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Analysis of Factors Affecting Rubber Production in Koto Alam Village, Pangkalan Koto Baru District, Lima Puluh Kota Regency, West Sumatra Province

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Abstract: People's rubber plantations play an important role in the welfare of farmers, the country and the world. However, people's rubber production is still low and many rubber plants are unproductive. This study aims to analyze the factors that influence rubber production in Nagari Koto Alam, Pangkalan Koto Baru District, Lima Puluh Kota Regency. This research was conducted conducted from March 2020 to July 2020. The research method used multiple linear regression and purposive sampling. The results of the study showed test regression R square = 0.827 was obtained, meaning that 82.7 % of the variables of land area, labor, and number of rubber trees were able to explain rubber production. Land area had 1.791 coefficient, a positive and significant effect. So, rubber farmers must expanded their land area Farmers. The number of rubber trees had a negative (0.099) and significant effect. Because did not maintain rubber trees properly, and many rubber plants was damaged. Labor had a negative (2.086) and insignificant effect on rubber production. So it is necessary to increase the maintenance and rejuvenation of rubber plants.

Keywords: Multiple linear; Production; Rubber farmers

Introduction

Indonesia's rubber export volume remains high at 2.28 million tons with an export value of USD 3.01 billion in 2020. Although it decreased compared to 2019, the rubber export volume was 2.50 million tons with an export value of USD 3.52 billion. Indonesia's three largest exported rubber products are Technically Specified Natural Rubber (TSNR 20) with HS code 40012220, TSNR 10 with HS code 40012210, and Ribbed Smoked Sheet Grade 1 with HS code 40012110. TSNR 20 is the most exported, accounting for 90 percent of the three types of rubber products (BPS, 2020). Wahyudy (2018) and Wati et al. (2023), stated that international rubber production and prices influence the value of Indonesian rubber exports. Zayani et al. (2024) and Anggraeni (2025) stated that Indonesian rubber exports are influenced by domestic production and world prices.

Indonesia is the second largest natural rubber producing country after Thailand. However, Indonesia's natural rubber production began to decline in 2019-2020 due to the COVID-19 pandemic and leaf fall disease in rubber plants. Indonesian rubber production in 2020 reached 3,037,348 tons on a land area of 3,726,173 hectares, compared to 3.30 million tons in 2019 (BPS, 2020). Furthermore, 90 percent of rubber production is produced by smallholder farmers or smallholder plantations, compared to large state-owned and private plantations. The problem that occurs is that people's plantations do not maintain their rubber plants properly and many of the rubber trees are no longer productive.

The five highest rubber-producing provinces in Indonesia are South Sumatra, West Sumatra, Riau, Jambi, and Central Java. West Sumatra has the second-highest dry rubber productivity, with 1,020 kg per hectare in 2023 (BPS, 2023). Lima Puluh Kota Regency is

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one of the rubber producers on people's plantations in West Sumatra in Pangkalan Koto Baru District. Most of the people of Pangkalan Koto Baru District make a living as rubber farmers. Nagari Koto Alam is a fairly large rubber producer in Pangkalan Koto Baru District. The problem is that rubber management is still simple, there is a lack of maintenance of rubber plants. So the productivity is low at 549 kg/ha/year, and the quality of farmers' rubber production is poor. Previous research stated that income of rubber farmers was very low. Putri et al. (2022) stated that agro-climatic conditions can affect the productivity level of rubber plants. According to Krisnawati et al. (2023), rubber production is influenced by land area and rubber plant productivity. Nugraha et al. (2018) and Rahmatika (2023) obtained research results that in the long term, rubber production is influenced by the price and area of rubber land. Similarly, research by Hendratno (2015) and Haryanto et al. (2019) found that rubber production and demand are influenced by the price and area of rubber plantations. Research by Syarifa et al. (2012); Syarifa et al. (2023) also found that long-term projections for natural rubber prices will continue to increase by US$1.5 per kg of dry rubber in From 2025 to 2027, the price of dry rubber reached US$1.5 per kg. Furthermore, projections indicate that rubber production will continue to decline until 2030 if there is no increase in production and productivity.

Therefore, the author conducted research to analyze the factors influencing rubber production in Nagari Koto Alam, Pangkalan Koto Baru District, and determine which factors most influence rubber production. The research is expected to benefit rubber farmers by using the results as a reference for increasing rubber production.

Method

Time and Place Research

The research was conducted in Nagari Koto Alam, Pangkalan Koto Baru District, Lima Puluh Kota Regency, West Sumatra Province. The research location was determined using a purposive method (Sugiyono, 2018; Mukhlis et al., 2019; Mukhlis et al., 2024; Asgaf et al., 2025), deliberately chosen the location was based on Nagari Koto Alam, which was a village where the majority of the population works as rubber farmers. The research was conducted from March 2020 to July 2020.

Sampling Techniques and Data Analysis

The analytical method used primary data and secondary data to answer the research result (Sugiyono, 2022; Mukhlis et al., 2022; Ogari et al., 2026). The data used are primary data through interviews with rubber farmers in Nagari Koto Alam using questionnaires and observations as well as secondary data from the Central Statistics Agency and other related agencies.

Determination of the number of samples (n) where the population (N) is 500 rubber farmers using the Slovin formula (degree of error 15%), namely:

$$n = \frac{N}{Ne^2 + 1}$$

$$n = \frac{500}{500(15\%)^2 + 1}$$

$$n = \frac{500}{12.25}$$

n= 40.9 rounded up to 41 rubber farmers

Each Jorong determines the number of samples taken, namely:

Simpang Tiga = $\frac{90}{500} x41 = 7$

Polong Duo = $\frac{70}{500} x41 = 6$

Koto Tangah = $\frac{120}{500} x41 = 10$

Koto Ronah = $\frac{220}{500} x41 = 18$

The next sample was selected using the purposive sampling method (Mubarokah et al., 2024; Marliyah et al., 2025; Ogari et al., 2026). The criteria used as samples were farmers who had rubber plants and whose main livelihood was as rubber farmers, owned their own land and rubber processing farmers.

The research model uses the Cobb Douglas production function regression model, converting it to natural logarithms, for multiple linear regression analysis. The research model examines the factors influencing rubber production in Koto Alam Nagari community plantations, namely:

$$\text{Ln } Y = \beta 0 + \beta 1 \ln X_1 + \beta 2 \ln X_2 + \beta 3 \ln X_3 \quad (1)$$

Where:

Y= rubber production (kg)

X_1 = land area (ha)

X_2 = labor (HKO)

X_3 = number of rubber trees (trunks)

Multiple linear regression analysis was using SPSS software version 26.

Result and Discussion

Characteristics of Rubber Farmers in Koto Alam Village, Pangkalan Koto Baru District

Several characteristics of rubber farmers are identified, including their age, education, land area, and land ownership. Table 1 shows that the highest number of farmers is 61-70 years old (14), and the lowest number

is over 70, the majority of rubber farmers are of productive age (59%, or 24).

Table 1. Age of Rubber Farmers

Age (Years)	Number of Respondents (People)	Percentage (%)
31-40	4	10
41-50	7	17
51-60	13	32
61-70	14	34
>70	3	7
Total	41	100

Based on Table 2, the majority of rubber Farmers had an elementary school education level of 34 people (83%). Farmers still cultivate rubber plants in a way that has been passed down from generation to generation, so that Good Agriculture Practice (Gap) has not been implemented. Farmers tend to choose rubber cultivation because it is simple to cultivate, did not require routine maintenance, but still produces results.

Table 2. Education Level of Rubber Farmers

Last Education	Number of Respondents (People)	Percentage (%)
Elementary School	34	83
Junior High School	1	2
Senior High School	5	12
S1	1	2
Total	41	100

Based on table 3, the area of rubber farmers' land is mostly < 1.5 ha (24 people) and 1.6-2 ha for 17 people (41%) with land ownership status of their own.

Table 3. Area of Rubber Farmers' Land

Land Area (Ha)	Number of Respondents (People)	Percentage (%)
<1.5	24	59
1.6-2	17	41
Total	41	100

Analysis of Factors Influencing Rubber Production

The results of the multiple linear regression test (can be seen in table 4) of the factors that influence rubber production in Nagari Koto Alam are as follows:

$$Y= 16.108 + 1.791X_1 -0.099X_2 -2.086X_3$$

Based on the results of the regression test, R = 0.827 was obtained, meaning that 82.7 % of the variables of land area, labor, and number of rubber trees were able to explain rubber production. The regression results showed that the area of rubber land had a positive and significant effect (real level α = 5%) on rubber production with a coefficient value of 1.791. This means that if the land area increases by 1 ha, it will increase rubber production by 1.791 kg. The average land area of rubber farmers is 1.5 ha. Therefore, rubber farmers need to increase their land area. According to Ibrahim et al. (2025), land area significantly influences rubber production, thus impacting the income of rubber farmers (Nugraha & Alamsyah, 2019). Nugraha et al. (2023) stated that rubber production will affect the income of rubber farmers. Research by Syarifa (2025) found that farmers still have the potential to increase rubber production by 26 percent.

Table 4. Regression Coefficients of Factors Influencing Rubber Production

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	16.108	5.432		2.965	.005
	Land area	1.791	.650	4.382	2.756	.009
	Labor	-.099	.441	-.022	-.225	.824
	Number of rubber trees	-2.086	.923	-3.583	-2.260	.030

a. Dependent Variable: Rubber production

The labor variable has a negative and insignificant effect (significance level α=5%) on rubber production. Based on the labor conditions used by rubber farmers, it is only for rubber plant maintenance labor with weed removal only twice a year and for harvesting and post-harvest processing of rubber. On average, farmers use 12 HKO (Person-Working Days) of labor per year. Routine maintenance should increase production, thereby increasing labor use (Stulov, 2016). Based on conditions in the research area, the frequency of rubber plant maintenance is very minimal and farmers do not provide fertilizer, resulting in an average rubber production of very small farmers of 92.34 kg per hectare per year. When compared to the standard productivity of rubber plantations in general, which is 1080 kg/ha/year. Hamdani et al. (2023) and Rouf et al. (2023) stated that work experience can increase the productivity of rubber tappers.

The variable of the number of rubber trees owned by farmers has a negative and significant effect on rubber production. The average number of rubber trees is 500 trees per hectare. However, most of the rubber trees are unproductive (rubber trees that are damaged due to very minimal maintenance and are old). Farmers

need to carry out maintenance by regularly fertilizing and increasing the frequency of weed removal. Nofriadi (2016), Zhang et al. (2019), Citra et al. (2025) stated that fertilization has a significant effect on rubber production. Alamsyah et al. (2022) stated a strategy to increase the productivity of Indonesian people's rubber plantations through rubber cultivation and rejuvenation technology. Heriyanto et al. (2017) also stated the need to rejuvenate old and damaged rubber by using superior seeds and maintaining them according to GAP.

Rubber propagation can be done in vitro to increase rubber productivity (Frederic et al, 2025). Cahyo et al. (2023) stated that institutional strengthening is necessary for the sustainability of Indonesian people's rubber plantations. This is also supported by research by Ali et al. (2020) on the need to combine social and institutional factors for sustainable rubber production. Research by Huang et al. (2026) suggests the need for a rubber crop diversification system with coffee, bamboo, and tea to mitigate the risk of rubber price fluctuations. Rubber farmers' incomes fluctuate due to the impact of fluctuating rubber prices (Mintawahyuningsih et al., 2021).

Conclusion

Based on the research results, it can be concluded that land area has a positive and significant effect on rubber production with a variable coefficient of 1.791, labor has a negative and non-significant effect on production (the coefficient obtained is 0.099) and the number of rubber trees has a negative and significant effect on rubber production (the coefficient is 2.086). So that rubber farmers need to increase the area of land, the frequency of rubber plant maintenance by carrying out routine fertilization so that rubber production increases or increases.

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Author Contributions
H.S.: Conceptualization, developing ideas, overseeing data collection, analyzing, writing, reviewing, responding to reviewers' comments; M.K.: Overseeing data collection, analyzing data, reviewing scripts and writing.

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Conflicts of Interest
The authors declare no conflict of interest.

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