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Analysis the distribution of total suspended solid using remote sensing in the coastal area of Barru Sub-district, Barru Regency, Sounth Sulawesi

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Abstract

Abstract. Monitoring the distribution of Total Suspended Solids (TSS) is a crucial aspect in preserving the quality of coastal waters. This thesis aims to analyze the distribution of TSS using remote sensing technology in the coastal area of Barru District, Barru Regency. The research utilizes satellite imagery and geographic information systems (GIS) to collect and analyze information regarding TSS concentrations in the area. Remote sensing methods are employed to acquire spatial data on TSS distribution, while GIS is utilized to map and visualize the analysis results. Various environmental factors such as river estuaries, human activities, and aquaculture in the coastal area of Barru District can contribute to TSS distribution. The research results are expected to provide a better understanding of TSS distribution in the coastal area and serve as a basis for more effective water management. This study is anticipated to contribute to the efforts in preserving and maintaining water quality in Barru Regency, as well as providing insights for the development of TSS distribution monitoring models using remote sensing technology and GIS.

Keywords: TSS, remote sensing, GIS, Satellite Imagery, landsat 8

Introduction

Barru Regency has a coastline of 78 km (BPS, 2019) [1]. Marine waters are influenced by various factors that cause changes in physical, chemical, and biological conditions, both from land and from the sea itself. Factors from land that affect water conditions include human activities such as settlements, industries, and mining. Meanwhile, factors from the sea include tides, waves, and currents. Additionally, significant impacts on the quality of seawater and marine environmental conditions are also caused by human activities such as mining and transportation (Robileo, 2016) [8]. One of the causes of water quality decline is Total Suspended Solids (TSS), which is an abbreviation for all solids (sand, silt, and clay). Suspended sediment is a parameter that can be used for calculating and analyzing water quality and pollution status (Siswanto & Wahyu, 2017; Lestari, 2009) [9]. One area with high turbidity levels in Barru Regency is located in Barru District due to high human activities, including tourism and culinary attractions, which increase the turbidity levels around the coastal waters of that region. High turbidity levels indicate high concentrations of Total Suspended Solids (Rauf et al, 2020) [7]. High TSS concentrations indicate the potential for siltation and increased turbidity TSS refers to suspended materials (diameter >1 µm) that are retained on a milipore filter with a pore diameter of 0.45 µm. TSS consists of fine sand, silt, and microscopic organisms, primarily caused by soil erosion or sediment carried into the water bodies. If the water condition has high turbidity, it will affect the survival of aquatic organisms living in it and disrupt maritime transportation activities around it (Herna, 2008; Supriharyono, 2000; Bioresuta *et al*, 2018) [5, 10]. The objective of this study is to determine the distribution of TSS in the waters of Barru District, Barru Regency in 2014, 2018, and 2022 using Landsat 8 satellite imagery data. This research is expected to contribute to the learning process in order to improve future research. Additionally, this study can serve as a reference for further research, providing an overview of the coastal water conditions in Barru Regency based on the distribution map of TSS. The research aims to provide data and information about the coastal water conditions in Barru District, Barru Regency.

Material and Method

This research was conducted for 2 months, from May 2023 to June 2023. It took place in the coastal area of Barru Regency. The study focused on 3 station points, namely a harbor and two rivers.

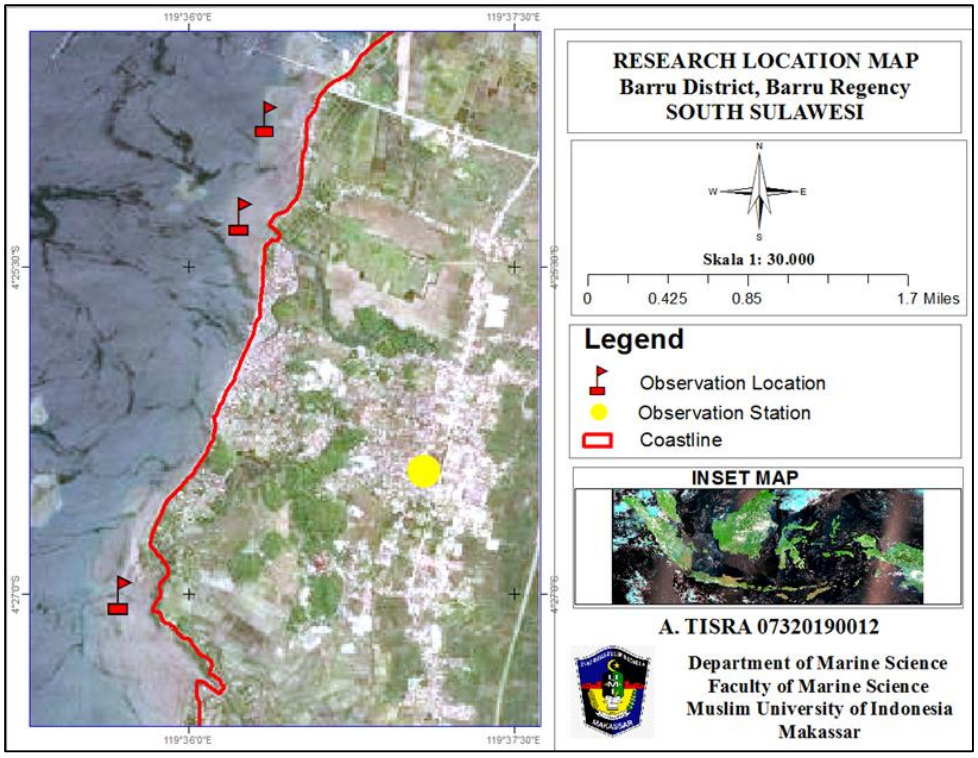

Fig 1: Research Location Map

The equipment and materials used in this research include a Laptop as the hardware for image processing, ArcGIS and ER Mapper software as image processing tools, a Camera for documentation, writing tools, GPS (Global Positioning System) for determining observation positions, Landsat 8 imagery, and RBI (Indonesian Topographic Map) for image processing.

The data collection technique used in this research is descriptive data collection. The data used in this study includes primary data obtained from field observations and secondary data obtained from RBI (Indonesian Topographic Map) and Landsat 8 satellite imagery data.

The method used for determining the research location is Purposive Sampling. The consideration for using this method is because Purposive Sampling is a technique for selecting locations based on specific considerations related to the distribution of TSS.

Data analysis

Stages in image data processing to generate Total Suspended Solid (TSS) distribution using Er Mapper 7.0 and ArcGIS software applications, as well as Landsat 8 data and Geographic Information Systems (GIS). The analysis conducted in this research utilizes remote sensing technology and ArcGIS approach, where spatial analysis is integrated with the Geographic Information System (GIS) to determine the TSS distribution in the coastal area of Barru Regency. The spatial analysis of TSS distribution utilizes the Universal Transverse Mercator (UTM) coordinate system and projection. The remote sensing data analyzed in the stages of sediment distribution monitoring consists of Landsat 8 satellite imagery data for the years 2014, 2018, and 2022, which have been radiometrically corrected. The combination of satellite image data bands is used to determine sediment distribution. The next stage involves remote sensing satellite data, which is commonly in raster format, being converted into vector format. TSS distribution with GIS involves the conversion of Digital Number (DN) values to Top of Atmosphere (TOA) reflectance corrected for solar angles. The formula for geometric correction and conversion from radians to TOA reflectance is as follows:

$$\rho\lambda' = M\rho * Qcal + A\rho$$

Description
$M\rho =$ Rescaling constant
$A\rho =$ Addition constant
$Qcal =$ DN Pixel Value
In calculating the distribution values of TSS, the Budiman S algorithm (2004) is used.

$$TSS\ mg/L\ =\ 8.1429\ (EXP(23.704\ 0.94) \times Red\ Band.$$

Results

Distribution and extent of sedimentation in the coastal area of Barru Regency, Barru District.

a) Distribution area of Total Suspended Solid in 2014

Based on the interpretation of Landsat 8 satellite image data in the coastal area of Barru District in 2014, it is known that TSS with an area of 135 ha (Figure 2).

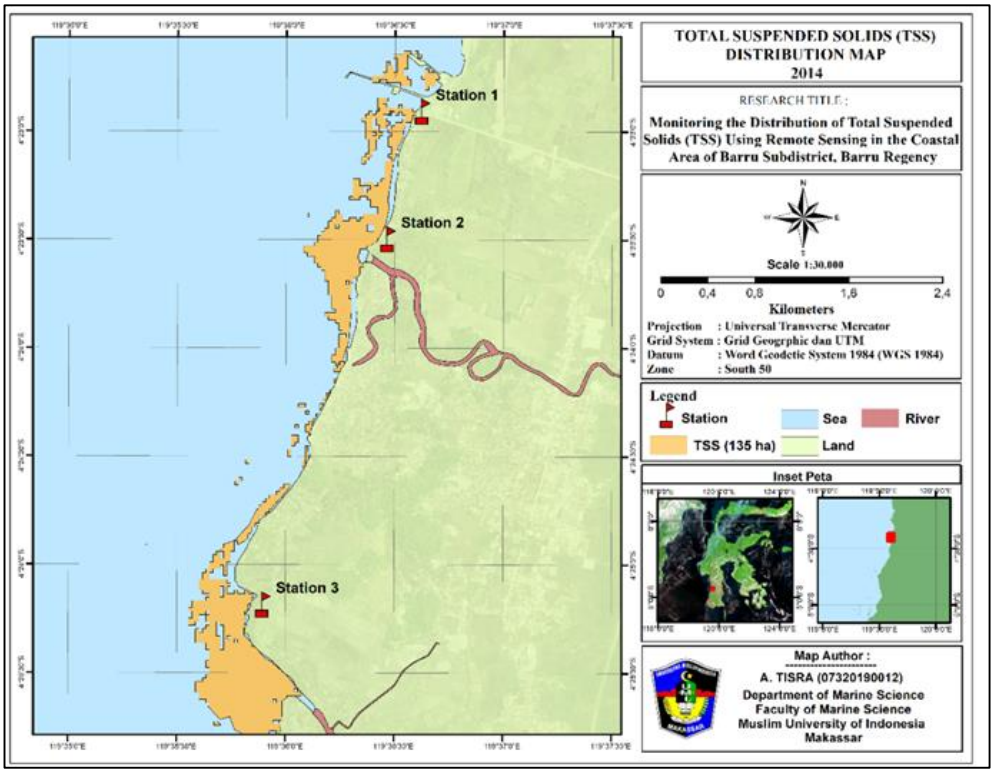

Fig 2: The Total Suspended Solids Distribution Map for 2014

b) Total Suspended Solid distribution area in 2018

Based on the interpretation of Landsat 8 satellite image data in the coastal area of Barru District in 2018 it is known that TSS is spread over an area of 143 ha (Figure 3).

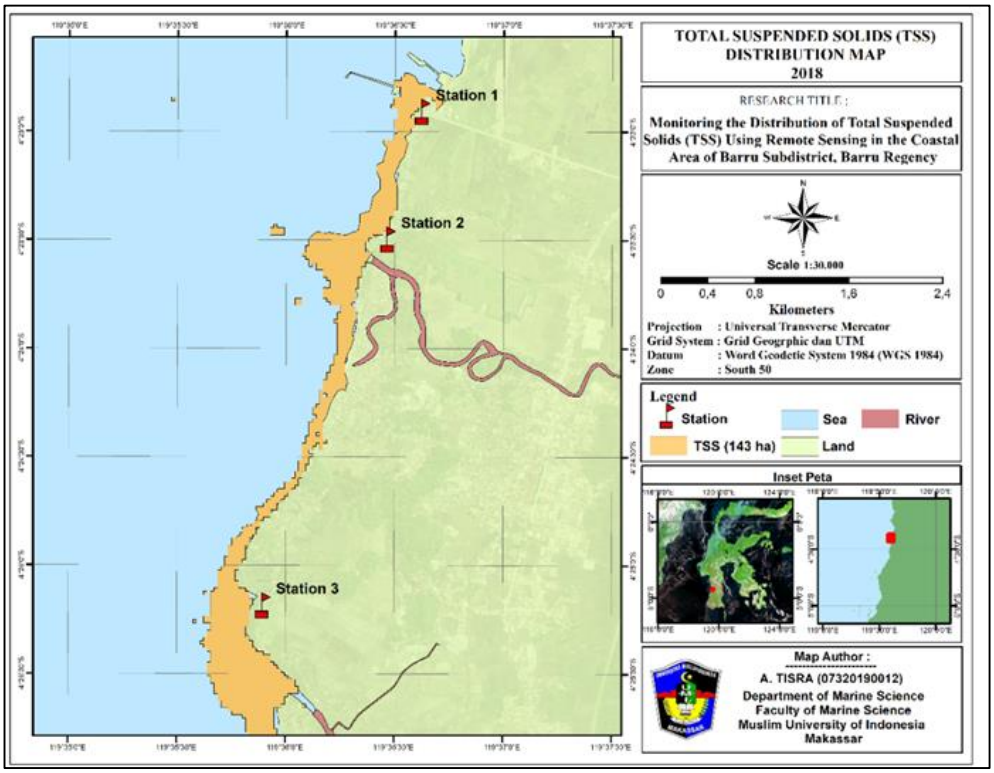

Fig 3: The Total Suspended Solids Distribution Map for 2018

c) Total Suspended Solid distribution area in 2022

Based on the interpretation of Landsat 8 satellite image data in the coastal area of Barru District in 2022, it is known that TSS with an area of 127 ha (Figure 4).

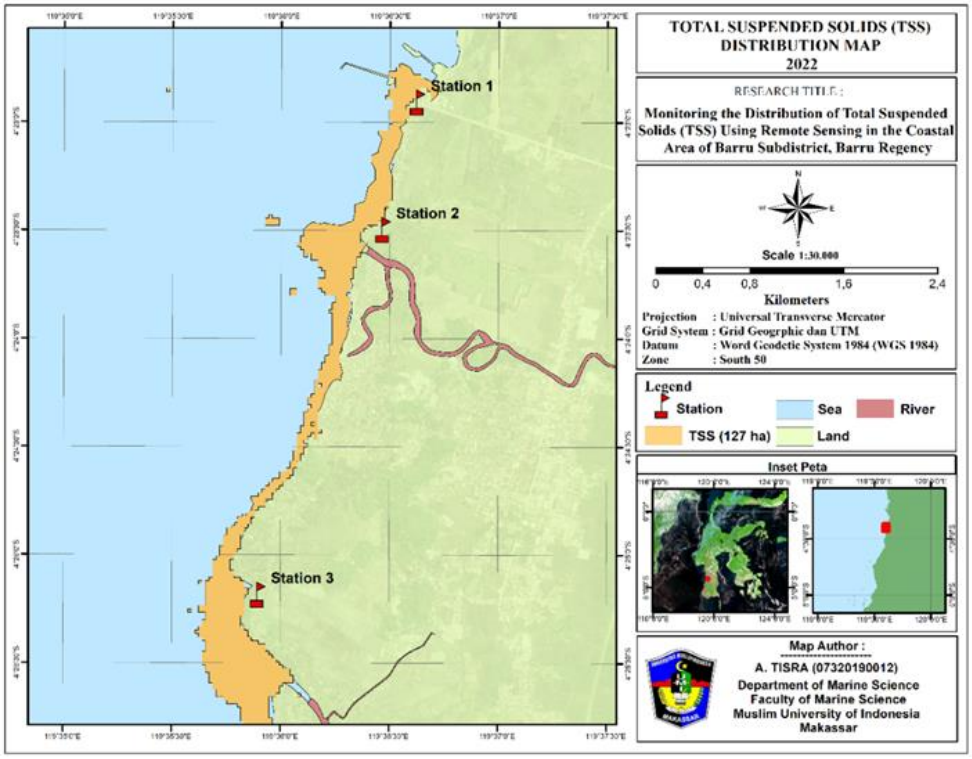

Fig 4: The Total Suspended Solids Distribution Map for 2022

Selection of the most appropriate algorithm for the study area is carried out by comparing the results of the TSS distribution of the algorithm used. The comparison of TSS values was carried out in three years, namely 2014, 2018 and 2022 where every year in month 7 because the observed observations are areas free from the influence of clouds. The results of the interpretation of the three data in 2014, 2018 and 2022 in every 7 months sho that the distribution of TSS was wider in 2018.

Comparison of Total Suspended Solid Distribution

The comparison of the extent of TSS distribution in the years 2014, 2018, and 2022 is presented in the diagram below.

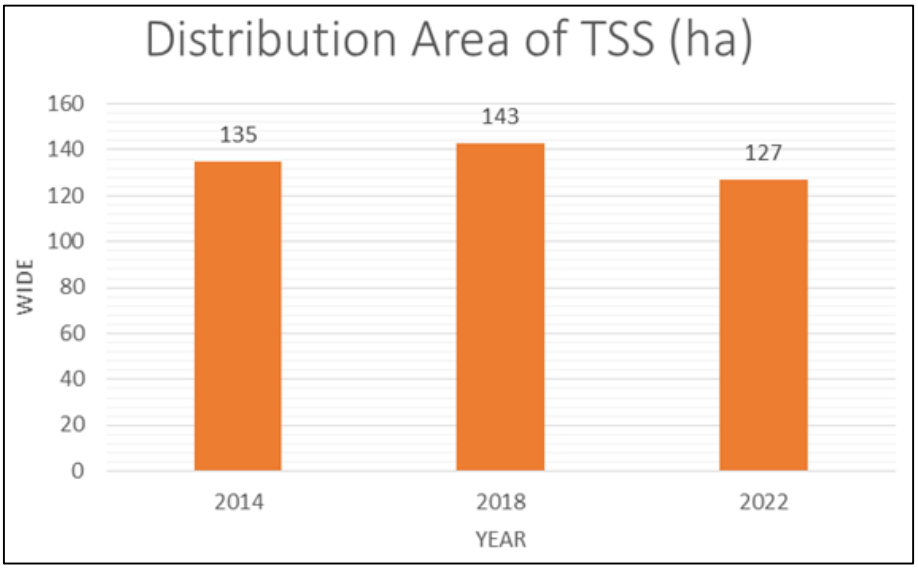

Fig 5: Comparison Diagram of the Extent of Total Suspended Solids Distribution in 2014, 2018, and 2022

Based on the Budiman S algorithm, the TSS concentration observed using Landsat 8 satellite imagery processed using remote sensing applications indicates a large extent of distribution in the year 2018, with a coverage area of 143 hectares. On the other hand, the lowest extent of distribution is found in the year 2022, with an area of 147 hectares, while in the year 2014, the TSS distribution covered an area of 135 hectares.

Accuracy Testing of Image Data. Based on the validation results of the image data and calculations performed, the following accuracy measures were obtained: procedural accuracy (to determine accuracy points based on field facts), user accuracy (to determine accuracy levels based on image interpretation), overall accuracy, and kappa accuracy. The accuracy test results for each class can be seen in Table 1.

Table 1: The Results of Accuracy Test Calculation

Image Classification	*Procedur Accuary*	*User Accuary*	*Overal Accuary*	*Kappa Accuary*
TSS	100%	100%	84,21%	80,84%
Beach	100%	85,71%		
Pond	100%	50%		
Mangrove	25%	100%		

Based on the table above, it can be seen that the accuracy rates vary for each land use type. From the calculation results, the overall accuracy value is 84.21%. According to the guidelines for supervised digital classification of multispectral satellite data prepared by Lapan in 2015, as mentioned in Asma (2018), the image classification is considered correct if the Confusion Matrix calculation result is >75%. Based on the obtained overall accuracy and kappa accuracy calculations, the classification results can be accepted.

Discussion

Based on the findings presented in this research, the following conclusions can be drawn:

1. The use of high-resolution imagery improves the quality and accuracy of data processing. High-resolution images provide more detailed information, leading to better analysis outcomes.
2. To obtain more accurate TSS analysis results, it is recommended to use algorithms that are suitable for the research location. Inappropriate algorithm selection for the specific research location may result in irrelevant analysis values. It is important to consider the characteristics and conditions of the study area when choosing an algorithm for TSS analysis.

Conclusion

Based on the research conducted in the coastal area of Barru Subdistrict, Barru Regency, it can be concluded that the extent of TSS distribution in the years 2014, 2018, and 2022 is 135 hectares, 143 hectares, and 127 hectares, respectively, with an accuracy test result of 80.84%.

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