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# Spatial dynamics model for sustainability landscape in Cimandiri Estuary, West Java, Indonesia

Supriatna[a*], Jatna Supriatna[b], Raldi Hendro Koestoer[c], Noverita Dian Takarina[b]

[a]*Doctorate Programme of Study Program of Enviromental Sciences, Universitas Indonesia. 10430, Indonesia*
[b]*Department of Biology, Faculty of Matematics & Natural Sciences, Universitas Indonesia. 16424, Indonesia*
[c]*Study Program of Enviromental Sciences, Universitas Indonesia. 10430, Indonesia*

**Abstract**

Population in Estuary Cimandiri area and the Pelabuhanratu Town increase continuously, which will cause an occurrence of land use changes from open space to built-up area. Due to the need of built up area, while the existing land area is very limited, so the shortage land will occur in the future. In this context, spatial dynamic model based on a combination between system dynamics and Geographic Information System (GIS) has to be elaborated for land availability model in Cimandiri Estuary, West Java. Thus, the existing surface can be a sustainability landscape. Population growth projection has an exponential growth pattern. Built-up area variable has a sigmoid pattern, which means that the land in estuarine area will be occupied for built-up activities in the future. Land availability variable has a decay pattern, which means that the available land will be run out to be used up by human settlement. The relationship between population growth and land availability will be contradictory. The intervention effect 60% ratio land restriction of built-up area will delay the development of built-up area, and after those delays it will remain constant. The projection of populations growth is implemented through projection development of built-up area which adapted by the landscape to be a sustainability landscape.

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* Corresponding author. Tel.: +62 8129270046; fax: +0-000-000-0000 .
*E-mail address:* ysupris@yahoo.com

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## 1. Introduction

Planning in a growth region usually use to the economic factor forward compared to that of the environmental balance factor, including ecosystem balance. It cannot be separated from the landscape characteristics. According to Guneroglu *et al.* (2015), the landscape characteristics of coastal area are the typology identification of landscape in various scales (geographic) for protecting the existing landscape and spatial in rural and urban area, where degradation in coastal area is a real phenomenon that has to be evaluated in a management planning of coastal area including estuary. The estuary management cannot be separated from the existing landscape. So that it needs a sustainable landscape.

Sustainable landscape is an example of key concept and priority in the research of the relations between landscape, ecosystems and human prosperity (Mussachio, 2013). Landscape in estuary cannot be separated from coastal (terrestrial) and coast (sea). It makes management of estuary area be more precisely. Landscape approach, is a broader application in an attempt to adjust the contradiction between the different interests in land and water resources. Landscape approach has considerable calculation in solving competition for land demand (Sayer *et al.*, 2015). Bohnet and Bailin (2015) state that the landscape is a description and as a results of human activities, the different ways that involve in the natural, cultural, social, perceptual, aesthetic components, among geological factors, soils, climate, flora, fauna, land use, settlement, religion, memory, mental, sounds, smells, colours, patterns, and shapes which interact and understanding among communities.

Estuary area is a region that is extremely important, both in terms of physical and terrestrial ecosystems and waters. Most of estuaries area is used phisically for human activities (factories, buildings, ports, etc), because land around the estuary was a relative rich of minerals and easy access for economic and business base. In the estuary aquatic ecosystems, many fish populations that breed to raise their population because estuary area is receive so many organic materials continuously from the stream and sufficient sunlight that illuminates the waters (Dyer, 1997).

Population in the estuary area of Cimandiri which increase continuously will cause the occurrence of land use change from open space to built-up area. The needs of built-up area increasing continuously while the existing land is very limited and will cause land shortage in estuary of Cimandiri. Eventually, it will causing the inadequate of land carrying capacity. The lack of land carrying capacity causing population pressures, environmental carrying capacity is not adequate anymore. It will be an impact on the damage of the existing landscape. Clarke *et al.* (2014) explained that at this time, the comprehension of estuary is very limited especially on populations around or which is utilizing and decision maker (government).

According to the discussion above, it is necessary to a spatial dynamic model for a sustainable landscape on estuary area. This model can be used for input to spatial planning in the estuary area which is environmental oriented.

In this case, which is used as a model is Cimandiri Estuary area that consist of two subdistricts (Pelabuhanratu and Simpenan), with Pelabuhanratu Town as the capital city of Sukabumi District, West Java Province. The administrative region that included in the estuary area is Pelabuhanratu Village, Jayanti Village, and Citarik Village at Pelabuhanratu Subdistrict. Loji Village and Cidadap Village at Simpenan Subdistrict.

According to **Table 1**, data from 2008 to 2014 showing the growth of population and built-up area, however, the population growth will increase continuously in line with economic development of Cimandiri Estuary Area. If the needs for land are increasing and the available land are decreasing, then will occur the shortage land, eventually, also occur the populations pressure which is causes the decreasing of land carrying capacity and the damage of landscape.

**Table 1.** The amount of Population and Built-up Area in Cimandiri Estuary Area

| No. | Years | Population Amount (inhabitants) | | | Built-up Area (ha) | | |
|---|---|---|---|---|---|---|---|
| | | Pelabuhanratu *) | Simpenan *) | Summary | Pelabuhanratu *) | Simpenan *) | Summary |
| 1 | 2008 | 93,679 | 48,048 | 141,727 | 308.23 | 49.56 | 357.79 |
| 2 | 2009 | 96,867 | 48,054 | 144,921 | 346.14 | 62.81 | 408.95 |
| 3 | 2010 | 99,842 | 48,281 | 148,123 | 375.89 | 93.35 | 469.24 |
| 4 | 2011 | 101,812 | 51,922 | 153,734 | 394.21 | 102.72 | 496.93 |
| 5 | 2012 | 103,005 | 53,519 | 156,524 | 411.56 | 111.51 | 523.07 |

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