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DYNAMIC OF CHANGING AREA OF SUSPENDED SOLID BY UTILIZING LANDSAT 8 OIL IMAGES IN LAKE SINGKARAK, WEST SUMATRA PROVINCE, 2017 and 2022

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ABSTRACT: TSS is suspended materials (diameter > 1 µm) retained on a millipore filter with a pore diameter of 0.45 µm. TSS consists of silt and fine sand and micro-organisms. The main cause of TSS in waterways is soil erosion or soil erosion that is carried into water bodies. If the TSS concentration is too high, it will inhibit the penetration of light into the water and result in disruption of the photosynthesis process (Effendi in Lestari, 2009:4). Many activities cause turbidity that affects the penetration of sunlight into water bodies, so it can hinder the process of photosynthesis and primary production of waters. Turbidity usually consists of an organic particle originating from watershed erosion and resuspension from the lake bottom. Keywords : Normalized Difference Vegetation Index, Normalized Burn Ratio, Landsat 8, Severity Level of Forest and Land Fires. Based on the results of the study, researchers have obtained TSS values in 2017 and 2022 at Lake Singkarak with the Landsat 8 image data processing method using the Syarif Budiman algorithm with several stages, namely first combining image data bands from band 1 to band 7 then cropping which serves to determine the area to examine then performs masking which functions to separate land from water and then enter the Syarif Budiman algorithm formula then classify the TSS values in Lake Singkarak. It can be seen that the predicted TSS concentration has not been too much different from the TSS concentration in the field. researchers have obtained TSS values in 2017 and 2022 at Lake Singkarak with the Landsat 8 image data processing method using the Syarif Budiman algorithm with several stages, namely first combining image data bands from band 1 to band 7 then cropping which functions to determine the area which will be examined then do masking which functions to separate land from water and then enter the Syarif Budiman algorithm formula then classify the TSS values in Lake Singkarak. It can be seen that the predicted TSS concentration has not had too much difference in the concentration in the field. researchers have obtained TSS values in 2017 and 2022 at Lake Singkarak with the Landsat 8 image data processing method using the Syarif Budiman algorithm with several stages, namely first combining image data bands from band 1 to band 7 then cropping which functions to determine the area which will be examined then do masking which functions to separate land from water and then enter the Syarif Budiman algorithm formula then classify the TSS values in Lake Singkarak. It can be seen that the predicted TSS concentration has not to have o much difference with wififrameS concentration in the field.

Keywords: TSS Change, TSS Area,Lake Singkarak

1. INTRODUCTION

TSS is suspended materials (diameter > 1 µm) retained on a millipore filter with a pore diameter of 0.45 µm. TSS consists of silt and fine sand and micro-organisms. The main cause of TSS in waterways is soil erosion or soil erosion that is carried into water bodies. If the TSS concentration is too high, it will inhibit the penetration of light into the water and result in disruption of the photosynthesis process (Effendi in Lestari, 2009:4).

The many activities that cause turbidity affect the penetration of sunlight into water bodies, so it can hinder the process of photosynthesis and the primary production of water. Turbidity usually consists of an organic particle originating from watershed erosion and resuspension from the lake bottom. The increasing activity of the people around Lake Singkarak has resulted in a decrease in the quality of Lake Singkarak waters. Also, the rapid increase in the number of uncontrolled floating cages results in lake pollution due to leftover fish food waste that settles to the bottom of the lake which will later be suspended to the surface which causes inhibition of photosynthesis and water primary production.

Lake Singkarak is located in Solok and Tanah Datar districts, West Sumatra province and has an area of 107.8 km². This lake is the headwater of the river Batang Ombilin. Lake Singkarak is one of the results of a tectonic process that is influenced by the Sumatra Fault. Functionally, Lake Singkarak has an important role from both ecological and economic aspects. Ecologically, Lake Singkarak is a habitat for many freshwater organisms. Economically, Lake Singkarak is used as a source of livelihood for the people around Lake Singkarak.

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Remote sensing technology is needed in this research for effective data collection techniques, obtained quickly and relatively easy to collect data. The development of remote sensing technology, especially those that utilize satellite media as a vehicle for carrying sensors, is increasingly rapidly supporting data acquisition that is increasingly accurate and more detailed, so that the information obtained is more complete. One of the uses of using remote sensing imagery is that remote sensing techniques and geographic information systems have the advantage of collecting data quickly over large areas without compromising their accuracy.

Based on these factors, efforts are needed to monitor the distribution of TSS in Lake Singkarak given the importance of the potential for water to support various needs, starting from the people around the lake and the aquatic ecosystem of Lake Singkarak. One of the monitoring that can be done is to use remote sensing satellite data. The use of remote sensing satellite data has several advantages, including wide area coverage, high repetition, and ease of spatial analysis.

2. THEA METHOD

2.1 Research Form

The form of this research is to use a form of research by carrying out an ecological approach in which geosphere phenomena such as the interaction of living organisms with their environment, especially in looking at the distribution of suspended solids in Lake Singkarak.

2.2 Time & Location of Research

This research will be carried out in the even semester of the 2021/2022 school year

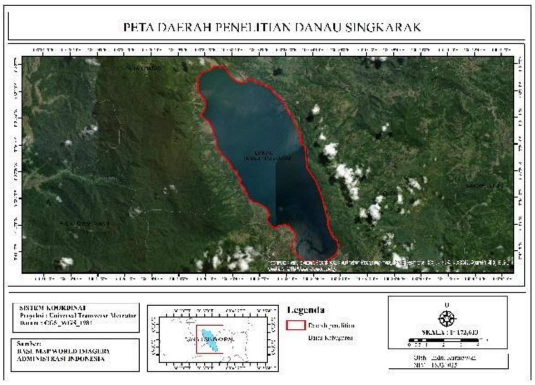

Figure 4.Research Location Map

2.3 Tools & Materials

Table 1. The tools and materials used to support the research are as follows:

No	Tool	Utility
1	Ryzen 5 Laptops	Data analysis
2	Er mapper software	Data processing
3	ArcGIS software	Data processing

No	Material	Acquisition Time	Source
1	Landsat 8 Oil Satellite Image	2017 and 2022	USGS
2	Indonesian administration shapefile data	2021	INA geoportal

2.4 Data Analysis Stage

1. Radiometric Correction

The purpose of geometric correction is to correct position distortion by placing image elements in their proper planimetric (x and y) positions, so that the image has an appearance that is more in line with the actual situation on the earth's surface so that it can be used as a map. The level of accuracy of the corrected image can be seen from the magnitude of the RMS error value for each control point made. In this study, the RMS error value used is < 1 pixel.

2. Cropping Data

Cropping is done to cut areas that are included in the research area with areas that are not included in the research area. on the image in the er mapper software by equalizing the band from B1=B1 to B7=B7, then saved in the er mapper format with the output raster dataset.

3. Masking

Masking is done to separate the land and water in the study area. mask the cropped results and enter the formula, namely IF 11/12<=0.8 THEN ELSE NULL where 11= band 5 and 12 = band 2 with that the resulting value on the mainland will be 0. Next, combine cropping and masking by duplicating layers 1- 8 and layers 1-7 are filled with cropping data then layer 8 is filled with data masking.

4. Estimation Algorithm

The algorithm is obtained through the reflectance of Landsat 8 imagery data. After that, it performs TSS data processing by entering a formula with the TSS algorithm (mg/l) = 8.1429 * (exp (23.704* 0.94* Band4)) then does a class in the arcgis software by doing properties then symbology and the classification is made with 4 levels namely Low, Medium, High and Very High based on the TSS value obtained after carrying out the Estimation Algorithm.

5. Water Sample Processing

Sampling is done after the results of image analysis which aims to test the accuracy of the image. The sample to be taken is at each river mouth in Lake Singkarak with the sample distance determined by the size of the river and the current of the river itself. The lake water that is sampled is water that is on the surface of the lake (<50). The samples taken were placed in bottles containing 200 ml of 11 samples which would be laboratory tested at the West Sumatra regional health laboratory. This sampling aims to test the accuracy of the image and whether the analysis results from the Landsat 8 imagery can be used for further research or do not match the distance between the TSS results which are very far between the image and the in-situ data.

6. Changes in the area of TSS values in 2017 and 2022

To see a comparison of TSS values from 2 different years, a record is made for each distribution of area values which will later make a graph of changes in the area for the distribution of values in 2017 and 2022. From a comparison between the area values of TSS in 2017 and 2022, the results will be obtained whether the area of TSS value in 2017 will be lower than TSS in 2022 or vice versa.

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3. RESULT AND DISCUSSION

3.1 TSS Map for 2017 and 2022

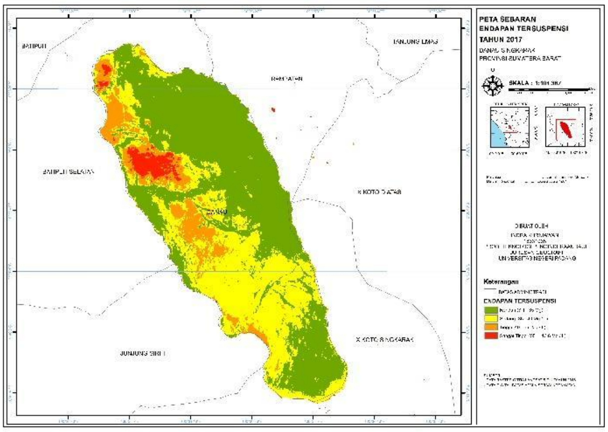

Figure 7. 2017 TSS Map

Figure 7 is the result of TSS analysis on Lake Singkarak using Landsat 8 image data processed in er mapper software using the Syarif Budiman estimation algorithm. Researchers gave 4 TSS classification classes in 2017 with tarragon green color, which color is a low classification class which indicates the area has a low concentration value with a value range of 8 – 35 Mg/L where the low class dominates in all directions of Lake Singkarak and the yellow diesel color indicates a moderate TSS value with a range of concentration values of 35-40 Mg / L with its distribution in a southerly direction to the west of Lake Singkarak.

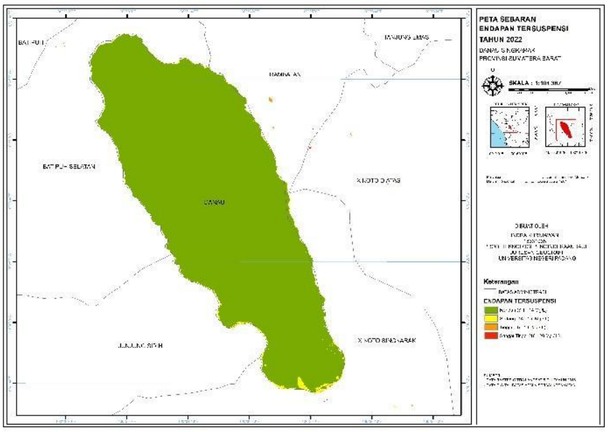

Figure 8. 2022 TSS Map

Figure 8 is the result of Landsat 8 imagery analysis in 2022 using an estimation algorithm from Syarif Budiman. Researchers also provide 4 classes of classification of TSS concentrations like2017 which will later be useful to see changes in TSS area for 5 years, namely from 2017 to 2022, a low classification which has a value between 8.1 – 14 Mg / L which is spread in almost all directions in the lake Singkarak with the largest area of value in which this classification is colored tarragon green, for medium classification which is marked in solar yellow which has a TSS value between 14 – 15 Mg / L which this classification is spread in the southeast of Lake Singkarak which is here there is a river estuary x koto singkarak leading to lake singkarak. The high classification has a concentration value between 15 – 16 Mg / L which is marked with an orange servile color this classification is spread on the shores of Lake Singkarah in all directions. The very high classification which is marked in red is spread to the south of Lake Singkarak and the river flow in X Koto Singkarak with a TSS value range between 16 – 20 Mg / L. from the analysis of Landsat 8 imagery in 2022, the TSS value is dominated by the low classification class.

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3.2 Knowing the Changes in TSS Area in Lake Singkarak water images in 2017 – 2022

The second objective of this research is to process data from image analysis results to see changes in the area of TSS in Lake Singkarak, along with tables and graphs of changes in TSS in 2017 – 2021:

Table 14. TSS Area in 2017 and 2022

No	area (km2) 2017	Area (km2) 2022	Classification
1	57	107	Low
2	36	2	Currently
3	12	1	Tall
4	3	1	Very high

Table 14 is a table of breasts in 2017 and 2022 which are in the broad lowclassification classes in 2017 it was 57 km2 while in 2022 it was 107 km2, for medium classification in 2017 it was 36 km2 and in 2022 it was 2 km2. In the high classification the TSS area in 2017 is 12 km2 and in 2022 the TSS area is 1 km2, for very high classification the TSS area in 2017 was 3 km2 and in 2022 the TSS area is 1 km2. If you look closely, the highest TSS area is in the low classification in the two years, namely 2017 and 2022.

Table 15. Changes in the area of each classification

2022 2017	Low	Currently	Tall	Very high	Grand Totals
Low	56.85806	0.196686	-	-	57.054746
Currently	35.327623	0.560791	0.00062	-	35.889034
Tall	11.18618	0.188253	0.017668	0.006022	11.398123
Very high	2.803026	0.015992	0.044056	0.001199	2.864273
Grand Totals	106.174889	0.961722	0.062344	0.007221	107.206176

Table 15 is a table of changes in the area of each TSS classification on the map. This table aims to provide information in the form of numbers and how many changes occur from one classification class to another.

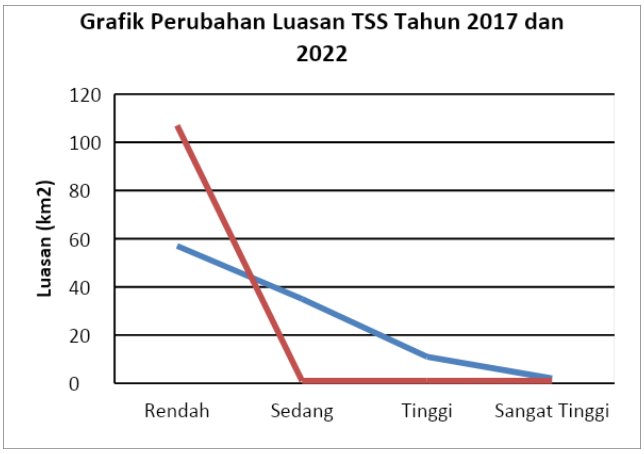

Figure 9. Graph of TSS Area Change

Figure 9 is a graph of the change in the TSS area for 5 years, namely 2017 and 2022, where the dark brown line represents the area of 2017 and the light brown color of 2022. In 2017 it hasvarious areas starting from the very high classification in 2017 having an area of 2 while the very high classification in 2022 has an area of 1 km2 which shows a very high area change of around 1 km2. The high class in 2017 has an area of 11 km2, while in 2022 it has an area of 1 km2, this shows a fairly high change in area with a distance of 10 km2. A medium classification that has an area of 35 km2 in 2017 decreased to 1 km2 in 2022 where the change in the area decreased by 33 km2 for 5 years this year. In the low class in 2017, which had an area of 57 km2, it increased to 107 km2, which shows that the TSS concentration value for 5 years has continued to decrease and generally has fallen to a low classification.

3.3 Accuracy Test

The results of spatial data analysis of Landsat 8 imagery were validated using a water sample test in the field by taking water samples at the mouths of the major rivers that enter the lake, namely the Ombilin estuary, the Sumani river estuary and the Air Batangang river. Samples were taken as many as 5 water samples due to field conditions, access to the field and the costs required for this accuracy test, then the samples that have been taken will be laboratory tested at the UPTD Laboratory of West Sumatra.

This accuracy test is used to compare the value of the results of image analysis with field data whether the processed image can be useful for further research or not, while the results of the accuracy test that has been carried out are as follows:

Table 16. Field data accuracy test results with image data

Sample No	coordinate		TSS Concentration Value		distance
	S	E	Field Data	2022 image	
1.	-0.699058	100.584703	13,7	15,3	1,6
2.	-0.699448	100.585034	11.5	16,1	4,6
3.	-0.699149	100.585377	10,2	16	5.8
4.	-0.560899	100.550355	12,1	13,7	1,6
5.	-0.538342	100.492779	15,2	15,9	0.7

Table 15 is a comparison of image accuracy test data which compares field TSS concentration values with TSS in image analysis. In sample 1, which has a concentration value from the laboratory test results, namely 13.7 mg/L and the results from image analysis, is 15.3 mg/L with a difference in the range of values, namely -1.6, sample 2 which has a concentration value from the test results labor 11.5 mg/L with a different value from the results of image analysis which has a value of 16.1 mg/L with a distance of -4.6 , sample 3 which has a concentration value of 10.2 mg/L which has a different distance from the data from the analysis image, which is -5.8, which is the value from image analysis, which is 16 mg/L.
Sample 4 has a concentration value of 12.1 mg/L while data from image analysis has a concentration value of 13.7 mg/L with a different distance of -1.6, sample 5 which has a concentration value of 15.2 mg/L which data from image analysis has a concentration value of 15.9 mg/L which has a not much difference of -0.7. A considerable difference can be seen in sample 3, which is 5.8 mg/L. To see the relationship between the alleged image data and field data are presented in Figure 10.

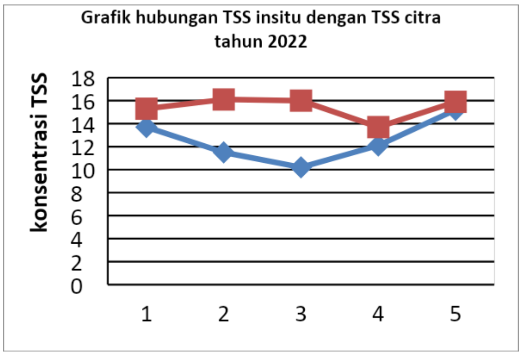

Figure 9. Graph of the alleged TSS relationship with field data

It can be seen that the predicted TSS concentration has not had too much difference from the TSS concentration in the field. The difference in the insitu TSS value with the presumed TSS as shown in table 15 can be caused by differences in the in-situ data collection time and the image recording time and the image conditions affected by the haze cover.

3.4 Discussion

Based on the results of the study, researchers have obtained TSS values in 2017 and 2022 at Lake Singkarak with the Landsat 8 image data processing method using the Syarif Budiman algorithm with several stages, namely first combining image data bands from band 1 to band 7 then cropping which serves to determine the area be examined then performs masking which functions to separate land from water and then enter the Syarif Budiman algorithm formula then classify the TSS values in Lake Singkarak.

The results of the TSS analysis on Lake Singkarak in 2017 used Landsat 8 image data which was processed in the Er Mapper software using the Syarif Budiman estimation algorithm. Researchers gave 4 TSS classification classes in 2017 with tarragon green color, which color is a low classification class which indicates the area has a low concentration value with a value range of 8 – 35 Mg/L where the low class dominates in all directions of Lake Singkarak and the yellow diesel color indicates a moderate TSS value with a range of concentration values of 35-40 Mg / L with its distribution in a southerly direction to the west of Lake Singkarak.

The results of the Landsat 8 image analysis in 2022 use the estimation algorithm from Syarif Budiman. Researchers also provide 4 classes of classification of TSS concentrations like 2017 which will later be useful to see changes in TSS area for 5 years, namely from 2017 to 2022, a low classification which has a value between 8.1 – 14 Mg / L which is spread in almost all directions in the lake Singkarak with the largest area of value in which this classification is colored tarragon green, for medium classification which is marked in solar yellow which has a TSS value between 14 – 15 Mg / L which this classification is spread in the southeast of Lake Singkarak which is here there is a river estuary x koto singkarak leading to lake singkarak. The high classification has a concentration value between 15 – 16 Mg / L which is marked with an orange servile color this classification is spread on the shores of Lake Singkarah in all directions. The very high classification which is marked in red is spread to the south of Lake Singkarak and the river flow in X Koto Singkarak with a TSS value range between 16 – 20 Mg / L. from the results of analysis of Landsat 8 imagery in 2022 for the TSS value is dominated by the low classification class.

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Figure 7 is a graph of changes in the area of TSS for 5 years, namely 2017 and 2022 where the blue line is the area of 2017 and the red color is 2022. In 2017 it has a variety of areas starting from a very high classification with number 4 in 2017 it has an area of 2 km2 while the very high classification in 2022 has an area of 1 km2 which shows a very high area change of around 1 km2.

In the 2017 high class marked with number 3 it has an area of 11 km2, while in 2022 it has an area of 1 km2, this shows a fairly high change in area with a distance of 10 km2. A medium classification that has an area of 35 km2 in 2017 decreased to 1 km2 in 2022 where the change in the area decreased by 34 km2 for 5 years this year. In the low class in 2017, which had an area of 57 km2, it increased to 107 km2, which shows that the TSS concentration value for 5 years has continued to decrease and generally has fallen to a low classification.

The high and low TSS values can also be affected by land use around the research area and sampling area, especially in the sampling area where samples 1, 2 and 3 are the Sumanti River estuary where the land use around this area is community-owned rice fields. The environment that allows erosion of the paddy fields if the river water is high and heavy, as well as aquatic plants in the mouth of this river, is water hyacinth which also affects the level of TSS in this area.In sample 4 which was taken at the mouth of the Ombilin river, the land use around this river was community settlements and the river mouth had a water dam in sample 5 which was taken at the mouth of the Batang river which the land use around this area was community plantations. around and also the rice fields where the river is associated with the swamps around the river.

It can be seen that the predicted TSS concentration has not have too much different from the TSS concentration in the field. The difference in the insitu TSS value with the presumed TSS as shown in table 15 can be caused by differences in the in-situ data collection time and the image recording time and the image conditions affected by the haze cover.

4. CONCLUSION

From the research conducted, it can be concluded that:

1. Image analysis has a distance that is not so much different between field data and image analysis data.

2. The pattern of change in the area of TSS tends to be dominated by low classes in the middle of lakes and river estuaries where there are many high concentrations.

5. REFERENCES

[1] (Junaidi et al., 2009)Bodri, S., Kendal, K., & Satriadi, A. (2004). Distribution of Suspended Solids at the Bodri River Estuary, Kendal Regency. MARINE SCIENCE: Indonesian Journal of Marine Sciences, 9(2), 101-107–107. https://doi.org/10.14710/ik.ijms.9.2.101-107
[2] The region, DI, River, A., & City, T. (2013). Undip Geodesy Journal October 2013 Undip Geodesy Journal October 2013. Undip Geodesy, 2(Geographical Information Systems), 240–252.
[3] Daneodoro. (2011). introduction to remote sensing. cv. and offsets.
[4] Effendi, Hefni. 2003. Study of Water Quality for Management of Water Resources and Environment. Kanisius (Member of IKAPI), Jakarta
[5] Hehanusa, PE and Haryani, GS 2009. Classification of lake morphogenesis in Indonesia for climate change impact mitigation. Paper presented at the I National Lakes Conference, Sanur-Denpasar-Bali, 13-15 August 2009.
[6] Hendrawan, IG, Uniluha, D., & Maharta, IPRF (2016). Vertical Characteristics of Total Suspended Solid and Turbidity in Benoa Bay Waters, Bali. Journal of Marine and Aquatic Sciences, 2(1), 29. https://doi.org/10.24843/jmas.2016.v2.i01.29-33
[7] Jewlaika, Lady, & Nurrachmi, I. (nd). DISTRICT KEPULAUAN MERANTI RIAU PROVINCE By Turbidity is closely related to the level of suspended matter because the suspended matter is present in the water column. Total suspended solids (Total Suspended Solid) are suspended materials (. 53–66.
[8] Junaidi, E., Patriono, E., & Sastra, F. (2009). Somatic Gonad Index of Bilih Fish (Mystacoleucus padangensis Blkr.) Entering the River Estuary Around Lake Singkarak. Journal of Science Research, Special(Special), 59–62.
[9] Jorgensen, SE, and RA Vollenweiden, 1989, Guidelines of Lakes Management: Principles of Lakes Management. Vol 1: International Lake Environment Foundation, Shiga, Japan
[10] Kardono, P., Karsidi, A., Haryani, NS, Purwadhi, FSH, Rakhmatulloh. 2015. Geographic Information System Remote Sensing Application for Regional Development. Jakarta : Polimedia Publishing.
[11] Lestari, Indah Budi. 2009. 'Estimation of Concentration of Total Suspended Solid (TSS) and Transparency of Jakarta Bay Waters with Landsat Satellite Imagery'. Essay. Bogor: Bogor Agricultural Institute.
[12] Lillesand, Kiefer. 1979. Remote Sensing and Image Interpretation. Yogyakarta: Gadjah Mada University Press.
[13] Prahasta, E., 2009. Geographic Information Systems: Basic Concepts (Geodesic and Geomatics Perspective). Bandung: Informatics.
[14] Purwadhi, SH (2001) 'Digital Image Interpretation', Jakarta: Grasindo. Purwadhi, SH and Sanjoto, TB (2008) 'Introduction to Remote Sensing Image Interpretation', Jakarta: LAPAN.
[15] Sandy, I Made. 1985. Republic of Indonesia Regional Geography. Jakarta: Depdikbud Tinggi, R., Di, T., & Padang, K. (2020). PIXEL-BASED GUIDED ACCURACY TEST OF IMAGERSENTINEL 2-A USING HIGH-RESOLUTION UPRERT IMAGES IN 2019 IN PADANG CITY, Dedy Fitriawan. 3(1), 21–27.
[16] Wetzel. 2001. Limnology: Lake and River Ecosystems Third Edition. Academic Press. 0127447601