Agriprimatech
Vol. 9 No. 2 Oktober 2026 *e-ISSN : 2621-6566*



THE EFFECT OF LAND AREA AND PALM OIL PRODUCTION ON THE GROSS REGIONAL DOMESTIC PRODUCT (GRDP) OF THE PLANTATION SUB-SECTOR IN NORTH SUMATRA

Berlianti Hondro[1], Muhammad Arif Nasution[2]*
[1],[2] Department of Agribusiness, Faculty of Agriculture, Universitas Prima Indonesia
[2]Agro Sustainable Center, Universitas Prima Indonesia
Email: muhammadarifnasution@unprimdn.ac.id

ABSTRACT
The study aims to evaluate the contribution of planted area and yield to the GRDP of the plantation subsector in North Sumatra. The research conducted is a quantitative study with data sources originating from BPS with data from 2010 to 2024. Data analysis used is multiple regression. From the results of the analysis, the results obtained the variable of land area has no significant effect, while production has a significant effect on the GRDP of the plantation subsector of North Sumatra. The variables of land area and production simultaneously have a significant effect on the GRDP of the plantation subsector with a contribution of 74.2%, while the remaining 25.8% is caused by other factors.
Keywords: *Land Area, Production, GRDP, Palm Oil, North Sumatra*

INTRODUCTION

Palm oil plays a vital role as a mainstay of both regional and national economies. According to BPS data (2024), the plantation sector contributes 3.76% of Indonesia's total GRDP and provides livelihoods for approximately 17 million workers across the country. As the world's largest producer, Indonesia recorded a crude palm oil (CPO) output of 49.71 million tons in 2023. Geographically, the island of Sumatra accounts for around 70% of the national production volume.

North Sumatra, historically a pioneer in plantation development since the colonial era, remains a key production area. In 2024, it had a planted area of 1.36 million hectares and produced 5.05 million tons of palm oil, placing it as the fourth-largest producing province in Indonesia after Riau, Central Kalimantan, and South Sumatra.

The economic contribution of palm oil in North Sumatra goes beyond raw CPO exports; it also includes value addition through processing activities, which is reflected in the sub-sector's GRDP. However, recent data shows that productivity levels have fluctuated and tended to decline. This trend is thought to be linked to the aging of plantations and the fact that newly replanted areas have not yet reached their full production potential.

In theory, the relationship between land expansion, production volume, and economic output follows agricultural production principles (Soekartawi, 2002), where increases in inputs such as land and production are expected to raise economic returns. The GRDP of the plantation sub-sector serves as a key indicator to measure this contribution.

Since 2020, downstream industry policies have further boosted the economic value of palm oil. The Ministry of Trade (2023) notes that exports of processed products such as biodiesel, stearin, and olein grew by 18% between 2020 and 2023, generating more foreign exchange and jobs in the manufacturing sector. Still, there is a gap in

understanding how physical factors directly relate to regional economic performance. Statistics show that annual growth in fresh fruit bunch (FFB) production (2–3%) does not always align with fluctuations in GRDP growth (2.5–7.8%). This suggests that economic performance depends not only on harvest volume but also on operational efficiency, market prices, trade policies, and local processing capacity.

Given these dynamics, this study was conducted to evaluate the specific influence of land area and production volume on the GRDP of the plantation sub-sector in North Sumatra from 2010 to 2024.

RESEARCH METHODS

This research uses a quantitative method. The independent variables are land area (X_1) and palm oil production volume (X_2), while the dependent variable is the GRDP of the plantation sub-sector (Y). Data was collected for the years 2010 through 2024. Analysis was carried out using multiple linear regression, preceded by classical assumption tests to ensure the model was valid and reliable.

RESULTS AND DISCUSSION

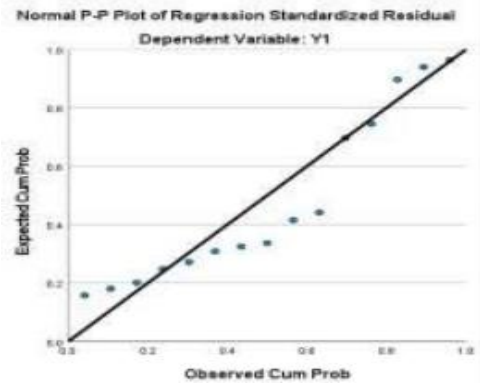
Hypothesis testing is carried out by first conducting classical assumption tests on the available data.

1. Classical Assumption Tests

Before proceeding to hypothesis testing, a regression model must first be verified to satisfy the classical assumptions — this serves as the main prerequisite. It is essential to ensure that the resulting parameters are accurate, unbiased, and meet the BLUE (Best Linear Unbiased Estimator) criteria. This series of statistical evaluations consists of four fundamental tests: the normality assumption test, heteroscedasticity test, multicollinearity test, and autocorrelation test. These tests are performed to determine whether the model is feasible for use in further analysis.

a. Normality Test

The data for each research variable must be tested to determine whether it follows a normal distribution. This is done using the Kolmogorov–Smirnov (K–S) statistical test, along with an assessment of normality through the model's P–P Plot. If the data points are distributed evenly along the diagonal line, the data is considered to be normally distributed, as illustrated in the figure below.

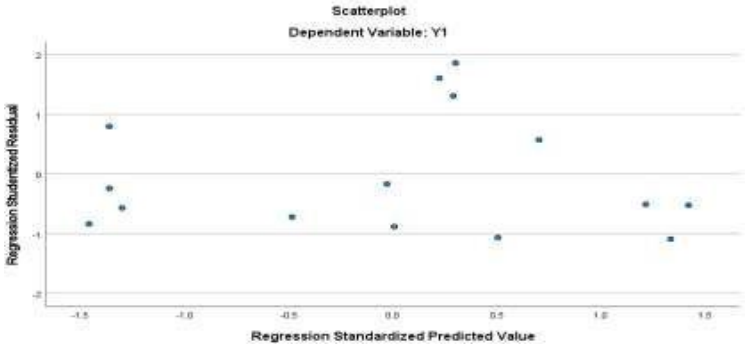


Based on the graph, it can be concluded that the data used follows a normal distribution.

b. Heteroscedasticity Test

The heteroscedasticity test is carried out by examining a scatter plot. Data is considered free from heteroscedasticity if the points are randomly distributed both above and below the value of 0 on the Y-axis. If the points show a systematic pattern in their

distribution, it indicates the presence of heteroscedasticity in the data. The results of this test are presented in the following figure.



The figure shows that the points are randomly distributed below the value of 0 and do not follow any specific pattern.

c. Multicollinearity Test

The multicollinearity test is also conducted to determine whether there is a correlation between the independent variables used in the study. The presence of multicollinearity can lead to inaccurate estimation results. The test results are shown in the table below.

Table 1. Multicollinearity Test

Independent Variable	Tolerance	VIF	Conclusion
Land Area (X_1)	0.545	1.834	Free from Multicollinearity
Palm Oil Production (X_2)	0.545	1.834	Free from Multicollinearity

From the results above, it can be seen that the tolerance value is 0.545, which is greater than 0.1, and the VIF value is 1.834, which is less than 10.

d. Autocorrelation Test

The autocorrelation test serves to ensure that there is no dependency between the value of the current observation and the values of previous observations. If autocorrelation exists in the regression model, the results will be biased. Therefore, the Durbin-Watson test is used to ensure unbiased conclusions. The results of the Durbin-Watson test are presented below.

Table 2. Durbin-Watson (DW) Test

DW Statistic	Lower Bound (dL)	Upper Bound (dU)	Conclusion
1.546	**0.95**	**1.54**	**Free from Autocorrelation**

To identify the presence of autocorrelation, the DW value is compared against the critical values. The test yields a DW value of 1.546, which falls within the range of 1.54 to 2.46. Therefore, it can be concluded that the regression model is free from autocorrelation.

2. Multiple Regression Analysis

Multiple regression analysis aims to determine the effect of land area and production on the Gross Regional Domestic Product (GRDP) of the plantation subsector. The test results are shown in the following table.

Table 3. Multiple Regression Results

Variable	Regression Coefficient (b)	t-statistic	Significance
Constant	-14,914.430	-0.705	0.494
Land Area (X_1)	1.236	0.058	0.955
Palm Oil Production (X_2)	17.466	4.372	< 0.001

The regression equation derived from the analysis is:

$$\hat{Y} = -14{,}914.430 - 1.236\ X_1 + 17.466\ X_2$$

The interpretation of this equation is as follows:

1. **Constant (-14,914.430):**

The negative constant value implies that if land area (X_1) and production (X_2) are assumed to be constant or equal to zero, the GRDP of the plantation subsector in North Sumatra is predicted to be negative at Rp 14,914.430 billion. Theoretically, this indicates that the plantation subsector is highly dependent on land availability and physical production activities to generate a positive economic contribution.

2. **Coefficient of Land Area (-1.236):**

Land area has a negative regression coefficient of 1.236. This means that, holding production constant, every increase in land area by 1,000 hectares is predicted to reduce GRDP by an average of Rp 1.236 billion. This small and negative coefficient suggests that, during the study period, expanding land area was no longer the main driver of increased economic value added in the region.

3. **Coefficient of Production (17.466):**

Production has a positive regression coefficient of 17.466. This indicates a strong and direct relationship: every increase in production by 1,000 tons significantly raises the GRDP of the plantation subsector by Rp 17.466 billion. This confirms that successful physical production remains the key factor supporting economic growth in the plantation subsector of North Sumatra.

3. Hypothesis Testing

a. t-test

The results of the t-test show the calculated t-values for the effect of land area on GRDP is -0.058, and for the effect of production on GRDP is 4.372, with the following interpretations:

1. The effect of land area on GRDP yields a calculated t-value of -0.058 with a significance level of 0.955. Since 0.955 > 0.05, it is concluded that land area has no statistically significant effect on the GRDP of the plantation subsector.
2. The effect of palm oil production on GRDP yields a calculated t-value of 4.372 with a significance level of 0.001. Since 0.001 < 0.05, it is concluded that production has a statistically significant effect on the GRDP of the plantation subsector.

b. F-test

The joint effect of land area and production on GRDP is tested using the F-test, as presented below:

Table 4. F-test Results

Model	F-statistic	Significance	Conclusion
Regression	17.223	0.001	Significant

The calculated F-value is 17.223, with a significance level of 0.001 < 0.05. Therefore, it can be concluded that land area and production together have a significant effect on the GRDP of the plantation subsector in North Sumatra. The model also demonstrates good fitness to explain variations in GRDP.

c. Coefficient of Determination (R^2)

This test measures the extent to which the independent variables explain the variation in the dependent variable, as shown below:

Table 5. Coefficient of Determination (R^2)

Mode	R	R^2	Adjusted R^2
1	0.861	0.742	0.699

The value of R^2 is 0.742, meaning that 74.20% of the increase or decrease in the GRDP of the plantation subsector in North Sumatra is explained by land area and palm oil production. The remaining 25.8% is influenced by other factors not included in this study, such as fluctuations in international crude palm oil (CPO) prices, export policies, and broader macroeconomic conditions. Based on the determination test, it is evident that land area and production together contribute 74.2% to the GRDP of the plantation subsector in North Sumatra. The analysis also shows an upward trend in the GRDP of the plantation subsector from 2010 to 2024.

CONCLUSIONS

1. Land area does not have a significant effect on the GRDP of the plantation sub-sector in North Sumatra. This shows that expanding land is no longer the main way to increase economic returns; instead, efforts should focus on plantation rejuvenation and improving productivity.
2. Production volume has a significant positive effect on GRDP, confirming that higher output directly contributes to greater economic value.
3. The result land area and production volume significantly influence GRDP, explaining 74.2% of its movement, while other factors account for the rest.

REFERENCES

Aini, N. (2021). *Analysis of the Effect of Land Area and Production Volume of Palm Oil on the GRDP of the Agricultural Sector in Several Districts in North Sumatra, 2000–2020*. Unpublished undergraduate thesis. Universitas Muhammadiyah Surakarta.

Central Statistics Agency. (2024). *North Sumatra in Figures 2024*. Medan: BPS North Sumatra.

North Sumatra Plantation Office. (2024). *Fresh Fruit Bunch Price Data, North Sumatra 2021–2024*. Medan: Disbun North Sumatra.

Reza, R. (2022). Analysis of Palm Oil Plantation Productivity on GRDP and Its Impact on Poverty Alleviation in North Sumatra. *Journal of Agricultural Economics and Development*, 32(2), 32–39.

Ministry of Agriculture of the Republic of Indonesia. (2024). *Outlook for Palm Oil Commodity 2024*.

Soekartawi. (2002). *Theory of Production Economics: With Special Reference to the Analysis of the Cobb–Douglas Function*. Jakarta: PT RajaGrafindo Persada.

Sugiyono. (2019). *Quantitative, Qualitative, and R&D Research Methods*. Bandung: Alfabeta.