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Correlation between Nitrate and Chlorophyll-A Concentration in Morodemak Waters, Demak District, Central Java, Indonesia

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A B S T R A C T

Morodemak Waters, which is located in Demak Regency, Central Java is one of the areas whose waters are dense with human activity. Some of the causes of high anthropogenic activity are that it is located close to the Morodemak Coastal Fishing Port (PPP), which is a place for fishermen to dock their ships, transfer their catches, auction their catches, and buy and sell their catches. This phenomenon influences the condition of nutrients in the form of chlorophyll-a and nitrate in the Morodemak Waters Area, therefore this research will discuss the concentration of nitrate and chlorophyll-a nutrients and the correlation between these two nutrients and their influence on organisms in the waters around the Morodemak waters. Researchers used exploratory quantitative methods with the results that nitrate nutrient concentrations in Morodemak waters, Demak Regency was measured ranging from 1.1637 µM to 3.3105 µM, while chlorophyll-a concentrations were obtained ranging from 1.2232 mg/m3 to 3.4139 mg/m3. The correlation test value between nitrate nutrient concentration and chlorophyll-a concentration at all stations was obtained at 0.682. The correlation test value of concentration with chlorophyll-a concentration is strong and directly proportional. Further analysis and study are needed regarding the impact and influence of nitrate and chlorophyll-a nutrient concentrations on aquatic organisms such as phytoplankton.

Keywords: Chlorophyll-a, Correlation, Nitrate, Morodemak Coastal Fishing Port (PPP), Morodemak

1. Introduction

Chlorophyll-a is a green pigment usually found in plants, algae, and cyanobacteria in waters. In the ocean, chlorophyll-a is associated with phytoplankton which is the main food source for zooplankton organisms which then become food for larger marine organisms, especially fish (Garini *et al.*, 2021). Measuring chlorophyll-a content is an effort expressed in primary productivity by measuring the fertility level of water.

According to Maslukah *et al.* (2014), besides chlorophyll-a, nutrients can also indicate water quality. These nutrients play an important role in organisms and the process of photosynthesis. Therefore, nutrients indirectly affect the fertility of water. One of the nutrients in water is nitrate. Nitrate is one of the compounds needed by organisms such as phytoplankton, so it often determines the primary productivity of phytoplankton.

Chlorophyll is a green leaf pigment that can be found in plants, algae, and cyanobacteria in aquatic environments. In the ocean, chlorophyll-a is synonymous with the presence of phytoplankton which is the main food source for zooplankton organisms, which then become food for larger marine organisms, especially fish (Garini *et al.*, 2021). By measuring the chlorophyll content, the fertility of a water body can be determined, expressed in the form of primary productivity.

According to Maslukah *et al.* (2014), nutrients can also be used as water quality indicators apart from chlorophyll-a. Nutrients play an important role in the tissue cells of living organisms and the process of photosynthesis. Therefore, nutrients indirectly affect the fertility of water bodies. One of the nutrients contained in water is nitrate. Nitrate is one of the compounds needed by organisms such as phytoplankton. The N element is often a limiting factor in the primary productivity of phytoplankton.

Morodemak waters, which are located in Demak Regency, are waters close to fishing grounds, fish auctions, and densely populated areas which cause high levels of anthropogenic waste, thus affecting the quality of the waters around Morodemak waters. The concentration of nitrate and chlorophyll-a nutrients is indirectly influenced by waste and anthropogenic activities around Morodemak waters, so research is carried out that can provide the latest and in-depth information regarding the conditions of nitrate and chlorophyll-a nutrient concentrations and how the correlation between these two nutrients and their effect on organisms in the waters around Morodemak waters. This research uses a method of collecting data on water samples of nitrate and chlorophyll-a nutrients in the field and directly measuring supporting data such as water quality. This research aims to study and measure nitrate nutrient concentrations and chlorophyll-a concentrations in Morodemak waters, as well as study the correlation between nitrate nutrient concentrations and chlorophyll-a concentrations in the waters. It is hoped that this research will provide additional knowledge regarding the correlation between nitrate concentration and chlorophyll-a concentration in Morodemak waters.

2. Material and Method

The material used in this research includes the data needed in research and in data processing. The main data used in this research is data on the concentration of nitrate and chlorophyll-a nutrients, while the secondary data used is temperature, salinity, pH, brightness, and DO (Dissolved Oxygen). Data collection has been carried out at 10 station locations in Morodemak Coastal Waters.

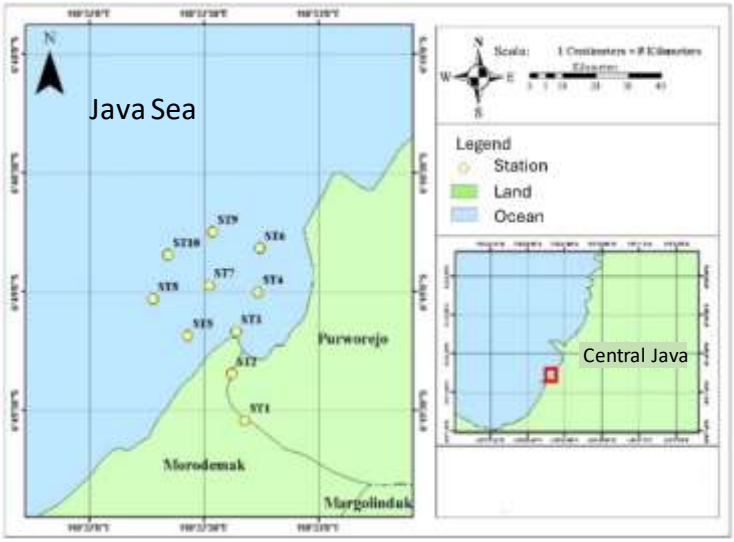

Fig 1. Area of Interest

Chlorophyll-a Concentration Analysis Method

In the chlorophyll-a analysis process, 1 liter of seawater sample is required. The seawater sample that has been prepared is filtered using millipore membrane filter paper with a pore size of 0.42 µm and assisted with the help of a vacuum pump. The filter paper resulting from chlorophyll-a filtration was then put into a test tube by adding 10 ml of 90% acetone solvent which was then stirred until it dissolved and became homogeneous. The dissolved sample was then tightly covered with aluminum foil and stored in the refrigerator for 24 hours. In the analysis process, the chlorophyll-a sample that has been mixed with 90% acetone is input and the solution separation process is carried out using a centrifuge at 1000 rpm for 10-15 minutes to separate the extraction results of the green chlorophyll-a content using Millipore filter paper. The chlorophyll-a sample that has been separated from the millipore filter paper is poured into a 1 cm glass cuvette and then inserted into the spectrophotometer so that the absorbance value can be read. For chlorophyll-a analysis, wavelengths of 630 nm, 647 nm, 664 nm, and 750 nm are used. The values obtained through observation will then be entered into Microsoft Excel calculations.

According to Parsons *et al*. (1984), chlorophyll-a concentration can be calculated using the following formula.

$$\text{Chl-a} = \frac{Ca \times Va}{V \times d} \quad (1)$$

Where Chl-a is the chlorophyll-a concentration (mg/m^3), Ca is (11,85(E_{664}-E_{750})-1,54(E_{647}-E_{750})-0,08(E_{630}-E_{750})), Va is the volume of the acetone (mL), V is the volume of the water sample is filtered (L), d is the diameter of the cuvette (1 cm), and E is the absorption at the wavelength.

Nitrate Concentration Analysis Method

Before carrying out sample processing and analysis, tools and materials along with a cadmium reduction column are prepared. Filtration of 1-liter seawater samples using millipore membrane filter paper and assisted with the help of a vacuum pump. Prepare 50 ml of sample water and put it in a 50 ml beaker. For every 25 ml of sample water, 1 ml of concentrated NH4Cl solution is added, then also prepare 25 ml of sample water and put it in a 50 ml beaker. This solution was not dripped with NH4Cl and was not reduced. Wash the reduction column using 50 ml of NH4Cl solution which has been diluted with distilled water and wait until 25 ml of solution comes out of the reduction column. Insert 25 ml of sample water into the reduction column before starting the cadmium reduction process. Enter the remaining 25 ml of sample water in the reduction column and wait until 25 ml of solution comes out of the reduction column. In 25 ml of reduced and unreduced sample water, each drop of 0.5 ml of sulfanilamide solution using a pipette.

Wait for 2-8 minutes then each drop of 0.5 ml of NED solution using a different pipette, and homogenize. The solution that has been reduced will change color to pink, while the solution that has not been reduced will not change color. Put each solution into a 1 cm glass cuvette to measure the absorbance value using a spectrophotometer with a wavelength of 543 nm. Regression values and standard solution curve equations can be obtained through processing using Microsoft Excel, by entering the absorbance value and concentration value of the standard solution. Also, calculate the absorbance value of the blank solution without using sample water. Prepare 50 ml of standard solution and separate it into 2 solutions, 25 ml each. Treat the standard solution like sample water

According to Muslim *et al*. (2013), nitrate levels can be calculated using the equation:

Nitrate concentration = Con Nitrate via the calibration curve equation – (0.95 x Con Nitrite) (2)

Pearson Correlation Analysis Method

Correlation analysis is a method for analyzing the relationship between two or more variables of a quantitative nature. Through correlation analysis, observations can be made between the relationship and influence of two or more variables on other variables. Pearson correlation is a statistical analysis tool used to see the closeness of the linear relationship between 2 variables whose data scale is interval or ratio.

The following is the formula used to determine the relationship between variables through Pearson Correlation.

$$r = \frac{n \sum ab - (\sum a)(\sum b)}{\sqrt{[n \sum a^2 - (\sum a)^2][n \sum b^2 - (\sum b)^2]}} \quad (3)$$

Where r is the correlation between a and b, x is the value of a, y is the value of b, and n is the amount of the value.

3. Results and Discussion

Nitrate and Chlorophyll-a Concentration

The nitrate concentration results obtained ranged from 1.16372 µM to 3.31053 µM. The highest nitrate concentration value was obtained at station 1 which was around 3.31053 µM, while the lowest nitrate concentration value was obtained at station 10 at 1.16372 µM. The average nitrate concentration in Morodemak waters, Demak Regency was found to be around 2.14974 µM.

The chlorophyll-a concentration results obtained ranged from 1.22316 mg/m^3 to 3.41394 mg/m^3. The highest chlorophyll-a concentration value was obtained at station 1 which was around 3.41394 mg/m^3, while the lowest chlorophyll-a concentration value was obtained at station 10 at 1.22316 mg/m^3. The average nitrate concentration in Morodemak waters, Demak Regency was obtained at 1.75906 mg/m^3.

The results of the research that has been carried out show that the nitrate concentration ranges from 1.1637 µM to 3.3105 µM, and the average nitrate concentration obtained is around 2.14974 µM. The highest nitrate concentration was obtained at station 1 at 3.3105 µM. Several factors are thought to cause high nitrate concentration values, such as the location of station 1 which is at the mouth of the river. The lowest nitrate concentration was obtained at station 10 at 1.1637 µM. The low nitrate concentration at station 10 is thought to be influenced by the location of station 10 which is far from land so that it does not receive input from river water or anthropogenic waste discharge. According to Arbianti *et al.* (2017), in general, river estuaries have an important ecological role related to tidal and tidal circulation. One of the functions of the estuarine ecosystem is to trap nutrients such as nitrate that come from the surrounding waters.

The chlorophyll-a concentration from the research results ranged from 1.2232 mg/m^3 to 3.4139 mg/m^3, the average chlorophyll-a concentration obtained was 1.7591 mg/m^3. The highest chlorophyll-a concentration of 3.4139 mg/m^3 was obtained at station 1, presumably because it is located at a river estuary which is busy with human activity which uses the river estuary as a place to anchor fishing boats, a place for fish auctions and the disposal of anthropogenic waste. The lowest chlorophyll-a content value was obtained at station 10 with a chlorophyll-a concentration level of 1.2232 mg/m^3. One of the factors that influences the low concentration value at station 10 is that it is located far from land so there is rarely a nutrient mixing process which causes minimal nutrient intake in this area. According to Sihombing *et al.* (2013), horizontally, chlorophyll-a content is found more in the surface layer which is close to land.

Water Quality

The temperature parameter shows a value range of 29.9 °C to 30.9 °C. The highest temperature measured at stations 7 and 8 was 30.9 °C, while the lowest temperature was obtained at station 6 at 29.9 °C. The salinity value ranges from 24.3 ‰ to 27.3 ‰, the highest salinity value was measured at station 10 at 27.3 ‰ while the lowest salinity value was obtained at station 1 at 24.3 ‰. Dissolved Oxygen (DO) content ranges from 9.09 ppm to 14.26 ppm. The highest DO value was at station 5 at 14.26 ppm and the lowest DO value was at station 1 at 9.09 ppm. In terms of brightness parameters, the brightness values obtained are 35 cm to 51.6 cm. The highest brightness value was obtained at station 5 at 51.6 cm, while the lowest brightness value was obtained at stations 7 and 10 at 35 cm. When measuring pH parameters, pH values ranging from 6.74 to 7.79 were obtained. The largest pH value was measured at station 5 at 7.79, while the lowest pH value was measured at station 1 at 6.74.

The Correlation Between Nitrate and Chlorophyll-a Concentration

Processing of nitrate concentration values against chlorophyll-a was carried out using the SPSS Statistics 26 application. The correlation value for nitrate concentration against chlorophyll-a at all stations was obtained at 0.682.

The results of the Pearson correlation test using SPSS Statistics 26 which was carried out between nitrate concentration and chlorophyll-a concentration were obtained at 0.682 with a fairly strong correlation category. According to Jabnabillah and Margina (2022), the correlation classification value of nitrate concentration with chlorophyll-a concentration is close to 1 and has a positive value. This can be interpreted as meaning that the correlation value between nitrate concentration and chlorophyll-a concentration is strong and directly proportional to one another.

Table 1. The Correlation between Nitrate to Chlorophyll-a Concentration

		Nitrate	Chla
Nitrate	Pearson Correlation	1	.682*
	Sig. (2-tailed)		.030
	N	10	10
Chla	Pearson Correlation	.682*	1
	Sig. (2-tailed)	.030	
	N	10	10

4. Summary

Based on the research that has been carried out, the following conclusions are obtained. The nitrate nutrient concentration in Morodemak waters, Demak Regency was measured to be around 1.1637 µM to 3.3105 µM, while the chlorophyll-a concentration was found to be around 1.2232 mg/m^3 to 3.4139 mg/m^3. The correlation test value between nitrate nutrient concentration and chlorophyll-a concentration at all stations was obtained at 0.682. The correlation test value of nitrate concentration with chlorophyll-a concentration is strong and directly proportional.

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