Land Suitability Assessment for the Potential Location of Transit Oriented Development (TOD)

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Abstract. Jakarta Metropolitan Region is Indonesia's largest metropolitan region with various urban transportation problems such as traffic jam, and pollution. Some efforts to remedy these problems have been carried out, but unfortunately, they have not been able to solve the problem thoroughly. To overcome these problems, it requires not only provision of network systems but also the adoption of innovative concepts through the application of integration between land use and transportation. One solution concept offered is the concept of Transit Oriented Development (TOD). The method of this study was using land suitability assessment based on Geographical Information System (GIS) to select the significant area for potential TOD. The criteria used were based on the opinions of experts through Analytical Hierarchy Process (AHP) technique. The results showed that some potential area for TOD are particularly concentrated in the middle of the Jakarta Metropolitan Region (JMR) and its surrounding areas. This indicates that there is a potential for the development of TOD-based transit areas in the region in order to encourage the use of public transport based commuter trains.

Keywords: Jakarta Metropolitan Region (JMR)
Transit Oriented Development (TOD) · Geographic Information System (GIS)
Spatial statistical analysis

1 Introduction

The objective of this study was to develop a method of land suitability assessment using AHP technique by integrating various assessment criteria from experts [1]. The second objective was to apply this method in the context of GIS by conducting case studies in the metropolitan area of Jakarta [3]. It helped identify the most potential location for Transit Oriented Development (TOD). TOD is a concept to incorporate various functional activities in the area around the transit station [2].

2   Methods

2.1   Land Suitability Assessment

Land suitability assessment using the Eq. 1

$$Si = \sum_{i=1}^{n} (WiXRi) \tag{1}$$

Where, Wi = the result of multiplication of all related weights, Ri = the standard assessment of each pixel on the map, n = the number of criteria under element.

2.2   Spatial Autocorrelation Analysis for Identifying Existence of Spatial Clusters

The moran's index (I) is a spatial autocorrelation measurement (Eq. 2):

$$I = \frac{n \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(x_j - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n} w_i(x_i - \bar{x})^2} \tag{2}$$

Where, n is the number of cases. x is the mean of the variable. Wij is a weight indexing location of i relative to j.

2.3   Hot Spot and Outlier Analysis for Mapping Spatial Clusters

Hot spot analysis using *Getis-Ord Gi** is formulated as Eq. 3 below:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{ij}(d)x_j}{\sum_{j=1}^{n} x_j} \tag{3}$$

Where, Wij is a spatial weight and (d) is the spatial object, while xj is the attribute value for feature j in distance d.

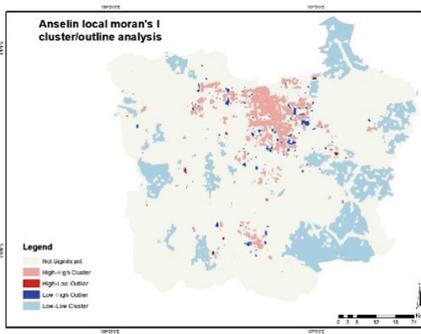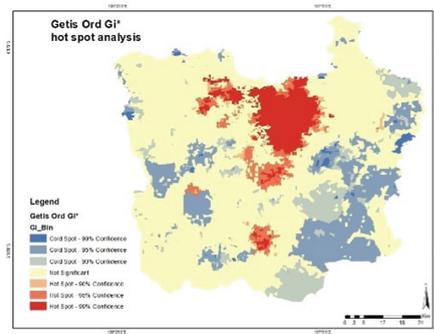## 3   Results and Discussion

3.1   Land Suitability Distribution

The result of land suitability analysis was the highly suitable class (S1) only has 2.3% of the study area Table 1. Otherwise, permanently not suitable class (N2) has the biggest percentage (36,4%)

Table 1. The distribution of potential TOD based on percentage and area

Suitable rating	Class	Percentage (%)	Area (ha)
Highly suitable	S1	2.3	174.69302
Moderately suitable	S2	9	682.65415
Marginally suitable	S3	28.1	2135.25561
Currently not suitable	N1	24.3	1847.69085
Permanently not suitable	N2	36.4	2769.68325
Total		100	7609.97688

3.2 Cluster Using Anselin Local Moran's I and Hot Spot Using Getis-Ord Gi*

The results in Figs. 1 and 2 show that the potential location for TOD, is located in the center area of the cluster and hot spots (strongly red color with high value).

Fig. 1. Cluster map (Color figure online)

Fig. 2. Hot spot map (Color figure online)

4 Conclusion

There was a spatial pattern of potential TOD index in the study area, where the area with high TOD tends to concentrate in the middle of JMR, while the area with low TOD tends to spread in the whole area. The middle of JMR means the capital of Jakarta along with Tangerang City, Depok City, and Bogor City.

References

1. Bunruamkaew, K., Murayam, Y.: Site suitability evaluation for ecotourism using GIS & AHP: a case study of Surat Thani Province Thailand. Procedia Soc. Behav. Sci. **21**, 269–278 (2011)
2. Taki, H.M., et al.: Planning TOD with land use and transport integration: a review. J. Geosci. Eng. Environ. Technol. **2**(1), 84 (2017)
3. Taki, H.M., et al.: Re-Assessing TOD index in Jakarta Metropolitan Region (JMR). J. Appl. GEOSPATIAL Inf. **1**(1), 26–35 (2017)