Spatial Distribution of Mangrove in Kelapan Island, South Bangka Regency

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***Abstract*— Mangrove forests are an important coastal renewable resources which were found in the brackish water, estuary, lagoon, and tropical island. These forest provide important ecosystem goods, create the new island in the coastal area and biofilter's supporting as a place to live, to spawn, to feed and coastal food web. One of the area in South Bangka Regency, Bangka Belitung Province, which found high biodiversity species and density mangroves is a Kelapan Island. A little Information about mangrove spatial distribution in Kelapan Island became main problem in the management of sustainability mangrove ecosystem, therefore this study done.**

The purpose of this study was to analyze the condition of mangrove area, despite of it was density level and wide changing of mangrove using remote sensing approach. The mangrove condition should be analyzed to observe human activities that influence surrounded environment. Output this study is to map out spatial distribution of mangrove using Sentinel 2A imagery high spatial resolution and GIS technology with acquired in April 05th 2018.

Mangroves canopy and the others was delineated by using visual interpretation, and standard true color composite band (483) and false color composite band (843) of Sentinel 2A and also using transformation NDVI formula based on histogram adjustment result. This research show that the mangrove density could be classified in to three classes: low density (18.12 ha), medium density (97.87 ha), and high density (110.61). Estimation of mangrove area based on result is 226.60 Ha. The field studies recognized that types of mangrove identified in Kelapan Island are dominated by *Rhizophora sp*, *Sonneratia sp*, *Bruguierra sp.*

***Keywords*— spatial distribution, mangrove, sentinel 2A**

I. INTRODUCTION

Mangrove is one of plants which grow abundantly in coastal area, laguna and the brackishwater with saline soil condition [1]. One of highly adaptive and productive ecosystems on the biosphere are mangrove forests. The role of mangroves in ecosytems divided into 3 part; biological fuction (biofilter) ecological fuction (habitat protection), and economical function (fuel, and wood production). Studying mangrove is a very important to giving invaluable service for coastal communities about ecological and sustainabiliy management of mangrove, that involves crucial knowledge of variability and and dynamics over a time and space [2]. Their plants which is usually scattered along intertidal zone of low energy tropical coastallines in coastal region near the equator [3]. Mangroves are unique plants capable of surviving under extreme saline environment, have to fragile ecosystem in the coastal areas. Mangrove have to tangled root sytems that protecting shorelines from erosion and stabilizing sediments [4]. The quality and quantity of seawater can be overcome by mangroves, with filtering pollutants and trapping sediments.

As we know, nurseries for shrimp and recreational fisheries, exporters of organic matter to adjacent coastal food chains, and enormous sources of valuable nutrients were biological function mangroves [5]. Canopy of mangrove forests in intertidal zone created by coastal accretion as a result of the interaction between freshwater and seawater [6]. One of the location in Bangka Belitung Province, where found high density mangrove is Kelapan Island.

Kelapan Island is a small island and habited island located in the South Bangka Regency, Bangka Belitung Province. There are potentions which found in Kelapan Island, Such as potential fisheries, marine resources, and ecouturisme. Kelapan Island is very unique with typical local cultural characteristics and physically the island area is surrounded by mangroves, white sand and coral reefs along the coastal line, so this condition is very supportive of marine tourism activities such as tourism activities in the beach (recreation/relaxing), snorkeling and diving. This island is a snorkeling paradise for tourists[7].In recent years, the island of Kelapan was proclaimed as the area for the leading marine tourism destinations in South Bangka Regency, especially diving and snorkeling tours with increasing tourist arrivals both local and foreign tourists. Based on this case, There are many problems that appears in this research coverage area, consist of existence and degradation mangrove issue. Therefore spatial distribution of mangrove must be done to know the condition of mangrove this research area, and to manage mangrove sustainability in the future time.

Spatial distribution and level density of mangrove in Kelapan Island can be evaluated, analyzed by using techniques of remote sensing and geographical information system (GIS). In spite of, Mapping and monitoring of mangrove environments multi years (for two decade) has been tried exstensively by researcher with using remote sensing approach. It offers some key advantages for mangrove studies, including indirect access to mangrove habitats that are usually hard to access [8,9]. Technology of remote sensing has been applied in various ways to characterize, condition mangrove ecosystems, divide mangrove density into several class, include mapping the areal extent, detecting individual species, and providing estimates of structure and parameters such as leaf area, canopy height, and biomass [10, 11].

The aim of this research is to identify the mangrove density in Kelapan Island, South Bangka Regency using Sentinel 2A as a high resolution image data. Furthermore, This article endeavored to the NDVI images using remote sensing, GIS and field survey. Satyanarayana *et al* [12] informed that ground survey and remote sensing technology is a good combination and very useful for for the assessment of mangrove vegetation types.

II. Research Method

A. *Study area*

The location of this research held at Kelapan Island, South Bangka Regency, Bangka Belitung Islands Province.

Kelapan Island is located in South Bangka, one of regency in Bangka Belitung Province. Kelapan Island is located geographically in 106º50ˋ31” E and 02º50ˋ59” S. Administratively, Kelapan Island is bordered with Java Sea at north, and bordered with Lepar Island at South. Kelapan Island is also bordered with Selemar Island at west, and bordered with Pongok Island at east. The research sampling area is located South, North, East, West Coastal Area in Kelapan Island. Field study of mangrove community structure area was in 4 points of island and conducted to collect alot of informations about ground check points, mangrove species, mangrove cover and density, and also mangrove condition in Kelapan Island. Map location of study area is shown in Fig .1.

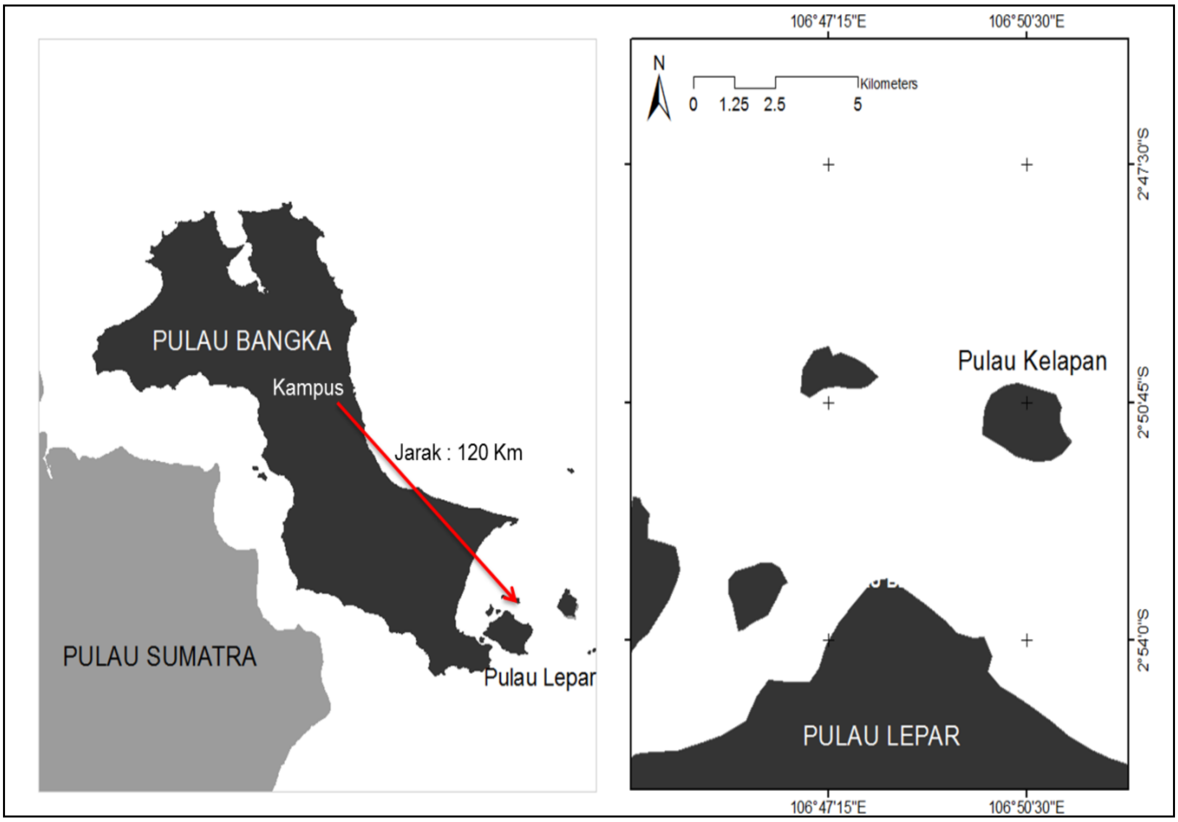

Fig. 1. Research location at Kelapan Island, South Bangka Regency

TABLE I. SENTINEL 2A MSI BAND SETTING [13]

Acronym	Band	Wave-Length (nm)	Spatial Resolution (m)
B1	Violet	443	60
B2	Bue	490	10
B3	Green	560	10
B4	Red	665	10
B5	Red-edge 1	705	20
B6	Red-edge 2	740	20
B7	Red-edge 3	783	20
B8	NIR	842	10
B8a	NIR Narrow	865	20
B9	NIR	945	60
B10	NIR	1380	60
B11	SWIR 1	1610	20
B12	SWIR 2	2190	20

B. *Data source and methods*

Data of Sentinel 2A imagery date acquisitions April 5th 2018 were used in this study. Sentinel 2A image data was processed using software Ermapper 7.0 and Arc GIS 10.3. Ermapper 7.0 were needed to analyze and integrate spatial data and and also processed layouting using ArcGIS version 10.3. The data of Sentinel 2A image was projected to Universal Transverse Mercator (UTM) coordinate system, Datum WGS 1984, Zone 48 South, However, Sentinel 2A image data were compared with topographic map of BIG.

Sentinel 2A Imagery has 12 bands (Look at **Table 1**). Bands combination of Sentinel 2A imagery was used to identify mangrove area.

The bands combination was known as False Color Composite (FCC = 843) and True Color Composite (TCC = 483). FCC and TCC applied on Sentinel 2A imagery was composite of band 3, band 4, and band 8. this band combination can make mangrove canopy look different from other land covers. Furthermore, doing step image processing: image interpretation, and digitalizing on screen. Digitalizing on screen process was conducted to get existence mangrove information, especially identified or determinate of mangrove and delineated other object's through visual interpretation. The further step after identifying mangrove area was applying NDVI transformation to grouping mangrove density into three classes (low, medium and high density). Level of mangrove canopy density was evaluated by using NDVI method. NDVI has been shown to be highly correlated with green biomass, crown closure, and leaf area index, among other vegetation parameters. The view which explained about bands combination had looked at in Fig 2.

NDVI is based on difference between maximum absorption of radiation in red due to chlorophyll and maximum reflection of radiation in NIR due to leaf cellular structure. NDVI provides the amount of photosynthesizing vegetation. Spectral reflectance measurements acquired in the red and near-infrared regions is calculated by using NDVI transformation. The combination of red and Infrared (IR) bands along with vegetation indices help in distinguishing between mangroves, swamps and other vegetation in the coastal area or weatland zone.

The NDVI is used as a pre-classification step to separate mangrove vegetation from another vegetation. The NDVI data layer is defined as:

$$NDVI = \frac{NIR - \mathrm{Re}d}{NIR + \mathrm{Re}d} \quad \text{..1}$$

The value of NDVI at [14] varies between -1.0 and +1.0 where increasing positive values indicate increasing green vegetation and negative values indicate non-vegetated surface features such as water, barren land, ice, snow, or clouds. The vigorously growing healthy vegetation has low red-light reflectance and high near-infrared reflectance. Therefore, it produces high NDVI values. The mounting amount of the positive NDVI values indicates the increasing amounts of green vegetation. Meanwhile, the NDVI values near zero and decreasing negative values indicate non-vegetated features, such as barren surfaces (rock and soil) and water, snow, ice, and clouds. To determine the value of mangrove canopy density using of calculation NDVI (high, medium and low).

Sentinel 2A image has been classified with supervised Maximum Likelihood Classification into 3 classes (Sea Water, Vegetation Mangrove, and Non Vegetation Mangrove), therefore the result from coverage of mangrove vegetation also must be classified with 3 classes density (spares, moderate, and dense). The classification images were followed by the field verification and accuracy assessment. Delineation of mangrove SNI 7717 Year 2011 is a depiction of boundaries of objects or features mangrove recorded on the image representation of the earth's surface with a stripe or emblem/specific symbols [15]. Step by Step had done this research in Fig 3.

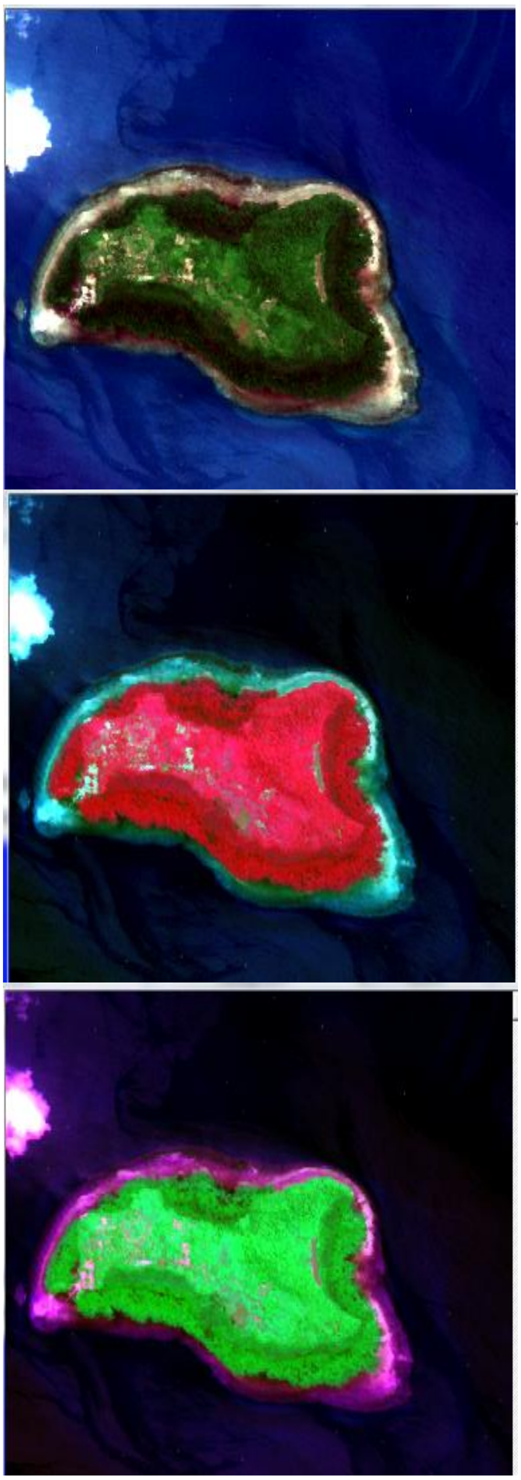

Fig 2. View of Composite Bands (432, 843, 483)

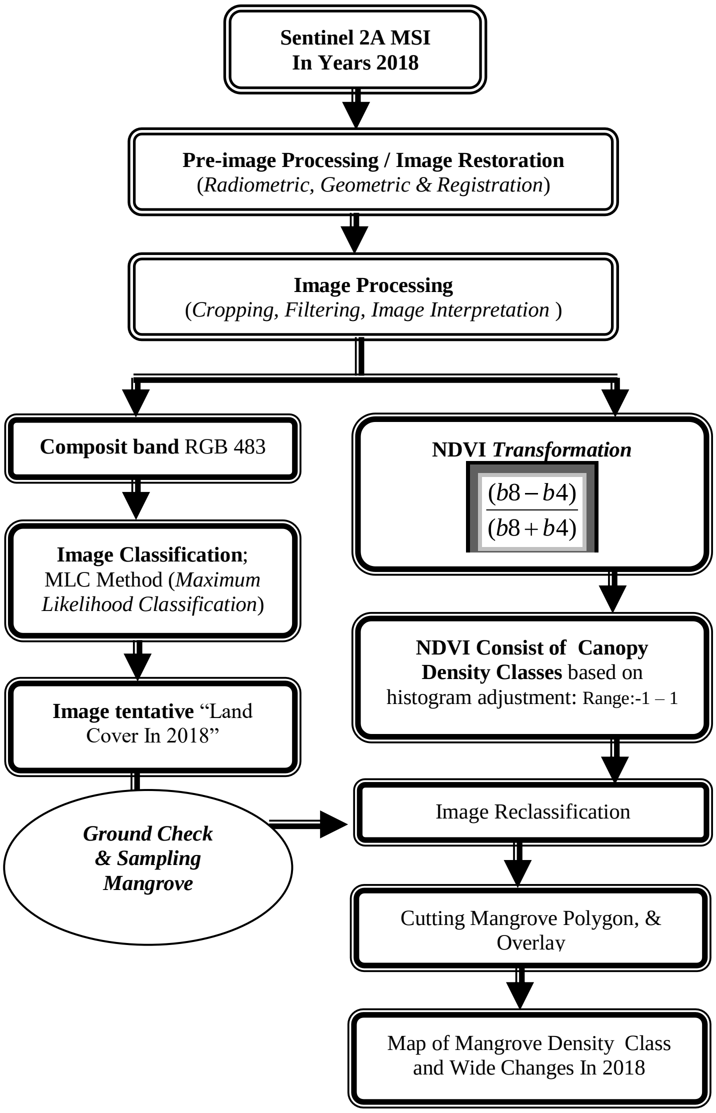

Fig. 3. *Image Processing flow chart*

III. RESULT AND DISCUSSIONS

Based on identification, we were found 12 mangrove species that identified in the research station. Mangrove species found in the study site was *Ceriops tagal, Excoecaria agallocha, Lumnitzera littorea, Bruguierra gymnorhiza, Pemphis acidula, Pongamia pinnata, Rhizophora apiculata, Rhizophora stylosa, Rhizophora mucronata, Sesuvium portulacastrum, Sonneratia alba* dan *Thespesia populnea*. This result according to LIPI Research in 2007 at Kelapan Island [16].

Type of mangrove dominated in Kelapan Island are *Rhizopora sp, Sonneratia sp*, and *Bruguierra sp*. the result Image processing using Sentinel 2A MSI Imagery show that level of mangrove density in Kelapan Island divided into 3 classes, based on NDVI range from Ministry of Forestry. Density classes are low density (18.12 ha), medium density (97.87 ha); high density (110.61 ha), and high density (110.61ha), Look at Table 2 and Fig 4.

Tin (Sn) mining activity in Kelapan Island was not found, thus the mangroves ecosystem in the Kelapan island during the observation was generally in better condition compared to prior years. Formerly, There are several activities which it's happened, such as illegal logging activity. The mangrove tree are takken for firewood and built their house, therefore the mangrove population was decreased for two decades [17, 18, 19]. Activities involved mangrove exploitation such as illegal logging and mangrove extinction had been over in 2014, therefore, the mangrove ecosystem could be visually observed in good status (based on Decree of the Minister of Environment No.201/2004 - Criteria and Guidelines for Determining Mangrove Damage) [20].

Based on survey in research location, the result showed that alot of people have to good perception and open minded about mangrove conservation in Kelapan Island. There are 60% people are strongly agree with the conservation, and 40% people are agree with the conservation. This is supported by LIPI (Indonesian Institute of Science). Based on LIPI research in 2007, mangrove area in Kelapan island is 200,095 ha, it is diffrerent from this result in 2018. There are wide changes of mangrove in Kelapan Island, and there are increase mangrove area for 11 years. This result showed that people have good vision and highly supportive mindset to the mangrove conservation. And based on that result, many people understand and realize that mangrove is very important to be protected and maintained because of their function to absorb abrasion and a place for coastal biota to live.

IV. CONCLUSION

Analyzing Sentinel 2A satellite using remote sensing and GIS is very helpful for analyze spatial distribution of mangrove and to know coverage mangrove area this year. maximum likelihood classification provided the classification of class density mangroves. Spatial distribution of mangroves could be well classified into 3 classes (low, medium and high), using Sentinel 2A imagery with accuracyapproximately 86%. Mangrove species were found 12 species and were dominated by *Rhizopora sp*, *Sonneratia sp*, *Bruguierra sp*. Overall, based on field study on mangrove community structure, mangrove in Kelapan Island has good density. It is shown by high density mangrove, which is the highest among the other density classes about 110, 61 Hectares. Condition of mangrove density in Kelapan Island is supported by local people who highly support the mangrove conservation to protect coastal area. Local communities did not allow tin mining activities conducted in Kelapan coastal area. However, further monitoring by time series satellite images is still needed to identify the changes of mangrove coverage area

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TABLE II.COVERAGE AREA OF CLASSIFIED MANGROVE DENSITY IN KELAPAN ISLAND AREA (IN HA)

Classes of Mangrove Density	Year 2018
Low density (NDVI range: -1-0.33)	18,12
Medium density (NDVI range 0.33-0.42)	97,87
High density (NDVI range 0.42-1)	110,61
Total	**226,60**

Source: Sentinel 2A Analysis

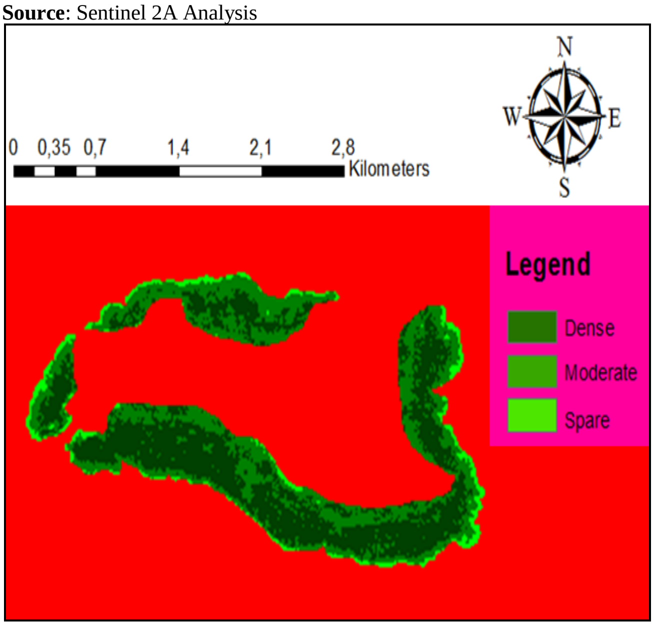

Fig 4. Map of Class Density Mangrove

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