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# Paper 7 - Correlation of Salinity and Temperature with Landsat Satellite Imagery & Case Study: Mayangan Coastal Probolinggo

*by Primasari Cahya Wardhani*

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# Correlation of Salinity and Temperature with Landsat Satellite Imagery & Case Study: Mayangan Coastal Probolinggo

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**Abstract:-** The coastal area of Mayangan is located at an altitude of ±4 m above sea level. Mayangan District is located north of Probolinggo Regency, which is the object of this research case study. Several aspects that affect the Mayangan coastal area are salt content (salinity) and temperature. Salinity is the salt content in the sea, and Sea Surface Temperature (SST) is one of the parameters used to measure water quality. The increase in salinity and temperature above the tolerance range of organisms can increase the rate of metabolisms, such as plants, reproduction, and activity. This research uses the Remote Sensing method with Landsat 8 Satellite Imagery. This image is included in the medium resolution, namely 30m x 30m resolution, using salinity and sea surface temperature (SST) variables. Identification Results of Salinity Distribution in the range of 32-35 per milliliter while the distribution of sea surface temperature (SST) ranges between 26,10 ° C – 30,50 ° C. The best mathematical model is in band 3, for salinity with a Logarithmic algorithm model  $y = -1,382\ln(x) + 30,195$ , while the Power Algorithm against sea surface temperature (SST) model  $y = 21,804x^{-0,1}$ . Band 3 correlation with salinity and SST is 0.625387012, which means the positive correlation is quite strong.

**Keywords:-** Identification of Salinity and sea surface temperature; Landsat 8 image; Mayangan Coastal Area Probolinggo.

## I. INTRODUCTION

The Mayangan District, geographically, is one of five sub-districts in Probolinggo Regency. Mayangan District is located at -7°43' north latitude and 113°13' east longitude, with an altitude of + 4 m above sea level. Mayangan District is in the north of Probolinggo Regency. The boundaries of the Mayangan District are to the north of the Madura Strait, to the east of Dringu District, to the south of Kanigaran District, and the west of Kademangan District. At the same time, the total area of the Mayangan District is 8,655 km<sup>2</sup> which is divided into five villages, namely: Wiroborang Village, Jati Village, Sukabumi Village, Mangunharjo Village, and Mayangan Village. Mayangan District has 3,455 Km<sup>2</sup> or 39.92 percent of the District area [1]. This research was conducted in the coastal area of Mayangan using the Remote Sensing method with Landsat 8 Satellite Imagery, where this image is included in the medium resolution of 30m x 30m with variable salinity and sea surface temperature (SST). Some influential aspects are salt content (salinity) and

temperature. Sea water has a 3-4% salt content, which is equivalent to a salinity of 30-40 ‰. While the surface temperature ranges from 0 - 30°C [5]. A36 is a steel that is often used [2].

Salinity is the salt content in the sea, and Sea Surface Temperature (SST) is one of the parameters used to measure water quality. Measurement of Sea Surface Temperature (SST) is based on water and ultimately affects the photosynthesis process in the waters [3]. Sea Surface Temperature (SST) that is too much can also reduce the availability of dissolved oxygen in the water. Salinity and temperature are important physical parameters for the life of organisms in sea and river waters. This parameter is very specific in estuary waters. The increase in salinity and temperature above the tolerance range of organisms can increase the rate of metabolisms, such as plants, reproduction, and activity [4].

This study aims to analyze Sea Surface Temperature Using Landsat 8 Satellite Imagery Case Study on the Mayangan coast of Probolinggo. The results of previous studies have succeeded in confirming and proving the effect of salinity levels and seawater temperature on the corrosion rate. The higher the salinity and temperature, the higher the corrosion rate. The highest corrosion occurred at a salinity of 38 ‰ with a temperature of 27°C of 0.5616 mmpy. For each addition of 3 ‰ salinity, the average corrosion rate increases by 0.0415 mmpy. Meanwhile, for the addition of a temperature of 10°C, the average corrosion rate increases by 0.2052 mmpy [2].

With a very wide reach, of course, it is an important requirement considering the vast ocean area owned by the Unitary State of the Republic of Indonesia so that it is useful for management both regionally and nationally or internationally. Remote sensing is very appropriate to be used as a solution for identification. For civil engineering management to anticipate buildings on the coast, sources of data and information are indispensable. To anticipate corrosion of coastal buildings in Mayangan Probolinggo, the data/information obtained is very efficient and effective, cheap, and fast.

**II. MATERIALS AND METHOD**

In situ salinity data retrieval using a refractometer, in situ seawater salinity ranges from 32 for the lowest salinity to 35 ‰ (per mill). In contrast, the sea surface temperature (SST) ranges from 26.1°C for the lowest temperature to 30.5 °C.

**III. RESULTS**

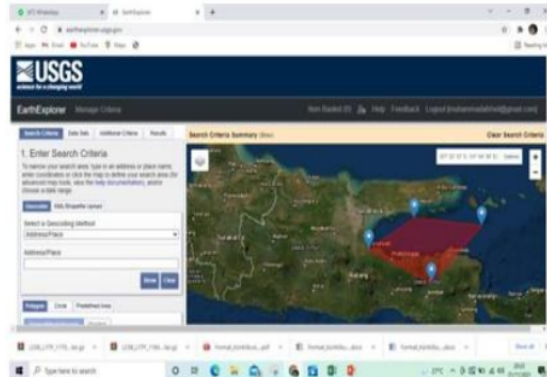


Fig 1. Downloaded map of the Mayangan coastal area of Probolinggo Regency from Landsat 8 Satellite

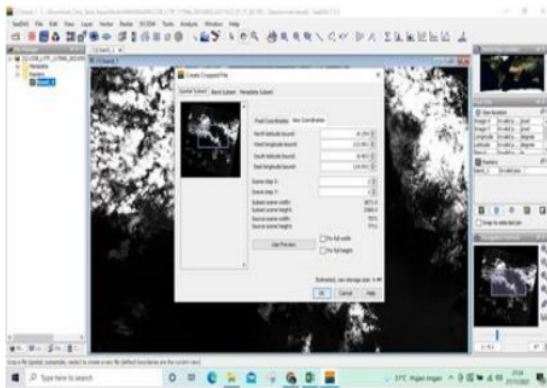


Fig 2. Map of the research area for the Mayangan coastal area, Probolinggo Regency from the original color Landsat 8 Satellite Image *Mayangan* location, *Probolinggo* Indonesia. Click on the coordinates, and it will be displayed on the map.

The equipment needed in this activity is a computer unit and **SPC** DAS 5.7.3 software. The variables studied are salinity and sea surface temperature (SST) in the coastal area of *Mayangan, Probolinggo* Regency.

The first step was to cut the image to reduce the image display area according to the coordinates of the desired area. This aims to make the file size smaller so that the processing process becomes faster. In other words, observations are made by creating an Area of Interest (AOI) by determining the coordinates. The coordinates of the research location are 114.144° East Longitude – 115.234 West Longitude and -

8.325 North Latitude – 8.998 South Latitude (Figure 2). The average surface temperature distribution data were extracted from Landsat 8 imagery in 2021. The data were cut and processed at Seadas for further use in visualization (display) and analysis (raw data) to observe the distribution of salinity and sea surface temperature. They were then processed in MS Excel into a graphical representation (chart) of the distribution of salinity and distribution of sea surface temperature (SST).

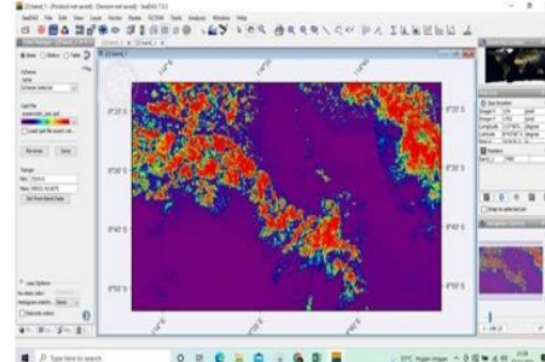


Fig 3. Results of Map cropping of the Mayangan coastal area of Probolinggo Regency

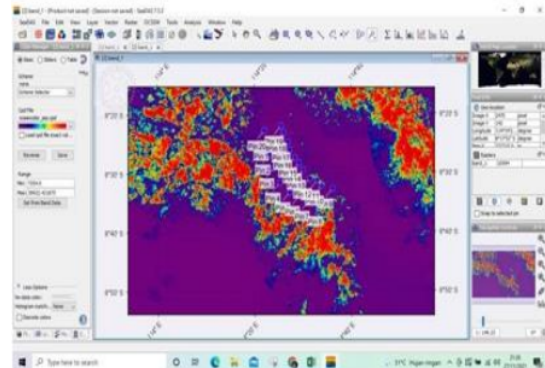


Fig 4. Placement of pins on the Salinity data map of the Mayangan coastal area, Probolinggo Regency

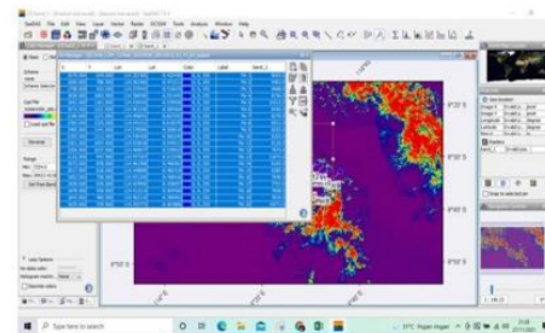


Fig 5. Placement of Salinity Data Pins Map of the research area of the Mayangan coastal area, Probolinggo Regency

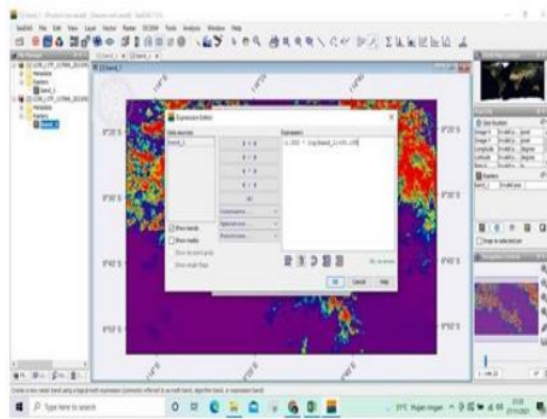


Fig 6. Math Band Process Salinity data in the Mayangan coastal area, Probolinggo Regency

The map that has been cut is marked with 20 sample points for taking sea surface temperatures and getting a large Digitalnumber. To bring up the reflectance, the digital number values multiplied by  $2 \times 10^{-5} - 0,1$ , which aims to obtain an Algorithm Model that is expected to map the distribution of salinity and distribution of sea surface temperature in the Mayangan coastal area, Probolinggo Regency. This study determined four algorithm models, namely Linear, Exponential, Logarithmic, and Power. Table 1 shows the analysis results in the distribution pattern of salinity, and Figures 5 and 6 show SST.

Below are the results of the analysis of the four reflectances using Landsat 8 imagery.

Pin	LONGITUDE	LATITUDE	BAND_2	BAND_3	BAND_4	SALINITY (permill)	SST INSITU	SALINITY LOGARITHMIC MODEL $y = -1,382\ln(x) + 30,195$	SST MODEL POWER $y = 21,804x^{-0,1}$
1	114,40250	-8,57383	0,09658	0,0568	0,04678	35	30,2	34,15888	29,047
2	114,41022	-8,52119	0,09156	0,05316	0,042	35	29,1	34,25041	29,240
3	114,41467	-8,54724	0,09184	0,0543	0,05052	34	28,2	34,22109	29,178
4	114,43205	-8,55603	0,09446	0,06596	0,04726	34	28	33,95225	28,616
5	114,44939	-8,56725	0,09144	0,07642	0,05306	34	27,9	33,74883	28,198
6	114,46920	-8,57823	0,10682	0,0783	0,05572	34	27,8	33,71524	28,129
7	114,50192	-8,57383	0,09886	0,07702	0,03826	34	27	33,73802	28,176
8	114,55103	-8,55925	0,10218	0,07642	0,05882	34	27,5	33,74883	28,198
9	114,58535	-8,55784	0,10132	0,1422	0,05552	33	26,8	32,89062	26,500
10	114,63358	-8,55569	0,10328	0,06864	0,04752	33	26,1	33,89721	28,502
11	114,66546	-8,55263	0,09454	0,07124	0,04038	33	30,5	33,84583	28,396
12	114,64980	-8,52976	0,10364	0,06364	0,04614	34	30,1	34,00174	28,719
13	114,62416	-8,53584	0,0991	0,0662	0,04572	32	30	33,94723	28,606
14	114,58299	-8,54508	0,09728	0,06892	0,04458	35	29,3	33,89159	28,491
15	114,53528	-8,55264	0,09942	0,0593	0,0439	34	29,3	34,09935	28,922
16	114,50585	-8,55408	0,09744	0,06902	0,04842	35	28,5	33,88958	28,486
17	114,49092	-8,54775	0,09894	0,06042	0,04748	34	28	34,07349	28,868
18	114,47356	-8,53652	0,09438	0,0655	0,04692	34	27,9	33,96192	28,636
19	114,45705	-8,52150	0,10114	0,067	0,04058	33	27,3	33,93063	28,571
20	114,45065	-8,50167	0,09844	0,06144	0,04014	34	26,9	34,05036	28,820

Table 1. Coordinates with wavelength / reflectance Band\_2 Band\_3 Band\_4 Landsat satellite imagery

No.	Reflectance	Regression	Salinity Algorithm Model	Degree of Determination /R <sup>2</sup>	Regression	SST Algorithm Model	Degree of Determination /R <sup>2</sup>
1	Band_2	Linear	$y = -56,355x + 39,43$	0,0924	Linear	$y = -77,631x + 35,938$	0,0681
2		Exponential	$y = 39,889e^{-1,661x}$	0,0911	Exponential	$y = 37,27e^{-2,808x}$	0,0719
3		Logarithmic	$y = -5,563\ln(x) + 20,981$	0,0936	Logarithmic	$y = -7,554\ln(x) + 10,777$	0,067
4		Power	$y = 23,158x^{-0,164} R^2 = 0,0923$	0,0708	Power	$y = 14,995x^{-0,273}$	0,0708
1	Band_3	Linear	$y = -14,361x + 34,907$	0,1137	Linear	$y = -29,729x + 30,601$	0,2114
2		Exponential	$y = 34,913e^{-0,424x}$	0,1124	Exponential	$y = 30,679e^{-1,056x}$	0,2155
3		Logarithmic	$y = -1,382\ln(x) + 30,195$	0,1299	Logarithmic	$y = -2,807\ln(x) + 20,989$	0,2325
4		Power	$y = 30,383x^{-0,041}$	0,1282	Power	$y = 21,804x^{-0,1}$	0,237
1	Band_4	Linear	$y = 0,5275x + 33,875$	1E-05	Linear	$y = -52,849x + 30,803$	0,0544
2		Exponential	$y = 33,849e^{0,0267x}$	4E-05	Exponential	$y = 30,815e^{-1,817x}$	0,0519
3		Logarithmic	$y = 0,0858\ln(x) + 34,163$	0,0002	Logarithmic	$y = -2,262\ln(x) + 21,388$	0,0438
4		Power	$y = 34,205x^{0,003}$	0,0002	Power	$y = 22,311x^{-0,078}$	0,0415

Table 2. Algorithm calculation of wavelength / reflectance Band\_2 Band\_3 Band\_4 Landsat satellite imagery

IV. DISCUSSION

Based on the analysis in table 2, the best regression model is found in band 3 for salinity and SST (sea surface temperature). The best mathematical model for salinity variable Logarithmic Algorithm Model  $y = -1.382\ln(x) + 30.195$  and degree of determination  $R^2 = 0.1299$ , while the best mathematical model is sea surface temperature with Power Algorithm model  $y = 21.804x^{-0.1}$ , degree of determination  $R^2 = 0.237$

➤ Band 3 Sea Surface Temperature/SST

Several factors that affect the surface temperature include seasonal conditions (climate), wind, and phenomena in the sea, such as upwelling, currents, and others

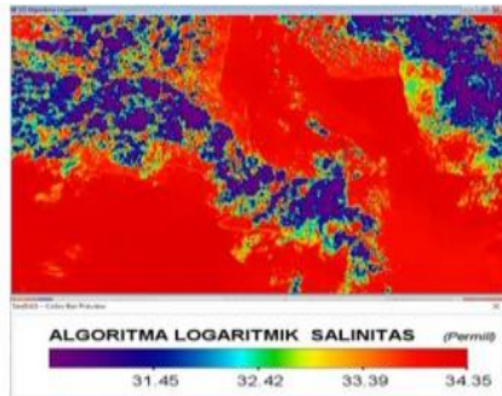


Fig 7. Salinity scale results Logarithmic Algorithm Model  $y = -1.382\ln(x) + 30.195$  research area Mayangan coastal area, Probolinggo Regency

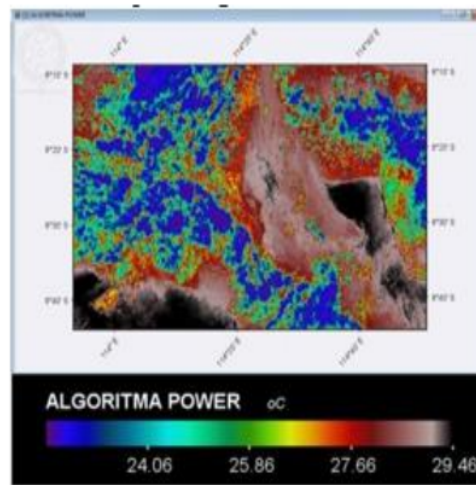


Fig 8. Results of SST/temperature mapping using the Power Algorithm Model  $y = 21.804x^{-0.1}$ , the degree of determination  $R^2 = 0.237$  the research area of the Mayangan coastal area, Probolinggo Regency

Table 3. Correlation of Band 3 with salinity and SST

Model	R	R Square	Adjusted RSquare	Std. Error of the Estimate	Durbin-Watson
1	.645 <sup>a</sup>	.416	.319	.017445257	1.490

a. Predictors: (Constant), X2, X1

b. Dependent Variable: Y

Several factors that affect the surface temperature include seasonal conditions (climate), wind, and phenomena in the sea such as upwelling, currents, and others. Suppose it is related to the observations in this study. In that case, it can be observed that the seasonal phenomenon affects the temperature of the coastal surface waters of the Mayangan coastal area, Probolinggo Regency. In general, the rate of photosynthesis of phytoplankton increases with increasing water temperature but will decrease drastically after reaching a certain temperature point. This is because each phytoplankton species always adapts to a certain temperature range. As the water in the tropics and right on the equator, throughout the year, generally, the surface temperature conditions of the coastal waters of the Mayangan coastal area of Probolinggo Regency range from 26,10 °C – 30,50 °C.

## V. CONCLUSION

Mayangan coastal area, Probolinggo Regency. The results of the identification of Salinity Distribution are in the range of 32-35 per millimeter. The distribution of sea surface temperature (SST) shows a range between 26,10 °C – 30,50 °C. Thus, the best mathematical model in band 3, concerning salinity with the Logarithmic algorithm model  $y = -1.382\ln(x) + 30.195$  while the sea surface temperature (SST) Power Algorithm model  $y = 21.804x^{0.1}$ . Band 3 correlation with salinity and SST / temperature is 0.625387012, which means the positive correlation is quite strong.

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