total revenue generated to the total costs incurred in farming activities (Tenrisanna & Kasim, 2021). Empirically, an R/C Ratio greater than one indicates that revenue exceeds costs and, therefore, that the farming enterprise is considered financially feasible (Swastika et al., 2021). Conversely, an R/C Ratio below one indicates that revenue is insufficient to cover all costs incurred, whereas a ratio equal to one represents a break-even condition in which revenue equals total costs. This indicator remains relevant in Indonesian farm studies because comparing revenue with costs enables researchers to assess whether production activities generate adequate economic returns for farmers (Purwono et al., 2024). Therefore, in this study, the R/C Ratio is used as the basis for assessing the economic feasibility of cocoa farming in Nagori Pinangratus by examining the relationship between farm revenue and production costs.

Factors Affecting Farmers' Income

Farmers' income is determined by the interaction among production capacity, input utilization, market conditions, and the ability to manage available resources in farming activities. Consequently, differences in income among farmers are associated not only with the quantity of commodities harvested but also with farm size, the quantity and prices of inputs used, labor utilization, product prices, market access, and available institutional support. Research on smallholder farmers indicates that farm size, labor costs, input costs, and participation in marketing institutions may be associated with farm income (Abdulai et al., 2024). Institutional factors also play an important role because access to credit, contractual arrangements, cooperative membership, and support services can influence farmers' ability to adopt technologies associated with productivity and income (Okello et al., 2021). In the context of cocoa farming, improvements in farmers' agribusiness competencies are also associated with productivity and income, while these competencies are shaped by internal characteristics, motivation, extension activities, empowerment interventions, and the business environment (Rayuddin et al., 2021). Thus, farmers' income results from the interaction of production factors, farmer characteristics, institutional access, and market conditions, although the magnitude of each factor's contribution may vary across commodities and study areas.

Within the context of cocoa farming, farm size, production costs, and production volume are among the principal factors considered in this study. Based on the scope of the research, the analysis therefore focuses on three main factors: farm size (X_1), production costs (X_2), and production volume (X_3), with cocoa farmers' income as the dependent variable (Y). Selecting these three variables enables

the study to examine income from three interrelated dimensions: resource capacity represented by farm size, economic expenditure represented by production costs, and farming output represented by production volume. Other factors, including prices, socioeconomic characteristics, access to financing, technology, and institutional conditions, are acknowledged as potentially associated with income but are placed outside the scope of the empirical model. By establishing these boundaries, the analysis can focus more specifically on determining the extent to which variations in cocoa farmers' income in Nagori Pinangratus are associated with the three variables examined.

Previous Studies

Several relevant studies have previously been conducted. Gea (2023), in a study conducted in Gunungsitoli City, found that cocoa farming was economically feasible, as indicated by a favorable R/C Ratio. Br. Damanik (2023) found that farm size and the number of cocoa trees were dominant factors determining cocoa farmers' income in Deli Serdang Regency. Santiani et al. (2022), in their study in Kapidi Village, reported an R/C Ratio greater than one, indicating that cocoa farming was economically feasible. Mardila et al. (2024), in South Sumatra, found that farm size and selling prices significantly affected cocoa farmers' income. These previous studies provide both a theoretical foundation and an empirical basis for comparison with the findings of the present study. Research on farm income and economic performance indicates that farmers' financial outcomes are determined by the interrelationships among farm scale, input utilization, production volume, and production costs. Widyastutik et al. (2026), for example, found that farm size and fertilizer use had positive effects on production, while farm profitability was significantly influenced by production volume, product prices, total costs, and pesticide costs (Widyastutik et al., 2026).

These findings demonstrate that income should not be viewed as an outcome isolated from the production process; rather, it is generated through farmers' ability to transform production inputs and land resources into outputs with economic value. In the context of cocoa farming, Owoeye et al. (2022) identified differences in economic performance between cocoa farmers who participated in a *Farmers' Business School* and those who did not. Farmers participating in the program achieved higher revenue, gross margins, and profits, while production-function estimates indicated that family labor, hired labor, pesticides, farm size, and fertilizers were significant factors in explaining the technical efficiency of cocoa production (Owoeye et al., 2022). These findings indicate that differences in the utilization of production factors may generate different economic outcomes across farming enterprises; therefore, cocoa income analysis should consider how production resources are utilized at the farm level.

Empirical evidence from other agricultural commodities in Indonesia also demonstrates that farm size and production costs are associated with farmers' income. Tinaprilla et al. (2022), in a study of shallot farmers in Central Java, found that farm income was influenced by several factors, including education level, harvested area, land tenure status, cooperative membership, access to credit, access to extension services, and certified seed costs (Tinaprilla et al., 2022). These findings demonstrate that farm size and cost components can contribute to income formation, although their effects occur alongside other socioeconomic and institutional factors.

Other studies have demonstrated that relationships among farm scale, costs, and profitability can also be observed across different types of agricultural enterprises. Jobirov et al. (2022) found that smallholder profitability was significantly influenced by farm size, farming experience, certain production costs, access to credit, and marketing arrangements (Jobirov et al., 2022). Although the commodity examined differs from cocoa, these findings provide comparative evidence that agricultural income or profitability is closely associated with farmers' ability to combine production capacity with effective expenditure management. Taken together, previous studies reveal three empirical patterns that are particularly relevant to the present research. First, farm size is associated with farmers' capacity to generate output. Second, production costs can affect profitability because input expenditures reduce revenue while simultaneously functioning as productive investments when their use contributes to higher output. Third, production volume plays an important role in determining revenue because it determines the quantity of products available for sale. However, the strength and direction of these

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relationships are not necessarily identical across commodities or geographical locations. Differences in farmer characteristics, cost structures, land productivity, technology, and market conditions may lead to different empirical outcomes.

III. RESEARCH METHODOLOGY

Research Location and Period

This study was conducted in Nagori Pinangratus, Jorlang Hataran District, Simalungun Regency, North Sumatra Province, Indonesia. Nagori Pinangratus was selected as the study area because cocoa farming remains actively practiced and agriculture constitutes the primary livelihood of a substantial proportion of the local population. Geographically, Jorlang Hataran District is located between 2°32′–2°40′ North Latitude and 98°56′–99°04′ East Longitude, covering a total area of 93.70 km². The study was conducted during the four-month cocoa production period from September to December 2025.

Population, Sample, and Data Collection Methods

This study employed a census method, whereby the entire population of cocoa farmers in Nagori Pinangratus was included as research respondents. The study involved 45 cocoa farmers who were actively engaged in cocoa production. Primary data were collected through direct interviews using a structured questionnaire covering information on farm size, number of cocoa trees, production costs—including fertilizers, pesticides, labor, transportation, and equipment depreciation—production volume, selling prices, and farming experience. Secondary data were obtained from Statistics Indonesia (BPS) of Simalungun Regency and other relevant official sources.

Data Analysis Methods

Data were analyzed using two main approaches. First, the economic feasibility of cocoa farming was assessed using the *Revenue–Cost Ratio* (R/C Ratio), calculated as: where TR represents *Total Revenue* and TC represents *Total Cost*. The decision criteria were as follows: an R/C Ratio > 1 indicates that the farming enterprise is economically feasible; an R/C Ratio = 1 indicates a break-even condition; and an R/C Ratio < 1 indicates that the farming enterprise is economically infeasible.

Second, multiple linear regression analysis was employed using the following model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$$

where Y represents cocoa farmers' income (IDR/4 months); X_1 represents farm size (ha); X_2 represents the number of cocoa trees (trees); X_3 represents production input costs (IDR); X_4 represents labor costs (IDR); X_5 represents farming experience (years); β_0 represents the intercept; β_1–β_5 represent the regression coefficients; and ε represents the error term. Statistical testing included the coefficient of determination (R^2), simultaneous significance test (F-test), and partial significance test (t-test), using a significance level of $\alpha = 0.05$. All statistical analyses were performed using SPSS software.

IV. RESULTS AND DISCUSSION

Characteristics of the Research Location

Nagori Pinangratus is one of the 13 *nagori* (villages) located in Jorlang Hataran District. According to Statistics Indonesia (BPS) of Simalungun Regency (2023), Nagori Pinangratus covers an area of 2.01 km², representing approximately 2.46% of the total area of Jorlang Hataran District (93.70 km²), making it the smallest *nagori* in the district in terms of land area. Nevertheless, the predominance of agricultural land makes the area suitable for cocoa cultivation. Nagori Pinangratus has a total population of 1,620 people, comprising 785 males and 835 females, indicating a relatively balanced gender composition.

Characteristics of Respondents

Characteristic of the 45 respondents included in the study, 84.4% were male and 15.6% were female. The largest proportion of respondents belonged to the 51–55-year age group (31.1%), indicating that cocoa farming in the study area is predominantly undertaken by mature farmers with considerable farming experience. In terms of educational attainment, the majority of respondents (75.6%) had

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completed only elementary school, suggesting relatively limited formal educational backgrounds that may constrain farmers' access to and utilization of information on modern cocoa cultivation technologies

With regard to occupation, 84.4% of the respondents reported farming as their primary source of livelihood. The largest proportion of respondents had 6–13 years of cocoa farming experience (44.4%), followed by those with 14–21 years of experience (42.2%) and 22–30 years of experience (13.3%). Furthermore, most respondents (57.8%) had three to four family dependents.

Table 1. Socioeconomic Characteristics of the Respondents

No	Characteristic	Category	Number of Responden	Percentage (%)
1	Gender	Male	38	84,4%
		Female	7	15,6%
2	Predominant Age Group	51–55 year	14	31,1%
3	Predominant Education Level	Elementary School	34	75,6%
4	Primary Occupation	Farmer	38	84,4%
5	Farming Experience	6–13 year	20	44,4%
6	Number of Family Dependents	3–4 person	26	57,8%

Source: Authors' calculations based on primary data (2026).

Characteristics of Cocoa Farming

Based on the study results, the farm size managed by the respondent farmers ranged from 0.08 to 1.00 ha, with an average of 0.27 ha per farm. The number of productive cocoa trees ranged from 50 to 720 trees, with an average of 178 trees per farm, equivalent to approximately 659.26 trees per hectare. The age of the cocoa trees ranged from 5 to 20 years, with an average of 9 years. These characteristics describe variations in farm scale, productive tree population, and plantation age among cocoa farmers in the study area. Farm size and cocoa tree characteristics are relevant dimensions of cocoa production systems because they may be associated with productivity and farm performance (Asante et al., 2023), while empirical evidence also indicates that farm size can significantly contribute to cocoa production (Donkor et al., 2023).

Table 2. Characteristics of Cocoa Farming in Nagori Pinangratus

No.	Characteristic	Unit	Minimum	Maximum	Average
1	Farm Size	Ha	0.08	1.00	0.27
2	Number of Productive Cocoa Trees	trees	50	720	178 (659.26/ha)
3	Age of Cocoa Trees	years	5	20	9

Source: Authors' calculations based on primary data (2026).

Analysis of Cocoa Farming Production Costs

Cocoa farming production costs consist of fixed and variable costs. Fixed costs include the depreciation of agricultural equipment, such as hoes, machetes, hand sprayers, saws, buckets, sacks, plastic ropes, knives, and wheelbarrows. The average fixed cost was IDR 165,468 per farm for the four-month production period, equivalent to IDR 612,844 per hectare.

Variable costs comprise expenditures on fertilizers, pesticides/herbicides, labor, and transportation. Labor constituted the largest component of variable costs, averaging IDR 2,651,333 per farm and accounting for 94.4% of total variable costs. This was followed by transportation costs of IDR 80,000, fertilizer costs of IDR 58,725, and pesticide/herbicide costs of IDR 18,368 per farm. Overall, the average variable cost incurred during the four-month production period was IDR 2,808,456 per farm. The predominance of labor costs indicates that labor represents a major component of cocoa production expenditure in the study area. This is economically relevant because empirical studies of cocoa farming have identified labor, fertilizers, pesticides, and other production inputs as important components of cocoa production and farm performance (Rouf et al., 2021), while research on cocoa farmers has also shown that labor and other farm inputs contribute to differences in production efficiency and profitability

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(Owoeye et al., 2022).

Table 3. Average Cocoa Farming Production Costs per Four-Month Production Period

No.	Cost Component	IDR/Farm	IDR/ha
A	**Fixed Costs**		
1	Equipment Depreciation (hoes, machetes, etc.)	165,468	612,844
B	**Variable Costs**		
2	Fertilizers	58,725	217,500
3	Pesticides/Herbicides	18,368	68,030
4	Labor	2,651,333	9,819,752
5	Transportation	80,000	296,296
	Subtotal Variable Costs	**2,808,456**	**10,401,578**
	Total Production Costs	**2,973,924**	**11,014,422**

Source: Authors' calculations based on primary data (2026).

Analysis of Cocoa Farm Revenue and Income

Cocoa harvesting was carried out over a four-month period from September to December, with the selling price of dried cocoa beans varying from week to week. The average selling price of dried cocoa beans was IDR 89,417 per kilogram. The average total production of dried cocoa beans during the four-month period was 156.80 kg per farm, equivalent to 580.74 kg per hectare. Based on the production volume and selling price, the average total revenue (TR) earned by cocoa farmers was IDR 14,020,587 per farm, or IDR 51,928,099 per hectare, during the four-month production period.

Net farm income was calculated by subtracting total production costs from total revenue. The average net income of cocoa farmers in Nagori Pinangratus was IDR 11,046,662.60 per farm, or approximately IDR 40.91 million per hectare, during the four-month production period. These findings indicate that despite the relatively small average farm size of 0.27 ha, cocoa farming generated substantial positive net income during the study period. The importance of considering both production costs and returns in evaluating cocoa farm performance is also supported by recent research showing that production financing and productivity are closely associated with cocoa farmers' gross and net income (Boansi et al., 2024).

Table 4. Average Cocoa Farm Revenue and Income per Four-Month Production Period

Description	Per Farm	Per ha
Dried Cocoa Bean Production (kg)	156.80	580.74
Selling Price of Dried Cocoa Beans (IDR/kg)	89,417	–
Total Revenue (TR) (IDR)	14,020,587	51,928,099
Total Production Costs (TC) (IDR)	2,973,924	11,014,422
Net Farm Income (π = TR − TC) (IDR)	**11,046,663**	**40,913,677**

Source: Authors' calculations based on primary data (2026).

Cocoa Farm Feasibility Analysis Using the R/C Ratio

The analysis yielded an R/C Ratio of 4.71 for cocoa farming in Nagori Pinangratus. Because this value is substantially greater than 1, cocoa farming in the study area can be considered economically feasible and profitable during the study period. An R/C Ratio of 4.71 indicates that every IDR 1.00 spent on production generated IDR 4.71 in revenue.

Table 5. R/C Ratio Analysis of Cocoa Farming in Nagori Pinangratus

Component	Per Farm (IDR)	Per ha (IDR)
Total Revenue (TR)	14,020,587	51,928,099
Total Costs (TC)	2,973,924	11,014,422
R/C Ratio	**4.71**	**4.71**

Source: Authors' calculations based on primary data (2026).

The relatively high R/C Ratio indicates favorable economic performance of cocoa farming in

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Nagori Pinangratus during the study period. This finding is broadly consistent with empirical evidence showing that cocoa farming can generate positive net returns when production resources are effectively utilized (Sb et al., 2024). In the present study, the high R/C Ratio was supported by the relatively high average selling price of cocoa beans during the research period (IDR 89,417/kg) and a production-cost structure in which total costs remained substantially below total revenue.

Multiple Linear Regression Analysis

Coefficient of Determination (R^2)

The coefficient of determination analysis produced an R value of 0.931, an R Square (R^2) value of 0.867, and an Adjusted R Square value of 0.850. The R value of 0.931 indicates a very strong overall relationship between the observed and model-predicted values of cocoa farmers' income. The R^2 value of 0.867 indicates that 86.7% of the variation in cocoa farmers' income can be explained collectively by farm size, number of cocoa trees, production input costs, labor costs, and farming experience. The remaining 13.3% is attributable to other factors not included in the regression model, which may include climatic conditions, pest and disease incidence, selling prices, and farmers' managerial capabilities.

Table 6. Results of the Coefficient of Determination (R^2) Test

Model	R	R Square	Adjusted R Square	Std. Error
1	0.931	0.867	0.850	0.21659

Source: SPSS output (2026).

Simultaneous Significance Test (F-Test)

The F-test was conducted to determine whether all independent variables jointly had a statistically significant effect on cocoa farmers' income. The results showed an F-statistic of 50.939 with a significance value of < 0.001. Because the significance value was lower than $\alpha = 0.05$, the null hypothesis (H_0) was rejected. Therefore, farm size, number of cocoa trees, production input costs, labor costs, and farming experience collectively had a statistically significant effect on cocoa farmers' income in Nagori Pinangratus.

Table 7. Results of the Simultaneous Significance Test (F-Test)

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Regression	11.948	5	2.390	50.939	<0.001
Residual	1.830	39	0.047		
Total	13.778	44			

Source: SPSS output (2026).

Partial Significance Test (t-Test) and Regression Coefficients

Based on the multiple linear regression analysis, the estimated regression equation was:

$$Y = 0{,}005 + 0{,}462X_1 + 0{,}443X_2 + 0{,}035X_3 - 0{,}001X_4 + 0{,}018X_5$$

Table 8. Results of Multiple Linear Regression Analysis and Partial Significance Tests (t-Tests)

Variable	Coef. B	Std. Error	Beta	t	Sig.	Interpretation
Constant	0.005	0.124	–	0.039	0.969	Not significant
Farm Size (X_1)	0.462	0.201	0.486	2.298	0.027	Significant
Number of Cocoa Trees (X_2)	0.443	0.135	0.452	3.284	0.002	Significant
Production Input Costs (X_3)	0.035	0.141	0.033	0.245	0.808	Not significant
Labor Costs (X_4)	−0.001	0.022	−0.003	−0.046	0.964	Not significant
Farming Experience (X_5)	0.018	0.050	0.021	0.351	0.728	Not significant

Source: SPSS output (2026).

The partial effects of the independent variables are interpreted as follows.

Farm Size (X_1). Farm size had a regression coefficient of 0.462 and a significance value of 0.027 < 0.05, indicating a positive and statistically significant relationship with cocoa farmers' income. Assuming that the regression model was estimated using logarithmically transformed variables, a 1%

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increase in farm size is associated with an approximately 0.462% increase in farmers' income, *ceteris paribus*. This finding is consistent with recent cocoa research showing that farm size can positively contribute to production performance (Donkor et al., 2023).

Number of Cocoa Trees (X_2). The number of cocoa trees had a regression coefficient of 0.443 and a significance value of 0.002 < 0.05, indicating a positive and statistically significant relationship with farmers' income. A larger number of productive cocoa trees provides greater production capacity and may consequently increase the quantity of cocoa available for sale and the revenue received by farmers. Recent evidence similarly shows that farm-level production capacity and productivity-enhancing practices can contribute positively to cocoa farmers' income (Asante et al., 2023).

Production Input Costs (X_3). Production input costs had a regression coefficient of 0.035 and a significance value of 0.808 > 0.05, indicating that this variable did not have a statistically significant relationship with cocoa farmers' income. One possible explanation is the relatively limited variation in fertilizer and pesticide use among respondents, which may have reduced the ability of this variable to explain differences in income. Nevertheless, evidence from Indonesian cocoa farming indicates that fertilizers and pesticides can contribute significantly to production efficiency when appropriately utilized (Rouf et al., 2021).

Labor Costs (X_4). Labor costs had a regression coefficient of −0.001 and a significance value of 0.964 > 0.05, indicating no statistically significant relationship with farmers' income. Although labor represented the largest component of production costs in the present study, differences in labor expenditure among farmers were not sufficient to explain variations in income statistically. The negative coefficient may indicate that higher labor expenditure was not accompanied by a proportional increase in income; however, because the coefficient was statistically insignificant, this negative sign should not by itself be interpreted as evidence of labor inefficiency. Research on cocoa production nevertheless confirms that labor constitutes an important production input and can influence productivity and technical efficiency (Donkor et al., 2023).

Farming Experience (X_5). Farming experience had a regression coefficient of 0.018 and a significance value of 0.728 > 0.05, indicating no statistically significant relationship with cocoa farmers' income. Although farming experience may theoretically contribute to farmers' managerial and technical capabilities, the present findings suggest that differences in years of farming experience did not explain income variation among respondents after controlling for the other variables included in the model. This result also illustrates why experience should be assessed together with other farm characteristics, resource availability, and production practices rather than treated as an independent guarantee of improved economic performance.

V. CONCLUSION

Based on the results and discussion, several conclusions can be drawn. First, cocoa farming in Nagori Pinangratus, Jorlang Hataran District, Simalungun Regency, was economically feasible and profitable during the study period. The R/C Ratio of 4.71 (> 1) indicates that every IDR 1.00 spent on production generated IDR 4.71 in revenue. The average net farm income was IDR 11,046,662.60 per farm over the four-month production period. Second, the independent variables—farm size, number of cocoa trees, production input costs, labor costs, and farming experience—jointly had a statistically significant effect on cocoa farmers' income ($F = 50.939$; $p < 0.001$; $R^2 = 0.867$). The model therefore explained 86.7% of the variation in cocoa farmers' income, while the remaining 13.3% was attributable to factors not included in the model. Third, the partial analysis showed that only two variables had statistically significant effects on cocoa farmers' income. Farm size had a positive and significant effect ($\beta = 0.462$; $p = 0.027$), while the number of cocoa trees also had a positive and significant effect ($\beta = 0.443$; $p = 0.002$). In contrast, production input costs, labor costs, and farming experience did not have statistically significant partial effects on farmers' income.

Recommendations

Based on these findings, cocoa farmers are encouraged to optimize the productive use of their

existing farmland and to replace old and unproductive cocoa trees with high-quality planting materials with greater productivity potential. Labor utilization should also be managed more efficiently, considering that labor constitutes the largest component of the production-cost structure. These recommendations are consistent with recent evidence showing that farm size and other production resources are important determinants of cocoa productivity and technical efficiency (Donkor et al., 2023).

Local governments and relevant agricultural agencies are encouraged to support cocoa farmers by facilitating access to high-quality certified planting materials at affordable prices and by strengthening agricultural extension services, particularly those related to improved cultivation practices, farm management, and post-harvest handling. Strengthening extension services and farmers' access to appropriate agricultural technologies is supported by evidence showing that institutional support and access to agricultural information can facilitate technology adoption and improve smallholder farm performance (Atube et al., 2021). Policies should also facilitate farmers' access to markets and market information and improve access to appropriate agricultural financing, as access to credit and market-related support can contribute to smallholder commercialization and economic performance (Waweru & Olweny, 2023).

Future studies are recommended to incorporate additional variables, such as cocoa selling prices, market access, technology adoption, access to credit, and institutional support, to provide a more comprehensive explanation of variations in cocoa farmers' income. Future research should also cover a broader geographical area and, where possible, involve a larger sample to improve the external validity and generalizability of the findings.

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