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## Nature Based Tourism Resources Assessment Using Geographic Information System (GIS): Case Study in Bogor

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### Abstract

A natural and socio-cultural resource is the capital in developing tourism in a region. The demand of sustainable tourism has become an important aspect that must be considered by local government. Therefore, nature-based tourism resources assessment is important in order to determine the appropriate region in the planning of a sustainable tourism destination. The aim of this study is to develop a spatial model of natural tourism planning based on criteria of attractiveness and accessibility of object in Bogor. The attractiveness of the object was developed based on the variety of landscape in term of Land cover & physical condition of villages, meanwhile the accessibility was determined based on distance from the sub-district capital. Result showed there were seven typologies of areas, namely (a) high attractiveness and accessibility (b) high attractiveness and medium accessibility, (c) high attractiveness and low accessibility, (d) medium attractiveness and high accessibility, (e) medium attractiveness and accessibility, (f) medium attractiveness and low accessibility (g) low attractiveness and accessibility.

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**Keywords:** nature based tourism resources; assessment; GIS; Bogor

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## 1. Introduction

Bogor is divided into two administrative areas, i.e. Bogor Regency and Bogor City. The cities are surrounded by several mountains; Mount Halimun, Mount Salak, Mount Gede, and Mount Pangrango [1], which provide Bogor with unique, distinct and various natural resources. In addition, Bogor also has diverse topographies, from low land, hilly, to mountainous areas.

Numerous unique and distinct natural environments, supported by various unique and distinct culture of its community provide tourism resources with noticeable attraction. Its eminence tourism resources had made Bogor appointed as one of nine prominence tourism areas of West Java Province [10].

Bogor's natural and cultural resource is the capital in nature-based tourism operation [7]. Therefore, assessment of nature-based tourism resources in Bogor is important to determine the suitability of an area in developing sustainable tourism destination area [5]. Sustainable and comprehensive approach is needed not only because each aspects are related to each other, but also because they are related to both natural and cultural resources [4].

## 2. Method

The study of nature-based tourism resources assessment in Bogor was carried out in two administrative areas, i.e. Bogor Regency and Bogor City, West Java Province (Fig. 1). A modified method of Bunruamkaewa and Murayama (2011) using natural and cultural resources approach was employed as the phases of this study, i.e. preliminary study to determine criteria of resources assessment, inventory, analyses, and synthesis [3]. The phase of study is presented in Fig. 2.

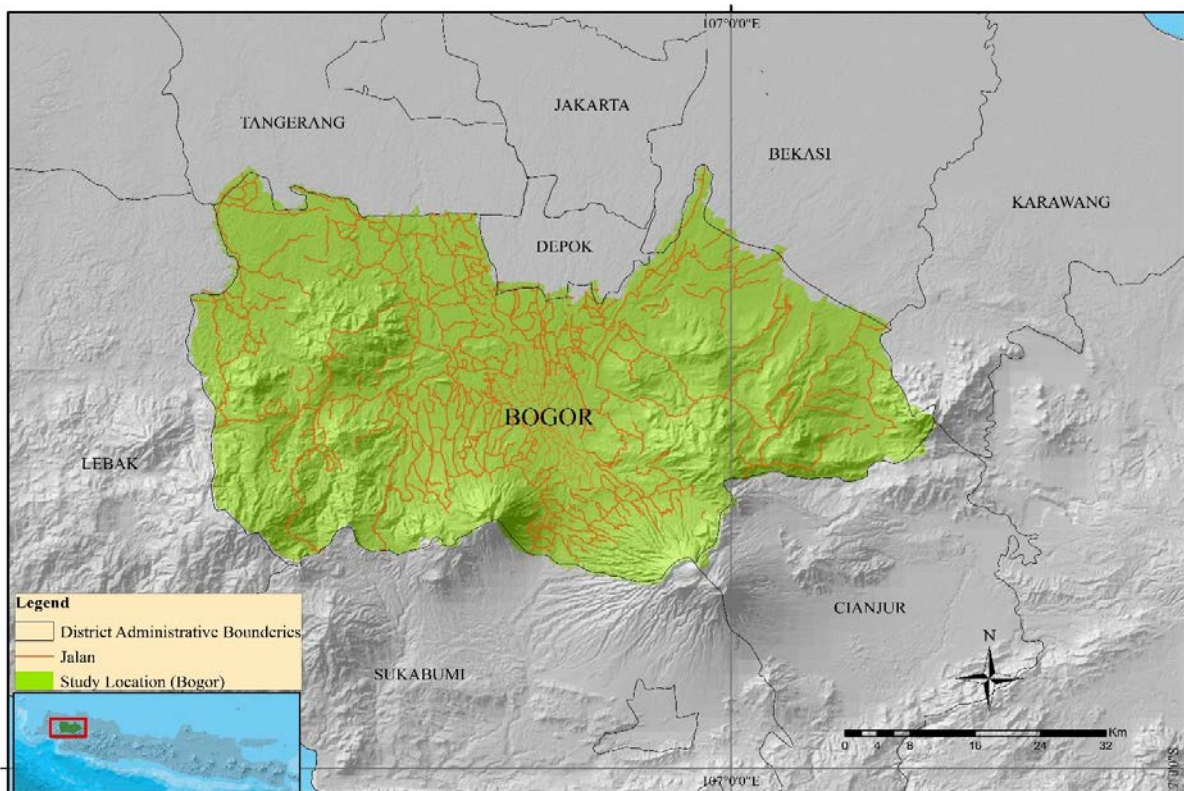


Fig. 1. Study location.

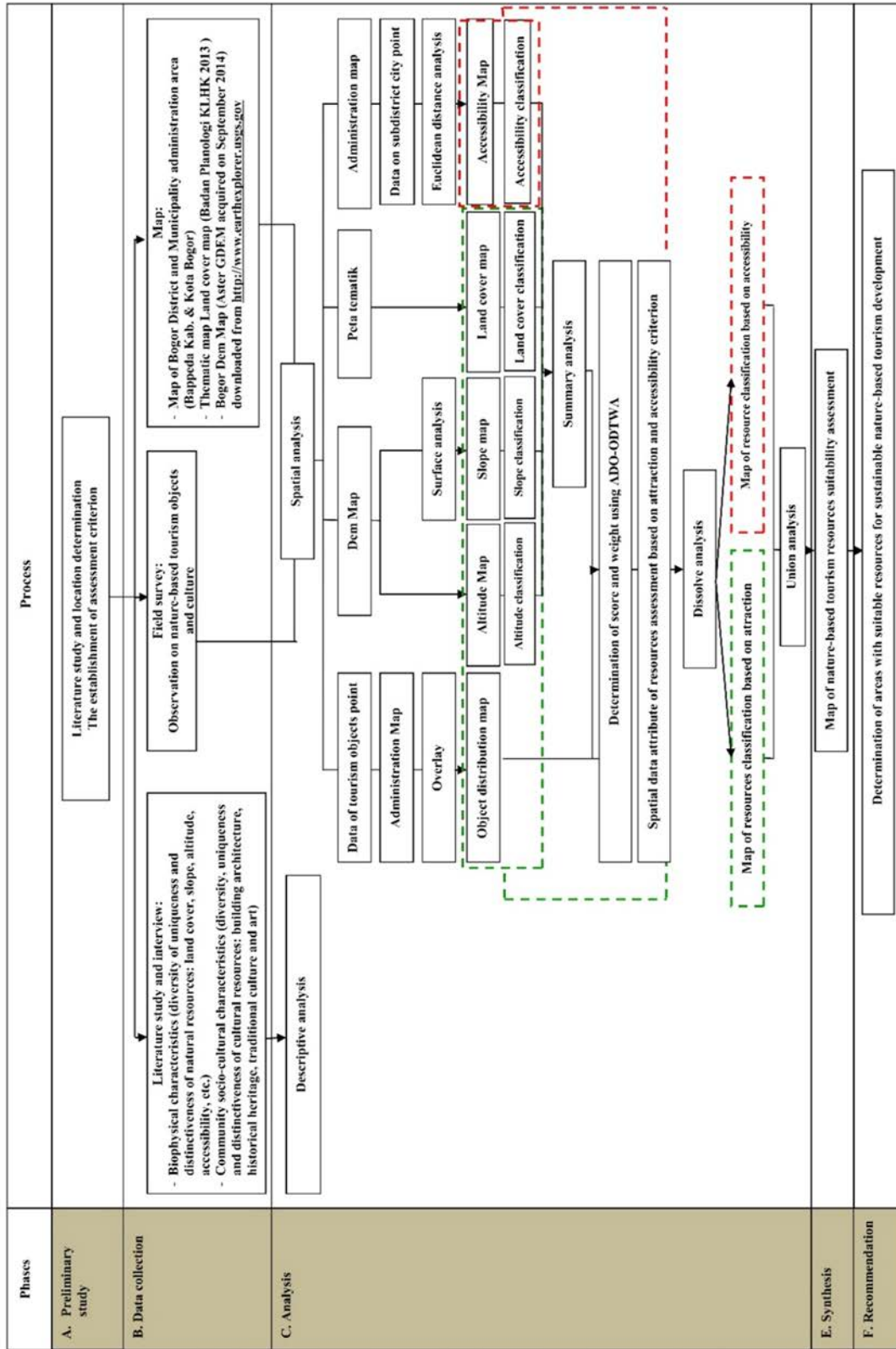


Fig. 2. Phases of research process.

### 2.1. Preliminary study

The initial step to determine resources assessment criteria for tourism planning is literature study. The study is carried out by collecting, studying, and reviewing documents related to the objective of the research. Through literature study, a conclusion on assessment criteria can be made. In addition, literature study will also help in obtaining general condition of research location, and collecting previous information related to the research.

### 2.2. Data collection

Data collection phase is a phase to identify natural and cultural resources. Data includes biophysical and socio-cultural characteristics of the community. Data collection in a planning activity should be comprehensive and thorough, since both natural and cultural resources are related to each other [4].

Data inventory phase is carried out through meetings and interviews with tourism actors [4]. In this research, interview was carried out with managements, i.e. local government of Bogor District and Bogor Municipality (Tourism and Culture Agencies and Planning Agencies), State-owned Company (Perhutani KPH Bogor), Gunung Halimun Salak National Park (GHSNP), and Gunung Gede Pangrango National Park (GGPNP). The objective of the interview was to identify the stakeholders involved in nature-based tourism management in Bogor, their implemented tourism planning, their plan and direction of management, tourism objects data, visitation data, history of Bogor, and local development plan related to nature-based tourism planning. In-depth interview with pre-determined respondents, using a list of questions as guidance, was employed in this research. Interview was also carried out with the community to obtain a description on the community's knowledge on the condition and location of natural and cultural tourism objects distribution in their area. Respondents from the community were community leaders, and community members involved in tourism activity in Bogor. Interview with the community was also carried out using in-depth interview method. The respondent were those who would be able to provide information related to research objective.

The next phase was field observation toward natural and cultural resources, which aimed at verifying/checking the data obtained from literature study and interview, with the real condition in the field. Field observation was conducted to record the coordinate of tourism objects and attraction and the coordinate of sub district capital using GPS, which were required in mapping the resources.

### 2.3. Data analysis

The main data analysis in this research was the spatial analysis to produce a map of nature-based tourism resources suitability. The first step was to compose basic maps, which included maps of land cover, tourism object distribution, altitude, slope, and distance from village to the center of sub district capital. Land cover map resulted from re-classification of the 2014 land cover map obtained from the Planology Agency of Ministry of Environment and Forestry. Map of tourism object variation in each village unit was developed from overlay between administrative map of Bogor District and Municipality with the coordinates of tourism objects distribution. Altitude and slope map was developed based on DEM Bogor acquired on 7<sup>th</sup> of September 2014. Map of distance between village and the center of sub district capital was built from administrative map of Bogor District and Municipality and coordinate point of sub district capital through Euclidean distance analysis using ArcGIS 9.3 software. The analysis process aimed to calculate the distance of each area to the nearest point, to obtain the approximate distance of each area/village unit to the center of sub district capital.

Basic maps, excluding the map of tourism objects variation, were then analyzed in raster data form using the summary analysis method by means of Erdas Imagine 9.1 software. The objective of the analysis was to identify the variation of resources in each village unit in Bogor District and Municipality. Result of the analysis was used as the basis in determining the weight value of each elements of attraction and accessibility criteria, which was previously determined for each village unit in Bogor District and Municipality.

The determination of weight value referred to a modified ADO-ODTWA (Operational Area Analysis – Nature-based Tourism Objects and Attraction) guidelines (Table 1). The criteria used in the assessment of nature-based tourism in Bogor were attraction and accessibility. Attraction criteria consisted of 7 elements, i.e. landscape

variation, tourism objects variation, resources uniqueness, resources value, tourism activity variation, altitude variation, and slope variation. Attraction was assigned the highest weight of 6, since attraction is the major capital in tourism activity operation. Accessibility criteria consisted of the distance between village and the center of sub district capital. It weight as much as 5, because accessibility is an important supporting factors in driving the market. Classification of each tourism resources criteria was calculated using the following formula =  $\sum$  (criteria value x weight). The result of classification assessment of the condition of each tourism objects and attractions was calculated using the formula =  $((Nt-Nr):3)$ , Nt = highest value and Nr = lowest value. The final classification of attraction assessment was categorized in to low, moderate, and high, on certain intervals (Table 2). The objective of this assessment was to obtain description of tourism potentials of natural and cultural resources that should be put in high priority for the development.

The result of weight value determination of each elements in each village unit were then saved as database of geographic information system (GIS), attribute factors represented as layers of map, which contain attribute value for each pixel in raster data. Next, dissolve analysis, a process to combine features with certain attributes similarity, was employed. The analysis aimed to unite and classify resources assessment data, which had been obtained from the derivative of previous elements classification map. Dissolve analysis resulted in derivative map of classification based on attraction and accessibility criteria.

Table 1. Criteria of nature-based tourism resources assessment in Bogor based on area/village unit, a modification of Gunn [4] and ADO-ODTWA Guidelines [9].

1. Attraction		Weight: 6					
		Village: .....					
No.	Elements/Sub elements of attraction	Score					
		5 sub elements	4 sub elements	3 sub elements	2 sub elements	1 sub element	none
	Variation of landscape based on land cover:						
1.	a. Forest scenery/view						
	b. Rice field scenery/view	30	25	20	15	10	1
	c. Plantation scenery/view						
	d. Garden/field scenery/view						
	e. Water body (lake, river, etc.)						
	Variation of objects based on tourism object distribution						
2.	a. Natural beauty (forest, plantation, etc.)						
	b. Natural phenomenon (Cave, crater, etc.)	30	25	20	15	10	1
	c. Water body (lake, waterfall, river, etc.)						
	d. Cultural attraction						
	e. Historical heritage						
	Uniqueness of resources based on land cover and object distribution						
3.	a. Forest ecosystem						
	b. Karst ecosystem	30	25	20	15	10	1
	c. Landscape scenery/view						
	d. Hot spring/waterfall/lake/river						
	e. Cultural and historical heritage						
	Sensitivity of resources based on the value, viewed from land cover and objects distribution:						
4.	a. Ecological value						
	b. Knowledge value	30	25	20	15	10	1
	c. Medicinal value						
	d. Economic value						
	e. Belief, cultural, & historical value						
	Variation of tourism activities based on land cover and objects distribution:						
5.	a. Research/education						
	b. hiking/tracking/climbing	30	25	20	15	10	1
	c. Photo hunting/photography						
	d. Enjoying scenery						
	e. Viewing cultural /historical heritage attraction						
6.	Variation of altitude:						
	a. > 2.000 meter (high mountain)	30	25	20	15	10	1

1. Attraction		Weight: 6				
		Village: .....				
No.	Elements/Sub elements of attraction	Score				
		5 sub elements	4 sub elements	3 sub elements	2 sub elements	1 sub element none
	b. 1.000 - 2.000 meter (mountain)					
	c. 500 - 1.000 meter (high hills)					
	d. 100 - 500 meter (hills)					
	e. 15 – 100 meter (lowland)					
	Variation of slope (%):					
7	a. >45 (very steep)	30	25	20	15	10
	b. 25-45 (steep)					
	c. 15-25 (wavy/undulating)					
	d. 8-15 (rather flat)					
	e. 0-8 (flat/level)					

Table 2. The final classification of attraction assessment.

Accessibility		Weight: 5			
		Village:.....			
	Elements/Sub elements of Accessibility	Score			
		Ring 1 (80)	Ring 2 (60)	Ring 3 (40)	Ring 4 (20)
	Distance estimation of a village to the centre of sub district capital	80	60	40	20
	a. 0-5 km (Ring 1)				
	b. 5-10 km (Ring 2)				
	c. 10-15 km (Ring 3)				
	d. 15-20 km (Ring 4)				

Table 3. Classification of resources criteria assessment.

No.	Criteria	Assessment classification		
		Low	Moderate	High
1.	Attraction	42-448	448-854	854-1260
2.	Accessibility	100-200	200-300	300-400

**2.4. Data synthesis**

During this phase, the classification map based on attraction and accessibility criteria was analyzed using union analysis. This analysis is an overlay process, which aimed to obtain the level of area typology with suitable nature-based tourism resource. The result is map of resources suitability for nature-based tourism.

**3. Result**

*3.1. Criteria and classification of resources assessment's elements*

Criteria of nature-based tourism resources assessment is an instrument to obtain confidence on the suitability of a certain resource to be developed as nature-based tourism objects. Criteria functions as the basis in planning the development of tourism resources, by establishing the elements of criteria, weight, and calculation of each sub elements [9].

- Criteria of attraction

The process of tourism resources assessment criteria based on attraction criteria includes spatial analysis process, which consist of criteria map derivation and classification. Related elements and sub elements factors as presented in Table 1 and 2 were created and saved as GIS layers. Attraction criteria which was divided into several elements. The first element was number of distinct resource types that was derived from land cover and tourism objects distribution with focus of analysis based on the variability of resources at each village unit of the research location (the District and Municipality of Bogor). Land cover factor was classified and re-classified using 2014 land cover map (data source: Baplan). Tourism objects was classified using 2014 objects distribution map produced from field verification to the 2013 data from Tourism and Culture Agency of Bogor District and Municipality. The other elements were the uniqueness of resources, value of resources, and variation of activities, of which scores determination were based on the result of number of distinct resources with focus of analysis on the variability of resources' uniqueness, value, and variation of activities in a village unit. Sub elements susceptibility of resources was derived from topography and elevation maps that was integrated with the location of nature uniqueness with focus of analysis based on variability of topography and elevation of a village unit. Topography and elevation factor was classified and re-classified using the 2014 Aster GDEM map.

- Criteria of accessibility

Accessibility criteria was consisted of element of distance to center of development of sib district city that was classified based on Euclidean analysis, in accordance with the nearest sub district city. In the GIS database, the attribute factors was represented as layers of map, which contained attribute values for each pixel in raster data. In relation to the obtained information, there were five important criteria in the form of GIS-based layers which were keyed in for nature-based tourism (Fig. 3). In this process, data from all selected factors was saved, presented, and managed individually.

The map derived from the attraction and accessibility criteria was then analyzed using the summary analysis to identify the variability of its resources. There were 5 derivative map obtained from the two criteria of tourism resources assessment in Bogor; the classification maps that was used as basis reference of element factors in conducting the assessment of resources in each village unit.

### 3.2. Weight score of each elements of criteria based on ADO-ODTWA

Weight score of each elements of the tourism resources criteria was obtained from the analysis toward the derivative map of criteria and elements classification (Fig. 3). Weight score was referred to the ADO-ODTWA as presented in Table 1 & 2. The result of scoring and weighting was then used as the basis in classifying tourism resources in each village unit in accordance to the pre-determined classification, i.e. high, moderate, and low. The result of classification and weighting of resources was the derivative map of elements classification from resources assessment based on attraction and accessibility criteria.

The analyses on derivative map of elements classification in tourism resources assessment resulted in weight score of each elements for each village unit in the administrative areas of Bogor District and Municipality. The result of weighted score was saved as GIS layer as the basis to carry out dissolve analysis. The analysis was aimed to unite and classify the data resulted from resources assessment obtained from the previous derivative map of elements classification (Fig. 4). Union analysis was then employed to further analyze the derivative map of resources assessment based on the attraction and accessibility (Fig. 5). The aim of this analysis was to identify each village unit which has the suitable resources, both its attraction and accessibility, for nature-based tourism development. The union analysis produced a map of nature-based tourism resources assessment in Bogor based on attraction and accessibility (Fig. 6). This derivative map of resources assessment showed seven area typologies, i.e. (1) areas with high attraction and low accessibility, (2) areas with high attraction and moderate accessibility, (3) areas with high attraction and low accessibility, (4) areas with both high attraction and accessibility, (5) areas with moderate attraction and moderate accessibility, (6) areas with moderate attraction and low accessibility, (7) areas with low attraction and high accessibility.

Areas within the typology of moderate attraction and high accessibility dominated Bogor, while the areas within typology of low attraction and high accessibility had the smallest area in Bogor. In addition, based on the seven typologies resulted from the union analysis, there were also areas of village unit in Bogor District and Municipality that had prominence tourism objects, but which were less/not suitable for tourism planning. The of area that is

suitable for tourism planning, based on the reference of ADO-ODTWA guidebook [9] is area with high attraction and high accessibility. There were 23 villages in Bogor District and 2 villages in Bogor Municipality with such typology.

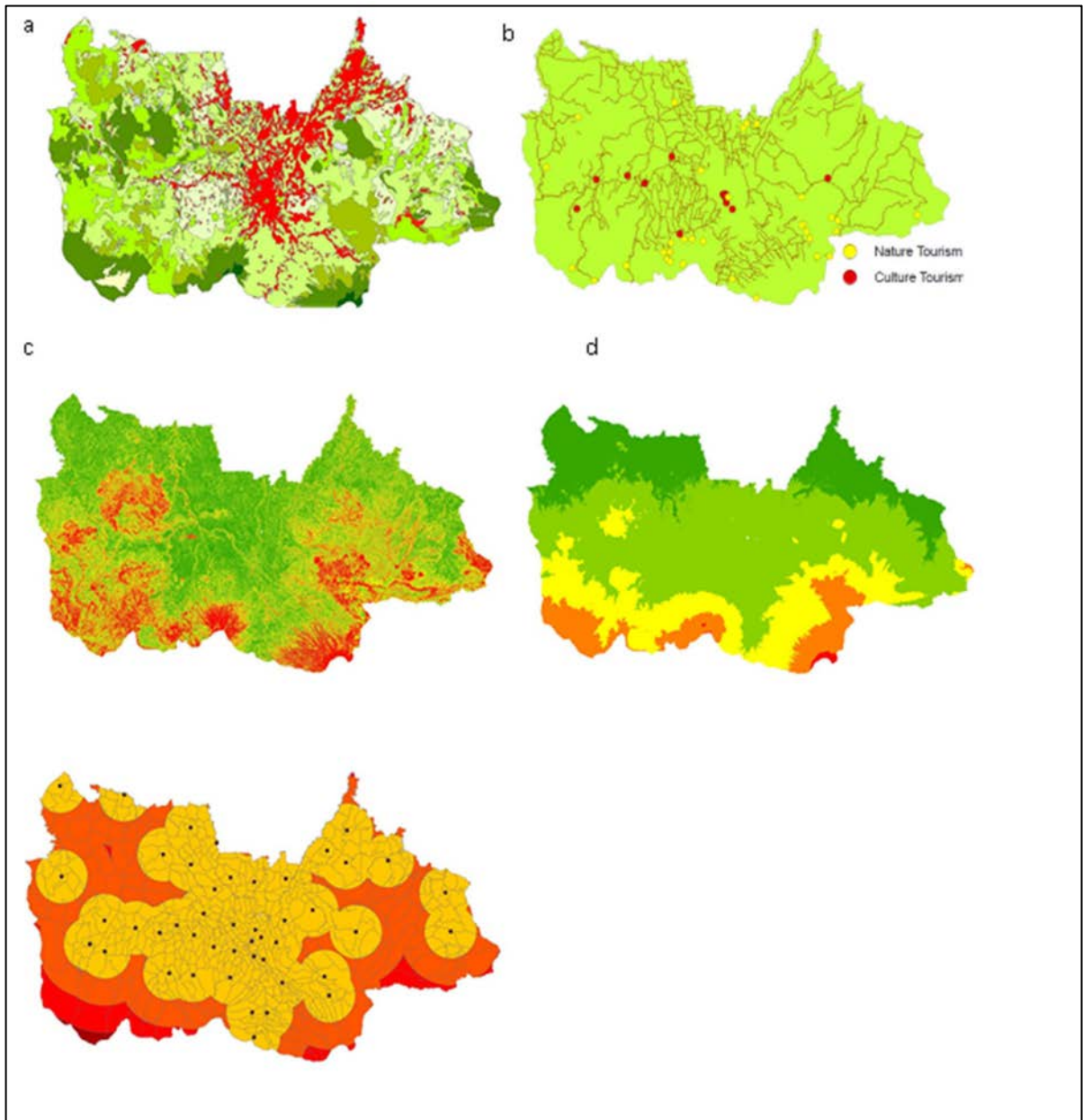


Fig. 3. (a) Resource's attraction based on land cover, (b) resource's attraction based on tourism objects distribution, (c) resource's attraction based on slope susceptibility, (d) resource's attraction based on altitude susceptibility, (e) accessibility based on distance of village to the center of sub district city.



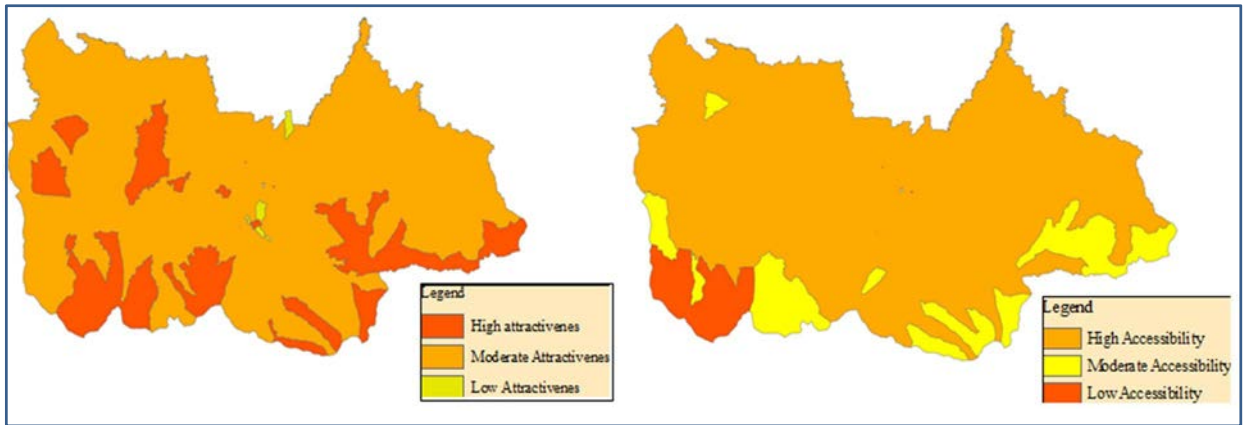


Fig. 4. (a) Resources assessment based on attraction, (b) Resources assessment based on accessibility.

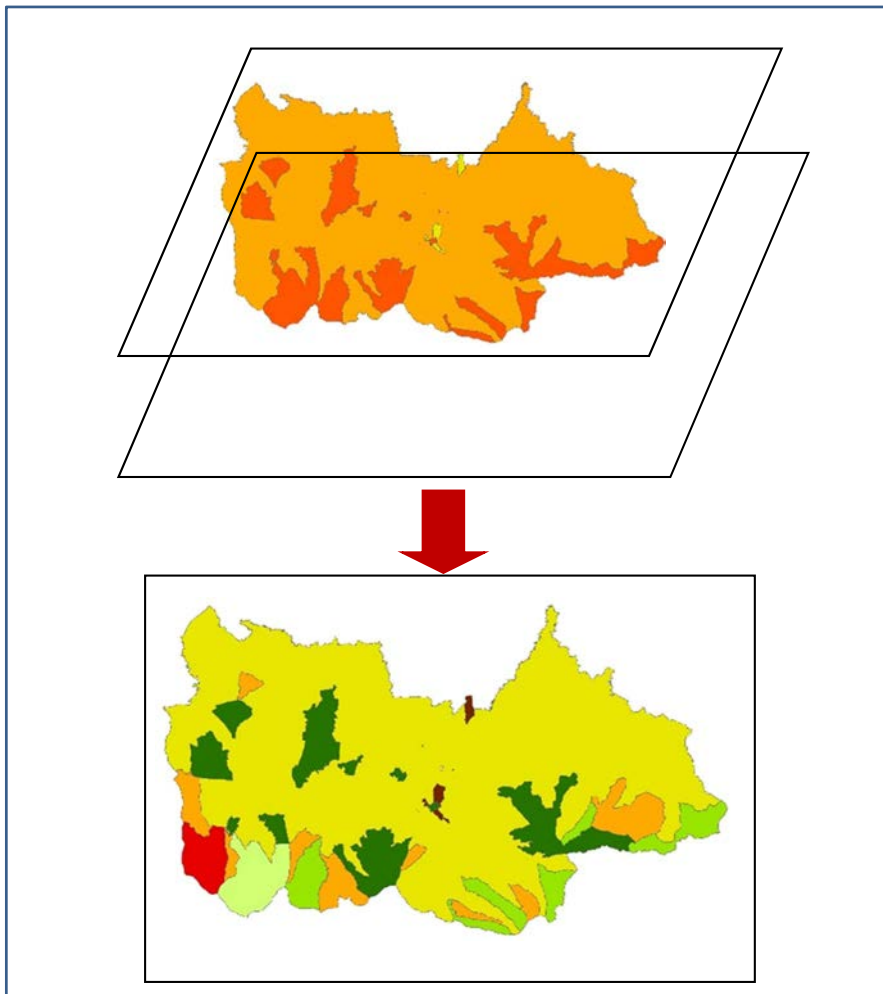


Fig. 5. Union analysis between derivative map of resources assessment based on attraction and accessibility.

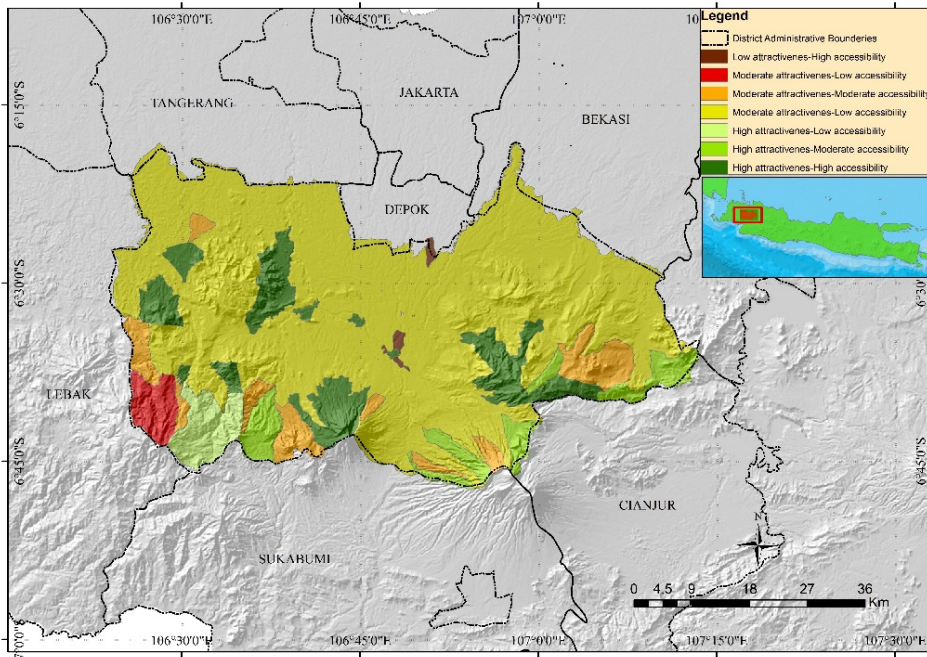


Fig. 6. Map of resources assessment results based on attraction and accessibility criteria.

#### 4. Conclusion

Based on the result of spatial analysis and tourism resources assessment the areas that recommended for nature-based tourism planning were the village unit of Bogor District and Municipality which had high resources attraction and high accessibility. A well-define planning is a prerequisite in tourism development. Without a definite direction of development that had been agreed upon by stakeholders being involved, development may lose focus and vulnerable to the possibility of undesired negative impact. Determining areas suitable for tourism is a mean to achieve sustainable tourism development, not the end-goal of a planning process.

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