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CHANGES DETECTION OF MANGROVE ECOSYSTEM BASED ON OBIA METHOD IN LIONG RIVER, BENGKALIS RIAU PROVINCE

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ABSTRACT: Status of mangrove ecosystem on Liong River, Bengkalis Island, Riau Province, is currently in a condition that tends to get a stressed doe to 60% of indigenous people living around mangroves are loggers. Series Landsat are used as recording data to map the mangrove and to see the changes in the region. This study aims to map changes in mangrove ecosystems from 1990 - 2017 using the OBIA method. The field observation was done using Unmanned Aerial Vehicle (UAV). The results showed that mangrove area has decreased every year. It was caused by anthropogenic and natural factors. Approximately 4.2% of mangrove decrease from 1990 to 2017 and mangrove highest exploitation occurred in 2007 with a decline of 31.5%.

Keywords: Liong River, Landsat, Mangrove, OBIA, Unmanned Aerial Vehicle (UAV)

1. INTRODUCTION

The degradation of global mangrove ecosystem has increased by 1% -2% every year [1]. Data for 2009 estimated the area of mangroves in Indonesia at 3.2 million hectares [2]. Mangroves in Riau Province experienced a decline of around 6.4% in 2009 [3]. The Liong River Mangrove is located on Bengkalis Island, Bengkalis Regency, Riau Province. The Liong river estuary is on the Pantai Selat Baru, it is unique in that it has a sloping shoreline, extends far to the edge of the sea (± 100 m) at low tide.

Mangroves in Bengkalis district in 1997 were estimated 69,000 hectares decline to 50,765.04 hectares in 2002 [4], It was confirmed by Fikri's [5] use Landsat 5 TM and Landsat 7 ETM + images in 1992 - 2002 there was a reduction in the mangrove area 2012.13 hectares. Furthermore, the mangrove area was reduced to 40,196.00 hectares in 2011 and it was 10.009.3 hectares and increased in 2015 to 33,016.00 hectares [6]. It is estimated that around 60% of Indigenous people living near the River Liong are mangrove area loggers, while the rest are charcoal, trading, farming and fishing entrepreneurs [7]. Based on this, efforts are needed to monitor the presence of mangroves in the River Liong area.

Monitoring fast techniques are needed to be used to manage of mangrove. Field surveys with conventional techniques will take a long time and are expensive. Remote sensing data has played an important role in mangrove monitoring, as was done [8-19].

According to [20], Landsat imagery used for mapping land cover has become an alternative for the use of research with medium resolution imagery. Its application has been so frequently used, which is the map to the mangrove ecosystem area [21]. Landsat included in the remote sensing medium category, while Roy et al. [22] stated that the mangroves were quite well received [23] reached 96.6%, Alatorre et al. [24] at 84% and Kirui et al. [25] at 87.5%.

[13][21] Mangroves use pixel-based classification techniques. This technique has drawbacks as announced by Whiteside et al. [26] which is the effect of salt and pepper. Object-based classification or better known as OBIA (Object Base Image Analysis) is an alternative compilation based on pixel values that cannot be shared by spatial objects, this is related to OBIA which is related to classification processes that not only fit the spectrum [27].

Based on the explanation above, the use of the OBIA method needs to be tested in the mangrove area to determine changes in the temporal area. The use of the OBIA method is expected to improve the results of accuracy. This study aims to map changes in mangrove ecosystems from 1990 - 2017 using the OBIA method on the river Liong, Bengkalis, Riau Province.

2. METHOD

This research was carried out in the area of mangrove ecosystem in Sungai Liong, Riau Province (Figure 1) in January - February 2018.

Geographical location of mangrove River Liong depends on 01 ° 33'59,60 "- 01 ° 29'30,28" LU and 102 ° 14'26.02 "- 102 ° 15'52.27" BT. The estuary of the Liongapai River on the New Straits Beach which faces the Malacca Strait. Based on Bengkalis Regency regional regulation Number 9 of 2012 regarding the expansion of villages in Bantan Subdistrict, the Liong River mangrove forest is currently in the area of 5 Villages, namely: Selat Baru, Berancah, Ulu Pulau, Bantan Tengah, and Mentayan.

The materials used in this study Landsat series images in 1990, 1998, 2007, 2017 (Table 1) used for the detection of changes in mangrove cover were downloaded from https://earthexplorer.usgs.gov/.

Table 1. Landsat Series Images

No	Series Landsat	Acquisition
1	Landsat 5 TM	1. 07/05/1990 2. 07/27/1998 3. 02/10/2007
2	Landsat 8 OLI	1. 03/17/2017

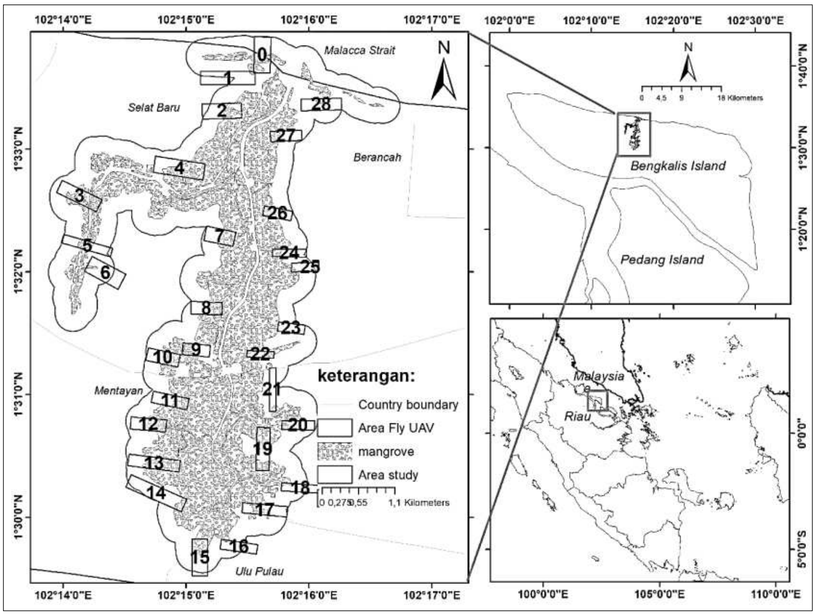

Fig 1. Location of Research

Land Cover Scheme

The land cover scheme used refers to BSN (2010), which consists of 4 land cover classes, namely: mangrove, waterbody, bare land (a combination of land without cover and which has undergone substitution of land cover that is both natural, semi-natural and artificially usually are waterproof and relatively permanent such as roads, settlements and dikes) and other vegetation (various types of heterogeneous and homogeneous natural vegetation with rare density to meeting density, including gardens).

OBIA classification

The OBIA classification has several stages, namely:

1) The implementation of algorithms serves to produce objects based on similarities built by various segmentation parameters contained in the image used. At this stage, the algorithm used is multiresolution segmentation (MRS) with a scale of 0.1 and compactness 0.5 [28].
2) Determination of sample objects based on observation point.
3) Application of algorithms, the algorithm used is Support Vector Machine (SVM)

Accuracy Assessment

Mangrove land cover classification was validated by using error matrices [31], then overall accuracy, producers accuracy, and user accuracy as well as Kappa were calculated [32]. To make the comparison between classification method easier, thematic accuracy is only according to observation point-based reference.

Detect mangrove changes

Detection of mangrove changes is known through spatial operations using geographic information system applications, land cover data in shapefile format obtained from object-based classification results. Each closing class is coded with a unique integer value, starting from 1 to i, and i is the number of land cover classes. In this study the values are: 1 (mangrove), 2 (water body), 3 (bare land), 4 (other vegetation), then each land

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cover class value is multiplied by a multiplier with the following equation [29]:

$$V' = Vi * 10^{x} \quad (1)$$

Where V 'is the new value, Vi is the integer value of the class I land cover class, 10 is the multiplier factor and x series. The x-Landsat image which is a positive integer starts at 0. Next, the value of V' land cover series is added up to predict changes in mangrove land cover, through the equation:

$$V'total = V'1990 + V'1998 + V'2007 + V'2017 \quad (2)$$

V'total is the new V 'addition value in the land cover class of the Landsat data series. It value consists of four digits, ranging from 1111 - 4444. The same four-digit number indicates no change in land cover, otherwise if one of the four digit numbers is different, then it indicates that there has been a change in land cover at the research location.

3. RESULTS AND DISCUSSION

Land cover class for detection of mangrove changes with object-based classification techniques has been successfully mapped well. The class of land cover that was built consisted of four classes of land cover namely mangrove, water bodies, open land, and other vegetation. The classification results show that mangroves are scattered along the Liong River and tributaries which lead to it. Mangroves can also be found along the coastline around the mouth of the Liong River which faces the Malacca Strait (Figure 2a). Changing mangrove land to other land or vice versa can be clearly mapped. In 1990 the open land class was only concentrated in several locations in the Liong River region, along with the increasing human interaction with mangroves, the distribution of open land classes became increasingly firm and encroached on mangroves. Other classes also contributed to changes in mangrove land cover on Sungai Liong.

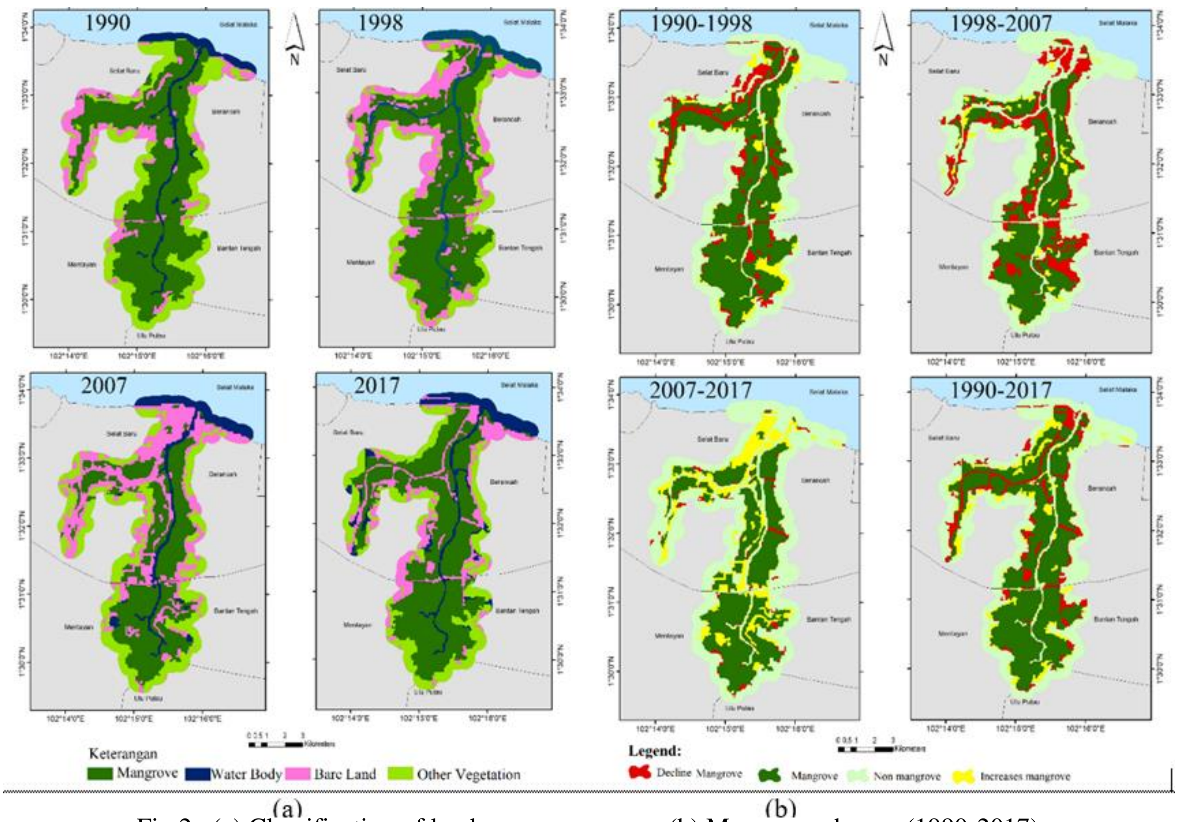

Fig 2. (a) Classification of land cover mangrove (b) Mangrove change (1990-2017)

From 1990 to 2017, the area of mangroves on the River Liong decreased every year (Table 2). Reduction of mangrove area is caused by anthropogenic factors, namely the high activity of humans who open mangrove land by hew down to be used as building materials and charcoal, the conversion of mangrove land into settlements, ponds and embankments. In 1990 the area of mangrove was estimated to be around 1041.63 hectares, which decreased by around 4.2% in 2017 to 997.94. The largest mangrove reduction occurred in 2007 amounting to 31.5%, this was due to continuous logging, the construction of floating net cages for snapper culture, the construction of an

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international seaport called "Bandar Sri Setia Raja" at the opposite river mouth directly with the Malacca Strait, the construction of the Sungai Liong bridge, the construction of dikes and roads in the mangrove area. The area of mangrove in 2007 was 723.56 hectares.

Until now mangrove reduction still occurs in the Liong River mangrove area. But now public awareness of mangrove functions has begun to grow. In some areas, mangroves have been replanted, this can be seen by the increase in mangrove area from 2007 to 2017 around 27.5% or 238.34 hectares, this is also reinforced by the difference in mangrove in 1990 to 2017, 43, 69 hectares.

Table 2 Estimation Area Land Cover (hectare)

Year	Area (Hectare)			
	Mangrove	Water Body	Bare Land	Other vegetation
1990	1041,63	128,55	268,78	531,27
1998	951,46	181,53	466,34	370,33
2007	723,56	169,97	566,07	550,64
2017	997,94	198,27	334,62	429,41

Based on the analysis of changes in mangrove land cover on the Liong River, currently, the River Liong mangrove area is still in a status of tending to get pressure. The results of recording Landsat 5 TM images in 1990 showed that several areas had turned into open land with an area of 268.8 hectares to 466.3 hectares in 1998, indicating that the mangrove on the Liong River had been under pressure, it was estimated that mangrove pressure in the Sungai Liong mangrove area has lasted longer. This is consistent with Jonniere's statement [29] that the practices of direct use of mangroves in the form of wood have been going on for a long time and are passed down through generations, especially the production of mangrove charcoal by the charcoal kitchen (panglong) which is commonly found around the mangrove area in Bengkalis Island.

Table 3 Result accuracy of series Landsat

Years	UA(%)	PA(%)	OA(%)	Kappa
1990	91,8	95,7	88,5	0,82
1998	86,4	92,3	83,5	0,74
2007	94	94	84,9	0,76
2017	89,8	98,3	89,9	0,84

This was reinforced by Kusmana [30] that since 1952, Bengkalis has been used as a model for mangrove management in Indonesia known as the working plan. Hew down mangrove for various purposes such as fuelwood, building materials and roads, charcoal raw materials, is often found during field checks. Logging of mangroves does not only result in the loss of mangrove cover but more importantly, is the change in mangrove community structure [29,31].

Mangrove classes can be mapped well, this is evidenced by the high accuracy of users and producers produced by each data, which is greater than 85% (Table 3). The high accuracy value indicates that object-based classification techniques and the use of SVM algorithm can be used as an alternative technique in mapping mangroves and surrounding land cover. Nevertheless, there are still errors in the separation (misclassification) of the mangrove class from the other classes.

Omission and commission errors are estimated to be less than 15%. Some things that can explain this are the land cover around the mangrove occupying the same morphological area, namely the tidal flat area behind the mangrove. It is therefore difficult to avoid spectral similarities when selecting object samples in establishing specific class rules [33]. The difference in recording time also contributes to misclassification, which influences water level fluctuations caused by tides for all four data.

Maps of mangrove changes from 1990 to 2017 are presented in Figure 2b. The range of 1990-1998, the conversion of mangroves into roads and open land occurred with the rate of mangrove reduction of 8.7%. The 1998-2007 range was the peak of mangrove exploitation on the Liong River with a reduced rate of 31.5%. The increase in the presentation of decreasing mangrove area was triggered by logging of mangrove vegetation, especially the types of *Rhyzophora spp*, *Bruguiera spp* and *Xylocarpus sp* for charcoal kitchen needs [7]. The conversion of mangrove functions increased with the construction of boundary embankments by the Bengkalis District government which aims to anticipate the rising water level at the highest tide and the opening of farms in the mangrove area. Starting in 2008 the regional government of Bengkalis Regency, through the Forest Service issued a regulation to temporarily stop the production of charcoal kitchens in the Bengkalis Regency. This succeeded in suppressing mangrove degradation in Sungai Kembung where the rate of addition of mangrove area was around 27.5% in 2007-2017.

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4. CONCLUSIONS

Based on the detection of changes in mangrove land cover, the River Liong mangrove area has decreased from year to year. The decrease was caused by anthropogenic factors and natural factors. Approximately 4.2% of mangrove decreases from 1990 to 2017. The largest mangrove exploitation occurred in 2007 with a decline of 31.5%.

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