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Water quality of a tributary of siak river and reservoir in Pekanbaru City, Riau Province, Using the CCME-WQI

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ABSTRACT

This research was conducted on one of the Siak River tributaries that crosses the urban area in Pekanbaru, namely the Pengambang River. The Pengambang River flow is dammed to become a reservoir; one of its functions is as a source of raw drinking water. Increased activity along rivers and reservoirs certainly has an impact on water quality. This research aims to determine the water quality level of the Pengambang River and Buatan Reservoirs in Pekanbaru City, Riau Province. The research was carried out in May-October 2023. Water sampling was taken at 3 points each along the river flow and in the Reservoir. The physicochemical water quality parameters measured include temperature, TSS, BOD, COD, DO, pH, TP, Nitrate, and Total coliforms for rivers and reservoirs, while Chorofil-a only for reservoirs. Water quality was evaluated using CCME-WQI. The results of water quality evaluation according to CCME-WQI in the Pengambang River at all sampling stations could have been bad to marginal. At the same time, in the reservoir, it was marginal. The CCME-WQI Index value in rivers ranges 42.33 to 54.97, while in reservoirs, it is higher 49-56, it indicated water quality in reservoir better than river. Parameters influencing water quality in rivers and reservoirs, especially TC and BOD come from household waste cage fish cultivation.

Introduction

Water is essential to every biochemical process. Life would be impossible without water. Water availability is decreasing due to increasing population and decreasing availability of clean water due to pollution (Jyothi *et al.,* 2021). River and reservoir pollution is a problem of great concern because some people in Indonesia depend on rivers and reservoirs for their household water consumption (Damayanti *et al.,* 2021; Sutadian *et al.,* 2018). Furthermore, rapid urbanization, agriculture, and industrialization are factors in the deteriorating water quality of rivers and reservoirs (Nair *et al.,* 2015; Prasad *et al.,* 2019; Jing *et al.,* 2023; Akbar and Rahayu, 2023).

In Riau Province, the Siak River is the main river that crosses one of the densely populated urban areas, Pekanbaru City. The Siak River has 13 tributaries, one of which is the Pengambang River. The flow of the Pengambang River is dammed to become a water source for the Buatan Reservoir. Meanwhile, the water from the reservoir exits through the dam site into the middle section of the Pengambang River and then empties into the Siak River. The Buatan Reservoir is a source of drinking water, irrigation, fish cultivation, and recreation, while the Pengambang River functions for fish cultivation and transportation. Currently, the downstream part of the Pengambang River where it meets the Siak River is being developed as an ecotourism area. Increased activity around reservoirs and rivers threatens to reduce the water quality and become polluted. Polluted waters will threaten human health (Mukate *et al.,* 2019) and the life of aquatic biota (Sun *et al.,* 2021). To control river and reservoir water pollution, it is necessary to determine

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the water quality status by testing physicochemical water parameters called the water quality index (WQI). The water quality index has been defined in several ways. But to put it briefly, the water quality index is a type of average produced by adding a number that represents a set of variables and relating them to a standard scale (Dao et *al.,* 2020).

There are several ways to calculate WQI, including the CCME-WQI method (Canadian Council of Ministers of the Environment Water Quality Index). It is a method evolved by the British Columbia Ministry of Environment, Lands and Parks, and Environment (Cash & Wright 2001). The CCME WQI offers a simple mathematical structure for calculating the final index value, which aids in users' assessment of a water body's health (Gikas *et al.,* 2023). Another advantage of this method is sensitivity to specific poor parameters and independence from a given set of quality parameters (Damayanti *et al.,* 2022). Due to its many advantages, WQI has been implemented in freshwater inland numerous in Indonesian provinces and has garnered positive reviews. This method has been widely used in Indonesia to evaluate the water quality of rivers and reservoirs, as reported by Marselina *et al.,* (2022) on the Citarum River, Darmayanti *et al.,* (2021) in Cirarab River and several rivers in Jayapura City (Tanjung *et al.,* 2021). However, information about the quality status of Siak River tributaries and Buatan Reservoir in Pekanbaru City is still very limited. Several studies on water quality in Siak tributaries and artificial reservoirs are still limited to physical and chemical factors and have not looked at the level of pollution as reported by Sibagariang and Budijono (2021) on the Sail River; Cahyani *et al.,* (2024) in the Air Hitam River; and Mazidah *et al.,* (2013) in Buatan Reservoirs. Based on this, this research aims to evaluate the quality of one of the tributaries and reservoirs of the Siak River in Pekanbaru City.

Materials and Methods

Location and time of research

This research was carried out in one of the tributaries of the Siak River, namely the Pengambang River and Buatan Reservoir in Riau Province. Water sample analysis was carried out in the Laboratory of Ecology and Water Environmental Management, Faculty of Fisheries and Marine Affairs, Riau University. The Buatan Reservoir was built by damming several tributary streams, including the Pengambang River. Sampling was carried out by purposive sampling from May to October 2023 with one-month intervals at six stations consisting of three stations along the river (Code P) and three stations in the reservoir (Code R) (Figure 1).

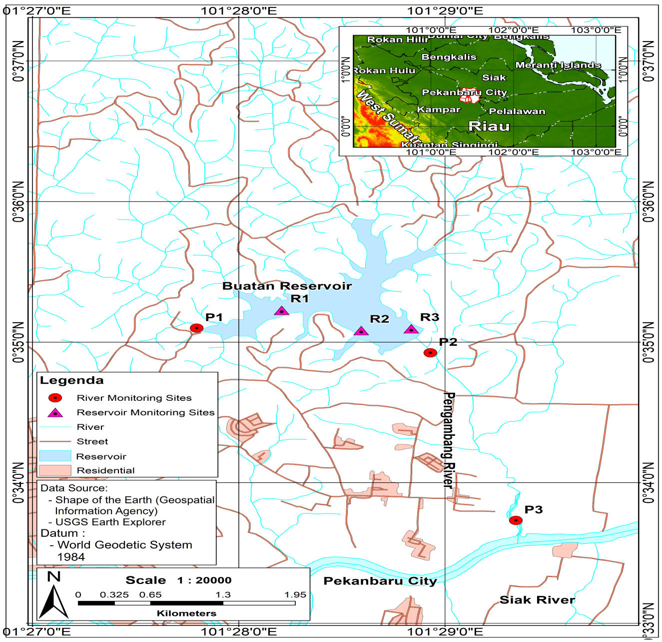

Figure 1. Study Location in Pengambang River and Buatan Reservoir in Pekanbaru City.

Sample collection

Water samples are collected using 2-liter water samples from the water's surface at each station. Water samples were placed in half-liter plastic bottles, then stored at temperature 4 ^{0}C (cool box) and transported to the laboratory for analysis. The physicochemical parameters measured consist of 12 parameters for river and reservoir namely temperature, dissolved oxygen (DO), pH, Total Suspended Solids (TSS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Phosphate (TP), and Total Coliform (TC). Nitrate (N) is only measured in rivers, while total nitrogen (TN) and chlorophyll-a are in reservoirs. (KepmenLHK 2021) (Table 1). In the laboratory, water samples are analyzed to determine the concentration of each parameter referring to APHA (2017).

Using WTW portable series equipment, the following parameters were measured in situ: pH, dissolved oxygen (DO), and water temperature (T). Using standard methods for surface waters (APHA 2017), water samples were analyzed in the lab to find the concentrations of TSS, COD, BOD, N, TN, TP, TC, and Chlorophyll-a.

Data analysis

The river and reservoir water quality index are evaluated with the acceptable limit for drinking water set by the standards of the Government Regulation of the Republic of Indonesia (GRRI), No. 22 of 2021, class II. Table 1 lists 12 water quality parameters used in rivers and reservoirs, along with the permitted limits.

Table 1. Parameters and permissible limits GRRI No. 22/2021.

No	Parameters	Permissible limit (Class II)	
		River	Reservoir
1	Temperature	Dev 3	Dev 3
2	TSS (mg/L)	50	50
3	pH	6-9	6-9
4	DO (mg/L)	4	4
5	BOD (mg/L)	3	3
6	COD (mg/L)	25	25
7	TP (mg/L)	1	0.03
8	TC (MPN/100 ml)	2000	5000
9	Nitrate (mg/L)	20	-
10	TN (mg/L)	-	0.75
11	Chlorofil-a (mg/m^3)	-	50

Evaluation of river and reservoir water quality using the CCME-WQI (CCME 2001). The British Columbia Ministry of Environment, Lands and Parks created the formula that serves as the foundation for the CCME Water Quality Index (1.0), which Alberta Environment then modified. Three components comprise the index: scope (F1), which measures the number of variables not meeting water quality objectives; frequency (F2), which measures how frequently these objectives are not met; and amplitude (F3), which measures the amount by which the objectives are not met

In order to calculate the WQI, the three factors F1, F2, and F3 are calculated as follows (CCME 2001):

- Assess the Scope (F1).

To calculate the scope element (F1) the following equation is used:

$$F1 = \left(\frac{Number\ of\ failed\ variables}{Total\ number\ of\ variables}\right) x\ 100 \qquad (1)$$

- Evaluate the Frequency (F2).

F2 (Frequency) is the percentage of tests that do not meet quality standards. The equation used to calculate F2 is as follows:

$$F2 = \left(\frac{Number\ of\ failed\ tests}{Total\ number\ of\ variables}\right) x\ 100 \qquad (2)$$

- Find the Amplitude (F3).

There are three processes involved in computing this: The following is how excursion is obtained: If the test value cannot exceed the quality standard:

$$Excursion_i = \left(\frac{failed\ test\ value_i}{Objectiv\ e_i}\right) - 1 \qquad (3)$$

If the test value cannot be less than the quality standard:

$$Excursion_i = \left(\frac{Objectiv\ e_i}{failed\ test\ value_i}\right) - 1 \qquad (4)$$

Equation is used to calculate NSE, or the normalized sum of excursion.

$$nse = \frac{(\sum_{i=1}^{n} excursion\ n_i)}{number\ of\ tests} \qquad (5)$$

After that, amplitude is calculated as follows:

$$F3 = \left(\frac{nse}{0.01nse + 0.01}\right) \qquad (6)$$

Tabel 2. Category of CCME-WQI (CCME 2001).

CCME-WQI	Category
0-44	Bad
45-64	Marginal
65-79	Fair
80-94	Good
95-100	Excellent

Results

The results of the physicochemical analysis of Pengambang River and Buatan Reservoir water quality are presented in Tables 3 and 4. During the sampling period, the mean temperature of the water along Pengambang River was relatively similar, from 28.83 ^{0}C to 29.33 ^{0}C. The highest temperature was recorded at location P1 and the lowest at P3 at the mouth of the river confluence with the Siak River. At all observation stations, the mean value of surface water temperature in the Buatan Reservoir was 28.33^{0}C at all station.

Table 4 shows the average values and standard deviations of physicochemical parameters in Buatan Reservoir. At all observation stations, the mean value of surface water temperature in the Buatan Reservoir was 28 ^{0}C. It indicated no significant difference in temperature in the Reservoir.

The average value of TSS in the river ranges from 19 to 61 mg/l. The highest TSS level of 61mg/l was recorded at Station P1 in the upstream part of river. The measured TSS is highest in the upstream part of the river (P1) and lowest in the river with an outlet from the dam. Meanwhile, TSS values in the reservoir are lower, 7.66 to 12.66 mg/l. The TSS values in these two waters still meet quality standards.

The dissolved oxygen on the surface of the water in the Pengambang River ranges from 2-5 mg/l, decreasing gradually from upstream to downstream. The highest DO value was recorded in the upstream part of the river (P1), while the lowest was at the river mouth (P3) with values of 5.2 mg/l and 2.1 mg/l respectively. Meanwhile, the mean oxygen content in the surface waters of the Buatan Reservoir is relatively similar between stations, ranging from 5.63-5.86 mg/l.

The BOD mean value in the river ranges from 9 to 13 mg/l and 3.6 to 3.8 mg/l in reservoir. The mean value of COD ranged from 20.66 to 39.33 mg/l in river and 13.66 to 18.66 mg/l in reservoir. In the reservoir, the highest COD concentration measured at station R3 was 18.66 mg/l.

Table 3. Mean and Deviation the water quality of the Pengambang River

Station	Temperature	TSS	DO	BOD	COD	pH	Nitrate	TP	T. Coliform
P1	29.33±0.57	61±58. 92	5.6±034	13.23 ± 4.20*	22.66 ± 8.73	7 7± 0	1.13 ± 1.19	0.15±0.15	16113.3 ± 13660.1*
P2	28 ± 1.00	19±14	4.05±0.25	9.36 ± 0.81*	20.66 ± 4.50	6 6± 0	0.78 ± 0.52	0.02 ± 0.01	16113.3 ± 13660.1*
P3	28.83 ± 0.28	32,33 ±2.56	2.82 ±0.29*	12.25 ± 1.27*	39.33 ± 9.30	76 ± 0	1.07 ± 1.23	0.12 ± 0.14	13667.6 ± 18479.54*

*= Parameters do not meet quality standards GRRI No. 22/2021.

Table 4. Mean and Deviation standard the water quality of the Buatan Reservoir

Station	Temperature	TSS	DO	BOD	COD	pH	TN	TP	Chla-a	T. Coliform
R1	28.33±1.52	7.66±3.21	5.86±0.30	3.83±0.30*	13.66±6.42	7±6.6	17±28.00*	0.07±0.03*	7.5±0.33	11333.33± 2081.66*
R2	28±1.73	10.33±1.52	5.76±0.40	3.76±0.35*	18.66±1.15	6±6.6	6±7.79*	0.07±0.03*	13.86 ±0.63	12000±1731 .05*
R3	28±1.73	12.66 ± 5.77	5.63±0.51	3.6±0.43*	15.66±0.57	7±6.6	5±6.06*	0.08±0.02*	16±0.63	28333.3±57 73.50*

*= Parameters do not meet quality standards GRRI No. 22/2021.

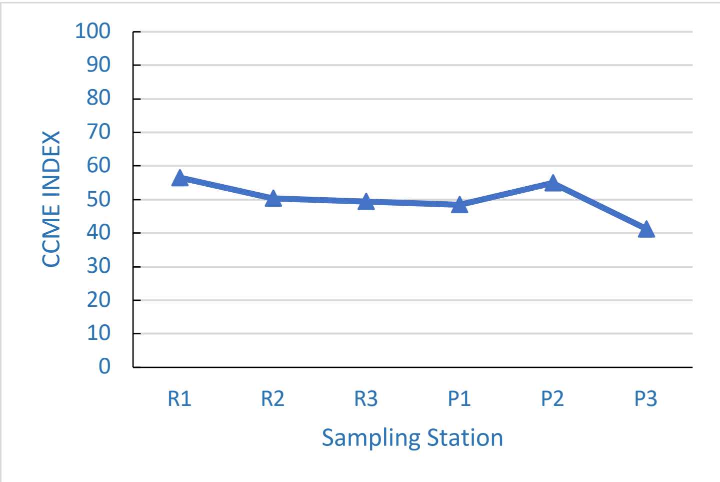

Figure 2. Value CCME-WQI in Buatan Reservoir (R) and Pengambang River (P).

The pH value in the Pengambang River and the Buatan Reservoir is not much different, ranging from 6 to 7. It is shown that the river category is natural. However, the pH value in the river is lower and acidic, especially at stations P2 and P3.

The mean values of the measured nitrate and TN in the river and reservoir are presented in Tables 3 and 4. Nitrate measured ranged 0.78-1.13 mg/l. Nitrate in the river at all stations (P1-P3) was below GRRI (20 mg/l). In reservoir, average value TN ranged from 5 to 17 mg/l. The concentration TN in stations R1-R3 exceeded quality standards (0.75 mg/l) with the maximum value at R3 (17 mg/L) and the minimum at R2 (0.5 mg/L).

The TP concentration in the river fluctuates; the highest levels were observed at stations P1 and P3 (0.15 and 0.12 mg/L), and the lowest were at station P2, namely 0.0 mg/l. In the reservoir, the P concentration is relatively the same at all observation stations, ranging from 0.07-0.08 mg/l).

TC levels are very high, ranging from 13000-16000 in rivers and 11000-28000 MPN/100 ml in reservoirs, which exceeds the quality standards set by GRRI, namely 2000 MPN/100 ml in rivers and 5000 MPN/100 ml in reservoirs.

Chlorophyll-a levels range from 7.5 to 16 mg/l in the reservoir. The highest chlorophyll-awas measured at station R3, where there was fish cage cultivation, and the lowest was at station R1 adjacent to tourism activities.

Water quality status of river and reservoir

Figure 2 shows the CCME index of the Pengambang Rivers and Buatan Reservoir in Pekanbaru city. The River CCME Index value ranges from 42.26 to 57.43 in the poor to marginal category. In the river observation section, the lowest water quality status is bad at station P3 downstream of the Pengambang River. In contrast, the water quality status is marginal in station P2 at the outlet of the dam site of the reservoir.

Figure 2 also shows the quality status of Buatan Reservoir. The water quality status of the reservoir is categorized as marginal in all sampling stations according to CCME-WQI with a value of 49.47 to 56.55. The highest index value recorded was 56.55 at station R3.

Discussion

Parameters of water quality can reflect changes in the ecological environment in river and lake basins, with natural conditions and human activities being the most significant factors influencing (Yang *et al.,* 2012). In general, the water quality of tributaries and reservoirs in the city of Pekanbaru is influenced by various human activities.

The average temperature values in the Pengambang River and Buatan Reservoir are relatively similar. The conditions of the two aquatic environments are similar, so it does not affect the water temperature. Surface water temperature fluctuates by location, elevation, time of day, air circulation, cloud cover, flow, and depth of the water body (Anh *et al.,* 2023). Temperature, in turn, affects chemical, biological, and physical processes in bodies of water, and that impacts the amount of many variable (Chapmans 1997).

The average value of TSS parameters in the Pengambang River has not passed the quality standard. Likewise, in reservoirs, TSS has not yet passed quality standards. However, the TSS value in rivers is higher than in reservoirs. This is because around the river, especially in the upstream part, there is open land so that soil particles are carried along with the flow of rainwater into the river, while around the reservoir it is more covered by forests and plantations. The primary sources of TSS are agricultural runoff, stormwater, road deicing, soil leaching, and soil contamination (Anh *et al.,* 2023). The rate of photosynthesis decreases as TSS increases (Panditt *et al.,* 2022).

Dissolved oxygen in the water column is an important factor for aquatic organisms. Thus, there is no significant difference in oxygen levels in reservoir between observation stations.

The dissolved oxygen content decreases towards the downstream of the Pengambang River. Stations P1 (in the upstream) and P3 (middle parts of the river), dissolved oxygen in water bodies still meets quality standards. In contrast, the station at the confluence with the Siak River (P3) no longer meets quality standards. This low value is because P3 is part of the river, which receives water flow from the Siak River when high tide occurs. At high tide, the Siak River water flows into the Pengambang River carrying organic pollutants. According to Yuliati *et al.,* (2021), when the Siak River is at high tide, the water enters the tributaries carrying several organic pollutants. Organic pollutants are broken down by bacteria using oxygen so that oxygen levels become low (Anh *et al.,* 2023). The low level of DO might be attributed to the large amount of organic pollutants from untreated wastewater discharge in urban regions. According to Custodio *et al.,* (2021), aerobic bacteria found in urban wastewater discharges from a variety of sources speed up the decomposition of organic materials and lower the water's oxygen level. In addition, the low oxygen in P3 is caused by higher TSS levels. High TSS concentrations reduce brightness levels and inhibit the photosynthesis process so that oxygen levels become low.

In contrast to Buatan Reservoir, the oxygen content meets quality standards at all observation stations (R1-R3). In this way, oxygen levels in the reservoir can support the life of aquatic organisms. This value shows that the dissolved oxygen content suits aquatic organisms. According to Chapman (1996); Anh *et al.,* 2023), the dissolved oxygen level that can support aquatic biota is 4-9 mg/l.

The pH values at the six stations (river and reservoir) range from 6 to 7. The pH in both of water are still within the natural pH range in waters. The natural range pH value in water ranges from 6 to 8.5 (Chapman 1996). The lower pH range of 5-6 was previously reported by Yuliati *et al.,* (2023), at other tributaries of the Siak River there are the Air Hitam River, Sibam Rivers, and Pengambang River Yuliati *et al.,* (2023).

The BOD concentration at all observation stations has exceeded the quality standard limit by GRRI, namely more than 3 mg/l, indicating that the waters have been contaminated with organic material. Similar to river, BOD in reservoir has has exceeded the quality standard limit. The highest average measured of BOD at Stations P1 and P3 shows the high level of organic material entering the river. Moreover, BOD in the present study unsuitable for aquatic organisms of 3-6 mg/L. The high level of biochemical oxygen demand in the water's is due to

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domestic waste and residential areas in and around the river (Panditt *et al.,* 2022). However, even though the BOD in the reservoir has exceeded the quality standards, the value is lower than in the river. A high BOD value indicates that the waters have been polluted by organic materials.

COD is the total quantity of oxygen needed to oxidize both inorganic and organic substances in water. The water contains a variety of organic materials that are not degraded by biological processes. In such situations, organic or inorganic matter reacts with oxygen and gradually oxidizes, converting it to oxides (Pimparkar *et al.,* 2023). COD concentration in the present study was higher in the river than reservoir. COD levels in the river have not exceeded the established standards except at station P3, which is the confluence with the main river flow of the Siak River. The concentration of COD in the river increases towards the downstream but in the reservoir is relatively similar at all observation stations. The COD value in the Pengambang River is not much different from other Siak tributaries that flow in the city of Pekanbaru such as the Sibam River and the Air Hitam River (Yuliati *et al.,* 2023). but it still did not exceed the quality standard. Thus, COD levels in rivers are higher than in reservoirs.

Nitrogen entering the waters is increasing due to various human activities, which are the primary source of wetlands pollution (Wang *et al.,* 2020). Nitrate values in the Pengambang River at all observation stations showed no significant differences, but TN levels in the Buatan Reservoir showed higher tiers, and there were fluctuations between stations. The high concentration of TN in Buatan Reservoirs is closely related to the characteristics of stagnant waters and activities around the reservoir.

A low nitrate Pengambang River due to River conditions and activities in basin. In Rivers, condition factors such as discharge and current affect nitrogen levels in river water bodies (Wang *et al.,* 2020). In addition, nitrogen concentration in water bodies is positively related to land use in the watershed. Land use for settlements, agriculture, and livestock has increased water nitrogen nutrients (Anh *et al.,* 2023). Nitrogen enrichment in freshwater has been linked to ecological problems causing harmful algal blooms, eutrophication, acidification, hypoxia, decreased fisheries production, and biodiversity (Swaney *et al.,* 2015).

The TP concentration in Buatan Reservoirs is lower than in Pengambang Rivers. However, the TP level in the reservoir has exceeded the quality standard set by PPRI at 0.3 mg/l; on the other hand, in the river, although the level is higher, it still meets the quality standard of 1 mg/l. Differences in catchment areas cause differences in TP concentration in the two water bodies. Yuliati *et al.,* (2022), reported that the Air Hitam River, one of the tributaries of the Siak River in Pekanbaru City, was polluted with phosphate from household waste and oil palm plantations. TP can enter water bodies from river erosion and agricultural, industrial, and residential activities. Agricultural activities related to the hydrological network affect phosphate concentrations in water bodies (Munishi *et al.,* 2022). High TP concentrations in water bodies risk changing ecosystems and disrupting water resources for household, industrial, and animal needs. Furthermore, TP concentrations in freshwater ecosystems exceeding 0.1 mg/l seriously impact the excessive growth of algae and aquatic plants due to the eutrophication phenomenon (Moss 2008). However, phosphate concentrations of more than 1.65 mg/l in waters due to leaching from agricultural fields cause eutrophication conditions (Munishi *et al.,* 2022).

The total coliform (TC) value in reservoirs and rivers in this study showed a very high value, indicating that coliform bacteria had polluted the waters. Water contaminated by bacteria is hazardous for drinking, bathing, swimming, etc. Coliform bacteria pollution in Pengambang Rivers and Buatan Reservoir originates from domestic waste and livestock waste around the basin area. According to Chinfak *et al.,* (2023), TC in aquatic environments can come from municipal wastewater discharges and septic leachate or non-point sources like agricultural and animal wastes (Divya & Solomon 2016). The presence of coliform bacteria causes a decrease in water quality, a common problem in various aquatic ecosystems, causing public health problems, so it is used as an indicator of water environmental pollution (Petculescu *et al.,* 2022).

Cholorofyl-a (Chl-a) is an important parameter that indicators the level of water fertility and algae growth (Boyer *et al.,* 2009). The Chl-a value in Buatan Reservoirs still does not exceed the quality standard set by GRRI (15 mg/l), so the fertility level is categorized as low. Numerous investigations have shown an appropriate upper limit of 3–15 µg/L for sestonic Chla concentration, with an ecologically suitable limit of 5 µg/L for sestonic Chl-a in rivers (Kim *et al.,* 2021). Chl-a in Buatan Reservoirs was observed to be high in R3, associated with high TP levels. According to Alizamir et *al.,* (2021), Chl-a is significantly related to the concentration of

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phosphate in water. However (Mungenge *et al.,* 2023), stated that Chl-a positively correlated with temperature, dissolved oxygen, pH and ammonium.

Water quality status of river and reservoir

In the river observation section, the lowest water quality status is bad at station P3 downstream of the Pengambang River. In contrast, the water quality status is marginal in station P2 at the outlet of the dam site of the reservoir. Overall, the data shows that the sampling points in the river have been polluted, especially by the Total Coliform and BOD. Both parameters no longer meet the quality standards set by GRRI. The data also shows that the Total Coliform concentration level is very high at all river stations. One of the primary sources of Coliform bacteria is untreated waste from septic tanks. On the banks of the Pengambang River, there are residential areas where sewage flows directly into the river without treatment. It is very likely that if waste disposal occurs, if it is released into the river without proper treatment, the Coli content in the water will increase (Jyothi *et al.,* 2021).

Station P3, the downstream part of the river that confluences the Siak River has the lowest index value with a bad category. Water quality is nearly always in jeopardy or compromised; conditions are typically not at optimal or natural levels. The data shows that the BOD and COD parameters have levels that exceed the established quality standards. Apart from that, it can also be seen from the DO value in the water column that it is also low and does not meet the quality standards set by GRRI. Station P3 is located downstream of the Pengambang River, where it meets the Siak River. Because tides influence the Siak River, water enters the Pengambang River when high tide occurs. In these conditions, organic materials and other pollutants from the Siak River will likely be carried into the Pengambang River. As is known, the Siak River, as the main river in Pekanbaru City, has been polluted by organic materials from domestic and industrial waste activities (Yuliati *et al.,* 2017). However, this is only a hypothesis that can be genuinely verified through careful and in-depth study of more water samples taken from various points at the mouth of the Pengambang River at high and low tide.

The quality status in Buatan Reservoir is shown in Figure 2. The water quality status of the reservoir is categorized as marginal in all sampling station according to CCME-WQI with a value of 49.47 to 56.55. During study, BOD, DO, and total coliform no longer meets quality standards for drinking water by GRRI 2021. Conditions frequently deviate from ideal or natural levels, endangering or impairing the quality of the water. The data shows that the CCME index value at station R3 is the lowest (49.47). Thus, station R3 is more polluted than R1 and R2. This difference in quality can be explained by the very high value of the Total coliform and BOD parameter measured. Station S3 is a part of the reservoir adjacent to residential areas and floating net cage activities. Household waste discharged into water is a source of total coliforms and organic material in water. Meanwhile, cultivating fish in cages is a source of water's organic material. According to da Silva (2021), Fish farming activities in reservoirs raise concerns about the release of large amounts of organic matter from fish feces and inedible feed. Furthermore, Varol (2019), also reported that wastes from fish farm can cause an increase organic matter.

Conclusion

The water quality of the Pengambang River is categorized as poor to marginal, while the water quality status of the Buatan Reservoir is classified as marginal at all sampling stations. Pollution in rivers and reservoirs is mainly caused by domestic waste and cage cultivation, characterized by high concentrations of Total Coliform and organic matter in the water column and exceeds quality standards. For this reason, domestic waste needs to be processed before it is discharged into water bodies.

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