Morphological Analysis of Siak Sri Indrapura City in 2005-2018

Febby Asteriani¹*, Hanifatul Jannah¹, Idham Nugraha¹, Catur Cahyaningsih², Mira Hafizjah Tanjung¹

¹Urban and Regional Planning Department, ²Geological Engineering Department, Faculty of Engineering, Universitas Islam Riau, Address: Jln. Kaharuddin Nasution No. 113 Perhentian Marpoyan, Pekanbaru, 28284

*Correspondent Email: febby.uir.fr@gmail.com

Abstract. Siak Sri Indrapura City is the one of a quite fast city in developing; it has increasingly seen since Tengku Agung Sultanah Latifah Bridge in 2007 which is the link between two areas that glide by the river for perfect accessibility. This study aims to examine the morphology Siak Sri Indrapura City in 2005-2018. The method of this study to use descriptive qualitative and quantitative analysis with GIS (Geographic Information System), which is analyzing and explaining phenomena in depth through in-depth data collection. The results of this study are known that the City of Siak Sri Indrapura experienced changed in land cover, land use, road and changed in building patterns and functions each year. The increase of the not built area is 15589 Ha or 83.45%, changed from the not built area into the built area is 2052 Ha or 10.99% and increase of land built area is 1039 Ha or 5.56%. The most dominant changed in land use in Siak Sri Indrapura City was increased of plantations, changed of plantations into settlements and increased of settlements. Road pattern is grid building pattern is heterogeneous and linear, a function of buildings dominated by residential buildings.

1. Introduction
The form of regional morphology is reflected in spatial patterns, architectural forms of buildings, and other physical elements of the city in the overall context of the development of the city [1]. A city always experiences development from time to time. The morphology of the city is formed in a long process; any changes in the shape of the region morphologically could provide meaning and benefits that are very valuable for handling the development of an urban area [2][3][4]. Definition of Morphology has three components regarding the physical condition of the area. These components are reviewed from land cover and regional land use that reflects regional activities, circulation patterns or road network patterns that connect between regions, and building patterns and their functions [5][6].

This research took place in the City of Siak Sri Indrapura because among the 12 Regencies in Riau Province, the City of Siak Sri Indrapura is one of the cities that is very fast in terms of development, both in terms of population growth and in the development of urban development. This aim of the study is classified the morphological nature of Siak Sri Indrapura between 2005 and 2018 [7][8].

2. Methodology
This study uses a technique overlay map used for map analysis, the technique overlay consists of two or more map layers (as needed). Analyze the mapping technique was overlaying in ArcGIS 10.1. The
overlay maps will use satellite imagery of Siak Sri Indrapura City from 2005-2018 to see changes in land cover and changes in land use, as well as the pattern of road networks in the of Siak Sri Indrapura City from 2005-2018[9].

The analysis phases in this study consist of:

a. Identify changes in land cover and changes in land use in the City of Siak Sri Indrapura in terms of 2005-2018. To see the development of land cover changes and land-use changes using GIS with overlay methods and using satellite imagery of the City of Siak Sri Indrapura from 2005-2018. After getting the image of the City of Siak Sri Indrapura, data management is using GIS (Geographic Information System). Land cover is basic information in the study of geoscience and global change (Jia et al 2014 in Sampurno and Thoriq 2016), while land use can also be interpreted as a human activity on land directly related to land location and conditions. Land use can also be interpreted as a form or form of business activity, utilization of a plot of land at a time [10].

b. Identifying the pattern of the road network in Siak Sri Indrapura City in 2005-2018 using GIS (overlay) and observation. To be able to make a map of the road network pattern of Siak Sri Indrapura City in 2005-2018, it is essential to use the satellite image of Siak Sri Indrapura City in 2005-2018. After obtaining some image, the Geographic Information System could be managed. After finishing, we could overlay the map, so we know how the pattern of the road network changes in Siak Sri Indrapura City. To prove the correctness of the map, field observations should be carried out, such as testing map accuracy. If it has matched the results of the map and in the field, then it will become a map of the road network pattern of Siak Sri Indrapura City in 2005-2018 [11].

c. Identifying Building Patterns and functions in Siak Sri Indrapura City in 2005-2018 using qualitative descriptive, in identifying building patterns and functions can be divided into three patterns, namely: Homogeneous Patterns, Heterogeneous Patterns and Spread Patterns. The building is a physical form the results of construction work that are integrated with the place of residence both above and below the ground and merging with the place of residence in the water. To find out the functions of buildings could be distinguished, whether the building is a trade and services, settlements, industry, etc. So it will be seen how the different patterns of buildings and their functions from 2005-2018 [12].

| Morphological Variable                      | Variable                          | Indicator                                                                 |
|--------------------------------------------|-----------------------------------|---------------------------------------------------------------------------|
| Changes in land cover and land use         | a. Geography, Topography          | b. Land cover                                                             |
|                                            | c. Land use                        | d. Land area                                                              |
|                                            | e. Siak Sri Indrapura City imagery in 2005-2018 | |
| Pattern of Road                            | a. Geographical                    | b. Land area                                                              |
|                                            | c. Road network policy             | d. Road area                                                              |
|                                            | e. Road network                    | f. Siak Sri Indrapura City imagery in 2005-2018                          |
| Pattern of Buildings and Function of Buildings | a. Distribution of buildings     | b. Building density                                                       |
|                                            | c. Building functions              | d. Land area                                                              |
|                                            | e. Land changes                    | f. Inhabitant                                                             |
|                                            | g. Admission Map of Siak           |                                                                          |

Morphology has three components regarding the physical condition of the area. These components are reviewed from land cover and regional land use that reflects regional activities, circulation patterns or road network patterns that connect between regions, and building patterns and their functions [13].
3. Result and Discussion

Land Closure (Ministry of Forestry in Darkono, 2006) is a condition of the surface or the shape of the earth that describes the appearance of vegetation. Changes in land cover would changes that occur in the description of objects on the surface of the earth that are obtained from selected data sources and grouped into closure classes according to their needs (Forest Planning Agency, 2004).

| Year | Built Area (Ha) | Built Area (Hectare) | Non Built area (Hectare) | % |
|------|----------------|----------------------|--------------------------|---|
| 2005 | 591            | 3.16                 | 18.089                   | 96.83 |
| 2012 | 1,039          | 5.56                 | 17.641                   | 94.44 |
| 2016 | 3,091          | 16.54                | 15.589                   | 83.45 |

The land Built area in 2005-2016 continue to increase, this built-up land was dominated by residential land. Whereas the land that was not built in 2005-2016 has decreased every time because of the development carried out in of Siak Sri Indrapura City. This non-built land is dominated by plantation land [7].

| Year | Changes in land | Area (Ha) | Percentage |
|------|----------------|-----------|------------|
| 2005 - 2012 | Non built area into built area | 448 | 18 |
| 2012 - 2016 | Non built area into built area | 2052 | 82 |

Increased change in land is non into built up land due to the already many infrastructure facilities in Siak Sri Indrapura City. The area of land that has been built has experienced many improvements in Kampung Dalam Village, Kampung Rempak Village, Langkai Village and Mempura River Village. While the area of non-built land which has decreased is in Langkai Village, Sungai Mempura Village, Benteng Hulu Village and Merempan Hilir Village. Changes in land cover from 2016 to 2018 consist of changes a land not built into built-up land because there are still many Subdistrict/ Villages that are under construction. And the change of land built to land not built in 2016 to 2018 is in Kampung Dalam Village precisely located in the Old Siak Market or known as China Town which is a famous trade and service center in Siak [14].

| Classification of Road | Year 2005 | Year 2012 | Year 2016 |
|-----------------------|-----------|-----------|-----------|
| Collector             | 36        | 66        | 75        |
| Arterial              | 140       | 339       | 375       |
| Total                 | 176       | 405       | 450       |

Road network pattern is one of the elements of city morphology. In 2005 the road network was in the form of irregular roads, in 2012 the road network had changed to an angled road pattern. The road network of Siak Sri Indrapura City follows the building blocks. In 2016 and 2018 the road network is still the same, in the form of an angular road pattern, but the number of road segments is increasing [10][15].
The pattern of building in this study explains the function of the building or referred to the allotment of the building. The function of allotment of buildings in the research location consists of settlements, trade and services, offices, industries, educational facilities, and health facilities, recreation. There are homogeneous, heterogeneous, linear, centralized and diffuse building patterns [15].

In 2005 the pattern of buildings was dominated by linear patterns and homogeneous patterns due to the accessibility of the community still using ferries or boats to go to their destination so that people preferred to build buildings on river banks, and homogeneous patterns because the majority of the buildings in Siak Sri Indrapura City had architectural forms the same is a one-story building. The building patterns and functions in 2012, 2016 and 2018 in the City of Siak Sri Indrapura are heterogeneous because the forms of buildings in the City have begun to vary, there are one-story, two-storey with non-permanent, semi-permanent and permanent building types and patterns linear because the construction in Siak Sri Indrapura City in 2012 follows a lot of river flow and is already on the edge of the road [15].
4. Conclusion

Siak Sri Indrapura City experienced rapid development. The city of Siak Sri Indrapura still has extensive land that is not built so that the land can be used for development either by the community or the government.

The form of the morphology of the City of Siak Sri Indrapura is the ribbon-shaped cities because the existing development in the City of Siak Sri Indrapura is more dominant than elongated. Morphology of the City of Siak Sri Indrapura tends to develop around the Siak River, this is due to the movement on the riverbank including fast, before 2007 the liaison between the City of Siak Sri Indrapura and other regions only used ferry crossing. To be closer to the transportation center, people prefer to build riverbanks, and now even though there is a bridge that connects Siak Sri Indrapura City with other regions, the community continues to build around the river to accelerate accessibility.

References

[1] F. Asteriani, “Preferensi Penghuni Perumahan Di Kota Pekanbaru Dalam Menentukan Lokasi Perumahan,” J. Ekon. Pembang. Kaji. Masal. Ekon. dan Pembang., vol. 12, no. 1, p. 77, 2011.
[2] C. Cahyaningsih et al., “Geomorphology and structural geology characterization of landslide prone area in Riau-West of Sumatra Highway,” IOP Conf. Ser. Mater. Sci. Eng., vol. 536, no. 1, pp. 0–12, 2019.
[3] M. A. Putri, M. J. Rahayu, and R. A. Putri, “Bentuk Morfologi Kawasan Permukiman Urban Fringe Selatan Kota Surakarta,” J. Pengemb. Kota, vol. 4, no. 2, p. 120, 2016.
[4] Catur Cahyaningsih; Puja Fransismik Crensonni., “Unicharacteristic of Geomorphological Landscape & Depositional Environment in Talawi Hilir: Geotourism Value of Sawahlunto,” vol. 3, pp. 42–51, 2018.
[5] Z. Zaim and F. Asteriani, “The Spatial Analysis to Choose a Location to be Designated as a Landfill Site,” MATEC Web Conf., vol. 159, p. 01035, 2018.
[6] F. Asteriani, “Analisis peringkat faktor-faktor pemilihan lokasi Ruko dari sudut pandang pengguna dan pengembang Ruko di Kota Pekanbaru.”
[7] I. Nugraha, F. Asteriani, and P. Astuti, “THE EFFECTS OF TENGKU AGUNG SULTANAH LATIFAH BRIDGE TOWARD PHYSICAL DEVELOPMENT IN SIAK SUB DISTRICTS,” 2017, no. November, pp. 8–10.
[8] R. Fatriadi, F. Asteriani, and C. Cahyaningsih, “Effectiveness of the National Program for Community Empowerment (PNPM) for Infrastructure Development Accelerated and Geoplanology in District of Marpoyan Damai, Pekanbaru,” J. Geosci. Eng. Environ. Technol., vol. 2, no. 1, p. 53, 2017.
[9] R. Sampurno and A. Thoriq, “Klasifikasi Tutupan Lahan Menggunakan Citra Landsat 8
Operational Land Imager (Oli) Di Kabupaten Sumedang,” J. Teknotan, vol. 10, no. 2, pp. 61–70, 2017.

[10] C. Cahyaningsih, “Safety Factor Characterization of Landslide in Riau-West of Sumatra Highway,” Int. J. GEOMATE, vol. 17, no. 63, 2019.

[11] C. Cahyaningsih et al., “Petrography, Geology Structure and Landslide Characterization of Sumatra Fault Deformation: Study Case In Km 10-15 Highway, Koto Baru Sub District, West of Sumatra,” J. Geosci. Eng. Environ. Technol., vol. 3, no. 4, p. 192, 2019.

[12] C. Cahyaningsih, “Hydrology Analysis and Rainwater Harversting Effectiveness as an Alternative to Face Water Crisis in Bantan Tua Village Bengkalis District-Riau,” J. Dyn., vol. 1, no. 1, pp. 27–30, 2016.

[13] R. H. Rio M Fauzi, Joko Nugroho R, “Analisa perubahan penutupan lahan pada kawasan hutan lindung gunung naning kabupaten sekadau provinsi kalimantan barat,” vol. 4, pp. 520–526, 2016.

[14] C. Cahyaningsih, A. L. Ritonga, S. Aldila, and Z. Zulhikmah, “Lithofacies And Depositional Analysis Environment Of West Section Kolok Nan Tuo Village, Sawahlunto City, West Of Sumatera,” J. Geosci. Eng. Environ. Technol., vol. 3, no. 2, p. 128, 2018.

[15] C. A. B. Puji Astuti, Mardianto Manan, Febby Asteriani and and D. Akhyar, The Prospective Analysis of Coastal Town Development Based on Waterfront City (Case Study: Bantan Sub-District, Bengkalis–Riau Province), no. August. 2014.