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Identification Of Mangrove Forest Damage By Using Object Based Image Analysis Study Case: Taman Hutan Raya Ngurah Rai, Denpasar, Bali

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Abstract – Mangrove forests have several functions, namely preventing the intrusion of sea water, erosion, abrasion, and was instrumental in the formation of the island and stabilize the presence of coastal habitat. Mangrove forest area of Denpasar, Bali is the largest mangrove forest in Indonesia. Taman Hutan Raya Ngurah Rai in 1993 has an area of 1373.50 ha based on the Ministerial Decree No. 554 / Kpt-II / 1993. Remote sensing providing opportunities for identifying, monitoring, mapping and calculation of the extent of land cover and deforestation. This mapping is very effective and efficient, especially for areas experiencing the dynamics of land use changes very fast. By looking at the dynamics of forest area changes from year to year, this research needs to be done to see how big the impact of land use change on forest area. One of the technologies and methods in the identification of remote sensing image information that is object-based image analysis (OBIA). OBIA classification process is an approach that not only take consider the spatial aspects but also the spatial aspects of the object. The research objective is to knowing the damage to mangrove forests and extensive damage at Tahura, Ngurah Rai, Bali 2015 by using remote sensing data Sentinel-2. This research develops methods for the identification of mangrove deforestation and Providing advice in the planning of land use in the management of coastal mangrove forests.

Keywords: Identification, Mangrove Damage, OBIA, Bali

1. Introduction

Mangrove forests are forest areas that are in the tidal area in which there is a swamp ecosystem. According to [1], mangrove forests are forests growing on brackish water marshes located on the coastline and affected by ocean tides. Mangrove forests grow in places silting and accumulation of organic matter.

The mangrove forest is a complex ecosystem composed of flora and fauna as well as a beach and a lively variety of habitat land and sea, between the boundary and low-tide. Mangrove forests have several functions, among others, prevent the intrusion of sea water, prevent erosion and abrasion, and was instrumental in the formation of the island and stabilize the presence of coastal habitat. Other functions for the environment, one of which is a carbon sink in the atmosphere. Carbon sequestration process itself comes from the absorption of CO₂ by photosynthesis that is then absorbed by the atmosphere and water in the soil which then produces O₂ and carbohydrates.

Mangrove forest area of Denpasar, Bali is the largest mangrove forest in Indonesia. Taman Hutan Raya Ngurah Rai in 1993 has an area of 1373.50 ha based on the Ministerial Forestry Decree No. 554 / Kpt-II / 1993.

According to [5], Remote Sensing is the science or art of obtaining information about an object, area or phenomenon, by analysing the data obtained by using the tool, without direct contact with the object, area or phenomenon to be studied. According to [8], Remote sensing is measurement or acquiring information from several properties of an object or phenomenon, using a tape recorder does not physically direct contact or contact with objects or phenomena under study. According to [11], Remote sensing system consists of several components, namely:

1. The source of power,
2. The atmosphere,
3. Object,
4. Sensors,
5. The data acquisition and data usage.

Every appearance on the earth's surface can be tracked information because each object has a distinct spectral characteristic in interaction with the energy that hits, giving rise to differences in the amount of reflected energy. Sensors mounted on a vehicle, serves as a natural power recorder remote sensing systems.

Geographic Information Systems (GIS) is a system that has a spatial element that represents the earth's surface appearance of the object in terms of both qualitative and quantitative. According to [4], SIG is a computer system for capturing, storing, querying, analysing and displaying geographic data.

Remote sensing technology and GIS provides the opportunity to do exactly the identification, monitoring, mapping and calculation of the extent of land cover and deforestation. This mapping is very effective and efficient, especially for areas experiencing the dynamics of land use changes very fast. By looking at the dynamics of forest area changes from year to year, this research needs to be done to see how big the impact of land use change on forest area.

High resolution remote sensing imagery is widely used in monitoring and forest mapping. Wiretap information using a medium resolution remote sensing imagery more frequently using the extraction-based. Each pixel values in remote sensing image representing the object appearance but less attention to the spatial aspect.

The development of technologies and methods in the identification of remote sensing image information, either in the form of object-based image analysis (OBIA). According to [7], OBIA classification process is an approach that not only take consider the spatial aspects but also the spatial aspects of the object. The object is formed through a process of segmentation that is the process of grouping the adjacent pixels with the same quality (spectral similarity). According to [6], the classification process by the method OBIA through two main stages, namely image segmentation and classification of each segment.

We using OBIA because we considered more superior than pixel-based classification because it is not only considering spectral aspects but also spatial aspects. The appearance of land use in a region one of which related to the growth of population and its activities. The increasing population and more intense activity of the population at somewhere impact on the increasing changes in land cover. Referring to the condition required a more representative method for the extraction of information on land use. OBIA with the specification that the analysis is based on the appearance of spectral and spatial considered able to accommodate the image of the object appearance on medium spatial resolution imagery.

Dissemination of data using multiple applications / software collaboration QGIS and CartoDB. QGIS is a software application of Geographic Information Systems (GIS) Open Source is user friendly with a license under the GNU General Public License. CARTO (formerly CartoDB) is a cloud computing platform as a Software Service (SaaS) that provides GIS and web mapping tools to display in the web browser.

2. Research Area

This study chose located at Taman Hutan Raya Ngurah Rai because it has an area of 1373.50 ha based on the Ministerial Forestry Decree No. 554 / Kpt-II / 1993. The administration area of research includes two regions of Bedugul regency and Denpasar city. Taman Hutan Raya Ngurah Rai is located inside the protected forest that has a high rate of mangrove biodiverse. For more information about research location please refer to Fig. 1.

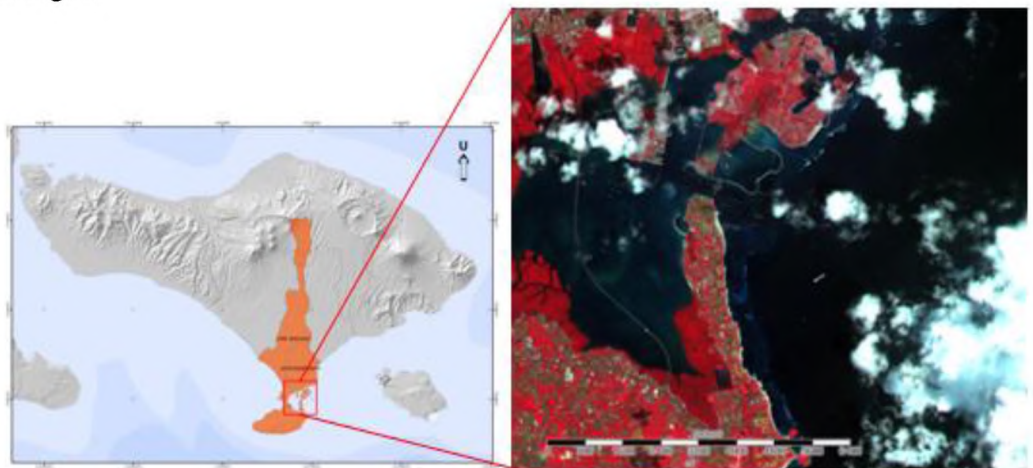


Fig. 1: Research area

2.1. Issue Background

There are two issues that were examined in this research, namely:

1. Is the identification of mangrove forest damage in Tahura Bali Ngurah Rai can be tapped by using remote sensing data Sentinel-2?
2. How large of mangrove forest damage at Tahura Bali Ngurah Rai?

2.2. Research Objective

There are two objectives in this research, namely:

1. Knowing the mangrove forest damage in Tahura Bali Ngurah Rai by using remote sensing data Sentinel-2?
2. Knowing large of mangrove forest damage at Tahura Bali Ngurah Rai?

2.3. Research Benefit

There are two benefits in this research, namely:

1. Develop methods for identifying the deforestation of mangrove forests.
2. Provide input into land-use planning, especially in the management of coastal mangrove forests.

2.4. Research Tool and Material

There are three tools in this research, namely:

1. SAGA (System for Automated Geoscientific Analysis) v.2.3.1
2. Quantum GIS v. 2.18
3. CARTO

There are two kinds of material in this research, namely:

1. Primary data
 - a. Raster data: Sentinel-2
 - b. Time data: December 30, 2015 and October 5, 2016
 - c. Data Location: Taman Hutan Raya Ngurah Rai, Bali
2. Secondary data
 - a. Vector Data: Administrative Boundary
 - b. Time Data: 2015

3. Research Methodology

Sentinel satellite imagery in 2015 and 2016 have been corrected both geometric and radiometric correction. Image correction and then enter the processing stage by using object-based image segmentation using SAGA software. Subsequently shaped region growing as parameters as object classification determination consideration. After some good parameters of color, shape and texture is formed, the software will automatically work to share some classifications were deemed to have differences in the appearance of the object. The results of the next segment of the class object distinguished mangrove and non-mangrove. In the process of segmentation, there are some objects that undergo over segmented / there are some objects that are considered the same by software. Thus it is necessary for supervised classification and done repeatedly to get the best segment to divide and differentiate objects appearance mangrove and non-mangrove.

After getting the best results for the division of mangrove object, then the object appearance interpreting mangrove damage in terms of both due to sedimentation of rivers or damage to the ecosystem. The appearance can be seen from the appearance of the object with visible moisture crops hue, shape and texture. For more information about research methodology please refer to Fig. 2.

After getting the results of impairment mangrove deemed appropriate, SAGA Software directly converts raster format into a vector format (.shp). Furthermore, the distribution mangrove damage vector file disseminated into CARTO applications based WebGIS. For more information about the vector file implemented into CARTO please refer to Fig. 5.

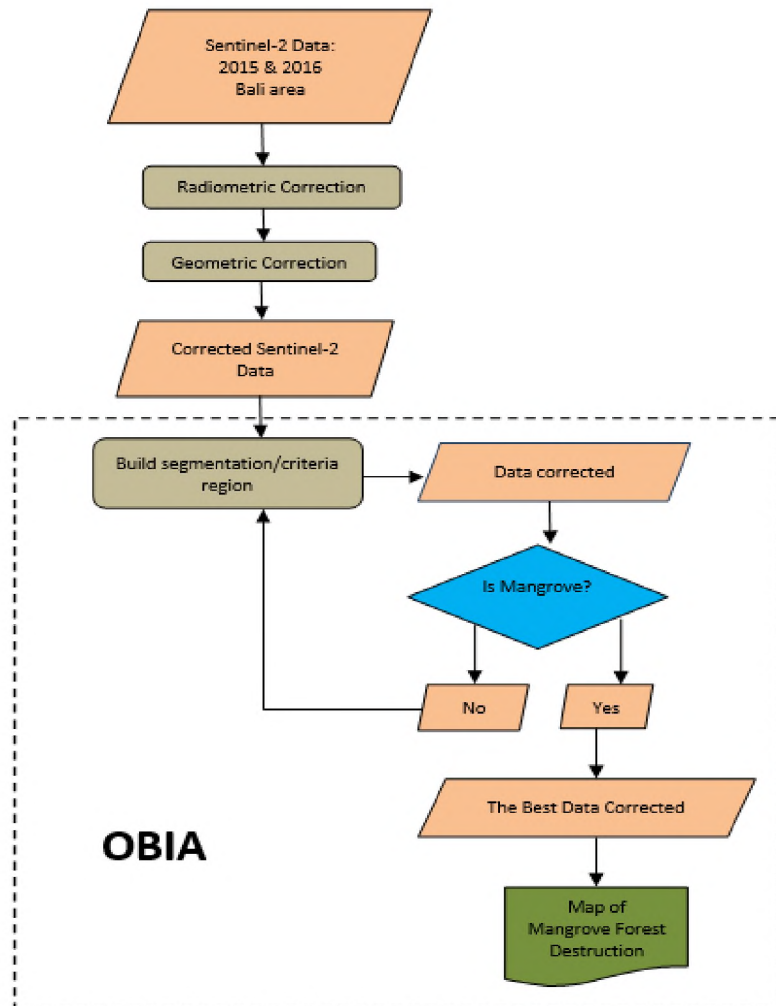


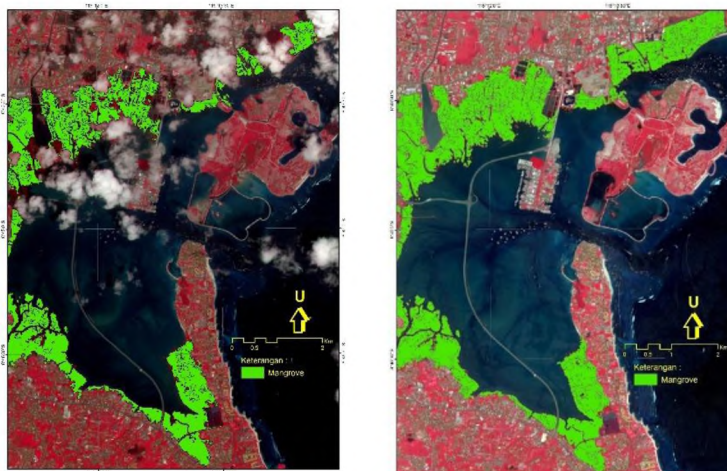
Fig. 2: Research methodology

4. Analysis and Result

The process of identification of objects with methods OBIA is by segmenting the image of Sentinel-2. To determine land cover, the distribution segment / region according to criteria of objects that can be identified. OBIA segmentation using segment classification approach of a homogeneous image data. Image segmentation is the process of grouping several adjacent pixels with the object polygon is based on the same spectral characteristics. Also in the region growing segmentation needs to be formed which is an algorithm that takes into account the color, shape, and texture. The parameter serves to identify the distinctive features of each land cover. Of the segmentation process, there are still categorized over segmented the same appearance. Over segmented is because there is less precise grading criteria segmentation of each object. Overcome it, the process of scoring done repeatedly so that scores the most appropriate segmentation.



Fig. 3: Comparison between the image that has not been segmented and already segmented



Mangrove map image extraction
Sentinel 2 in 2015

Mangrove map image extraction
Sentinel 2 in 2016

Fig. 4: Mangrove map image extraction Sentinel 2 in 2015 and 2016

The process of object classification using supervised classification system that requires training area at each grade appearance mangrove and non-mangrove. Given the over segment that need to be separated by the appearance of the object identified because hue has a humid nature. After separating the mangrove and non-mangrove class goes on to identify changes in the area of mangroves in 2015 and 2016.

Areas such damage is spread in the north and south Taman Hutan Raya Ngurah Rai. The area of mangrove areas that were damaged are 31,714.305 Are. However, in this case for the data in 2015, there are some areas that are cloud cover. The position of the clouds was right mangrove forests area, thereby reducing the accuracy of the calculation area. In addition, this study has not been conducted field surveys to obtain accurate test land cover.



Fig. 5: Distribution mangrove damage map

5. Conclusion

According our analysis, there are four conclusions, namely:

1. Sentinel-2 satellite imagery with a spatial resolution of 10 meters capable of detecting the presence of mangrove damage.
2. The method as an alternative method of identification OBIA mangrove damage by observing the appearance of colors, shapes and textures.
3. Sentinel-2 satellite imagery and Method OBIA able to provide information of value extent of mangrove damage.
4. It should be carried out field surveys to find out information on the level of damage to the mangrove and mangrove accuracy test.

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