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Analysis of the Influence of Oil Palm Plantations on the GDP of Riau Province

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ABSTRACT
This study examines how oil palm plantations affect the Gross Regional Domestic Product (GRDP) of Riau Province during the 2020-2021 period. A panel data regression approach, considering common effect, fixed effect, and random effect models, was chosen as the methodology to analyze cross-section data (districts/cities) and time-series data (2020-2021). This research utilized secondary data obtained from the Central Statistics Agency of Riau Province and the Information and Documentation Management Officer of Riau Province. It was found that land area has a positive impact on Riau Province's GRDP. Conversely, production showed a negative influence on Riau Province's GRDP. In terms of labor, the findings did not indicate a significant impact on Riau Province's GRDP.

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INTRODUCTION

Economic growth and economic development are closely related to each other. Solid economic growth has the potential to accelerate economic development, and in turn, economic development can drive further growth rates. According to Sukirno (2015), economic growth refers to the development of economic activities which is characterized by an increase in the number of outputs and people's welfare. In classical theory, the growth of total Gross Domestic Product (GDP) output is the most important component of economic growth.

Economic growth functions as an indicator of the progress of a region's development, which is reflected in changes in the level of economic activity in various sectors. An increase in economic production indicated by an increase in national income is called economic growth.

If economic growth increases compared to the previous year, economic growth is considered good. If there is no growth within a certain period of time, or even if growth decreases compared to the previous year, economic growth is considered problematic. Economic growth can indicate the progress or development of a country or region. Economic growth is sometimes slow and sometimes rapid.

The agricultural sector is divided into three main subsectors: (1) Agriculture, Livestock, Hunting, and Agricultural Services, which includes horticulture, plantations, livestock, and agricultural services; (2) Forestry and timber logging; and (3) Fisheries. These three subsectors accounted for 13.28 percent of GDP for Indonesia in 2021.

The plantation subsector has the highest percentage of the total agricultural sector, which is 3.94 percent from 13.28 percent. The fisheries subsector has a percentage of 2.77 percent, food crops have 2.6 percent, livestock has 1.58 percent, and horticulture has 1.55 percent of each subsector.

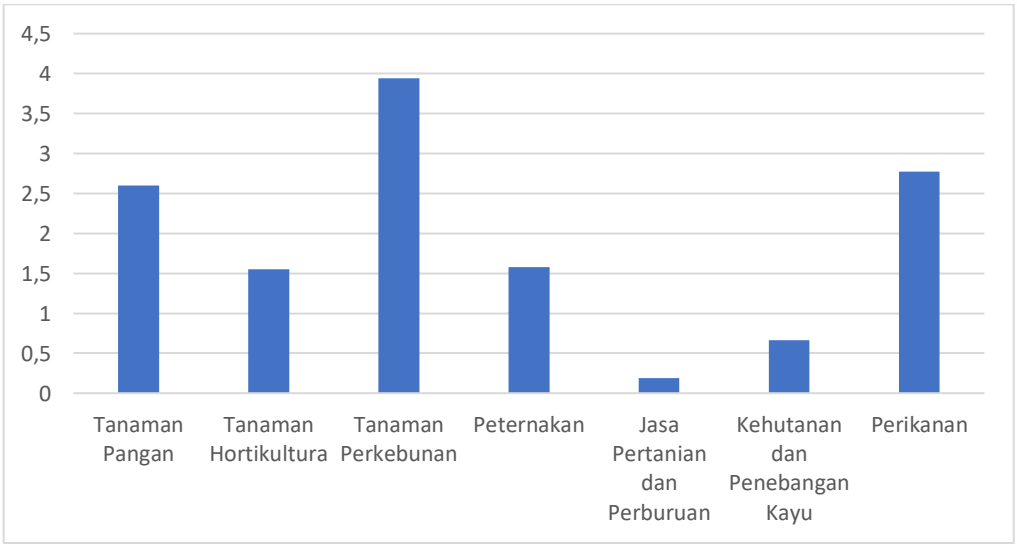


Figure 1. GDP Distribution of Agriculture, Forestry, and Fisheries Subsectors in 2021

Source: Central Statistics Agency (BPS), 2021

One of the well-known plantation commodities is oil palm. As an important commodity, palm oil makes a significant contribution to GDP, improving people's welfare, and local income. According to Afifuddin (2007), development in the oil palm sub-sector contributes to job creation and provides a source of income for farmers. Oil palm plantation activities are known to have a beneficial impact on the surrounding environment. Syahza (2005) explained that the socio-economic dimension of plantation activities includes improving the welfare of the surrounding community, increasing employment and entrepreneurial opportunities, and supporting development at the regional level.

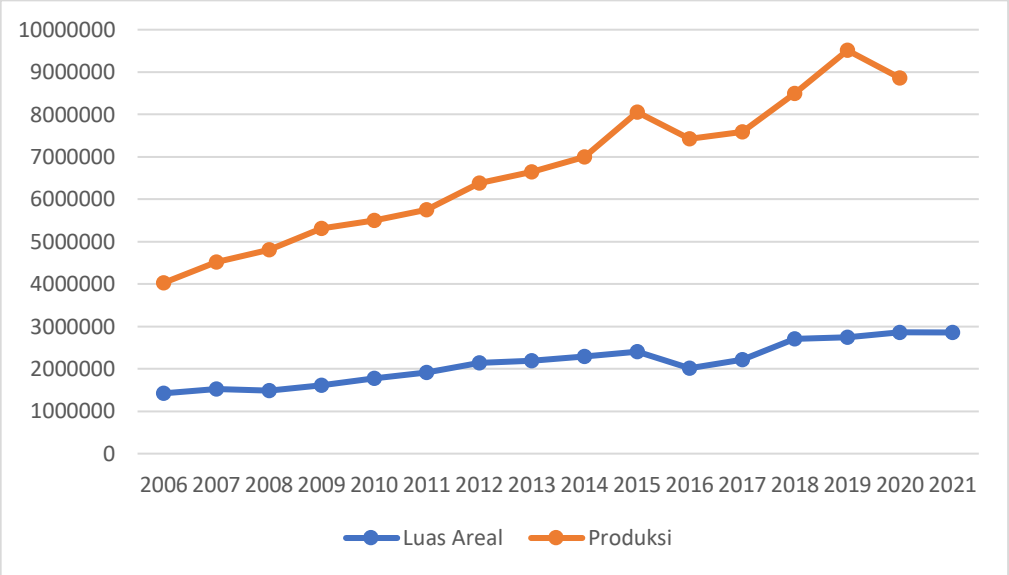


Figure 2. Area (ha) and Production (tons) of Palm Oil in Riau Province in 2006-2021
Source: BPS Riau Province, 2021

The area of oil palm in Riau Province has increased over the past five years, but contracted in 2021. Data shows that from 2.21 million hectares in 2017, there was a significant increase of 22.50 percent to reach 2.71 million hectares in 2018. Furthermore, in 2019, the area of oil palm plantations in Riau increased by 1.28 percent, bringing the total to 2.74 million hectares.

Oil palm plantations in Indonesia are spread across 26 provinces. This distribution covers the entire region of Sumatra and Kalimantan, as well as a number of other provinces such as West Java, Banten, Central Sulawesi, South Sulawesi, Southeast Sulawesi, West Sulawesi, Gorontalo, Maluku, North Maluku, Papua, and West Papua. In 2021, Riau Province was recorded as the largest contributor to the area of national oil palm plantations, with a contribution of 19.55 percent of the total area, or equivalent to 2.86 million hectares.

In 2021, the majority of oil palm plantations in Riau were managed by the people, covering 1.76 million hectares or 61.65 percent of the total. The private large plantation sector followed with 1.02 million hectares (35.72 percent), while the state's large plantations controlled 0.08 million hectares (2.63 percent). This

composition is almost similar to 2020, where smallholder plantations also dominated with an area of 1.76 million hectares (61.57 percent), followed by large private plantations of 1.02 million hectares (35.81 percent), and large state plantations of 0.08 million hectares (2.63 percent).

Table 2. Plantation Crop Production in Riau Province

No	Commodities	Production (tons)
1	Coconut	391.333
2	Crude palm oil	3.701.856
3	Rubber	405.747
4	Coffee	2.417
5	Cocoa	992
Sum		4.502.345

Source: BPS Riau Province, 2021

Palm oil with a production of 3,701,856 tons and rubber with a production of 405,747 tons are the largest plantation subsectors in Riau Province, as shown in Table 1.1. The high area and level of oil palm production are strong indicators of community participation in this sector. Given the huge industry needs and the high income potential of palm oil, the marketing aspect is no longer a major concern for farmers.

Palm oil (CPO) production in Riau in early 2020 is estimated to decline by 6.82 percent from 2019, reaching 8.86 million tons, as a result of the Covid-19 pandemic. Nevertheless, in 2021, production is projected to increase slightly to 8.96 million tons, which is equivalent to around 19.55 percent of total national production, thus placing Riau as the largest CPO producer in Indonesia. A total of 7.28 million tons or 12.47 percent of national CPO production comes from Central Kalimantan Province, making it the second largest producer.

In 2020, palm oil (CPO) production in Riau was dominated by smallholder plantations (53.38 percent or 4.73 million tons), followed by large private plantations (42.5 percent or 3.78 million tons), and large state plantations (4.05 percent or 0.36 million tons). For 2021, the estimated CPO production is 4.82 million tons (53.76 percent) from smallholder plantations, 3.75 million tons (41.85 percent) from large private plantations, and 0.39 million tons (4.39 percent) from large state plantations.

The development process carried out in Riau should refer to the five main pillars of regional development. Because the success of regional development is highly dependent on local potential, local government policies must be designed based on potentials that have development opportunities, especially in the agricultural sector. Regional potentials include: (1) Horticultural Plants; (2) Plantation Plants; (3) Fisheries Business; (4) Livestock Business; (5) Mining Business; Industrial Sector; and (7) Tourism Potential. As expressed by Syahza (2003), the development of the agricultural sector at large is also important to be directed at the agribusiness and agro-industrial systems because this method is expected to boost local business income. Thus, this study seeks to analyze the impact of oil palm plantations on the GDP of Riau Province during the 2020-2021 period.

THEORETICAL REVIEW

Economic Growth

From a macroeconomic perspective, economic growth is a fundamental topic that is discussed in the long term. Sukirno (2016) explained that this phenomenon is essentially an increase in economic activity that produces a larger quantity of goods and services. Furthermore, Junaedi & Salistia (2020) stated that positive economic growth will encourage economic expansion, while negative values will actually cause contraction.

Keynesian theory specifically examines economic growth in a short-term perspective. In contrast, Harrod-Domar analyzes the issue of long-term economic growth through a theoretical framework called Harrod-Domar's theory. . According to this theory, a total increase in aggregate demand needs to be achieved in the long term to realize economic growth. Stable economic growth conditions can be realized through sustained improvements in components such as investment, government spending, and net exports.

According to Schumpeter's theory, an increase in *output* results from economic growth. This theory emphasizes the importance of entrepreneurs in making reforms to create economic growth. Dila Fitriani (2022) stated that certain indicators can indicate economic growth. These indicators include an increase in national income, an increase in the per capita income of the workforce that exceeds the unemployment rate, and a reduction in the poverty rate.

Plantation Sector

According to the Plantation Law Number 18 of 2004, a series of actions taken to manage certain crops on land or other growing media in the appropriate ecosystem are referred to as plantations. This activity also includes the processing and marketing of plant products, supported by the application of science, technology, capital, and management. The ultimate goal is to optimize the welfare of plantation business actors and the wider community (Indonesia, 2004).

The plantation sector is not limited to one specific commodity. On the contrary, it covers various types of crops whose production is processed and marketed, especially to meet the needs of domestic and foreign markets, not just the local market. Therefore, there are various types of plantations, including cassava, bananas, pineapples, oil palm, sugarcane, and so on (Rusdi Evizal, 2014). According to the Ministry of Agriculture (2022), oil palm plantations include a series of comprehensive management activities. This involves the use of natural and human resources, production facilities, as well as equipment and machinery, in addition to the cultivation, harvesting, processing, and marketing processes related to oil palm plants.

METHODOLOGY

This study used secondary data, which combined cross-section and time-series characteristics. The variables analyzed are the GDP, area area, production, and labor. This data comes from the official websites of the Riau Provincial Central Statistics Agency and the Riau Provincial Information and Documentation Management Officer, covering 2020–2021.

The panel data regression method, which includes common effect, fixed effect, and random effect approaches, was applied to analyze the data in this study. To determine the best model among the three, panel data specification testing was performed, which involved Chow, Hausman, and Lagrange Multiplier tests.

The equation of the panel data regression model used in this study is presented as follows:

$$Yit = a + b1X1it + b2X2it + b3X3it + eit$$

Where the variables are described as:
Y: GDP
X1: Area
X2: Production
X3: Labor
i: Indicators for districts/cities
t: Indicators for the year
e: *Error term*

RESULTS AND DISCUSSION

Model Selection Test Results

Chow Test Results

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	22.575639	(10,8)	0.0001
Cross-section Chi-square	74.246435	10	0.0000

With a Probability value of 0.0000, which is less than 0.05, *the Fixed Effect* (FEM) model is the appropriate choice.

Hausman Test Results

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	2.369679	3	0.4993

With a Probability value of 0.4993, which is greater than 0.05, the *Random Effect* (REM) model is the appropriate choice.

Lagrange Multiplier Test Results

Lagrange Multiplier Tests for Random Effects
Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	7.490290 (0.0062)	0.975764 (0.3232)	8.466055 (0.0036)
Honda	2.736839 (0.0031)	-0.987808 (0.8384)	1.236752 (0.1081)
King-Wu	2.736839 (0.0031)	-0.987808 (0.8384)	-0.116650 (0.5464)
Standardized Honda	3.311212 (0.0005)	-0.689231 (0.7547)	-1.384221 (0.9169)
Standardized King-Wu	3.311212 (0.0005)	-0.689231 (0.7547)	-2.016409 (0.9781)
Gourieroux, et al.	--	--	7.490290 (0.0090)

Given that the Probability value is 0.0062, which is smaller than 0.05, the Random Effect (REM) model is chosen as the appropriate model.

Based on a series of tests, namely the Chow, Hausman, and Lagrange Multiplier tests, it can be concluded that the Random Effect (REM) model is the most suitable approach for this study.

Classical Assumption Test Results

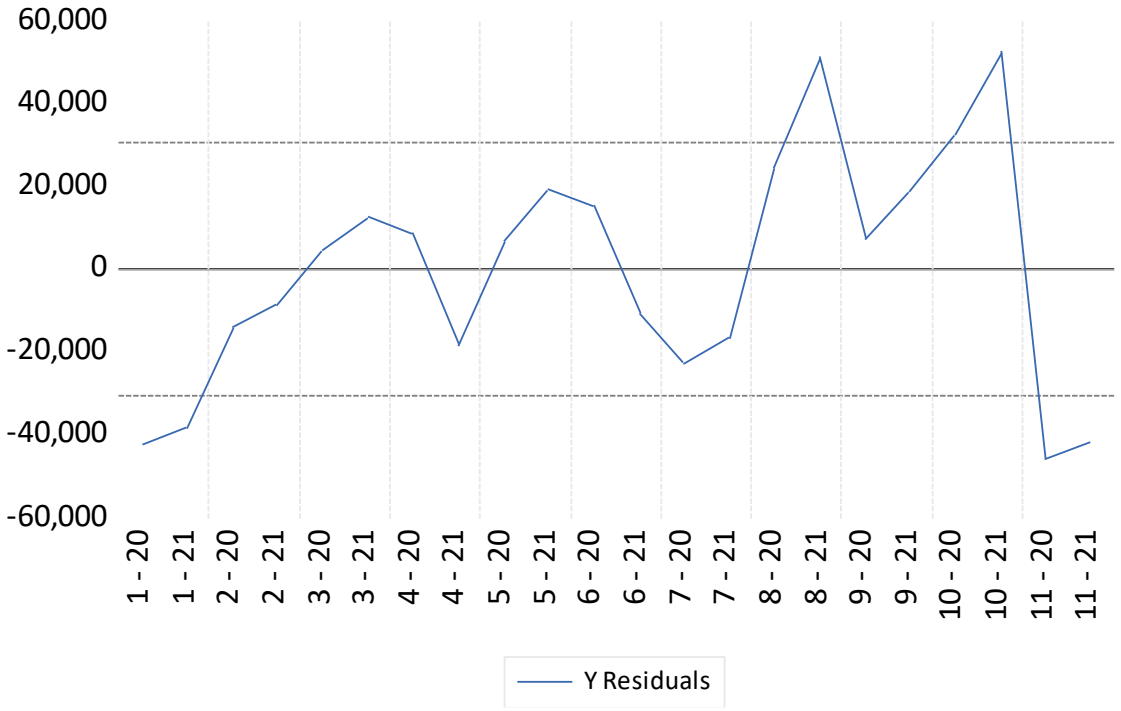
Since the Random Effect (REM) model has been established, the implementation of classical assumption tests needs to be carried out. The classical assumption test applied in this study includes multicollinearity and heteroscedasticity.

Multicollinearity Test

	X1	X2	X3
X1	1.000000	0.935723	0.796448
X2	0.935723	1.000000	0.689695
X3	0.796448	0.689695	1.000000

The calculation results showed that the correlation coefficient between X1 and X2 was 0.935723 (greater than 0.85), while between X1 and X3 it was recorded as 0.796448 (less than 0.85), and between X2 and X3 was 0.689695 (also less than 0.85). Based on these results, this model is free from multicollinearity, or has passed the multicollinearity test (Napitupulu et al., 2021, p. 141).

Heteroscedasticity Test



The residual graph (in blue) shows a pattern of spread that is not constant and tends to widen or narrow over a given period, indicating a variation (not the same) in the residual variance. It is seen that residual values fluctuate significantly, with some points reaching highest positive values of around 45,000 and lowest negative values of around -40,000. The uneven distribution pattern and the presence of this variation trend are indications of heteroscedasticity. Therefore, based on visual observations of residual graphs, this heteroscedasticity test is most likely not to pass.

Panel Data Regression Equation Model

Y = 81663 + 0,50*X1 – 0,20*X2 – 0,30*X3

The interpretation of this model is as follows:

1. The constant number of 81,663 indicates that the variables of area (X1), production (X2), and labor (X3) are at zero, GDP (Y) is expected to increase by 81,663 million Rupiah.
2. The area variable (X1) has a beta coefficient of 0.50. The interpretation is that, if other factors are assumed to be constant, an increase of 1 hectare on X1 will push GDP (Y) up by 0.50 million Rupiah. Similarly, if X1 decreases by 1 hectare and other variables do not change, GDP (Y) will decrease by 0.50 million Rupiah.
3. The production variable (X2) has a beta coefficient of -0.20. This is interpreted as follows: if the other variables do not change, every 1 ton increase in production will cause GDP (Y) to decrease by 0.20 million

Rupiah. On the other hand, if production (X2) decreases by 1 ton and other variables remain, GDP (Y) will increase by 0.20 million Rupiah.

4. For the labor variable (X3), the beta coefficient is -0.30. This implies that, assuming the other variables are fixed, every addition of 1 worker will trigger a decrease in GDP (Y) by 0.30 million Rupiah. On the other hand, if the number of workers (X3) decreases by 1 person and other variables are constant, GDP (Y) will increase by 0.30 million Rupiah.

Hypothesis Test

Dependent Variable: Y
Method: Panel Least Squares
Date: 04/25/25 Time: 13:41
Sample: 2020 2021
Periods included: 2
Cross-sections included: 11
Total panel (balanced) observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	81663.85	14220.94	5.742507	0.0000
X1	0.502183	0.272076	1.845745	0.0814
X2	-0.195518	0.096977	-2.016125	0.0590
X3	-0.298953	0.365228	-0.818539	0.4238

a. The t-test for the area variable (X1) yields a t-calculated value of 1.845745, which is smaller than the t-table (2.085963). In addition, the significance value (sig.) is 0.0814, below the threshold of 0.1. This condition leads to the acceptance of Ha and rejection of H0, so that the area variable has an influence on the GDP of Riau Province.
b. For the production variable (X2), the t-test results show a t-count of -2.016125, which is lower than the t-table (2.085963). With a significance value of 0.0590 (less than 0.1). This is consistent with the acceptance (Ha) and rejection (H0), that the production variable has a negative influence on the GDP of Riau Province.
c. For the labor variable (X3), the t-test gives a t-calculated value of -0.818539, which is below the t-table of 2.085963. However, a significance value of 0.4238 (more than 0.1) causes Ha to be rejected and H0 to be accepted. This means that the labor variable does not have an influence on the GDP of Riau Province.

Test F

R-squared	0.188632...
Adjusted R-squared	0.053404...
S.E. of regression	30760.65...
Sum squared resid	1703192...
Log likelihood	-256.357...
F-statistic	1.394922...
Prob(F-statistic)	0.276647...

The F-test shows that the F-count is 1.394923, which is lower than the F-table of 3.521893. In addition, the significance value of 0.276647 exceeds 0.1. Therefore, H0 is accepted and Ha is rejected, implying that simultaneously, the area area, production, and labor do not affect the GDP of Riau Province.

Determination Coefficient Test (R^2)

The Adjusted R-square *coefficient* obtained is 0.053404 or equivalent to 5%. This figure indicates that independent variables, namely area area, production, and labor, have the ability to explain the variation in Riau Province's GDP by 5%. The remaining 95% (calculated from 100% minus *the adjusted R-square* value) is influenced by variables outside the research model that are not included in this analysis.

The influence of area area on GDP

The results of hypothesis testing indicate that the area has a positive influence on the GDP of Riau Province during the 2020-2021 period. Thus, the hypothesis that suggests the positive influence of area area on GDP is acceptable. The suitability of these results is also supported by previous research from Arotaa et al. (2016), Bangun (2019), Purnomo (2019), Sianturi & Wibowo (2018), and Sitorus (2019). They all show that the analysis of the influence of land area on GDP consistently results in the finding that land area contributes significantly to GDP growth. Nur's research (2019) also corroborates this finding, where his analysis of the influence of land area, labor, and palm oil exports on GDP shows that land area has a contribution to increasing GDP. In this context, land area refers to the entire agricultural area that is used for the production of agricultural commodities. The area of agricultural area used in the production process plays a crucial role, considering its impact on the scale of agricultural business and, subsequently, on land optimization. However, phenomena in the field often show that too large a land area can lead to a lack of supervision, resulting in suboptimal agricultural yields. This condition can even mean the addition of production factors without a proportionate increase in yield (Daniel, 2002). On the other hand, land with a seemingly small scale often facilitates the use of more optimal production factors. With investment in labor and capital that is not excessive, a high level of efficiency can be achieved in agricultural businesses. However, it should be noted that too small land also has the potential to cause operational inefficiencies (Soekartawi, 1993).

The Effect of Production on GDP

The results of the hypothesis test indicate that production has a negative impact on the GDP of Riau Province during the 2020-2021 period. Therefore, the hypothesis that puts forward the negative influence of production on GDP is acceptable. The suitability of these results can also be seen from the research of Anwar Said (2024). The findings of this study are supported by the research of Anwar Said (2024). Although analyzing the effect of palm oil production on the original income of the North Sumatra region in 2016, the study found that palm oil production did not have a significant impact on the original income of the

region. Although not negative, "insignificant" can be interpreted as not having a strong enough positive contribution to be clearly reflected in GDP.

The Influence of Labor on GDP

From the hypothesis test carried out, it was revealed that the workforce did not show an impact on the GDP of Riau Province from 2020 to 2021. Thus, the hypothesis that labor has no influence on GDP can be confirmed. These findings are consistent with the research of Vermana et al. (2019), which states that labor variables in the agricultural sector do not affect the production of the agricultural sector in West Sumatra. A study conducted by Safira et al. (2019) also concluded that there was no significant influence of labor variables on the GDP of the agricultural sector.

CONCLUSION AND RECOMMENDATION

Referring to the research findings that have been presented, here are the main conclusion points:

(1) The area shows a positive influence on the GDP of Riau Province.
(2) Production shows a negative influence on Riau Province's GDP Output.
(3) Labor does not have an influence on the GDP of Riau Province.

However, the regression model applied has limited explanatory capabilities (indicated by the low R-squared value). In addition, the three variables simultaneously did not show a significant influence, indicating that there were other factors that were more influential in determining the GDP of Riau Province.

FURTHER STUDY

Further research is needed to explore additional variables that may have a more significant impact on the GDP of Riau Province. Future studies should consider incorporating factors such as investment levels, government expenditure, infrastructure development, and sectoral contributions like mining or agriculture. Moreover, improving the regression model through the use of panel data or time-series analysis may enhance its explanatory power. A broader and more comprehensive approach will help provide a clearer understanding of the key drivers of economic growth in Riau Province.

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