Land use change simulation based on land price spatial model in Tembelang, Indonesia

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Abstract. The construction of the toll gate interchange in Tembelang district, Jombang, has resulted in the increased land price in the area. This is because the area is getting more accessible, that led to new developments and land use changes. Areas with good infrastructure tend to have high land prices because it is more desirable, therefore land prices can be used as an approach in analysing land use change. Spatial modelling is done with Spatial Regression and produces land price maps classified as 0 - 200000 (low), 200000.0001 - 410000 (medium), and 410000.0001 - 1059240.75 (high) with an area of 1210.16 Ha, 1158.20 Ha, 1080.02 Ha. The price of the land is in units of Indonesian Rupiah (IDR) per square meter. From land pricing class, arranged potential for land use change by applying Query Builder. Land use change from non-built land to built-up land was simulated in high and medium land pricing class and predicted conversion for high land price 725.42 Ha and 901.04 for the medium land price. This research can be used as a recommendation to spatial arrangement and to anticipate land conversion that is not in accordance with its allocation in planning documents.

1. Introduction

There is a relationship between land price and change of land use. Land price is an assessment of land based on nominal price in units of money for a unit area of the land market in particular [1]. Vink in Sitorus [2] stated the land use is a human intervention to land resources, among permanent or a cyclic which aims to their life. Land price is affected by various factors. One of them namely the expansion of transportation network, according to [3], land prices will increase naturally. Mostly trend of land prices will be higher in areas with good infrastructure availability. People generally choose the areas with good infrastructure availability for their occupied, in spite of relatively high land prices. Therefore, land price is considered to constructing buildings which can be as an approach in analysing land use to knowing the potential area.

Jombang is currently building toll road with long reach 40.5 km that connects Mojokerto and Kertosono. The construction could trigger the occurrence of land use change and the increased price of land in the area of toll gate interchange. According to [4], transportation also provides a market for transportation excite land use, especially at intersection area. The development of areas causing a threat to the availability of agricultural land. The main reason why farmers convert their land is explained in [5], which are the need for land and the high land price, while the scale of business Inefficient to inflate. The government should identify the potential of land use based on land price as a result of development at Jombang's toll road in Tembelang districts. Predictions of land use change can be simulated from

potential changes. The main problem according to the research background above is the increasing land price after the construction of the toll road interchange in Tembelang, Jombang, may led to an increasing land use changes. Therefore, it is necessary to simulate the land use change based on land price spatial model to anticipate over the land function which deviated from the planning document. In order to reach the goal, there are several objectives that must be done below.

- Identifying factors affecting the land price.
- Creating a spatial model of land price.
- Simulating land use change based on the land price spatial model.
- Land use change simulation in this research can bring some benefits as mentioned below.
- Land use change prediction can be a recommendation to the planning document in Tembelang, Jombang.
- Land price spatial model can be a reference to decide land price zone (ZNT) and land tax value (NJOP).
- As a contribution to the methods and techniques in the field of land use change modelling.

2. Methods
This research is done within three steps of quantitative analysis. Here are the methods used in simulating the land use change based on the land price spatial model.

2.1. Confirmatory Factor Analysis
Confirmatory Factor Analysis (CFA) is used to know and confirm the interaction between independent factors which has been grouped before in each aspect. The data used in this analysis step is the Euclidean distance of each factor found in ArcGIS 10.1. Data processing is run using SPSS 21. Below are the conditions when the factors are accepted in CFA.

- Bartlett's Test significance < 5%
- Kaiser-Meyer-Olkin (KMO) ≥ 50%
- Measure of Sampling Adequacy (MSA) ≥ 50%

2.2. Spatial Regression
Spatial regression is a combination of Ordinary Least Square (OLS) regression and mapping. The analysis is used to create the land price, spatial model. The data used in performing spatial regression are land price samples (Rp/m2) as Y and factors influencing it (meter) as X followed by the coefficient in b_1. Here is the formula of OLS with b_o as constant.

$$Y = b_o + b_1 X \tag{1}$$

2.3. Query Builder
Query builder is an analysis technique for tracking and processing data to create a new one which can be done by using Structured Query Language (SQL) in ArcGIS 10.1. Before running query builder to simulate land use change, it is needed to intersect land use and land price map. Land price must be classified into three class using data quartile and categorized in low, medium, and high. Land use change between non-built land to built-up land is simulated in high category land price because it is the highest possibility of land transform

3. Results and Discussions

3.1. Determinant Factors of Land Price
The result of the Confirmatory Factor Analysis is shown in Table 1. Most of the aspects are proven to be significant for predicting the land price. Only the Housing and Environment aspect is considered insignificant.
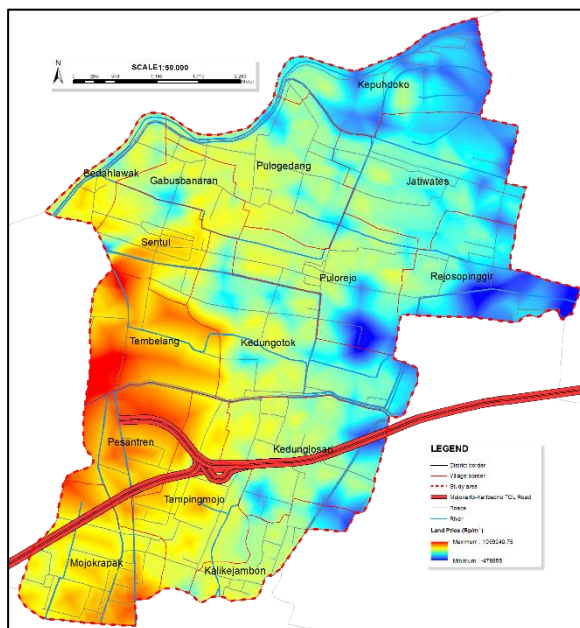
Table 1. The result of CFA.

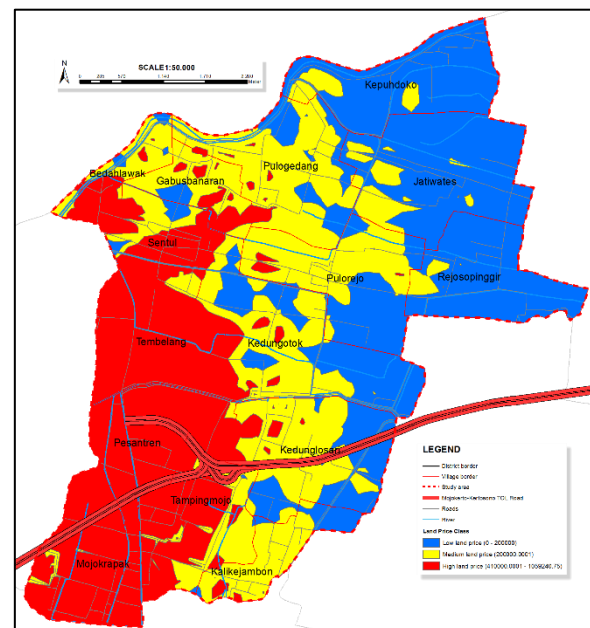| Aspect	Factors	MSA	Sig.	KMO	Reduced factors
Public service facility	Worship (A1)	0.196	0.000	0.601	A1, A2
	Education (A2)	0.390			
	Medical (A3)	0.570			
	Office (A4)	0.649			
	Commercial (A5)	0.721			
Transportation	Toll gate interchange (B1)	0.960	0.000	0.700	-
	Collector road (B2)	0.627			
	Neighbourhood road (B3)	0.896			
	Public transportation route (B4)	0.628			
Housing and Environment	River (C1)	0.494	0.581	0.492	C1, C2, C3
	Housing zone (C2)	0.495			
	Flood area (C3)	0.469			
Government policy	Planned industrial zone (D1)	0.515	0.000	0.521	-
	Planned transportation network (D2)	0.515			
	Planned housing zone (D3)	0.655			

3.2. Land Price Spatial Model

The mathematical model is built form 10 factors. There are 403 sample points of the land price that spread over an area of Tembelang district in Jombang city. Numbers of the sample is determined by applying Slovin formula to numbers of family in Tembelang. Here is the mathematic model as the result of OLS with Y as land price, X1 as medical, X2 as office, X3 as commercial, X4 as toll gate interchange, X5 as collector road, X6 as neighborhood road, X7 as public transportation route, X8 as planned industrial zone, X9 as planned transportation network, and X10 as planned housing zone.

$$Y = 695994.67 + 30.43\,X_1 - 33.01\,X_2 + 508.04\,X_3 - 117.59\,X_4 - 3595.15\,X_5$$
$$+ 803.19\,X_6 + 3121.64\,X_7 - 62.42\,X_8 - 26.16\,X_9 - 1064.51\,X_{10} \qquad (2)$$

Land price mathematic model is converted to spatial model using Raster Calculator tool in ArcGIS 10.1. According to the model, the highest land price reached Rp 1059240.75/m2 and the lowest is Rp - 478955/m2. Minus sign indicates that land tends to have a very low selling value close to 0. Quartile calculation based on existing land price data obtained from the survey is done to decide the limit of each class. Q1 is 200000 and Q3 is 410000. Using these parameters, maps that shows the land price in the study area are calculated, shown in Figure 1 and Figure 2.

Figure 1. Land price spatial model

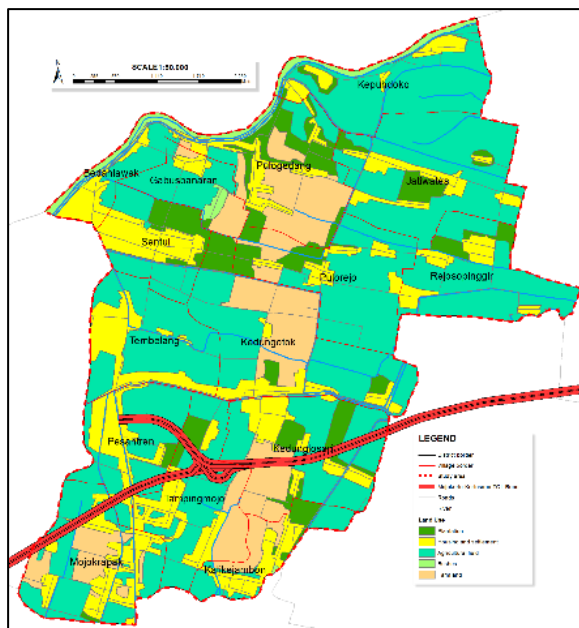**Figure 2.** Classified land price map

3.3. Land Use Change Simulation

Simulation of land use change is done by several steps. First to do is to overlay existing land use map and classified land price map, then intersecting it. Land use change potential is known from the new data as the result of the intersection between existing land use and land price map. Classification of land use change potential is shown in Table 2.
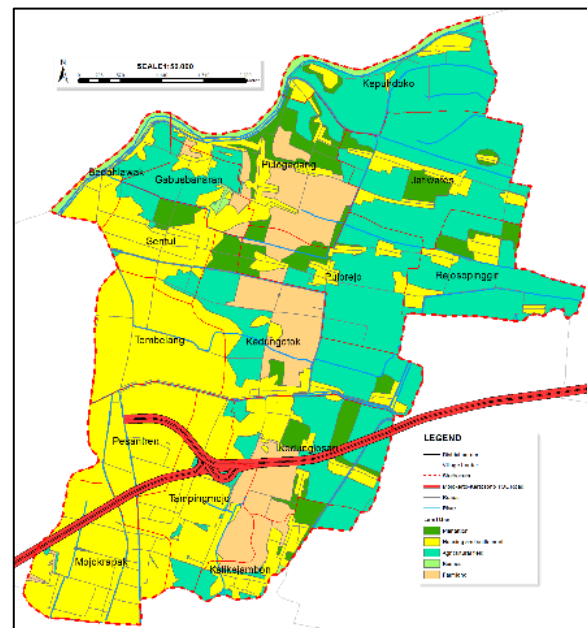
Table 2. Land Price and Changes Potential

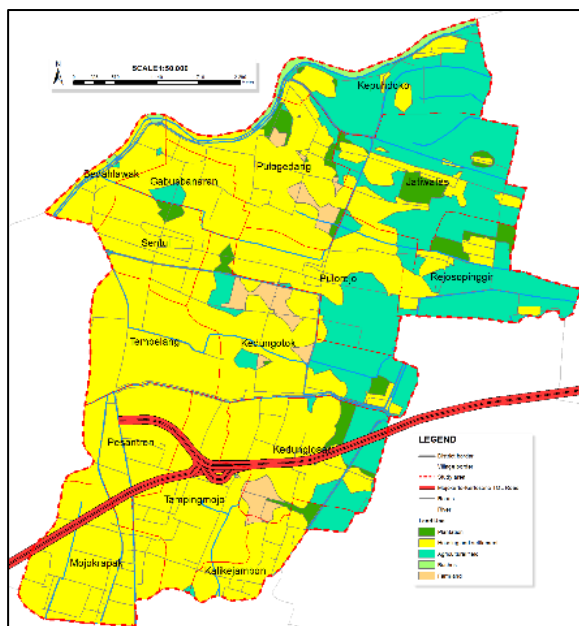| Class	Land Price (Rp/m^2)	Change Potential Non-built to Built
I	0 - 200000	Low
II	200000.0001 - 410000	Medium
III	410000.0001 - 1059240.75	High

Map of land use change potential is the input to simulate the land use change prediction through data processing in Query Builder. The first scenario, simulating land use change to high land price. There is 725.42 Ha of non-built land predicted to be converted to built land. The second scenario is applied to medium land price (which also included high price). The result is 901.04 Ha of non-built area predicted to be converted. Low land price is not simulated because it has the smallest probability to be converted. The results of the simulations are shown in Figure 3, Figure 4, and Figure 5.

Figure 3. existing land use

Figure 4. land use change prediction in medium land price

Figure 5. land use change prediction in high land price.

4. Conclusions

There are 10 factors that make up the model $Y = 695994.67 + 30.43 X1 - 33.01 X2 + 508.04 X3 - 117.59 X4 - 3595.15 X5 + 803.19 X6 + 3121.64 X7 - 62.42 X8 - 26.16 X9 - 1064.51 X10$. Y represents land price, X1 as medical, X2 as an office, X3 as commercial, X4 as toll gate interchange, X5 as collector road, X6 as neighbourhood road, X7 as a public transportation route, X8 as a planned industrial zone, X9 as a planned transportation network, and X10 as planned housing zone. According to the simulation done, 725.42 Ha is predicted to be converted from non-built to built-up area in high land price scenario. There is 901.04 Ha conversion as predicted from medium land price scenario. The spreading and development of housing and settlements based on the land price spatial model are concentrated near to

toll road interchange because land price over there is relatively high with complete and adequate infrastructure.

5. References

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