



Random Forest Classification for Calculating the Area of Mangrove Forest in Benoa Bali Bay

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Abstract. The Benoa Bay area in Bali is an interesting area to study because of its influence on the community's economy and the presence of mangrove forests in overcoming the issue of climate change, especially in Bali. The extent of mangrove forests in the bay of the continent of Bali needs to always be observed considering their great influence on life. This research aims to provide information on the extent of mangrove plants found in Benoa Bay, Bali. The technique used is to classify satellite images using the random forest method so that the area of mangrove plants in Benoa Bay, Bali, can be measured. The steps taken in this research are: Image acquisition, pre-processing, pixel classification using random forest and measuring the area of mangrove plant objects in Benoa Bay, Bali. The area of mangrove forest obtained was 1,230.4 hectares. There was a decrease in area compared to previous research of around 143.1 hectares..

Keywords: Benoa Bay, Mangrove, Random Forest.

1 Introduction

The Benoa Bali area is one of the areas in the east of Bali which has various functions and strategic roles for the lives of the Balinese people. The Benoa Bali area is used as a buffer for various water use functions such as sea transportation routes. The Benoa Bali area is also used as a habitat for mangrove plants [5] [2]. Benoa Bay is also a tourism area located in South Kuta District, Badung Regency, Bali. The total area of the mangrove ecosystem in Benoa Bay is around 1,373.50 ha [6]. The Benoa area is very interesting to study considering the various functions it has. The mangrove ecosystem has high productivity both ecologically and economically. The mangrove ecosystem has the ability to store high carbon which is useful in reducing greenhouse gas emissions. The results of previous research show that mangrove ecosystems are capable of storing three to four times more carbon than forests. The majority of carbon is stored in the soil. This makes the mangrove ecosystem have an important role in mitigating climate change. However, mangroves can be effective in supporting carbon dioxide emission mitigation if the level of mangrove deforestation is low. [4]

To monitor the condition of mangrove forests is to use remote sensing. The use of remote sensing technology makes it possible to analyze various mangrove forest

conditions at any one time. One thing that can be monitored is the area of mangrove forests. This research aims to apply the random forest classification method to measure the area of mangrove forests in the Benoa Bali area. The random forest method was chosen because it has good performance in classifying data[8]. The random forest classification method has also been widely used in various fields and as a method in machine learning [1] [3]. The stages carried out are Data Acquisition, pre-processing, Random Forest Classification and Area Calculation.

2 RESEARCH METHODS

This research consists of 4 core stages. The stages of this research can be seen in Fig 1.

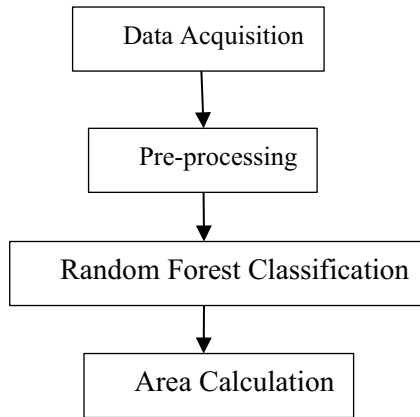


Fig. 1. Research Methods.

2.1 Data Acquisition.

The data used in this research is secondary data obtained using sentinel satellite imagery obtained by the European Union/ESA/Copernicus. The Copernicus data used is in 2023. Copernicus is a part of the European Space Program. Open and free Copernicus data consists of 6 Earth observation data services, namely climate change, maritime monitoring, atmospheric layer monitoring, land monitoring, security and emergency mitigation. Data access is carried out using Google Earth Engine

2.2 Pre-processing

This stage includes:

Observation Object Filtering. This stage is carried out for Layer masking which is used to narrow the data processing area. Layer masking is also used to speed up data

retrieval. Formation of layers of mangrove areas in Tanjung Benoa, Bali. The formation of the mangrove area layer is the boundary of the mangrove conservation area in Benoa Bali. The mangrove area layer was formed by digitizing the mangrove area in Benoa on the map of Bali province.

Cloud object Filtering. The Copernicus satellite image obtained at the data acquisition stage still contains cloud objects, so the cloud objects are noise so they need to be removed. The method used uses Quality Assessment (QA) on the pixels that form the cloud object. On the sentinel satellite, cloud objects are located in the QA band with a spatial resolution of 60 meters. Band QA 60 is the band that contains cloud objects in the Copernicus image. To obtain a cloud object, there are 2 pixel components that are analyzed. Components of cloud sets and cirrus clouds. The cloud collection is obtained by analyzing bit 10 in the image, while for cirrus clouds the bit analyzed is bit 11. Or in other words, the image with bit 10 is a cloud object and the image component with bit 11 is the cirrus component. The other values will be set to 0 and saved as a cloud masking object. After the cloud masking object is formed, the satellite image that was carried out in the previous step will be operated using a median filter.

Determination of Image Object Features. The image object feature used is the canopy feature. The canopy feature is the top view of the mangrove plant object. The canopy features used are 6 types of mangrove appearance in satellite images.

2.3 Random Forest Classification

Random Forest is a supervised learning algorithm. "Forest" is a collection of decision trees and the training process is usually using the "bagging" method. The general idea of the bagging method is a combination of learning models to improve overall results. Random Forest classification uses canopy features that have worked on the appearance of mangrove objects that have been determined in the previous step. [8] [3]

2.4 Area Calculation

The final stage is to calculate the area of the mangrove object according to the random forest classification results.

3 RESULTS AND DISCUSSION

The following are the results and discussion of this research

3.1 Observation Object Filtering

The results of the observation object filter stage can be seen in the Fig 2.

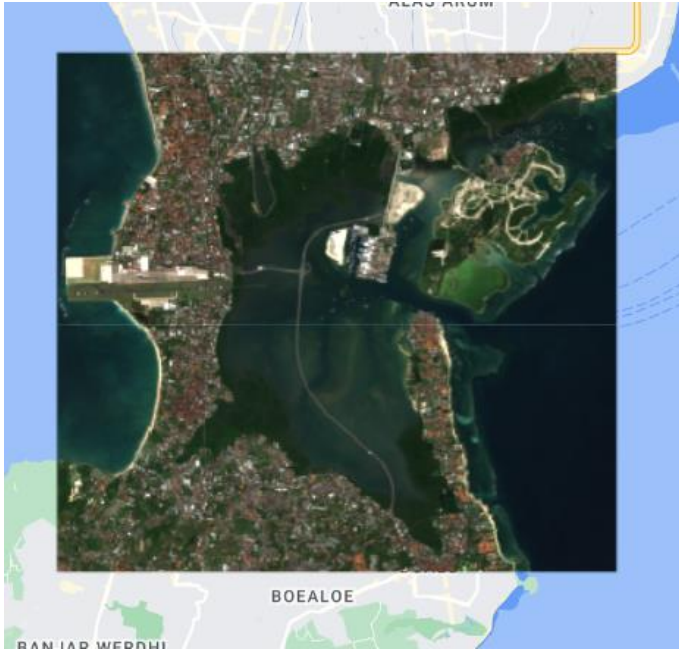


Fig. 2. Observation Object Filtering.

In Figure 2 you can see 2 views, namely the satellite view and the map view, which overlap. This step is taken to limit and focus the world map to the location of the object of observation.

3.2 Cloud object Filtering Result

The results of the cloud removal process can be seen in figure 3.

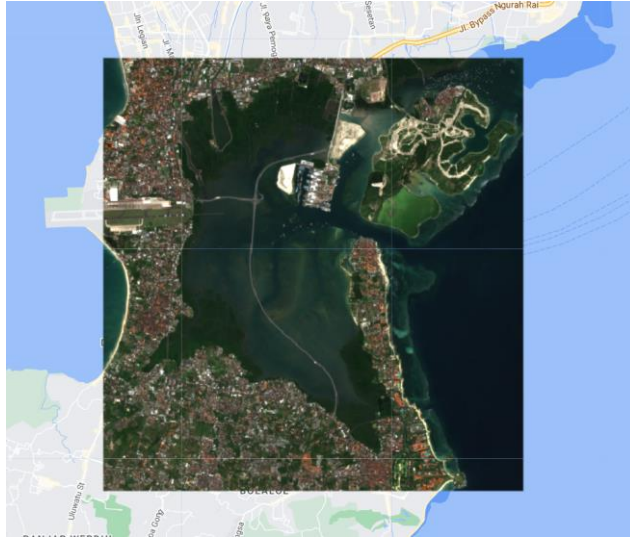


Fig. 3. Cloud object Filtering Result.

In Figure 3 above, you can see that the object is clearer because the cloud removal process uses a median filter. The median filter uses the middle value so that it can improve image quality through removing noise (clouds) [7].

3.3 Determination of Image Object Features

In this study, 6 canopy features of mangrove plants were used. The canopy features used can be seen in the Figure 3

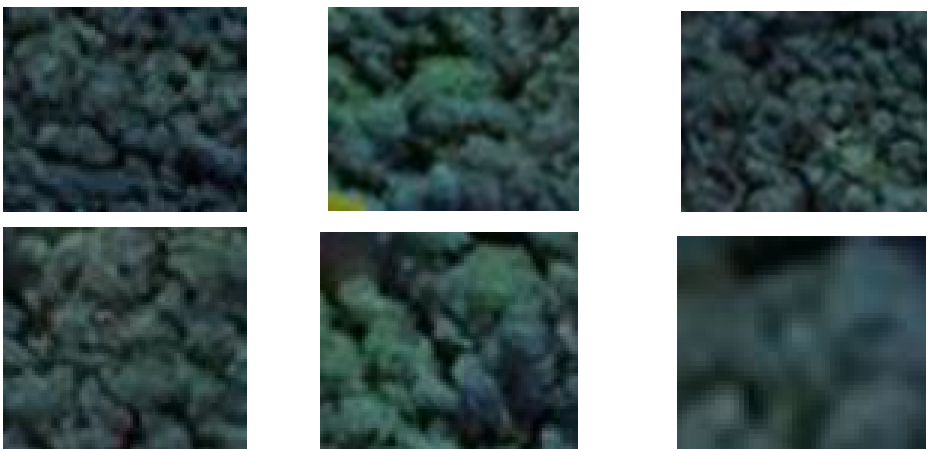


Fig. 4. Canopy Features.

The canopy feature used is based on real conditions in the field and is a top view of the mangrove plant. Canopy features are taken from objects with different pixel colour content

3.4 Random Forest Classification Result

The results of applying object analysis using random forest can be seen in figure 5

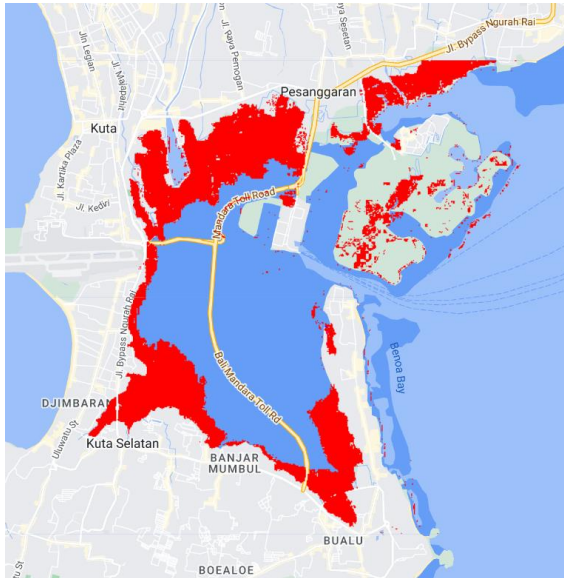


Fig. 5. Random Forest Classification Result.

The red image above indicates the mangrove area. The area of mangrove plants in Benoa Bay, Bali is 1230.4 hectares, measured using random forest classification with mangrove forest type canopy features. There is a difference with previous research [6] of 143.1 hectares. If we look at the previous research year, there was a change in area of around 143.1 hectares over 3 years and there was a decrease in area.

4 CONCLUSIONS

Calculating the area of mangroves in the Benoa Bali area using canopy features and random forest classification produces an area value of 1230.4 hectares. There is a difference with previous research of 143.1 hectares. The cause of this difference needs to be investigated further considering the importance of the mangrove area in Benoa Bali

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