

Application of satellite remote sensing technology in monitoring sediment distribution in the coastal waters of Pangkep Regency, South Sulawesi, Indonesia

¹Abdul Rauf, ²Muhammad I. Wamnebo, ¹Kamil Yusuf

¹ Department of Marine Science, Faculty of Fisheries and Marine Sciences, Indonesian Muslim University, Makassar, Indonesia; ² Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Muslim University of Indonesia, Makassar, Indonesia.
Corresponding author: A. Rauf, arauf_umimksr@yahoo.com

Abstract. Information concerning the distribution of sedimentation is very useful in determining utilization activities in coastal areas, especially for aquaculture and coastal tourism activities. This study aims to interpret the distribution and extent of sediment in the dry season and rainy season in the coastal waters of Pangkep Regency by using the application of satellite remote sensing technology. The present research used a satellite remote sensing technology application approach and Geographic Information System (GIS). The results showed that the sedimentation in the coastal area of Pangkep Regency were spread evenly along the coast in the dry and rainy season, with sedimentation areas of 2,232 ha and 2,010 ha, respectively. The average distance of sediment distribution from river estuaries (large and small) to the sea during the dry and rainy seasons was 992.53 m (0.99 km) and 983,455 m (0.98 km), respectively. The average distance of the distribution of sediment along the coast to the sea in the dry and rainy seasons was 507.80 m (0.51 km) and 379.78 m (0.38 km), respectively.

Key Words: sedimentation, Landsat-8 Satellite Imagery, coastal areas, Geographical Information Systems (GIS).

Introduction. Pangkep Regency has a coastline of 49.71 km (Rauf et al 2019). Along the coast there are several large and small river estuaries so that they contribute quite a lot to sedimentation (TSS) (Arsyad 2000) and cause a decrease in water quality (Suripin 2002). The cause of TSS in waters is soil erosion that is carried into water bodies (Nasution 2008; Purwadi et al 2016). The existence of this sediment can result in turbidity and reduced penetration of sunlight into water bodies, thereby disrupting utilization activities in coastal and marine areas such as marine cultivation, marine tourism beach recreation, and others. For this reason, data and information are needed how far and wide the sedimentation entering the coastal and marine areas in these locations. Remote sensing can be used to detect the distribution of sediment quickly over a large area (Prahasta 2009). Therefore the aim of the present research was to determine the distribution and area of sediment in the rainy and dry season in the coastal waters of Pangkep Regency by using the application of satellite remote sensing technology.

Material and Method. The method used in the present research was survey and application of remote sensing technology and Geographical Information System (GIS). This research was conducted along the coast of Pangkep Regency (Figure 1).

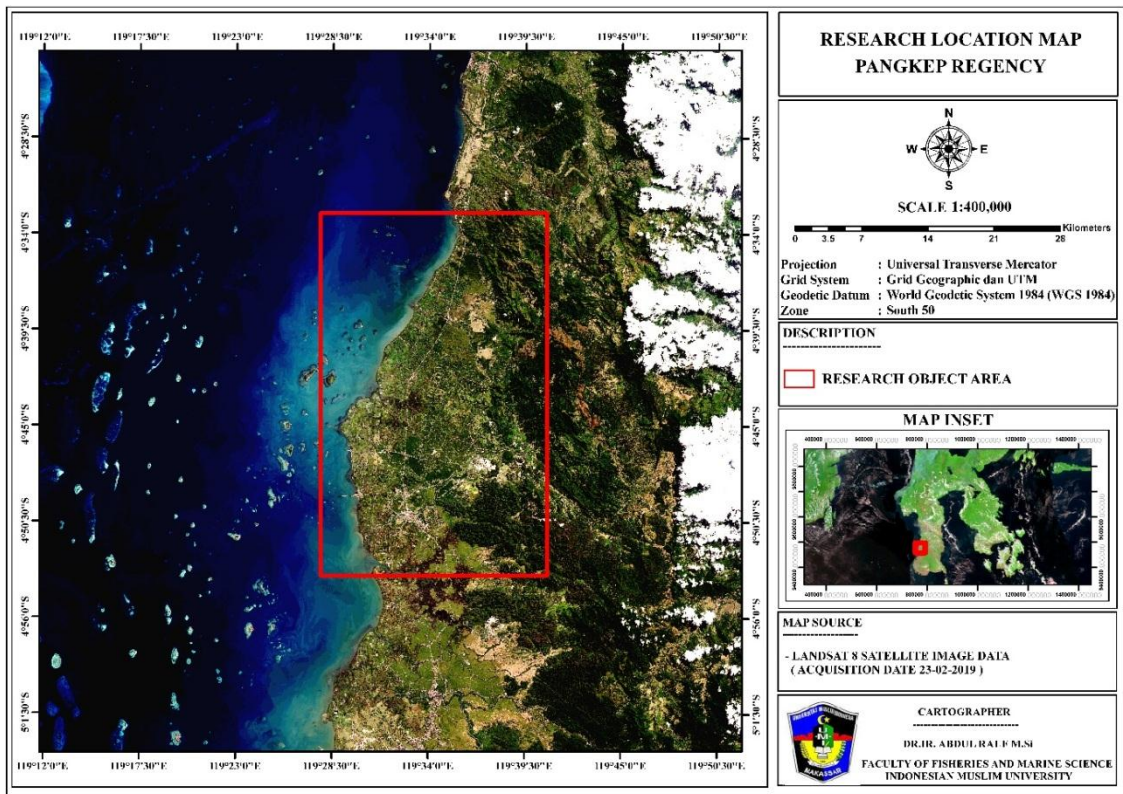


Figure 1. Map of the research location.

The present research was carried out by following the protocol presented in Figure 2.

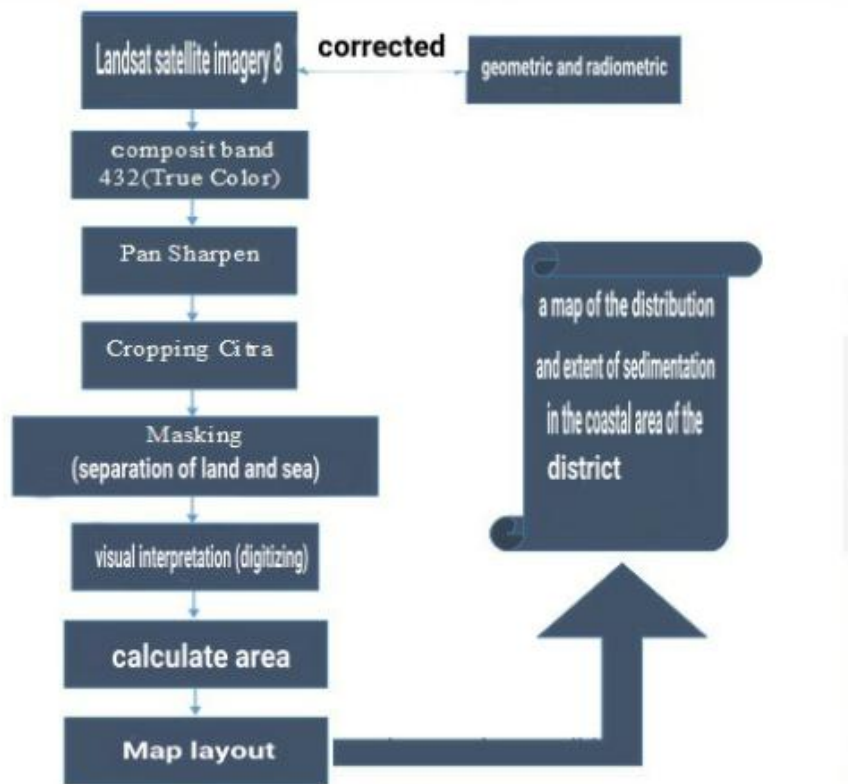


Figure 2. Research flow.

The research design was carried out through several stages of activities presented in the form of a flow chart (Figure 2) as follows:

- 1) The preparation stage. This stage is the first step before conducting field research, namely conducting literature studies, selecting satellite images and field observations.
- 2) Implementation stage. The method used in making a sedimentation distribution map and its area is by using the Landsat 8 satellite remote sensing technology application, namely the ER Mapper 7.0 software and ArcGis 10.3 software which were carried out in the remote sensing laboratory and GIS FPIK-UMI. Activities carried out at this stage are data import, image cropping, image compositing, and image sharpening and data interpretation.

Data analysis. The data analysis used in this study is a spatial analysis using satellite remote sensing technology and geographic information systems.

1. Analysis of remote sensing data

The data analyzed at this stage is the Landsat 8 satellite image data (July 2018 and February 2019) which has been corrected radiometrically and geometrically. In this analysis, visualization and interpretation are carried out to determine the distribution of sedimentation through a combination of composite satellite image data. Furthermore, digital remote sensing data is converted into data that can be aggregated with GIS data (vector format data) through digitization.

2. Analysis of the distribution of sedimentation with GIS

Analysis of the distribution of sedimentation was carried out by digitizing the boundaries of the distribution of sedimentation at sea along the coastal and marine areas of Pangkep Regency.

Results

Distribution and extent of sedimentation in the coastal zone of Pangkep Regency

a. Dry season

Based on the interpretation of satellite image data in the coastal area of Pangkep Regency during the dry season, it was found that the sediment spreads along the coast with an area of 2,232 ha (Figure 3).

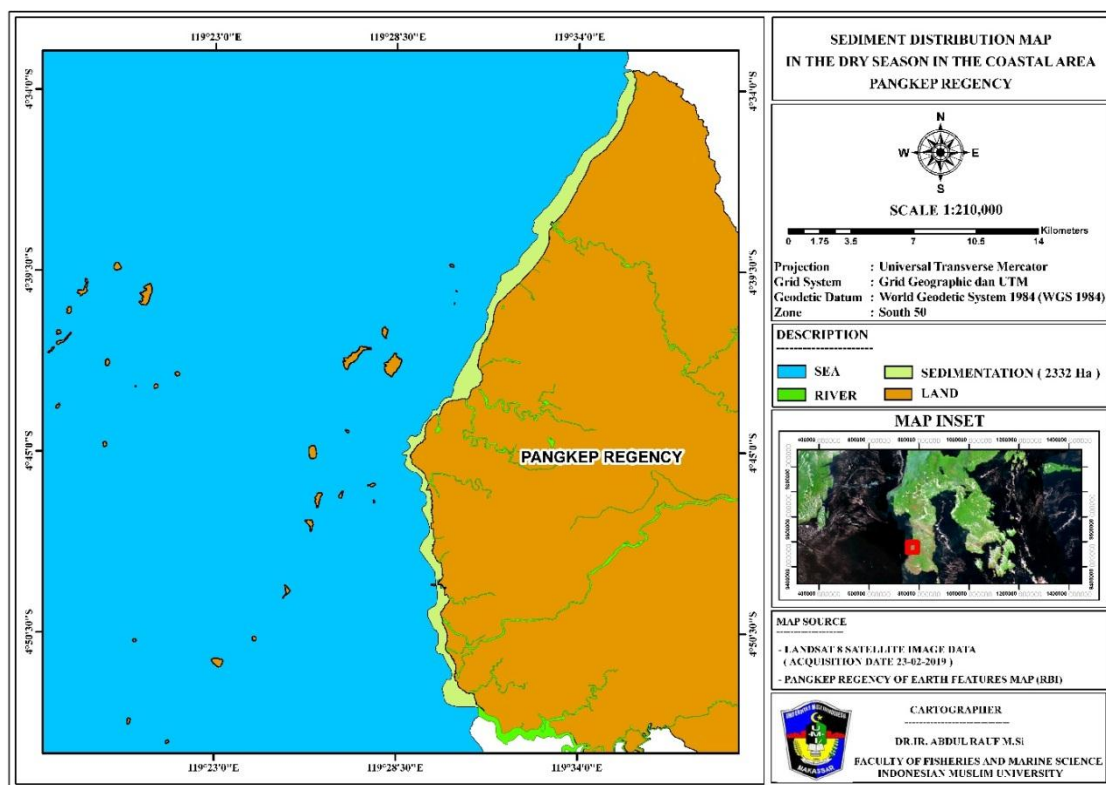


Figure 3. Results of interpretation on the distribution of sedimentation in the dry season (Google image. 2014).

b. Rainy season

The results of the interpretation of Landsat-8 satellite imagery data in the coastal area of Pangkep Regency during the rainy season found that sediment spreads along the coast with an area of 2,010 ha (Figure 4).

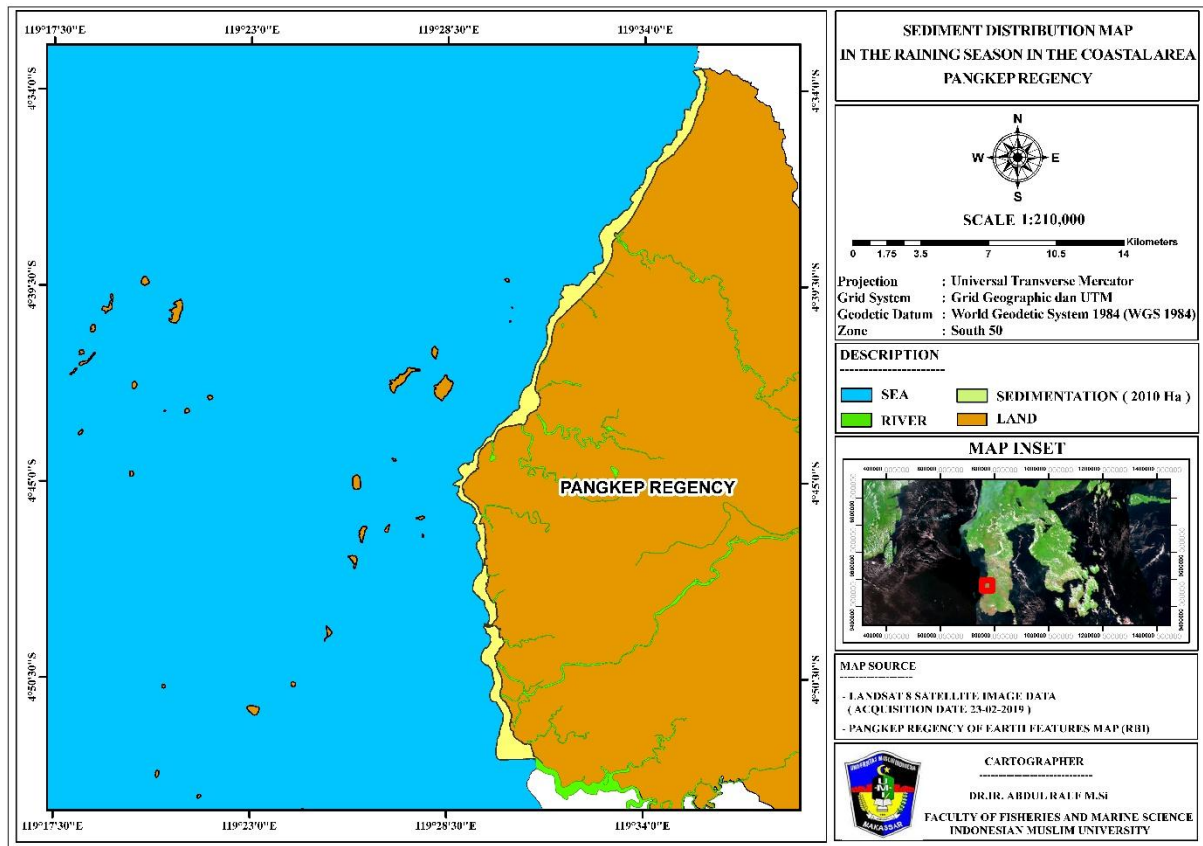


Figure 4. Interpretation results of the distribution of sedimentation in the rainy season (Google image. 2014).

The results of the interpretation of the two data within different years and months indicate that the distribution of sediment is wider during the dry season than during the rainy season. The high sedimentation in the coastal and marine areas of Pangkep Regency during the rainy season and the dry season is thought to be due to the large number of rivers that flow into the sea, where the number of river estuaries along the coast of Pangkep Regency is 24 river estuaries consisting of 7 large rivers and 17 small rivers. The number of rivers was obtained from the interpretation of satellite data from Landsat 8, SPOT 6 and Google Earth for Pangkep Regency.

Average distance of sedimentation distribution from coastline to sea in the coastal area of Pangkep Regency. In determining the average distance of the distribution of sedimentation from the coastline to the sea in the coastal area of Pangkep Regency, 30 random points were taken on the processed satellite image data, starting from the farthest distance to the closest distance. The results of these measurements are added and divided by the number of points to produce the average distance. The average distance of sediment distribution along the coast of Pangkep Regency, starting from the border of Maros Regency to the border of Barru Regency, was found in the dry season of 507.80 m (0.51 km) while in the rainy season it was 379.78 m (0.38 km).

This average result can be used as recommendations for policy making in determining locations that have the potential to be used as utilization areas, especially marine cultivation activities and coastal tourism activities. All of these activities are not suitable for the conditions of the turbid waters or high sedimentation, so the

sedimentation distance is very important as a reference in choosing a suitable location for these activities.

The influence of surrounding environmental factors on the distribution of sedimentation in the coastal areas of Pangkep Regency. Watershed (DAS) is a sediment transport medium from land (upstream) to sea (downstream) (Wibowo 2010). Sediment from land that enters the watershed can be sourced from land water flows that enter rivers, such as water discharge from ponds, rice fields, irrigation, settlements or deforested land during the rainy season (Saripin 2003).

The results of interpretation of satellite image data show that Pangkep Regency has 24 river estuaries that empty into the sea (BPS 2018). In the upper land (upstream area) along the river there are many ponds, rice fields, mixed gardens, empty land and forests with sparse conditions. All of these land uses contribute to high sedimentation in the river during the rainy season, including landslides (erosion) that occur along the river.

The impact of this sedimentation in addition to causing silting in rivers, also greatly affects the environment for organisms or biota that live in rivers or estuaries or in the sea that are affected such as savannah (Wibowo 2010), if the sedimentation is high, it can interfere with its growth (Hidayat et al 2014) because this plant really requires sufficient sunlight for the photosynthesis process, besides that, land use in coastal areas is very limited due to high sediment, especially for cultivation and coastal tourism, both for seaweed cultivation and fish farming and coastal tourism. Therefore the research results are very useful as basic data in determining utilization activities to be carried out in coastal and marine areas.

Discussion. In the West monsoon, sediment spreads along the coast with an area of 2,232 ha and in the East monsoon the sediment spreads along the coast with an area of 2,010 ha (BPS 2018). The high sedimentation in the coastal and marine areas of Pangkep Regency during the rainy season and the dry season is thought to be due to the large number of rivers that empties into the sea (Saripin 2003). Where the number of river estuaries along the coast of Pangkep district are 24 river estuaries. The average distance of sediment distribution along the coast of Pangkep Regency, starting from the border of Maros Regency to the border of Barru Regency, in the dry season was 507.80 m (0.51 km) while in the rainy season was 379.78 m (0.38 km).

Conclusions. Based on the description of the results and the previous discussion, it can be concluded as follows:

- Sedimentation in the coastal area of Pangkep Regency spreads evenly along the coast, both during the dry and rainy seasons, with sedimentation areas of 2,232 ha and 2,010 ha, respectively.
- The average distance of sediment distribution along the coast to the sea, both during the dry and rainy seasons was 507.80 m (0.51 km) and 379.78 m (0.38 km), respectively.
- Watershed (DAS) is an environmental factor that greatly influences the distribution of sedimentation in the coastal area of Pangkep Regency.

References

- Arsyad S., 2000 Soil and water conservation. IPB Press, Bogor, Indonesia.
- Hidayat M., Ruswahyuni, Widyorini N., 2014 Sedimentation Rate Analysis in the Seagrass Region with Different Density Levels on the Panjang Island, Jepara. Diponegoro Journal of Maquares 3(3):73-79.
- Nasution M. I., 2008 Determination of Ammonia Ammonia and Total Suspended Solids in Wastewater Treatment PT. Bridgestone SumateraRubber Estate Dolok Merangkir. University of North Sumatra.
- Prahasta E., 2009 Geographical Information Systems Basic Concepts (Geodesy and Geomatics Perspective). Bandung: Informatics.

- Purwadi O. T., Indriana D., Lubis A. M., 2016 Analysis of Sedimentation in the Way Besai River. *Engineering. Journal*, Vol. 20, No. 3, December 2016. Faculty of Engineering, University of Lampung.
- Rauf A., Yusuf K., Asmidar, Kasnir M., Tajuddin M., 2019 Application of Remote Sensing Technology and Geographical Information Systems in Monitoring the Potential of Coastal and Marine Resources in Pangkep Regency. Volume 1 No 1, *Journal Of Indonesian Tropical Fisheries*. FPIK-UMI
- Saripin I., 2003 Study of Future Satellite Utilization: Remote Sensing System Ldc Satellite (Landsat-8) *Agricultural Engineering Bulletin* Vol.8 No.2.
- Suripin, 2002 Conservation of Soil and Water Resources, Publisher ANDI, Yogyakarta.
- Wibowo, 2010 Ocean currents. Research Center for Marine and Non-Living Resources, Jakarta.
- *** BPS (Central Bureau of Statistics for Pangkajene Regency and the Islands) 2018 Pangkep in numbers. Central Bureau of Statistics, Pangkep, Indonesia.
- *** Google image.2014.<http://googleimage.com/> accessed on December 5, 2014 at 20.00 WIB.

Received: 14 September 2020. Accepted: 22 October 2020. Published online: 30 October 2020.

Authors:

Abdul Rauf, Indonesian Muslim University, Faculty of Fisheries and Marine Sciences, Department of Marine Science, Indonesia, 90231 Makassar, Jl. Urip Sumoharjo KM 5, e-mail: arauf_umimksr@yahoo.com

Muhammad Ikhsan Wamnebo, Indonesian Muslim University, Faculty of Fisheries and Marine Sciences, Department of Aquaculture, Indonesia, 90231 Makassar, Jl. Urip Sumoharjo KM 5, e-mail: ikhsanwamnebo25@gmail.com

Kamil Yusuf, Indonesian Muslim University, Faculty of Fisheries and Marine Sciences, Department of Marine Science, Indonesia, 90231 Makassar, Jl. Urip Sumoharjo KM 5, e-mail: kamilyusufumi@gmail.com

This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

How to cite this article:

Rauf A., Wamnebo M. I., Yusuf K., 2020 Application of satellite remote sensing technology in monitoring sediment distribution in the coastal waters of Pangkep Regency, South Sulawesi, Indonesia. *AACL Bioflux* 13(5):3182-3187.