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UTILIZATION OF REMOTE SENSING IMAGES IN MAPPING SUSPENDED SOLID IN LAKE MANINJAU WEST SUMATRA PROVINCE

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ABSTRACT: Remote sensing is generally defined as the technical art of obtaining information or data regarding the physical condition of an object or object, target, target or area and phenomenon without touching or direct contact with the object or target (Soenarmo, 2009). With remote sensing data, this research can easily see how the condition of the lake water. Based on these factors, efforts are needed to monitor the distribution of TSS in Lake Maninjau considering the importance of water potential to support various needs. In this study the classification was divided into 5 for the first class with concentration values of tss- 0 – 15 mg/L, 15 – 25 mg/L, 25 – 35 mg/L, TSS 35 – 80 mg/L, TSS > 80 mg/L. The result of in situ data processing is the lowest value is 8.2 mg/L and the highest is 72.2 mg/L. The Syarif Budhiman algorithm has the lowest at 8.14 mg/L and the highest at 40.04 mg/L. The lowest Parwati algorithm is 3.32 mg/L and the highest is 32.86 mg/L. The Guzman - Santaella algorithm has the lowest at 3.15 mg/L and the highest at 164.38 mg/L. The TSS concentrations in the alleged party and budhiman algorithms tend to have the same pattern as the TSS concentrations in the field, but there are several points with significant differences. The validation test shows that the Budhiman Algorithm (2004) has the smallest NMAE value between in situ data and image processing with a value of 14.4%.

Keywords: TSS, TSS Algorithm, Lake Maninjau

1. PRELIMINARY

Lake Maninjau is a natural lake located in Agam Regency, West Sumatra Province. The lake at an altitude of about 461.5 meters above sea level with an area of about 99.5 km2. The agriculture, fishery, tourism and electricity energy sources depend entirely on the water potential of Lake Maninjau. The importance of water potential that is able to support various needs makes its own concern for the quality and quantity of water in Lake Maninjau.

The quality of the water in the lake affects the organisms that live in it. In Presidential Regulation No 60 of 2021 Article 3 paragraph (1) concerning Saving the National Priority Lake, Lake Maninjau, West Sumatra Province, including lakes in Indonesia, is already in a state of degradation, either in the form of damage to water catchment areas, lake borders, decrease in natural resources and biodiversity, decrease in water quality , increased erosion, and extinction of endemic biota species. Even though Lake Maninjau has been designated as a national priority lake, the pollution in this lake has not shown any improvement. The increasing activity of the people around Lake Maninjau has resulted in a decrease in the quality of Lake Maninjau.

One of the contributors to pollution in Lake Maninjau is the watershed (DAS) which carries sedimentation or suspended sediment such as fine sand mud and micro-organisms which are mostly caused by soil erosion or soil erosion carried by flowing river water.
empties into Lake Maninjua. Then another factor is the uncontrolled existence of floating net cages (KJA). Currently the number of active marine cages in Lake Maninjau has reached 18,000 plots, which is more than three times the carrying capacity of the lake which is only 6,000 plots (LIPI Limnology, 2014). The large number of KJA causes the remaining fish feed and fish waste to accumulate at the bottom of the lake, causing sedimentation of water quality. To see the level of turbidity of the water seen from the suspended matter (TSS) in the water.

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Total Suspended Solid (TSS) is a parameter that determines the quality of water bodies. TSS are suspended materials (diameter > 1 µm) retained on a milliopore filter with a pore diameter of 0.45 µm. TSS consists of silt and fine sand and micro-organisms. (Effendi in Lestari, 2009). In waters that have high concentrations of TSS tend to experience high sedimentation. One of the monitoring that can be done is to use remote sensing satellite data. Technological developmentremote sensing in particular utilizing satellite media as one of the increasingly sensor-carrying vehiclesrapidly supports data acquisition.

Whichthe more accurate and more detailed, so the information obtained is more complete.Based on these factors, monitoring is required distribution of TSS in Lake Maninjau given the importance of the water potential support various needs. Suspended Solids Map or Total Suspended Solid in Lake Maninjau, Tanjung Raya sub-district, Agam regency, was made using remote sensing imagery in the form of landsat 8 OLI with the calculation of TSS values that will be used by three types of algorithms namely Syarif Budiman (2004), Parwati (2006), Guzman - Santaella (2009) and also a survey conducted carried out in the field in the form of in-situ data so that there are no errors in the interpretation of remote sensing images.

2. THE METHOD

2.1 Research Form

This form of research uses a quantitative descriptive study with a spatial approach to determine the suspended solids that are scattered in Lake Maninjau. Quantitative descriptive research is research that aims to describe, record, analyze and interpret, and classify the conditions that occur.

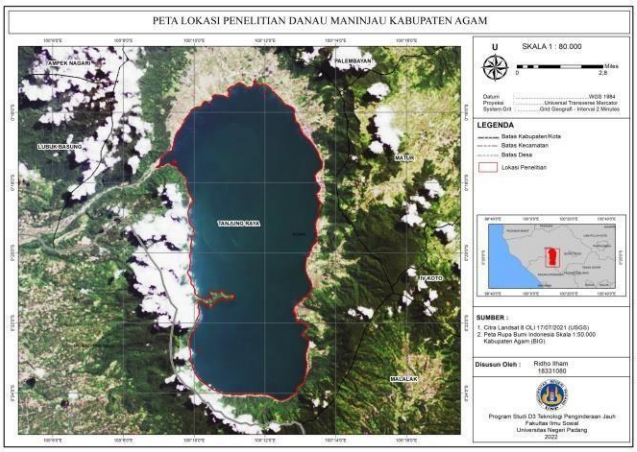

Fig 1.Research sites

2.2 Time & Location of Research

The time of the research was carried out within a period of two months, namely in April and May 2022. The research location was carried out on Lake Maninjau, Agam Regency, West Sumatra Province

2.3 Tools & Materials

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

Table 1. Research Tools

No	Tool	Laptops
1	Laptops	Data analysis
2	Stationery	Written documentation
3	Water sample	Knowing the value of tss in the field
4	GPS	Determination of sample point coordinates

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Table 2. Materials used in the study

No	Name Material	Year	Source	Utility
1	Landsat 8 image	2022	USGS	AnalysisTSS
2	Scale RBI map 1:50,000	2021	BIG	Territory boundaries study
3	Data in-there	2022	Lab. Health	Field tss value
4	Supportersarea information	2022	BPS	Supportersstudy

2.4 Data Analysis Techniques

1. Cropping
   Landsat 8 image cropping in the desired area to facilitate data processing to reduce the processed area in the study area
2. Geometric correction
   The goal of geometric correction is to correct position distortion by placing image elements in their proper planimetric (x and y) positions.
3. Radiometric correction
   Radiometric correction to change the digital values in the image to reflectance values. Radiometric correction provides a wider range of values and color changes in the image.
4. Masking
   Area masking is done to separate the water area from the land using the NDWI algorithm. image data will be separated into two-pixel values, if the NDWI value is > 0, then the area is water and if NDWI ≤0, then the area island.
   NDWI= Green-NIR/Green+NIR
5. Estimation Algorithm
   After the Landsat image has been corrected, the image can only be processed using 3 predetermined TSS algorithms. The TSS algorithm used includes:
   - Syarif Budiman Algorithm (2004)
   TSS (mg/l) = 8.1429 * (exp (23.704* 0.94* Red Band))

   - Parwati Algorithm (2006)
   TSS (mg/l) = 3.3238 * exp (34.099* Red Band)

   - Guzman – Santaella Algorithm (2009) TSS (mg/l) = 602.63 * (0.0007e47.755* (Red-Band))) + 3.1481
6. Classification
   Classification of TSS values is carried out to facilitate the process of making TSS distribution maps. TSS values are classified into 5, namely: 0 – 15 mg/L, 15.01 – 25 mg/L, 25.01 mg/L – 35 mg/L, 35.01 - 80 mg/L, and > 80 mg/L.
7. Output
   The output resulting from this processing is a map of the distribution of suspended solids in the Lake Maninjau area in 2022 using three different algorithms.
8. In Situ Data
   In situ data processing in the form of lake water samples. Lake water used the sample is water that is on the surface of the lake (<50cm) then stored in a 200ml bottle, which is then processed by laboratory tests at the West Sumatra Regional Health Laboratory using the gravimetric method to determine the condition of the TSS value in Lake Maninjau at that time. At the same time, the coordinates of sample point data were collected using GPS. This sampling aims to test the accuracy of the 3 algorithms from the image so that you can find out which accuracy is more valid to use on Maninjau Lake.

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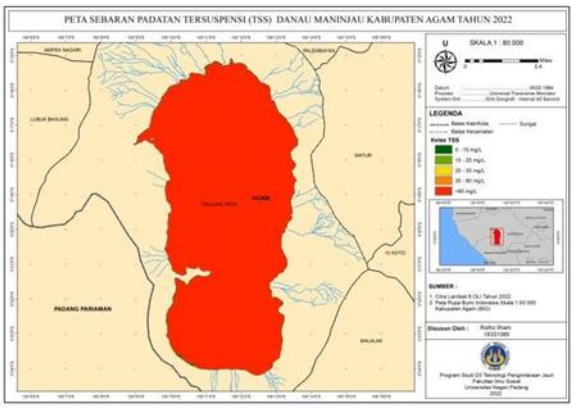

Fig 2.Sample Point Location Map

9. In situ data accuracy test with the Budhiman, Parwati, Guzman - Santaella algorithm
   The accuracy test aims to determine the accuracy of the results of the TSS value of the image processing algorithm for in situ data. The validation test in this study uses the Normalized Mean Absolute Error (NMAE). The minimum requirement for NMAE is ≤ 30%.

   NMAE (%) = 1 N Σ x estimate, ix measured . 100
   x measured

3. RESULTS AND DISCUSSION

3.1 Algorithm Mapping of Syarif Budiman, Parwati, and Guzman – Santaella

From the three algorithms, the results of the TSS mapping research obtained from each algorithm are as follows:

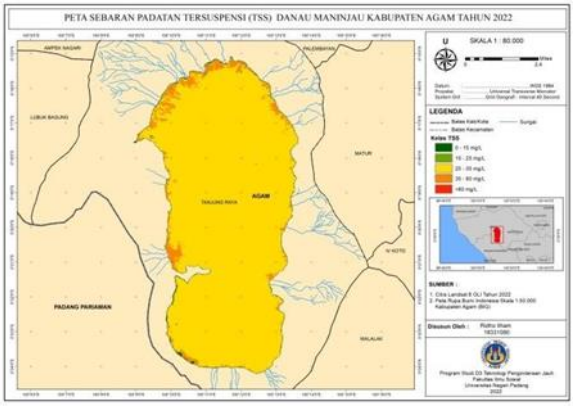

Fig 3.TSS Distribution Using Syarif budiman's Algorithm

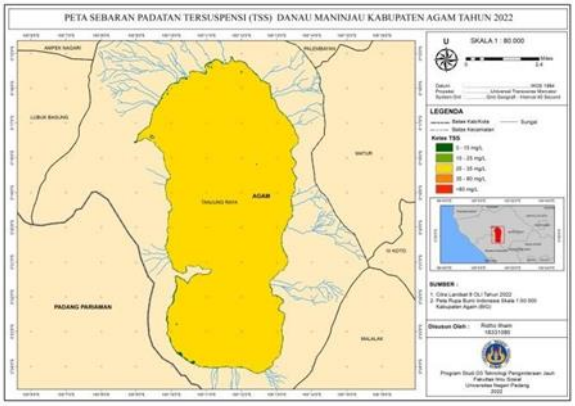

Fig 4.TSS Distribution Using Parwati Algorithm

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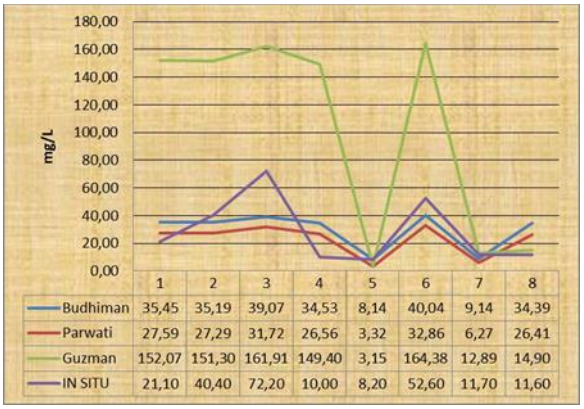

Fig 5.TSS Distribution Using Guzman & Santaella Algorithm

The results of this study, researchers can find out how the distribution of tss is using different algorithms. For the distribution of suspended solids mapping the first algorithm uses the Syarif Budiman algorithm which has been presented in the results of Figure 2. From the Syarif Budiman algorithm the distribution of tss in Lake Maninjau dominantly has a tss value of 25-36 mg/L which means it is included in the moderate classification and other classifications that are scattered to the north there is a suspended solids value of 35 – 80 mg/L, meaning that this class is a high distribution. The results of the second tss mapping distribution, namely the Parwati algorithm are presented in Figure 3 where the most dominant distribution is in the 25 – 35 mg/L class. The distribution of this classification almost covers the entire body of Lake Maninjau. It is different with Guzman & Trend deployment sedimentation from the highest class to the lowest class, spread based on the contours of the slope of Lake Maninjau. So that high-class sedimentation tends to collect in areas that have shallow bathymetry.

3.2 In-Situ Data

In-situ data in this study are TSS data obtained by direct observation at the research location. A sampling of lake water was carried out on April 3, 2022.

Table 3. Field TSS Observation Data

No.	Coordinates	In Situ Data	
	S	E	(mg/L)
1	-0.400347	100.192378	21.1
2	-0.391130	100.218917	40.4
3	-0.342914	100.219521	72.2
4	-0.290704	100.225921	10
5	-0.267979	100.213411	8.2
6	-0.255390	100.182904	52.6
7	-0.275662	100.158806	11.7
8	-0.307909	100.165826	11.6

Table 4. TSS Concentration Value Using In-Situ Data & 3 Different Algorithms

No.	In Situ	Alg. Budhiman	Alg. Parvati	Alg. Guzman
1	21.1	53,45	27.59	152.07
2	40.4	35,19	27,29	151.30
3	72.2	39.07	31,72	161.91
4	10	43,53	26,56	149,40
5	8.2	8,14	3,32	3,15
6	52.6	40.04	32.86	164.38
7	11.7	9,73	6,27	12.89
8	11.6	34,39	26,41	14.90

Table 4 shows the values that vary depending on the use of the algorithm. Point position affects the results of data processing. Positions close to the coast show higher values, while positions far from the coast show lower values. Based on the results of insitu data processing, the lowest value was 8.2 mg/L and the highest was 72.2 mg/L. The lowest Syarif budhiman algorithm is 8.14 mg/L and the

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highest is 40.04 mg/L. The lowest Parwati algorithm was 3.32 mg/L and the highest was 32.86 mg/L. The lowest Guzman - Santaella algorithm is 3.15 mg/L and the highest is 164.38 mg/L.
From the graph above it can be seen that the TSS concentrations in the alleged parwati and budhiman algorithms have the same trend as the TSS concentrations in the field, but there are several points with significant differences, namely at points 3 and 4. In the Guzman algorithm the TSS concentrations are very much different from the results in the field and the value obtained was very high, reaching 164.38 mg/L. The difference between the in situ TSS value and the presumptive TSS is shown in the table 4 and Figure 5 can be caused by differences in the time of taking in situ data with the time of recording the image and the condition of the image which is affected by the thin fog cover.

3.3 TSS In Situ value validation test with satellite image processing TSS algorithm

The validation test in this study uses the Normalized Mean Absolute Error (NMAE). The minimum requirement for NMAE is ≤ 30%.

Table 5. NMAE Validation Test

No	TSS Algorithm	NMAE %
1	Syarif Budhiman (2004)	14.4
2	Parwati (2006)	15.18
3	Guzman – Santaella (2009)	64.54

Budhiman's algorithm (2004) obtained the smallest NMAE value between in situ TSS concentration and Landsat 8 image processing TSS concentration, namely 14.4%. This shows that the Budhiman Algorithm is the most suitable and suitable algorithm for measuring TSS concentrations in Lake Maninjau, Agam Regency.

4. CONCLUSION

From the results of this study, based on the formulation of the problems previously described, we can conclude that:

1. From the 2022 TSS distribution map of Lake Maninjau as a result of Landsat 8 image processing above, the lowest tss concentration of the Syarif Budhiman algorithm is 8.14 mg/L and the highest is 40.04 mg/L. The lowest Parwati algorithm was 3.32 mg/L and the highest was 32.86 mg/L. The lowest Guzman - Santaella algorithm is 3.15 mg/L and the highest is 164.38 mg/L.
2. The appropriate accuracy for Lake Maninjau is that Syarif Budhiman's algorithm (2004) has the smallest NMAE value of 14.4%.

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