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UTILIZATION OF LANDSAT 7 AND 8 IMAGES FOR MAPPING OF CHANGES IN THE NORTH COAST MANGROVE AREA, AESESA DISTRICT

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ABSTRACT

In 2019 there was damage to the mangrove forest which was converted into fish ponds by cutting down 200 hectares of mangrove land in Aeramo Village, which is the northern coastal area of Aesesa District, Nagekeo Regency. This study aims to map changes in mangrove areas and determine mangrove density values.This study uses the NDVI (Normalized Difference Vegetation Index) analysis technique to determine the density of mangrove vegetation in 2011, 2016 and 2021 using Landsat 7 and Landsat 8 imagery and uses an overlay analysis technique from the results of classifying mangrove density classes to determine changes in the area of mangrove areas. The results of the study show that the mangrove area on the north coast of Aesesa District shows density values that vary with The range of vegetation density index in Landsat 7 imagery in 2011 is from -0.573770464 to 0.54666682, in 2016 it has a vegetation density index range from -0.291984737 to 0.609456897 and in 2021 it has a vegetation density index range from -0.067266561 to 0.579148531 which is divided into 5 density classes namely; very rare, rare, moderate, rare and very tight. Based on the classification results, the results of changes in the mangrove area decreased to the medium class with forest area from 102.35 hectares to 66.86 hectares from 2011 to 2016 and experienced the largest increase in the very dense class in 2011-2016 where the forest area was in the very dense class. meeting from 128.86 hectares to 210.65 hectares.

Keywords: *Landsat; Mapping, NDVI; Remote Sensing.*

INTRODUCTION

The word mangrove is a combination of Portuguese mangue and English grove. In Portuguese the word mangrove is used to denote individual plant species, whereas in English the word mangrove describes a plant community that grows in the tidal range as well as individual plant species that make up the community (W. Macnae 1974). Indonesia is the largest archipelagic country with one of the potential resources in large coastal areas, namely mangrove forests (Arfan, Nyompa, Rakib, & Juanda, 2021; Junianto, Sugianto, & Basri, 2023; Rustam, Asrinaldi, Koeswara, & Kamaruddin,

2022; Openg 2018). Mangrove forests in Indonesia are divided into 2 (two) geographic mangrove zones, namely Asia and Oceania (Elisabeth B. L. Openg, 2018). The two zones have a greater diversity of plants, animals and microorganisms than other countries, due to the different natural conditions between islands and even between locations within the same island.

One of the districts that has a mangrove forest ecosystem in NTT is Nagekeo District. Based on the (BLH 2020), it has a distribution of mangrove ecosystems with a total area of mangrove areas along the north coast as far as 60 km (6000 hectares). The potential for this large mangrove natural resource is being damaged, as much as 200 hectares of mangrove forests or mangrove forests in Aeramo Village, Aesesa District are damaged and threatened with extinction due to land conversion into milkfish ponds and salt ponds by the Nagekeo District Government (PEMKAB) without sustainable management. This research utilizes landsat imagery to find out how the density level of mangrove forests is using NDVI analysis and changes in mangrove areas that occur in Aesesa District, Nagekeo Regency, this is also the same as research that has been conducted by Silvianus Nay in mangrove areas in Riung District, Ngada Regency which utilizesLandsat 8 imagery in identifying the mangrove area of 334.971 ha and the distribution of mangroves in Riung District.

In this study, Landsat 7ETM+ and Landsat 8 images to identify mangrove density using NDVI analysis and using RGB 564 to identify objects.

MATERIALS AND METHODS

This research was conducted in the northern coastal area of Aesesa District, Nagekeo Regency, with research locations in 5 villages with 1 sub-district, including:

a. Aeramo Village

   Aeramo Village has a total area of 2,786 hectares, with the northern area bordering Nangadhero Village, the southern part is bordering with Olaia Village, the eastern part is bordering Anakoli Village, and the western part is bordering with Lape Village. The population of Aeramo Village is 5,410 people, most of whom work as farmers.

b. Marapokot Village

   Marapokot Village has a total area of 517.25 hectares, the north area is

bordered by the Flores Sea, the south is bordered by Danga Village, the east is bordered by Nangadhero Village and the west is bordered by Tongurambang Village. The population of Marapokot Village is 2,177 people with an average profession as a farmer.

c. Nangadhero Village

Nangadhero Village has an area of 3097 km², the North area is bordered by the Flores Sea, the South is bordered by Lape Village, the East is bordered by Aeramo Village and the West is bordered by Marapokot Village. The total population of Marapokot Village is 1786 people.

d. Tonggurambang Village

Tonggurambang Village has an area of 1,580 hectares, with the northern area bordering the Flores Sea, the southern part is bordering with Mbay I Village, the eastern part is bordering with Marapokot Village and the western part is bordering with Mbay II Village. The population of Tonggurambang Village is 1,495 people with the average population working as farmers.

e. Mbay II Village

Mbay II Village has an area of 1,416.69 km2², the northern area is bordered by the Flores Sea, the southern part is bordered by Mbay I Sub-district and Towak Sub-district, the eastern part is bordered by Tonggurambang Village and Mbay I Sub-district and the western part is bordered by Waekokak Village and Nggolonio Village. The population of KelurahanMbay II is 1,527 people with an average profession as a farmer.

f. Nggolonio village

Nggolonio Village has an area of 32.58 km², the northern area is bordered by the Flores Sea, the southern part is bordered by the western part by the village of Lengkongsambingada Regency and the eastern part by the village of Mbay 11 Village. The population of Nggolonio Village is 1,450 people.

The study utilized Landsat 7 imagery in 2011 and Landsat 8 imagery in 2016 and 2021 which were used to determine changes in mangrove areas based on the mangrove vegetation density index using NDVI (Normalized Difference Vegetation Index) analysis, which was divided into 5 density classes, namely: very rare, rare, medium, meeting, very

meeting, which is then done Reclassification (Reclass). by references if quoted from others. Classification of mangrove mapping based on SNI dividing the density of mangrove forests according to the percentage as follows shown in **Table 1**.

Table 1. Classification of mangrove mapping based on SNI dividing the density of mangrove forests according to the percentage as follows

NO.	Class	Denisity value range
1	Very dense mangroves	(>90%)
2	Dense mangroves	(70%-90%)
3	Medium mangroves	(50%-69%)
4	Sparse mangroves	(30%-49)
5	Mangroves are very rare	(<30%)

Reclassification aims to classify NDVI transformed images using the Erdas imagine 2014 application by entering Landsat 7ETM+ and 8 images for the NDVI transformation process where the NDVI index value range is -1.0 (minus 1) to 1.0 (positive) which is then divided into several density class according to the density of mangrove forest.To manage the results of the data, it is done by comparing changes in the mangrove area from year to year. After getting an interpretation of the image of the mangrove forest area in 2011, 2016 and 2021 in the North Coast region of Aesesa District, the next data processing is to find out changes in the area of mangrove forest whether it has decreased or increased the area of mangrove forest. Get the results of image interpretation in the form of changes in the area of mangrove forests in the North coast area of Aesesa District in 2011, 2016 and 2021. Overlay the map of the distribution of mangrove forest area in 2011 and 2016, so that you get the results of changes in the area of mangrove forest from 2011-2016. Overlay the map of the distribution of mangrove forest area in 2016 with 2021, so that you get the results of changes in the area of mangrove forest from 2016-2021.

Analyzing the Overlay map of the distribution of mangrove forest area in 2011-2016, the map of the distribution of mangrove forest area in 2016-2021, so as to get the results of changes in the area of mangrove forest from 2011-2016 in the North coast area of Aesesa District which is then carried out a general accuracy test carried out on the data the result of remote sensing classification is by using an error matrix by measuring

overall accuracy (OA), producer accuracy (PA), user accuracy (UA). Classification accuracy testing aims to see classification errors so that the percentage of accuracy (accuracy) can be determined. The accuracy of the classification results is tested by creating a contingency matrix which is often referred to as an error matrix or confusion matrix which is the calculation of every error in each form of land use from the results of the image classification process. Accuracy test is the stage that determines whether the results of the classification carried out are in accordance with the conditions in the field and can be accepted for truth. Assessment of the accuracy of the classification is useful for obtaining the level of confidence from remote sensing. The result of an acceptable classification process is a classification process that has an accuracy value of more than or equal to 85% or a coefficient of 0.85 (Openg 2018). Error matrix in this study shown in **Table 2**.

Table 2. Error matrix

Reference Data	**Classified Into Class**				**Amount**	***Producer's Accuracy***
	A	B	C	D		
A	X11	X 12	X 13	X 14	X1+	X11/X1+
B	X21	X 22	X 23	X24	X2+	X22/X2+
C	X31	X 32	X 33	X 34	X3+	X33/X3+
D	X41	X42	X43	X44	X4+	X44/X4+
Amount	X+1	X+2	X+3	X+4	N	
User's Accuracy	X11/X+1	X22/X+2	X33/X+	X44/X+4		

This accuracy calculation is usually measured based on the division of pixels that are correctly described by the total pixels. used (the number of pixels contained in the diagonal of the matrix by the sum of all the pixels used). This accuracy is called overall accuracy, which usually exceeds estimates. overall accuracy is calculated by the formula.

$$OA = \frac{\sum_{i=1}^{r} Xii}{N} 100\%$$

With overall accuracy:

$$Overall\ acuracy = \frac{The\ correct\ value}{Total\ number} x100\%$$

RESULTS AND DISCUSSION

Based on observations during research in mangrove forests, Aesesa District, Nagekeo Regency has two types of mangroves, namely Avicennia alba mangroves and Avicennia marina based on research conducted by (Rahayu 2022). In addition, mangroves suffered quite severe damage due to community actions.who cut down mangrove trees, especially in Aeramo Village, Marapokot Village, and Nanggadhero Village. In Aeramo Village, the community cleared the forest to make way for milkfish ponds which were quite extensive, in Marapokot Village and Nanggadhero Village the mangroves were cut down to make land for residents' settlements. The swampy soil conditions and the location close to the sea are not suitable for building settlements, so they are vulnerable to disasters, for example, floods that occur during high tides, and the foundation of a house that is not strong enough can result in a house not being able to withstand earthquakes. Logging of mangrove trees is also carried out in order to fulfill their subsistence needs. The people cut them down to make firewood and make fences. Mangrove forest damage shown in **Figure 1**.

Figure 1. Mangrove Forest damage

NDVI (Normalized Difference Vegetation Index) analysis

The results obtained by performing image processing using the NDVI method in the research area, namely Aesesa District, have NDVI values in the three observation years, namely 2011, 2016 and 2021 which are very diverse, in 2011 it has a minimum value of -0.573770464 and a maximum value

of 0.54666682 , in 2016 it has a minimum value of -0.291984737 and a maximum value of 0.609456897 and in 2021 with a minimum value of -0.067266561 and a maximum value of 0.579148531 into five classes which are very rare,rare, moderate, frequent and very frequent.Based on the results of landsat imagery management, the density value of mangrove vegetation is obtained in the form of a map layout (**Figure 2-4**).

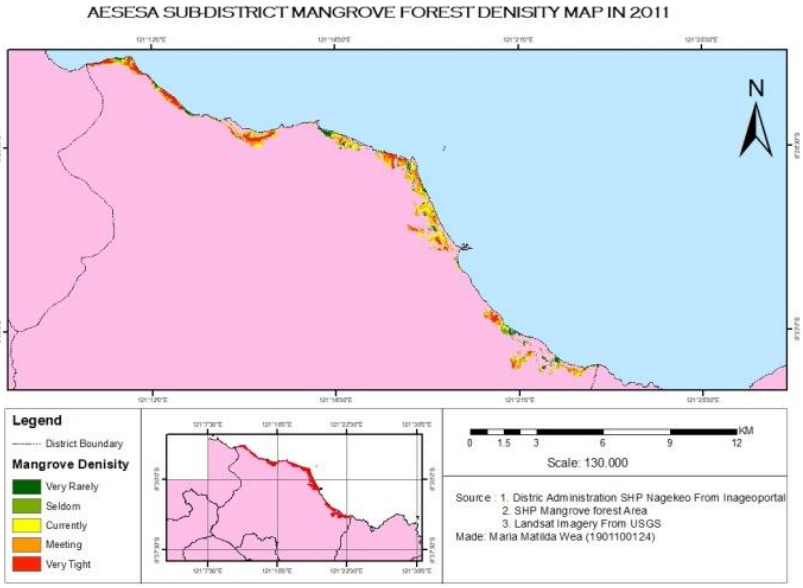

Figure 2. Mangrove Forest Density Map 2011

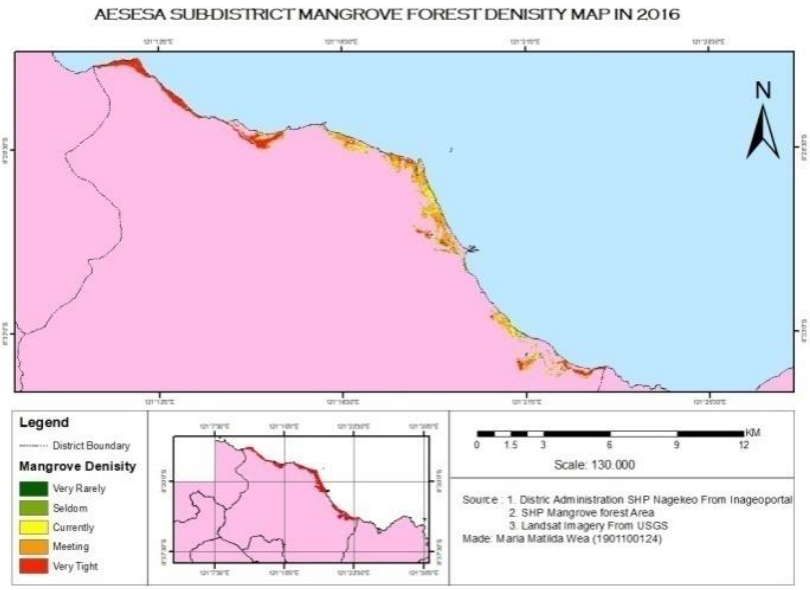

Figure 3. Mangrove Forest Density Map 2016

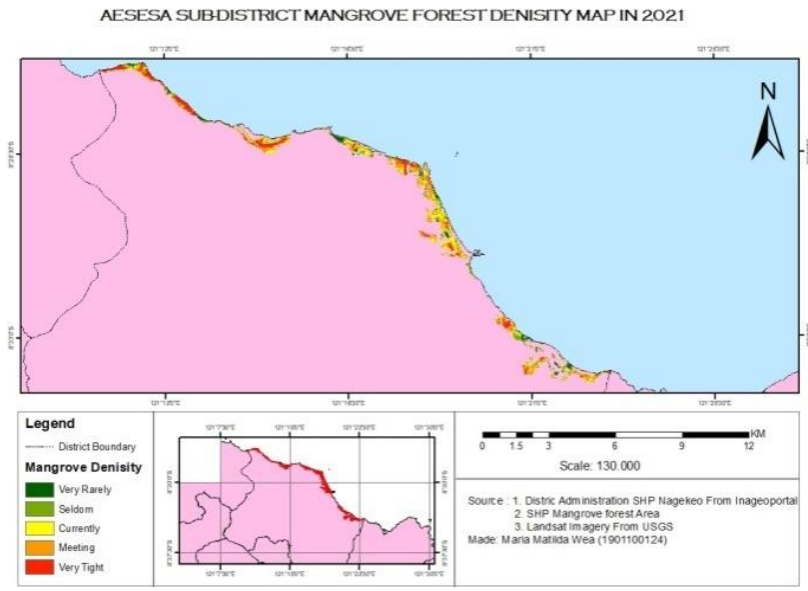

Figure 4. Mangrove Forest Density Map 2021

Changes in Mangrove Forest Areas

Management of changes in mangrove forest areas utilizing the Arcgis 10.8 application and Microsoft Excel using the overlay technique, where the results of image classification are converted into vector or shp data using raster to polygon in Arcgis 10.8, then the vector data is dissolved to combine the same attributes which is then carried out by a technique overlay on map of mangrove density classification results (**Table 2**)

Table 2. Changes in Mangrove Forest Area

NO	Class	Area (ha)					
		Year 2011	%	Year 2016	%	Year 2021	%
1	Very rarely	46.39	7%	16.36	2%	33.35	5%
2	Seldom	102.35	16%	66.81	10%	82.78	13%
3	Currently	181.97	28%	154.72	24%	143.84	22%
4	Meeting	198.04	30%	209.06	32%	189.82	29%
5	Very Meeting	128.86	20%	210.65	32%	207.82	32%
Total		**657.61**	**100%**	**657.61**	**100%**	**657.61**	**100%**

Source: Analysis Results, 2023

Based on the results (**Table 2**) of the analysis, it showed that there were differences in each class of mangrove forests which were analyzed based on the results of the mangrove density classification. The data shows that in 2011 forests with a sparse class with an area of 7% decreased by 2% in 2016, but in 2021 it has increased by 5%. In the rare class, it has an area of 16% in 2011,

a decrease of 10% in 2016 and an increase of 13% in 2021. In 2011, the medium class shows an area of 28%, decreased in 2016 and 2021 by 24 and 22%, then there was an increase in the meeting class from 30% to 32% in 2016, and a decrease of 29% in the meeting class in 2021. Graph of change in mangrove forest area shown in **Figure 6**.

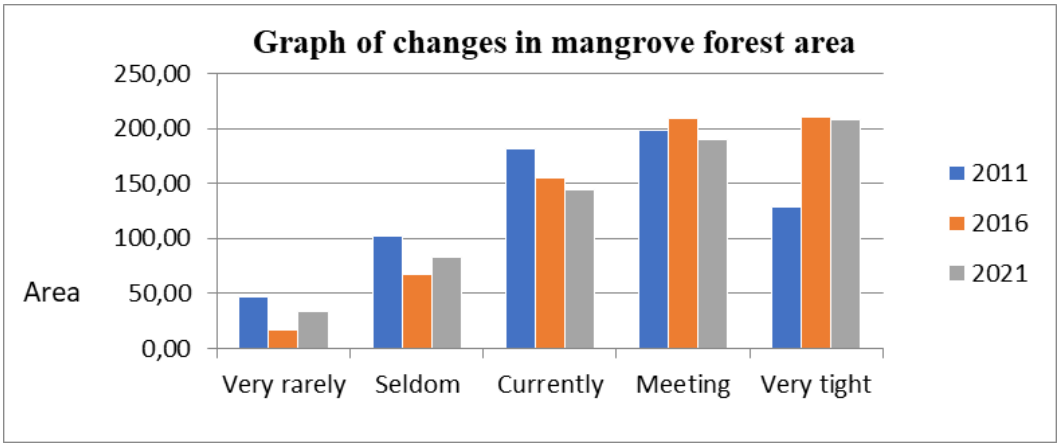

Figure 6. Graph of change in mangrove forest area

Based on the graph (**Figure 6**) of changes in the area of mangrove forests with five density classes in 2011, 2016 and 2021, the area of change is obtained. In the very rare class, mangroves covering an area of 49.36 hectares in 2011 decreased to 16.36 hectares in 2016, but in 2021 it has increased to 33.5 hectares. Then in the sparse class it has an area of mangrove forest of 102.35 hectares in 2011 it experienced a decrease in forest area in 2016 to 66.81 hectares and in 2021 again experienced a slight increase to 82.78 hectares, then in the medium class in 2011 mangrove area of 181.97 hectares decreased consecutively in 2016 and 2021 where in 2016 it decreased by 154.72 hectares and in 2021 it amounted to 143.84 hectares. In the meeting class, the mangrove area increased, which in 2011 was 198.04 hectares, increased to 209.06 hectares in 2016, but decreased in 2021 to 189.82 ha, then in the 2011 meeting class, the mangrove area was 128. 86 hectares increased in 2016 to 210.65 hectares but experienced a slight decrease in 2021 to 207.82 hectares. Changes that occur in the mangrove forest area occur due to the actions of people who cut down the mangrove forest to make it into fish ponds, settlements and to fulfill

household activities such as making mangrove trees as firewood and fences in their yards. but decreased in 2021 to 189.82 ha, then in the 2011 mangrove area density class of 128.86 hectares it increased in 2016 to 210.65 hectares but slightly decreased in 2021 to 207.82 hectares. Changes that occur in the mangrove forest area occur due to the actions of people who cut down the mangrove forest to make it into fish ponds, settlements and to fulfill household activities such as making mangrove trees as firewood and fences in their yards. but decreased in 2021 to 189.82 ha, then in the 2011 mangrove area density class of 128.86 hectares it increased in 2016 to 210.65 hectares but slightly decreased in 2021 to 207.82 hectares. Changes that occur in this mangrove forest area occur because of the actions of people who cut down mangrove forests to make fish ponds, settlements and to fulfill household activities such as making mangrove trees as firewood and house yard fences.

Accuracy Test

The accuracy test was carried out to determine the accuracy of the classification results by comparing the coordinate points obtained in the field with the results of the landsat image classification. In the accuracy test, the confusion matrix test is used (**Table 3**).

Tabel 3. Confusion Matrix Test

Classification	SJ	J	S	R	SR	Row Totals	User Accuracy %
Very rarely	6	0	0	0	0	6	100%
Seldom	0	9	0	0	0	9	100%
Currently	0	0	9	0	1	10	90%
Meeting	0	0	1	14	0	15	93.33%
Very tight	0	0	0	2	22	24	91.66
Columns Total	6	9	10	16	23		Amount
Producer Accuracy %	100%	100%	90%	87.5%	95.65%		64

$$Overall\ acuracy = \frac{The\ correct\ value}{Total\ number} x100\%$$

$$Overall\ acuracy = \frac{64}{60} x100\% = 93.75\%$$

The results of the classification process are acceptable if the classification process has an accuracy value of more than or equal to 85% or a coefficient of

0.85 (Elisabeth 2018), based on this, a classification accuracy of 93.75% is obtained, which means acceptable, where the minimum classification accuracy level using remote sensing must be not less than 85%.

CONCLUSIONS

Based on the analysis and discussion, it can be concluded that the Aesesa District area, Nagekeo Regency has a range of vegetation density index on Landsat 7 ETM+ imagery in 2011 from -0.573770464 to 0.54666682, in 2016 it has a vegetation density index from -0.291984737 to 0.609456897 and in 2021 it has a range Vegetation density index from -0.067266561 to 0.579148531 which is divided into 5 density classes namely; very rare, rare, moderate, rare and very tight.

Changes in the area of mangrove areas in the mangrove forest class are relatively variable due to additions and reductions in the area of mangrove areas. The largest decrease in area occurred in 2011 to 2016 which occurred in the rare class where there was a decrease of 10% where the total area of 102.35 hectares of mangrove forest area decreased to 66.81 hectares. very dense by 12% in 2011-2016 where the mangrove forest area which was initially 128.86 hectares increased to 210.65 hectares. The addition of the mangrove class area occurred due to natural growth and reforestation activities by the community.

The results of the accuracy test using the confusion matrix show that the overall accuracy is 93.75%.

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