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ANALISIS KUALITAS AIR DAN TINGKAT PENCEMARAN DI SUNGAI AIR HITAM KOTA PEKANBARU PROVINSI RIAU MENGGUNAKAN INDEKS CCME

Analysis of Water Quality and Pollution Level in Air Hitam River Pekanbaru City Using CCME Index

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ABSTRAK

Sungai Air Hitam merupakan salah satu sumber daya air penting di Kota Pekanbaru yang memiliki peran vital bagi kehidupan masyarakat dan ekosistem akuatik di sekitarnya. Namun, meningkatnya aktivitas domestik, industri, dan pertanian di daerah aliran sungai berpotensi menurunkan kualitas air. Penelitian ini bertujuan menganalisis kualitas air dan tingkat pencemaran di Sungai Air Hitam, Kota Pekanbaru, Provinsi Riau menggunakan indeks Canadian Council of Ministers of the Environment Water Quality Index (CCME-WQI). Penelitian dilakukan bulan September-November 2024 dengan metode survei. Sampel air diambil secara *purposive sampling* di tiga stasiun. Sampling dilakukan sebanyak tiga kali dengan interval setiap satu bulan. Tingkat pencemaran Sungai Air Hitam dianalisis menggunakan metode CCME. Parameter yang diamati meliputi fisika (suhu, TSS, kecerahan, kedalaman, kecepatan arus), kimia (pH, DO, COD, BOD, nitrat dan fosfat), serta biologi (T. coliform). Baku mutu air yang di gunakan kelas III (PP 22/2021). Hasil penelitian ini menunjukkan kualitas air sungai masih memenuhi baku mutu kecuali BOD dan total coliform melebihi baku mutu di semua stasiun pengamatan. Nilai indeks CCME-WQI yang terukur adalah 44,35 (Stasiun 1), 26,02 (Stasiun 2), dan 44,18 (Stasiun 3). Hasil ini menunjukkan Sungai Air Hitam pada kategori buruk di semua stasiun pengamatan. Penurunan kualitas air dipengaruhi oleh aktivitas domestik, industri, dan pertanian. Sungai Air Hitam telah tercemar bahan organik dan bakteri coliform sehingga tidak sesuai untuk kegiatan perikanan.

ABSTRACT

The Air Hitam River is an important water resource in Pekanbaru City, vital for the lives of the community and the surrounding aquatic ecosystem. However, increasing domestic, industrial, and agricultural activities in the river basin have the potential to degrade water quality. This study aims to analyze water quality and pollution levels in the Air Hitam River, Pekanbaru City, Riau Province, using the Canadian Council of Ministers of the Environment Water Quality Index (CCME-WQI). The study was conducted from September to November 2024 using a survey method. Water samples were taken using purposive sampling at three stations. Sampling was carried out three times with a monthly interval. The pollution level of the Air Hitam River was analyzed using the CCME method. Observed parameters included physical (temperature, TSS, clarity, depth, current velocity), chemical (pH, DO, COD, BOD, nitrate, and phosphate), and biological (T. coliform). The water quality standard used is Class III (PP 22/2021). The results of this study indicate that the river water quality still meets the quality standards, except that BOD and total coliform exceeded them at all observation stations. The measured CCME-WQI index values were 44.35 (Station 1), 26.02 (Station 2), and 44.18 (Station 3). These results indicate that the Air Hitam River is in the poor category at all observation stations. The decline in water quality is influenced by domestic, industrial, and agricultural activities. Organic matter and coliform bacteria have polluted the Air Hitam River, rendering it unfit for fisheries.

Kata Kunci	*Kualitas air, Sungai Air Hitam, indeks CCME-WQI, Pencemaran air*
Keywords	*Water quality, Air Hitam River, CCME-WQI index, Water pollution*
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INTRODUCTION

Rivers are used for various activities, such as providing raw water for drinking and industry, agricultural irrigation, fishing, and as habitat for aquatic organisms. Meanwhile, river basins are utilized as residential areas and water catchment areas. However, with the rapid growth of human activity around rivers, this diversity of vital roles is threatened. Pollution and overexploitation result in river degradation, which ultimately can endanger ecosystem sustainability and the balance of nature (Setyowati and Ermanto, 2018).

This condition also occurs in the Siak River Basin (DAS), including its tributaries, such as the Air Hitam River, which traverses residential areas and industrial activities in Riau Province. Various domestic activities, oil palm plantations, and industries in the river basin have the potential to increase the pollutant load in the waters. The impacts of these activities are generally reflected in low oxygen levels, increased organic matter, and increased coliform bacteria counts, leading to a decline in water quality and assimilation capacity. Based on Government Regulation No. 22 of 2021, most river segments in this region are designated as Class III waters, specifically for fisheries, livestock, and agricultural irrigation. Therefore, an assessment method capable of comprehensively describing water quality conditions is needed. One widely used approach is the CCME-WQI, which integrates various physical, chemical, and biological parameters to assess water quality status more objectively and easily understand current velocity (Panagopoulos et al., 2022).

The Air Hitam River, a tributary of the Siak River, flows through Pekanbaru City. This river has experienced declining water quality due to various anthropogenic activities. In the upstream area, densely populated settlements produce domestic waste such as detergents and plastic waste. Furthermore, workshops, warehousing industries, residential areas, and oil palm plantations along the river contribute to pollution through the discharge of waste and fertilizer residues into the river. Fertilizer use in oil palm plantations can degrade the quality of groundwater and river water, thus worsening the condition of the Air Hitam River (Pasaribu et al., 2012).

Research related to pollution levels in the Air Hitam River has been conducted by Yuliati et al. (2023); Using the Pollution Index (PI) method, the Air Hitam River is lightly polluted. However, determining the level of pollution using the CCME-WQI composite index has never been done in this area. The CCME index has the advantage of integrating various water quality parameters by considering three assessment dimensions: F1 (scope), which indicates the proportion of parameters not meeting quality standards; F2 (frequency), which describes the frequency of violations; and F3 (amplitude), which reflects the severity of deviations from quality standards. This approach provides a more representative assessment of the actual condition of the waters. In contrast, the Pollution Index (PI) and STORET methods tend to have limitations due to their deterministic nature and inability to reflect dynamic variations in water quality. The IP only emphasizes the ratio to quality standards without considering the frequency or severity of violations, while STORET often produces quality categories that are too rigid and insensitive to small changes in certain parameters. Therefore, the use of the CCME-WQI is considered superior in providing a comprehensive picture of the water quality status of the Air Hitam River and can serve as a scientific basis for decision-making on sustainable water quality management. This study is to calculate the quality of the Air Hitam River using the CCME pollution index and calculate the pollutant load in the Air Hitam River. By knowing the condition of the Air Hitam River waters, it is useful as a first step to find a solution if the Air Hitam River is in poor condition, in addition, this study is also useful as information for readers, which of course is expected to be used in the world of fisheries science, especially the Department of Aquatic Resources Management or the general public who are looking for information about the quality of the Air Hitam River waters.

RESEARCH METHODS

Research Location and Timeline

The research was conducted in the Air Hitam River from September to November 2024. This location is in Pekanbaru City, Riau. Water sampling and observation were conducted directly at the research site, while laboratory analysis was conducted at the Laboratory of the Faculty of Fisheries and Marine Sciences, University of Riau.

Methods

A survey method was used through direct field observations. The data generated consisted of primary and secondary data. Primary data came from direct measurements in the river and in the laboratory. Data measured directly in the river included temperature, pH, dissolved oxygen, clarity, river depth and width, and current velocity. Laboratory analysis included BOD, COD, phosphate, nitrate, and T. coliform. Secondary data included supporting information on regional conditions, population activities, and relevant environmental data to support the results of the water quality analysis in the Air Hitam River (from relevant agencies).

Research Procedure

Station Location Determination

There are three observation stations, each with its own criteria (Figure 1):

Station 1 (S1): Located in the upstream part of the Air Hitam River, specifically on Jl. Sido Rukun RW 2, Bandaraya Village, Payung Sekaki District. This area is characterized by residential areas, warehouses, and plantation activities.

Station 2 (S2): Represents the middle segment of the Air Hitam River, located on Jl. Riau Baru, Payung Sekaki District. This location is still subject to tidal flow from the Siak River. Anthropogenic activities at this station include workshops and oil palm plantations.

Station 3 (S3): Located downstream of the Air Hitam River, precisely at the confluence of the Air Hitam and Siak Rivers. This station is geographically located on the border of the two rivers.

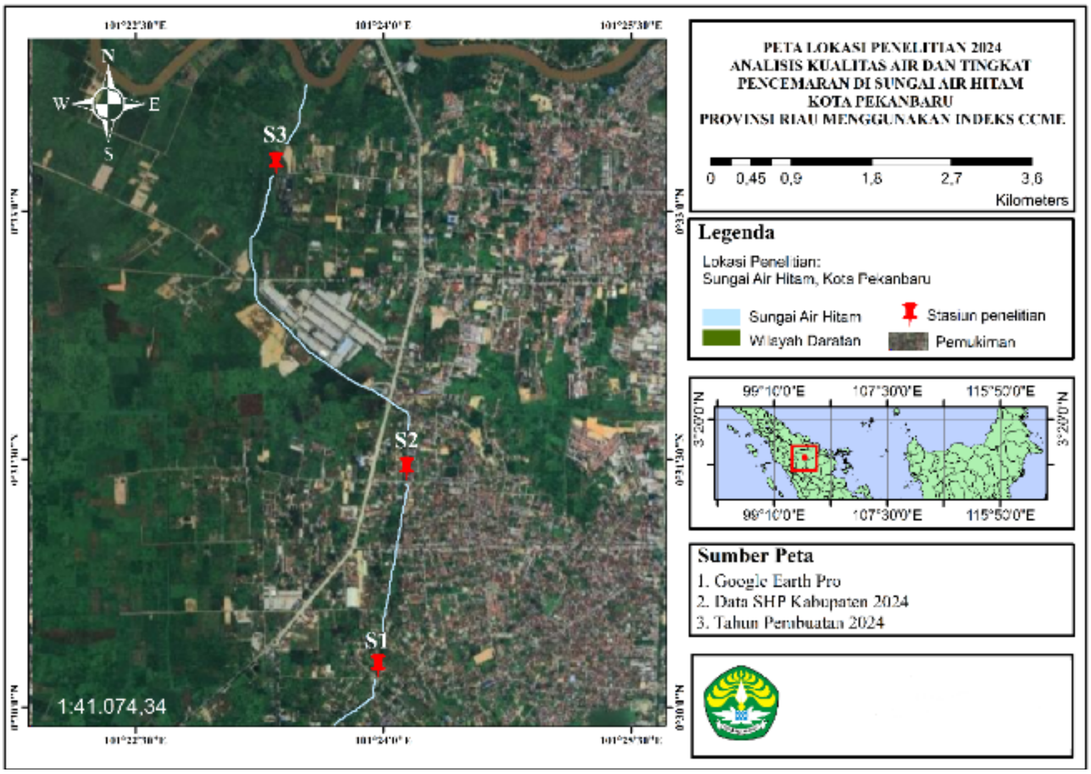

Figure 1. Research Location Map

Sampling Method

A 1-liter water sampler was used to collect water samples. Samples were placed in 500 mL polyethylene bottles, stored in a cool box, and subsequently analyzed in the laboratory. Samples were collected from morning to afternoon at three designated observation stations. SNI 6989.57:2008 served as the reference for surface water sampling methods. Three samples were taken at each station, with a two-week interval between samplings. Data on river clarity, depth, current velocity, and width were also collected to describe the physical condition of the Air Hitam River.

Data Analysis

The parameters used in calculating the CCME-WQI index include temperature, pH, DO, TSS, nitrate, phosphate, BOD, COD, and T. coliform. The analysis results of each parameter were then compared with the river water quality standards stipulated in Government Regulation No. 22 of 2021, Class III. The steps in calculating the water quality index using the CCME-WQI method involve several measurement and analysis steps, as described below (Khan et al., 2005).

a) F1 (Scope) is a measure of the percentage of parameters whose values are below the quality standard threshold. This calculation is performed by comparing the number of parameters that meet the standard to the total number of parameters tested, at least for a certain time period.

$$\mathbf{F1} = \frac{[\,\textbf{Number of Failed Variables}]}{[\,\textbf{Total Variables}\,]} \times \mathbf{100}$$

b) F2 (Frequency), used to determine the percentage of failed test results for each parameter. This means calculating the number of times each parameter has a value that exceeds the quality standard relative to the total number of tests performed.

$$\mathbf{F2} = \frac{[\,\textbf{Number of Failed Tests}\,]}{[\,\textbf{Total Test}\,]} \times \mathbf{100}$$

c) F3 (Amplitude), serves to measure the extent to which test values deviate from the quality standard. This indicates the severity of non-compliance. There are several methods for calculating F3, including:

1) If the parameter value is greater than the quality standard: 18 Excursion$i$ = [$Failed\ test\ valuei\ Objectivei$] – 1

$$\boldsymbol{Excursion\ i} = \frac{[\,\boldsymbol{Failed\ Test\ Score\ i}\,]}{[\,\boldsymbol{Objektive\ i}\,]} - \mathbf{1}$$

2) If the parameter value is smaller or less than the quality standard, use the formula :

$$\boldsymbol{Excursion\ i} = \frac{[\,\boldsymbol{Objektive\ i}\,]}{[\,\boldsymbol{Failed\ Test\ Score\ i}]} - \mathbf{1}$$

3) The excursion test from the quality standard and divided by the total test. This variable is called the normalized number of excursions (nse):

$\boldsymbol{nse} = [\,\boldsymbol{\sum t{=}1\ n\ excursioni\ \#\ of\ test}\,]$

$$\boldsymbol{nse} = \frac{[\sum_{t}^{n} = \mathbf{1}\ \boldsymbol{Excursion\ i}\,]}{[\,\#\boldsymbol{of\ Test}\,]} - \mathbf{1}$$

4) If the nse has a range of numbers from 0 to 100, then the formula used is :

$$\boldsymbol{nse} = \frac{[\boldsymbol{nse}\,]}{[\,\mathbf{0.01}\,\boldsymbol{nse} + \mathbf{0.01}\,]}$$

d) If the values of the factors have been obtained, the CCME WQI value can be calculated using the formula:

$$CCME - WQI = 100 - \left[\frac{\sqrt{F1^2 + F2^2 + F3^2}}{1.732}\right]$$

Description:
F1: Indicates the number of parameter types found to exceed or fall below the established quality standard.
F2: The total number of times the test results did not meet the established quality standard.
F3: The severity or magnitude of the deviation of test results from the expected standard.

After the calculations have been performed based on the previous steps, the next step is to analyze the water quality status using the scores obtained through the CCME-WQI method (Table 1).

Table 1. CCME-WQI Index Classification

No	Value CCME	Status	Information
1	0-44	Poor	Water quality is under continuous threat
2	45 – 64	Marginal	Water quality often faces risks and challenges
3	65 – 79	Fair	The water quality is good, although there is potential for disturbances
4	80 – 94	Good	Water quality is safe from significant threats
5	95 – 100	Excellent	Water quality is well maintained

RESULTS AND DISCUSSIO

Water Quality Measurement Results

Water quality measurement results show significant variation between stations, correlated with anthropogenic activities around the river. Station 1, located in the upstream part of the Air Hitam River, generally exhibited better water quality than Stations 2 and 3. However, several parameters, such as dissolved oxygen (DO) and total coliform counts, indicated pollution pressure, likely stemming from nearby domestic and agricultural activities. At Station 2, located in the middle part of the river, a significant decline in water quality was observed, possibly due to an increase in pollutant load due to more intensive industrial and domestic activities. The average measurement results for all parameters are presented in detail in Table 2.

Table 2. Average Water Quality of the Air Hitam River and Quality Standards

No	Parameter	Stasiun			Baku Mutu	Satuan
		1	2	3		
1	Temperatur	26,33	26,67	28,33	Dev 3	^0c
2	*Total Suspended Solids*	29,15	46,66	49,89	400	mg/L
3	Brightness	26	26,8	27		-
4	Depth	192	52,33	230,67		-
5	Current Speed	0,51	0,42	0,52		-
6	pH	6,00	6,00	6,00	6-9	-

7	DO (*Disolved Oxygen*)	5,10	5,09	5,73	3	mg/L
8	BOD (*Biological Oxygen Demand*)	7,06	8,88	12,54	6	mg/L
9	COD (*Chemichal Oxygen Demand*)	24,39	34,85	38,16	40	mg/L
10	Nitrate	0,13	0,12	0,11	20	mg/L
11	Fosfate	0,33	0,36	0,40	1,0	mg/L
12	Total Coliform	213.333	240.000	213.333	10.000	MPN/100 ml

Discussion

Physical Parameters

1. Temperatur

The Air Hitam River exhibits temperature variations influenced by environmental conditions. Measurements showed temperatures ranged from 26°C to 28.33°C, with the highest value measured at Station 3. This temperature difference is caused by factors such as sunlight exposure, water depth, and the presence of vegetation around the river. At Station 3, the water temperature was higher because the weather was very hot during the measurements, allowing high levels of sunlight to penetrate the water. This was because sampling was conducted in an open area unobstructed by vegetation or other structures, allowing sunlight to directly reach the water surface. The river's unshaded riparian vegetation resulted in an increase in water temperature (Kalny et al., 2017).

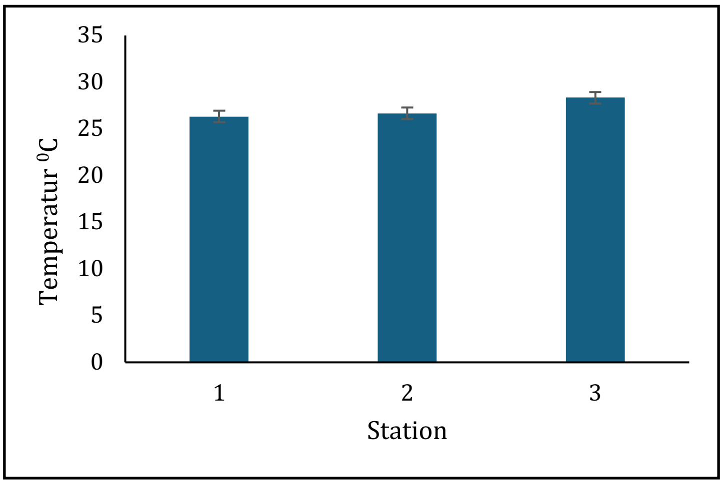

Figure 2. Average Temperature Graph

2. TSS (*Total Suspended Solids*)

The highest TSS content was found at Station 3 with a value of 49.89 mg/L. The high TSS levels were due to soil erosion, domestic waste, and agricultural waste around the river basin, while the lowest value was at Station 1 (29.15 mg/L) (Figure 3). The increase in Total Suspended Solids (TSS) values at Station 3 was caused by various factors, one of which was the soil erosion process that occurred due to runoff that carried sediment particles from the upstream to the downstream of the river. In addition, anthropogenic activities such as domestic waste disposal, agricultural practices, and industrial activities also played a role in increasing TSS levels in the waters (Anas & Suryani., 2020).

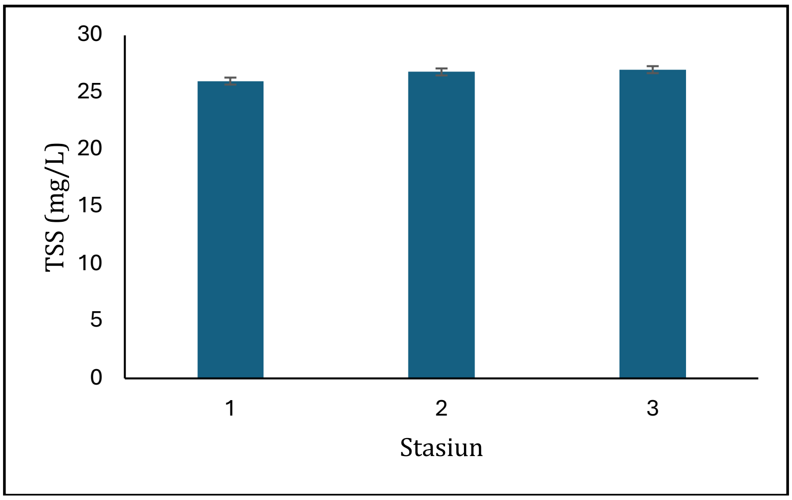

Figure 3. Average Total Suspended Solid Graph

Based on water quality standards (Class III), the TSS level is no more than 400 mg/L. Therefore, the TSS values at all stations are within the permitted limits. However, the increased TSS value at Station 3 may indicate an increased sedimentation rate due to soil erosion carried by water flow from upstream to downstream.

3. Brightnes

Based on measurements during three sampling sessions, the highest clarity was recorded at Station 3 with a value of 27 cm, while the lowest clarity was recorded at Station 1 with a value of 26 cm. Lower clarity values indicate high suspended solids (TSS) content, which can affect light penetration into the water. The water clarity measurement graph can be seen in Figure 4.

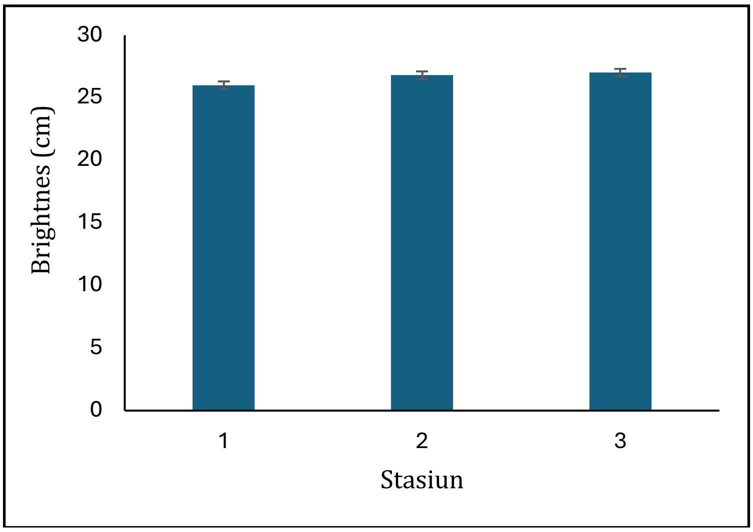

Figure 4. Average Water Clarity Graph

According to Government Regulation No. 22 of 2021, there is no specific standard for water clarity, but values lower than 50 cm may indicate high levels of suspended particles. Decreased clarity can be caused by several main factors, including heavy rainfall, soil erosion, and domestic and industrial activities around rivers.

4. River Dept

River depths during the three sampling sessions showed significant variation. The highest depth was recorded at Station 3, at 230.67 cm, while the lowest was recorded at Station 2, at 52.33 cm. A graph of the river depth measurements can be seen in Figure 5.

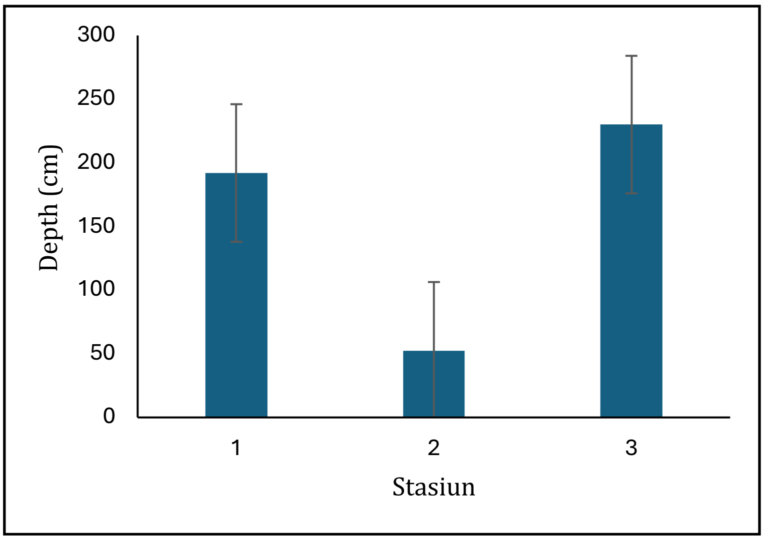

Figure 5. Average Water Depth Graph

In the depth measurement during the 3rd sampling, the data showed that the river being measured had a higher depth, this was because at the time of the measurement the water conditions were high tide.

5. Current Speed

River current velocity showed significant variation based on measurements taken over three sampling periods. The highest value was recorded at Station 3 (0.52 m/s), while the lowest value was recorded at Station 2 at 0.46 m/s. A graph of river current velocity is shown in Figure 6.

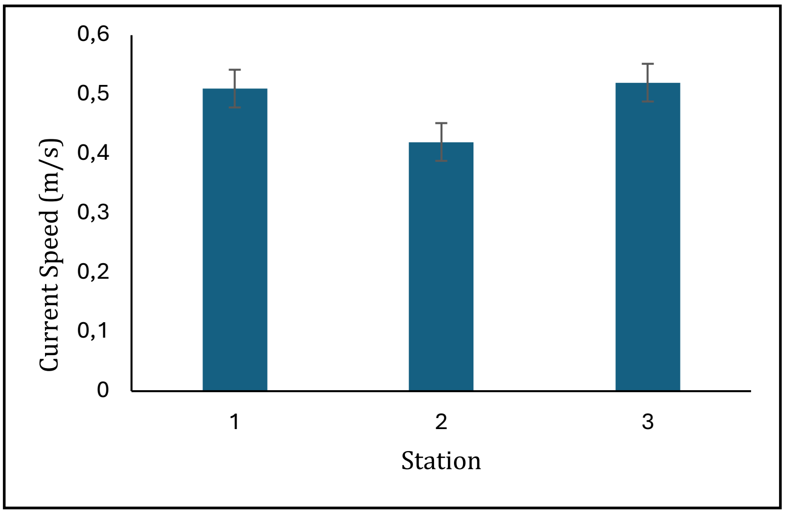

Figure 6. Average Current Velocity Graph

4.1. Chemical Parameters

1. pH Value *(Potential Hydrogen)*

The pH value of the Air Hitam River water at three research stations was 6. A trend toward the lower limit of pH can indicate potential pollution due to the presence of organic matter or domestic waste. This pollution stems from household, industrial, and agricultural activities that discharge waste into the water without adequate treatment (Wulandari & Jar, 2024).

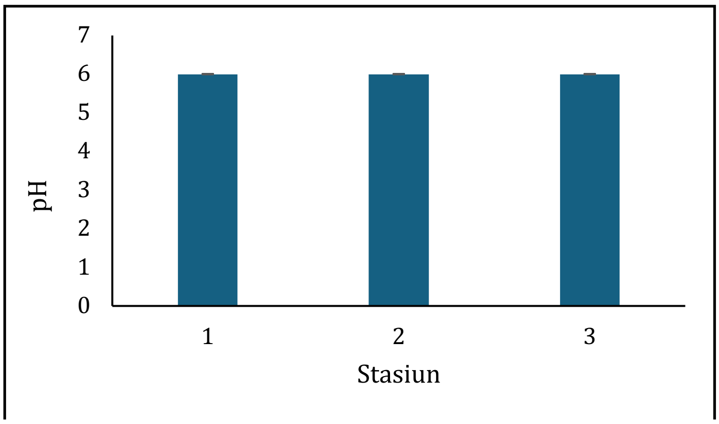

Figure 7. Average pH (Potential Hydrogen) Graph

2. *DO (Dissolved Oxygen)*

Dissolved oxygen (DO) is one of the main parameters for assessing water quality because it directly affects the life of aquatic organisms. Measurement results show that the highest DO value was recorded at Station 2 (5.73 mg/L), and the lowest was recorded at Station 5 (5.09 mg/L) (Figure 3). Based on Class III water quality standards, the minimum permitted DO level is 3 mg/L. Therefore, all research stations are still within the range that meets water quality standards.

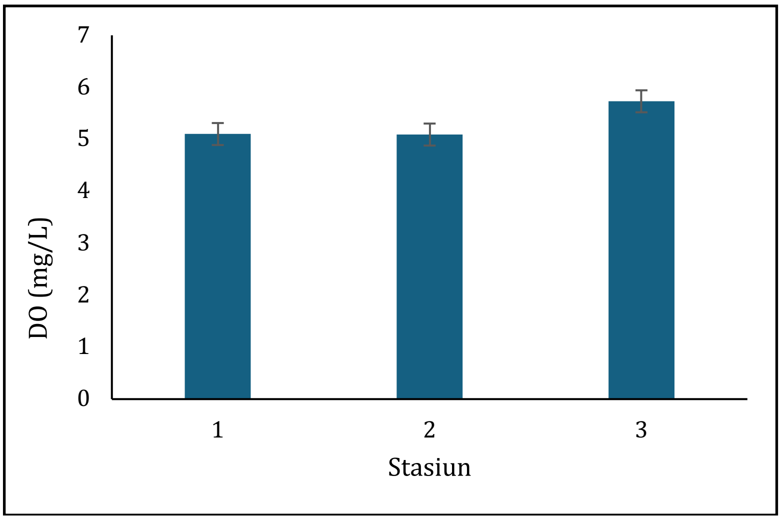

Figure 8. Average DO (Dissolved Oxygen) Graph

The lower DO values at Stations 1 and 2 are thought to be due to the high organic pollutant load from domestic and agricultural waste. Furthermore, the environmental conditions at both stations, which are obscured by large trees, which prevent sunlight from entering the river, also contributed to the lower DO levels compared to Station.

3. *Nitrate*

The highest nitrate level was recorded at Station 1 at 0.1316 mg/L, and the lowest at Station 3 at 0.1188 mg/L. Station 2 showed a value between the two, ranging from 0.1316 to 0.1188 mg/L (Figure 9). Based on Class III water quality standards (PP 22/2021), the maximum permissible nitrate level is 10 mg/L. Therefore, nitrate levels at all stations were well below the established threshold and showed no indication of significant contamination by this element.

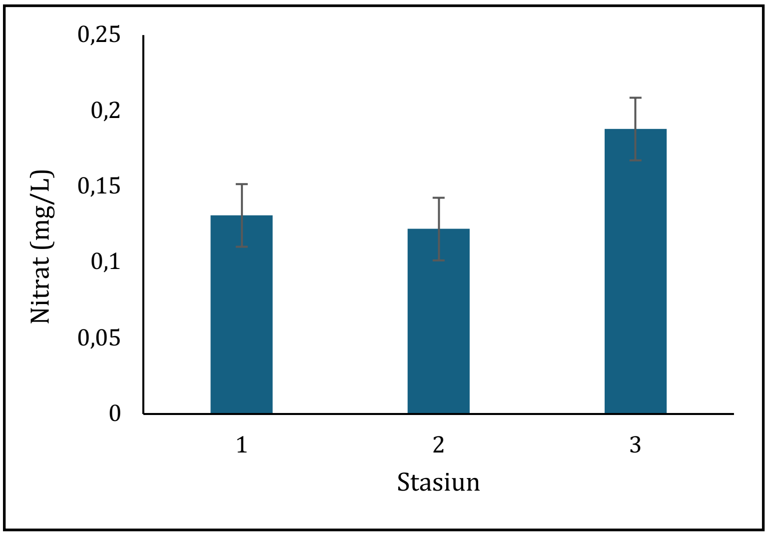

Figure 9. Average Nitrate Measurement Graph

The higher nitrate concentration at Station 1 may be attributed to fertilizer runoff from agricultural and plantation areas upstream. Furthermore, rainwater runoff can carry nitrogen compounds into the river and temporarily increase nitrate levels in the water (Dong et al., 2022). Conversely, the lower nitrate levels at Station 3 suggest possible assimilation by microorganisms. Algae utilize nitrate as a nutrient source for their growth, thereby reducing nitrate concentrations in the water (Effendi 2024).

4. *Fosfate*

Figure 10 shows the measured phosphate levels during the study. The highest value was at Station 3, at 0.4014 mg/L, while the lowest was at 0.3367 mg/L at Station 1. Station 2 had phosphate levels between the other two stations, ranging from 0.3367 to 0.4014 mg/L. The increase in phosphate levels from upstream to downstream indicates the accumulation of pollutants originating from various anthropogenic activities.

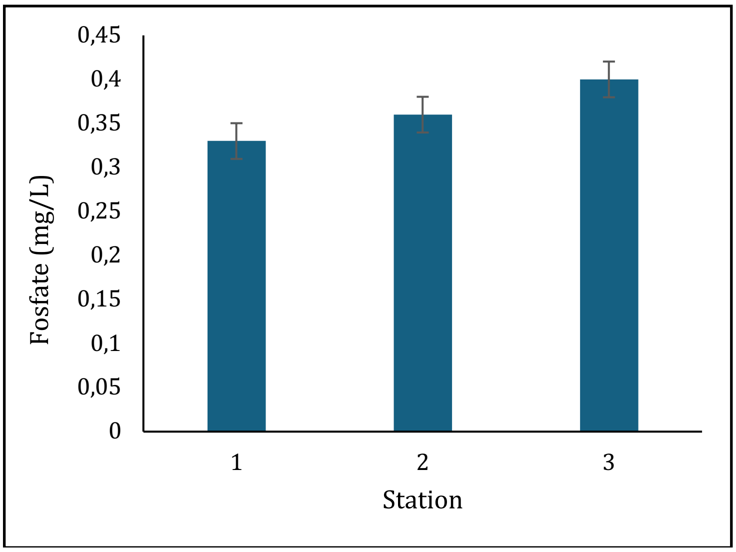

Figure 10. Graph of Average Phosphate Measurements

The main sources of phosphate in water can come from the use of detergents in domestic wastewater, industrial wastewater, and agricultural activities that use phosphate fertilizers. The higher phosphate concentration at Station 3 may indicate waste accumulation from upstream to downstream.

5. *BOD (Biochemical Oxygen Demand)*

The BOD measurement results graph is presented in Figure 11. The BOD value increases from Station 1 to Station 3. This increase indicates that the organic matter load in the water increases downstream. This can be caused by the influx of domestic waste, residential activities, and runoff from human activities around the river. According to Effendi (2003), the BOD value indicates the amount of dissolved oxygen required by microorganisms to decompose organic matter biologically. The higher the BOD value, the greater the organic matter content in the water and the lower the water quality. A BOD value > 6 mg/L generally indicates heavily polluted waters (PP No. 22 Tahun 2021).

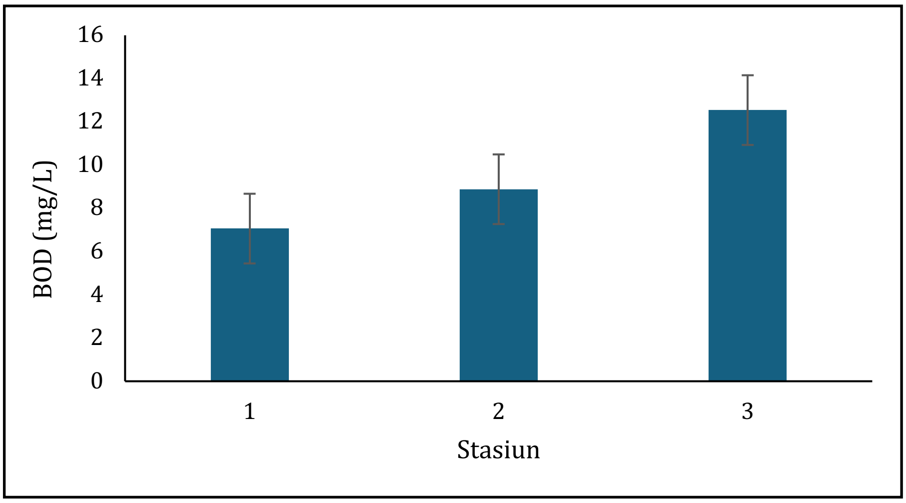

Figure 11. Average BOD Measurement Grap

Based on the Class III water quality standards according to Government Regulation No. 22 of 2021, the maximum permissible BOD level is 6 mg/L. The BOD values measured at all stations exceeded the permitted threshold, indicating that the Air Hitam River is experiencing significant levels of organic pollutio.

6. *COD (Chemical Oxygen Demand)*

The measurement results showed that the highest COD value of 39.23 mg/L was found at Station 3, while the lowest value was recorded at Station 1 at 23.07 mg/L. The higher COD value at Station 3 indicates the accumulation of pollutants from domestic, industrial, and agricultural activities entering the river water without adequate treatment (Permatasari, 2024). The graph for river COD measurements is attached in Figure 12.

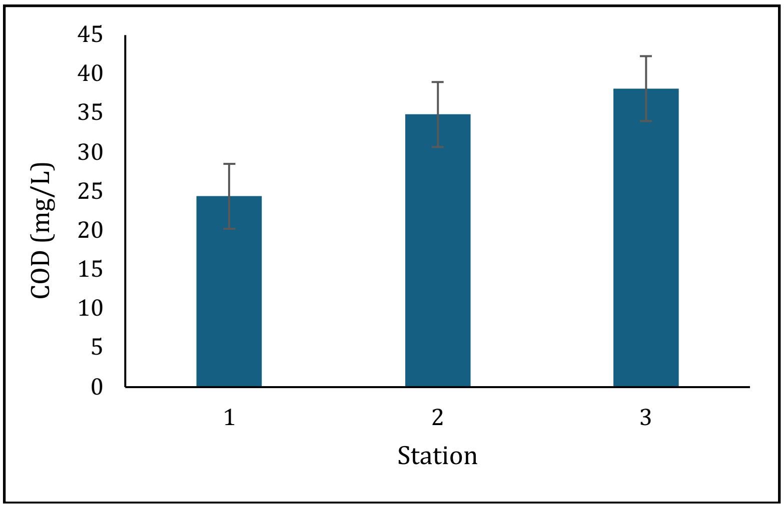

Figure 12. Average graph of COD measurements

Based on Class III water quality standards, Government Regulation No. 22/2021, the maximum permitted COD level is 40 mg/L. Therefore, the COD value obtained is still within the permitted threshold.

Biological Parameters

1. Total Coliform (T. coliform)

The analysis results showed that the highest T. coliform count was 240,000 MPN/100 mL at station 2, but stations 1 and 3 each had 213,333 MPN/100 mL (Figure 13). According to quality standards (PP No. 22 of 2021), the maximum allowable T. coliform count is 10,000 MPN/100 mL. Thus, the measurement results show that all research stations had T. coliform levels far exceeding the permitted threshold. This indicates significant biological pollution in the Air Hitam River.

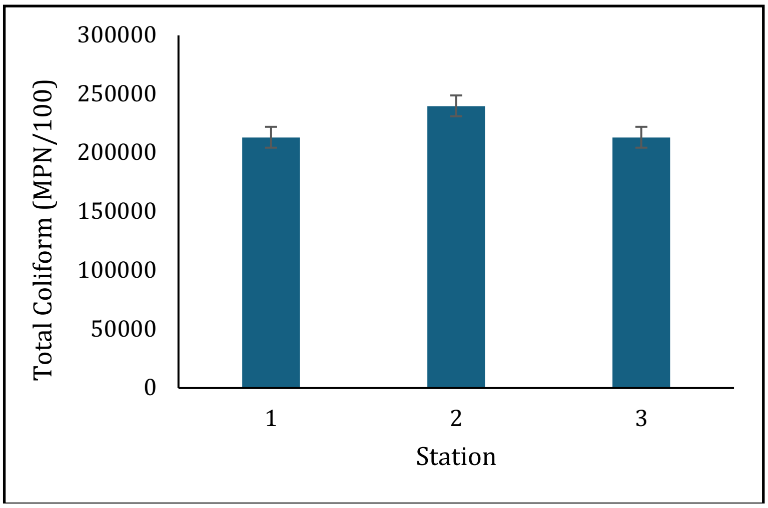

Figure 13. Graph of Average T. coliform Measurements

Water Quality Analysis Based on the CCME Index

The results of the analysis using the CCME-WQI method indicate that the Air Hitam River is categorized as poor at all observation stations, with index values below 45 (Station 1: 44.35; Station 2: 26.02; Station 3: 44.18) (Table 3). These values indicate that the river water does not meet Class III water quality standards. This is lower than the results of the study by Yuliati et al. (2023) which used the Pollution Index (PI), which found the Air Hitam River's water quality status was still classified as lightly polluted. This difference in results indicates that the CCME-WQI method is more stringent, as it not only assesses the number of parameters exceeding the water quality standard but also takes into account the frequency and magnitude of deviations (amplitude) of violations of water quality standards through factors F1 (scope), F2 (frequency), and F3 (amplitude).

Specifically, the two main parameters that consistently did not meet the water quality standard were BOD and T. coliform. High BOD levels reflect organic contamination from domestic waste and agricultural activities (Setiawan et al., 2023). Meanwhile, high T. coliform levels indicate fecal contamination due to household waste disposal and inadequate sanitation systems (Imamah, 2025).

Table 3. Water Quality Status Results Using the CCME-WQI Method

Station	Failed Variabl	Failed Test	Σ *Exc*	nse	F1	F2	F3	Score	Inf
1	2	6	61,5317	10,2553	22,22	22,22	91,13	44,35	Bad
2	2	6	70,4384	11,7397	22,22	22,22	92,14	26,02	Bad
3	2	6	64,2484	10,7114	22,22	22,22	91,46	44,18	Bad
			Average					38,18	Bad

Of the three observation stations, Station 2 showed the lowest CCME index value (26.02), indicating the highest level of pollution. This can be attributed to the denser industrial, workshop, and domestic activities in the middle reaches of the river, which increase the load of organic and inorganic materials, as well as microbiological contamination. Stations 1 and 3 tend to have better water quality due to the limited influence of human activity. Therefore, integrated pollution source control efforts are needed. Several strategic measures can be implemented, including the construction of communal septic tanks and communal wastewater treatment plants (WWTPs) in densely populated areas to reduce domestic waste load. Furthermore, good housekeeping practices in workshops and small industries can prevent the discharge of oil and solvents into waterways, and improvements in solid waste management systems around residential areas. The implementation of these management strategies is expected to reduce BOD, COD, phosphate, nitrate, and T. coliform levels, thereby improving the water quality of the Air Hitam River and approaching the moderate or good category based on the CCME-WQI.

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CONCLUSSION

Results of the research indicate that the Air Hitam River is in the poor category at all observation stations. The decline in water quality is influenced by domestic, industrial, and agricultural activities. Organic matter and coliform bacteria have polluted the Air Hitam River, rendering it unfit for fisheries.

REFERENCES

Alfatihah, A., Latuconsina, H., dan Prasetyo, H. D. (2022). Analisis Kualitas Air Berdasarkan Paremeter Fisika dan Kimia di Perairan Sungai Patrean Kabupaten Sumenep. *AQUACOASTMARINE: Journal of Aquatic and Fisheries Sciences*, *1*(2), 76-84.

Anas, I., & Suryani, S. (2020). Analisis Total Suspended Solid (TSS) Perairan Danau Toba di Kecamatan Girsang Sipangan Bolon, Sumatera Utara. *Jurnal Harian Regional*, 5(2), 104–110.

Antika, R., Cokrowati, N., & Scabra, A. R. (2024). The use of ultraviolet in the production of nursing tilapia fish Oreochromis niloticus using a recirculation system. Indonesian Journal of Aquaculture Medium, 4(3), 90–105. https://doi.org/10.29303/mediaakuakultur.v4i3.3834

Dong, Y., Yang, J. L., Zhao, X. R., Yang, S. H., Mulder, J., Dörsch, P., & Zhang, G. L. (2022). Nitrate runoff loss and source apportionment in a typical subtropical agricultural watershed. *Environmental Science and Pollution Research*, *29*(14), 20186-20199.

Effendi, H. (2024). *Telaah kualitas air: Bagi pengelolaan sumber daya dan perairan*. Edisi Revisi. PT Kanisius. Yogyakarta.

Hasani, M. S., Scabra, A. R., & Mulyani, L. F. (2025). Growth of Vannamei Shrimp (Litopenaeus vannamei) Challenged by Vibrio parahaemolyticus Bacteria with addition of Moringa oleifera Leaf Powder through Feed. Asian Journal of Fisheries and Aquatic Research, 27(8), 76–88. https://doi.org/10.9734/ajfar/2025/v27i8978

Kalny, G., Laaha, G., Melcher, A., Trimmel, H., Weihs, P., & Rauch, H. P. (2017). The influence of riparian vegetation shading on water temperature during low flow conditions in a medium sized river. *Knowledge & Management of Aquatic Ecosystems*, (418), 5.

Khan, A. A., Tobin, A., Paterson, R., Khan, H., & Warren, R. (2005). Application of CCME procedures for deriving site-specific water quality guidelines for the CCME Water Quality Index. *Water Quality Research Journal*, *40*(4), 448-456.

Mokodompit, MSP, Umboh, JM, & Pinontoan, OR (2020). Uji Kualitas Air Danau berdasarkan Kandungan Escherichia Coli dan Total Coliform di Danau Mooat Kabupaten Bolaang Mongondow Timur Tahun 2019. *KESMAS: Jurnal Kesehatan Masyarakat Universitas Sam Ratulangi*, *9* (2).

Pemerintah Republik Indonesia. (2021). *Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup*. Jakarta: Sekretariat Negara.

Pasaribu, P. (2012). *Analisis Perbandingan Usaha Tani Padi Organik pada Kelompok yang Mendapatkan Fasilitas Alat Pengomposan dari Pemerintah dengan Kelompok yang Tidak Mendapatkan Alat Pengomposan*. Skripsi. Fakultas Pertanian Universitas Andalas Padang.

Permatasari, E. D. (2024). *Distribusi Spasial-Temporal Chemical Oxygen Demand (COD) pada Daerah Aliran Sungai (DAS) Serayu*. Skripsi, Universitas Jenderal Soedirman.

Imamah, N. (2025). Analisis Kontaminasi Coliform Pada Air Limbah Domestik. *Jurnal Biosense*, *8*(4), 491-496.

Santoso, A. D., & Wijayanti, W. (2021). Dampak Perubahan Morfologi Sungai terhadap Habitat Biota Akuatik dan Kualitas Air. *Jurnal Lingkungan dan Pembangunan Berkelanjutan*, 12(2), 123–135.

Scabra, A. R., Yasa, K. N., & Lumbessy, S. Y. (2025). Shrimp Vannamei Culture (Litopenaeus Vannamei) in Low Salinity Media on Biofloc System With Different C/N Ratio Media Intake. Indonesian Journal Of Aquaculture Medium, 5(2), 76–91. https://doi.org/http://doi.org/10.29303/mediaakuakultur.v5i2.5047

Setiawan, B. (2023). Analisis hubungan antara BOD, COD, dan oksigen terlarut di perairan sungai tropis. *Jurnal Riset Perairan*, 15(4), 100-112.

Panagopoulos, Y., Alexakis, D. E., Skoulikidis, N. T., Laschou, S., Papadopoulos, A., & Dimitriou, E. (2022). Implementing the CCME water quality index for the evaluation of the physicochemical quality of Greek Rivers. *Water*, *14*(17), 2738.

Setyowati, T., & Ermanto, D. (2018). Kualitas Air Sungai Citarum di Kecamatan Dayeuhkolot Kabupaten Bandung. *Jurnal Sains dan Teknologi MIPA*, 5(2), 111-120.

Yuliati, Y., Sumiarsih, E., Efawani, E., Mulyani, I., & El Fajri, N. (2023). The assessment of status of Sibam River and Air Hitam River Pekanbaru city Riau Province using pollution index. *Depik*, *12*(2), 229-235.

Wulandari, B. M., & Jar, N. R. (2024). Analisis Pengendalian Kualitas Air Sungai dengan Penerapan Metode Six Sigma (DMAIC): Studi Sungai Wonokromo Segmen Jl. Nginden Intan–Jl. Wonorejo. *Jurnal Ekologi, Masyarakat dan Sains*, *5*(1), 66-77.