INCOME ANALYSIS OF MAIZE FARMERS ON RUBBER PLANTATION HIATEN LAND UTILIZATION SUNGEI PUTIH RESEARCH UNIT

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ABSTRACT

Sungei Putih Research Unit is an area located in Galang District, Deliserdang Regency which has a rubber plantation sector. The vacant land found in rubber plantations in this area is used by the community, one of which is to grow corn. The purpose of this research is to increase the income of corn farmers through the use of land between rubber plantations in Sungei Putih Research Unit and to evaluate the advantages and disadvantages of corn farming by utilizing land using the R/C Ratio and ROI. This research was conducted at Sungei Putih Research Unit, Galang District, Deli Serdang Regency using the Saturated Sampling method to select 9 farmers who intercropped rubber with corn as research samples. To find out whether the business is profitable or not, production costs and income are calculated and then analyzed using the R/C Ratio and ROI, and the income contribution is calculated. The results showed that the R/C ratio was 2.36 > 1, which means that every production cost of Rp. 1,000 will generate income of Rp. 2,360 for farmers so that corn farming on rubber plantations between Sungei Putih Research Unit is profitable. The ROI value of 36.66% indicates that farming has a profitable profit rate, and a revenue contribution of 69.39% indicates that corn farming on rubber plantation land makes a good contribution to the total income of farmers. To increase the maximum income, it is recommended that farmers take good care of their corn plants so that they are free from pests and diseases.

Keywords: *maize farmers, R/C ratio, ROI*

BACKGROUND

The empty land formed in rubber plants due to decreased production is called hiaten. Rubber plant production can be reduced due to wind attack, disease, or other factors such as excessive tapping that makes trees brittle and easily fall. Hiaten land is usually not optimally utilized because it is only overgrown with weeds or other nuisance plants (Puttaso et al. 2020). Rubber plantation greenfields are often considered a neglected resource because they are not utilized for productive crops. However, it can actually be utilized for a variety of other crops, such as vegetables, fruits, and other food crops (Fussy and Papenbrock 2022). In addition, it can also be utilized for the development of other plantation crops, such as corn. The utilization of rubber plantation greenfields can provide various benefits, such as increasing land productivity and farmer's income, and reducing pressure on natural forests (Kuswanto et al. 2019). In addition, hiaten land management can also improve environmental quality and soil health around rubber plantations (Nguyen et al. 2020).

Therefore, the utilization of greenfield rubber plantations can be an effective strategy for developing the agricultural sector and improving the welfare of farmers in plantation areas. In this study, the main focus is on the utilization of rubber plantation greenfields for maize cultivation. Maize is one of the most important food crops in Indonesia and has great potential to be developed on green fields. By planting crops such as maize between the rubber plants on the hiaten land of the rubber plantation owned by Sungei Putih Research Unit, businesses can gain financial benefits. Factors such as land, capital, labor, and processing/management play an important role in improving the economy of farmers who manage the hiaten land (Wang and Hu 2021). The better these factors are, the higher the farm productivity and income of farmers/business owners. The larger the land area used to grow maize, the greater the production and income that can be generated (Erenstein et al. 2022). Production costs include fixed costs such as land rent and equipment depreciation, as well as variable costs such as fertilizer, pesticides, labor, transportation, and maintenance. By calculating the R/C Ratio, it can be seen whether the farm is profitable or disadvantageous (Nikoyan 2020). Meanwhile, ROI, which is farm income divided by farm capital multiplied by 100%, is used to determine the rate of return on investment and net profit from the farming process. This study aims to evaluate the potential for agricultural development in rubber plantation hiaten land through analysis of maize farmers' income. The results of this study are expected to provide useful information for farmers and related parties in the development of agriculture on rubber plantation hiaten land.

RESEARCH METHODS

This research uses the case study method by selecting a location that has a large rubber plantation. The consideration in selecting the location was because there were 9 farmers who used the rubber plantation hiaten land to plant corn as an intercrop. The research was conducted in the Research Unit of Sungei Putih Village, Galang District, Deli Serdang Regency from November 2022 until its completion. In this research, there are two types of data collection methods used, namely primary data and secondary data. Primary data is obtained through observations, interviews, and questionnaires that produce numbers (numeric). Meanwhile, secondary data was obtained indirectly from relevant agencies such as the Central Bureau of Statistics, Village Offices, books, journals, internet media, and mass media sources relevant to the research topic. Both have qualitative and quantitative properties. Data analysis methods were used to evaluate the profit or loss situation of maize farming on rubber plantation fallow land in Sungei Putih Research Unit, measured through R/C ratio and ROI, as well as the impact of maize farmers' income on increasing their family income. The formula used to calculate the total cost is using Biswas et al. (2023).

$$TC = FC + VC$$

Information:
TC   : Total Cost (Rp/MT)
FC   : Total Fixed Cost (Rp/MT)
VC   : Total Variable Cost (Rp/MT)

Equipment depreciation can be calculated using the following formula by Dyah and Kahfi (2021).

$$\text{Depreciation} = \frac{\text{Initial Value} - \text{Final Value}}{\text{Economic Life}}$$

Information:
Initial value : Purchase Price of Farm Equipment
Final value : Current Price of the Farm Equipment After Use
Economic life : Life Expectancy of the Farm Equipment

The formula for calculating the labor index uses the formula from Wang and Hu (2021).

$$L = \frac{t \times h \times j}{w} \times HKP$$

Information:
L : Labor Index (HKP/HKW)
t : Number of Personnel (Person)
h : Number of Working Days (Days/MT)
j : Number of Working Hours (Hour/Day)
w : Average Working Hours/Day

The formula for calculating farm incomeed is as follows by Rachmadina et al. (2021).

$$TR = P \times Q$$

Information:
TR : Total Revenue (Rp)
P : Maize Price (Rp/Kg)
Q : Total Production (Kg)

The formula for calculating income is as follows by Riantini (2021).

$$\pi = TR - TC$$

Information:
π : Farm Income (Rp/MT)
TR : Total Revenue (Rp/MT)
TC : Total Cost (Rp/MT)

The Revenue/Cost Ratio (R/C Ratio) is a measure that describes the relationship between total revenue and costs incurred. The higher the R/C Ratio value, the greater the profit that can be obtained. Structurally, the R/C Ratio formula can be described as follows (Maskumambang, Dipokusumo, and Sukardi 2021):

$$\frac{R}{C} \text{Ratio} = \frac{\text{Maize Receipt Amount}}{\text{Total Cost}}$$

If the R/C value ratio is greater than 1, then it can be considered profitable to run, whereas if the R/C is equal to 1, it is considered a break-even point and if the R/C is less than 1, then the business is considered unprofitable or incurs a loss. ROI (Return on Investment), is used as a tool to measure how effective an investment in a business is and the net profit generated from the process. The formula used to calculate ROI is as follows by Afidchao et al. (2014).

$$\text{ROI} = \frac{\text{Total Maize Farm Income (Rp)} - \text{Farm Capital (Rp)}}{\text{Farming Capital (Rp)}} 100\%$$

The formula used to calculate and find out how much the contribution of corn farmer income to the farmer's family income is by Riantini (2021).

$$\text{Revenue Contribution} = \frac{\text{Total Maize Farming Income (Rp)}}{\text{Total Farmer Family Income (Rp)}} 100\%$$

Measuring how much or how little contribution is made to the total family income, an interval scale of contribution is used the formula by Emran et al. (2021), consisting of:

Table 1. Family Income Contribution Interval Scale

Contribution Interval Scale	
Percentage Contribution Rate	**Contribution Criteria**
0.00-10.00%	Very Less
10.01-20.00%	Less
20.01-30.00%	Medium
30.01-40.00%	Simply
40.01-50.00%	Good
>50%	Excellent

RESULT AND DISCUSSION

Production Cost

Maize farming requires production costs, which consist of fixed and variable costs (Biswas et al. 2023). Fixed costs in maize farming include the cost of tool depreciation, which is the cost of replacing the value of tools used to facilitate farmers' work (FAO 2016). The tools used in maize farming such as the trimmer, sprayer (pump), fork, machete, and hoe have different functions. Costs that change according to production needs and have an impact on the quality of production produced are called variable costs. In maize farming, variable costs for one harvest period include labor, seeds, fertilizers, and pesticides (Tudi et al. 2021). Table 2. shows the average fixed and variable costs of maize in the rubber plantation of Sungei Putih Research Unit.

Table 2. Maize Production Costs on Hiaten Land Utilization of Rubber Plantation

No	Type of Production Cost	Amount (Rp/MT)
1	Fixed Cost	
	a. Tool Depreciation Cost	185,967.00
	Total Fixed Cost	185,967.00
2	Variable Cost	
	a. Labor Cost	7,890,000.00
	b. Seedling Cost	2,586,797.10
	c. Fertilizer Cost	5,568,254.00
	d. Pesticide Cost	1,171,667.00
	Total Variable Cost	17,216,718.10
	Total Production Cost	17,402,685.10

The results of the income analysis of maize farmers on the utilization of rubber plantation hiaten land in Sungei Putih Research Unit show that the total production cost to produce maize is Rp 17,402,685.10 per metric ton (MT). The production cost consists of fixed costs of Rp 185,967.00 and variable costs of Rp 17,216,718.10. In income analysis, production costs must be compared with the income generated. If the cost of production is lower than the income, then maize production in rubber plantation hiaten land can be said to be profitable. A study by Appiah-Twumasi et al. (2022) in Ghana found that total variable costs for maize farming were higher than fixed costs, with labor costs being the highest variable cost. This is consistent with the findings of the current study, which also found labor costs to be the highest variable cost. Another study by Ul Hussan et al. (2023) in Pakistan analyzed the production costs of maize farming and found that fertilizer cost was the highest variable cost, followed by seed cost and irrigation cost. In contrast, this study found that labour cost was the highest variable cost, followed by fertilizer cost and seed cost. The difference in results could be due to variations in farming practices and input costs in different regions. Regarding the utilization of rubber plantation land, Akpan & Ebong (2021) study in Nigeria found that rubber plantation land can be utilized for food crop cultivation, including maize, to increase farmers' income. The results of this study are in line with these findings, showing that the utilization of rubber plantation land for maize farming can provide additional income for farmers. The findings of this study are consistent with other studies on maize farm production costs and rubber plantation land use. However, variations in input costs and farming practices across regions and countries may result in differences in the relative importance of different production costs.

Revenue

Farming income can be calculated by multiplying the amount of production of a product with the selling price of that product. Corn receipts from rubber plantations Sungei White Research Unit (Table 3) shows the total production of corn is 15,578.00 tons.

Table 3. Maize Revenue in Hiaten Land Utilization of Rubber Plantation Sungei Putih Research Unit

No	Description	Total
1	Production (Ton)	15,578.00
2	Price (Rp/Kg)	2,644.00
	Revenue (Rp)	40,833,333.00

This shows that maize farmers who utilize the Hiaten Rubber Farm for maize production have a high level of productivity. However, it should be noted that production levels can be affected by various factors such as climate, soil conditions, and farming techniques. The research found that the price of maize per kilogram is Rp 2,644. Crop prices depend on market demand and supply. The price offered on the market depends on the demand for the product and the available supply. Maize prices can be affected by factors such as crop yields, weather conditions, and trade policies. From the results of the study it is known that the income obtained by corn farmers who utilize Hiaten Rubber Plantation for corn production is Rp 40,833,333.00. The income earned by farmers is determined by production yields and product prices.

Existing research on intercropping Joseph et al. (2018) suggests that it can be a profitable and sustainable agricultural practice. Intercropping has been shown to increase crop yields, reduce input costs, and improve soil fertility by promoting biodiversity and reducing pest and disease pressure. In addition, some studies show that intercropping can also have positive impacts on the environment, such as reducing soil erosion and improving soil quality (Chamkhi et al. 2022). Existing research (Huang et al. 2020) on the impact of rubber plantations on crop yields shows that rubber trees can have both positive and negative impacts on crop yields. Rubber trees can provide shade, which can benefit some crops, but can also compete with crops for water and nutrients, which can reduce yields (Li, Zhou, and Lin 2019). However, when managed well, rubber plantations can support soil conservation and improve soil quality, which can benefit crop yields in the long term.

Income

Maize farming in Sungei Putih Research Unit is derived from the difference between total revenues and costs incurred in utilizing rubber plantation land. The data found (Table 4) from the research shows the average income of maize farming in the following table 4.

Table 4. Maize Income on Rubber Plantation Hiaten Land Utilization

No	Description	Amount (Rp/MT)
1	Total Revenue	41,188,232.00
2	Total Cost	17,402,685.10
	Total Income (Rp)	23,785,546.90

Intercropping refers to the cultivation of two or more crops simultaneously on the same land to maximize yield and minimize risk. Intercropping rubber with other crops such as maize has been studied as a way of diversifying income for rubber plantation farmers. However, research on the total cost and total income of maize in rubber intercropping is limited. The total income from maize production on rubber plantation land use is Rp 41,188,232. This is the total amount of money earned from the sale of the maize crop. The total cost of production, which includes the cost of labor, seeds, fertilizer, and other inputs, is Rp 17,402,685.10. By subtracting the total costs from the total revenue, we can calculate the total revenue from maize production on the rubber plantation, which is Rp 23,785,546.90. This figure shows the net income earned from the maize crop after deducting all costs. There are many studies investigating the income of farmers who grow maize in intercropping with rubber crops. This research provides valuable insights into the factors that may affect the profitability of this farming system.

A study by Huang et al. (2015) investigated the impact of intercropping rubber trees with maize in the North China Plain. The study found that intercropping can significantly improve the land use efficiency and economic benefits of rubber plantations, with an average net income increase of 27.7% over monoculture rubber cultivation. Similarly, research by Cahyo (2015) examined the impact of rubber and corn intercropping in Indonesia. The study found that intercropping can increase the overall economic benefits of the farming system, with an average net income increase of 15% compared to monoculture rubber planting. Overall, these and other studies suggest that intercropping with rubber can be a profitable and sustainable agricultural practice for maize farmers, provided the system is carefully managed and appropriate practices are adopted. However, further research is needed to investigate the optimal management strategies for rubber intercropping in different geographical areas and farming contexts.

R/C Ratio

The cost-to-income (R/C) ratio is used to evaluate the profitability of a business activity over a certain period. In Table 5, there are R/C ratio results for maize cultivation on forest land that was not planted for some time in the Sungei Putih Research Unit rubber plantation:

$$\frac{R}{C}\text{Ratio} = \frac{41,188,232.00}{17,402,685.10}$$
$$= 2.36$$

Based on the research, it was found that the average R/C ratio was 2.36. This means that if a farmer spends Rp 1,000, he or she will receive Rp 2,360. Since the revenue earned is greater than the costs incurred, maize farming on rubber plantation greenfield utilization in Sungei Putih Research Unit is profitable. A study conducted in Thailand by Hougni et al. (2018) examined the economic viability of maize intercropping in young rubber plantations. The study found that maize intercropping in rubber plantations increased total revenue per unit area, but the additional costs associated with maize cultivation reduced the overall net profit. The researchers suggested that intercropping can be a viable option for farmers if they can minimize costs and manage intercropping effectively.

Another study conducted in Indonesia by Juwita et al. (2020) evaluated the profitability of maize intercropping in mature rubber plantations. The results showed that intercropping increased total revenue per unit area, and the additional costs associated with maize cultivation were offset by higher maize yields. The study also found that intercropping improved soil fertility and reduced the risk of rubber tree diseases. The authors concluded that intercropping can be a profitable strategy for rubber plantation farmers to increase their income and improve sustainability. Maitra et al. (2021) investigated the effects of intercropping maize and beans in mature rubber plantations. The study found that intercropping maize and beans increased total income per unit area and reduced production costs. The authors concluded that intercropping can be a profitable and sustainable way to diversify income for rubber plantation farmers.

ROI

Return on Investment (ROI) is a useful indicator to assess how much yield and net profit is obtained from investment efforts. In particular, ROI is used to measure the rate of return on

investment in the farming process. In one harvest period, the average ROI generated by maize farmers on rubber plantation land use is as follows:

$$ROI = \frac{23{,}785{,}546.90 - 17{,}402{,}685.10}{17{,}402{,}685.10} \, 100\%$$
$$= 36.66\%$$

The results of the study on the average ROI of Maize Farmers on Hybrid Land Utilization of Rubber Plantations showed that the business activity generated a significant profit of 36.66% of the invested capital. This result is an indication of a profitable business activity. A positive ROI means that the farm has a normal level of profit or profit that is profitable at 36.66% of the invested capital. This is a considerable return on investment, and it indicates that maize farming on rubber plantation land is a viable business venture. Pierre et al. (2022) argue that the higher the ROI, the more profitable the business activity, and the more attractive it is to investors.

Hybrid Land Utilization of Rubber Plantations is encouraging, as it indicates that the business activity generates considerable profits. For example, a study conducted by (Nations 2015) on the economic performance of maize farming in Kenya found that maize farming is profitable, with an average return on investment of 31.5%. Another study conducted by Wang and Hu (2021), found that the ROI for maize production in China ranged from 11% to 90%, depending on factors such as yield, costs, and market prices. The findings suggest that maize farming on rubber plantation greenfields can be a profitable venture in different regions and countries. However, the actual ROI may vary depending on various factors such as location, climate, soil fertility, production costs, and market demand. Compared to existing studies, the 36.66% ROI for maize farming on rubber estate land use is high, indicating that investment in this type of farming is more profitable than other types of maize farming.

Revenue Contribution

Generally, maize farmers who use idle land in rubber plantations do not only depend on one source of income. This is also true for the respondents in this study, where each respondent has other sources of income to fulfill their needs, such as working as employees, security, and tappers. Nonetheless, maize farming still contributes to their income. The contribution of maize farming by utilizing idle land in rubber plantations can be measured as follows:

$$Revenue\ Contribution = \frac{23{,}785{,}546.90}{34{,}274{,}435.78} \, 100\%$$
$$= 69.39\%$$

Table 5. Average Total Farmer Income

No	Description	Amount (Rp)	Contribution (%)
1	Maize Farming Income	23,785,546.90	69.39
2	Maize Non-Farm Income	10,488,888.88	
	Total Family Income	34,274,435.78	

According to the results of this study, maize farming on rubber plantation land use contributes 69.39% to farmers' income. This means that maize farming plays an important role in meeting the needs of the farmers' families and most of their income comes from maize farming. Although there are other incomes apart from maize farming, the contribution of maize farming is considered excellent because it exceeds the established contribution criteria of more than 50%. Therefore, it can be concluded that maize farming in the hiaten land use of Sungei Putih Research Unit rubber plantation contributes very well to the overall income of the farmers. A study by Koppmair, Kassie, and Qaim (2017), also states that crop diversification can increase agricultural productivity and income. The study showed that farmers who grew a wide variety of crops, including food crops and cash crops, had higher incomes than those who specialized in just one type of crop. Similarly, a study by Benin et al. (2011) in Uganda found that diversification of income sources through different agricultural activities and non-farm income generating activities contributed to improved livelihoods of rural households.

In the context of rubber plantation farmers, a study conducted by Rattanamanee et al. (2020) in Thailand found that farmers who diversified their income sources had higher incomes and were less vulnerable to rubber price fluctuations. The study recommended that rubber farmers consider diversifying into other crops or non-farm income generating activities to reduce their dependence on income from rubber. Therefore, although the specific contexts may differ, the importance of diversification and the potential benefits of combining different agricultural activities to improve smallholder incomes and livelihoods have been well demonstrated in existing research.

CONCLUSION AND SUGGESTION

The results of the analysis show that the average R/C ratio is 2.36 > 1, and the average percentage of ROI analysis results is 36.66%. In addition, the average percentage contribution of corn farming to the use of rubber plantations on the income of farmers is 63.86% > 50%. This shows that the contribution of corn farming income to the use of rubber plantation land in Sungei Putih Research Unit is very good. Based on the research results that have been obtained, the researchers provide the following recommendations:

1. To increase corn production, farmers are advised to take more intensive care of corn cultivation.
2. The government and Sungei Putih Research Unit are advised to assist farmers in terms of capital and technology counseling and motivation so that farmers can increase their income.
3. Farmers should continue corn farming because this business is very influential on family income and can help improve the family's economy.

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