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Analysis and Comparison of Mangrove Forest Area on the South Coast of East Java Using the 2 Canal Algorithm of Landsat-8 Satellite Image.

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***Abstract**. Trenggalek and Malang districts are among the coastal cities in East Java that have mangrove forests. The function of mangroves as a wear prevention to maintain the plains is the background of this research. The purpose of this study is to compare the vegetation density of mangrove forests in Trenggalek and Malang using Landsat 8 image 2 channel algorithm method by calculating the vegetation index value with NDVI and EVI methods. The difference in vegetation values can be seen based on thematic maps with differences in average diameter of mangrove trees where in mangrove forests in Trenggalek Regency has an average diameter of mangrove trees of 6.55 cm while in Malang Regency has an average diameter of mangrove trees of 5.73 cm. There are also differences in vegetation values based on the two methods used in the study, namely NDVI and EVI show differences in vegetation values. Using the NDVI method, the vegetation value is 0.53232 for the Malang area while 0.6263 for the Trenggalek area. Although both are classified as very dense, there is a difference in the t-test on the average vegetation value using the NDVI method. Using the EVI method, the vegetation value of 0.33994 for the poor area is classified as moderate while 0.42033 in the Trenggalek area is classified as dense.*

***Keywords** Mangrove, Vegetasi, NDVI, EVI*

1. INTRODUCTION

Mangrove is a plant community or a type of plant that forms a community in tidal areas. Mangrove forests are very important coastal ecosystems with various ecological and economic functions. These forests not only serve as habitat for various flora and fauna, but also play an important role in protecting the coastline from erosion, regulating water quality, and absorbing carbon dioxide. Mangrove forests also have economic functions, such as providing raw materials for industry and supporting the tourism sector. The extent of mangrove forests is a key factor in maintaining their optimal function. The results of the study can be used to develop sustainable mangrove forest management strategies, especially in Trenggalek district. Research can be conducted periodically to monitor changes in mangrove forest area and the effectiveness of management strategies implemented. The results of this study are expected to provide useful information to local governments in formulating appropriate and effective mangrove forest management strategies, as well as to other researchers in developing research on mangrove forests.

2. LITERATURE REVIEW

Mangrove forest is a plant community that grows in tidal and freshwater areas influenced by the tides (Kathiresan & Bingham, 2001). Mangrove forests themselves are

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usually found in brackish water on the ocean-land boundary. Mangrove forests are forest vegetation that grows between tidal lines, but can also grow on coral beaches, as well as on dead coral plains covered with a thin layer of sand, mud, or muddy beaches (Saprianto, 2007). Mangrove forests play an important role in maintaining the balance of the coastal environment, such as protecting the coastline from erosion, providing habitat for various species of flora and fauna, and helping to absorb carbon dioxide from the atmosphere (Alongi, 2008). According to Sampurno (2016), remote sensing has long been an important and effective tool for providing information about the spatial diversity of the Earth's surface quickly, easily, widely, and accurately. Data or information obtained in the form of digitally based images, commonly referred to as imagery. Digital images are two-dimensional models of objects in the form of real appearances on the earth's surface obtained through the process of recording the reflection, emission, or backscatter of electromagnetic waves with optical-electronic sensors attached to a vehicle (platform).

NDVI

One of the algorithm models on vegetation index transformation used is NDVI (Normalized Difference Vegetation Index) which is a combination of image enhancement and subtraction techniques between the near infrared channel and the red channel (Amran, 1999). The range of values obtained by NDVI is between -1 and +1. Only positive values correspond to vegetated areas, and the higher the index, the higher the chlorophyll content of the observed object. As for negative values, they are produced by a higher reflectance in the red channel compared to the near infrared channel. This is due to the fact that the observed objects are cloudy areas, snow, bare ground and rocks. With the following equation :

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

Description:

RED = digital value in red channel image

NIR = digital value in near infrared channel image

EVI

EVI (Enhanced Vegetation Index) is an evolution of the vegetation index determination method to address the limitations of NDVI by improving the sensitivity of the vegetation signal in areas of high biomass (a serious drawback of NDVI), improving the greenness of plants by the influence of soil background and canopy signal, and reducing the influence of atmospheric conditions on vegetation index values by the addition of blue channel information. EVI is more responsive to determining changes in canopy structure, including leaf area index (LAI), canopy type, plant physiology, and canopy architecture than NDVI, which is generally only responsive to chlorophyll content (Huete et al., 2002 in Setiawan. 2018). With the following equation :

$$EVI = G\ x \frac{NIR - RED}{NIR + C1\ RED - C2BLUE + L}$$

Description:

C1 and C2 = aerosol coefficients, valued at 6.0 and 7.5, respectively.

L = calibration factor of canopy and soil effects, value 1

G = scale factor, value 2.5

RED = digital value in red channel imagery

BLUE = digital value in blue channel imagery

NIR = digital value in near infrared channel imagery

3. METHODS

Figure 1. Research Flow Diagram

The method used in this thesis is an exploratory descriptive method, which is by conducting collection, analysis and interpretation activities that aim to make a description (Suryabrata, 1987). The data collection method is not only limited to collecting and compiling data, but includes analysis and discussion of the data.

Data is information or information about something related to the purpose of a study because the main purpose of a study is to get data (Sugiyono, 2010 in Setiawan, 2017). The data to be processed in this thesis are primary data and secondary data.

This research procedure was carried out in several stages, namely: preparation stage, field survey, satellite image data collection, analysis of satellite and field image data, and preparation of research report results. The explanation of these stages is as follows:

1. The preparation stage includes literature study on the research topic, consultation with the supervisor, preparation of tools and materials that will be used during research activities as well as supporting files and information related to the core of the research.
2. Field surveys were conducted to obtain an overview of the research location and used as data collection for satellite image data. Field sampling was conducted to obtain mangrove density data. For mangrove vegetation data that will be taken is the diameter of mangrove tree trunks with the distance between point one to point berukutnya is 25 - 40 meters.
3. This study used Landsat 8 satellite images. Sampling of Landsat 7 and Landsat 8 satellite images was done by downloading images on the official Landsat website www.glovis.usgs.gov. The downloaded images were then processed with the help of a set of PCs and some software to get information about remote sensing of mangrove area at the research site.
4. Image processing is a stage of extracting information from image data and presenting it in a working map. Image processing consists of two stages, namely pre-processing and interpretation. Image data pre-processing is a stage that is performed before image interpretation, in order to obtain mangrove distribution data information. According to LAPAN (2015), data pre-processing is divided into 2, namely radiometric correction, which aims to improve pixel values by considering atmospheric disturbance factors as the main source of error. Vegetation index analysis is used to separate the spectral reflectance index of vegetation from other objects such as water, soil (non-vegetation). The formulas used for this vegetation index analysis are NDVI (Normalized Difference Vegetation Index) and EVI (Enhanced Vegetation Index). The classification of vegetation density and mangrove crown density is determined based on the range of NDVI and EVI values resulting from the calculation.

4. RESULTS

The first step in working on this research is to determine the sample area. the area under study is in two locations. The first location is in Sumbermanjing Wetan District, Malang Regency and the second location is in Watulimo District, Trenggalek Regency.

The next step was to measure the diameter of the mangrove trees and the coordinates of each tree. On June 8, 2024 in Sumbermanjing Wetan District, Malang Regency and on June 29, 2024 in Watulimo District, Trenggalek Regency, in-situ data were collected at 20 points and the coordinates were determined using the avenza maps application.

Table 1. In-situ data results and Coordinates of Malang area.

No	Coordinates Data		In-situ Data
	Longtitude	Latitude	(cm)
1	112.66961	-8.43698	5.62
2	112.66954	-8.43723	3.96
3	112.66937	-8.43710	6.47
4	112.66920	-8.43706	4.35
5	112.66931	-8.43725	3.91
6	112.66922	-8.43748	4.73
7	112.66929	-8.43770	7.71
8	112.66936	-8.43770	4.18
9	112.66946	-8.43762	3.84
10	112.66964	-8.43758	5.22
11	112.66951	-8.43742	4.36
12	112.66981	-8.43756	3.49
13	112.66974	-8.43728	4.56
14	112.66979	-8.43705	5.19
15	112.66994	-8.43686	7.22
16	112.67000	-8.43704	4.74
17	112.66999	-8.43722	6.14
18	112.67018	-8.43744	6.77
19	112.67019	-8.43712	3.64
20	112.67039	-8.43677	4.48

Table 2. In-situ data results and Coordinates of Trenggalek area.

No	Data Koordinat		Data In-situ
	Longtitude	Latitude	(cm)
1	111.706343	-8.298747	4.53
2	111.706127	-8.298680	3.12
3	111.707888	-8.298600	4.06
4	111.707668	-8.298555	5.73
5	111.706392	-8.297475	2.73
6	111.706327	-8.298762	2.74
7	111.706337	-8.298933	6.71
8	111.705390	-8.298180	4.42
9	111.705380	-8.298393	8.44
10	111.705428	-8.299508	7.21
11	111.706017	-8.298575	9.97
12	111.706856	-8.298627	8.33
13	111.706650	-8.298504	6.49
14	111.705360	-8.297449	5.19
15	111.706368	-8.297394	4.21
16	111.705330	-8.298538	3.22
17	111.705360	-8.298655	7.98
18	111.705368	-8.298803	6.28
19	111.705330	-8.298913	4.68
20	111.705338	-8.298038	8.49

Landsat-8 Satellite Imagery Data Processing

Processing of Landsat-8 satellite image data is done using a mathematical system in algorithm modeling. To obtain reflectance values using Digital Number data obtained from certain bands on Landsat-8 which will be processed using Microsoft Excel application. The bands used in this study are band 4 and band 5. The data in this study were taken in June 2024. the data displayed is reflectance data from band 4 and band 5.

Table 3. Reflectance Value of Landsat-8 Imagery in Malang Area.

No	Data Koordinat		Band 4	Band 5
	Longtitude	Latitude		
1	112.66961	-8.43698	0.08316	0.23124
2	112.66954	-8.43723	0.07392	0.23206
3	112.66937	-8.43710	0.08658	0.22180
4	112.66920	-8.43706	0.07750	0.25526
5	112.66931	-8.43725	0.08770	0.24302
6	112.66922	-8.43748	0.07774	0.28800
7	112.66929	-8.43770	0.07980	0.23256

No	Data Koordinat		Band 4	Band 5
	Longtitude	Latitude		
8	112.66936	-8.43770	0.07980	0.23256
9	112.66946	-8.43762	0.08136	0.22800
10	112.66964	-8.43758	0.06614	0.24400
11	112.66951	-8.43742	0.08136	0.22800
12	112.66981	-8.43756	0.06162	0.25748
13	112.66974	-8.43728	0.07392	0.23206
14	112.66979	-8.43705	0.08316	0.23124
15	112.66994	-8.43686	0.06164	0.23626
16	112.67000	-8.43704	0.06164	0.23626
17	112.66999	-8.43722	0.06234	0.23210
18	112.67018	-8.43744	0.06566	0.27048
19	112.67019	-8.43712	0.06126	0.23294
20	112.67039	-8.43677	0.06010	0.23922

Table 4. Reflectance Value of Landsat-8 Imagery in Trenggalek Area.

No	Data Koordinat		Band 4	Band 5
	Longtitude	Latitude		
1	111.7063	-8.29875	0.05926	0.28426
2	111.7061	-8.29868	0.05926	0.28426
3	111.7079	-8.29860	0.07518	0.23734
4	111.7077	-8.29856	0.06672	0.26128
5	111.7064	-8.29748	0.05926	0.27258
6	111.7063	-8.29876	0.05442	0.28426
7	111.7063	-8.29893	0.05574	0.29772
8	111.7054	-8.29818	0.05574	0.25840
9	111.7054	-8.29839	0.05440	0.25840
10	111.7054	-8.29951	0.06276	0.23402
11	111.7060	-8.29858	0.05820	0.27532
12	111.7069	-8.29863	0.06486	0.29386
13	111.7067	-8.29850	0.06690	0.26314
14	111.7054	-8.29745	0.06486	0.25044
15	111.7064	-8.29739	0.06690	0.26314
16	111.7053	-8.29854	0.06126	0.25044
17	111.7054	-8.29866	0.06126	0.27524
18	111.7054	-8.29880	0.05582	0.27524
19	111.7053	-8.29891	0.05582	0.28438
20	111.7053	-8.29804	0.07582	0.28438

After obtaining the reflectance value, continue processing reflectance data with in-situ data using the Microsoft Excel application. Data processing is aimed at determining the best algorithm value using scatter plots. Four equations, namely linear, exponential, logarithmic and power, are used to analyze the value of the greatest degree of determination (R2), with reflectance values as x and in-situ data as y.

Landsat-8 Cita Data Processing with In-situ Data

Image data processing in the form of band 4 and band 5 reflectance of Landsat-8 satellite images with in-situ data in the form of mangrove tree diameter. Data processing is done with Microsoft Excel application to generate a scatter diagram. The scatter diagram is used to determine the best algorithm model from 4 equations, namely linear, exponential, logarithmic, and power, using the largest degree of determination (R2) value.

Landsat-8 Cita Data Processing with In-situ Data Malang Area

Table 5. Recapitulation of Data Processing Results with Band 4 and Band 5 Malang Area

No	Band	Equation Type	Algorithm Model	Determination Degree
1	Band 4	Linear	$y = -2.7067x + 5.2275$	$R^2 = 0.0004$
2	Band 4	Exponential	$y = 4.9497e^{-0.15x}$	$R^2 = 0.0004$
3	Band 4	Logarithmic	$y = -0.197\ln(x) + 4.5126$	$R^2 = 0.0005$
4	Band 4	Power	$y = 4.6378x^{-0.02}$	$R^2 = 0.0002$
5	Band 5	Linear	$y = -3.7924x + 5.94$	$R^2 = 0.0024$
6	Band 5	Exponential	$y = 5.7518e^{-0.671x}$	$R^2 = 0.0025$
7	Band 5	Logarithmic	$y = -1.072\ln(x) + 3.4978$	$R^2 = 0.0031$
8	**Band 5**	**Power**	$\mathbf{y = 3.7106x^{-0.194}}$	$\mathbf{R^2 = 0.0032}$

The value of the degree of determination (R^2) of band 4 and band 5, the highest value of the degree of determination is at the wavelength of Band 5 with the type of Power equation obtained is y = 3.7106x-0.194 with $R^2 = 0.0032$.

Table 6. Comparison Value of In-situ Data with Image Data.

	Data In-situ	Linear	Exponential	Logarithmic	Power
Data In-situ	1				
Linear	-0.822675868	1			
Exponential	-0.822696225	0.999999851	1		
Logarithmic	-0.823044758	0.999914216	0.999921216	1	
Power	**-0.823094237**	0.999877338	0.999885737	0.999996712	1

Table 6 shows the results of the correlation test value between in-situ data and satellite image data using four algorithms, obtained the Power algorithm equation with the formula y = 3.7106x-0.194 with R^2 = 0.0032. has a negative correlation value of -0.823094237 meaning that the variables have a very strong negative relationship.

Landsat-8 Cita Data Processing with In-situ Data Trenggalek Area

Table 7. Recapitulation of Data Processing Results with Band 4 and Band 5 Trenggalek Area

No	Band	Equation Type	Algorithm Model	Determination Degree
2	**Band 4**	**Exponential**	**$y = 3.5667e^{5.1307x}$**	**$R^2 = 0.013$**
3	Band 4	Logarithmic	$y = 1.3727\ln(x) + 8.8586$	$R^2 = 0.012$
4	Band 4	Power	$y = 11.992x^{0.3211}$	$R^2 = 0.0123$
5	Band 5	Linear	$y = -4.4155x + 6.2185$	$R^2 = 0.004$
6	Band 5	Exponential	$y = 7.4291e^{-1.548x}$	$R^2 = 0.0045$
7	Band 5	Logarithmic	$y = -1.33\ln(x) + 3.2822$	$R^2 = 0.0052$
8	Band 5	Power	$y = 2.7552x^{-0.438}$	$R^2 = 0.0057$

Table 7 presented the value of the degree of determination (R2) of band 4 and band 5, the highest value of the degree of determination is at the wavelength of Band 4 with the type of Exponential equation obtained, namely y = 3.5667e5.1307x with R^2 = 0.013.

Table 8. Comparison Value of In-situ Data with Image Data.

	Data In-situ	Linear	Exponential	Logarithmic	Power
Data In-situ	1				
Linear	**0.248171087**	1			
Exponential	-0.248171087	-1	1		
Logarithmic	-0.240116787	-0.999104019	0.999104019	1	
Power	-0.242795188	-0.999593644	0.999593644	0.999904427	1

Table 8 shows the results of the correlation test value between in-situ data and satellite image data using four algorithms, obtained the Power algorithm equation with the formula y = 3.7106x-0.194 with R^2 = 0.0032. has a negative correlation value of -0.823094237 meaning that the variables have a very strong negative relationship.

NDVI Algorithm Model Calculation

Table 9. Satellite image data results Observation of NDVI Measurement of Mangrove Trees in Malang area

No	Band 4	Band 5	NDVI
1	0.08316	0.23124	0.47099
2	0.07392	0.23206	0.51683
3	0.08658	0.22180	0.43848

4	0.07750	0.25526	0.53420
5	0.08770	0.24302	0.46964
6	0.07774	0.28800	0.57489
7	0.07980	0.23256	0.48905
8	0.07980	0.23256	0.48905
9	0.08136	0.22800	0.47401
10	0.06614	0.24400	0.57348
11	0.08136	0.22800	0.47401
12	0.06162	0.25748	0.61379
13	0.07392	0.23206	0.51683
14	0.08316	0.23124	0.47099
15	0.06164	0.23626	0.58617
16	0.06164	0.23626	0.58617
17	0.06234	0.23210	0.57655
18	0.06566	0.27048	0.60933
19	0.06126	0.23294	0.58355
20	0.06010	0.23922	0.59842
		Rata-rata	0.53232

Table 10. Satellite image data results Observation of NDVI Measurement of Mangrove Trees in Trenggalek area

No	Bend 4	Bend 5	NDVI
1	0.05926	0.28426	0.65498
2	0.05926	0.28426	0.65498
3	0.07518	0.23734	0.51888
4	0.06672	0.26128	0.59317
5	0.05926	0.27258	0.64284
6	0.05442	0.28426	0.67863
7	0.05574	0.29772	0.68460
8	0.05574	0.25840	0.64513
9	0.05440	0.25840	0.65217
10	0.06276	0.23402	0.57706
11	0.05820	0.27532	0.65100
12	0.06486	0.29386	0.63838
13	0.06690	0.26314	0.59459
14	0.06486	0.25044	0.58858
15	0.06690	0.26314	0.59459

16	0.06126	0.25044	0.60693
17	0.06126	0.27524	0.63590
18	0.05582	0.27524	0.66278
19	0.05582	0.28438	0.67184
20	0.07582	0.28438	0.57901
		Rata-rata	0.62630

Table 11. Klasifikasi Tingkat Kerapatan Vegetasi Mangrove

Density Level	**Tree Density**
Rare	<1000
Medium	<1000 - <1500
Dense	>1500

Sumber: Dewanti et., 1999

From the above calculations, it is known that the average NDVI of mangrove trees is 0.53232 for the Malang area. From the results of the above calculations, a classification was obtained that states that the mangrove vegetation is very dense and 0.62630 for the Trenggalek area. from the results of the above calculations, a classification was obtained that states that the mangrove vegetation is very dense according to Dewanti et al, 1999 classification level mangrove vegetation density is dense in Malang area, then the tree density is more than 1500 tree trunks per hectare. While the level of mangrove vegetation density is very dense in Trenggalek area, then the tree density is more than 1500 tree trunks per hectare.

T-test Between Average NDVI Values of Malang and Trenggalek Regions

Table 12. T-test Results of NDVI Values of Malang Region with Trenggalek Region

	NDVI Trenggalek	***NDVI Malang***
Mean	0.626302	0.532322536
Variance	0.001812594	0.00326882
Observations	20	20
Pearson Correlation	0.09019228	
Hypothesized Mean Difference	0	
df	19	
t Stat	6.168504288	
P(T<=t) one-tail	3.14518E-06	
t Critical one-tail	1.729132812	
P(T<=t) two-tail	6.29036E-06	
t Critical two-tail	2.093024054	

EVI Algorithm Model Calculation

Table 13. Satellite image data results Observation of EVI Measurement of Mangrove Trees in Malang area

No	Band 2	Band 4	Band 5	EVI
1	0.06086	0.08316	0.23124	0.290638
2	0.05978	0.07392	0.23206	0.322148
3	0.06506	0.08658	0.22180	0.269721
4	0.06598	0.07750	0.25526	0.362654
5	0.06372	0.08770	0.24302	0.300700
6	0.06432	0.07774	0.28800	0.413234
7	0.06504	0.07980	0.23256	0.312122
8	0.06504	0.07980	0.23256	0.312122
9	0.06284	0.08136	0.22800	0.294491
10	0.05802	0.06614	0.24400	0.368793
11	0.06284	0.08136	0.22800	0.294491
12	0.05736	0.06162	0.25748	0.409064
13	0.05978	0.07392	0.23206	0.322148
14	0.06086	0.08316	0.23124	0.290638
15	0.05296	0.06164	0.23626	0.361113
16	0.05296	0.06164	0.23626	0.361113
17	0.05542	0.06234	0.23210	0.356492
18	0.05842	0.06566	0.27048	0.417560
19	0.05542	0.06126	0.23294	0.362240
20	0.05508	0.06010	0.23922	0.377343
			Rata-rata	0.339941

Table 14. Satellite image data results Observation of EVI Measurement of Mangrove Trees in Trenggalek area

No	Bend 2	Bend 4	Bend 5	EVI
1	0.05232	0.05926	0.28426	0.450931
2	0.05232	0.05926	0.28426	0.450931
3	0.06444	0.07518	0.23734	0.336398
4	0.06326	0.06672	0.26128	0.409721
5	0.05610	0.05926	0.27258	0.441697
6	0.05232	0.05442	0.28426	0.471610
7	0.05272	0.05574	0.29772	0.489141
8	0.05202	0.05574	0.25840	0.421264
9	0.05202	0.05440	0.25840	0.426903
10	0.05080	0.06276	0.23402	0.348208
11	0.05230	0.05820	0.27532	0.440488

12	0.05176	0.06486	0.29386	0.442146
13	0.05338	0.06690	0.26314	0.388075
14	0.05440	0.06486	0.25044	0.376705
15	0.05338	0.06690	0.26314	0.388075
16	0.05440	0.06126	0.25044	0.390868
17	0.05278	0.06126	0.27524	0.429007
18	0.05278	0.05582	0.27524	0.451738
19	0.05232	0.05582	0.28438	0.465727
20	0.05232	0.07582	0.28438	0.387111
			Rata-rata	0.420337

From the above calculations it is known that the results of the acquisition of the average EVI value of mangrove trees in Malang area is 0.339941 It can be concluded from the above qualifications that the EVI value is between 0.32 to 0.42 which means that the data obtained by the mangrove vegetation level of the poor area is in the medium category. While the acquisition of the average EVI value of mangrove trees in Trenggalek area is 0.420337 It can be concluded from the above qualifications that the EVI value is between 0.42 to 0.47 which means that the data obtained by the mangrove vegetation level of the poor area is in the Dense category.

T-test Between Average EVI Values of Malang and Trenggalek Regions

Table 15. T-test Result of EVI Value of Malang Region with Trenggalek Region

	EVI Trenggalek	***EVI Malang***
Mean	0.4203372	0.339941324
Variance	0.001687217	0.002012324
Observations	20	20
Pearson Correlation	0.187401566	
Hypothesized Mean Difference	0	
df	19	
t Stat	6.554555313	
P(T<=t) one-tail	1.41107E-06	
t Critical one-tail	1.729132812	
P(T<=t) two-tail	2.82214E-06	
t Critical two-tail	2.093024054	

5. CONCLUSION

Based on the analysis of image data with field data that has been carried out on the results, it is concluded that:

1. The following are the results of the calculation of Mangrove Tree density in Malang and Trenggalek Areas
   a) Based on the results of the calculation of the average NDVI Mangrove Tree Malang area is 0.53232, included in the category Very Dense. For the calculation of the average NDVI Mangrove Tree Trenggalek area is 0.62630, included in the category Very Dense. Showing mangrove forest Trenggalek area is more dense than Malang area.
   b) Based on the results of the calculation of the average EVI of Mangrove Trees in Malang is 0.33994, included in the Medium category. For the calculation of the average EVI Mangrove Tree Trenggalek area is 0.42033, included in the category Dense. It shows that the mangrove forest in Trenggalek area is denser than Malang area.
2. The results of the T test analysis on the comparison of Mangrove Tree vegetation density values using NDVI and EVI methods in Malang and Trenggalek areas show that:
   a) The results of the T test analysis of the vegetation density value of Mangrove Trees in Malang and Trenggalek using the NDVI method state that Ho is rejected because Thitung = 4.5393> Tkritis = 1.7291 meaning that there is a difference in density between Mangrove forests in Malang and Trenggalek areas. The results of the calculation of the average NDVI value of Malang = 0.5508, included in the classification of dense density. While the results of the calculation of the average NDVI value of the Trenggalak area = 0.6263, included in the classification of very dense density.
   b) The results of the T test analysis of Mangrove Tree vegetation density values in Malang and Trenggalek areas using the EVI method state that Ho is rejected because Thitung = 4.7211> Tkritis = 1.7291, meaning that there is a difference in density between Mangrove forests in Malang and Trenggalek areas. The results of the calculation of the average EVI value of Malang = 0.3580, included in the classification of moderate density. While the results of the calculation of the average EVI value of the Trenggalak area = 0.4203, included in the classification of dense density.
3. Based on thematic maps made based on the correlation of image data with field data shows the level of vegetation density of mangrove trees in the Trenggalek area is more fertile than Malang, it is shown from the average distribution of mangrove trees

with larger diameter in the Trenggalek area. Where the average size of the diameter of mangrove trees in Trenggalek is 6.54 cm, while the average size of the diameter of mangrove trees in Malang is 5.73 cm.

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