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Acidity (pH) and Dissolved Oxygen Levels as Indicators of Water Quality Around the Tuban Coastal Area

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ABSTRACT

The coast of Tuban is a fairly dynamic area, where the lives of fishermen depend on fishing efforts. Ecosystem changes that occur in the coastal area of Tuban greatly affect the fishing effort, where one of the parameters that can be observed is the distribution of oxygen content from water bodies on the coast. The purpose of this study was to analyze and map the distribution of acidity content (pH) and its correlation with dissolved oxygen in the coastal area of Tuban. This is based on the fact that research on the distribution of dissolved oxygen has been carried out by many experts, as well as the acidity value of seawater, there have also been those who have done it, only here that needs to be emphasized, that there have not been many dissolved oxygen studies involving other parameters such as acidity pH.

Keywords: Acidity, dissolved oxygen, remote sensing, landsat 8, coastal Tuban

Introduction

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 the sea level. Coastal areas are often used for various activities such as residential areas, aquaculture, tourism, and so on (Harlyan & Sari, 2015; Patty & Akbar, 2018). Utilization of coastal areas requires good management because environmental conditions are influenced by many factors such as wind, sea currents, tides, abrasion, sedimentation, and so on (Gao et al., 2022; Joesidawati, 2016).

The coast of Tuban is a fairly dynamic area, where the lives of fishermen depend on fishing efforts. Ecosystem changes that occur in the coastal area of Tuban greatly affect the fishing effort, where one of the parameters that can be observed is the distribution of oxygen content from water bodies on the coast (Patty & Akbar, 2018; Wibisana et al., 2019).

Changes in the value of the degree of acidity (pH) and oxygen concentration which act as indicators of water quality can occur as a result of the abundance of chemical compounds, both pollutant and non-pollutant (Joesidawati, 2016; Damaianto & Masduqi, 2014; Yolanda et al., 2016).

Waste that flows into marine waters is generally rich in organic matter, originating from various sources such as household waste, food processing, and various other chemical industries (Yolanda et al., 2016). Organic materials in the waste are in the form of chemical compounds such as carbohydrates, proteins, fats, humus, surfactants, and various other chemical substances (Susana, 2009).

Seawater generally has a pH value above 7 which means it is normal, but under certain conditions, the value can be lower than 7 so that it becomes acidic (Menteri Negara Lingkungan Hidup, 2004). Most aquatic biotas are sensitive to changes in pH values, the ideal value for life is

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between 7 – 8.5. At lower pH values (< 4), most aquatic plants die because they cannot tolerate low pH (Susana, 2009; Salmin, 2005).

Previous research in the coastal area of Tuban, seems that none of them meet the quality standards, so there need to be improvements must be done. Such as improving the environment, improving fishing ports, especially making ship repair facilities, improving waste management, and so on (Joesidawati, 2016).

Material and Methods

Satellite image data

The satellite image data used in this study is Landsat 8 image data taken from the page. Web Error! Hyperlink reference not valid. nama file:
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.

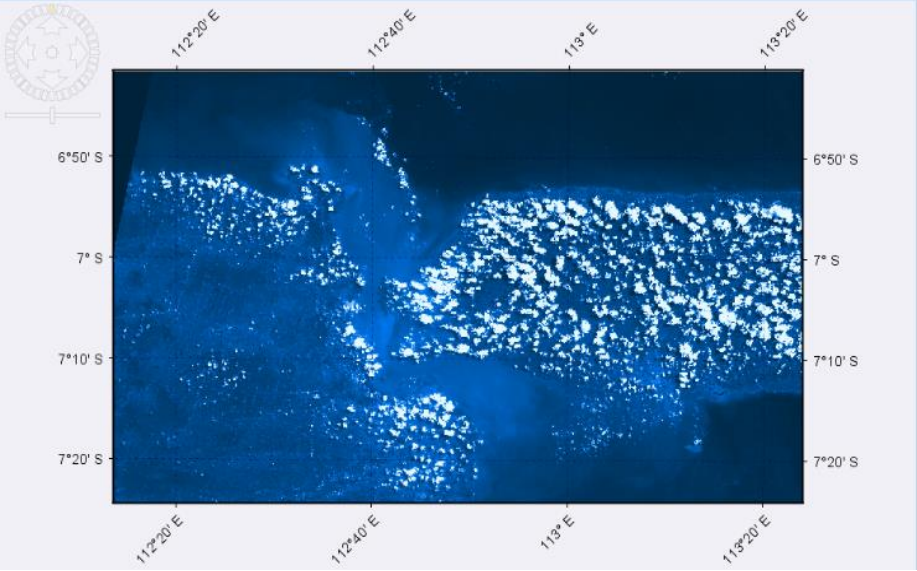


Figure 1. Landsat 8 (satellite image data)

Calculation of acidity level (pH)

To obtain data on the level of acidity (pH) data collection was carried out directly in the field using fishing boats and preparing a sample bottle with a volume of approximately 1 liter. When in the field, seawater is taken at a depth of 20-30 cm from sea level and then tested for the level of acidity (pH) that exists. Measurements are carried out at predetermined coordinates with the help of GPS navigation from existing application devices and stored in the mobile phone. The acidity level data (pH) obtained from the field is recorded for later calculation of the algorithm with the chosen mathematical model, namely linear, exponential, logarithmic, and power.

Calculation of dissolved oxygen

To get the dissolved oxygen value, a sample of 20 bottles of seawater taken in the field was tested in the laboratory with an accuracy of 0.01 readings. The results of recording the values of Ph and dissolved oxygen are given in Table 1, including the corresponding coordinates.

Table 1. pH and Dissolved Oxygen data with field coordinates

Point	Lon	Lat	pH	Dissolved oxygen
1	112.342761	-6.867808	7.6	4.78
2	112.343069	-6.866683	7.7	4.79
3	112.345591	-6.866280	7.7	4.79
4	112.346547	-6.865337	7.7	4.78
5	112.348434	-6.865004	7.7	4.77
6	112.349364	-6.864002	7.7	4.75
7	112.351177	-6.862529	7.8	4.74
8	112.353707	-6.861343	7.8	4.61
9	112.355353	-6.860792	7.8	4.62
10	112.356747	-6.860072	7.9	4.75
11	112.358198	-6.859461	8	4.62
12	112.356620	-6.859603	8	4.63
13	112.353366	-6.860206	7.9	4.78
14	112.350107	-6.861107	7.9	4.64
15	112.347874	-6.862097	8	4.65
16	112.345896	-6.863217	7.8	4.78
17	112.343811	-6.864691	7.9	4.79
18	112.342892	-6.865708	7.9	4.79
19	112.342080	-6.867094	7.8	4.80
20	112.8341721	-6.869154	7.7	4.80

Source : take from field measurement

Results and Discussion

From the data obtained in Table 1, the next step is to calculate the algorithm by involving linear, exponential, logarithmic, and power mathematical models. For processing results with scatter diagrams at wavelengths of Band 2, band 3, and band 4, it is obtained for the variable degree of acidity (pH) the highest correlation is in band 4 with the Power Algorithm model with the equation Acidity =7,4129x-0,019 R^2 = 0,3553 as shown in Table 2. As for the dissolved oxygen variable, the highest correlation is in band 3, with a logarithmic algorithm model with the equation DO = 0,0734ln(x) + 4,8917 R^2 = 0,2677 as can be seen in Table 3.

Table 2. Model mathematic calculation at Band_4 wavelength Acidity

No	Algorithm	Mathematical model	R^2
1	Linear	Acidity = -1,0899x + 7,8983	0,3472
2	Exponent	Acidity = $7,8983e^{-0,14x}$	0,3524
3	Logarithmic	Acidity = -0,15ln(x) + 7,4054	0,3510
4	**Power**	**Acidity = $7,4129x^{-0,019}$**	**0,3553**

Source: algorithm calculation

Table 3. Model mathematic calculation at Band 3 wavelength Dissolved oxygen

No	Algorithm	Mathematical model	R^2
1	Linear	DO= 0,4089x + 4,6785	0,2330
2	Exponent	DO = $4,6782e^{0,0866x}$	0,2314
3	**Logarithmic**	**DO = 0,0734ln(x) + 4,8917**	**0,2677**
4	Power	DO= $4,8943x^{0,0156}$	0,2659

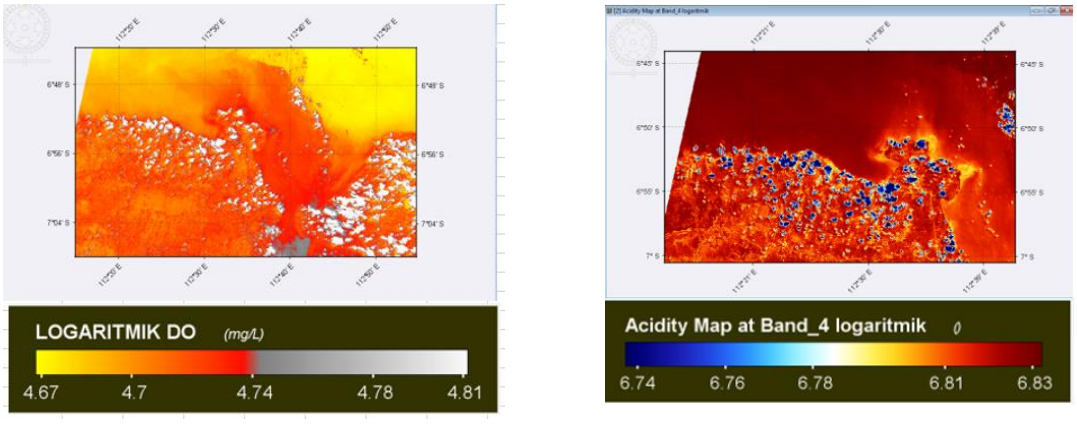
Source: algorithm calculation

For the measurement of the acidity or pH value, it can be seen that the highest correlation value is obtained in the Power mathematical model, which can be seen in Table 3, where this model has an R^2 value of 0.3553, meaning that there is a match between the data and the model of 35.53%, while for the measurement Dissolved oxygen has an R^2 value of 0.2677 which means that there is a suitability of the data with the model of 26.77%. The correlation between pH and dissolved oxygen is shown in Table 4. In this table it can be seen that the mathematical Power model has a better correlation between the other models, namely R^2 of 0.3846, so that later this power model will be used to create a thematic map of the distribution of Salinity with the effect of pH on the coastal area of Tuban.

Table 4. Model mathematic calculation at Band 3 wavelength

No	Algorithm	Mathematical model	R^2
1	Linear	DO= -0,1294 Acidity + 5,7319	0,3792
2	Exponent	DO = $5,8416e^{-0,027\ Acidity}$	0,3788
3	Logarithmic	DO = -1,018ln(Acidity) + 6,8143	0,3839
4	**Power**	**DO = 7,338 Acidity $^{-0,215}$**	**0,3846**

The thematic map for Acidity (pH) against the best reflectance value is shown in Figure 2, namely at wavelength band 4 with variations in pH values ranging from 6.74 to 6.83, while the thematic map for Dissolved Oxygen (DO) for the best reflectance value is band 3 wavelengths with variations in dissolved oxygen values from 5.18 mg/L to 5.2 mg/L are shown in Figure 3.



(a) (b)

Figure 2. a) Logaritmik Dissolved Oksigen (DO) of Tuban area with the logarithmic algorithm on Band 3 wavelength Landsat 8 and b) Acidity map of Tuban area with logarithmic the alg rithm on Band 4 wavelength Landsat 8

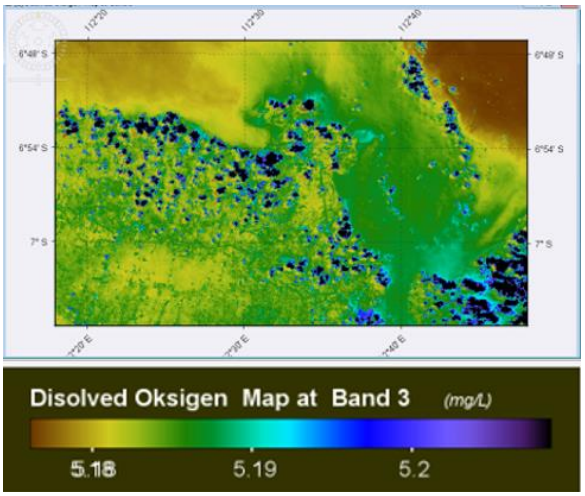


Figure 3. Dissolved Oxygen map of Tuban area algorithm Power on Band 3 wavelength Landsat 8

Figure 3 shows the thematic Map for the best Acidity/PH for dissolved oxygen (DO) using the Power. Algorithm model DO = 7,338 Acidity $^{-0,215}$.

Conclusion

Landsat 8 satellite imagery can be used to analyze dissolved oxygen and acidity of coastal areas even though its coverage is very wide, it can still provide a good reflectance on the research area, besides that the distribution of dissolved oxygen that occurs turns out to have a mathematical model of Power with acidity, this is shown with the best mathematical model is Power DO = 7.338 Acidity -0.215 with R2 = 0.3846, where the variable attachment of dissolved oxygen with pH is 38.46%. The results of the observations show that variations in pH and dissolved oxygen values in the coastal waters of Tuban and its surroundings are still in relatively normal conditions for the category of coastal waters and are still good for the life of marine biota (KLH, 2004).

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