JOURNAL OF APPLIED GEOSPATIAL INFORMATION

Vol 4 No 2 2020

http://jurnal.polibatam.ac.id/index.php/JAGI
ISSN Online: 2579-3608

Land Use and Its Suitability to the Spatial Pattern in Batam City

Novika Dora [*], Arif Roziqin[*]
[*]Geomatics Engineering, Politeknik Negeri Batam, Batam 29461, Indonesia
[*]Corresponding author e-mail: novikadpanjaitan10@gmail.com , arifroziqin@polibatam.ac.id

Received: March 09, 2020
Accepted: July 10, 2020
Published: July 13, 2020

Abstract

Land use continues to grow as population increases in an area, various activities and human needs require land. Land use will affect the suitability of the spatial pattern determined by the Government stipulated in the laws and regulations governing spatial patterns. The purpose of this research is to identify land use that occurred in Batam City in 2019 and determine the suitability of the land use of the Batam City spatial pattern. In this study, the spatial pattern used is the spatial pattern obtained from BP Batam, this is because the spatial pattern originating from the Batam City Government has not yet been approved. The research method used is the method of Classification of Multispectral Maximum Likelihood and Overlay. The results of the map show the class of land use classifications totaling 11 classes in accordance with the class III land use classification class specified by Malingreau, which consists of lakes, forests, industry, pool, bare land, mangroves, ports, plantations, settlements, airports, and livestock. The results of the suitability of land use maps to the spatial pattern of Batam City indicate that the area of the area that is in accordance with the spatial pattern is 30986.77 Ha and the area that is not suitable is 34554.29 Ha.

Keywords: Land Use, Suitability, Spatial Pattern.

1. Introduction

Land use continues to grow as population increases in an area, various activities and human needs require land. Land use needs to be known to find out its impact on the carrying capacity of land (Roziqin, 2016).

Batam City is one of the cities in Indonesia which is experiencing very rapid development (BPS, 2020). Batam City in 1971 was an island with a population of 10,000 inhabitants with most residents living as fishermen (Dicky, 2008). The population of Batam City continues to increase every year (BPS, 2020). The increase in the urban population will increase land requirements (Kusrini *et al*, 2011). In addition, rapid development has also resulted in changes in land-use patterns, more and more natural space changes its function into a built-up space (Pribadi *et al*, 2006).

Land use patterns that occur will certainly affect the suitability of land use to the spatial patterns determined by the Batam City. The purpose of this research is to map the land use in Batam City, arrange spatial land use modeling, and determine the suitability of land use that occurs with the spatial pattern determined by the Batam City and its suitability for spatial patterns so that it can then be expected that the development process that occurs will remain in accordance with regulations based on the provisions of the Batam City Business Entity to support the creation of sustainable development in accordance with existing regulations. Limited of existence space and grew up of people comprehension against spatial planning are required spatial planning that transparent, effective, and participatory (Iskandar *et al*, 2016).

2. Research Method

The research data needed is Landsat 8 2019 imagery data, Batam City administration map, Batam City spatial pattern map and location sample field coordinates. Landsat 8 satellite imagery data for 2019 sourced from the United State Geological Survey (USGS), Batam City Administration Map obtained from Batam City, Batam City Spatial Pattern Map obtained from BP Batam and Coordinate sample data obtained from field validation results using GPS handheld.

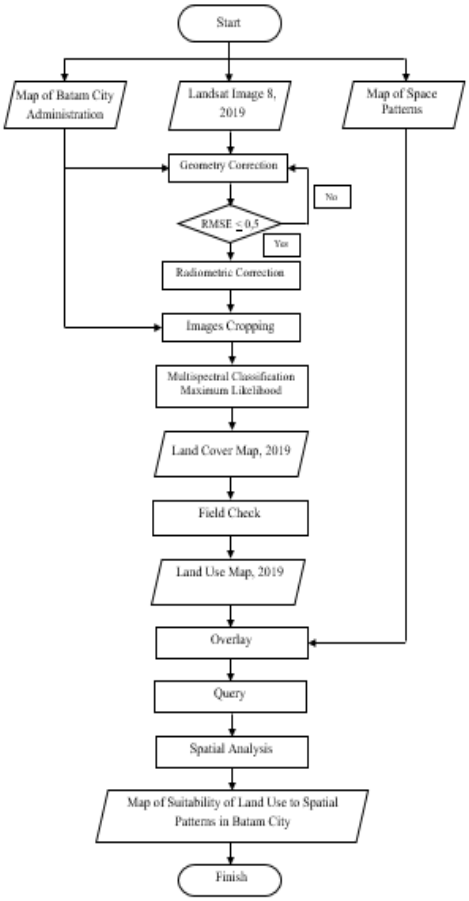

Fig. 1. Research Flow Chart

The research conducted is located in Batam City, Riau Islands Province between 0º 25' 29" - 1º 15' 00'' North Latitude and 103º 34' 35" - 104º 26' 04" East Longitude (Batam City Regional Regulation number 2 of 2004 concerning Batam City Regional Spatial Planning 2004-2014). Batam City Region consists of Rempang Island, Galang Island, Batam Island, and other small islands.

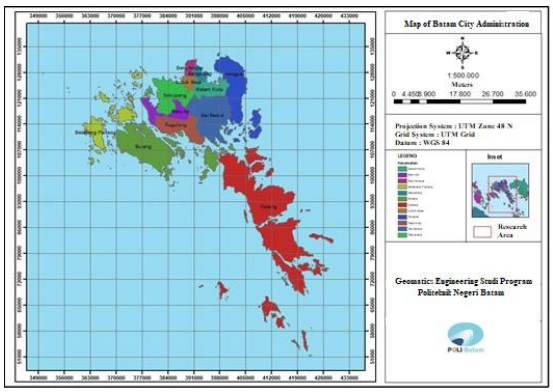

Fig. 2. Location of the research

Batam city is a region with increasing economic economic that requires spatial planning in accordance with the spatial patterns (Roziqin and Kusumawati, 2017).

3. Result and Discussion

In making land use maps the initial stage to do is to make the process of correction of the satellite image data used. The next stage is the multispectral classification process. Based on the results of the maximum likelihood multispectral classification that has been done on Landsat 8 satellite imagery data (Sampurno and Thoriq, 2016), it is obtained 4 levels of land use classification I based on the Malingreau classification class consisting of residential areas, non-vegetated areas, and vegetated areas, and waters as seen in Figure 3.

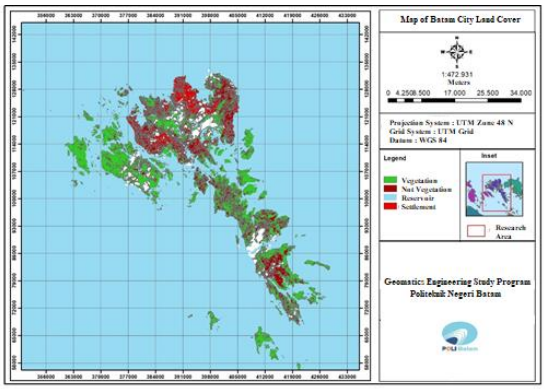

Fig. 3. Result of Maximum Likelihood Classification

Furthermore, after conducting the classification stage, apply the field validation test stage to the classification of land cover classes by taking as many as 44 samples determined using the calculation of the Slovin formula by looking at population values based on polygons for each class of land cover that has been classified. Field validation test results are shown in Figure 4.

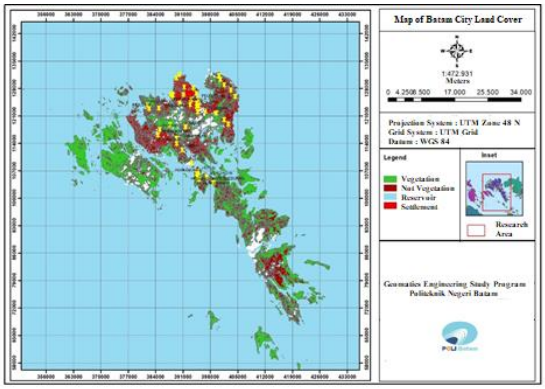

Fig. 4. Field validation test results

An accuracy test is performed using the confusion matrix method in the form of an error table in determining the relationship between the two variables. In this study, the two variables are the classification data of satellite imagery and the data from field validation results. The Confusion matrix method is a method used to determine the accuracy value of land use. There are 3 stages in the confusion matrix accuracy test, namely overall accuracy (OA), user's accuracy (UA), and producer's accuracy (PA). Calculation of the Confusion Matrix accuracy test as shown in Table 1:

Table 1. Confusion Matrix Accuracy Test

Field Data					Total	User
Classification Result Data	Vegetation	Areas Without Vegetation	Settlement	Reservoir		
Vegetation	11	1			12	92
Not Vegetation	2	5	1		8	63
Settlement	1	1	19		21	90
Reservoir				3	3	100
Total	14	7	20	3	44	
Producer	79	71	95	100		

Calculation accuracy:

1. Overall Accuracy :

$$= \left(\frac{Diagonal\ number}{the\ sum\ of\ all\ point}\right) x\ 100\%$$

$$= \left(\frac{38}{44}\right) x\ 100\% = 0{,}86 = 86\%.$$

Based on the results of the calculation of the overall accuracy that has been done, the results of the accuracy of the image of the results of field validation are 86%. The accuracy is in accordance with the requirements of the accuracy standard of 85% (Danoedoro, 2012), and a value of 86% is said to have met the requirements between the accuracy of the results on the image of the field results.

2. Producers Accuracy :

$$= \left(\frac{Number\ of\ class\ points\ in\ the\ field}{the\ total\ number\ of\ class\ lines\ in\ the\ image}\right) x\ 100\%$$

- Vegetation $= \left(\frac{11}{14}\right) x\ 100\% = 79\%$
- Not Vegetation $= \left(\frac{5}{7}\right) x\ 100\% = 71\%$
- Settlement $= \left(\frac{19}{20}\right) x\ 100\% = 95\%$
- Reservoir $= \left(\frac{3}{3}\right) x\ 100\% = 100\%$

From the results of the above calculation, it can be seen that the water class has an accuracy value of 100% which means that the class has been correctly classified in the field. Whereas for vegetated area class has an accuracy value of 79% while the remaining 21% is still not classified into that class but included in another class. For non-vegetated areas class has an accuracy value of 71% means the remaining 29% has not been classified into that class but belongs to another class. The residential area class has an accuracy value of 95%, while the remaining 5% is still not classified into that class but included in another class.

3. User's Accuracy

$$= \left(\frac{Jumlah\ titik\ \ per-kelas\ di\ lapangan}{jumlah\ total\ kolom\ per-kelasnya}\right) x\ 100\%$$

- Vegetation $= \left(\frac{11}{12}\right) x\ 100\% = 92\%$
- Not Vegetation $= \left(\frac{5}{8}\right) x\ 100\% = 63\%$
- Settlement $= \left(\frac{19}{21}\right) x\ 100\% = 90\%$
- Reservoir $= \left(\frac{3}{3}\right) x\ 100\% = 100\%$

From the calculation results above, it can be seen that the water area class has a value of 100% accuracy, which means that the class represents all samples on the map in the field.

As for the class of vegetation, the sample determined on the map represents 92% in the field, for the non-vegetated area class, the sample specified on the map represents 63% in the field, for the class of the sample settlement area on the map represent 90% in the field.

After going through the stages above, the land use map of Batam City is obtained. The results of the map show the class of land use classifications amounting to 12 classes according to the class III land use classification class specified by Malingreau, which consists of lakes, forests, industry, ponds, open land, sea, mangroves, ports, plantations, settlements, airports, and animal husbandry.

After the results of the land use map are obtained, the next step that must be done is the overlay process between the land use map and the spatial pattern map so that the results obtained in the form of a land-use suitability map to the spatial pattern in Batam City are shown in Figure 5.

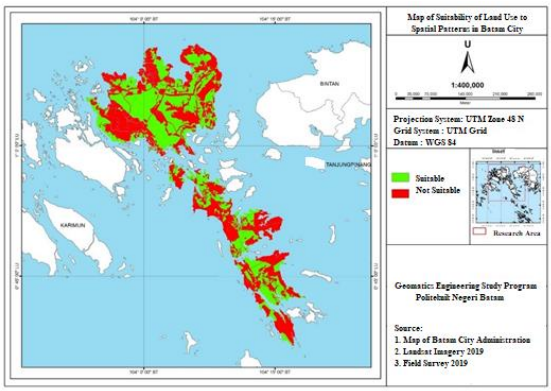

Fig. 5. Map of Suitability of Land Use to Batam City Spatial Pattern

Based on Figure 5. the suitability of land use is obtained with the spatial pattern in Batam City and can be seen in Table 2.

Table 2. above shows the inconsistencies between land use and the spatial pattern of Batam City in 2019

No	Land Use	Spatial Pattern	Area
1	Airport	Cultivation Area	Cultivation Area
2	Forest	Protected Area	Protected Area
3	Industry	Cultivation Area	Industrial Area
4	Pool	Cultivation Area	Cultivation Area
5	Bare Land	Cultivation Area	Cultivation Area
6	Mangrove	Protected Area	Tourist Area
7	Port	Cultivation Area	Cultivation Area
8	Plantation	Cultivation Area	Cultivation Area
9	Settlement	Cultivation Area	Residential Area
10	Animal Husbandry	Cultivation Area	Cultivation Area
11	Reservoir	Protected Area	Protected Area

In the table above the land use classification falls into a spatial pattern type.

Table 3. Area Results (Ha) and Percentage of Land Suitability

No.	Information	Large (Ha)	Percentage
1	Suitable	30986.77 Ha	47.3 %
2	Not Suitable	34554.29 Ha	52.7 %

Table 3. The above shows the results of the total area and percentage of area that is appropriate and not in accordance with the spatial pattern of Batam City. From the results of research conducted, it can be seen that land use is incompatible with a spatial pattern that occurs in the forest land use class being a residential area located in Nongsa District and Sekupang District and the use of forest land into agricultural areas located in Galang District. This is in accordance with the research of Eko and Rahayu (2012) in a study with the title Analysis of Changes in Land Use Conformity to Spatial Detailed Plans in the Peri Urban Area Case Study: Mlati District. Land use that matches the spatial pattern occurs in the forest land use class located in Galang District.

4. Conclusion

Based on the objectives and results of the study, the conclusions of this study (1) Accuracy test results between the image classification results of the field validation test results fall into the category of fulfilling the specified accuracy requirements that are not less than 85%, (2) Produce a map of land use in Batam City with 12 classes of land use classification based on class III land use class classification according to Malingreau, (3) The results of the map show that the area of the area corresponding to the spatial pattern is 30986.77 Ha and the area of the area that is not suitable is 34554.29 Ha.

5. References

BPS. (2020). *Kota Batam Dalam Angka*. Batam: BPS Kota Batam.

Danoedoro, P. (2012). *Introduction to Digital Remote Sensing*. Yogyakarta: C.V Andi Offset.

Dicky, M. (2008). Implikasi Perubahan Penggunaan Lahan Terhadap Kualitas Air Baku Kota Batam. (Thesis).

Eko, T., Rahayu, S. (2012). Perubahan Penggunaan Lahan dan Kesesuaiannya terhadap RDTR di Wilayah Peri-Urban Studi Kasus: *Kecamatan Mlati. Jurnal Pembangunan Wilayah dan Kota Volume 8 (4) : 330-340.*

Iskandar, F., Awaluddin, M., Yuwono, B.D. (2016). Analisis Kesesuaian Penggunaan Lahan Terhadap Rencana Tata Ruang/Wilayah di Kecamatan Kutoarjo Menggunakan Sistem Informasi Geografis. *Jurnal Geodesi Undip Vol. 5 No. 1.*

Kusrini, Suharyadi, Hardoyo, S. R. (2011). Changes in Land Use and Factors Affecting it in Gunung Pati District, Semarang City. *Majalah Geografi Indonesia Vol.25.*

Pribadi, D. O., Shiddiq, D., Ermyanila, M. (2006). The Model of Land Cover Change and Factors Affecting it. *Journal of Environmental Engineering. P3TL-BPPT. 7 (1) 35-5.*

Roziqin, A. (2016). Pemodelan SIG untuk Kesesuaian Lahan Permukiman Wilayah Pesisir Nongsa di Pulau Batam. *Seminar Nasional Teknologi Terapan (SNTT) UGM.*

Roziqin, A., Kusumawati, N.I. (2017). Analisis Pola Permukiman Menggunakan Data Penginderaan Jauh di Pulau Batam. *Prosiding Industrial Research Workshop and National Seminar 8, 52-58.*

Sampurno, R. M., Thoriq, A. (2016). Klasifikasi Tutupan Lahan Menggunakan Citra Landsat 8 Operational Land Imager (OLI) di Kabupaten Sumedang. *Jurnal Teknotan Vol. 10 No. 2.*