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# Correlation of Salinity and Temperature with Landsat Satellite Imagery 8 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 ofthis 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 of32-35 per milliliter while the distribution of sea surface temperature (SST) ranges between 26,10 º C – 30,50 º C. The best mathematical model is in band 3, for salinity with a Logarithmic algorithm model y = -1,382ln(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 isquite 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 -7º43' north latitude and 113º13' 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 km² which is divided into five villages, namely: *Wiroborang* Village, *Jati* Village, *Sukabumi* Village, *Mangunharjo* Village, and *Mayangan* Village. *Mayangan* District has 3,455 Km² 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 0/00. While the surface temperature ranges from 0 - 300C [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 $38^0/_{00}$ with a temperature of $27^0$C of 0.5616 mmpy. For each addition of $3^0/_{00}$ salinity, the average corrosion rate increases by 0.0415 mmpy. Meanwhile, for the addition of a temperature of $10^0$C, the average corrosion rate increases by 0.2052 mmpy [2]

With a very wide reach, of course, it is animportant requirement considering the vast ocean area owned by the Unitary State of the Republic of Indonesia so that it isuseful 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.

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## II. MATERIALS AND METHOD

In situ salinity data retrieval using a refractometer, in situ seawater salinity ranges from 32 for the lowest salinityto 35 ‰ (per mill). In contrast, the sea surface temperature (SST) ranges from 26,1ºC for the lowest temperature to 30,5 ºC.

## III. RESULTS

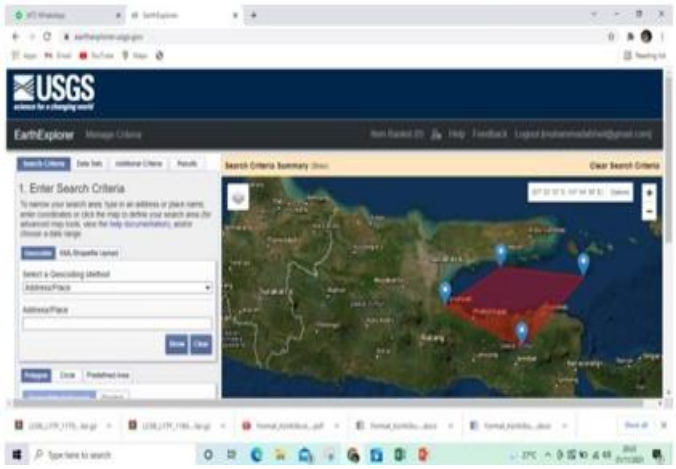


**Fig 1.** Downloaded map of the Mayangan coastal area of Probolinggo Regency from Landsat 8 Satellite

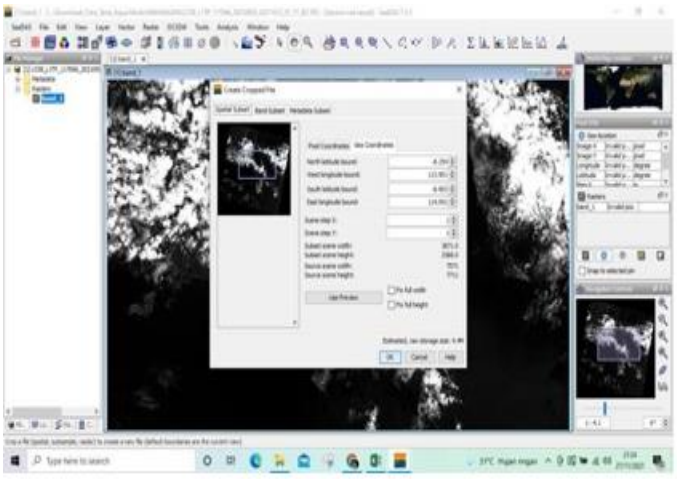

Fig 2. Map of the research area for the Mayangan coastal area, Probolinggo Regency from the original color Landsat 8 Satellite Image *Mayangan* location, *Probolinggo* Indonesia. Click on the coordinates, and it will be displayed on the map.

The equipment needed in this activity is a computerunit and SeaDAS 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 aremade by creating an Area of interest (AOI) by determining the coordinates. The coordinates of the research location are 114,144º 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).

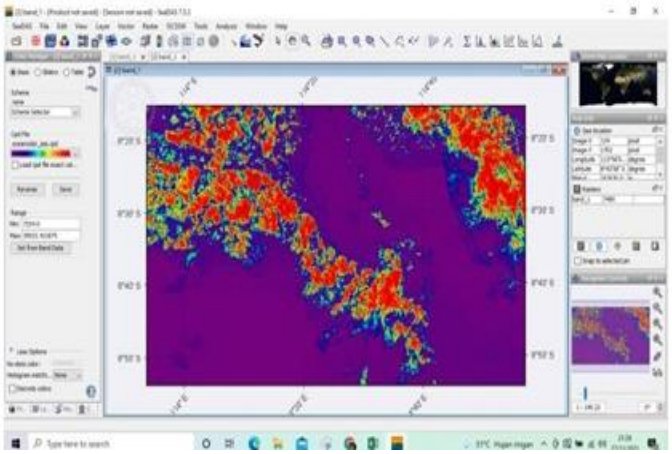

Fig 3. Results of Map cropping of the Mayangan coastalarea of Probolinggo Regency

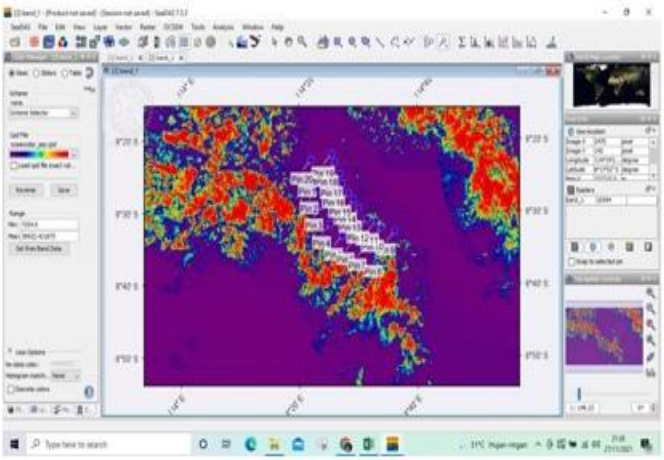

Fig 4. Placement of pins on the Salinity data map of the Mayangan coastal area, Probolinggo Regency

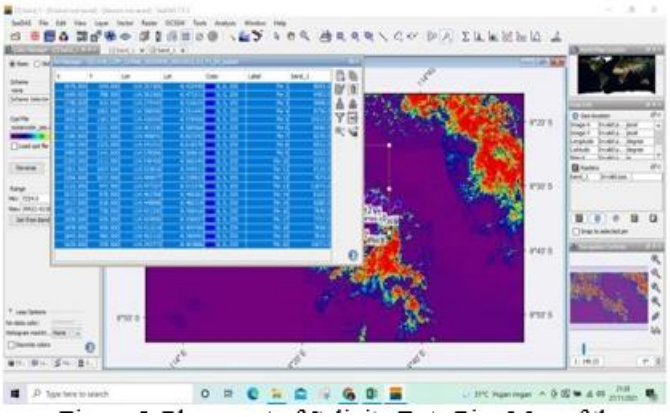

Fig 5. Placement of Salinity Data Pins Map of theresearch area of the Mayangan coastal area, Probolinggo Regency

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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 valueis multiplied by $2x10^{-5}$ – 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 = -1,382ln(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

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| No. | Reflectance | Regression | Salinity Algorithm Model | Degree of Determination /$R^2$ | Regression | SST Algorithm Model | Degree of Determination /$R^2$ |
|---|---|---|---|---|---|---|---|
| 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 = -5,563ln(x) + 20,981 | 0,0936 | Logarithmic | y = -7,554ln(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 = -1,382ln(x) + 30,195 | 0,1299 | Logarithmic | y = -2,807ln(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 = 0,0858ln(x) + 34,163 | 0,0002 | Logarithmic | y = -2,262ln(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 modelis found in band 3 for salinity and SST (sea surface temperature). The best mathematical model for salinity variable Logarithmic Algorithm Model y = -1.382ln(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

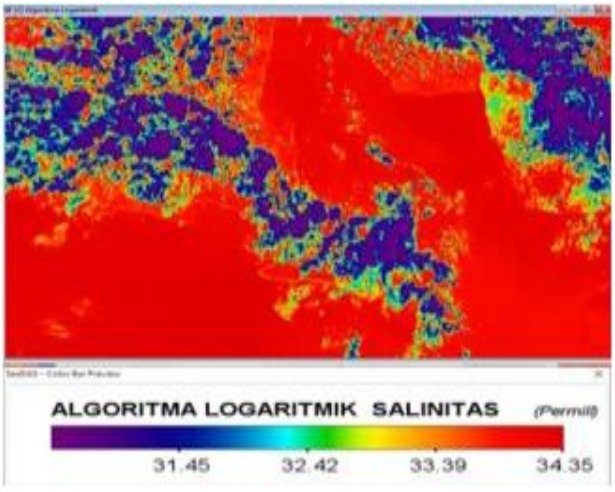


Fig 7. Salinity scale results Logarithmic Algorithm Model y = -1.382ln(x) + 30.195 research area *Mayangan*coastal area, Probolinggo Regency

➢ *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

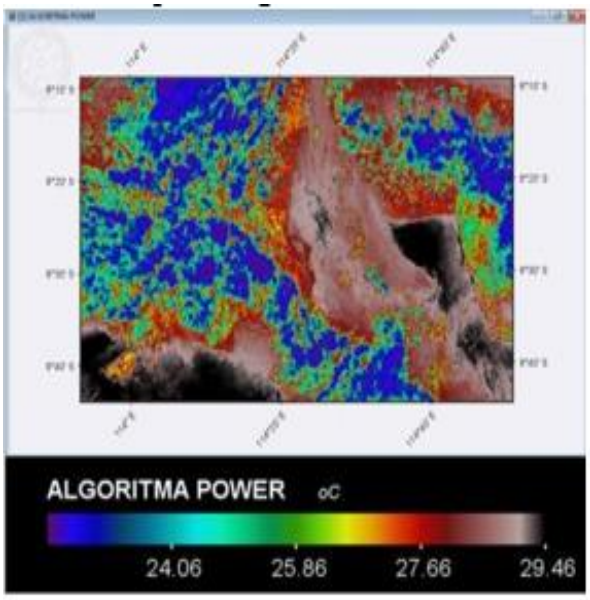


Fig 8. Results of SST/temperature mapping using the Power Algorithm Model $y = 21.804x^{-0.1}$, the degree of determination $R^2$ = 0.237 the research area of the Mayangan coastal area, Probolinggo Regency

Table 3. Correlation of Band 3 with salinity and SST

| Model | R | R Square | Adjusted RSquare | Std. Error ofthe Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | .645[a] | .416 | .319 | .017445257 | 1.490 |

a. Predictors: (Constant), X2, X1

b. Dependent Variable: Y

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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 º C – 30,50 º C.

## V. CONCLUSION

Mayangan coastal area, Probolinggo Regency. The results ofthe identification of Salinity Distribution are in the range of 32-35 per millimeter. The distribution of sea surface temperature (SST) shows a range betwee 26,10 º C – 30,50 ºC. Thus, the best mathematical model in band 3, concerning salinity with the Logarithmic algorithm model y = -1.382ln(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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