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Mapping Of Vegetation And Mangrove Distribution Level In Batam Island Using SPOT-5 Satellite Imagery

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Abstract

Mangrove is a plant that plays a significant role in the balance of the ecosystem and coastal environment. Batam Island which is one of the islands in Batam island become one of the areas rich in mangrove plants. As time goes by, mangrove forests are getting worse. This research uses SPOT-5 imagery data in analyzing mangrove density value in Batam island with MSAVI (Modified Soil Adjusted Vegetation Index) method. The results of this study have mangrove density in Batam Island which is divided into four classes, which is very tenuous, tenuous, medium, and very tightly where Batam Island is dominated by a class of density. Theoretically, NDVI values range from -1 to +1 but the mangrove vegetation index values are generally in the range between +0,1 to +0,7. NDVI values greater than this range are associated with a representation of a better level of vegetation health in the islands of Batam.

Keywords: Mangrove, Vegetation index, MSAVI, SPOT-5 Satellite Imagery

1. Introduction

Mangrove forest is a type of forest overgrown with typical mangroves along the coast or river estuaries and affected by tidal water (Hidayah & Wiyanto, 2013; Ajithkumar *et al.,* 2008). Mangrove is a type of plant that lives in brackish water located on the coastline and is influenced by sea tides. The unique Mangrove ecosystem is one of the factors why Mangrove has a significant role in maintaining environmental and ecosystem balance such as preventing coastal erosion and abrasion, living on the source of food sources of some animals, and contributing to the formation of the island as well as stabilizing the coastal area (Anurogo *et al.,* 2015).

Riau Islands are one of the provinces in Indonesia which has a large mangrove forest, one of them is Batam City, but the condition of Mangrove Forest in the city of Batam increasingly critical is marked by the extensive depth of Mangrove Forest in Batam City which originally 27% until now only remaining 4.7 %. Riau Islands is one of the provinces in Indonesia which has a large mangrove forest, one of them is Batam City, but the condition of Mangrove Forest in the city of Batam increasingly critical is marked by the extensive depth of Mangrove Forest in Batam City which originally 27% until now only remaining 4.7 % (Lubis & Daya, 2017; Anurogo *et al.,* 2017.

Along with the development of technology Especially in the field of remote sensing allows us to monitor and examine the condition of Mangrove forest in the city of Batam by using satellite imagery (Farizki & Anurogo, 2017). With remote sensing technology, spectral values in satellite imagery can be extracted into mangrove object information in the range of near-visible spectra (Suwargana, 2008; Sari, & Lubis, 2017; Lubis et al., 2017; Conchedda *et al.,* 2008).

In this research is to know the distribution and value of mangrove density in Batam City using SPOT-5 satellite image, using the composite technique of band 3,2,1 in vegetation identification using Band 2 as red spectrum and Band 3 as near infrared (NIR).

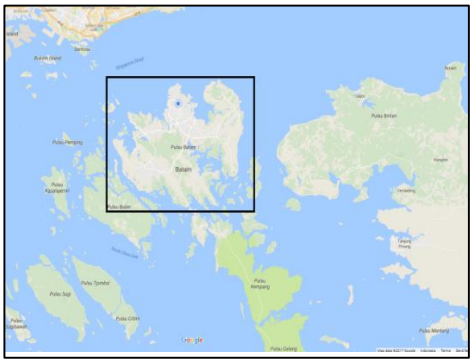


Fig. 1. Research location

2. Material and Methodology

The location of the study was conducted in the area of Batam, Riau Islands Province at coordinates 01º 08 'LU 104º 00' BT. Satellite data used is SPOT- 5 imagery with the date of acquisition 09 April 2014 which previously been done by geometric and radiometric correction process. Map of research location can be seen in Fig. 1.

3. Data Processing Method

Analysis of image data for the determination of mangrove vegetation refers to the results of RGB 321 composite image exploration and supervised classification (Green *et al.*, 2000). The value of mangrove vegetation density was determined by using ratio method between infra red channel and red channel (Green *et al.*, 2000) with the following formula:

$$NDVI = \frac{(infrared - red)}{(infrared + red)} \quad (1)$$

Information:
NDVI = Normalized Difference Vegetation Index
Infrared = channel 3 SPOT-5 imagery
red = channel 2 SPOT-5 imagery

In addition to NDVI, there are several transformations that can be used to determine the density value of a vegetable object, we used MSAVI (Modified Soil Adjusted Vegetation Index) method. MSAVI is a transformation developed from NDVI transformation to minimize the effect of soil reflections on NDVI, with the following formula:

$$MSAVI = \frac{\{2\,(NIR)+1-\sqrt{\{2(NIR)+1\}^2-8\,\{(NIR)-Red}}}{2} \quad (2)$$

Where NIR (Near Infra Red) is band 3 and Red is band 2 for SPOT-5 imagery. Then the class value of NDVI is reclassified into five classes, ie very rare density, rare, medium, meeting and very tight. Calculation of the density class interval based on the formula (Huete,1988) are as follows:

$$KL = \frac{xt-xr}{k} \quad (3)$$

Where KL is the interval class, xt is the highest value, xr is the lowest value and k is the desired number of classes. The research flow diagram can be seen in Fig. 2.

Before doing the processing and identification of Mangrove on SPOT-5 imagery first done geometric and radiometric. Geometric correction for Geometric correction is the process of positioning an image that corresponds to the actual world map coordinates. To improve the pixel image that looks more clear, by performing the mathematical calculation of the required band.

There are three stages in the radiometric correction process:

a. DN to Radiance

$$L = \frac{DN}{A} \quad (4)$$

Where :

DN = Band
A = Gain

b. Radiance to Reflectance

$$\rho_P = \frac{\pi . L_\lambda . d^2}{ESUN_\lambda . COS\,\theta_S} \quad (5)$$

Where:

P = Unitless Planetary Reflectance
Lλ = Spectral Radiance at The Sensor's Aperture
d2 = Earth-Sun Distance in Astronomical Units
ESUNλ = Mean Solar Exoatmospheric Irradiances
θ = Solar Zenith Angle in Degrees

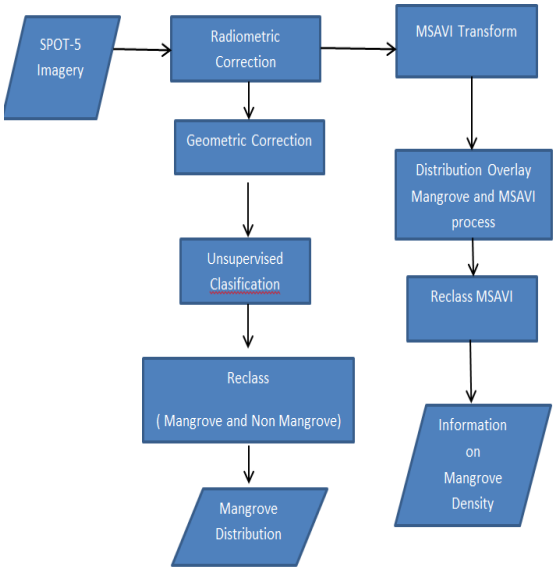


Fig. 2. The research flow diagram

4. Results And Discussion

The results of RGB 321 composite image analysis and image classification shows that the existence of this ecosystem is only found to spread on the coastal city Batam (Fig. 3). Object detection (Mangrove location) sample can be seen in Fig. 4. By doing its classification between mangrove and non-mangrove then we can identify mangrove plants

found around coastal areas in some areas of Batam island, especially in Batu Aji Subdistrict.

The mangrove density value is explained based on the pixel value of the transformation of MSAVI which has been done and explained into 4 classes namely; very tenuous, tenuous, medium, tight and very tight. With the lowest pixel value 0.134842247 and the highest pixel value 0.364502162 (see table 1).

The vegetation index (NDVI) can represent the density (biomass) or greenish level calculated as the ratio between the measured reflections of the red band (R) and the near infra red band (NIR) on the spectrum of electromagnetic waves. Both bands were chosen because their size results were most influenced by the absorption of leaf chlorophyll. The red light (R) is very slightly reflected while the near infrared light (NIR) is reflected strongly. Theoretically, NDVI values range from -1 to +1 but the mangrove vegetation index values are generally in the range between +0,1 to +0,7.

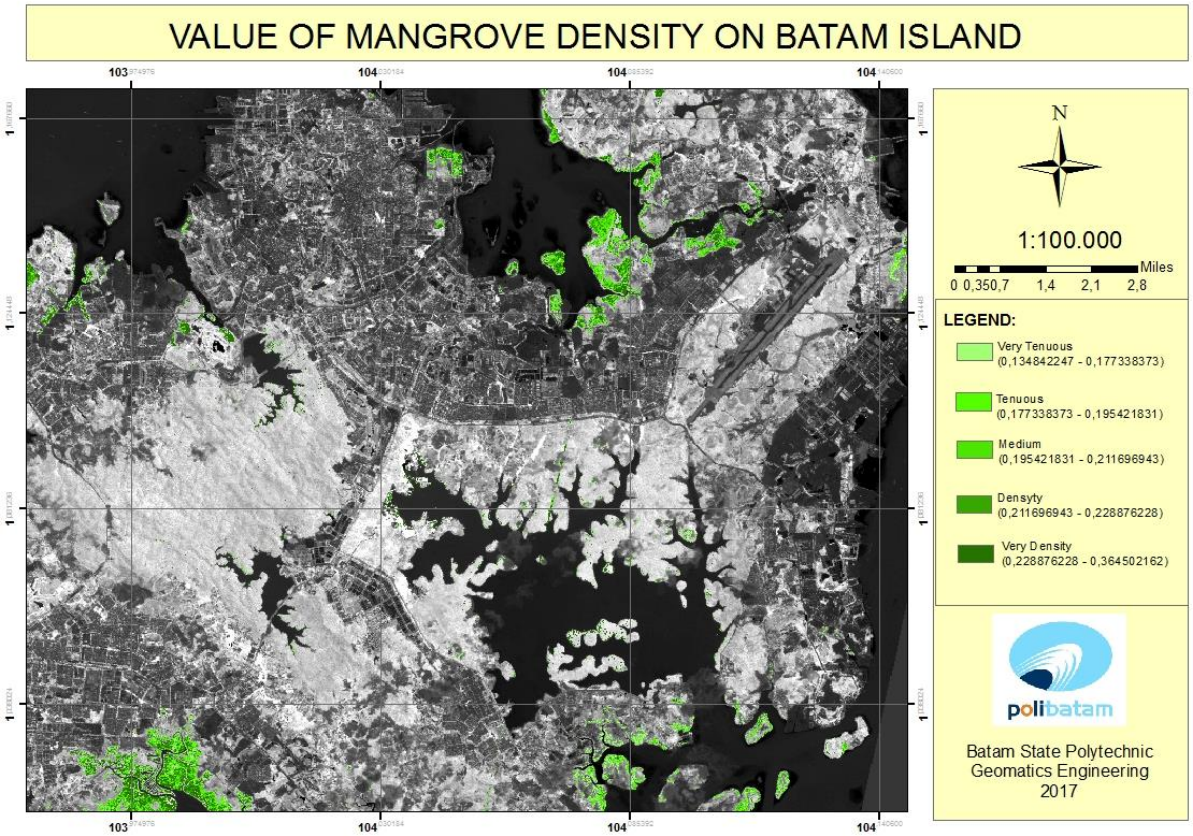
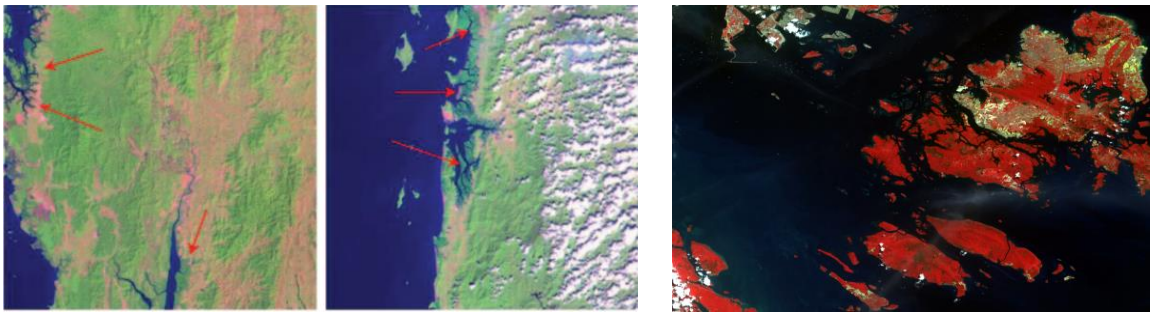


Fig. 3. Value of mangrove density on Batam island



(a) (b)

Fig. 4. Detection example of mangrove on research location (SPOT-5 visible) (a), Composite band 321 SPOT-5 (b)

Table 1. Range value of Density Class of Mangrove

Class	Range
Very tenuous	0.134842247- 0.177338373
Tenuous	0.177338373-0.195421831
Medium	0.195421831-0.211696943
Density	0.211696943-0.228876228
Very density	0.228876228-0.364502162

5. Conclusion

The mangrove condition in Batam Island is dominated by the density of tenuous With the widest mangrove distribution in the southern area of Batam City, that means the preservation of mangrove forests should continue to be done in order to maintain the balance of the environmental ecosystem of Batam as one of the coastal areas in Indonesia.

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