THE EFFECT OF LAND AREA, PRUNING AND PLANT AGE ON COFFEE PRODUCTIVITY IN POCO VILLAGE, MANGGARAI REGENCY

Gabriella Nuet[1]*, Ester Nurani Keraru[2], Fabianus Gangkur[3]

[1)] *Student, Agricultural Socio-Economics Study Program, Faculty of Agriculture and Animal Husbandry, Universitas Katolik Indonesia St. Paulus Ruteng*

2-3) Agricultural Socio-Economic Study Program, Faculty of Agriculture and Animal Husbandry, Universitas Katolik Indonesia St. Paulus Ruteng.

*Correspondence: gabriellanuet@gmail.com

Abstract: The present study aims to: (1) analyze the effect of land area on coffee productivity in Poco Village, Manggarai Regency; (2) examine the effect of pruning on coffee productivity in Poco Village, Manggarai Regency; and (3) investigate the effect of coffee plant age on coffee productivity in Poco Village, Manggarai Regency. The research was conducted in Poco Village, Manggarai Regency, over a period of one month, from April 8, 2025, to May 8, 2025. The study population consisted of 115 individuals, with samples determined through a simple random sampling technique using the Slovin formula. Data were collected through interviews, questionnaires, and documentation, while the analysis was performed using multiple linear regression. The findings reveal that land area has a positive and significant effect on coffee productivity, with a coefficient value of 0.023. Pruning also shows a positive and significant effect on coffee productivity, with a coefficient value of 0.022. Conversely, the age of coffee plants has a negative and significant effect on productivity, with a coefficient value of -0.001. Collectively, land area, pruning, and plant age significantly influence coffee productivity in Poco Village, Manggarai Regency, as indicated by a calculated F value of 14.615.

Keywords: *Land, Pruning, Age, Productivity, Coffee*

INTRODUCTION

The coffee plant (Coffea sp.) is a species of tree from the genus Coffea and the Rubiaceae family which can reach a height of 12 meters, grows upright and has branches. Coffee is an export product with high

economic value on the international market. Furthermore, coffee is a very popular commodity in Indonesia. To meet domestic and global demand, coffee cultivation in Indonesia has been devoted to nearly three centuries (Haniefan & Basunanda, 2022)Indonesia is the fourth largest coffee producer in the world. However, when compared to the top three coffee-producing countries, Indonesian coffee production is very low. Indonesia can only meet 4% of the European Union's coffee demand, despite the huge market there (Irfansyah et al., 2021).

Table 1.1 Indonesia's Coffee Planted Area and Total Coffee Production from 2021 to 2023

Year	Planted Area (000 Ha)	Production (000 Tons)
2021	786.19	786.19
2022	774.96	774.96
2023	758.73	1254.52

Source:Central Bureau of Statistics Indonesia (2024)

The data in Table 1.1 shows that in 2021 and 2022, coffee production was proportional to land area, at around 1 ton per hectare. However, in 2023, although land area decreased to 758.73 hectares, production actually increased significantly to 1,254.52 tons.

Coffee serves as a source of income, a beverage, and an element of local culture for the people of the Greater Manggarai region, East Nusa Tenggara (NTT). Coffee is an integral part of the culture of Manggarai Regency. Manggarai people generally recognize coffee as their primary beverage. However, coffee productivity is considered low compared to other coffee-producing regions and remains below the national average.(Keraru, 2023).

Table 1.2Coffee Planted Area and Total Coffee Production in Manggarai Regency from 2019 to 2023

Year	Planted Area (Ha)	Production (Tons)
2019	7,444	2,567.48
2020	3,746	2,553.00
2021	7,536	2,523.00

2022	7,537	2,525.60
2023	7.5537	2,529.10

Source:Central Statistics Agency of NTT (2024)

The data in Table 1.2 shows that coffee production in Manggarai Regency tended to be stable during the 2019–2023 period, despite fluctuations in land area. In 2019, there were 7,444 hectares of land, producing 2,567.48 tons. In 2020, the land area decreased drastically to 3,746 hectares, but production only slightly decreased to 2,553 tons. Although land area increased again in 2021–2023, coffee production remained relatively stable, at around 2,525–2,529 tons.

Several studies have found that several factors influence coffee productivity. Seed selection is the first step in achieving successful coffee cultivation (Hendrawan et al., 2022). Selection of coffee seeds, climate factors, fertilization and labor (Wardana et al., 2023). In addition, the size of the planting area used for coffee cultivation significantly influences coffee production. The size of the land supporting the coffee plantation is very influential, where the larger the land used for coffee cultivation, the higher the coffee production. Conversely, the smaller the land used for coffee cultivation, the lower the coffee production (Putra & Sudibia, 2023).

Pruning coffee plants also plays a crucial role in increasing coffee production. Pruning is necessary to ensure the plants not only grow with numerous branches and leaves but also produce more fruit. If left unpruned, coffee plants tend to grow tall and branch abundantly, ensuring the nutrients absorbed from the soil are distributed throughout the branches. both those that produce and those that do not. Pruning is done with the aim of ensuring that the growth and development of the coffee plant is more concentrated on generative growth than vegetative growth (Putri et al., 2024). Another very important factor in determining coffee production is the age of the plant. Coffee plants are most productive for five to twenty years. However, after reaching over twenty years of age, productivity begins to decline. This occurs because the stems become very old and the root

system begins to decline. As a result, nutrient absorption from the fertile soil becomes less effective (Hidayati et al., 2023).

Poco Village, Manggarai Regency, is an area with coffee as its main commodity. However, in recent years, there has been a decline in coffee productivity based on initial observations and reports from local agricultural extension workers. This decline is feared to have a direct impact on the welfare of farmers, given the community's dependence on coffee as a primary source of income. Some of the main causes identified are limited land, old plant age, and suboptimal cultivation practices such as pruning. Therefore, this study aims to analyze the effect of land area on coffee productivity in Poco Village, Manggarai Regency, analyze the effect of pruning on coffee productivity in Poco Village, Manggarai Regency, and analyze the effect of coffee plant age on coffee productivity in Poco Village, Manggarai Regency.

METHOD

The type of research used was quantitative, employing a multiple linear regression approach. Quantitative research is an approach that uses data that can be calculated or measured objectively, with information presented in the form of numbers or numerical values (Susanto et al., 2024)The object of this research is coffee farmers in Poco Village, Manggarai Regency.

Population refers to all individuals, objects, or events that are the main focus of a research activity.(Susanto et al., 2024)The population used in this study was all coffee farmers in Poco Village, Manggarai Regency, totaling 115 people. The sample size was determined using the Slovin formula with a 10% margin of error, resulting in a sample size of 53 people. Sample selection was carried out using the simple random sampling technique, namely a sampling method in which each member of the population has the same opportunity to be selected as part of the sample (Sari et al., 2023).

The research instruments used include interviews, questionnaires and documentation. Interviews are an effective data collection technique for obtaining in-depth information, especially on complex or personal topics. This method allows researchers to explore respondents' answers further by asking additional questions and gaining a more comprehensive understanding of their perspectives (Romdona et al., 2024)This method was used to collect the data needed by the researcher. In this study, the researcher interviewed coffee farmers in Poco Village, Manggarai Regency. A questionnaire is a data collection method that involves providing respondents with a list of written questions to answer based on their knowledge or opinions. This technique is widely used in research because it allows for data collection from a large number of respondents in a more time- and cost-efficient manner (Romdona et al., 2024). A questionnaire is a data collection method in which researchers ask respondents to answer a number of questions. Documentation is one of the data collection methods used in research, where documentation is used to trace data using photos or images at the research location.

The data analysis process in this study began with the classical assumption tests to ensure that the regression model met the validity criteria required in econometric analysis. These tests included assessments of normality, multicollinearity, heteroscedasticity, and linearity (Djuli et al., 2021). The normality test was conducted to determine whether the data were normally distributed, using the Kolmogorov–Smirnov test, histogram, and probability plot. The data are considered normally distributed if the *asymp. sig (2-tailed)* value exceeds 0.05. The multicollinearity test aimed to identify correlations among independent variables; no multicollinearity is indicated when the *Tolerance* value is greater than 0.01 and the *Variance Inflation Factor (VIF)* value is less than 10. The heteroscedasticity test was used to determine whether there were differences in residual variance among observations. A significance value of the independent variable greater than 0.05 indicates homoscedasticity, meaning that the residual

variances are equal. Meanwhile, the linearity test assessed the linear relationship between independent and dependent variables. A significance value greater than 0.05 indicates a linear relationship, while a value less than 0.05 indicates nonlinearity (Shabrina et al., 2020).

Furthermore, the study employed a multiple linear regression analysis to examine the effects of land area, pruning, and plant age on coffee productivity in Poco Village, Manggarai Regency. According to Sari and Putri (2023), the multiple linear regression model incorporates several independent variables to explain their respective contributions to the dependent variable. In this study, the model was formulated as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$$

where Y represents coffee productivity (tons/hectare), X_1 denotes land area (hectares), X_2 represents pruning (times/year), and X_3 indicates the age of the coffee plant (years). The constant (β_0) represents the intercept, while β_1, β_2, and β_3 are the regression coefficients that measure the partial effect of each independent variable on the dependent variable. The error term (ϵ) accounts for unexplained variations in the model. This regression model was applied to determine how each factor, land area, pruning, and plant age, collectively and individually influences coffee productivity in the study area.

RESULT AND DISCUSSION

1. Classical Assumption Test

Table 3.1 Results of the Classical Assumption Test

No	Test Type	Variables	Test Value/Sig.	Conclusion
1.	Normality Test	Residual	0.643	Normally distributed data

2.	Multicollinearity Test	X1 (Land Area)	Tolerance = 0.877; VIF = 1.140	There is no multicollinearity
		X2 (Pruning)	Tolerance = 0.988; VIF = 1.012	There is no multicollinearity
		X3 (Plant Age)	Tolerance = 0.884; VIF = 1.132	No multicollinearity occurs
3.	Heteroskasticity Test	X1 (Land Area)	0.300	There is no indication of heteroscedasticity
		X2 (Pruning)	0.593	There is no indication of heteroscedasticity
		X3 (Plant Age)	0.326	There is no indication of heteroscedasticity
4.	Linearity Test	X1 (Land Area)	0.473	The relationship is linear
		X2 (Pruning)	0.093	The relationship is linear
		X3 (Plant Age)	0,,197	The relationship is linear

Source: Primary data processed 2025

Table 3.1 presents the results of the classical assumption tests conducted to ensure the validity and reliability of the regression model applied in this study. The normality test shows a significance value of 0.643, which exceeds the threshold of 0.05, indicating that the residuals are normally distributed. This finding suggests that the model meets the assumption of normality, thereby supporting the accuracy and consistency of subsequent statistical inferences.

The multicollinearity test results demonstrate that all independent variables—land area (X_1), pruning (X_2), and plant age (X_3)—have *Tolerance* values greater than 0.01 and *Variance Inflation*

Factor (VIF) values below 10. Specifically, the *Tolerance* values for land area, pruning, and plant age are 0.877, 0.988, and 0.884, respectively, with corresponding *VIF* values of 1.140, 1.012, and 1.132. These results confirm the absence of multicollinearity among the predictor variables, implying that each independent variable provides unique explanatory power within the regression model.

The heteroscedasticity test further reveals that the significance values for land area (0.300), pruning (0.593), and plant age (0.326) are all greater than 0.05, indicating no evidence of heteroscedasticity. This suggests that the residual variances are homogenous across observations, thus fulfilling another important assumption of classical linear regression. Finally, the linearity test results show significance values of 0.473 for land area, 0.093 for pruning, and 0.197 for plant age—all exceeding the 0.05 threshold—indicating that the relationships between each independent variable and coffee productivity are linear. Collectively, these findings confirm that the regression model satisfies all classical assumptions, validating its suitability for analyzing the influence of land area, pruning, and plant age on coffee productivity in Poco Village, Manggarai Regency.

2. **Multiple Linear Regression**

Multiple Linear Regression Analysis was used to determine the effect of land area (X1), pruning (X2), and plant age (X3) variables on coffee productivity (Y) in Poco Village, Manggarai Regency.

Table 3.2 Results of Multiple Linear Regression Analysis

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.123	.012		10,382	.000
	Land area	.023	.009	.293	2,641	.011
	Pruning	.022	.004	.582	5,570	.000
	Plant Age	-.001	.000	-.311	-2,815	.007

Source: Primary data processed 2025

Table 3.2 presents the results of the multiple linear regression analysis examining the effects of land area, pruning, and plant age on coffee productivity in Poco Village, Manggarai Regency. The regression equation includes a constant value of 0.123 with a *t*-value of 10.382 and a significance level of 0.000, indicating that the model possesses a statistically significant intercept. This suggests that, when the independent variables are held constant, the baseline level of coffee productivity is 0.123 tons per hectare.

The results further reveal that land area exerts a positive and significant effect on coffee productivity, as indicated by a regression coefficient (*B*) of 0.023, a *t*-value of 2.641, and a *p*-value of 0.011. This implies that each additional hectare of land is associated with an increase of 0.023 tons in coffee productivity, assuming other variables remain constant. Similarly, pruning has a positive and highly significant effect on coffee productivity, with a regression coefficient of 0.022, a *t*-value of 5.570, and a *p*-value of 0.000. This finding indicates that more frequent or effective pruning practices contribute substantially to increased coffee yields. In contrast, the age of coffee plants exhibits a negative and significant effect on productivity, reflected in a regression coefficient of –0.001, a *t*-value of –2.815, and a *p*-value of 0.007. This result suggests that as coffee plants age, their productivity tends to decline, likely due to physiological degradation

or reduced fruit-bearing capacity. Overall, the findings underscore that land area and pruning positively enhance coffee productivity, while plant age negatively influences it, highlighting the importance of both agronomic and management factors in optimizing coffee yields.

Based on the regression equation, it shows that the constant value is 0.123, meaning that if the variables of land area (X1), pruning (X2), and (X3) plant age are considered fixed or constant and do not change, then the value of coffee productivity is 0.123.

The regression results show that land area has a positive coefficient of 0.023 with a significant value of 0.011, which means that every one unit increase in land area will significantly increase coffee productivity. The significance value of 0.011 < 0.05, so H0 is rejected and H1 is accepted. This indicates that the larger the land area owned by farmers, the higher the coffee productivity produced. Research by Gufran (2019)This finding supports the findings that land area has a positive and significant effect on smallholder coffee productivity. In this study, land area was the dominant variable with a regression coefficient of 0.450, indicating that the larger the area of land owned by farmers, the higher the coffee productivity.

The pruning variable has a coefficient of 0.022 with a significant value of 0.000, indicating a positive and significant effect on coffee productivity. The coefficient of 0.022 indicates that a one-unit increase in pruning can increase coffee productivity by 0.022 units, with a value <0.05, thus rejecting H0 and accepting H1. This indicates that pruning can significantly increase coffee productivity. This finding is in line with the results of previous research. Atikah et al. (2024) which shows that proper maintenance pruning can increase the number of productive branches and fruit yield. Pruning stimulates new shoot growth and improves distribution within the coffee plant, thereby increasing yields.

The regression coefficient for the plant age variable is negative, at -0.001 with a significance value of 0.007, which is <0.05. This

indicates that every 1 unit increase in plant age will significantly decrease productivity by -0.001 units. This suggests that as coffee plants age, productivity tends to decline. In research conducted by Muliyah et al. (2020).The results of the multiple linear regression analysis show that the tree age variable has a regression coefficient of -85.901. This indicates that each additional year of coffee tree age tends to reduce farmers' net income by Rp 85,901, assuming other variables remain constant. This coefficient indicates that as coffee plants age, their productivity tends to decline.

CONCLUSION

Based on the results of the data analysis and discussion above, the conclusions can be drawn. Land area has a positive and significant effect on coffee productivity in Poco Village, Manggarai Regency, with a coefficient value of 0.023. This indicates that the larger the land area owned by farmers, the higher the coffee productivity. Pruning has a positive and significant effect on coffee productivity in Poco Village, Manggarai Regency, with a coefficient value of 0.022. This means that better and more regular pruning practices increase coffee productivity. Pruning helps maintain plant health and encourages the growth of new, productive shoots. Coffee plant age has a negative and significant effect on coffee productivity in Poco Village, Manggarai Regency, with a coefficient of -0.001. As the plant ages, its productivity tends to decline. This is because older coffee plants have a lower production capacity than plants that are still in their productive years.

REFERENCES

Atikah, N., Suhartanto, MR, & Wachjar, A. (2024). Pruning Increases Productivity of Robusta Coffee Plants (Coffea canephora Pierre ex. A. Froehner) in Malang, East Java. Agrohorti Bulletin,12(2),294–303. https://doi.org/10.29244/agrob.v12i2.51583

Central Bureau of Statistics, I. (2024). Indonesian Coffee Statistics (Vol. 8).

Central Statistics Agency, PNTT (2024). Plantation Crop Production by Regency/City (Tons), 2019-2023. https://ntt.bps.go.id/id/statistics-table/2/NTcjMg==/produksi-tanaman-perkebunan-menurut-kabupaten-kota.html

Djuli Sjafei Purba, Wico Jontarudi Tarigan, Mahaitin Sinaga, VT (2021). Training on the Use of SPSS Software in Multiple Linear Regression Processing for Students of the Faculty of Economics, Simalungun University During the Covid-19 Pandemic. 5, 202–208.

Gufran, M. (2019). Analysis of Capital, Land Area, and Labor on the Productivity of People's Coffee in Silo District, Jember Regency. Thesis.

Haniefan, N., & Basunanda, P. (2022). Exploration and Identification of Liberica Coffee Plants in Sukorejo District, Kendal Regency. Vegetalika, 11(1), 11–18. https://doi.org/10.22146/veg.44325

Hendrawan, D., Sulardi, & Hakim, T. (2022). Agribusiness of Arabica Coffee Cultivation.

Irfansyah, D., Mustikasari, M., & Suroso, A. (2021). Alexnet Convolutional Neural Network (CNN) Architecture for Pest Classification in Coffee Plant Leaf Images. Informatics Journal: IT Development Journal, 6(2), 87–92. https://doi.org/10.30591/jpit.v6i2.2802

Keraru, EN (2023). Study of Coffee Production Increase Strategy in the Greater Manggarai Region, East Nusa Tenggara Province. JASc (Journal of Agribusiness Sciences), 7(1), 75–81. https://doi.org/10.30596/jasc.v7i1.14409

Muliyah, P., Aminatun, D., Nasution, SS, Hastomo, T., Sitepu, SSW, & Tryana. (2020). Marketing Mix Strategy and Application. In Journal GEEJ (Vol. 7, Issue 2).

Putra, IBGYJ, & Sudibia, IK (2023). The impact of financial resources, labor, technology, and planting area on coffee production and income of farm laborers in Kintamani. Jimea, 7(3), 399–415.

Romdona, S., Junista, SS, & Gunawan, A. (2024). Data Collection Techniques: Observation, Interviews, and Questionnaires. Social, Economic, And Political Sciences, 3(1), 1–47.

Sari, A., & Putri, DU (2023). Application of Multiple Linear Regression to Predict Diabetes Early. Jurnal Tekniki, 3(1), 32. https://doi.org/10.54314/teknisi.v3i1.1255

Sari, SPP, Hasan, I., & Ilsan, M. (2023). Factors Affecting Arabica Coffee Production In North Toraja Regency (Case Study in Paonganan Village, Buntu Pepasan District). Wiratani: Scientific Journal of Agribusiness, 6(1), 34. https://doi.org/10.33096/wiratani.v6i1.114

Shabrina, N., Darmadi, D., & Sari, R. (2020). The Influence of Motivation and Work Stress on Employee Performance at CV. Muslim Gallery Indonesia. Madani Journal: Science, Technology, and Humanities, 3(2), 164–173. https://doi.org/10.33753/madani.v3i2.108

Susanto, PC, Arini, DU, Yuntina, L., Panatap, J., Soehaditama, & Nuraeni. (2024). Quantitative Research Concepts: Population, Sample, and Data Analysis (A Literature Review). Multidisciplinary Journal of Science, 3(1), 1–12. https://doi.org/10.38035/jim.v3i1.504