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Study on Water Quality of Some Tributaries in Palembang City

Kajian Kualitas Air pada Beberapa Anak Sungai di Kota Palembang

Heni Kurniawati[*)]

Environmental Agency of Palembang City Government, Palembang 30152, South Sumatra, Indonesia
[*)]Corresponding author: henidani@yahoo.com

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ABSTRAK

Hasil pemantauan kualitas air sungai Sekanak, Sungai Bendung dan Sungai Ogan pada beberapa titik telah melebihi baku mutu mengacu pada Baku Mutu Air Kelas II, sesuai Peraturan Pemerintah Republik Indonesia Nomor 22 tahun 2021. Untuk mengetahui tingkat pencemaran air dan kondisi kualitas air sungai tersebut perlu dilakukan perhitungan status mutu dan indek kualitas air. Tujuan dari penelitian adalah untuk mengevaluasi status kualitas air dan indeks kualitas air Sungai Sekanak, Sungai Bendung dan Sungai Ogan. Perhitungan status mutu air menggunakan metode Indeks Pencemaran Nemerrow Sumitomo dengan parameter pH, DO, BOD, COD, TSS, Nitrat, Phosfat, dan Fecal Coli dan perhitungan indeks kualitas air sesuai dengan Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomor 27 tahun 2021. Dari data konsentrasi BOD dan COD tertinggi di Sungai Sekanak kondisi surut dengan nilai 9,51 mg/l sedangkan COD 41,36 mg/l. Hasil perhitungan nilai indeks pencemar pada rentang 0,75 sampai 2,47 dengan status memenuhi hingga cemar ringan. Status mutu air sungai Sekanak dan Sungai Bendung tahun 2020 – 2022 adalah cemar ringan sedangkan status mutu air Sungai Ogan terdapat status mutu air memenuhi hingga cemar ringan. Nilai Indeks Kualitas Air tahun 2020 – 2022 di lokasi Sungai Sekanak dan Sungai Bendung adalah pada katagori sedang, untuk lokasi Sungai Ogan tahun 2021 Indeks kualitas air katagori baik dan tahun 2022 katagori sedang. Hasil Analisa statistik terdapat hubungan antara konsentrasi BOD dan COD dan parameter yang paling berpengaruh terhadap indeks pencemaran di Sungai Sekanak dan Bendung adalah Phospate dan di Sungai Ogan adalah BOD.

Kata kunci: kualitas air sungai, status sungai, indeks pencemar

ABSTRACT

The results of monitoring the water quality of Sekanak, Bendung, and Ogan river at some point have exceeded the quality standards referring Class II Water Quality Standards in accordance with Government Regulation of Indonesian Republic Number 22 of 2021. To find out the level of water pollution and water quality in the river, it is necessary to calculate the water status and water quality indeks. The purpose of study was to evaluate the water quality status and water quality index of the Sekanak, Bendung and Ogan Rivers. Calculation of water quality status used the Nemerow and Sumitomo Pollution Index method with parameters pH, DO, BOD, COD, TSS, Nitrate, Phosphate, and Fecal Coli and calculation of water quality index in accordance with the Regulation of the Ministry of Environment and Forestry of the Indonesian Republic Number 27 of 2021. The highest

concentration of BOD and COD were in Sekanak river at low tide with a value of 9.51 mg/l and 41.36 mg/l. The pollution index was in the range of 0.75 to 2.47 with a meeting quality standars status up to mildly pollutants. Water quality indexs at Sekanak, Bendung and Ogan river in 2020 - 2022 were in the moderate category, except at Ogan river in 2021 was in a good category. From statistical analysis there were correlation between BOD and COD at the Sekanak, Bendung and Ogan River and the most significant parameters on the pollution index for Sekanak and Bendung River were Phosphate and for Ogan River was BOD.

Keywords: river water quality, river status, pollution index

INTRODUCTION

Rivers in Palembang City have several benefits for the community, namely functioning as water resources for drinking water, transporting facilities, and water resources for industrial processes or other activities. The main river in Palembang City is Musi River across Palembang City with a length of 36.04 km which is the estuary of several tributaries such as Sekanak, Bendung and Ogan river. Functioning as a water resourced, several PDAM intakes are in Musi River, Keramasan and Ogan river. The results of monitoring the quality of rivers and tributaries carried out by the Environmental Agency of Palembang City government for Sekanak, Bendung and Ogan river showed that several polluting parameters already exceeded the quality standards of BOD, COD parameters and some metal parameters. Those measured parameters refer to the Class 2 River Water Quality Standards in accordance with Government Regulation of Indonesian republic Number 22 of 2021. The increased levels of water pollutants can be partly caused by human activities such as industrial waste or domestic waste (Amneera, 2013; Hendriarianti et al., 2017; Martinus et al., 2018). The increase in population (Sharma, 2020; Harefa et al., 2021; Said & Azmiyati, 2022), industries or other activities will increase the production of waste on the banks of rivers which can cause a decrease in water quality (Elvania et al., 2019; Edward, 2021; Pongoh et al., 2021; Rahmatillah et al., 2021; Karolina et al., 2022) because the population increase will increase the amount of domestic wastewater (Gazali et al., 2017) and potentially bring about the river to be a receiving water body.

The increase in human activities if balanced with high awareness of river preservation creates the condition of river water quality to be relatively good. In contrast, the river water quality will be poor if there is no community awareness (Mailisa et al., 2021). One of the most serious environmental problems is the degradation of water quality because it can affect the quality of health, economy and biotic communities, so for the ecological sustainability of water resources, economic value and human health needs to control the level of water pollution (Bhutiani, 2018; Sharma, 2020). Finding out the level of water pollution can be done through the calculation of the pollution index (PI) (Al-Othman, 2019; Elvania et al., 2019), which is the number used to determine the level of pollution relative to the permissible water quality parameters that its measurement is based on a method in accordance with the Regulation of the Ministry of Environment and Forestry number 27 of 2021 (Minister of Environment and Forestry of The Republic of Indonesia, 2021), is further used to calculate the water quality index (Hossain et al., 2013) to be useful for assessing the suitability of river water for its use such as household activities, farming, or cultivation (Naubi, 2016). The water quality index also can be used as a basis in policies for pollution control (Zhang, 2017). The calculation of the Pollution index was carried out by monitoring the river water for the parameters of pH, DO, BOD, COD,

TSS, Nitrate, Phosphate, and Fecal Coli. The data was derived from the monitoring results of the Office of Environment of Palembang City in 2020-2022. The results of measurements and calculations showed that the quality status of each location was in a good category, mildly polluted, moderately polluted, and heavily polluted.

The calculation of Pollution index on Sekanak, Bendung and Ogan river needs to be carried out to evaluate and analyze the source of pollutants that will enter the Musi River as an estuary of a tributary. This is because the upstream pollutants will flow along the flow of the river to the downstream of the river estuaries (Fahimah et al., 2020). The purpose of this study was to evaluate the water quality status and water quality index of the Sekanak, Bendung and Ogan Rivers.

MATERIALS AND METHODS

Sampling Location on High Tide and Low Tide

The river water monitoring was carried out on the Tributaries of Sekanak, Bendung, and Ogan three times a year, each at high tide and low tide in sampling locations as showed in Table 1.

Sampling Method

The sampling was carried out by instantaneous means (grab sampling method) and the analysis was conducted through field measurements and the laboratory analysis was carried out at the Laboratory of the Environmental Agency (Table 2).

Table 1. Sampling point

Sampling Point	Coordinate Points	
	S	E
Sekanak River Estuary	-2.994630556	104.7574139
Sekanak River of Bridge on Jl. Radial	-2.980555556	104.7473056
Sekanak River Near Provincial DLHP Office	-2398022222	104.7413611
Bendung River Estuary	-2.984972222	104.7694444
Bendung River Near 13 Ilir Bridge	-2.970322222	104.7613861
Bendung River Near PLN Sekip	-2.963069444	104.7594444
Bendung River opposite PT. ASKES	-2.952027778	104.7591389
Ogan River Estuary	-3.01325	104.7504361
Ogan River opposite PT. PAN	-3.022963889	104.7658889
Ogan River Under Bridge	-3.016505556	104.7528389

Table 2. Analysis methods

Parameters	Test Methods
pH	SNI 06-6989.11-2004
DO	ELEKTROKIMIA
TSS	SNI 06-6989.3-2004
COD	SNI 6989.2-2009
BOD_5	SNI 6989.72-2009
Nitrat	SPEKTROFOTOMETRI
Phosfat	SNI 06-6989.9-2004
Fecal Coli	SNI 01-2897-1992

Data Analysis

The data of the laboratory analysis result were used to calculate the Pollution Index carried out in accordance with the Regulation of the Ministry of Environment and Forestry of the Republic of Indonesia with 8 (eight) parameters, namely pH, DO, BOD, COD, TSS, Nitrate, Phosphate, and Fecal Coli using the method of Nemerrow Sumitomo Pollution Index (PI) in order to find out the level of pollution relative to the permissible water quality:

$$PIj = \sqrt{\frac{(C_i/L_{ij})_M^2 + (C_i/L_{ij})_R^2}{2}}$$

PI Nemerrow & Sumitomo

where

L_{ij} : Standard Concentration of Water Allotment (j)

C_i : Sample concentration of water quality parameters (i)

PI_j : Pollution for designation (j)

PI_J : $(C_i/L_{ij}, C_2/L_{2j}, \ldots)$

(C_i/L_{ij}) Maximum: Maximum value of C_i/L_{ij}

(C_i/L_{ij}) Average: Average value of C ij/L_{ij}

The calculation results showed that the Quality Status of each monitoring location under the condition of $0 \leq PI_j \leq 1.0$ good (meeting quality standards); $1.0 \leq PI_j \leq 5.0$ mildly polluted; $5.0 \leq PI_j \leq 10.0$ moderately polluted; $PI_j \geq 10.0$ heavily polluted, which were then used to calculate the Water Quality Index by calculating the number of each quality status (good, mildly polluted, moderately polluted, and heavily polluted) for each site-wide monitoring data and calculating the percentage of the number of each quality status to the total number of monitoring locations and further transforming the Pollution index (PI) value into the Water Quality Index (WQI) by multiplying the weight of the index value by the percentage of quality status, with the index weighting as follows: meeting quality standards = 70; mildly polluted = 50; moderately polluted = 30; heavily polluted = 10. The WQI value was obtained by summing the result of the multiplication of the percentage of the quality status by its weight, Excellent ($90 \leq x \leq 100$); Good ($70 \leq x < 90$); Medium ($50 \leq x < 70$); Poor ($25 \leq x < 50$); Very poor ($0 \leq x < 25$).

Statistical Analysis

Statistical analysis were used linier regression and multiple linier regression. For BOD and COD correlation was used linier regression and to find out the most effective parameters on the pollution index, multiple linear regression data analysis methods were used by using Microsoft Excel. The initial stage was to do a T-test first on each independent variable (pH, BOD, COD, DO, TSS, Phosphate, E. Coli, Nitrate) on the dependent variable (PI) . Then, the p value of each variable was compared with the value of α to see whether the null hypothesis (H0) was accepted or not. For all independent variables that have a significant effect on the dependent variable, they were included in the feasibility test of the regression equation model simultaneously. If the results of the partial test show that the independent variables were not significant in the model, then these variables could be excluded from the model one by one based on the highest p value until a model with a significant variable (p value < α) was obtained.

RESULT AND DISCUSSION

Water Quality Analysis of Sekanak, Bendung, and Ogan River

The results of the water quality analysis of Sekanak, Bendung, and Ogan River from 2020 to 2022 showed that the parameters of BOD, COD, TSS, and Phosphate already exceeded class II quality standards in accordance with the Government Regulations Number 22 of 2021. At the low tide, the highest of BOD and COD values was in Sekanak River at the location of monitoring point of the bridge at Jl. Radial in 2021, for BOD a value of 9.51 mg/l with a quality standard of 3 mg/l, while the COD

was 41.36 mg/l, the quality standard was 25 mg/l as which Table 3, the highest TSS (*Total Suspended Solid*) value was 127 mg/l in Bendung River on period III, 2020 at a location near PLN (State Electricity Company) Sekip , the quality standard was 50 mg/l as which Table 4 and for the highest phosphate value was in the Ogan River at the location monitoring under the bridge in period III, 2020 with a value of 1,02 mg/l as which Table 5.

At the high tide the highest of BOD and COD value was 7,27 mg/l and 32,04 mg/l at Sekanak River in 2021 as which Table 6, for the TSS (*Total Suspended Solid*) parameters the highest value was in Bendung river with a concentration of 149 mg/l in 2020 at a location near PLN (State Electricity Company) Sekip as which Table 7 and for the phosphate parameter the highest concentration was found in the Ogan River under the bridge in 2020 with a value of 1,431 mg/l as which Table 8. The high levels of BOD indicate a reduction in dissolved oxygen due to the decomposition of organic pollutants going through biochemical processes requires oxygen (Hendriarianti et al., 2017). The existence of these organic pollutants causes an increase in the parameters of BOD and COD pollutants that were likely from the activities around the riverside locations such as settlements, restaurants, hotels and traditional markets. The high concentrations of TSS in water could cause water turbidity, decreased photosynthesis rate due to obstruction of sunlight resulting in disruption of food supply of biota in the waters (Jantama & Ondara, 2017).

Table 3. Water quality analysis of sekanak river during low tide

Location	Year	Period	pH*	BOD5*	COD*	TSS*	DO*	Nitrate	Phosphate	E Coliform
			-	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Total/100 ml
Estuary	2020	1	6.2	3.56	17.81	18	5.9	0.8	0.4	28
2.994630556S		2	6.1	3.53	17.65	11	6.01	0.6	0.227	23
104.7574139E		3	5.4	3.19	15.95	29.4	6.24	0.6	0.12	38
	2021	1	6.3	4.77	23.84	16	6.11	1.2	0.059	64
		2	5.9	4.32	21.58	24	6.17	1.5	0.034	93
		3	6	4.18	20.94	25	6.25	1.4	0.031	74
	2022	1	6.4	4.02	20.11	21	6.61	0.8	0.033	43
		2	5.5	4.34	21.69	26	6.22	0.8	0.035	93
		3	6.3	4.75	23.75	5	6.25	0.6	0.036	93
Sekanak river	2020	1	6.2	3.94	17.93	14	5.7	1	0.34	20
Radial St.		2	6.3	4.04	18.37	16	6,11	1,0	0,293	74
Bridge		3	5.6	3.68	17.56	33.6	6.14	0.8	0.152	43
2.980555556S	2021	1	6.3	9.51	41.36	20	6.01	0.8	0.044	120
104.7473056E		2	6.7	5.97	27.14	25	6.08	1	0.03	120
		3	6.7	5.53	26.37	27	6.2	1	0.04	74
	2022	1	6.4	5.01	23.89	24	6.53	0.7	0.029	74
		2	6.1	4.94	23.54	24	6.31	0.6	0.043	120
		3	6.2	5.38	25.64	2.6	6.2	0.5	0.044	150
DLHP	2020	1	5.3	2.03	10.15	7	6.2	0.7	0.21	38
Province,		2	6.1	4.12	18.74	11	5.66	0.6	0.329	74
2398022222S		3	5.8	3.57	17.01	3	6.05	0.5	0.218	74
104.7413611E										
	2021	1	6.1	6.92	30.11	13	6.03	0.7	0.058	93
		2	6.6	6.7	30.48	30	5.93	1	0.028	160
		3	6.8	5.34	25.42	28	6.16	0.9	0.034	64
	2022	1	6.2	5.4	25.76	21	6.21	0.5	0.031	120
		2	6.2	5.18	24.67	21	6.18	0.6	0.058	120
		3	6.4	5.34	25.46	38.6	6.2	0.4	0.055	120
Quality Standard (Class II)			6 – 9	3	25	50	4	10	0,2	1000

Table 4. Water quality analysis of bendung river during low tide

Location	Year	Period	pH*	BOD5 *	COD*	TSS*	DO*	Nitrate	Phosphate	E Coliform
			-	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Total/100 ml
Estuary	2020	1	5.1	3.47	17.38	18	6	0.7	0.39	15
2.984972222S		2	6.1	3.68	18.42	21	6.14	0.6	0.209	64
104.7694444E		3	5.5	2.85	14.27	24.2	6.28	1.4	0.148	36
	2021	1	5.4	4.15	20.76	21	6.24	1	0.102	74
		2	5.2	4.17	20.86	21	6.24	1.1	0.044	74
		3	4.8	3.7	18.49	27	6.5	1.1	0.031	93
	2022	1	6.9	3.64	18.19	23	6.35	1.3	0.097	64
		2	5.8	4.06	20.31	15	6.37	0.9	0.053	43
		3	5.8	4.3	21.48	15.8	6.39	1.2	0.055	64
Near 13 Ilir	2020	1	5.5	3.68	16.73	20	5.7	0.8	0.34	11
Bridge		2	6.4	5.36	24.37	19	6.04	0.5	0.273	64
2.970322222S		3	5.5	3.32	15.79	15.4	6.25	1.2	0.082	64
104.7613861E	2021	1	5.3	6.94	30.21	11	6.18	1.2	0.062	74
		2	5.2	5.23	23.75	28	6.15	1.3	0.03	93
		3	5.9	4.01	19.08	23	6.35	1.3	0.038	93
	2022	1	5.7	3.58	17.08	29	6.48	2.5	0.055	93
		2	6	4.75	22.64	23	6.35	1.8	0.055	38
		3	6.1	4.86	23.17	25.6	6.4	0.9	0.057	120
Near PLN of	2020	1	6	4.27	19.45	17	5.6	1.1	0.3	38
Sekip		2	6.2	5.68	25.81	18	6.15	0.8	0.269	74
2.963069444		3	5.9	3.8	18.11	127	6.13	1.4	0.175	64
S	2021	1	5.2	7.47	32.48	24	6.17	1.2	0.1	64
104.7594444		2	7	5.74	26.11	20	6.13	1.2	0.029	93
E		3	6.9	3.8	18.11	28	6.18	1.4	0.044	74
	2022	1	6	3.76	17.91	20	6.31	1.2	0.106	74
		2	6.7	4.59	21.85	27	6.31	1	0.057	74
		3	6.1	5.02	23.95	37.3	6.38	1.5	0.058	93
Opposite PT.	2020	1	5.9	3.73	16.98	15	5.4	0.7	0.33	29
ASKES PTC		2	7.3	4.76	21.64	6	6.11	0.6	0.133	64
2.952027778		3	6	4.34	20.67	17.2	5.98	1.2	0.087	43
S	2021	1	5.7	7.3	31.73	13	6.2	1.4	0.101	43
104.7591389		2	6.9	5.35	24.33	19	6.12	1.5	0.028	120
E		3	6.7	4.06	19.37	29	6.25	1.5	0.039	64
	2022	1	6.7	4.2	20.01	21	6.28	1.5	0.098	120
		2	6.7	5	23.79	18	6.29	1.3	0.053	64
		3	6.1	4.78	22.78	2.6	6.36	1.2	0.052	93
Quality Standard (Class II)			6 – 9	3	25	50	4	10	0,2	1000

For the phosphate parameter, the sources of phosphate waste possibly come from domestic activities such as the use of detergents, fertilizer farming activities or other industrial activities (Muliawan et al., 2022).

Pollution Index (PI) and Water Quality Status at Sekanak, Bendung and Ogan River

From the results of the water quality analysis, the value of pollution index and the status of water quality were obtained from the pollution index data in the range of 0.75 to 2.47 with a meeting status up to mild pollutants as which Table 9.

Water Quality Index at Sekanak, Bendung and Ogan River

From the results of laboratory analysis, the calculation of the Pollution index as which Table. 9 was carried out to find out the status of water quality. The water quality status of Sekanak and Bendung River at all points were in a mildly polluted condition, while on the Ogan Stream there were monitoring points with water quality status meeting the allocation of class 2

water in 2020 and 2021. In 2022 at low tide it was in a mildly polluted status and when the tide of the quality status meet quality standard, the change in status indicated an increase in the content of pollutants in the stream water caused by an increase in some polluting parameters such as BOD and COD at low tide. These data showed that the conditions in the downstream (estuary) levels of polluting parameters tended to increase. This probably occurred because the flow caused an increase in concentration in the downstream rivers. The potential sources of pollutants in the watershed apart from the domestic waste, restaurant and hospitality settlements could also result from the activities of household industry and other activity industries.

For the value of Water Quality Index of the Sekanak and Bendung river on 2020-2022 the WQI was in the moderate category, in the range of 50-60, while for the Ogan River in 2021 was in a good category with a value of 70 as which Table 10. This index value depicts the condition of water quality which was a composite value of water quality parameters in one area at a certain time whose calculation was in accordance with the Regulation of the Ministry of Environment and Forestry Number 27 of 2021.

Table 5. Water quality of ogan river during low tide

Location	Year	Period	pH*	BOD5*	COD*	TSS*	DO*	Nitrate	Phosphate	E Coliform
			-	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Total/100 ml
Estuary 3.01325 S 104.7504361 E	2020	1	5.7	2.4	12.04	10	6	0.7	0.19	9
		2	6.1	1.97	9.832	14	6.18	0.6	0.226	11
		3	5.3	2.15	10.76	42.5	6.28	0.7	0.14	27
	2021	1	6.1	4.03	20.17	10	6.2	1	0.05	27
		2	5.6	3.4	16.99	21	6.15	1.3	0.032	64
		3	5.9	2.94	14.68	20	6.45	1.1	0.039	64
	2022	1	6	2.81	14.05	23	6.69	1.2	0.045	64
		2	5.6	3.4	17.01	17	6.35	1.2	0.035	35
		3	5.8	3.42	17.09	30.8	6.37	1.2	0.033	120
Opposite PT. PAN 3.022963889 S, 104.7658889E	2020	1	5.6	2.45	12.27	23	6	0.8	0.19	9
		2	6.3	1.99	9.941	16	6.28	0.7	0.225	20
		3	5.4	2.16	1.83	15.4	6.3	0.5	0.126	35
	2021	1	6.7	4.01	20.05	13	6.17	1.1	0.057	27
		2	5.4	3.35	16.75	19	6.11	1.3	0.035	120
		3	6	3.06	15.28	23	6.24	0.8	0.052	36
	2022	1	5.4	2.8	14.01	21	6.68	1.1	0.037	43
		2	6.2	3.47	17.37	23	6.37	1.2	0.031	64
		3	5.7	3.55	17.78	3.5	6.4	1.1	0.033	93
Under Bridge 3.016505556S 104.7528389 E	2020	1	5.1	2.05	10.28	18	6.1	0.8	0.17	11
		2	6.2	1.84	9.214	13	6.21	0.7	0.311	9
		3	5.3	2.01	10.05	24	6.31	0.6	1.02	14
	2021	1	6.2	3.53	17.66	17	6.21	0.8	0.042	21
		2	5.7	3.35	16.76	19	6.09	1.1	0.032	74
		3	5.8	3.05	15.28	24	6.38	1	0.048	43
	2022	1	5.8	2.97	14.85	20	6.79	1.3	0.044	64
		2	6	3.49	17.45	26	6.38	0.9	0.029	38
		3	5.7	3.27	16.38	33	6.41	0.8	0.03	93
Quality Standard (Class II)			6 – 9	3	25	50	4	10	0,2	1000

Table 6. Water quality analysis of sekanak river during high tide

Location	Year	Period	pH*	BOD5*	COD*	TSS*	DO*	Nitrate	Phosphate	E Coliform
			-	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Total/100 ml
Estuary	2020	1	6	3.07	15.37	13	6	0.5	0.42	20
2.994630556S		2	6.5	3.45	17.28	9	6.03	0,4	0.112	20
104.7574139E		3	5.5	2.88	14.39	9.2	6.43	0.5	0.164	29
	2021	1	6.5	4.2	21.01	15	6.24	1	0.032	36
		2	5.9	4.01	20.01	10	6.24	1.2	0.033	74
		3	6	3.95	19.78	11	6.28	1.2	0.038	43
	2022	1	6.5	3.89	19.46	11	6.72	1.2	0.028	93
		2	5.8	4.07	20.38	10	6.24	1	0.031	64
		3	6.5	4.12	20.63	3.8	6.28	1.4	0.033	93
Sekanak river	2020	1	5.9	3.54	16.11	10	5.9	0.8	0.33	27
Radial St. Bridge		2	6.2	4.17	18.96	8	6.13	0.6	0.306	43
2.980555556S 104.7473056E		3	5.6	3.34	15.94	5	6.18	0.7	0.185	35
	2021	1	6.2	7.37	32.04	12	6.13	0.6	0.041	64
		2	6.8	5.72	25.98	19	6.15	0.8	0.029	93
		3	6.8	5.06	24.11	13	6.24	0.8	0.033	43
	2022	1	6.5	4.85	23.13	9	6.58	1	0.027	43
		2	6.2	4.51	21.48	9	6.32	0.8	0.029	93
		3	6.8	4.64	22.11	15.8	6.3	0.9	0.028	120
DLHP	2020	1	7.1	3.47	15.78	14	5.7	0.4	0.19	28
Province,		2	6.1	4.03	18.34	5	5.87	0.5	0.307	64
2398022222S 104.7413611E		3	5.9	3.41	16.25	43.8	6.17	0.4	0.226	43
	2021	1	6.2	6.38	27.6	20	6.08	0.5	0.052	93
		2	6.7	6.16	28.01	20	6.11	0.6	0.026	93
		3	6.9	5.01	23.86	14	6.21	0.6	0.032	43
	2022	1	6.3	4.94	23.54	12	6.38	1	0.028	43
		2	6.5	4.27	20.33	10	6.2	0.8	0.055	93
		3	6.5	4.76	22.7	5.8	6.25	0.6	0.052	160
Quality Standard (Class II)			6 – 9	3	25	50	4	10	0,2	1000

Table 7. Water quality analysis of bendung river during high tide

Location	Year	Period	pH*	BOD5*	COD*	TSS*	DO*	Nitrate	Phosphate	E Coliform
			-	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Total/100 ml
Estuary	2020	1	5.2	3.03	15.19	11	6	0.5	0.37	11
2.984972222S		2	6.8	3.53	17.65	9	6.32	0.4	0.181	43
104.7694444E		3	5.7	2.56	12.81	62	6.4	1.2	0.209	27
	2021	1	5.6	3.6	18.79	20	6.27	1	0.052	36
		2	5.3	3.87	19.38	16	6.37	1	0.042	43
		3	4.9	3.45	17.28	20	6.52	1.2	0.029	43
	2022	1	7	3.67	18.37	17	6.38	1.2	0.047	64
		2	5.9	3.73	18.64	11	6.36	1.4	0.048	38
		3	5.8	3.95	19.76	10	6.42	1.5	0.045	64
Near 13 Ilir	2020	1	5.7	3.48	15.83	8	5.8	0.6	0.32	14
Bridge		2	6.5	4.71	21.42	11	6.11	0.5	0.271	43
2.970322222S		3	5.6	3.07	14.63	39	6.31	1	0.112	38
104.7613861E	2021	1	5.4	5.66	24.61	21	6.21	0.8	0.048	43
		2	5.2	4.83	21.96	18	6.01	0.9	0.03	74
		3	5.9	3.97	18.91	8	6.38	1	0.03	74
	2022	1	5.8	3.56	16.96	16	6.71	0.9	0.044	43
		2	6.1	4.15	19.78	13	6.38	1.3	0.05	38
		3	6.1	4.37	20.81	15.4	6.4	1.2	0.042	93
Near PLN of	2020	1	5.9	3.75	17.08	12	5.9	1	0.29	20
Sekip		2	6.1	5.19	23.59	19	6.17	0.7	0.26	74
2.963069444		3	5.8	3.53	16.85	149	6.18	1.2	0.216	38
S	2021	1	5.3	6.24	27.11	24	6.2	1	0.036	64
104.7594444		2	7.1	5.58	25.38	13	6.17	1.2	0.028	93
E		3	7	3.72	17.74	13	6.21	1.2	0.033	74
	2022	1	6.1	3.69	17.58	13	6.41	1.5	0.032	93
		2	6.8	3.86	18.36	10	6.35	1.2	0.049	64
		3	6.4	4.07	19.41	60.5	6.38	1	0.048	74
Opposite PT.	2020	1	5.8	3.58	16.31	13	5.7	0.5	0.28	16
ASKES PTC		2	7.2	4.57	20.79	20	6.2	0.5	0.127	28
2.952027778		3	5.9	3.23	15.37	14.5	6.08	1	0.116	27
S	2021	1	5.8	6.2	26.95	20	6.24	0.7	0.044	36
104.7591389		2	7	5.09	23.13	12	6.08	1	0.026	74
E		3	6.8	3.99	19.01	10	6.28	0.9	0.035	38
	2022	1	6.8	3.93	18.72	15	6.39	1	0.041	64
		2	6.7	4.18	19.92	12	6.35	0.8	0.051	43
		3	6.8	4.36	20.76	4	6.4	1.3	0.055	64
Quality Standard (Class II)			6 – 9	3	25	50	4	10	0,2	1000

Table 8. Water quality analisys of ogan river during high tide

Location	Year	Period	pH*	BOD5*	COD*	TSS*	DO*	Nitrate	Phosphate	E Coliform
			-	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Total/100 ml
Estuary 3.01325 S 104.7504361 E	2020	1	5.9	2.27	11.37	9	6	0.5	0.18	11
		2	6.7	1.95	9.761	6	6.26	0.5	0.201	14
		3	5.5	2.07	10.38	30.7	6.37	0.5	0.264	16
	2021	1	6	3.48	17.38	12	6.2	0.7	0.041	20
		2	5.6	3.19	15.97	18	6.17	0.8	0.031	64
		3	6	2.81	14.05	15	6.39	0.9	0.037	38
	2022	1	5.7	2.66	13.31	11	6.75	1	0.031	43
		2	6.5	3.38	16.92	15	6.37	1.2	0.033	35
		3	5.9	3.36	16.84	31.6	6.38	1.1	0.032	93
Opposite PT. PAN 3.022963889 S, 104.7658889E	2020	1	5.8	2.3	11.53	10	6	0.6	0.17	11
		2	6.8	1.87	9.371	7	6.32	0.4	0.219	15
		3	5.5	2.13	10.65	7.6	6.39	0.4	0.188	20
	2021	1	6.8	3.89	19.46	20	6.19	0.7	0.039	20
		2	5.5	3.21	16.04	15	6.24	1	0.033	43
		3	6	3.01	15.01	10	6.46	0.8	0.045	43
	2022	1	5.5	2.75	13.78	13	6.72	1	0.029	43
		2	6.4	3.48	17.38	10	6.41	0.9	0.028	43
		3	5.8	3.31	16.56	17.7	6.42	0.8	0.029	74
Under Bridge 3.016505556S 104.7528389 E	2020	1	5.3	2.03	10.15	7	6.2	0.7	0.15	7
		2	6.6	1.8	9.011	12	6.38	0.7	0.235	7
		3	5.3	1.97	9.871	20.6	6.49	0.5	1.431	14
	2021	1	6.3	2.86	14.28	24	6.24	0.6	0.038	15
		2	5.8	3.1	15.54	17	6.21	0.8	0.03	34
		3	5.9	3.02	15.11	13	6.4	0.8	0.04	38
	2022	1	5.9	2.91	14.56	10	6.83	1.2	0.027	64
		2	6.3	3.3	16.48	11	6,43	1.2	0.027	35
		3	5.8	3.22	16.11	6.3	6.4	1	0.029	64
Quality Standard (Class II)			6 – 9	3	25	50	4	10	0,2	1000

Table 9. Pollution index (PI) values and water quality status

Location	Class	2020				2021				2022			
		High		Low		High		Low		High		Low	
		PI	Quality Status	PI	Quality Status	PI	Quality Status	PI	Quality Status	PI	Quality Status	PI	Quality Status
Estuary of Bendung River	II	1.16	mildly polluted	1.20	mildly polluted	1.39	mildly polluted	1.49	mildly polluted	1.67	mildly polluted	1.64	mildly polluted
Bendung River near 13 Ilir Bridge	II	1.15	mildly polluted	1.29	mildly polluted	1.51	mildly polluted	1.69	mildly polluted	1.55	mildly polluted	1.59	mildly polluted
Near PLN Sekip	II	1.35	mildly polluted	1.48	mildly polluted	1.60	mildly polluted	1.75	mildly polluted	1.43	mildly polluted	1.53	mildly polluted
Near PT. ASKES PTC	II	1.14	mildly polluted	1.32	mildly polluted	1.57	mildly polluted	1.72	mildly polluted	1.31	mildly polluted	1.48	mildly polluted
Estuary of Sekanak River	II	1.01	mildly polluted	1.14	mildly polluted	1.22	mildly polluted	1.37	mildly polluted	1.21	mildly polluted	1.34	mildly polluted
Sekanak River Radial St. Bridge	II	1.18	mildly polluted	1.17	mildly polluted	1.84	mildly polluted	2.08	mildly polluted	1.43	mildly polluted	1.58	mildly polluted
Sekanak River near DLHP South Sumatra Province	II	1.09	mildly polluted	1.15	mildly polluted	1.79	mildly polluted	1.91	mildly polluted	1.43	mildly polluted	1.65	mildly polluted
Estuary of Ogan River	II	0.88	meet	1.05	mildly polluted	0.90	meet	0.99	meet	0.83	meet	1.08	mildly polluted
Ogan River opposite PT PAN	II	0.75	meet	0.99	meet	0.94	meet	0.99	meet	0.89	meet	1.16	mildly polluted
Ogan River under the bridge	II	2.47	mildly polluted	2.18	mildly polluted	0.76	meet	0.92	meet	0.83	meet	1.02	mildly polluted

Correlation BOD and COD Sekanak, Bendung and Ogan River

From Statistical Analysis the correlation BOD and COD at the Sekanak, Bendung and Ogan River according to procedure at the method was find out the equation as which Table 11.

The Most Significant Water Quality Parameter on Pollution Index Sekanak, Bendung and Ogan River

The result of multiple regression analysis according to procedure at the method was find out (Table 12) Sekanak River. From this table, The DO and Nitrate variables do not have a significant effect, so that the feasibility test was continued together on the variables that have a significant effect (pH, BOD, COD, TSS, Phosphate and E.Coli on the dependent variable (PI) and from the results there were variables with a P-value > 0.005 (COD and E.Coli) so they were removed from the model and a feasibility test was carried out with the variables pH, BOD, TSS and Phosphate to obtain a significance value of F of 7.58878E-18 <0.05 then the regression equation model was feasible to use. R square value of 0.823. Regression equation:

PI = - 0.094 + 0.112 pH + 0.171 BOD + 0.005 TSS - 0.463 Phosphate

From this equation, it could be seen that **the most significant Phosphate variable** to PI than pH, BOD, and TSS variables.

From Table 13, the pH and TSS variables were removed from the feasibility test of the regression equation model and continued with the feasibility test together on the variables that had a significant effect on BOD, COD, DO, Phosphate, E. Coli and Nitrate and the results were variables BOD, COD, DO, and E-Coli had a significance value > 0.05 (no effect) so it was removed from the model and a feasibility test was carried out with the COD, Phosphate and Nitrate variables with a significance value of F of1.42937E-15 < 0.05 then the regression equation model was feasible to use. R square value of 0.652the regression equation was:

PI = 0.866 + 0.021 COD - 0.532 Phosphate + 0.208 Nitrate

From this equation, it could be seen that the Phosphate variable has the most significant effect on PI than the COD and Nitrate variables.

Table 10. Water quality index value

River Name	WQI Value		
	2020	2021	2022
Bendung	50.00	50.00	50.00
Sekanak	50.00	50.00	50.00
Ogan	60.00	70.00	60.00

Table 11. Correlation BOD and COD

Location	Equation	R^2
Sekanak River	COD = 2.929 + 4.101 BOD	0.98
Bendung River	COD = 3.436 + 3.911 BOD	0.98
Ogan River	COD = - 1.004 + 5.296 BOD	0.88

Table 12. T-Test – Sekanak River

Variables	Sig	Interpretation
pH	0.000110928	Sig < 0.05 significant
BOD	1.10869E-17	Sig < 0.05 significant
COD	3.55748E-18	Sig < 0.05 significant
DO	0.607447809	Sig > 0.05 not significant
TSS	0.014828034	Sig < 0.05 significant
Phosphate	2.25752E-06	Sig < 0.05 significant
E-Coli	8.28054E-06	Sig < 0.05 significant
Nitrate	0.728154298	Sig > 0.05 not significant

Table 13. Test t - Bendung River

Variable	Sig	Interpretation
pH	0.444491901	Sig > 0.05 No effect
BOD	6.8625E-06	Sig < 0.05 Has a significant effect
COD	6.43243E-07	Sig < 0.05 Has a significant effect
DO	0.008395194	Sig < 0.05 Has a significant effect
TSS	0.79584617	Sig > 0.05 No effect
Phosphate	4.97391E-09	Sig < 0.05 Has a significant effect
E-Coli	2.91064E-07	Sig < 0.05 Has a significant effect
Nitrate	2.32136E-07	Sig < 0.05 Has a significant effect

Table 14. t test - Ogan River

Variable	Sig	Interpretation
pH	0.073725351	Sig > 0.05 No effect
BOD	0.000458776	Sig < 0.05 Has a significant effect
COD	0.005170709	Sig < 0.05 Has a significant effect
DO	0.682444455	Sig > 0.05 No effect
TSS	0.970227223	Sig > 0.05 No effect
Phosphate	0.001556357	Sig < 0.05 Has a significant effect
E-Coli	0.029817315	Sig < 0.05 Has a significant effect
Nitrate	0.162159099	Sig > 0.05 No effect

From Table 14, the variables pH, DO, TSS, and Nitrate sig > 0.05, have no effect, and the feasibility test was continued together on the variables that have a significant effect on BOD, COD, Phosphate and E-Coli and the results were COD and E-Coli variables. Coli has a significance value > 0.05 (no effect) so it was removed from the model and a feasibility test was carried out with the BOD and Phosphate variables with a significance value of F of4.40157E-05 < 0.05 then the regression equation model was feasible to use. R square value of 0.325 so the regression equation was as followed:

PI = 1.884 - 0.285 BOD + 0.001 Phosphate

With the BOD variable was the most significant on PI than the Phosphate variable.

CONCLUSION

The study results on several tributaries of Musi River, namely the Sekanak, Bendung and Ogan River, some parameters of BOD and COD pollutants already exceeded the quality standards and tended to increase from the previous year. From the monitored points for the status water quality of Sekanak River and Bendung River, they were in a mildly polluted condition, while the water quality status of Ogan River, its water quality status meet the quality standard up to mildly polluted based on the class II water quality standard.

The Water Quality Index of 2020 - 2022 at the the Sekanak and Bendung River was in the moderate category, for the Ogan River in 2021, the water quality index was in good category while in 2022 it was moderate. From statistical analysis there were correlation between BOD and COD at the Sekanak, Bendung and Ogan River and the most significant parameters on the pollution index for Sekanak and Bendung River were Phosphate and for Ogan River was BOD.

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