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Modeling of Land Prices in Karang Joang, Balikpapan City

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Abstract. Spatial Plan of Balikpapan City in 2012-2032 decides Karang Joang Village as a strategic area of economic interest. As a consequence, the development of regional infrastructure was built to support the emergence of new centers of activity, such as State Universities, highways and regional industrial area. Therefore, the price of land in Karang Joang has doubled over the past two years. High land prices tend to be used for commercial activities. On the other hand, zoning activities are needed to ensure the harmony of space and control the growth of land outside of its designation. Land use that is not in accordance with the plan as a result of high land prices can cause many land conflicts such as land speculation, inappropriate land use, and other problems. A land pricing model is needed as a fundamental for zoning of spatial utilization activities to minimize land conflicts. The land price model can also be used by the government to make policies or space planning in accordance with the development of land prices. The Euclidean distance method from GIS was used to identify land characteristics against factors affecting land pricing and regression analysis to construct land prices models. We found that there were nine factors that influence land prices, namely the distance of land to government centers, markets, universities, hospitals, arterial roads, collector roads, industrial areas, availability of electricity services and land use. Among these factors, the availability of electricity services contributed the largest increase of 252,234 IDR and the land that close to the industrial estate tended to decrease by 648 IDR/m^2.

Keywords: *Land prices, linear regression, euclidean distance*

1. Introduction

Spatial Plan of Balikpapan City in 2012-2032 mentions that Karang Joang Village serves as a sub center of urban services. In addition, Karang Joang Village also functions as a center for regional trade services and education centers. The development of Karang Joang Village as a service sub-center is supported by infrastructure development that can bring new centers of activity, such as state universities, highways and regional industrial area. The development accelerated economic growth and increased land prices around the infrastructure. Areas with good infrastructure will become centers of growth with high land prices [1].

The price of land is an assessment of the land measured by the nominal price in units of money for a certain unit of land on the land market based on the economic capacity of land in relation to productivity and economic strategy [2]. The price of each land varies depending on the aspects that affect it. There are four aspects that can affect the price of land, namely, the aspect of public service facilities, transportation network aspect, environmental aspect and government policy aspect [3].

Based on direct observations conducted by researchers, we found that the price of land in Karang Joang had doubled over the past two years. High land prices can lead to problems such as land conflicts, environmental problems, congestion, land speculation and land use deviations. The ideal land use is a land allotment in accordance with the existing spatial plan. If that is allowed to continue, then the spatial arrangement in the plan document will be difficult to occur [4]. This is because land prices can be representative of land that has high accessibility and has the potential to be developed in commercial activities [5]. The development of commercial activity is part of the transformation of Balikpapan city from the oil city to the center of commerce and industry [6]. In the last 5 years, industry and trade sectors experienced annual economic growth of more than 25%, while mining was only 0.05%. This condition created a strong economic attraction that increased urban activity and population growth, especially the urbanization process in Karang Joang Urban Village as the service center [6]. This transformation is proven from the number of simple housing developments, new stores, and MSMEs. Based on data from the Trade, Industry and Cooperatives Office of Balikpapan, there are 167 new business licenses for MSMEs in North Balikpapan. In addition, the construction of simple housing type 36 has been popping up around the main road of this area.

Therefore, it is necessary to identify the land prices as an instrument of land control, such as the land prices model. The land pricing model can be used to determine appropriate land use zoning based on factors affecting land prices. Based on this background, a study was conducted to develop the model of land prices in Karang Joang Village. In addition to providing information on land pricing patterns, the results of the analysis can also be used as a basis for formulating spatial plans. The purpose of this research was achieved through three stages. First, identify the distance between research samples and factors that influence land prices. Second, arrange the land prices model and third, arrange the map of land prices classification.

2. Method of Research

2.1 Setting of Research

The research was conducted in Karang Joang Village, Balikpapan City East Kalimantan Province which has an area of 93.09 km^2. We used a quantitative method through the mathematical calculation of land price patterns from the estimated spread of existing land prices. Therefore, some sample locations are needed to identify existing land prices. Determination of the research sample point was performed by spatial sampling which is a method of preparing a research sample design from a population in the form of spatial data [7]. Spatial sampling was conducted with the aim of obtaining scattered observation points and representing the entire area of Karang Joang Village.

The division of the area into 181 grids was performed to facilitate sampling. The logic of spatial sampling is that the value of the adjacent observation point will have the same value (almost similar) compared to the value at a farther point [7]. Therefore, the selected sample should be evenly distributed across the grid so that the sampling data used can interpret the entire population. The value of a grid is the sampling value that is positioned in the center (in the middle) of the relevant pixels [8]. The location of the research sample point in the form of a map is shown in Figure 1.

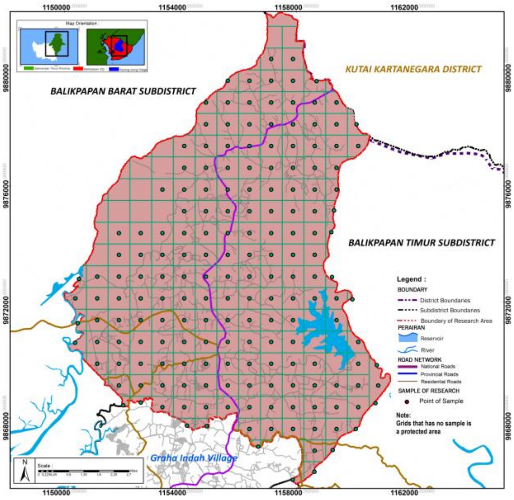

Figure 1. Map of sample points in the Karang Joang Village

2.2 Identifying Land Distance against Factors Affecting the Land prices

The variables used in this study consisted of dependent variable and independent variable. The dependent variable is land price based on the market price of land which consists of the estimated value of land transactions when transferred its ownership. Meanwhile, independent variable used was the factors that influence the price of land in Karang Joang Village, such as public service facility, transportation network, environment of the surrounding, and government policies.

Facilities and infrastructure that can affect land prices are availability of electricity, availability of clean water, government facilities, health facilities, security facilities and educational facilities. The proximity of land with facilities and infrastructure is considered to have the ability to attract residents to live in the area so that the price of land increases [9,10]. The aspect of the transportation network is related to the accessibility of the land. If the land has good accessibility, the price of the land will be higher [10]. Accessibility to the land can be measured by proximity to roads, public transport lines and land distance to terminals because land with good accessibility can reach various locations easily and quickly [2,10]. Furthermore, environmental aspects or land conditions can affect land pricestopography and type of land use because the sloping topography will be easy to construct and the utilization of land that generates huge profits will have high land prices [3,9].

In this study, the calculation of the distance to each factor that affected the price of land was performed to the sample of land that the price has been known. The distance can be calculated by using Euclidean distance which is a technique of calculating the distance between two objects using the Pythagoras theorem [3]. Euclidean distance is a raster radius/buffer map of the object affecting the price of the land.

The result of the radius/buffer map was then over layered with the map of research sample point thus the researcher produced a map that contained the price of the land of each sample and the distance of each object affecting the price of the land from the sampling point. The stages of using Euclidean distance can be seen in Figure 2.

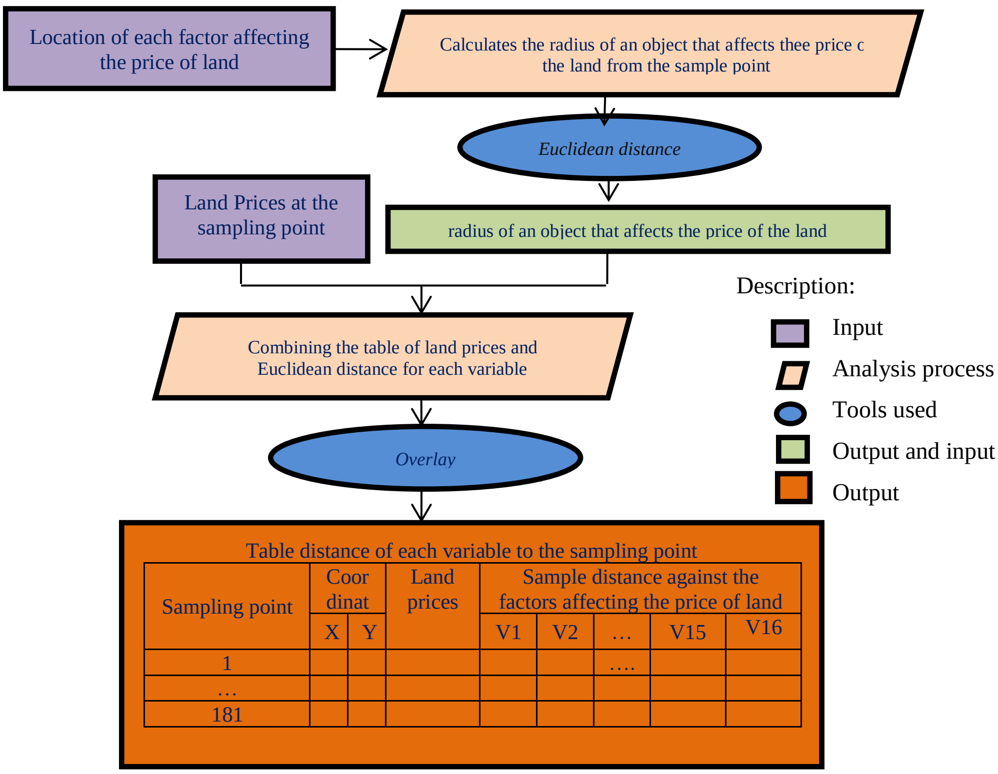

Figure 2. The stages of Euclidean distance

2. 3 Formulating theland prices models at Karang Joang Village

Regression analysis was used to analyze factors affecting land prices. The purpose of this analysis was to create an estimation model of the parameter values that describe the relationship between the dependent variable and the independent variable. Regression parameters are assumed by OLS (Ordinary Least Square) estimation method [11]. The OLS formula is:

$$Y = \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta n\, Xn + \beta_0 \quad (1)$$

Description:
Y = Dependent variable
β_0 = Constants (intercept)
β_1 = Regression coefficient of variable 1
X_1 = Independent variable 1
β_2 = Regression coefficient of variable 2
X_2 = Independent variable 2
βn = Regression coefficient of variable n
Xn = Independent variable n

Before the regression analysis is performed, the model formed must fulfill the model feasibility test, namely regression coefficient test (t-test), F test and determination coefficient test.

a) Regression Coefficient Test (t-test)

The t-test in multiple linear regressions is intended to determine whether the alleged parameters (regression coefficients and constants) are appropriate parameters or not. If the t-count is greater than the t-table then the model is acceptable. The equation used in the t-test is as follows:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad (2)$$

Description:
t = t-count which will be compared with t-table
$\hat{y}_i$ = Ratio to estimated values
$\bar{y}$ = Average value
y_i = Observation values

b) Model Test (Test F)

The feasibility test of the model or F test is the initial stage of identifying regression models that are estimated to be feasible or not. A feasible model is a model that is estimated to be used to explain the effect of independent variables on the dependent variable. The model is stated to fulfill the F test when the significance value is less than 0.005. The equation used in the F test is as follows:

$$F = \frac{R^2/k}{(1-R^2)/(n-k-1)} \quad (3)$$

Description:
F = F-count which will be compared with F-table
R^1= Partial correlation
n= Number of samples
k = Number of independent variables

c) Coefficient of Determination

The coefficient of determination explains the variation in the effect of independent variables on the dependent variable. Or it can also be said as a proportion of the influence of all independent variables on the dependent variable. The equation used in the coefficient test is:

$$R^2 = \frac{variance\ that\ can\ be\ explained}{the\ total\ variance\ of\ the\ independent\ variable} = \frac{\sum(\hat{y}_i-\bar{y})^2}{\sum(y_i-\bar{y})^2} \quad (4)$$

Description:
R = Coefficient of Determination
$\hat{y}_i$ = Ratio to estimated values
$\bar{y}$ = Average value
y_i = Observation values

After the model estimation was established, further testing of classical assumptions was performed. Assumption testing was not conducted through SPSS software operations; however SPSS output was only used to read the assumption test. Some of assumption tests weremulticollinearity,

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autocorrelation, heteroscedasticity and normality.

2. 4 Developing a Map of Land prices Classification

The land pricesclassification was divided into three classes with high, medium, and low description. The method of land prices grouping was conducted by calculating the value or value for each pixel of land based on the selected land prices model with the Raster Calculator tool in Quantum GIS. After each pixel has a value, then the classification of the land prices classification into three groups was performed using reclassify tools. Furthermore, map conversion was performed by using Raster to Polygon. Threfore, thethe final result obtained is a map of the price of land in Karang Joang Village. The process flow analysis of zone determination using Quantum GIS software is shown in the Figure 3 below.

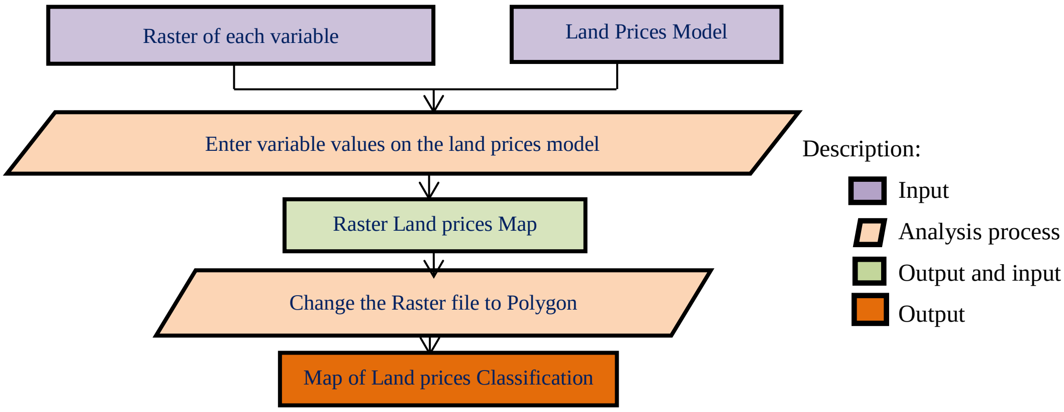

Figure 3. Stages of Developing a Map of Land pricesClassification

3. Result and Description

3.1. General Condition of Research Area

Karang Joang Village is located in North Balikpapan Sub-district. Based on its geographical location, Karang Joang Urban Village is located between 116,6^{0}and 117.00 LU and 1,5^0 LS and has the most dominant slope in the range of 25-40%.

Land use in Karang Joang Village is dominated by shrubs covering an area of 50.830.810 m^2. While the smallest land use is the fishpond for an area of 4,088 m^2. Utilization of land for trade and services spread along Soekarno-Hatta Street, while for the utilization of land for settlement is dominated in the southern region Karang Joang Village. Industrial activities and warehousing are located along PulauBalang Street. Meanwhile, other areas are used for other activities such as plantations, agriculture, educational facilities, social facilities, and so forth.

The market price of land in Karang Joang Village is between 20,000 IDR/m^2 up to 1.250.000 IDR/m^2, except for protected forest area that does not have a certain land prices because the designation is not for the cultivation area. The price of land is getting higher in the area that closes to the arterial road and in the southern region of Karang Joang Village. Maps of slope, land use and land prices in Karang Joang Village can be seen in Figure 4 below.

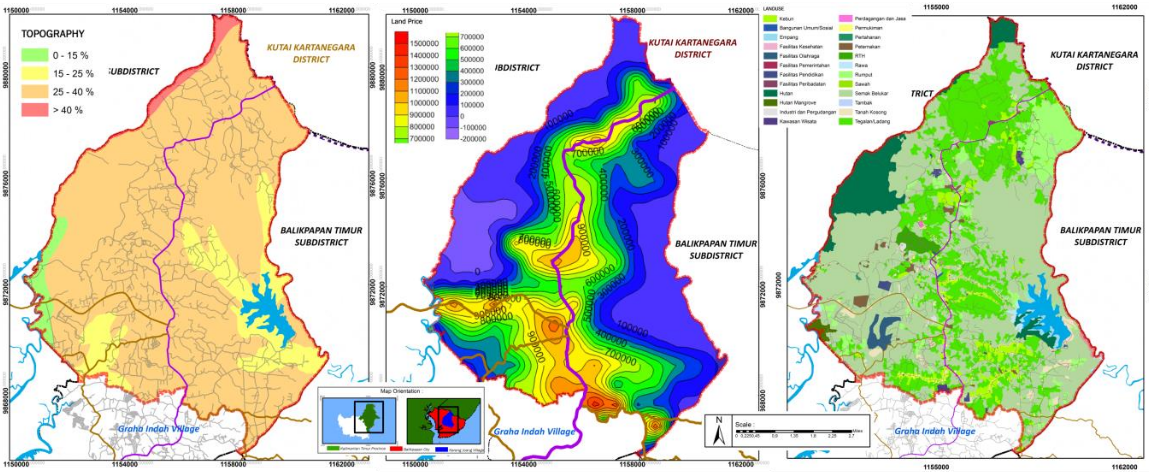

Figure 4. Maps of Land prices in Karang Joang Village

3.2. Calculation Analysis of Euclidean Distance

The usage of Euclidean Distance aimed to calculate the distance of an object in a raster or vector format (feature) expressed in pixel size. The pixel size used in this study as the outcome was one meter. The collection of government facilities closest to the Karang Joang Village is a government facility in the Dome area in East Balikpapan District with an average distance of 11 km whereas, the market and hospital closest to Karang Joang Village are Butun Market located in BatuAmpar Village. The average distance of the research sample to the market and hospital is 9 km. Educational facilities located in Karang Joang Village consist of 14 elementary/equivalent, four junior high school/equivalent, two high school/equivalent, and two colleges. Arterial road located in Karang Joang Village is Soekarno-Hatta Street. While the environmental road spreads throughout Karang Joang Village. The results of Euclidean distance analysis can be seen in Figure 5 and 6.

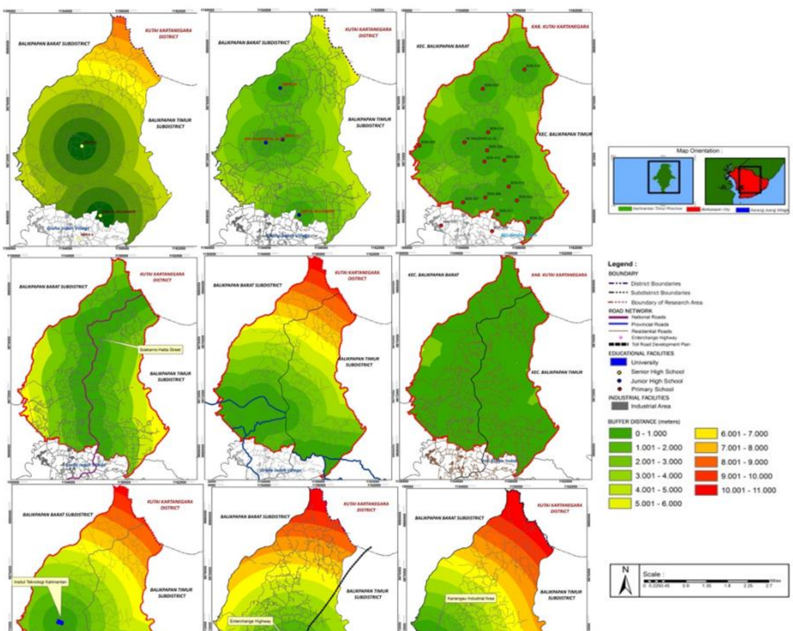

Figure 5. Map of Euclidean Distance (a) Senior High School/equivalent, (b) Junior High School/equivalent, (c) Elementary/equivalent, (d) Arterial road, (e) Collector road, (f) Environmental road, (g) Highways, (i) Industrial areas, (j) Government facilities, (k) Markets, (l) Hospitals.

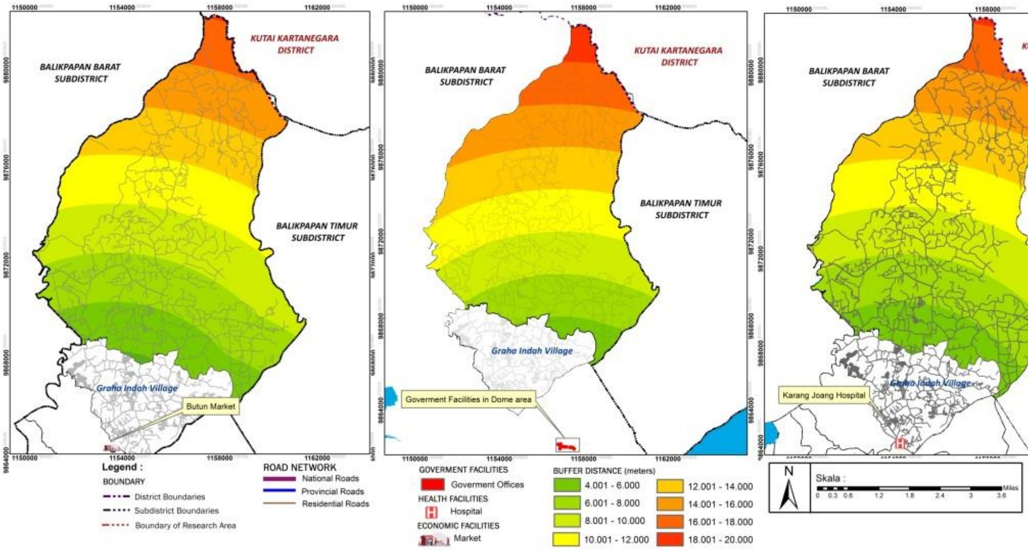

Figure 6. Modeling result

3.3. Formulating the Land Pricing Model using Multiple Regression

After regression analysis was performed, the results of the t-test are shown in Table 1.

Table 1.Sig Value on t-test

Variabel	Variable	Sig	Description
	Constants	0.000	Significant
V_1	Land distance to the central government	0.000	Significant
V_2	Land distance to market	0.295	Not significant
V_3	Land distance to universities	0.046	Significant
V_4	Land distance to senior high school/equivalent	0.216	Not significant
V_5	Land distance to junior high school/equivalent	0.271	Not significant
V_6	Land distance to elementary school/equivalent	0.580	Not significant
V_7	Land distance to hospital	0.001	Significant
V_8	Availability of electricity services	0.000	Significant
V_9	Availability of water services	0.445	Not significant
V_{10}	Land distance to arterial roads	0.280	Not significant
V_{11}	Land distance to the collector's road	0.002	Significant
V_{12}	Land distance to environmental roads	0.530	Not significant
V_{13}	Land distance to the toll gate	0.384	Not significant
V_{14}	Existing land use	0.000	Significant
V_{15}	Topography	0.542	Not significant
V_{16}	Land distance to industrial areas	0.000	Significant

Based on the result of the t-test for all variables, there are some variables that have the significant value below 0.05 thus it can be interpreted that variable is not the appropriate parameter for the model. The statistical test is sensitive to the number of variables. If the composition of variables changes, thus it will affect the results. Therefore, a test of some variable composition was performed to produce the best model. The test was conducted to find out whether the variable that was not included in the composition of the prepared variable provided significant influence or not. The composition of variables consists of:

Land prices model using all research variables

2) Land prices model without variables of basic education facilities such as land distance to senior high school/equivalent, land distance to junior high/equivalent and land distance to primary school/equivalent because the variable did not fulfill T-test.
3) Land prices model without the variable of settlement environment needs such as availability of water service and overland distance to road environment because the variable did not fulfill T-test.

4) Land prices model without topographic variables.
5) Land prices without all variables that did not fulfill t-test results.
6) The land prices model without the variables that did not fulfill t-test results except distance land to market and distance land to the arterial road. Both variables were maintained in accordance with the price of existing land that is higher if it is closer to the market and arterial road.

Table 2.Test Result of Land prices Model

Model	Coefficient Determination Test	Model Test (F Test)	Regression Coefficient Test (t-test)	Classic assumption test			
				Multicollinearity	Autocorrelation	Heteroscedasticity	Normality
Model 1	57.1%	Fulfilled	43.75% variable are fulfilled	50% variable free from multicollinearity	Fulfilled	Data with the same variant	Data is normally distributed
Model 2	57.5%	Fulfilled	53.8% variable are fulfilled	46,1% variable free from multicollinearity	Fulfilled	Data with the same variant	Data is normally distributed
Model 3	57.3%	Fulfilled	42.8% variable are fulfilled	57,1% variable free from multicollinearity	Fulfilled	Data with the same variant	Data is normally distributed
Model 4	57.1%	Fulfilled	46.7% variable are fulfilled	30% variable free from multicollinearity	Fulfilled	Data with the same variant	Data is normally distributed
Model 5	56.4 %	Fulfilled	100% variable are fulfilled	28.5% variable free from multicollinearity	Fulfilled	Data with the same variant	Data is normally distributed
Model 6	58.2%	Fulfilled	100% variable are fulfilled	35% variable free from multicollinearity	Fulfilled	Data with the same variant	Data is normally distributed

Out of the six models that are formed, the model that has the highest Adjusted R square value is the land prices model using the research variable by dropping out variables that did not fulfill the results of the t-test and maintaining the variables of land distance to the market and land distance to the arterial road. The results of the analysis carried out on model 6 are showed in Table 3.

Table 3. The Result of Best Model Testing

Model		Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
		B	Std. Error			Tolerance	VIF
1	(Constant)	1,826,780.138	381,966.467	4.783	0.000		
	V_1	-1,157.551	185.586	-6.237	0.000	0.001	1,360.837
	V_2	481.847	183.248	2.629	0.009	0.001	1,245.378
	V_3	140.080	37.299	3.756	0.000	0.041	24.126
	V_7	864.002	211.292	4.089	0.000	0.001	1,645.088
	V_8	252,033.915	52,731.934	4.780	0.000	0.806	1.241
	V_{10}	-43.547	22.009	-1.979	0.049	0.431	2.322
	V_{11}	212.947	52.999	4.018	0.000	0.015	68.506
	V_{14}	61,725.404	7,304.754	8.450	0.000	0.836	1.196
	V_{16}	-648.368	104.025	-6.233	0.000	0.003	303.864

The value of the determination coefficient that was formed is 58.2%, which means that the independent variable can describe the model as much as 58.2% while the other 41.8% is described by other variables outside the model. The model fulfills the F test, has autocorrelation, the data variant is the same and has a normal distribution. All the variables in the model fulfill the t-test, whereas the multicollinearity test results show that 35% of the variables in the model are free from multicollinearity. The selected model has the following equation:

Y = 1.826.780 - 1.157 X1 + 482 X2 + 140 X3 + 864 X4 + 252.0340 X5 + 44 X6 + 213 X7 + 61.725 X8 – 648 X9

Description:

Y = Land prices (IDR)
X1 = Land distance to government facilities (meter)
X2 = Land distance to market (meter)
X3 = Land distance to university (meter)
X4 = Land distance to hospital (meter)
X5 = The availability of electricity service
X6 = Land distance to the arteri road (meter)
X7 = Land distance to the collector road (meter)
X8 = Existing land use
X9 = Land distance to industrial area (meter)

3.4 Formulating a Map of Land prices Classification

Land classification maps are made based on the results of the modeling of land prices that have been carried out in the previous stage. The land classification map can be seen in Figure 7.

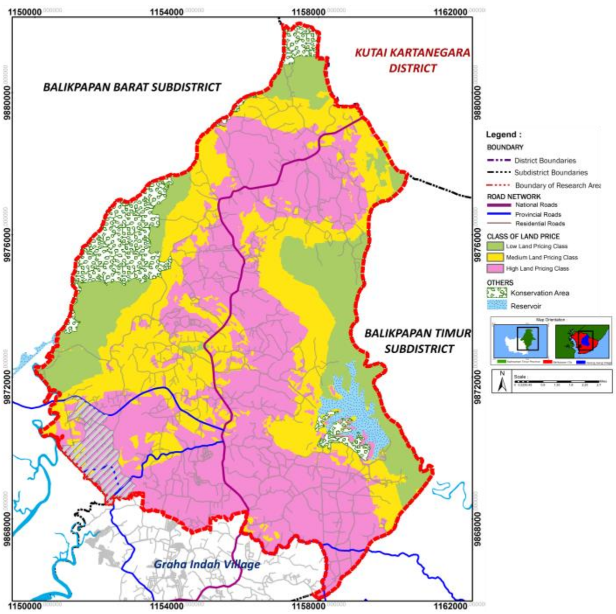

Figure 7. Map of Land prices Classification

The map of land pricesclassification based on the land prices model, as shown above, provides the information on the land prices in Karang Joang Village. Low land prices are located in areas near the northern, eastern and southern of urban boundaries. Middle land prices are located in the area between the high land prices area and the middle land prices area. Whereas the high land prices area is located in the southern Karang Joang Village and along the arterial road. The characteristics of low land prices, middle land prices, and high land prices area can be seen in Table 4.

Table 4. Characteristics of Land Prices Classification

Aspect	High land price	Middle land price	Low land price
Density of settlements	Medium	Medium	Rare
Distance to government facilities	An average of 10.5 km	An average of 12 km	An average of 13.4 km
Distance to market	An average of 8 km	An average of 10 km	An average of 11.9 km
Distance to universities	An average of 900 m	An average of 200 m	An average of 4.9 km
The availability of electricity and water	Most of them have been fulfilled	Most of them have been fulfilled	Not yet fulfilled
Distance to the arterial roads	An average of 1 km	An average of 1.8 km	An average of 2.7 km
Distance to the collector road s	An average of 2 km	An average of 3.6 km	An average of 5.1 km
Distance to hospital	An average of 9 km	An average of 10.5 km	An average of 12 km
Distance to industrial area	Side by side	An average of 5 km	An average of 6.8 km
Use of cultivated land	Mostly used for settlements, trade, and services	Mostly used for settlements and agriculture	Mostly used for agriculture and protected areas

4. Conclusion

4.1. Conclusion

Land prices model in Karang Joang Village showed that high land prices tend to be in the south. Researchers tested several variable compositions to formulate the best land prices model. We found the best model that has an Adjusted R square value of 58.2%. The model fulfilled the F test, has autocorrelation, is normally distributed and data with the same variants. All variables in the model fulfilled the t-test, while 35% of the variables in the model are free from multicollinearity. Nine significant factors to form the land prices model are the distance to the center of government, distance to the market, distance to universities, distance to hospitals, distance to arterial roads, distance to collector roads, distance to environmental roads, distance to toll road, and distance to industrial areas, the availability of electricity services, the availability of water services, land use, and topography.Among these factors, the availability of electricity services contributed the largest increase of IDR 252,234 and the land that close to the industrial estate tended to decrease by IDR 648/meter. The model showed that the low land prices zone is located on the outskirts of Karang Joang Village, away from the main road and directly adjacent to the protected area. While the high land prices zone is located in the southern region of Karang Joang Village and close to the main road.

4.2. Recommendation

This study resulted in the data of land pricing models and the direction of trade and service zoning that can be a reference in determining the Land Value Zone and the Sales Value of Objects Tax on Land in Karang Joang Village and a reference for developer companies. In addition to reviewing spatial plans against the applicable government policies, developers are required to check at potential areas in terms of land prices.

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