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# Distribution of Water Quality Concerning Sea Surface Temperature and Dissolved Oxygen Using Landsat 8 Satellite Imagery on the Tuban Coast, East Java

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**Abstract:- The coast of Tuban is a fairly dynamic area where the lives of fishers depend on fishing. Changes in the eco system in Tuban's coastal area significantly affect fishing activities. One of the parameters that can be observed is the distribution of oxygen content and sea surface temperature of the water bodies on the coast. Sea surface temperature and dissolved oxygen have a vital role as a determinant of water quality and are crucial factors for the life of organisms in theocean.**

**This study aims to analyze the distribution of nutrients in sea surface temperature and dissolved oxygen with Landsat 8 Satellite Imagery, a Case Study on the coast of Tuban, using a computer unit and Seadas 4.7.3 software.**

**Identifying the Tuban coastal area is to get the distribution of sea surface temperature (SST) in the range of 27.717136904597ºC to 40.287807002664ºC, while dissolved oxygen has a range from 4.670533359051 mg/L to 4.820914387703 mg/L. Dissolved Oxygen Algorithm Model y = 0.0734ln(x) + 4.8917 with $R^2$ = 0.2677, Sea surface temperature (SST) Algorithm Model y = 4.8634ln(x) + 44.941 with $R^2$ = 0.2872.**

**The correlation between sea surface temperature (SST) and dissolved oxygen from Landsat 8 satellite imagery is a linear model Y (Dissolved Oxygen) = 91.246 X (Sea Surface Temperature) - 399.14.**

***Keywords:-*** *sea surface temperature; dissolved oxygen; Landsat 8 image; Tuban Coastal Area.*

## I. INTRODUCTION

In general, East Java's coastaland marine are as can be grouped into the north coast, south coast, and east coast. Tuban Regency is one of the northern coastal areas. The northern coast of East Java is a low-lying area whose height is almost the same as sea level. Coastal areas are of ten used for various activities such as residential areas, aqua culture, tourism, et cetera. The utilization of coastal areas requires good management because environmental conditions are influenced by many factors such as wind, sea currents, tides, abrasion, sedimentation, etc etera. [1][2][3]

The coast of Tuban is a fairly dynamic area where the lives of fishers depend on fishing activities. Changes in the ecosystem in Tuban's coastal area significantly affect fishing activities. One of the parameters that can be observed is the distribution of oxygen content and sea surface temperature from water bodies on the coast[4][1]. Sea surface temperature and dissolved oxygen have a vital role as a determinant of water quality and are crucial factors for the life of organisms in the ocean[5], because these two variables indicate the presence of nutrients and the presence of chlorophyll as food for marine biota.

This study aims to analyze the distribution of nutrients in sea surface temperature and dissolved oxygen with Lands at 8 Satellite Imagery Case Study on the coast of Tuban, using a computer unit and Sead as 4.7.3 software [6][7].

This study uses a computer unit, Seadas 5.7.3 software, and secondary data from Landsat 8 satellite imagery launched on February 11, 2013. This earth monitoring satellite has two sensors, namely Operational Land Imager (OLI) and Thermal Infrared Sensors (TIRS). These two sensors provide a spatial resolution of 30 meters (visible, NIR, SWIR), 100 meters (thermal), and 15 meters (panchromatic). Landsat 8 is more suitable to be called a satellite with a mission to continue Landsat 7 than to be called a new satellite with new specifications. This can be seen from its characteristics, similar to Landsat 7 in terms of resolution (spatial, temporal, and spectral), correction method, flight altitude, and the sensors' characteristics. However, several additions become the improvement points of Landsat 7, such as the number of channels, the lowest electromagnetic wave spectrum range that the sensor can capture, and the bit value (Digital Number value range) of each image pixel. Landsat 8 satellite has Onboard Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) sensors with 11 channels [8].

Among these channels, nine channels (channels 1-9) are on OLI, and two others (Channels 10 and 11) are on TIRS. Most of the canals have specifications similar to Landsat 7. In the interests of marine and fisheries management, efficient and effective sources of data and information are supported by cheap and fast data types [6][9][10].Some of the issues to be aware of include:

- How does this study identify areas to get the distribution of sea surface temperature (SST) throughout and dissolved oxygen in the entire coastal area of Tuban?
- How does this study comprehend the estimation of sea surface temperature (SST) and dissolved oxygen in the coastal area of Tuban?
- How is the correlation between sea surface temperature (SST) and dissolved oxygen from Landsat 8 satellite imagery throughout the coastal area of Tuban?

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## II. MATERIALS AND METHOD

Landsat 8 satellite imagery data was taken from the website https://earthexplorer.usgs.gov/with the election time being June 2022 according to the date of sampling Sea Surface Temperature in the field [11][12].

The variable studied was sea surface temperature/SST in the coastal area of Tuban, Tuban Regency. The next step is image cropping, to reduce the image display area according to the coordinates of the desired area. This aims to make the file size smaller, making the processing process faster. For data processing purposes, observations are made by creating an Area of interest (AOI) by determining the coordinates. The coordinates of the research location are 112.245 East Longitude to 112.973 West Longitude and -6.764 North Latitude to -7.203 South Latitude. The average sea surface temperature data distribution was extracted from Landsat 8 satellite imagery.

- Data processing stage
  - Opening the downloaded image data using the SeaDAS application. Cropping, this process is done so that the position of the research area looks clearer and focuses on that area only.
  - Reprojecting the cropped image. Carrying out this reprojection process aims to make the map position based on the actual coordinates on the earth. The following is an image display after the reprojection process.
  - Take digital number data by pinning the part under study. In the process of giving this pin, the longitude and latitude position for each period must be the same so that 20 points can be compared as material for calculations.
  - Adjusting SeaDAS image data with Microsoft Excel tables 1 and 2. High accuracy is required in transferring data from SeaDAS to Ms.Excel due to several formats that need adjustment and different data readings between the two. Processing the first 20 data of each wave with scatter to get a mathematical equation with the best degree of determination/$R^2$.
  - Entering the equation obtained by clicking on the math band to get a thematic map image, namely a map of the distribution of dissolved oxygen and sea surface temperature presented in Figures 2, 3, and

## III. RESULTS

The survey data below are the coordinates and measurements of dissolved oxygen and sea surface temperature.


Fig. 1: Tuban coastal area research location map

The satellite image data used in this study is Landsat 8 image taken from web https://earthexplorer.usgs.gov./ web page. Filename:
LC08_L1TP_118065_20220416_20220420_02_T1_B2,
LC08_L1TP_118065_20220416_20220420_02_T1_B3,
LC08_L1TP_118065_20220416_20220420_02_T1_B4
The image data is Level 2 image data downloaded for June 2022 as shown in Figure 1.

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| Point | Lon | Lat | SST/ºC | Dissolved Oxygen/mg/L |
|---|---|---|---|---|
| 1 | 112,342761 | -6,867808 | 35,4 | 4,78 |
| 2 | 112,343069 | -6,866683 | 36,3 | 4,79 |
| 3 | 112,345591 | -6,866280 | 32,6 | 4,79 |
| 4 | 112,346547 | -6,865337 | 31,5 | 4,78 |
| 5 | 112,348434 | -6,865004 | 29,3 | 4,77 |
| 6 | 112,349364 | -6,864002 | 28,2 | 4,75 |
| 7 | 112,351177 | -6,862529 | 29,1 | 4,74 |
| 8 | 112,353707 | -6,861343 | 28,8 | 4,61 |
| 9 | 112,355353 | -6,860792 | 24,5 | 4,62 |
| 10 | 112,356747 | -6,860072 | 19,2 | 4,75 |
| 11 | 112,358198 | -6,859461 | 23,7 | 4,62 |
| 12 | 112,356620 | -6,859603 | 28,6 | 4,63 |
| 13 | 112,353366 | -6,860206 | 35,4 | 4,78 |
| 14 | 112,350107 | -6,861107 | 36,2 | 4,64 |
| 15 | 112,347874 | -6,862097 | 38,2 | 4,65 |
| 16 | 112,345896 | -6,863217 | 38,9 | 4,78 |
| 17 | 112,343811 | -6,864691 | 39,6 | 4,79 |
| 18 | 112,342892 | -6,865708 | 39,1 | 4,79 |
| 19 | 112342080 | -6,867094 | 40,0 | 4,80 |
| 20 | 112,8341721 | -6,869154 | 40,1 | 4,80 |

Table 1: SST and Dissolved Oxygen data and coordinate data

Source: taken from field measurement

**Dissolved Oxygen Data Processing with Reflectance Band 2**

Below is a table of reflectance band 2 for dissolved oxygen, such as the following data,

| Point | Digital Number | Reflectance Band 2 | Digital Number | Reflectance Band 3 | Digital Number | Reflectance Band 4 |
|---|---|---|---|---|---|---|
| 1 | 21327 | 0,32654 | 20245 | 0,30490 | 19974 | 0,29948 |
| 2 | 14967 | 0,19934 | 13449 | 0,16898 | 12362 | 0,14724 |
| 3 | 11386 | 0,12772 | 10040 | 0,10080 | 8387 | 0,06774 |
| 4 | 10848 | 0,11696 | 9691 | 0,09382 | 8021 | 0,06042 |
| 5 | 12951 | 0,15902 | 9398 | 0,08796 | 7742 | 0,05484 |
| 6 | 10560 | 0,1112 | 9066 | 0,08132 | 7494 | 0,04988 |
| 7 | 10514 | 0,11028 | 8992 | 0,07984 | 7399 | 0,04798 |
| 8 | 10627 | 0,11254 | 9117 | 0,08234 | 7526 | 0,05052 |
| 9 | 11830 | 0,1366 | 10313 | 0,10626 | 9243 | 0,08486 |
| 10 | 10855 | 0,1171 | 9003 | 0,08006 | 7518 | 0,05036 |
| 11 | 11015 | 0,1203 | 9327 | 0,08654 | 7830 | 0,0566 |
| 12 | 10492 | 0,10984 | 8842 | 0,07684 | 7368 | 0,04736 |
| 13 | 10713 | 0,11426 | 9166 | 0,08332 | 7635 | 0,0527 |
| 14 | 10390 | 0,1078 | 8822 | 0,07644 | 7347 | 0,04694 |
| 15 | 10677 | 0,11354 | 9130 | 0,08260 | 7607 | 0,05214 |
| 16 | 11356 | 0,12712 | 9967 | 0,09934 | 8428 | 0,06856 |
| 17 | 11728 | 0,13456 | 10221 | 0,10442 | 8729 | 0,07458 |
| 18 | 19492 | 0,28984 | 19218 | 0,28436 | 19057 | 0,28114 |
| 19 | 21262 | 0,32524 | 21483 | 0,32966 | 21494 | 0,32988 |
| 20 | 16421 | 0,22842 | 17720 | 0,25440 | 14467 | 0,18934 |

Table 2: Data Value of Digital Number and Reflectance Band2, Band3, Band4

Source: taken from field measurement

SeaDAS software version 7.5.3 provides a digital number to change the digital number into a reflectance in band 2, band 3, and band 4 using the following formula:

Reflectance band x = Digital Number*0.000002-0.1

Below is presented a scatter diagram to determine the best algorithm model.

| No | Algorithm | Mathematical model Dissolved Oxygen | $R^2$ | Mathematical model SST | $R^2$ |
|---|---|---|---|---|---|
| BAND_2 | Linear | y = 0,4936x + 4,6448 | 0,1473 | y = 28,182x + 26,553 | 0,0905 |
| | Exponent | $y = 4,6447e^{0,1047x}$ | 0,1466 | $y = 26,286e^{0,9488x}$ | 0,083 |
| | Logarithmic | y = 0,1012ln(x) + 4,9183 | 0,1708 | y = 5,0686ln(x) + 40,737 | 0,0808 |
| | Power | $y = 4,9223x^{0,0215}$ | 0,1698 | $y = 42,383x^{0,1707}$ | 0,0742 |
| BAND_3 | Linear | y = 0,4089x + 4,6785 | 0,2330 | y = 30,001x + 27,283 | 0,1108 |
| | Exponent | $y = 4,6782e^{0,0866x}$ | 0,2314 | $y = 26,943e^{1,0089x}$ | 0,1014 |
| | Logarithmic | y = 0,0734ln(x) + 4,8917 | 0,2677 | y = 4,8601ln(x) + 41,782 | 0,1138 |
| | Power | $y = 4,8943x^{0,0156}$ | 0,2659 | $y = 43,942x^{0,1641}$ | 0,105 |
| BAND_4 | Linear | y = 0,3558x + 4,6954 | 0,2080 | y = 33,403x + 29,207 | 0,2558 |
| | Exponent | $y = 4,6949e^{0,0754x}$ | 0,2066 | $y = 28,779e^{1,044x}$ | 0,2268 |
| | Logarithmic | y = 0,0533ln(x) + 4,8669 | 0,2474 | y = 4,8634ln(x) + 44,941 | 0,2872 |
| | Power | $y = 4,8685x^{0,0113}$ | 0,2457 | $y = 47,058x^{0,152}$ | 0,2546 |

Table 3: Recapitulation of bands 2, 3, and band 4 is the most optimal

Source: take from field measurement

## IV. DISCUSSION

Table 3 Recapitulation of the three bands, it is shown that for dissolved oxygen the best interest/response is in band 3 logarithmic model y = 0.0734ln(x) + 4.8917 with $R^2$ = 0.2677 while sea surface temperature has the best response in band_4 logarithmic model y = 4.8634ln(x) + 44,941 with $R^2$ = 0.2872. Below is a histogram of each band.

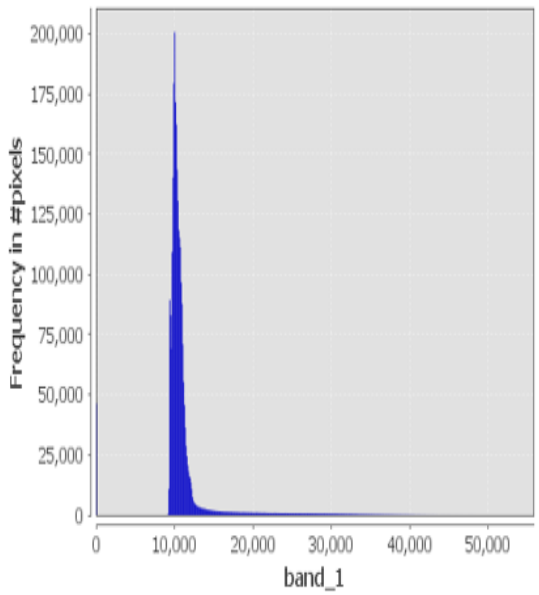


Fig. 2 Histogram of the Band 2 reflectance of a Landsat 8 satellite image

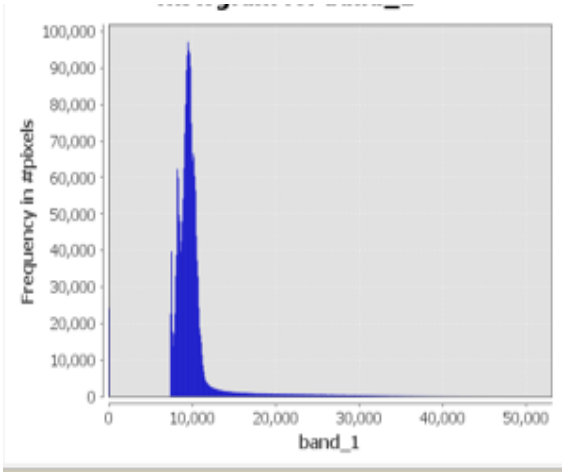


Fig. 3: Histogram of the Band 3 reflectance of a Landsat 8 satellite image

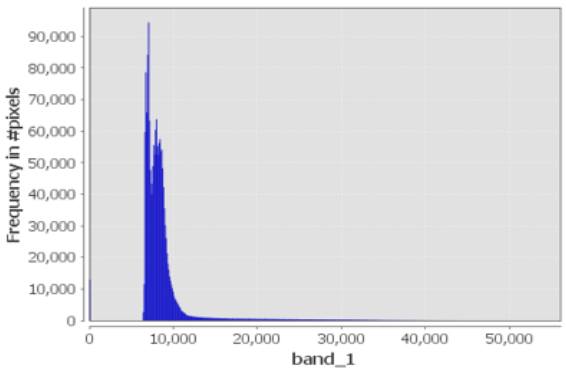


Fig. 4: Histogram of the Band 4 reflectance of a Landsat 8 satellite image

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The following is a thematic map of Dissolved Oxygen in band 3 logarithmic model y = 0.0734ln(x) + 4.8917. Dissolved oxygen ranges between 4.670533359051 mg/L to 4.820914387703 mg/L in the coastal area of Tuban. The thematic map below shows that the redder the dissolved oxygen is getting lower while the bluer the dissolved oxygen is getting higher. In the Decree of the Minister of the Environment, the standard of seawater quality for marine biota is greater than five, so the dissolved oxygen level in the coastal area of Tuban is less suitable for the life of marine biota.

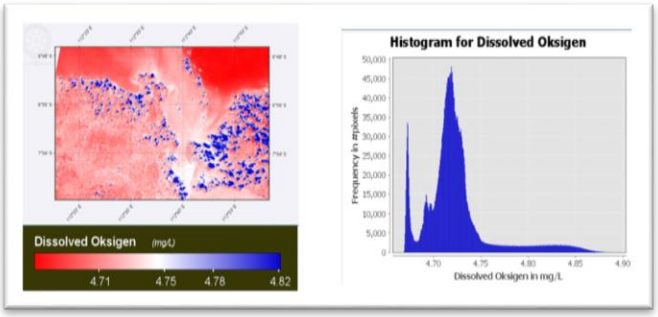


Fig. 5: Dissolved Oxygen Band_3 distribution map Landsat 8 satellite image

The following is a thematic map of the best sea surface temperature on band_4 logarithmic model y = 4.8634ln(x) + 44.941 with its histogram. The picture shows that the more toward the blue, the lower the sea surface temperature, while the more it leads toward the brown, the sea surface temperature is getting higher.

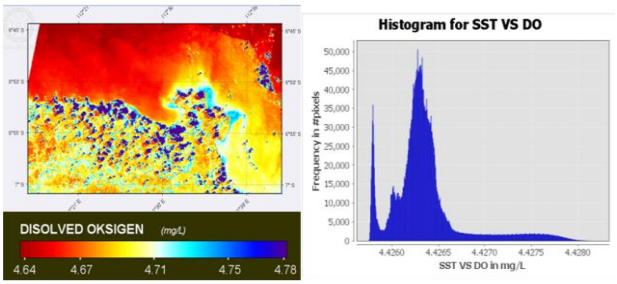


Fig. 6: Distribution map of Sea Surface Temperature Band_4 satellite imagery Landsat 8

Thematic map Overlay of Sea Surface Temperature Distribution to Dissolved Oxygen Landsat 8 satellite imagery model Logarithmic algorithm:
Y (Dissolved Oxygen) = 91.246 X (Sea Surface Temperature) - 399.14

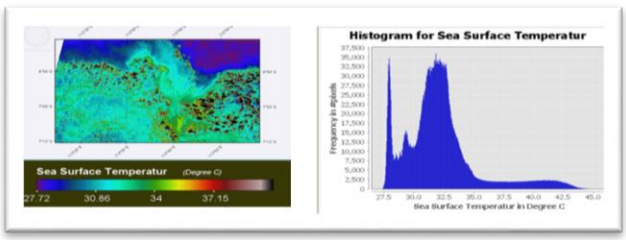


Fig. 7 Thematic Map Overlay Sea Surface Temperature Distribution Band_4 Landsat 8 satellite image

## V. CONCLUSION

Identifying the Tuban coastal area is to obtain the distribution of sea surface temperature (SST) in the range of 27,717136904597ºC to 40,287807002664ºC, while dissolved oxygen has a range from 4.670533359051 mg/L to 4.820914387703 mg/L in the coastal area of Tuban. In the Decree of the Minister of Environment, the standard of seawater quality for marine biota is greater than five. At the same time, the dissolved oxygen level in the coastal area of Tuban is 4.820914387703 mg/L < 5, so the coastal area of Tuban is less suitable for the life of marine life. The correlation between sea surface temperature (SST) and dissolved oxygen from Landsat 8 satellite imagery is a logarithmic algorithm model Y (Dissolved Oxygen) = 91.246 X (Sea Surface Temperature) - 399.14.

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