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Analysis of The Influence of Changing Land Area on The Value of Gross Regional Domestic Product (GRDP) (Case Study: Lampung Province)

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Abstract

Residents' activities will always use the land as a place to carry out activities which will affect the GRDP value. This study uses data on the GRDP values of Lampung Province in 2014–2021 obtained from BPS Lampung Province and uses land cover area data obtained from the classification results of Landsat 8 imagery for 2014–2021. The data analysis technique used in this study is correlation analysis and linear regression using panel data. The results of the correlation analysis found that the value of GRDP in total, GRDP in the agriculture, forestry, and fisheries sectors, GRDP in the processing industry sector, and GRDP in the construction sector all correlated with built-up land cover, for GRDP in the agriculture, forestry, and fisheries sectors, in addition to correlation with built-up land cover as well correlated with paddy field cover, and pond land. GRDP values that correlated with the land cover area were carried out by a linear regression analysis of panel data. The results of panel data linear regression calculations show that changes in the area of built-up land cover in Lampung Province do not affect the total value of GRDP, but the built-up land cover has a negative effect on GRDP in the agriculture, forestry, and fisheries sectors and a positive effect on GRDP in the processing industry sector and GRDP in the construction sector. The area covered by paddy fields and ponds has a positive effect on GRDP in the agriculture, forestry, and fisheries sectors.

Keywords: Land Cover, GRDP, Panel Data Linear Regression, Correlation

1. Introduction

Population growth is always followed by population activities and will not be separated from the sustainability of natural resources, natural resources will always be utilized in population activities, and one of these natural resources is land. The land is the land part of the earth's surface, including the land and several factors that can affect its utilization, including climate, relief, geological aspects, and hydrology which can be formed naturally or as a result of human intervention (UURI, 2014). The land has special characteristics, including fixed properties, a limited amount of land, and the availability of land that cannot be changed (Nur, 2019). The nature of the land is not directly proportional to the increasing number of human populations, because an increase in the number of human populations is not accompanied by an increase in the availability of land as a place to carry out community life activities, it will encourage the opening of new land to meet the needs of people's lives so that changes The extent of land use to fulfill people's lives cannot be prevented. According to (Yy Azimah & Antomi, 2020) meeting, the community's need for land to carry out an activity will affect the production and individual income of the people who live in the area. The total combined production in an area is called the Gross Regional Domestic Product (GRDP).

GRDP can be said to be the result of the sum of the values of goods and services that have been produced by an area in one year (BPS, 2022b). The added value in question is the value that has been generated from various production factors and raw materials for production procedures (Putri, 2018). Based on this definition, it can be seen that the GRDP figure is determined based on the influence resulting from a combination of production factors.

Lampung Province has quite a high natural resource potential and also has a relatively large area. In addition, Lampung Province is located in a strategic area because the gateway to Sumatra Island, namely connecting Java Island and Sumatra Island is widely accessible by people from both Java Island and Sumatra Island, or any other island. The Central Bureau of Statistics collects data on population density on the island of Sumatra, and it is known that

After North Sumatra Province and also South Sumatra Province, Lampung Province has the third highest population on the island of Sumatra (BPS, 2022a). 8,026,191 people until 2021, when the total population increased to 9,081,792 people, an increase in population and strategic location of areas will increase community activities in Lampung Province and will require more land area as a place to do activities. The existence of a link between population activities, land use, and the value of GRDP in an area raises the question "Does land area affect the value of GRDP in an area?". The goal of this research is to determine whether there is a relationship and influence caused by changes in a land area on the GRDP value in several sectors in Lampung Province. This objective will be accommodated by a statistical calculation process using a panel data linear regression model. So that it can predict the magnitude of the relationship between the area of land cover and the GRDP value.

2. Methodology

This research activity was carried out in Lampung Province, which is geographically located at positions 103°40'–105°50' East Longitude and 6°45'–3°45' South Latitude, while the scope of the research object can be seen in Figure 1 below:

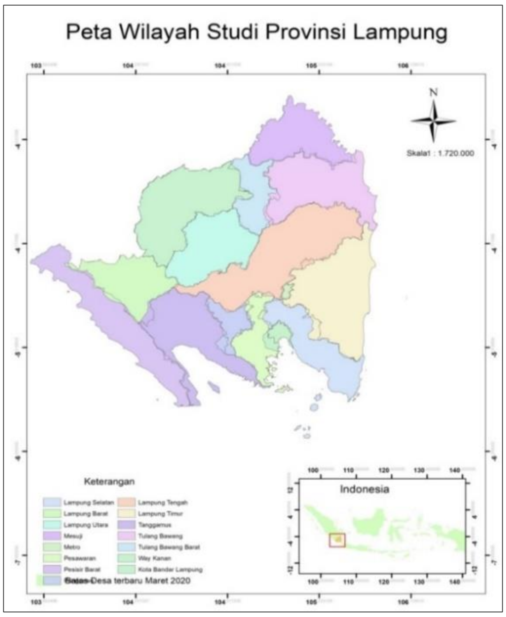

Fig 1. Map of the Study Area of Lampung Province

This study employs data on total GRDP values, GRDP in the agriculture, forestry, and fisheries sectors, GRDP in the manufacturing sector, and GRDP in the construction sector as dependent variables obtained from the official website of the Central Agency Statistics (BPS) in Lampung Province, as well as land cover area data as the independent variable obtained from the classification results obtained using Landsat 8 satellite imagery in 2014, 2018, and 2021 with the assistance of the Google Earth Engine. The methodology in this study is described using a flowchart as shown in Figure 2 below:

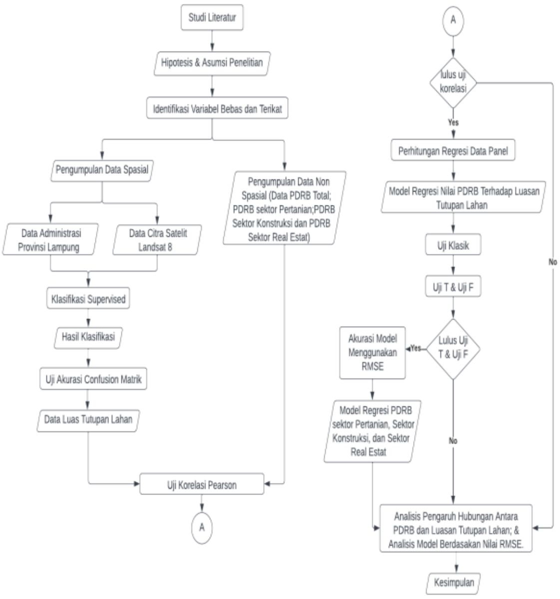

Fig 2. Research Methodology
(Researcher, 2022)

3. Literature Review

3.1 Classification of Land Cover Using Remote Sensing Methods

Land cover change is interpreted as a loss, destruction, or improvement, depending on the human perspective that will benefit or be harmed from the transition process (Juniyanti et al., 2020). Remote sensing functions as a tool to generate information in the form of land cover, namely maps. There are various kinds of satellite imagery that can classify land cover, one of which is Landsat satellite imagery (Sampurno & Thoriq, 2016). This study uses the supervised method. The technique of supervised classification is carried out by identifying objects, such as satellite imagery or what is commonly referred to as training areas. Objects in the image (training area) will represent spectral values, which will be a reference for other pixel values, that is, if an object has a pixel density that is almost the same as the spectral area training data density, then it will be classified as a land cover class similar to the training region that has been identified, an example of the training area is shown in Figure 3 below.

Fig 3. Taking Training Samples on Image

Fig 4. Samples of Forest Land Accuracy Tests

3.2 Image Classification Accuracy Test

The accuracy of the classification results that have been obtained must be tested to evaluate the classification processing methods and models. The confusion matrix is used to measure the accuracy of the classification results in this study. The confusion matrix will produce several values, including the Kappa Coefficient, Overall Accuracy, User Accuracy, and Producer Accuracy values" (Sutanto et al., 2014). The accuracy test is carried out by comparing field conditions using high-resolution Google imagery in 2022 with classification results. Sampling for the accuracy test on Google images with high resolution for 2022 is presented in Figure 4. The results for the classification of Landsat 8 satellite imagery that has been tested for accuracy in 2014, 2018, and 2021 are presented in Figures 5, 6, and 7.

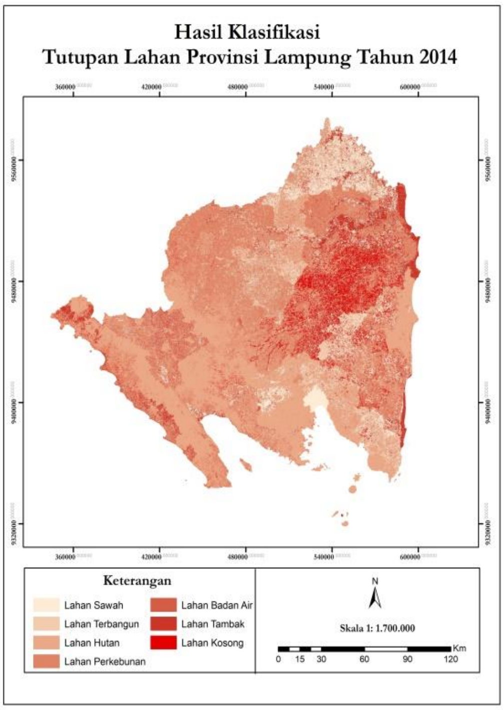

Fig 5. Coverage Land 2014

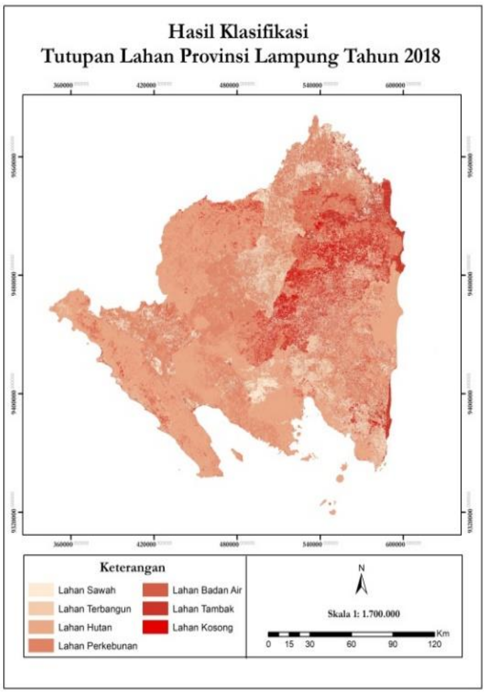

Fig 6. Land Cover 2018

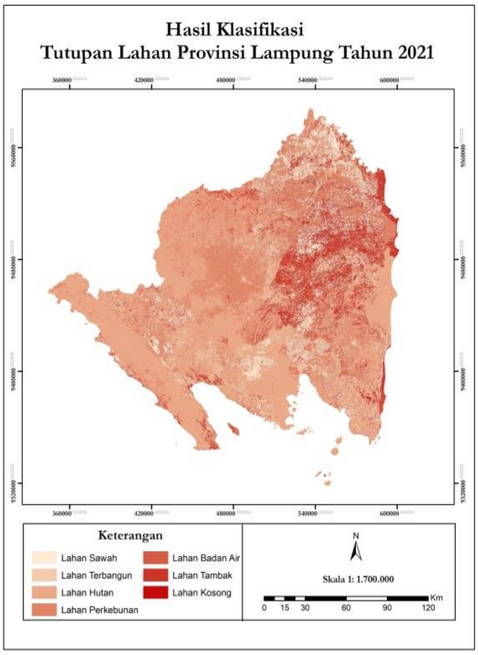

Fig 7. Land Cover 2021

3.3 Correlation Analysis

The technique used is the Pearson product-moment. correlation Pearson is a correlation that can be applied as a means of determining the relationship between one dependent variable and one independent variable. The equation of the panel data regression model can be written as follows (Sugiono, Izzaty, et al., 2015):

$$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{(\sum x^2 - \frac{(\sum x)^2}{n})(\sum y^2 - \frac{(\sum y)^2}{n})}}$$

Where:

r = Pearson Correlation Value

$\sum x$ = Total Observation Result of Variable X

$\sum y$ = Sum of Observations Variable Y

$\sum xy$ = Total of Observations of Variable X and Variable Y

$\sum x^2$ = Sum of X Observations that have been squared

$\sum y^2$ = Sum of Observations Y that has been squared

3.4 Linear Regression Analysis of Panel

Data Regression analysis of panel data is a regression analysis that uses a combination of two types of data in the form of time series data and cross-sectional data. data A time series is data on one object consisting of several periods. Cross-sectional data is defined as data consisting of several objects in the same period (Indrasetianingsih & Wasik, 2020). The general panel data regression model equation can be written as follows:

$$Y_{it} = \beta_{0it} + \sum_{K=1}^{K} \beta_{kit} X_{kit} + \varepsilon_i$$

Where:

Y_{it} = The dependent variable

X_{kit} = Independent variable

B_0 = Constant slope

ε_{it} = Error

k = A large number of regression parameters are predicted.

Analysis using panel data regression requires several steps, which are written in Figure 8 below:

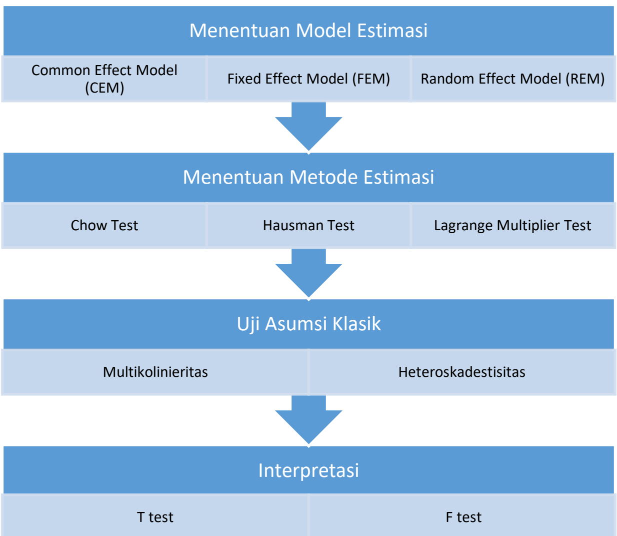

Fig 8. Panel Data Stages
(Hidayat, 2014)

3.5 Testing the Classical Assumptions

According to (Iqbal, 2015) in the panel data regression model, there are two classical assumption tests, namely the multicollinearity test which is used to determine whether there is a linear relationship between the variables that explain the regression model (predictor variable), and the heteroscedasticity test, which is used as a tool to determine the error in the model whether it will be fixed (homoscedasticity) or changing (heteroscedasticity) (Pangestika, 2015).

4. Findings and Discussion

4.1 The Relationship and Influence of GRDP in Total on the Area of Built-up Land Cover in Lampung Province

The relationship between total GRDP and built-up land cover in Lampung Province can be seen through the correlation results presented in Table 1. Table 1 shows that only built-up land cover correlates with the total GRDP in Lampung Province.

Table 1. Total GRDP Correlation Results with Land Cover Area

GRDP-TL Correlation	Correlation Value	Symbol	R Value Table	Results
PDRB-TL paddy fields	0.058	<	0.3061	Not Significant
PDRB-TL built-up area	0.577	>	0.3061	Not Significant
PDRB-TL forest	-0.101	<	0.3061	Not significant
PDRB-TL Plantation	0.178	<	0.3061	Not significant
PDRB- TL pond	0.176	<	0.3061	Not Significant

To see how much influence is produced, a regression analysis is carried out between GRDP in total on the land cover area, the estimated model chosen is the CEM model, and the results of model interpretation are carried out using the T-test and F-test, the results of the interpretation show that the probability value of the built-up area is 0.4974 which means it is greater (>) than the value of α, which is 0.1, it can be interpreted that in this model the change in the area of built-up land cover in Lampung Province does not affect the value of the total GRDP in the province This is because built-up land cover in Lampung Province is mostly used as houses or residential areas compared to goods and services production facilities which will be related to the value of GRDP, so that the area of built-up land cover alone does not affect the GRDP value.

4.2 The Relationship and Influence of GRDP in the Agriculture, Forestry, and Fisheries Sectors on the Covered Area of Paddy Fields, Built-up Land, and Pond Land in Lampung Province

Table 2. Correlation of GRDP in the Agriculture, Forestry, and Fisheries Sectors with Land Cover Area

GRDP-TL Correlation	Correlation Value	Symbol	R Value Table	Results
PDRB-TL paddy fields	0.473	>	0.3061	Significant
PDRB-TL built-up area	0.738	>	0.3061	Significant
PDRB-TL forest	0.135	<	0.3061	Not Significant
PDRB-TL Plantation	0.299	<	0.3061	Not Significant
PDRB- TL pond	0.356	>	0.3061	Significant

Table 2 can show that the area of land cover that correlates with GRDP in the agriculture, forestry, and fisheries sectors in Lampung Province is the area of paddy fields, built-up land, and pond land. The estimation model used for regression analysis of GRDP in the agriculture, forestry, and fisheries sectors for the area covered by paddy fields, built-up land, and ponds in Lampung Province is the FEM model. The results of the T-test interpretation have a probability value for paddy fields of 0.0629, built-up land of 0.0032, and pond land of 0.0148. And the results of the interpretation of the F-test have a probability value of 0.000005, which means that all probability values produced are less than (<) the value of $\alpha = 0.1$, then the area covered by paddy fields, built-up land, and ponds in Lampung Province has an effect on the value of GRDP in the agricultural and forestry sectors, and fisheries simultaneously and partially. The magnitude of this influence can be expressed in the equation below:

Y=2803.974 + 3.423156 x Paddy Field - 9.629306 X Built-Up Area +4.588232 x Pond Area.

Based on the regression equation above, it can be the case that every time you add 1 km^2 of paddy fields, it will increase or decrease the GRDP value in the agriculture, forestry, and fisheries sectors by 3.423156 billion. For built-up land, each additional 1 km^2 of built-up land will reduce the value of the GRDP in the agriculture, forestry, and fisheries sectors by 9.629306 billion. And for ponds, every time you add 1 km^2 of ponds, it will increase the value of GRDP in the agriculture, forestry, and fisheries sectors by 4.588232 billion.

4.3 The Relationship and Influence of GRDP in the Construction Sector on the Area of Built Land Cover in Lampung Province

Table 3. Correlation of GRDP in the Construction Sector with Land Cover Area

GRDP-TL Correlation	Correlation Value	Symbol	R Value Table	Results
PDRB-TL paddy fields	-0.045	<	0.3061	Not Significant
PDRB-TL built-up area	0.482	>	0.3061	Significant
PDRB-TL forest	-0.179	<	0.3061	Not Significant
PDRB-TL Plantation	0.062	<	0.3061	Not Significant
PDRB- TL pond	0.174	<	0.3061	Not Significant

Based on table 3, it can be seen that only the area of built-up land cover is correlated with GRDP in the construction sector. The regression analysis estimation model used in the GRDP in the construction sector for the area of built-up land cover in Lampung Province is the REM model. The results of the interpretation of the T-test and F-test have a probability value of 0.0222 and 0.023958, which means less than (<) the value of $\alpha = 0.1$, then the area of built-up land cover in Lampung Province affects the GRDP value in the construction sector. The magnitude of this influence can be expressed in the equation below:

Y=813.6524+1.852644 x Built-Up Land

Based on the regression equation above, it can be a scenario that every time you add 1 km^2 of built-up land, it will increase/increase the GRDP value of the construction sector by 1.85644 billion.

4.4 The Relationship and Influence of GRDP in the Processing Industry Sector on the Area of Built-up Land Cover in Lampung Province

Table 4. Correlation of GRDP in the Processing Industry Sector with Land Cover Area

GRDP-TL Correlation	Correlation Value	Symbol	R-Value Table	Results
PDRB-TL paddy fields	-0.017	<	0.3061	Not Significant
PDRB-TL built-up area	0.506	>	0.3061	Significant
PDRB-TL forest	-0.215	<	0.3061	Not Significant
PDRB-TL Plantation	0.103	<	0.3061	Not Significant
PDRB- TL pond	0.243	<	0.3061	Significant

Based on table 4, it can be seen that only the area of built-up land cover correlates with the GRDP in the processing industry sector in Lampung Province. The regression analysis estimation model used in the GRDP in the processing industry sector for the area of built-up land cover is the REM model. The results of the interpretation of the T-test have a probability value of 0.0259, and the results of the interpretation of the F-test have a probability value of 0.030229 which means that all probability values produced are less than (<) the value of α = 0.1, then the area of built-up land cover in Lampung Province affects the value of GRDP processing industry sector either simultaneously or partially. The magnitude of this influence can be written in the equation below:

Y=1582.494+3.140954 x Built-Up Land.

Based on the regression equation, it can be the case that every time you add 1 km2 of built-up land, it will increase the GRDP value in the processing industry sector by 3.140954 billion.

4.5 Model Accuracy Based on the RMSE Value

In the experiments that have been carried out, three models have a relationship and influence between the GRDP value and the land cover area, so that the three models are then carried out for model accuracy by calculating the RMSE value so that the strength of the model can be known, based on table 4 it can be seen that the value The RMSE model of GRDP in the agriculture, forestry, and fisheries sectors for the area of built-up paddy fields and ponds is 2,407.06 billion / district, it can be said that this model can estimate the value of GRDP for the area of land change with an average error of IDR 2,407.06 billion / district, for the second model, namely the GRDP model of the construction sector to the area of built land cover, the RMSE value is Rp. 1,330.91 billion / district, it can be said that this model can estimate the GRDP value in the construction sector to the built cover area with an average error of IDR 1,330.91 billion / district, and the last model, modeling the GRDP value in the processing industry sector to the built cover area, is obtained RMSE value of Rp. 2,617.80 billion / district, it can be said that this model can estimate the GRDP value in the processing industry sector to the built-up area with an average error of IDR 1,330.91 billion / district. The RMSE value generated for the three models can be said to be too large. So, the accuracy of this model can be categorized as not good. This is because this study used GRDP adjusted for production prices. where the production approach focuses more on activities that can produce products in the form of services and goods (Ari Sudirman, 1999: 85) (Putri, 2018). And in the production process itself, there are various factors of production, namely capital factors, labor factors, natural resource factors, and production management factors to produce production products (output) that are as expected. However, this study produced a model that only used one factor of production, namely the factor of natural resources in the form of land cover area. As a result, the accuracy of the resulting model is less accurate, as demonstrated by the RMSE value in Table 4.Therefore, to produce an accurate model with a small RMSE value it is necessary to add other production factors to the independent variables used during the model-building process.

Table 5. RMSE Value Calculation Results

No	Type of Model	RMSE (billions/regency)
1	PDRB model of the agricultural, forestry, and fisheries sectors to the area covered by built-up paddy fields and fishponds	Rp. 2,407.06
2	GRDP model of the construction sector to the area of built-up land cover	Rp. 1,330.91
3	GRDP model of the processing industry sector to the area of built-up land cover	Rp. 2,617.80

6. CONCLUSION

There is an influence of some land covers on the GRDP value in several sectors in Lampung Province, but the resulting influence is quite small as evidenced by the RMSE value in each model which has a fairly large value. Built-up land cover has a relationship to GRDP in total; GRDP in the agriculture, forestry, and fisheries sectors; GRDP in the construction sector; and GRDP in the processing industry sector. This is indicated by the resulting correlation value which is greater than the R table value which indicates a significant relationship between these variables. Even though the built-up land cover is correlated but has no effect on the total GRDP model, regression analysis cannot be used to predict the magnitude of total GRDP's effect on built-up land cover. Built-up land cover has a positive effect on the GRDP in the construction sector and the GRDP in the processing industry sector so every additional 1 km² of built-up land cover will increase the GRDP value in the construction and processing industry sectors. However, the built-up land cover has a negative effect on GRDP in the agriculture, forestry, and fisheries sectors so every additional 1 km² of the built-up land area will reduce GRDP in the agricultural, forestry, and fisheries sectors. The magnitude of the resulting influence on the model is very small. To produce a model with a very large influence other independent variables are needed such as capital factors, labor factors, and production management factors.

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