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# Spatial-ecological approach in cirebon's peri-urban regionalization

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**Abstract.** The environmental transformation from rural into urban is a regional development process, it usually happens to industrial countries and formed a peri-urban region. Understanding the peri-urban development is an attempt to analyze the potential changes in environmental quality due to landscape changes in Cirebon Regency. The method of determining a peri-urban region is based on the spatial-ecological approach that is not only to use administrative boundaries. This study aims to analyze the regionalization of Cirebon's peri-urban using spatial-ecological approach. Parameters to determine the region based on built-up area, road density, distance from Cirebon City, and residential population density. The Cirebon's peri-urban was obtained from overlay analysis and defined interval reclassification. This study shows that the Cirebon's peri-urban has an area of 76.83 km<sup>2</sup> which is divided into five sub-districts and 48 villages surrounding Cirebon City. This peri-urban is mostly in the western of Cirebon Regency. This phenomenon shows the development direction of Cirebon City (urban sprawl) is more dominant towards the western and northwest because of massive development in industries, services, and transportations.

## 1. Introduction

Rural and urban interactions are constantly developing as regional development processes involving various intraregional, interregional, and supraregional factors [1]. In industrialized countries, the transformation of urban environment is common would be form transitional region known as peri-urban [2]. The peri-urban landscape in Indonesia generally found around metropolitan cities that have developed since hundreds of years ago as trade and government centers [3,4]. Understanding the peri-urban region is an effort to determine the urban development rate or urban sprawl, it various factors, as well as the potential environmental impacts it can causes [5]. In Indonesia, the dominant peri-urban area is found around cities that are the destination of urbanization - in the context of migration - such as Jakarta, Bandung, Semarang, Surabaya, Malang, and Cirebon.

In West Java, the Cirebon-Indramayu-Majalengka-Kuningan (Ciayumajakuning) region has a major growth center, namely Cirebon City which has been developing since the Sultanate of Cirebon and the Dutch East Indies [6]. Currently, Cirebon City is a major development center in the northeastern of West Java. The influence of industrialization and urbanization of Cirebon City has grown to surrounding areas and breaks its administrative, especially in Cirebon Regency which causes its rural characteristics to slowly change into urban. The changes have implications for some areas in Cirebon Regency which has a role as peri-urban which over time will develop into an urban region, where physically it cannot be distinguished from metropolitan which affects regional development. The real consequence of the peri-



urban presence is livelihood changes that previously depended on agricultural to become industrial and service sectors, even though the previous sector has provided a comparative advantage in the West Java's regional economy [7].

Peri-urban regionalization is compiled based on the physical environmental aspects included land use and land cover (LULC), especially the ratio between agricultural land and built-up area [8]. Besides that, peri-urban regionalization takes into demographic and infrastructure aspects as an area located between consolidated urban and rural [9]. As a region, peri-urban does not only apply in a purely spatial context but includes the ecological transformation caused by rural and urban interactions [10]. Spatial-ecological approach has special characteristic that involves physical and social environmental factors to compile peri-urban which not have only limited by administrative boundaries using geospatial information [11,12]. Therefore, this study aims to analyze the regionalization of Cirebon's peri-urban using spatial-ecological approach. This regionalization is the first step in analyzing the dynamics and transformation of the landscape in peri-urban Cirebon.

## 2. Methods

This study focuses on Cirebon Regency which is directly adjacent to Cirebon City in 7 (seven) sub-districts include Beber, Greged, Gunungjati, Kedawung, Mundu, Talun, and Tengahtani. This region bordering Java Sea in the north at UTM's zone 49 southern hemisphere. Cirebon's peri-urban is an area of interest (AOI) which delineated based on the parameters of built-up area, accessibility, population density, and distance from the city's core (**Table 1**). These parameters are representations of land use and land cover, transportation, demographic conditions, and the socio-economic effects of the city core [13,14]. The author does not involve the legal ownership of established land for this regionalization, although other researchers have studied it [15].

To accommodate various types of spatial data, each parameter was converted into an analysis unit of 78 villages or urban-villages. The various parameters are assigned scores and weights to facilitate spatial analysis using a geographic information system – union overlay [16,17]. The data resulted by overlay analysis was reclassified to produce two class regions, where locations with a total value of more than 50 percent were declared as peri-urban and vice versa [29,30]. This reclassification implies heterogeneity in the results at the sub-district level. This regionalization result was validated using 100 field samples and reach 96 persen for overall accuracy.

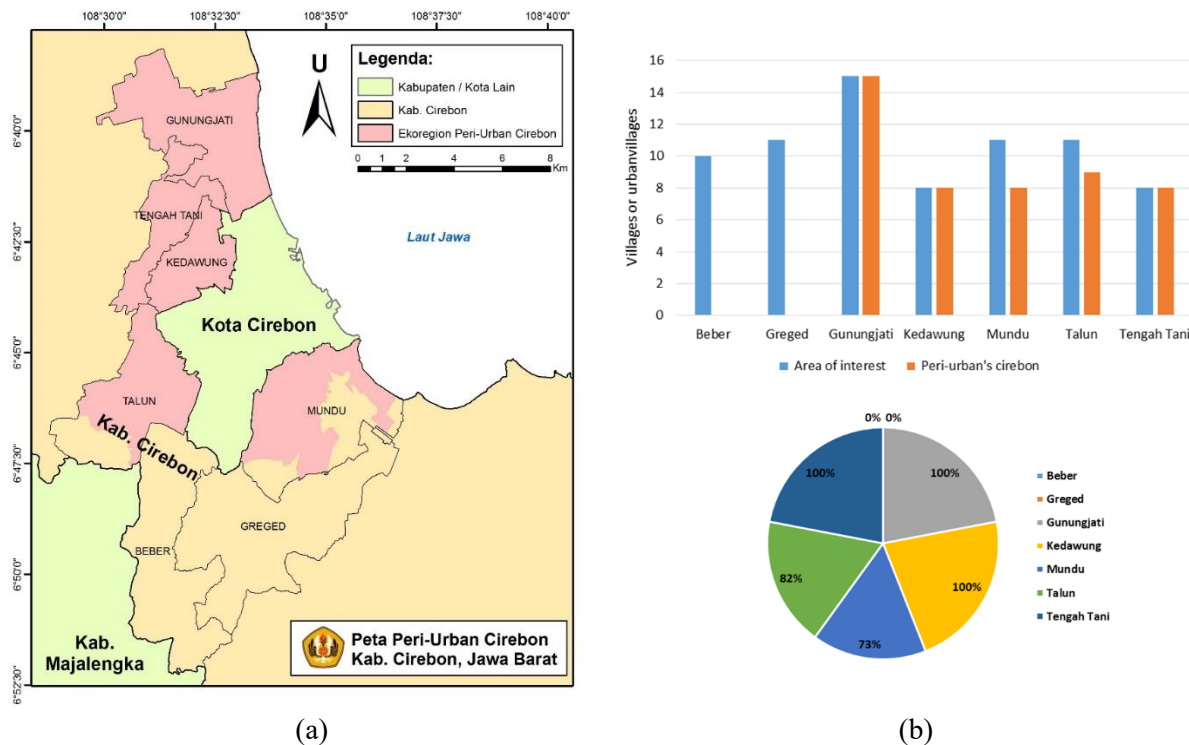
**Table 1.** Parameters for Cirebon's peri-urban regionalization [29].

Parameter		Source	Score	Weight
Built-up density	NDBI > 0	Landsat-8 OLI (USGS)	0	1
	NDBI ≤ 0		2	
Road density	0-100 km <sup>2</sup>	Indonesia Geospasial Agency (BIG)	1	1
	> 100-250 km <sup>2</sup>		2	
	> 250-500 km <sup>2</sup>		3	
	> 500-750 km <sup>2</sup>		4	
	> 750 km <sup>2</sup>		5	
Distance from Cirebon City (CBD)	2,500-5,000 m	Buffering from Cirebon City's core	3	1
	5,000- 10,000 m		2	
	> 10,000 m		1	
Population density (residential)	0-2,500 person per km <sup>2</sup>	Indonesian Statistics Agency (BPS)	1	1
	> 2,500-5,000 person per km <sup>2</sup>		2	
	> 5,000-7,500 person per km <sup>2</sup>	Agency (BPS)	3	
	> 7,500-10,000 person per km <sup>2</sup>		4	
	> 10,000 person per km <sup>2</sup>		5	

## 3. Results and Discussion

Peri-urban regionalization is basis for realizing the sustainability of urban development because this process leads to the emergence of various environmental degradation phenomena such as decreasing air quality, urban heat island, flood, water scarcity, and green space availability [18-20, 31]. This

phenomenon is due to some fact that urban development is identical to the built-up area expansion with various sub-land uses [21]. From the regionalization result is known that Cirebon's peri-urban covers five sub-districts (Gunungjati, Kedawung, Mundu, Talun, and Tengah Tani). On these sub-districts, only Mundu and Talun not all of which are peri-urban (**Figure 1a**). This implies a reduction in the number of villages or urban-village that are included in the peri-urban, even though they were previously included in the AOI. The regionalization result has an area of 76.83 km<sup>2</sup> covering five sub-districts and 48 villages or urban-villages.



**Figure 1.** Cirebon's peri-urban as result from regionalization using spatial-ecological approach (a), the difference between number of villages or urban-village before and after the regionalization (b).

The differences in each sub-district are identified as Cirebon's peri-urban indicate that Cirebon City's development was more dominant to the west and northwest. **Figure 1b** illustrates this phenomenon, because Gunungjati, Kedawung, and Gunungjati are fully-completely in the peri-urban. These different from Beber and Grege which are not included in peri-urban areas even though geographically it is directly adjacent to Cirebon City at the south and southeast. The western and northwestern areas contribute 59.20 km<sup>2</sup>, while the eastern area only covers 17.63 km<sup>2</sup>. As a result, much densely vegetated areas have undergone significant changes in the western and northwestern – these areas were decreasing [22]. This phenomenon also indicates a development gap in Cirebon Regency, especially between the western and eastern, which from a development index perspective - the western are relatively more developed [23].

The Cirebon's peri-urban which is more developed to the west and northwest, it can be seen from the physiographic landscape and historical aspects. The western and northwestern have relatively flatter physiographic, abundant surface water from three watersheds, and large potential mining resources [24]. It is not surprising that the region has developed rapidly to become peri-urban with access to more transportation infrastructures from a long time ago through penetration of road development and non-agricultural economic centers including services, manufacturing, and tourism [25]. If viewed from its historical aspect, Cirebon's peri-urban at the west and northwest relatively closer to the government centers during the period of Sultanate of Cirebon and Dutch East Indies (*Gemeente Cheribon*) [26].

Although the intention of equitable development from the local government has emerged with regional autonomy [27]. The significant wide differences from peri-urban regionalization in the eastern (at Mundu) indicate that these efforts have not been optimal because some of the sub-districts not influenced by urban sprawl, it partially identified in the west and the northern through new industrial and settlement areas [28].

#### 4. Conclusion

The peri-urban regionalization based on the spatial-ecological approach is suitable for analyzing the dynamics of landscape development of Cirebon City to its surrounding areas. The regionalization that uses four spatial-ecological parameters included built-up area, accessibility (road density), population density, and distance from the city's core has resulted in the Cirebon's peri-urban which covering an area of 76.83 km<sup>2</sup>, it includes five sub-districts and 48 villages or urban-villages. This regionalization shows that Cirebon City is more developing urban sprawl to the west and northwest. The character of this development is influenced by differences in physiographic, transportation infrastructure presence, and historical aspect. In addition, Cirebon's peri-urban region also shows an urban sprawl to the east to be precise in parts of Mundu.

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