

Analysis of Nitrogen and Phosphate Content During High and Low Tides in The Karang Asam Besar River in Samarinda City

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ABSTRACT

Rivers are open waters that flow and get input from various human activity discharges such as; settlements, industries that will result in changes in physical, chemical and biological factors in the waters. This can cause damage, disturbance and danger to living things that depend on water resources. This research was conducted in March 2022 in Karang Asam Besar River, Samarinda City, East Kalimantan Province. This study aims to determine the difference in Nitrogen and Phosphate content at high and low tide in Karang Asam Besar River, Samarinda City. Total Nitrogen at the five stations in the Karang Asam Besar River at average values ranged from 13.02-16.45 mg/L and at low tide ranged from 13.20-20.78 mg/L, the highest Nitrogen value at high tide was at Station 2 and the lowest at Station 4, while the highest Nitrogen at low tide was at Station 4 and the lowest at Station 1. Total Phosphate at the five stations at high tide ranged from 0.14-0.19 mg/L and at low tide ranged from 0.18-0.23 mg/L, the highest Total Phosphate value at high tide was at Station 1 and the lowest at Station 4, while the highest Phosphate at low tide was at Station 4 and the lowest at Stations 1, 3 and 5. Nitrogen compounds at each station in the Karang Asam Besar river based on the quality standards of PP No. 82 of 2001, Ammonia has exceeded the quality standard threshold which exceeds 0.5 mg/L. Nitrite does not exceed the quality standard threshold of less than 0.06 mg/L. Nitrate does not exceed the quality standard threshold value of less than 10 mg/L. Phosphate is still within normal levels and there is no pollution by phosphate compounds.

INTRODUCTION

Rivers are open water systems that flow and receive inputs from all human activities, such as settlements and industries, which result in changes to the physical, chemical, and biological factors of the water, as described by (Sahabudin, 2014). Additionally, rivers are specifically influenced by activities that tend to affect their condition. According to (Effendi, 2003), industrial, domestic, and other activities negatively impact water resources, including a decline in water quality. This can cause damage, disruption, and harm to living organisms that depend on water resources (Sasongko, 2014). Therefore, the various activities occurring in and around rivers significantly affect the water resource system. Similarly, the high content of nutrients, particularly Nitrogen and Phosphate, also affects the population of aquatic organisms that require nutrients as essential elements for their life processes (Isnaeni et al., 2015). The Mahakam River has several tributaries, including the Karang Mumus River, the Karang Asam Besar River, and the Karang Asam Kecil River. The Karang Asam Besar River, one of its tributaries, is still utilized by the local community around Samarinda City, with a length of approximately 18,000 meters,

located in several districts of Samarinda City. This study aims to determine the differences in Nitrogen and Phosphate content during high and low tides in the Karang Asam Besar River in Samarinda City.

Considering the important role of plankton in maintaining the balance of aquatic ecosystems, particularly marine ecosystems in the waters of Selangan Hamlet, the authors are interested in conducting research on the plankton community structure in the seagrass beds of Selangan Hamlet waters.

METHODOLOGY

Research Location and Time

This research was conducted in the Karang Asam Besar River, Samarinda City, East Kalimantan Province, which flows into Jalan Slamet Riyadi. The study was carried out in March 2022.

Materials

This research used tools required to support the study. The equipment includes GPS (Global Positioning System) to determine the coordinates of the station, a Secchi disk to measure water clarity, a boat as transportation to the research site, a cool box for storing samples, a thermometer to measure water temperature, a current meter to measure water flow speed, and titration to determine dissolved oxygen and CO₂ levels in the water. A spectrometer was used to measure ammonia, nitrite, nitrate, and phosphate parameters. Water samples were collected using sample bottles for analysis in the Water Quality Laboratory of Mulawarman University.

Research Parameters

The primary parameters to be studied are Total Nitrogen (Ammonia, Nitrite, and Nitrate) and Total Phosphate during high and low tides. Supporting parameters include Depth, Flow Speed, Temperature, Clarity, Dissolved Oxygen (DO), pH, and CO₂.

Research Procedure

1. Research Location Survey

A survey of the observation site was conducted to assess the environmental conditions around the Karang Asam Besar River in Samarinda. This was done to determine the sampling station points.

2. Determination of Research Stations

The research station points were determined using the purposive method through direct field observations to comprehensively understand the aquatic biota activities and Nitrogen and Phosphate levels in the Karang Asam River. The GPS was used to determine the coordinates of the stations. The stations were divided into five points:

- Station 1: Jalan Slamet Riyadi, Karang Asam Besar River Estuary (discharge area directly flowing into the Mahakam River)
- Station 2: Kedondong Market Bridge (high-density residential area and traditional market)
- Station 3: Jalan Kahoi (high-density residential area)
- Station 4: Teuku Umar Bridge (small industries around the area)
- Station 5: Jalan Rapak Indah (river flow area dominated by aquatic weeds)

3. Sampling Procedure

Samples were collected three times, with one week between each sampling. Samples were taken from five stations during both high and low tides. A total of 500 mL of water was collected from the surface layer (± 50 cm below the surface) and stored in a cool box filled with ice for further analysis at the Water Quality Laboratory, Faculty of Fisheries, Mulawarman University.

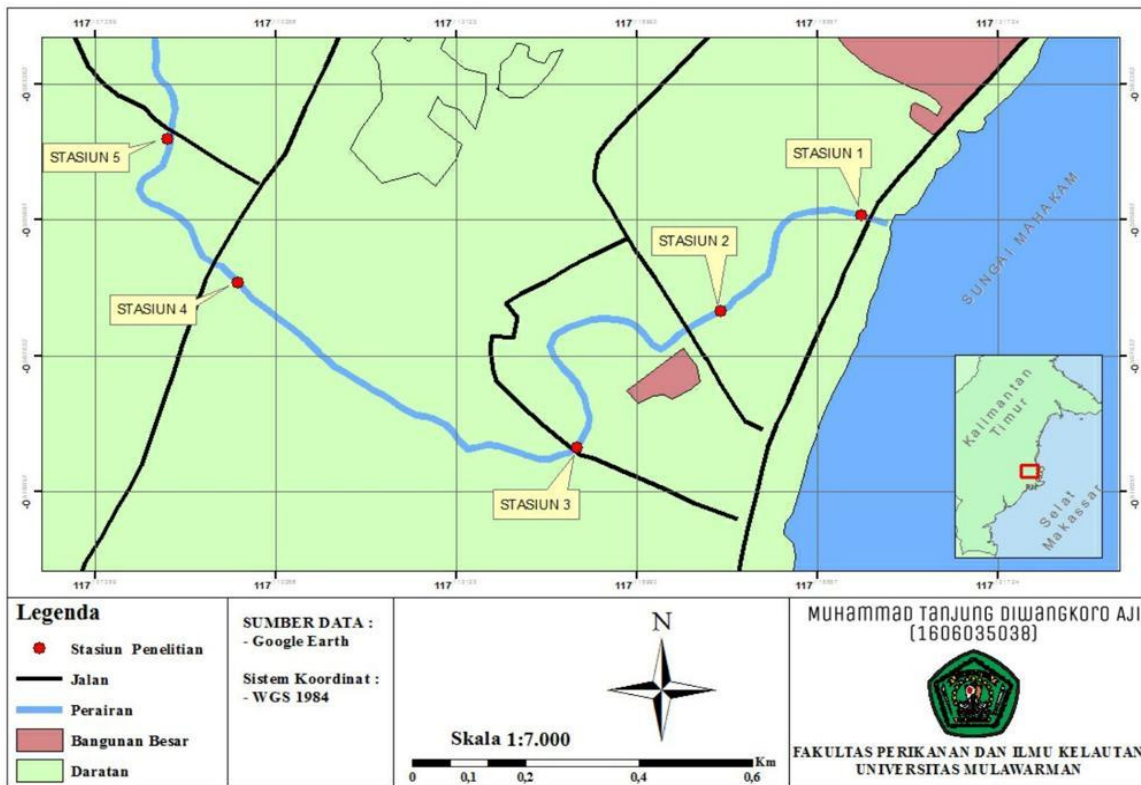


Figure 1. Study area map

Data Analysis

To compare the levels of Ammonia, Nitrite, and Nitrate during high and low tides, an unpaired t-test is used.

$$S^2 = \left(\frac{\sum d^2 - \left(\frac{\sum d}{n} \right)^2}{n - 1} \right)$$

$$S_d = \frac{\sqrt{S^2}}{n}$$

$$T_{hit} = \frac{d}{S_d}$$

$$Db = n - 1$$

d = difference between X_1 and X_2

n = Number of Samples

S_d = Standard deviation of d

The calculated t value is then compared with the t table at a 5% significance level. If $T_{hit} < T_{table}$, H_0 is accepted, and if $T_{hit} > T_{table}$, H_0 is rejected.

Where:

H₀ = There is no significant difference between high and low tide water

H₁ = There is a significant difference between high and low tide water

The water quality parameters analyzed will be compared with the water quality standards according to Government Regulation No. 22 of 2021.

RESULT AND DISCUSSION

Total Nitrogen

Based on the measurements conducted to analyze nitrogen content at the five stations of the Karang Asam Besar River during high and low tides, the average values ranged from 13.02 to 16.45 mg/L during high tide and from 13.20 to 20.78 mg/L during low tide. The highest average nitrogen level during high tide was at Station 2, while the lowest was at Station 4. During low tide, the highest nitrogen level was at Station 4, and the lowest was at Station 1. When compared to the water quality standards in Government Regulation No. 22 of 2021 on Environmental Protection and Management, the total nitrogen content in the Karang Asam Besar River remains below the standard limit.

Total Phosphate

Based on the measurements conducted to analyze total phosphate (TP) content at the five stations of the Karang Asam Besar River during high and low tides, the average values ranged from 0.14 to 0.19 mg/L during high tide and from 0.18 to 0.23 mg/L during low tide. The highest average TP value during high tide was at Station 1, while the lowest was at Station 4. During low tide, the highest TP value was at Station 4, and the lowest was at Stations 1, 3, and 5. According to Government Regulation No. 22 of 2021, the maximum allowable total phosphate concentration is 1 mg/L. Therefore, the total phosphate content in the Karang Asam Besar River remains below the quality standard.

Table 1. Water Quality Measurements During High and Low Tides

Parameter	Station	Station	Station	Station	Station	PP No.
	1	2	3	4	5	22 of 2021
	High Tide	Low Tide	High Tide	Low Tide	High Tide	Low Tide
Flow	0.4	0.32	0.41	0.44	0.51	0.47
Temperature	26.67	26.67	26.67	27.00	27.00	27.33
Brightness	4.0	3.33	3.67	3.67	4.30	3.33
Depth	1.83	1.43	1.72	1.41	1.41	1.22
pH	6.59	6.63	6.63	6.65	6.63	6.77
DO	2.27	2.13	2.40	2.40	2.80	2.40
CO ₂	17.16	19.80	23.76	22.44	25.43	21.12
Ammonia	0.96	0.95	1.34	1.00	1.11	0.89
Nitrite	0.002	0.006	0.003	0.008	0.003	0.004
Nitrate	0.337	0.258	0.343	0.088	0.341	0.241
Orthophosphate	0.051	0.048	0.055	0.045	0.043	0.050

Temperature

The average temperature in the Karang Asam Besar River at the five research stations ranged from 26.67°C to 27°C. The obtained water temperature values are consistent across all stations. A temperature range of 20-30°C is considered normal and good. According to the water quality standards of PP No. 22 of 2021, this range is within the acceptable limits for Class III waters (with a deviation of 3°C for natural water temperature).

Flow Speed

At the five stations, the average flow speed ranged from 0.40 to 0.51 m/s during high tide and from 0.32 to 0.49 m/s during low tide. Flow speed is influenced by factors such as slope, sedimentation, depth, and water flow, leading to different speeds across the river, which can affect the riverbed substrate type (Odum, 1993).

Brightness

The average water brightness at the five stations ranged from 2.67 to 4.3 m. According to Effendi (2003), reduced brightness can disrupt photosynthesis, which affects the aquatic organisms and reduces oxygen levels in the water.

Dissolved Oxygen (DO)

The average DO content across the five stations ranged from 2.27 to 2.80 mg/L during high tide and from 2.13 to 2.53 mg/L during low tide. Compared to the water quality standards in PP No. 22 of 2021 for Class III waters, which require a minimum dissolved oxygen content of 3 mg/L, the levels observed are below the standard.

Carbon Dioxide (CO₂)

The average CO₂ content at the five stations ranged from 17.16 to 25.43 mg/L during high tide and from 19.80 to 22.44 mg/L during low tide.

pH

The average pH values across the five stations ranged from 6.59 to 6.63 during high tide and from 6.63 to 6.77 during low tide. According to Wiriani (2018), most aquatic biota are sensitive to pH changes and prefer a range of 7.8 to 5. When compared to the water quality standards in PP No. 22 of 2021, the pH values at all stations remain within the acceptable range of 6 to 9.

Ammonia

Ammonia levels during high tide ranged from 0.89 to 1.34 mg/L, and during low tide, they ranged from 0.59 to 1.00 mg/L. The highest ammonia level during high tide was found at Station 2, and during low tide, at Station 2. The lowest ammonia level during high tide was at Station 4, and during low tide, at Station 5. Compared to the water quality standards in PP No. 22 of 2021, the ammonia levels at the five stations generally exceeded the threshold of 0.5 mg/L.

Nitrite

Nitrite levels during high tide ranged from 0.002 to 0.004 mg/L, and during low tide, they ranged from 0.004 to 0.008 mg/L. The highest nitrite level during high tide was at Station 5, and during low tide, at Station 2. Compared to the water quality standards in PP No. 22 of 2021, the nitrite levels at the five stations were below the maximum limit of 0.06 mg/L.

Nitrate

Nitrate levels during high tide ranged from 0.148 to 0.343 mg/L, and during low tide, they ranged from 0.088 to 0.326 mg/L. The highest nitrate level during high tide was at Station 2, and during low tide,

at Station 4. Compared to the water quality standards in PP No. 22 of 2021, nitrate levels at all stations were below the threshold of 10 mg/L.

Orthophosphate

Orthophosphate levels during high tide ranged from 0.040 to 0.055 mg/L, and during low tide, they ranged from 0.045 to 0.050 mg/L. The highest orthophosphate level during high tide was found at Station 2, and during low tide, at Station 3. Compared to the water quality standards in PP No. 22 of 2021, the orthophosphate levels in the Karang Asam Besar River were below the threshold of 1 mg/L.

CONCLUSION

The nitrogen content in the Karang Asam Besar River is still within the normal range and does not exceed the quality standards of Government Regulation No. 22 of 2021. The phosphate content in the Karang Asam Besar River, based on the quality standards of Government Regulation No. 22 of 2021 for class 1, indicates that the total phosphate concentration in the river is still within the normal range, and there is no pollution caused by phosphate compounds.

From the t-test analysis of total nitrogen during high and low tides, it can be concluded that the two averages differ at the 5% significance level. The total nitrogen content during low tide is significantly higher than during high tide. The t-test analysis for total phosphate during high and low tides shows that the two averages do not differ at the 5% significance level. The total phosphate content during high tide is the same as during low tide.

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