International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 09 Issue 12 ǁ 2021 ǁ PP. 34-42

Analysis of Land Use Changes in Pontianak City from 2008 to 2021 Using GIS and Remote Sensing

Iin Arianti[1], Muhammad Rafani[*1]
[1]*Department of Civil Engineering, Politeknik Negeri Pontianak, Pontianak, Indonesia*
**Corresponding author:r4f4n1@yahoo.com*

Abstract
The increase in population is in line with changes in land use area so that the need for built areas is increasing. In this study, satellite data will provide information about land use in Pontianak City. Land use is focused on built-up areas which includes five classifications, namely services and industry, education and offices, settlements, rice fields and green open space. The development of land use changes in an area can be analyzed by utilizing remote sensing data in the form of multi-temporal satellite images. According to (Petit et al. 2001) one way to find out quickly the land use change is by using remote sensing technology. Geographic Information System (GIS) is an information system that is designed to be able to work with data that has spatial/spatial references or geographical coordinates, the term in other words GIS is a data-based system that has a unique ability to handle data that has spatial references (spatial), with a set of work operations that work concurrently. From the 2008 land use map, the service and industrial area of 7.1 km^2 is equivalent to 6.6%; education and office area of 3.6 km^2 equivalent to 2.9%; a residential area of 26.8 km^2 equivalent to 24.3%; rice fields area of 21.3 km^2 equivalent to 19.7%, and green open space of 50.2 km^2 equivalent to 46.5%. The total area of Pontianak is about 109 km^2. The total area of Pontianak, mainland and rivers, is 116 km^2. Land use in 2021 shows that the condition of the residential built area has the largest area of 41.91 km^2 equivalent to 38% and the smallest area is the service and industrial area of 7.7 km^2 equivalent to 7% of the total area of Pontianak city, while other areas are education and office space is 15.13 km^2 equivalent to 14%, rice fields are 18.14 km^2 equivalent to 17% and green open space area is 26.57 km^2 or 24%. Based on the study of land use changes in Pontianak City from 2008 to 2021, it shows that green open land and rice fields are decreasing. This is evidenced by the increase in the area of residential areas in the city of Pontianak and the service and industrial areas or trade areas. The area of green open space and rice fields has decreased in area. Validation is needed to determine the suitability between the interpretation results and the existing results. The validation results on the land use map produce an accuracy of 100%, so the research results can be used as basic information for further research.

Keywords: *land use, GIS, remote sensing*

Date of Submission: 08-12-2021 Date of acceptance: 23-12-2021

I. INTRODUCTION

Pontianak City is the capital of West Kalimantan Province of Indonesia, growing rapidly in the coastal area, with the presence of a port making Pontianak a strategic area, as a gateway to its service area. Pontianak is also the closest city to the airport that serves domestic and international flights, making Pontianak a busy city. In addition, Pontianak is also an education area, there are several universities in the city of Pontianak, both private and public universities on a national scale. The trade and office center complements the city's features so that it becomes a regional attraction and results in urbanization towards the Pontianak City area. The growth of urban areas has implications for the reduction of private open space (non-built) or water catchment areas. This is due to the development of the Pontianak area caused by population growth, as well as the increase in built-up land for the fulfillment of land facilities and regional functions. In accordance with Law no. 26 of 2007 concerning Spatial Planning has mandated that one strategy to control the development of cultivation activities so as not to exceed the carrying capacity and capacity of the environment is to develop green open spaces with an area of at least 30% (thirty percent) of the urban area. This is so that the balance, harmony and preservation of the physical environment of the city can be maintained while also maintaining the microclimate so that floods and droughts can be avoided [1].

Good governance of land use change can avoid negative effects. The development pattern of land use in a city is usually shaped so that it can be estimated. City development decisions develop freely, but efforts are made to use the land according to what has been planned. This study was conducted in Pontianak City to determine changes in land use that occurred from 2008 to 2021. Land use was categorized into five

classifications, namely services and industry, education and offices, settlements, rice fields and green open space. Changes in land use are intended to be changes from previous land uses to other land uses that can be permanent or temporary and are the result of growth and changes in the social and economic structure of the developing community.

1.1 Study Area

The location of this study is Pontianak City, West Kalimantan Province, Indonesia, which is located between 0^0 02' 24" North Latitude and 0^0 05' 37" South Latitude and between 109^0 16' 25" East Longitude to 109^0 23' 01" East Longitude, with an area of 107.8 km^2, consists of 6 districts and 29 villages.

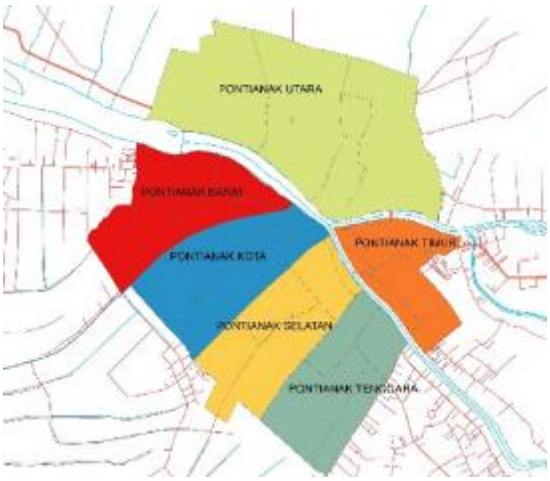

Figure 1: Map of the research location (Pontianak City) West Kalimantan Indonesia

1.2 Research Objectives

The purpose of this study is to determine changes in land use from 2008 to 2021 in the city of Pontianak, Indonesia, so that land use data can be used as basic data for further research and to find out how large the area of land use changes is.

1.3 Research Benefits

The results of this study are expected to become basic data for spatial-based research or spatial modeling, such as spatial modeling of flood, fire, earthquake and other disasters and can be used for calculating local taxes and so on, so that the impact and material losses due to disasters that occur can be minimized.

1.4 Material and Method

In this research, there are several processes of making land use maps, the process of making land use maps in 2008, interpretation using Iconos imagery in 2008. The land use map consists of 5 classifications which are detailed maps of the built up area. The built-up area is divided into areas or locations designated as service and industrial areas, education (schools) and offices, settlements, rice fields and green open spaces (RTH). The second stage is making the 2021 land use map, interpretation using Google Earth images in 2021. Satellite imagery for the Pontianak area in 2021. Satellite images can use the image analyst extension in the ArcGIS program. You can also download from Google earth by using image downloader software such as Universal map downloader.

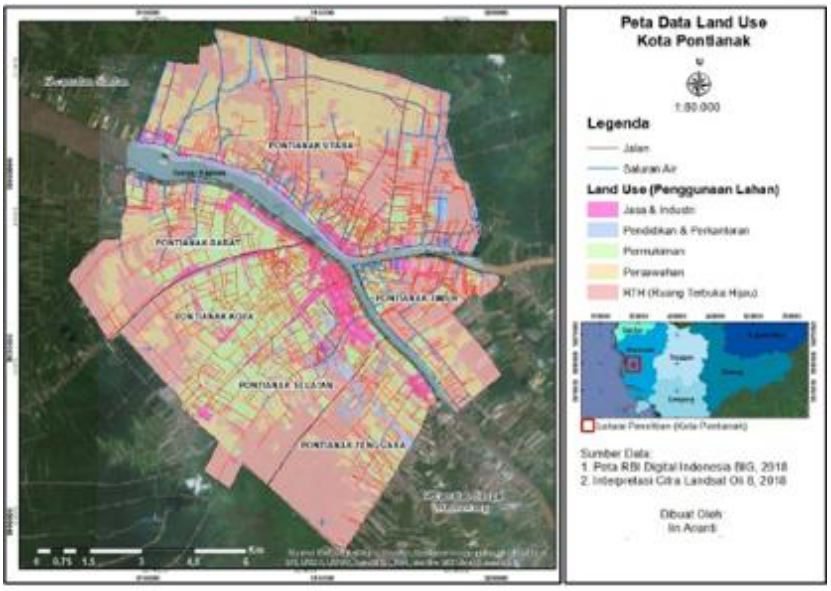

Figure 2: land use of Pontianak City in 2008

Figure 3: Google Earth satellite image of Pontianak City in 2021

The finished 2008 shapefile data sourced from Pontianak local government (BAPPEDA) which will be upgraded to 2021, the 2021 shp land use data is combined with 2021 satellite imagery. Perform the symbologies process on the 2021 shp land use. Land use that shows undeveloped land is given a Hollow symbol while the land that is built remains a color block symbol. Then carry out the digitization process by cutting (Cut polygon tools) each polygon from non-built land, namely rice fields and green open space into built-up land such as industrial services or education/offices or settlements. Do this process until all non-built land turns into built-up land. After all the land use 2021 columns are filled with new land, the symbologies process is carried out in the 2021 shp land use so that the map display shows the 2021 land use land and ends with the map layout making. Next, display the area, in this case the unit is hectares (ha) in the attribute table by right clicking. The next stage is the creation of a land use change map from 2008 to 2021. The 2008 land use shp and 2021 land use shp are overlaid using the Intersect toolbar in the ArcMap program. Then proceed with processing the table data, namely opening the shp table for changes to land use 2008_2021. Add a new column/field with the name Land Change. In order to speed up the filling between the Land use 2008 column and the 2021 Land use column in the Change_Landuse column, use the Field Calculator toolbar, especially in rows that have changed land from

non-built land in the 2008 land use column/field to built-up land in the 2021 land use column/field. After the land use change column filled in all correctly then continued with the symbologies process to display the 2021 Land use image and ended with making the layout. The next process is land use map validation.

II. RESULT AND DISCUSSION

Landuse of Pontianak city in 2008, From the land use map in Figure 2, with the division based on 5 (five) classes, the service and industrial area is 7.1 km^2 equivalent to 6.6%; education and office area of 3.6 km^2 equivalent to 2.9%; a residential area of 26.8 km^2 equivalent to 24.3%; rice fields area of 21.3 km^2 equivalent to 19.7%, and green open space area of 50.2 km^2 equivalent to 46.5%. The total area of Pontianak is about 109 km^2. The total area of Pontianak, mainland and river is 116 km^2.

The 2021 land use map shows (figure 4) that the condition of the residential built area is the largest area of 41.91 km^2 equivalent to 38% and the smallest area is the service and industrial area of 7.7 km^2 equivalent to 7% of the total area of Pontianak city, while other areas namely education and offices is 15.13 km^2, rice fields are 18.14 km^2 and green open space area is 26.57 km^2, more details in figure 5.

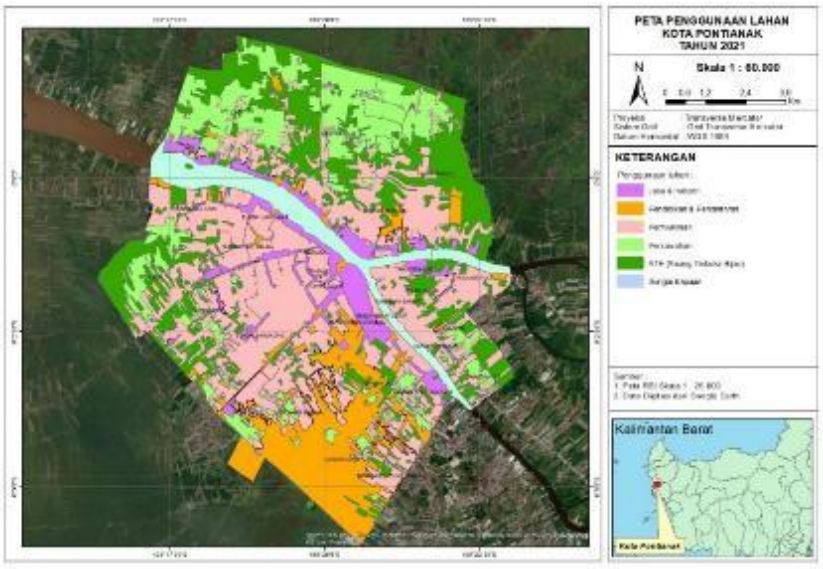

Figure 4: Land use of Pontianak City in 2021

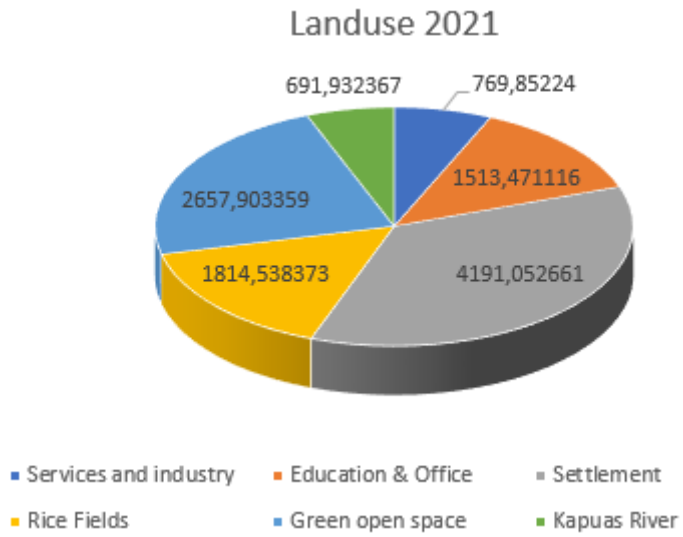

Figure 5: *Pie Chart* Land use of Pontianak City in 2021

Validation is needed to determine the suitability between the interpretation results and the existing results. The more conformity or compatibility between the interpretation and actual conditions in the field, the more accurate the resulting map. The following are the results of the suitability of the interpretation with the

actual conditions (table 1) and table 2 is the accuracy of the suitability. The following sample points are used for validation checks.

Table 1: Validation data between interpretation and existing results

NO	INTERPRETATION	EXISTING	PHOTO
1	Education & Office	Education & Office	
2	Services and industry	Services and industry	
3	Services and industry	Services and industry	
4	Education & Office	Education & Office	
5	Rice fields	Rice fields	
6	Green open space	Green open space	
7	Green open space	Green open space	
8	Education & Office	Education & Office	

9	Settlement	Settlement	
10	Green open space	Green open space	
11	Rice fields	Rice fields	
12	Settlement	Settlement	
13	Kapuas River	Kapuas River	
14	Settlement	Settlement	
15	Rice fields	Rice fields	
16	Green open space	Green open space	
17	Green open space	Green open space	
18	Settlement	Settlement	

19	Settlement	Settlement	
20	Services and industry	Services and industry	
21	Kapuas River	Kapuas River	

Table 2: Accuracy image interpretation *Google Earth* 2021

No	Interpretation	Existing	Accuracy
1	Education & Office	Education & Office	1
2	Services and industry	Services and industry	1
3	Services and industry	Services and industry	1
4	Education & Office	Education & Office	1
5	Rice fields	Rice fields	1
6	Green open space	Green open space	1
7	Green open space	Green open space	1
8	Green open space	Green open space	1
9	Settlement	Settlement	1
10	Green open space	Green open space	1
11	Rice fields	Rice fields	1
12	Settlement	Settlement	1
13	Kapuas River	Kapuas River	1
14	Settlement	Settlement	1
15	Rice fields	Rice fields	1
16	Green open space	Green open space	1
17	Green open space	Green open space	1
18	Settlement	Settlement	1
19	Settlement	Settlement	1
20	Services and industry	Services and industry	1
21	Kapuas River	Kapuas River	1
			100 %

Based on checking the accuracy of the map, it obtained a validation result of 100%, meaning that this land use map is feasible to be used as a reference for further research.

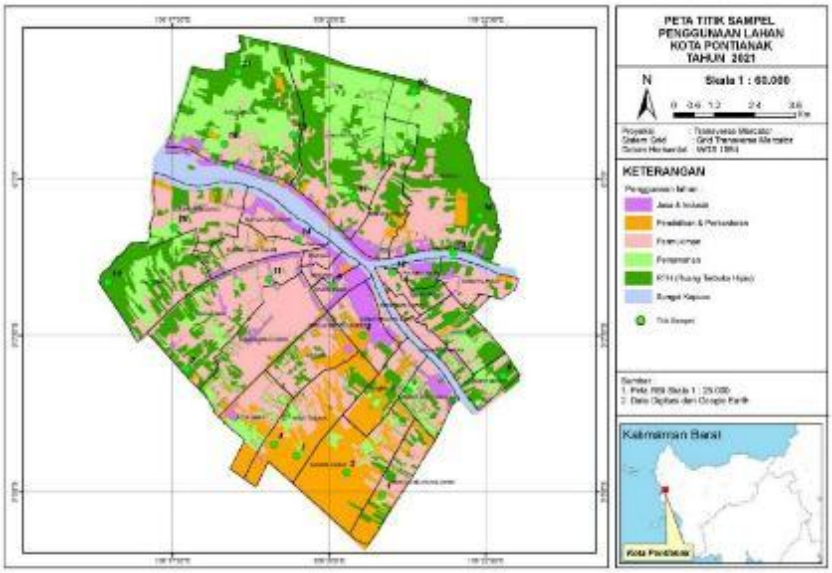

Figure 6: Validation Land use of Pontianak City in 2021

III. CONCLUSION

Based on the study of land use changes in Pontianak City from 2008 to 2021, it shows that green open space and rice fields are decreasing (table 3). This is a reasonable thing when viewed from the increase in population which always increases every year. The increase in population is in line with the increase in the area of the Pontianak city settlement and the service and industrial areas or trade areas.

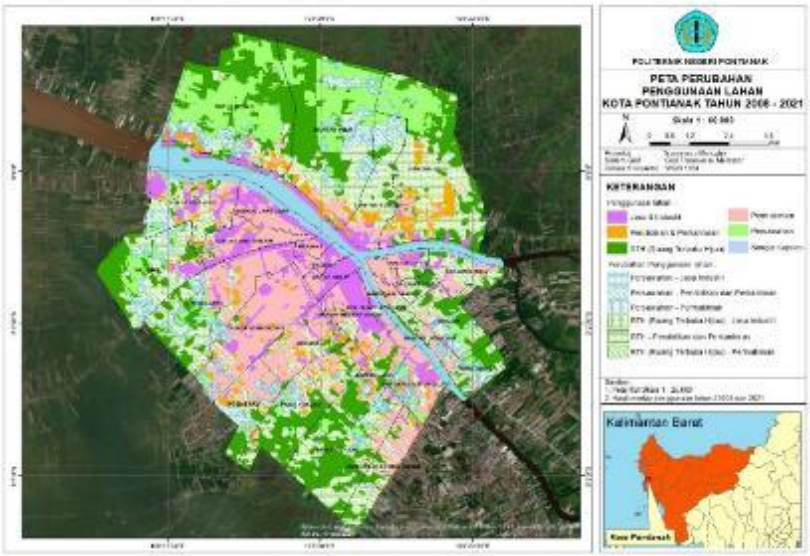

Figure 7: Land use Change of Pontianak City in 2008 to 2021

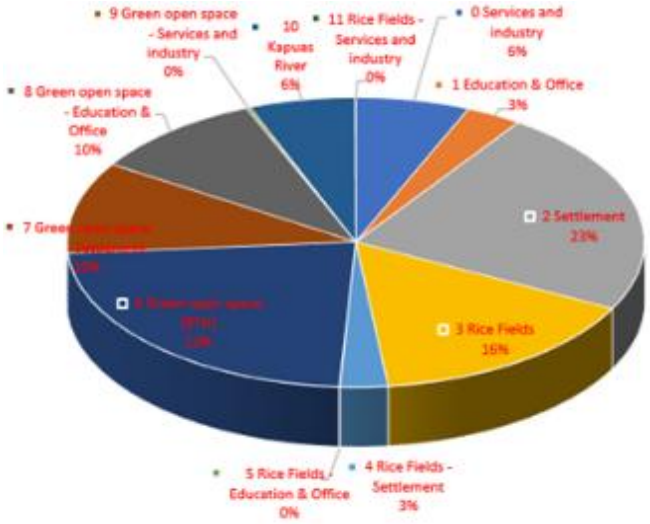

Figure 8: *Pie Chart* Land use Change of Pontianak City in 2021

Table 3: Land use Change Area from 2008-2021

Land use change	ha	%
Services and industry	743,1769776	6,385367
Education & Office	365,4451089	3,1399
Settlement	2687,079381	23,08735
Rice Fields	1814,538373	15,59049
Rice Fields - Settlement	310,0279813	2,663756
Rice Fields - Education & Office	4,507683516	0,03873
Green open space	2657,903359	22,83667
Green open space - Settlement	1193,945298	10,25836
Green open space - Education & Office	1143,518323	9,825095
Green open space - Services and industry	22,90662871	0,196813
Kapuas River	691,932367	5,945074
Rice Fields - Services and industry	3,769638507	0,032389

REFERENCES

[1]. Arianti, I. (2010). Ruang Terbuka Hijau. *Jurnal Ilmu Pengetahuan dan Rekayasa.*Vol. 9, No. 1, Jan 2010.
[2]. ESRI. (1990). *Sistem Informasi Geografis.* Bandung: Informatika
[3]. International Strategy for Disaster Reduction (ISDR). (2004). *Living with Risk – A Global Review of Disaster Reduction Initiatives*, New York and Geneva: United Nations Publication.
[4]. Jaya, N. (2010). *Penginderaan Jauh Satelit Kehutanan*. Laboratorium Inventarisasi Hutan, Jurusan Manajemen Hutan, Fakultas Kehutanan IPB. Bogor.
[5]. Kubangun, S.H., Haridjaja, O., and Gandasasmita, K. (2016). Model perubahan penutupan/penggunaan lahan untuk identifikasi lahan kritis di Kabupaten Bogor, Kabupaten Cianjur, dan Kabupaten Sukabumi, *Majalah Ilmiah Globe 18(1), 21-32*.
[6]. Nasiri, H., & S.K. Shahram. (2013). Flood vulnerability index as a knowledge base for flood risk assessment in urban area. Journal of Novel Applied Sciences, 2: 269-272.
[7]. Petit C, Scudder T, Lambin E. (2001). Quantifying processes of land-cover change by remote sensing: resettlement and rapid land-cover changes in south-eastern Zambia. International Journal Remote Sensing. 22(17): 3435–3456.
[8]. Soehaimi, Asdani. (2011). Seminar Nasional Mitigasi Bencana Geologi: Pengalaman Bencana/Risiko Gempa Bumi Masa Lalu Cerminan Bencana/Risiko Gempa Bumi di Masa Mendatang. Jakarta.