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MANAGEMENT OF SEKETAK RIVER, CENTRAL JAVA, INDONESIA BASED ON DETERMINATION OF WATER QUALITY STATUS AND POLLUTION LOAD APPROACH

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ABSTRACT

Due to the presence of renowned universities, Tembalang, Semarang City, is experiencing rapid development. However, this development brings positive impact and raises environmental issues, one of which is river pollution. Seketak River, a ±10.5 km long river with headwaters in Banyumanik Subdistrict and empties into Diponegoro University's Education Reservoir, is one of the affected areas. This river pollution has the potential to disrupt water quality and aquatic biota life. The source of pollution is suspected to come from domestic, industrial, and livestock waste around the Seketak watershed. Therefore, intensive research was conducted to analyze the status of water quality and pollution load based on point sources. This research aims to provide recommendations for proper management and control of pollution. Data were collected during the transitional season (dry to rainy) using the Pollution Index (IP) method based on the Decree of the Minister of Environment No. 115 of 2003 and the Pollution Load (BP) method. The research involved four sampling points, each representing a pollutant source (industry, settlement, campus, and livestock), with two repetitions. The results showed that the average IP value of Seketak River was in the lightly polluted category, referring to the Class II Quality Standard of PP No. 22 of 2021. In the first repetition, the IP value was 2.87, while in the second repetition it reached 3.26. The Pollution Load Analysis identified 5 variables that exceeded the maximum load including Nitrite, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), iron (Fe) and lead (Pb). These findings emphasize the importance of integrated management efforts to mitigate pollution in Seketak River.

Keywords: Index Terms- Water Quality Status; Pollution Index (PI);Load Pollution; Seketak River; lightly polluted.

INTRODUCTION

Tembalang Sub-district, Semarang City, Indonesia, is experiencing rapid development due to the presence of several renowned universities, which has led to an increase in domestic, commercial, and social activities in the area. This rapid growth not only brings positive impacts, such as economic improvement and easy access to education but also puts pressure on the environment, especially aquatic ecosystems. The development of infrastructure and settlements has the potential to affect the quality of the surrounding ecosystem. River conditions can worsen because they are influenced by several factors including population growth, reduced water catchment areas, and increased riverside settlements (Nurlianti et al., 2022). One of the important rivers in this area is Seketak River, which has its headwaters in Banyumanik Subdistrict and empties into Tembalang Subdistrict, precisely at the Diponegoro University Education Reservoir. This reservoir has a strategic function in maintaining the stability of the local ecosystem, preventing flooding, increasing water absorption, and supporting various business activities. In addition, the reservoir is also utilized as a recreational area, such as a fishing spot, and a source of water for the surrounding community for daily needs. However, increased pressure from human activities can potentially disrupt the quality and sustainability of this ecosystem if not managed properly. Research by Hudiyah and Saptomo (2019) shows that poorly managed human activities can cause water pollution in water sources, including rivers.

Since ancient times, rivers have been considered strategic areas that are the center of human life. Settlements, economic activities and infrastructure often develop around rivers. Rivers have an important role as those that can support people's lives (Putri et al., 2019). However, modernization has drastically changed the function of rivers. Currently, many rivers are used inappropriately as dumping grounds for domestic and industrial waste. Uncontrolled human activities, such as rapid urbanization, industrialization, as well as non-point waste disposal from urban areas, have caused degradation of river quality (Gautam et al., 2019). This is also the case in Banyumanik and Tembalang sub-districts, where rapid population growth has worsened the condition of the river. The high level of community activity is often followed by an increase in the amount of waste found in river bodies. Many people still consider the river as the easiest option to dispose of waste without considering the long-term impact on the environment. Water quality can change according to environmental developments caused by human activities (Mumpuni et al., 2020). This condition increases the levels of pollutants in the river, such as organic matter, heavy metals, and other pollutants. A decrease in water quality can be caused by increased human activities that produce waste in an area (Lusiyana et al., 2020). One of the impacts arising from river water pollution is an increase in nutrient content, causing eutrophication (Indriyani et al., 2020). Although rivers have the natural ability to perform self-purification, they have a limited capacity and depend on the amount and type of incoming pollution load. According to the Ministry of Environment and Forestry, around 75% of river water in Indonesia is heavily polluted. This is caused by the activity patterns of people living along the riverbanks, where domestic waste and other activities have a direct impact on water quality (Ajiansyah and Surdin, 2016).

This study aims to determine the status of water quality based on water quality parameters, such as pH, temperature, Total Suspended Solid (TSS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), nitrite (as N), total phosphate, lead (Pb), and iron (Fe). The analysis was conducted using the pollution index method to provide a comprehensive picture of river water quality conditions. In addition, this research also aims to calculate the pollution load to determine the level of pollution occurring in Seketak River. Through an in-depth analysis of these variables, the research on Seketak River is expected to provide a clear and in-depth picture of the environmental condition and become the basis for better policies in the effort to conserve and restore water quality, especially in minimizing the negative impacts of human activities on water quality and aquatic ecosystems. Monitoring water quality status is an important part of supporting river management efforts through the PROKASIH (Program Kali Bersih), an Indonesian government program dedicated to conserving the aquatic environment, especially the river.

RESEARCH METHODS

Study Area

This study was conducted in October 2024, coinciding with the transition season from dry to rainy season, in Seketak River. The river is located in Semarang City, stretching across Banyumanik and Tembalang Subdistricts with a length of approximately ±10,571 meters. Sampling locations were determined based on strategic point sources to illustrate variations in river conditions.

Station 1 was located near the iron factory with coordinates S: 7°4'4.44" and E: 110°24'46.48". This location was chosen because it has great potential to generate chemical and organic waste that can significantly affect river water quality. Station 2 is located in a dense area with residential areas, student boarding houses, and shops, with coordinates S: 7°3'22.11" and E: 110°26'17.54". This location illustrates the influence of domestic waste generated from the daily activities of the community and students. Station 3 is located around the Diponegoro University campus area, with coordinates S: 7°5'51.27" and E: 110°43'86.55". This point is important to show the impact of academic activities and campus facilities on river water quality. Station 4 is located near cattle, chicken, and goat farming areas, as well as agricultural activities, with coordinates S: 7°5'47.05" and E: 110°44'18.81". This location was chosen to understand the effect of organic waste from livestock farming and agricultural fertilizer residues on the river ecosystem (Figure 1). Activities such as agriculture, livestock, settlements, and industrial waste disposal contribute to the decline in water quality (Sofiana et al., 2022).

Determination of the coordinates of each sampling point was carried out using a GPS device and then plotted using ArcGIS Desktop 10.3 software to map the exact distribution of locations. Sampling was carried out using a purposive sampling method, namely the deliberate selection of sample points to illustrate each category of pollutant sources. This method ensures that the data obtained covers a variety of river conditions from industrial, domestic, academic, and agricultural activities. This research is expected to provide a comprehensive picture of the condition of water quality in Seketak River and the level of pollution that occurs along the river.

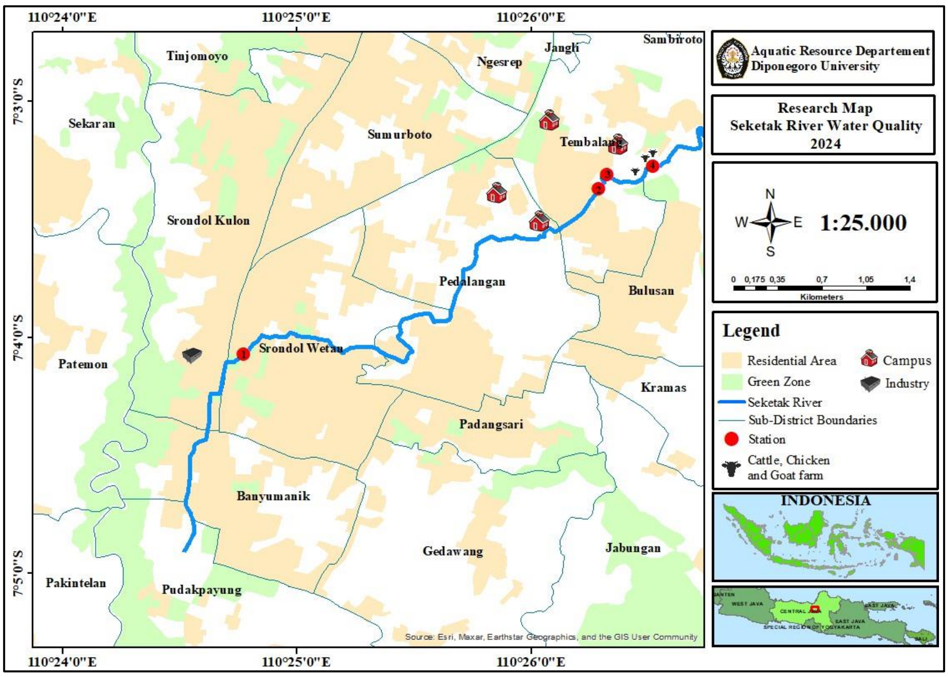

Figure 1. Map of Sample Point

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Sample Collection

River water samples were taken in 2 repetitions with an interval of 2 weeks. Samples were taken at 0.5 times the depth of the river surface with composite samples from 3 points of each station. Water sampling using a sample bottle. The river has a weak discharge between 0.39-2.92 m3/s. Water samples were taken at 3 points namely ¼, ½, and ¾ the width of the river in one sample bottle, then shaken to make it homogeneous. River water samples are then stored in 1000ml polyethylene (PE) bottles stored in a coolbox with a temperature of ± 4°C. Temperature, pH, and Dissolved Oxygen (DO) were measured in situ using a pH meter and DO Meter.

Analysis Procedures

There are several variables used in this study including TSS (gravimetric method), BOD (incubation method for 5 days at 20°C), COD (spectrophotometric closed reflux method), total phosphate (spectrophotometer method with ascorbic acid reduction), nitrite (spectrophotometric method), lead and iron (Atomic Absorption spectrometry (SSA) method).

Data Analysis

Determination of water quality status using primary data taken directly from the field and using secondary data in the form of appendix VI of Indonesian government regulations 22 of 2021 concerning the implementation of Class II environmental protection and management as a reference for the quality standards used. Analysis of water quality status using the Pollution Index refers to Indonesian Minister of Environment Decree Number 115 of 2003 concerning guidelines for determining water quality status. This method shows a quantitative description of the condition of pollution in waters based on each station. The following is the equation used to calculate water quality status with the pollution index (PI):

$$PIj = \frac{\sqrt{\left(\frac{C_i}{L_{ij}}\right)R^2 + \left(\frac{C_i}{L_{ij}}\right)M^2}}{2} \quad \text{.....................................} (1)$$

PI_j is the pollution index for designation (j), then the function Li_j is the concentration of water quality variables listed in the quality standard, and Ci expresses the concentration of water quality variables obtained from the analysis of water samples in the field. The R value is an index that shows the average level of pollution of all parameters. The value of M is the maximum value that will show one dominant variable to affect water quality. PIj can be calculated with the following steps:

1. Clustering variables which, if low, will affect water quality
2. Calculate the Ci/li_j value of each variable at each station based on repetition.
3. If the water quality decreases as a result of a decrease in the concentration of a variable, use the formula (Li_j/Ci) as in the DO variable.
4. If the value of $(Ci/Li_j) > 1$ then use the $(Ci/Li_j)_{New}$

Determination of water quality status based on pollution index:

Table 1. Determination of Water Quality Status

Value of PI	Description
0,0 < PIj < 1,0	Meet Quality Standards
1,0 < PIj < 5,0	Lightly Polluted
5,0 < PIj < 10,0	Moderately Polluted
PIj > 10	Severely polluted

Source: Minister of Environment Decree Number 115 of 2003

Data on the levels of pollutant elements including Total Suspended Solid (TSS), pH, temperature, Dissolved Oxygen (DO), Nitrite (As N), Total Phosphate (As P), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Iron (Fe) and Lead contained in water at each sampling point were calculated with the actual pollutant load using the equation,

$$BP_A = Q \ x \ C_M \quad \ldots\ldots(2)$$

This equation is to determine the actual pollutant load in the waters of the Seketak watershed, with the Q component being the measured discharge with units (m3/sec), the C_M component being the actual concentration with units (kg/day). In order to determine the maximum pollutant load that the waters can receive, the following equation is used,

$$BP_M = Q \ x \ C_{BM} \quad \ldots\ldots(3)$$

This equation is to determine whether the maximum pollutant load in the waters of the Seketak watershed exceeds the maximum pollution load or not, with the **Q** component being the measured discharge with units (m3/sec), the C_{BM} component being the concentration (Standard standards based on Indonesian Government Regulation Number 22 of 2021 concerning the Implementation of Class II Environmental Protection and Management) with units (mg/liter). Through this calculation, it can be concluded that the pollutant load contained in Seketak River is still below the maximum acceptable limit or not.

RESULT AND DISCUSSION

General Condition of Seketak River

Based on the statistical data of land use of Tembalang Subdistrict, Semarang City, Indonesia in 2023 studied by Ahmada and Sarifudin (2023), land use in the Tembalang area consists of several types, with residential areas covering 32.98% of the total area of 4195.401 hectares. In addition, there is 6.99% of land used for agriculture, 51.47% for moorland, and 0.27% for Open Green Space (Figure 2). The largest land use in Tembalang Sub-district is residential area and moorland which covers a total area of 3543.286 Ha.

The density of settlements in the Tembalang area is one of the main factors that has the potential to cause increased pollution in Seketak River. Dense domestic activities such as the disposal of household waste, garbage and other pollution can affect the water quality in the river. In addition, changes in land use, such as land conversion into residential areas, can also increase the pollution load entering the river ecosystem.

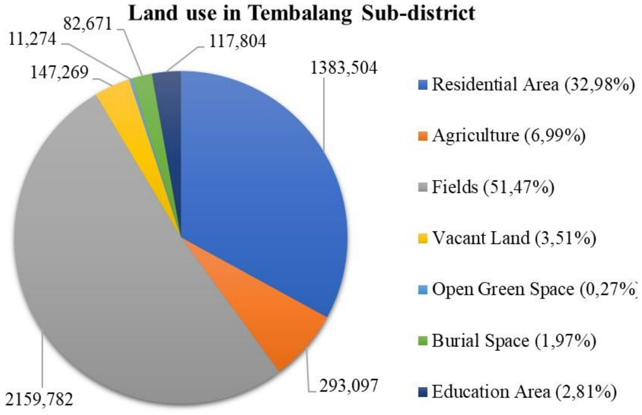


Figure 2. Land use in Tembalang Sub-district, Indonesia
Source : Ahmada dan Sarifudin (2023)

Physical Parameters

The results of the research conducted at four stations in Seketak River with two repetitions showed quite diverse water quality characteristics based on the observed variables. The water quality data of Seketak River for repetition I and II are presented in Table 2 and Table 3. One of the important variables observed is temperature, which has a significant influence on the quality of aquatic ecosystems.

The water temperature in Seketak River ranges from 29.2℃ to 33.2℃. Based on the Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning class II water quality standards, this value exceeds the normal temperature standard for water, which ranges from 28℃ to 31℃ (Safitri, 2019). Increased water temperature can reduce dissolved oxygen (DO) concentration, which is one of the important indicators of water quality. Low DO reduces the ability of aquatic organisms to survive, potentially leading to a decrease in biodiversity and disruption of the food chain (Suriadikusumah, 2020).

Environmental factors such as the presence of vegetation on the riverbank also affect water temperature. Vegetation functions as a natural shade, absorb radiation emitted by long waves, and creates a microclimate that can reduce evaporation, maintain soil temperature, and stabilize water temperature (Dallas, 2008). Therefore, the presence of sufficient vegetation can help maintain the thermal quality of water.

In addition to temperature, Total Suspended Solid (TSS) concentration was also observed in this study. The measured TSS values ranged from 5.1 mg/L to 21.74 mg/L, which is still below the quality standard threshold. However, high TSS concentrations can increase water temperature due to greater heat absorption (Marlina et al., 2017). TSS is also influenced by factors such as river current velocity, human activities, and the presence of sediment on the riverbed (Pamuji et al., 2015). Controlled TSS concentration is important to ensure that there is no excessive deposition that can reduce light penetration into the water, which in turn disrupts the photosynthesis process of aquatic organisms. In the context of Seketak River, maintaining a stable flow rate and reducing activities that can increase sediment load is one of the strategic steps in water quality management.

Chemical Parameters

The degree of acidity (pH) is an important parameter in aquatic ecosystems because it functions to balance the acid and base content and the concentration of hydrogen ions in the water. In Seketak River, the pH concentration was recorded to range from 7.5 to 9.3, where the pH is close to the normal value of 7. Factors that affect pH include acid rainfall, biological activity in water, and pollution from industrial or household waste, such as detergents, which can disrupt the chemical balance of water (Gazali et al., 2013).

In addition to pH, another parameter observed was Dissolved Oxygen (DO), with concentrations ranging from 4 to 6.4 ppm. These values indicate that the DO concentration is still above the class II quality standard (4 ppm) according to applicable regulations. DO is produced from the photosynthesis process of plants and algae, as well as through air diffusion. DO is very important for the respiration of aquatic biota and microorganisms in the process of decomposition of organic matter. A decrease in DO levels below the minimum limit indicates polluted water conditions, so it is important to maintain the balance of the ecosystem.

The Biological Oxygen Demand (BOD) concentration in Seketak River ranges from 15 to 22 mg/L. BOD describes the amount of oxygen required by microorganisms to decompose organic matter. High BOD values indicate an increase in organic waste content in the waters, which can trigger ecosystem damage. On the other hand, Chemical Oxygen Demand (COD) concentrations ranged from 33 to 48 mg/L, with the highest value recorded at station 3 in the first test (48 mg/L). These concentrations far exceeded the established class II quality standards, indicating a significant chemical pollutant load. COD concentrations are influenced by other variables such as DO, TSS, and pH, with an influence that can reach more than 90% (Sihotang et al., 2021).

The concentration of nitrite (NO_2-) in Seketak River was recorded to range from 0.21 to 0.66 mg/L, with all values exceeding the quality standard set for class II. The highest concentration value was found at station 1, followed by station 4 which is a farming area. This indicates that nitrite pollution in the river mainly comes from livestock activities and runoff of organic matter into the water body. Nitrite levels in water are usually very low, especially in uncontaminated waters. Safe drinking water quality standards, as set by the World Health Organization (WHO) and Government Regulation of the Republic of Indonesia Number 22 of 2021, require that the concentration of nitrite in water should not exceed 0.1 mg/L. Nitrite is highly toxic to aquatic organisms, especially fish, and its presence in high concentrations can indicate serious water pollution conditions. Nitrite is usually found in the aquatic environment due to the decomposition of organic matter and metabolic products of organisms (Setyowati et al., 2016). Nitrite and Nitrate are naturally produced from the phytoplankton nitrogen cycle (Yasa et al., 2024). High nitrite content has the potential to disrupt the balance of aquatic ecosystems and is toxic to aquatic organisms, especially if the concentration exceeds the threshold that can be tolerated by aquatic biota. Nitrite is harmful to aquatic ecosystems because it can interfere with the ability of the blood of aquatic organisms, especially fish, to transport oxygen. Nitrite can bind to hemoglobin in fish blood (Wahyudi et al., 2014), forming methemoglobin that is unable to carry oxygen, a condition known as “methemoglobinemia”. This can cause respiratory stress or even death in fish and other aquatic organisms if nitrite concentrations are too high (Aini and Parmi, 2022).

Meanwhile, the concentration of total phosphate (PO_4^{3}-) in Seketak River showed relatively low values, ranging from 0.01 to 0.13 mg/L, with all measurement results still below the established quality standards. The highest concentrations were recorded at stations 1, 3, and 4, which are thought to come from anthropogenic activities such as the use of fertilizers on agricultural land or domestic activities around the area. Although the total phosphate value is still within safe limits, phosphate still plays a major nutrient role in algae growth, which can trigger eutrophication if the concentration is too high. The main source of phosphate in waters usually comes from human activities, such as domestic waste (detergent, soap, food waste), industrial waste, and agricultural runoff containing fertilizers (Simbolon, 2016). Nutrients are often carried by rainwater into rivers, lakes and reservoirs, which then increases the phosphate concentration in water bodies (Hindaryani et al., 2020).

Heavy metals are also a major concern in this study. Lead (Pb) concentrations in Seketak River ranged from 0.01 to 0.05 mg/L, with some stations showing values exceeding the class II quality standard (0.03 mg/L). The high lead concentration at station 2 is expected due to vehicle activity on the main road close to the site, as well as population density in the surrounding area. Lead is a heavy metal that has the potential to accumulate in aquatic biota, so it can have a negative impact on the food chain and ecosystem health (Desriyan et al., 2015).

In addition to lead, iron (Fe) levels in Seketak River also need to be considered, especially considering the presence of iron industry around the river. Iron concentrations ranged from 0.18 to 1.07 mg/L, with all stations in the first repetition recording values exceeding the class I quality standard (0.3 mg/L). Heavy metals such as iron are persistent, so they have the potential to accumulate in the tissues of aquatic biota and can cause bioaccumulation in the food chain. At low pH conditions, heavy metals such as iron, lead, and aluminum tend to dissolve more easily, which increases toxicity to aquatic organisms (Supriyantini and Endrawati, 2015). Heavy metals pose a serious threat to the environment because they are not easily degradable and have the potential to cause long-term toxic effects, both for aquatic ecosystems and for humans who consume catches from these waters (Ogbomida et al., 2018).

Water Quality Status

The water quality status of Seketak River was analyzed using the Pollution Index (PI) method which refers to the Indonesian Decree of the Minister of Environment Number 115 of 2003 concerning guidelines for determining water quality status. The quality standard reference used is Government Regulation Number 22 of 2021 (Appendix VI), with a classification for class II river waters.

Based on the calculation results, the PI value in the first repetition is 2.36 - 2.91, which is categorized as lightly polluted. In the second repetition, the PI value was in the range of 2.80 - 3.25, with the same category of lightly polluted (Figure 3).

This shows that the water quality of Seketak River experienced a slight increase in pollution load in the second repetition compared to the first repetition. However, the difference is not too significant. The category of lightly polluted indicates that although the water quality is still within the tolerance limit for class II waters, a potential disturbance may arise to the ecological function of the waters.

Table 2. Water Quality Testing Result Repetition 1

Variable	Station				Average	Quality Standard	Unit
	1	2	3	4			
Physical Parameters							
Depth	0,6	0,8	0,75	0,2	0,59	#	m
Brightness	0,38	0,75	0,55	-	0,56	#	m
Debit	0,40	1,16	2,26	0,39	1,05	#	m/s^2
Total Suspended Solid (TSS)	5,34	13,78	11,08	5,5	8,93	50	mg/l
Temperature	29,9	32,2*	33,2*	31,4*	31,68*	Deviation 3	°C
Chemical Parameters							
Potential of Hydrogen (pH)	7,7	7,8	8	7,5	7,75	6-9	-
Dissolved Oxygen (DO)	6,1	4	6,1	5,8	5,50	4	ppm
Nitrit	0,21*	0,22*	0,22*	0,47*	0,28*	0,06	mg/L
Total Phosphate	0,01	0,01	0,01	0,01	0,01	0,2	mg/L
BOD	15*	16*	20*	21*	18,00*	3	mg/L
COD	33*	33*	43*	44*	38,25*	25	mg/L
Iron (Fe)	0,32*	0,78*	1,07*	0,67*	0,71*	0,3	mg/L
Lead (Pb)	0,01	0,01	0,01	0,02	0,01	0,03	mg/L

Table 3. Water Quality Testing Result Repetition 2

Variable	Station				Average	Quality Standard	Unit
	1	2	3	4			
Physical Parameters							
Depth	0,56	0,72	0,75	0,2	0,56	#	m
Brightness	0,35	0,59	0,66	-	0,53	#	m
Debit	0,46	0,99	2,92	0,61	1,24	#	m/s^2
Total Suspended Solid (TSS)	5,1	21,74	18,78	6,06	12,92	50	mg/l
Temperature	29,2	31,1*	31,2*	30,6*	30,53*	Deviation 3	°C
Chemical Parameters							
Potential of Hydrogen (pH)	8,9	8,5	9,3*	9,2*	8,98	6-9	-
Dissolved Oxygen (DO)	6,5	4,7	4,7	6,4	5,58	4	ppm
Nitrit	0,66*	0,48*	0,44*	0,39*	0,49*	0,06	mg/L
Total Phosphate	0,13	0,06	0,07	0,09	0,09	0,2	mg/L
BOD	20*	19*	22*	21*	20,50*	3	mg/L
COD	45*	41*	48*	44*	44,50*	25	mg/L
Iron (Fe)	0,18*	0,53*	0,44*	0,49*	0,41*	0,3	mg/L
Lead (Pb)	0,03*	0,05*	0,03*	0,05*	0,04*	0,03	mg/L

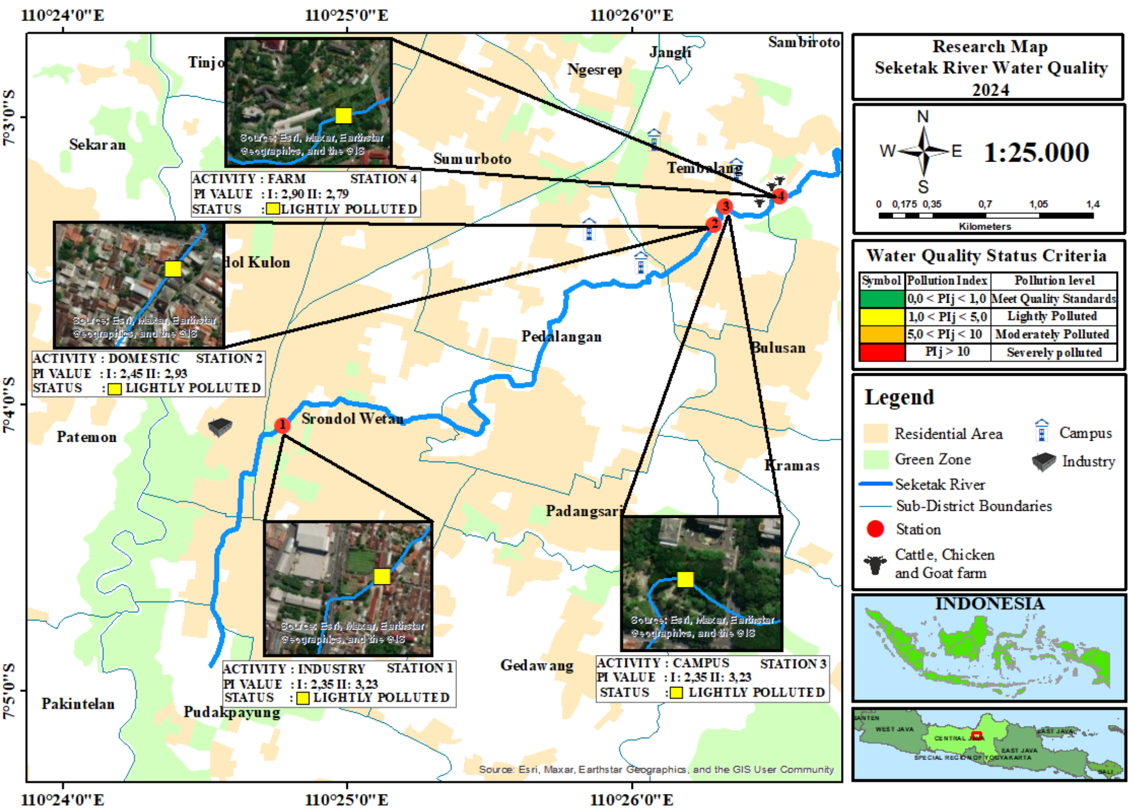
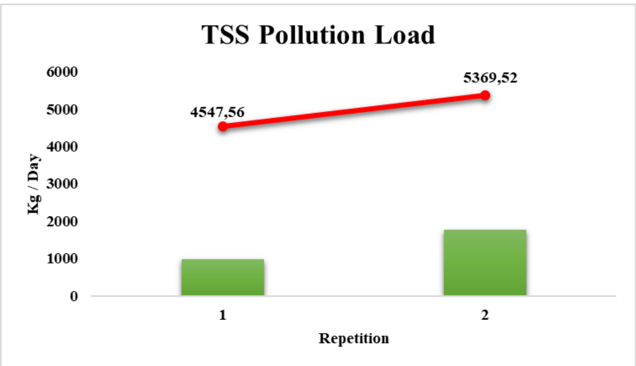
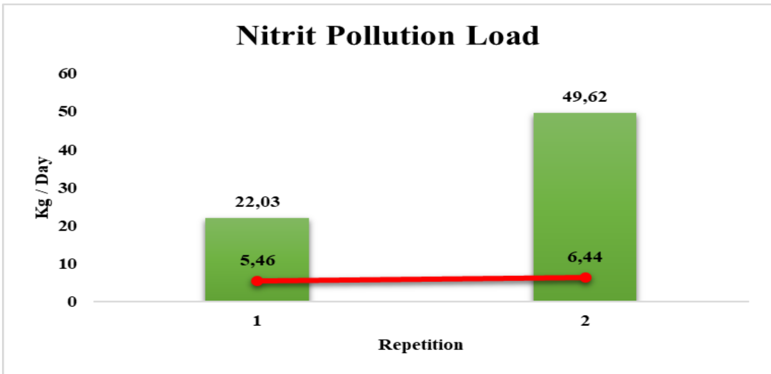
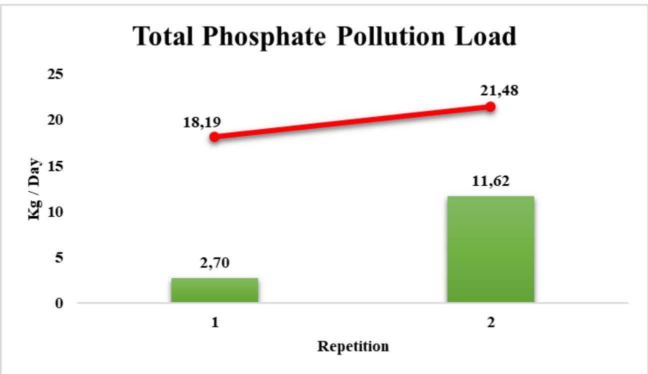
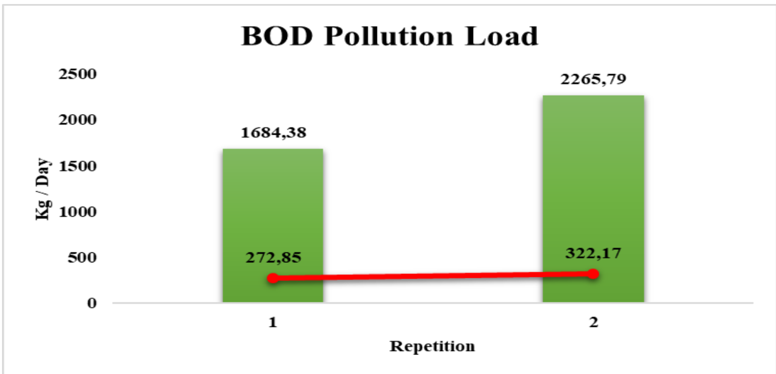


Figure 3. Seketak River Water Quality









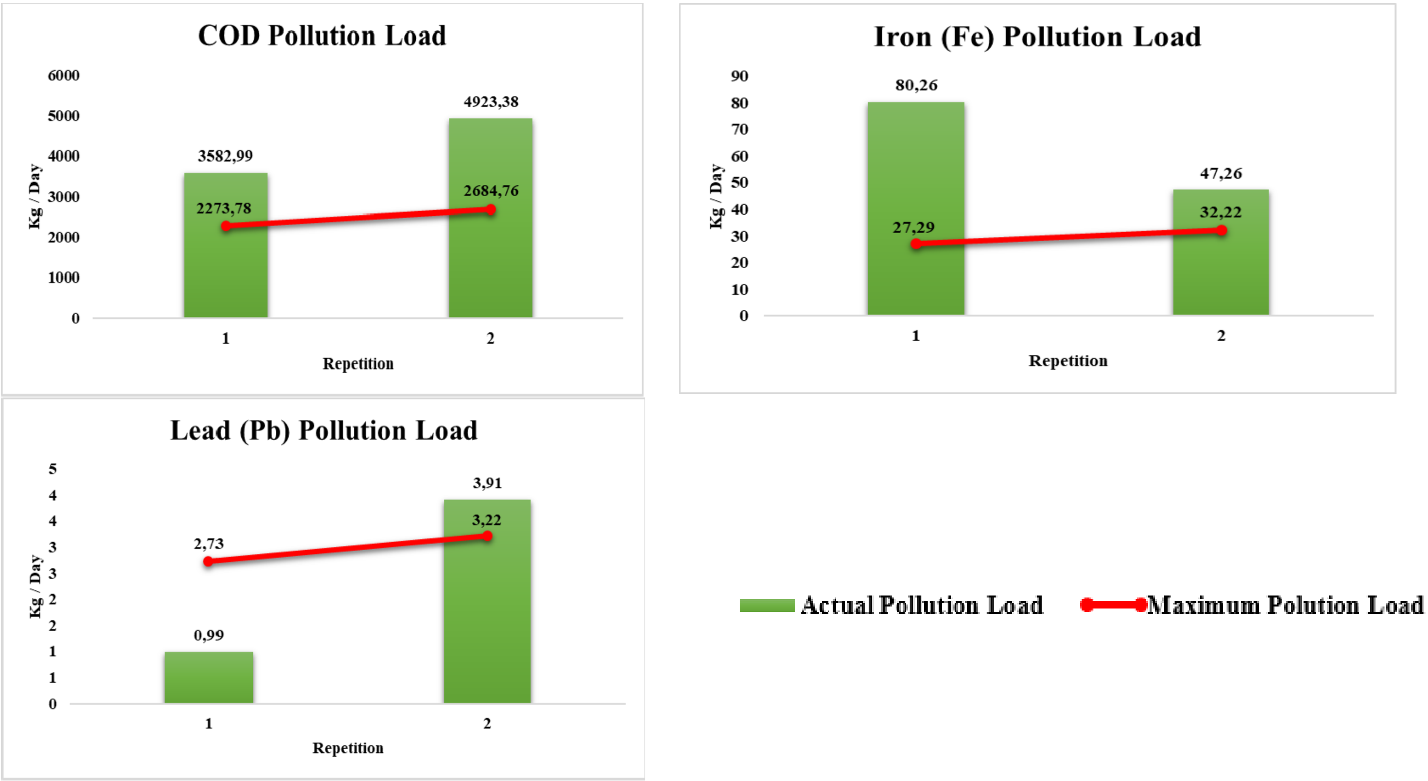


Figure 4. Pollution of Seketak River

Pollution Load

The pollution load of Seketak River was calculated by comparing the actual pollution load and the maximum pollution load. The results of the calculation show that in the first repetition, the variables nitrite, BOD, COD, and iron exceeded the maximum pollution load. Based on the second repetition, the variables of nitrite, BOD, COD, iron, and lead exceeded the maximum pollution load. Actual Pollution Load (APL) which exceeds the value of the Pollution Load (BPM) then the waters are considered polluted because it has exceeded the maximum acceptable limit for a body of water, making it difficult for the waters to be able to perform natural purification (self-purification). The calculation of pollution load can be reviewed in Figure 4.

Discussion

The results of the Pollution Index and Pollution Load analysis show that there is an influence of human activities on changes in the water quality of Seketak River. Industrial and livestock activities also show an influence on changes in water quality as shown in station 1 (pollutant source from industry) with the highest Pij value in repetition I and station 4 (pollutant source from livestock) with the highest Pij value in repetition II. This proves that the increase in river pollution is caused by activities in the upstream to downstream areas of the river. The value obtained shows that there is pressure or influence that causes river pollution, but the value obtained is still at a low level or does not directly have a significant impact on pollution. The values obtained also illustrate that the Dissolved Oxygen (DO), TSS, and pH variables are still at the threshold of river water quality standards. The variables that have a major influence on the decline in the quality status of Seketak River waters are BOD and COD. Based on the pollution load (BP) analysis, it shows that the variables of Nitrite, BOD, COD, lead, and iron at several stations exceed the Maximum Pollution Load (BPM). This can be seen in Figure 4 where in repetition I the variables of nitrite, BOD, COD, and iron exceeded the threshold, and in repetition II lead also showed that there was an increase. The highest pollution load is at stations 2 and 3, this is due to the location adjacent to residential areas and student boarding areas.

River discharge also has an influence on water quality. This is in line with the research of Suriadikusumah et al. (2021), which states that a fast flow rate can cause the ability of self-purification (natural purification) to decrease, increasing water pollution. Slow flow rates allow for more effective contact between substrates and microorganisms, while high flow rates reduce the interaction time between substrates and bacteria. As a result, there are still substrates that have not been fully washed away. The decline in water quality status is also suspected to be due to the increase in people living in the Seketak River area. An increase in the number of people is relevant to an increase in the volume of waste. However, based on data obtained from the Semarang City Communication, Information, Statistics, and Signage Agency, there is a decrease in the amount of waste volume that can be handled each year and a decrease in manageable waste in Semarang City from 2021 of 74.22% and decreasing to 72.1% in 2024 (Figure 5). So there is approximately 18% of community waste that cannot be managed. This is suspected to be the trigger for the community to dispose of waste in the water body due to waste services in Semarang City, causing a decrease in water quality in Seketak River. Research by Pramesti et al. (2020), stated that only 60-70% of waste can be transported to landfills. The assumption is that there is 40% of waste that cannot be accommodated in the landfill.

CONCLUSION

The status of water pollution of Seketak River, which was reviewed using the Pollution Index (PI) method, showed the presence of pollution with a Pij value of 2.36 - 2.91 (lightly polluted) in repetition I and repetition II of 2.80 - 3.25 (lightly polluted). The highest Pollution Index in repetition I was at station 1 (polluting source from industry) and station 4 (polluting source from livestock) in repetition II. Regarding pollution load. The pollution load of Seketak River shows that the variables of nitrite, BOD, COD, iron, and lead exceed the maximum pollution load (BP_M) at several observation stations. Industrial activities at Station 1, domestic waste from residential areas and student boarding houses, and livestock activities at Station 4 are the main sources that contribute to the high pollution load. The water condition is exacerbated by the uneven management of domestic and industrial waste and the limited capacity of waste services in Semarang City.

Therefore, there is a need for strategies in the form of technical and non-technical aspects to reduce pressure on aquatic ecosystems and restore water quality.

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