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THE IMPACT OF TOBACCO PRODUCTION AND CULTIVATED AREA ON THE GRDP OF THE AGRICULTURAL SECTOR IN LAMPUNG PROVINCE: A MULTIPLE LINEAR REGRESSION ANALYSIS

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Abstract || This study examines the impact of tobacco production and cultivated tobacco area on the Gross Regional Domestic Product (GRDP) of the agricultural sector in Lampung Province from 2016 to 2022. Utilizing the multiple linear regression analysis method, this research analyzes the relationship between tobacco production (X_1) and tobacco cultivation area (X_2) as independent variables, with GRDP of the agricultural sector (Y) as the dependent variable. The analysis results indicate that both independent variables exhibit a negative relationship with the agricultural sector's GRDP, with regression coefficients of -2688 for tobacco production and -3309 for tobacco area. The classical assumption tests confirm the model's validity by meeting all statistical assumptions. These findings suggest that an increase in tobacco production and cultivated area may actually lead to a decline in the agricultural sector's GRDP, potentially due to the reallocation of resources from more productive agricultural sub-sectors.

Keywords || GRDP; Tobacco; Agricultural Sector; Multiple Linear Regression

Abstrak || Penelitian ini menganalisis pengaruh produksi tembakau dan luas area tembakau terhadap Produk Domestik Regional Bruto (PDRB) sektor pertanian di Provinsi Lampung periode 2016-2022. Menggunakan metode analisis regresi linier berganda, penelitian ini menguji hubungan antara produksi tembakau (X_1) dan luas area tembakau (X_2) sebagai variabel independen terhadap PDRB sektor pertanian (Y) sebagai variabel dependen. Hasil analisis menunjukkan bahwa kedua variabel independen memiliki hubungan negatif terhadap PDRB sektor pertanian, dengan koefisien -2688 untuk produksi tembakau dan -3309 untuk luas area tembakau. Uji asumsi klasik mengonfirmasi validitas model dengan terpenuhinya semua asumsi. Temuan ini mengindikasikan bahwa peningkatan produksi dan luas area tembakau justru dapat menurunkan PDRB sektor pertanian, yang mungkin disebabkan oleh pengalihan sumber daya dari subsektor pertanian lain yang lebih produktif.

Katakunci || PDRB; Tembakau; Sektor Pertanian; Regresi Linier Berganda

Introduction

Indonesia is a country rich in natural resources, which could serve as a significant potential if managed and developed optimally (Diana et al., 2022). These resources encompass agricultural products, forestry, fisheries, as well as vast mineral and energy reserves. When utilized effectively, this natural wealth can make a substantial contribution to national economic development and improve the welfare of communities.

Historically, Indonesia has been recognized as an agricultural country, where the agricultural sector plays a crucial role in supporting both the economy and the livelihoods of its population (Lestari, 2024). Agriculture serves not only as the primary source of food but also provides employment to a large portion of the population, particularly in rural areas. Additionally, this sector holds strategic importance in maintaining food security and national economic stability, making it a key pillar of Indonesia's development.

Indonesia produces a variety of agricultural products with significant economic value, including rice, corn, sweet potatoes, cassava, sugarcane, tobacco, rubber, rosella, and coffee (Permana et al., 2023). These commodities are not only essential sources of food but also contribute to the industrial and trade sectors. The diversity of agricultural products highlights Indonesia's considerable potential for developing agriculture as a central component of the national economy.

In Lampung Province, the agricultural sector plays a vital role in driving regional economic growth, particularly through its contribution to the Gross Regional Domestic Product (GRDP). GRDP represents the total added value generated by all business units within a region or the total value of final goods and services produced by all economic units in the region (Dardanila & Sari, 2023). With its strategic importance, the agricultural sector in Lampung not only supports national food security but also generates employment opportunities and enhances the welfare of local communities.

The agricultural sector in Lampung Province is crucial for supporting both the local economy and regional food security (Alghifari et al., 2022). The diverse agricultural products in this region not only meet local demands but also contribute to the national market and exports. With its abundant natural resources and continued advancements in agricultural technology, this sector remains a cornerstone of regional economic growth.

Tobacco is one of the leading commodities that significantly contributes to the agricultural sector in Lampung. Tobacco plants, a type of tropical species, are well-adapted to various climate conditions and are categorized as annual crops (Azhari et al., 2024). These characteristics enable tobacco to be cultivated extensively and yield high economic value, making it a strategic commodity for both farmers and the agricultural industry in the region.

According to (Badan Pusat Statistik Provinsi Lampung, 2023), Lampung Province ranked 9th among all provinces in Indonesia, with approximately 500 hectares dedicated to tobacco cultivation. Key areas in Lampung known for tobacco production and intensive cultivation include East Lampung, Pringsewu, and Pesawaran. Data from the Lampung Provincial Plantation Service in 2022 indicated that tobacco production in the province plays a significant role in supplying raw materials for Indonesia's tobacco and cigarette industries.

Tobacco is also well-suited for intercropping during the summer months and can be planted in rice fields. When farmers do not have access to sufficient irrigation for paddy cultivation, the land typically used for rice can be repurposed for tobacco farming. This cropping strategy enables farmers to optimize the use of agricultural land, maintaining productivity even with limited water resources.

This condition indicates that Lampung Province is a strategically located area with significant potential for developing tobacco plantations (Indah et al., 2022). The diversity of land conditions and the adaptability of tobacco plants to various soil types and climatic conditions make Lampung an ideal region for large-scale tobacco production. With appropriate management, this commodity has the potential to further contribute to the regional economy and enhance the welfare of local farmers.

Tobacco production in Lampung Province serves not only as an economic commodity but also as a major source of employment, particularly for rural populations. Many farmers rely on tobacco cultivation as their primary livelihood, engaging in planting, maintenance, and harvesting activities. Additionally, this sector creates job opportunities across various industries, including tobacco processing and distribution, further reinforcing the role of tobacco in the regional economy.

To enhance the quality and productivity of tobacco, the regional government, through the Lampung Provincial Plantation Service, has implemented several supportive programs. One prominent initiative is the Tobacco Excise Revenue Sharing Fund (DBH-CHT), which aims to improve the quality of tobacco raw materials. This program includes the provision of production facilities, farmer training, and the introduction of post-harvest technologies, such as tobacco shredding machines, to increase efficiency and enhance product value. With these initiatives, it is anticipated that Lampung's tobacco production will become more competitive in both national and international markets.

Based on the aforementioned context, this study seeks to examine the impact of tobacco plant production (in tons) and tobacco plant area (in hectares) on the Gross Regional Domestic Product (GRDP) of the Agricultural Sector (in millions of Rupiah). The data used in this study consists of time-series data from 2016 to 2022. The primary dependent variable is the GRDP of the Agricultural Sector (Y), while the independent variables are Tobacco Plant Production (X1) and Tobacco Plant Area (X2).

Methodology

This study employs various statistical analysis techniques to process and interpret the data accurately. The primary technique used is descriptive statistical analysis, which aims to characterize the data through measures such as the mean, median, and standard deviation. Additionally, this study utilizes multiple linear regression to examine the relationship between independent and dependent variables, providing a clearer understanding of the patterns and relationships involved.

In addition to regression analysis, this study tests hypotheses through both simultaneous and partial tests. Simultaneous tests are conducted to assess the collective influence of the independent variables on the dependent variable, while partial tests aim to determine the contribution of each independent variable individually. The inclusion of these tests allows the study to produce more comprehensive results and a better understanding of the factors influencing the variables under examination.

To ensure the validity of the model, this study also performs classical assumption testing. The normality test is used to assess the distribution of the data, while the multicollinearity test identifies any strong correlations among the independent variables that could impact the accuracy of the regression results. Furthermore, the autocorrelation test is conducted to ensure that no correlation exists between the residuals, while the heteroscedasticity test evaluates whether the variance of residuals remains constant. Finally, the linearity test is applied to confirm that the relationship between the analyzed variables is linear, ensuring that the research findings are reliable and can serve as a sound basis for decision-making.

Multiple Linear Regression Analysis

Multiple Linear Regression Analysis is a technique used to understand the influence and direction of the relationships between several independent variables and a dependent variable (Nainggolan et al., 2023). This method helps determine the direction of the relationships between variables and predict their values by calculating the effects of multiple independent variables on the dependent variable (Mandey et al., 2023; Said et al., 2024). The equation for Multiple Linear Regression is as follows:

$$\mathbf{Y = \beta 0 + \beta 1X1 + \beta 2X2 + \ldots + \beta nXn + e}$$

Description:

Y	= Response
Xi, X2…Xn	= Independent Variables
β0	= Intercept
β1, β2,…βn	= Regression Coefficients
e	= Error

Hypothesis Testing

1) Simultaneous Test (F Test)

Simultaneous testing is conducted to determine whether the independent variables collectively affect the dependent variable (Malikhah et al., 2023). The criteria for simultaneous testing at a 5% significance level are as follows:

- If P-Value > alpha (0.05), there is a simultaneous effect.
- If P-Value < alpha (0.05), there is no simultaneous effect.

2) Partial Test (t-Test)

Partial tests (t-tests) are conducted to assess whether there is a partial influence of each independent variable on the dependent variable (Andries et al., 2023). The decision criteria for partial tests with a 5% significance level are as follows:

- If the significance value > alpha (0.05), there is no partial effect.

- If the significance value < alpha (0.05), there is a partial effect.:

Classical Assumption Test

1) Normality Test

The normality test is conducted to examine the distribution of residual values to determine whether they follow a normal distribution (Rizky et al., 2024). This study uses the Shapiro-Wilk normality test, with the following criteria:

- A significance value (P-Value) greater than alpha 5% (0.05) indicates normality.
- A significance value (P-Value) less than alpha 5% (0.05) indicates non-normality.

2) Multicollinearity Test

The multicollinearity test is used to assess whether there is a high or perfect correlation between the independent variables in the regression model (Sholihah et al., 2023). To evaluate the correlation among the independent variables, this test employs the Variance Inflation Factor (VIF), with a VIF value of less than 10 used to avoid multicollinearity.

3) Autocorrelation Test

Autocorrelation occurs when there is a correlation between residuals in period t and residuals in the previous period (t-1). The optimal regression model is one that does not exhibit autocorrelation (Mardiatmoko, 2020). The autocorrelation test is conducted using the Durbin-Watson (DW) test, with the following decision criteria at a 5% significance level:

- A DW value below -2 indicates positive autocorrelation.
- A DW value between -2 and +2 indicates no autocorrelation.
- A DW value above +2 indicates negative autocorrelation.

4) Heteroscedasticity Test

The heteroscedasticity test is performed to detect the presence of unequal residual variance across observations in the regression model (Imaniar & Rajriyah, 2023). In this study, the Breusch-Pagan test is used to assess heteroscedasticity, with a 5% significance level, as follows:

- A significance value (P-Value) greater than alpha 5% (0.05) indicates no heteroscedasticity.
- A significance value (P-Value) less than alpha 5% (0.05) indicates the presence of heteroscedasticity.

5) Linearity Test

The linearity test is used to assess whether the relationship between the independent and dependent variables is linear (Nasar et al., 2024; Widana & Muliani, 2020). The decision criteria for the linearity test in this study, with a 5% significance level, are as follows:

- A significance value (P-Value) greater than alpha 5% (0.05) indicates linearity.
- A significance value (P-Value) less than alpha 5% (0.05) indicates non-linearity.

Analysis Flow

The data for this study were processed using the R-Studio application to ensure that the analysis was conducted systematically and accurately. The first step involved collecting the relevant data, where the dependent variable (Y) represents the Gross Regional Domestic Product (GRDP) of the agricultural sector in millions of rupiah, while the independent variables (X) include tobacco production (tons) and tobacco area (hectares). After data collection, descriptive statistics were applied using numerical summaries and data visualization to understand the patterns and distribution of the variables. The next step involved the application of multiple linear regression analysis, followed by simultaneous and partial hypothesis testing. To validate the model, classical assumption tests were conducted, including tests for normality, multicollinearity, autocorrelation, heteroscedasticity, and linearity. If multicollinearity is detected, the analysis will proceed with the Principal Component Analysis (PCA) method to address the issue. Once the multiple linear regression model is developed, the final stage involves interpreting the results, drawing conclusions, and discussing the research implications for the agricultural sector, particularly regarding the influence of tobacco production and area on GRDP.

Research Data

The data used in this study are secondary data, which refers to data collected indirectly from published sources such as books, notes, or public archives (Abdullah, 2022). The type of data is quantitative, which consists of numerical values that are processed using statistical methods (Srihidayati, 2022). The data for this study were obtained from the official website of the Central Statistics Agency of Lampung Province (Wahyuningsih & Mukhlis, 2024). The data consist of time series data from the period 2016 to 2022. The dependent variable (Y) is influenced by several independent variables, as indicated by previous research conducted in Southeast Sulawesi Province (Said et al., 2024). The research variables are presented as follows:

Table 1. Research Variables

Variabel	Keterangan	Satuan
Y	GRDP of the Agricultural Sector	Million Rupiah
X_1	Tobacco Production	Tons
X_2	Tobacco Cultivated Area	Hectares (Ha)

Analysis and Discussion

This section presents the results of data analysis on the influence of tobacco production and cultivated tobacco area on the Gross Regional Domestic Product (GRDP) of the agricultural sector using the multiple linear regression analysis method. The objective of this analysis is to determine the extent to which tobacco production and cultivated tobacco area contribute to economic growth in the agricultural sector, particularly in the context of the tobacco subsector's impact on GRDP.

Descriptive Statistical Analysis

This section provides a numerical summary of the research variables, including minimum, maximum, mean, and median values, to describe the overall distribution and variability of the data. This summary helps in understanding the fundamental characteristics of the dataset before conducting further analysis.

Table 2. Summary Statistics

Variable	Minimum	Maximum	Mean	Median
Y	65730543	69299162	67485519	67848653
X_1	394.0	960.0	783.4	910.0
X_2	507.0	861.0	768.1	818.0

The lowest recorded GRDP in the agricultural sector in Lampung Province occurred in 2016, amounting to 65,730,543 million rupiah, while the highest GRDP was observed in 2022, reaching 69,299,162 million rupiah. The average GRDP over the study period was 67,485,519 million rupiah, with a median of 67,848,653 million rupiah.

Regarding tobacco production, the highest recorded production was 960.0 tons in 2017, whereas the lowest was 394.0 tons in 2022. The mean tobacco production was 783.4 tons, with a median of 910.0 tons. For cultivated tobacco area, the largest recorded value was 861.0 hectares in 2018, while the smallest was 507.0 hectares in 2022. The average cultivated area was 768.1 hectares, with a median of 818.0 hectares.

The following visualizations include density plots, histograms, and scatter plots for each variable used in the study.

1) Density Plot and Histogram

The density plot represents the distribution of data using a smooth density curve, illustrating how data points are distributed across a given range (Cohen & Cohen, 2006). Meanwhile, the histogram displays the frequency of observed values within specific intervals, providing insights into distribution patterns and data trends. These visualizations are commonly employed in statistical analysis to assess data characteristics before proceeding with further analysis.

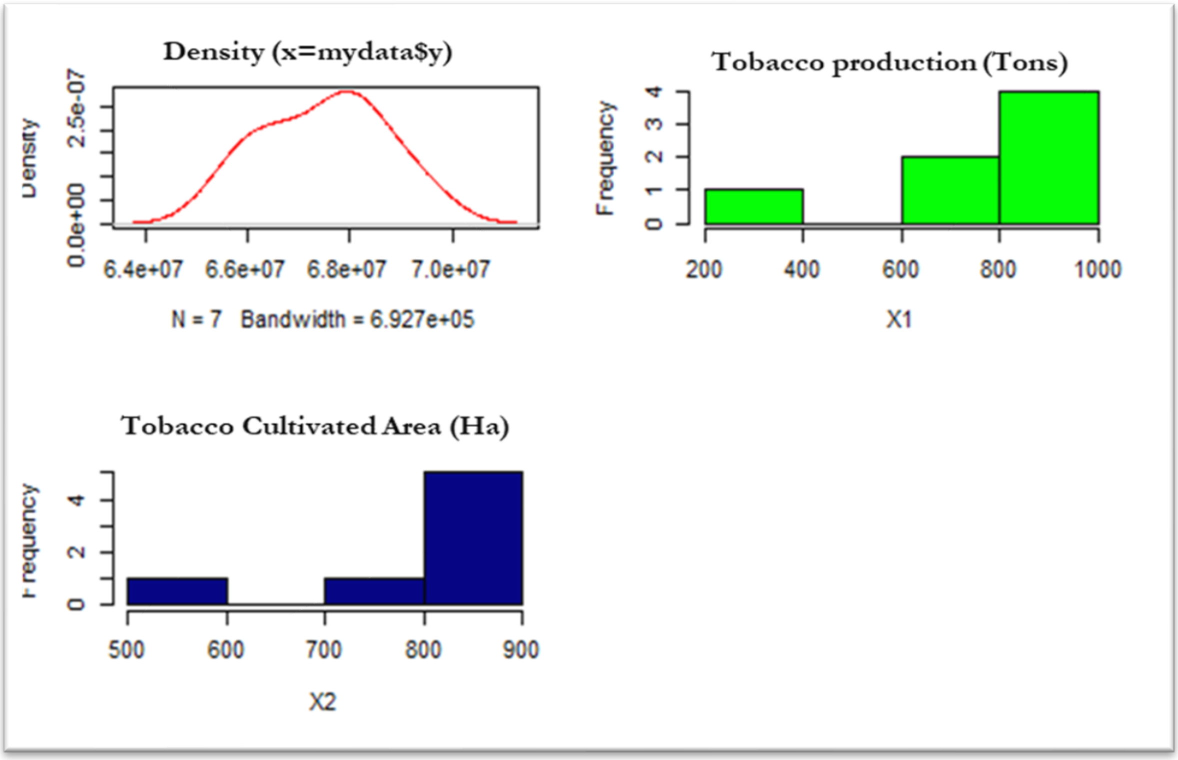

Figure 1. Density Plot of Variable Y and Histogram of Variables X_1 and X_2

As shown in Figure 1, the density plot for Y (GRDP in million rupiah) illustrates a distribution pattern resembling a normal distribution, though with slight asymmetry. The peak density occurs between 67 million and 68 million rupiah, indicating that most GRDP values fall within this range.

The histogram for X_1 (tobacco production) reveals that the highest frequency of production values occurs within the 800–1000-ton range, whereas lower frequencies are observed in the 200–400-ton range. The distribution is left-skewed, suggesting that a majority of the observations are concentrated toward higher production values.

The histogram of X2, which is the variable of tobacco area, shows that most of the data is concentrated on the right side (large area), while the left side of the histogram has a lower frequency, which means that the distribution is skewed to the left because higher values or larger areas appear more often, while smaller areas appear less often.

2) Scatter plot

Scatter plots are used to identify data distribution patterns and relationships between variables, thus helping to understand possible correlations. In addition, scatter plots also make it easier to detect outliers or data that does not conform to the general pattern, which can affect the results of the analysis. With this visualization, data analysis becomes more intuitive and allows for more accurate decision making based on the patterns formed.

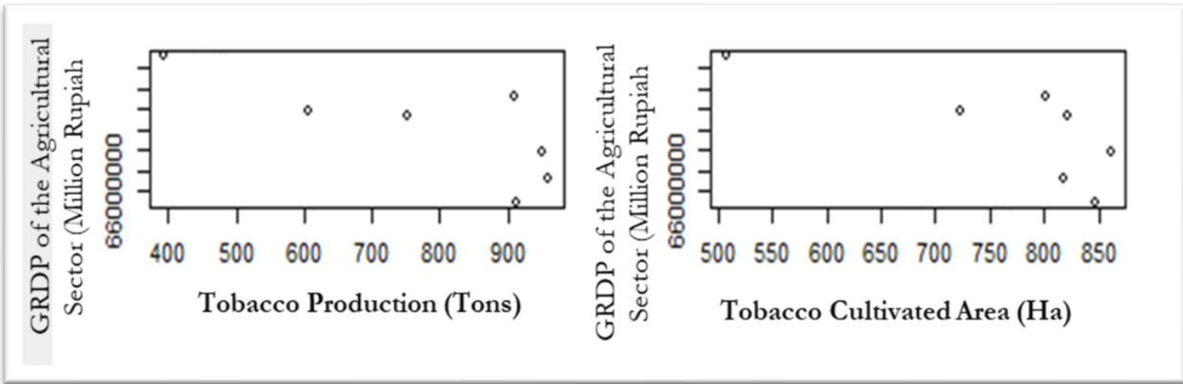

Figure 2. Scatter Plot X_1 and X_2 against Y

Based on Figure 2, the two scatter plots explain that there is a random data distribution pattern, which indicates that the higher tobacco production and the wider tobacco plant area can reduce the GRDP value of the agricultural sector. This can occur in situations where tobacco prices are low, or production costs and land management are greater than income.

Multiple Linear Regression Analysis

This study was conducted using the multiple linear regression analysis method using the RStudio application. To ensure the feasibility of the regression model, it involves two hypothesis tests to measure the influence of variables X1 and X2 simultaneously and the independent variables have an influence on the Y variable, namely as follows:

1) Hypothesis Test

a) Simultaneous Test (f Test)

The simultaneous test, or often called the F test, is used to test whether all independent variables in the regression model simultaneously have a significant influence on the dependent variable. This test aims to determine whether the overall regression model can explain the variation in the data, by comparing the calculated F value with the F table value. If the F test results show a significant value, it means that there is a strong influence of the independent variables on the dependent variable simultaneously.

Table 3. Simultaneous Test (f test)

F-statistic	*p-value*
3.195	**0.1482**

Based on Table 3, the p-value = 0.1482> alpha 0.05 is obtained and meets the test assumption criteria. Therefore, it can be concluded that there is a significant simultaneous influence between tobacco production (X1) and the area of tobacco plants (X2) on the GRDP of the agricultural sector (Y).

b) Partial Test (t-Test)

Partial test, or known as the t-test, is used to test the influence of each independent variable on the dependent variable separately. The purpose of the t-test is to determine whether each independent variable has a significant contribution in the regression model, by comparing the calculated t value with the t-table value at a certain level of significance. If the results of the t-test show that the p value is smaller than the specified level of significance, then it can be concluded that the variable has a significant effect on the dependent variable.

Table 4. Partial Test

	Estimate	Std.Error	*t*-value	Pr(>|t|)
Intercept	72132987	3188210	22.625	2.26e-05
X_1	-2688	4650	-0.578	0.594
X_2	-3309	8083	-0.409	0.703

Based on the results of Table 4, a p-value of 0.594> alpha 0.05 is obtained, so that variable X1 partially has no effect on variable Y. Then in the results of the X2 hypothesis, a p-value of 0.703> alpha 0.05 is obtained, variable X2 partially has no effect on the GRDP of the agricultural sector (Y). From the results of the partial test, it can be concluded that variables X1 and X2 do not have a significant effect partially on variable Y.

Classical Assumption Test

The classical assumption test in this study was conducted to ensure that the multiple linear regression model is reliable and produces valid results. The tests performed include the normality test, autocorrelation test, heteroscedasticity test, linearity test, and multicollinearity test (Sari, 2024). The following table presents the results of these tests:

Table 5. Classical Assumption Test Results

	Normality Test *Shapiro-Wilk*	Autocorrelation Test *Durbin-Watson*	Heteroscedasticity Test | *Breusch-Pagan*	Linearity Test	Multicollinearity Test | VIF
p-value	0.9808	0.01329 *dw*=1.0521	0.3687	0.5674	X_1 6.807273 X_2 6.807273

1) Summary of Classical Assumption Tests

a) Normality Test

The Shapiro-Wilk normality test yielded a p-value of 0.9808, which is greater than 0.05. This indicates that the residuals are normally distributed, fulfilling the normality assumption.

b) Autocorrelation Test

The Durbin-Watson (DW) test was conducted to detect autocorrelation. A DW value within the range of −2 to +2 indicates no autocorrelation. The test result of 1.0521 falls within this range, confirming the absence of autocorrelation.

c) Heteroscedasticity Test

The Breusch-Pagan test produced a p-value of 0.3687, which is greater than 0.05. This suggests that heteroscedasticity is not present, satisfying this assumption.

d) Multicollinearity Test

The variance inflation factor (VIF) values for the independent variables X_1 and X_2 are 6.807, which are below the threshold of 10. Additionally, the tolerance (TOL) values for each independent variable exceed 0.1, indicating that multicollinearity is not an issue.

e) Linearity Test

The linearity test produced a p-value of 0.5674, which is greater than 0.05. This confirms that X_1 and X_2 have a linear relationship with Y. Based on the results of these classical assumption tests, the regression model satisfies all the fundamental assumptions of linear regression: normality, no autocorrelation, no heteroscedasticity, no multicollinearity, and linearity. Consequently, the regression model is considered reliable, and its estimation results are valid and unbiased.

Multiple Linear Regression Model and Its Interpretation

Based on the regression analysis results presented in Table 3, the following multiple linear regression equation was obtained:

$$\mathbf{Y = 72132987 - 2688x_1 - 3309x_2}$$

This regression equation indicates that both an increase in tobacco production (X_1) and an expansion of cultivated tobacco area (X_2) are negatively associated with the GRDP of the agricultural sector (Y). Specifically, for every additional ton of tobacco produced, GRDP decreases by 2,688 million rupiah, and for every additional hectare of cultivated tobacco area, GRDP decreases by 3,309 million rupiah.

From an economic perspective, this negative relationship suggests that expanding tobacco production and cultivation areas may reduce overall productivity or income in the agricultural sector. Possible explanations include:

- Increased tobacco production may require additional resources (e.g., labor, land, water) that could otherwise be allocated to more profitable agricultural sub-sectors.
- The expansion of tobacco cultivation may displace other crops that have higher economic value, leading to a decline in overall agricultural productivity.

These findings highlight the potential trade-offs associated with tobacco cultivation and its broader implications for the agricultural economy.

Conclusion

Based on the results of multiple linear regression analysis, hypothesis testing, and classical assumption testing, this study provides answers to the research questions and objectives. The tobacco production variable (X_1) and the tobacco cultivation area variable (X_2) were found to have a minimal and statistically insignificant influence on the GRDP of the Agricultural Sector (Y) in Lampung Province. These findings are supported by the output of the multiple linear regression model, as well as by classical assumption tests and both partial and simultaneous hypothesis tests, which indicate that increases in both tobacco production (X_1) and cultivated tobacco area (X_2) exhibit a negative relationship with the agricultural sector's GRDP in Lampung Province.

These findings can serve as a reference for the Lampung Provincial Government in assessing the actual contribution of tobacco production to the GRDP of the agricultural sector. For instance, efforts to increase tobacco production may require additional resources, such as labor and land, which could potentially reduce productivity in other agricultural sub-sectors. Additionally, large-scale tobacco cultivation may displace other crops that are economically more valuable. Therefore, policymakers should carefully evaluate the broader economic implications of expanding tobacco production to ensure sustainable agricultural growth in the province.

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