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ANALYSIS OF POLLUTION STATUS IN RIVER SATUI, TANAH BUMBU REGENCY, SOUTH KALIMANTAN PROVINCE

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ABSTRACT
The Satui river consists of small rivers above it, namely the Baruna river and the Tandui river, while the Batulaki river consists of tributaries, namely the Asikin river and the Waluangin river. The Satui River, whose utilization is used by the community on a daily basis, provides the potential for the availability of clean water, so that if the river is polluted it will have an impact on the surrounding community. This study aims to provide water pollution data that can be used to see the current condition of the Satui River. Based on the analysis of the water quality status of the Satui River in terms of the Pollution Index (IP) value, the Satui River for the period of July Class I to the four sampling locations indicated moderately polluted quality status, class II indicated mildly polluted. During August class I, Sungai Danau was categorized as heavily polluted, while the other three locations were moderately polluted. Class II, the four locations are classified as lightly polluted. Meanwhile, based on the water quality index (IKA) for the July period Class I and II indicated moderately polluted quality status, the August Class I period indicated moderately polluted water quality status, class II indicated mildly polluted.

KEYWORDS: Satui River, Pollution Index, Water Quality Index.

INTRODUCTION

Humans use water to meet household needs, industrial activities, agriculture and so on, so that to meet these needs, the existence and availability of clean water is very necessary. Poor quality water will result in bad environmental conditions that will affect the health and safety conditions of humans and other living things (Eko et al., 2018).

Water pollution can vary from upstream to downstream depending on activities near water bodies. Activities in the water body area of the river such as settlements, industry and agriculture which affect the entry of pollutants into the river flow. Pollutants will have an impact on the quality of river water, so that in their utilization they must go through a processing process or if they are used directly they can have an impact on health (Mawaddati, 2021). Poor upstream conditions will affect the conditions below, so that upstream activities that cause pollution such as domestic waste disposal, household waste and toilet activities will have an impact on the quality of the downstream river.

The Satui river consists of small rivers above it, namely the Baruna river and the Tandui river, while the Batulaki river consists of tributaries, namely the Asikin river and the Waluangin river. If we look at the length of the river and the type of river, the Batulaki river really has a considerable influence on flood events which often occur when there is very heavy rain, besides that there are many activities that are no longer environmentally friendly, such as lots of illegal logging.

Calculation of activity performance indicator projections in Satui District, namely the projection of drinking water service needs based on a capacity of 115 L/dd, households of 7,823 while the ability to absorb access to drinking water services based on a capacity of 90 L/d, households of 7,200 (SPAM PDAM Tanah Bumbu, 2021) means that the need for clean water in households is higher than the absorption capacity of drinking water services. The Satui River, whose utilization is used by the community on a daily basis, provides the potential for the availability of clean water, so that if the river is polluted it will have an impact on the surrounding community.

Research methods

1. Time and Place

The time used by researchers for research is approximately 4 (four) months, 2 months of report preparation, preliminary observation and 2 months of sampling, laboratory analysis, data processing and preparation of the final report.

The research was carried out in Sungai Danau Village, the downstream point with the coordinate point S = 03°48'13.32" E = 115°24'23.49", the second location is in Sungai Danau Village, midpoint 1 with the coordinate point S = 03°46' 43.48" E = 115°24'23.76", the third location is Sungai Danau Village, the upstream point with coordinates S = 03°45'26.25" E= 115°24,34,23", the fourth location namely in Sungai Danau Village midpoint 2 with coordinates S = 03°46'07.19" E = 115°26'47.88", and analysis at the Environmental Laboratory of the South Kalimantan Provincial Environmental Service.

2. Data collection procedures

There are two types of data in general, namely quantitative data and qualitative data, the author focuses more on quantitative data in conducting the analysis.

3. Sampling technique

Sampling of river water is carried out in accordance with SNI 6989.57:2008 Water and waste water – Section 57: Surface water sampling method. Determination of the sampling point was carried out using the purposive sampling method, to cover the source of the impact, namely the method of determining the water sampling point by looking at the considerations made by the researcher, among others, based on the ease of access to health, costs and time in the research. Based on the determination of the sampling point, in flow, middle flow and lower flow analysis is carried out.

4. Data collection techniques

The method used for data collection was determined by the participant observation method where the researcher directly measured and took samples to the field and carried out documentation.

5. Data analysis

5.1 Water quality analysis

The water quality analysis data used in this study was based on sampling in the Satui River, which was then carried out by laboratory tests for water quality parameters including temperature, brightness, pH, TSS, TDS, DO, BOD, COD, iron, manganese, zinc, cadmium., Copper, Lead, Arsenic, Mercury, Sulfate, Ammonia, Nitrate, Nitrite, Hardness, Chloride, Orthophosphate, Total Phosphate, Oil and Fat, Fecal Coliform and Total Coliform.

5.2 Pollution index analysis

The level of pollution is measured by the IP method (Pollution Index) which is regulated in the Decree of the Minister of Environment No. 115 of 2003 concerning Guidelines for Determining Water Quality. Waters are more polluted on the label if the (Ci/Lij)R and/or (Ci/Lij)M values are greater than 1.0. If the maximum Ci/Lij value and/or the average Ci/Lij value is higher, then the pollution of the water body is also higher. Therefore, the length of the line from the starting point to the Pij point is proposed as a factor to express the degree of pollution.

$$PIj = m\sqrt{(Ci/Lij)_M^2 + (Ci/Lij)_R^2}$$

5.3 Information

PIj = Pollution index for designation j
Ci = concentration of water quality parameters i
Lij = concentration of water quality parameter i listed in the water allotment standard
M = maximum
R = average
(Ci /Lij)R = average index
(Ci /Lij)M = maximum index
Evaluation of the PI value is presented in Table 1.

Table 1: Pollution index.

Value	Pollution index
$0 \leq PIj \leq 1,0$	Meet quality standard (good condition)
$1,0 < PIj \leq 5,0$	Lightly blackened
$5,0 < PIj \leq 10$	Medium blackened
$PIj > 10$	Heavy blackened

Source: Minister of Environment Decree 115 Status of Water Quality (2003)

5.4 Analysis of water quality index

Analysis of the Water Quality Index (WQI, Brown et al., 1972) is used to analyze physical and chemical parameters that have environmental quality standards. To obtain the value of the Water Quality Index (IKA) using the Pollution Index-PI method. The parameters used in the calculation of the Water Quality Index (IKA) are pH, DO, BOD, COD, TSS, Phosphate, Nitrate and Fecal Coliform.

Based on the quality status of the weighted value of each surface water quality status is presented in the table 2

Table 2: Weight of quality status based on IKA.

No	Quality Status	Value Weight
1	Meet quality standards	70
2	Lightly blackened	50
3	Medium blackened	30
4	Heavy blackened	10

RESULTS AND DISCUSSION

Water quality

Based on the results of the research conducted, the results of the water quality of the Satui River in July and August can be seen in the following table.

Table 1: Results of satui river water quality.

Parameter	Unit	1 T Downstream	2 T Downstream	1 T Middle 1	2 T Middle 1	1 T Upstream	2 T Upstream	1 T Middle 2	2 T Middle 2
Physics									
Temperature	°C	25	25	26	26	27	27	29	29
TSS	mg/L	109	22	114	48	227	91	93	95
TDS	mg/L	111	111	71	71	585	59	137	137
Chemistry									
pH	-	6,5	7	7,2	7	6,8	6,8	7,2	7,2
BOD	mg/L	16,1	3	19,0	4	21	3,8	23,0	4,7
COD	mg/L	28	17	32	13	37	<10	51	10
DO	mg/L	4,4	4,4	4,5	4,5	4,9	4,9	5,7	5,7
Sulfate (SO_4)	mg/L	29	271	29	34	70	28	27	42
Chloride (Cl)	mg/L	5	9197	<1,5	6	264	7	3	<1,5
Nitrate	mg/L	2	1	2	2	4	2	3	1
Nitrite	mg/L	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Ammonia	mg/L	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Total Phosphate	mg/L	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03
Fluoride (F)	mg/L	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02
Mercury (Hg)	mg/L	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001
Arsenic (As)	mg/L	<0,005	<0,005	<0,005	<0,005	<0,005	<0,005	<0,005	<0,005
Iron (Fe)	mg/L	<0,3	<0,3	<0,3	<0,3	<0,3	<0,3	0	<0,3
Manganese (Mn)	mg/L	<0,1	<0,1	<0,1	0,16	<0,1	<0,1	<0,1	<0,13
Sinc (Zn)	mg/L	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Copper (Cu)	mg/L	<0,005	<0,005	<0,005	<0,005	<0,005	<0,005	<0,005	<0,005
Lead Pb)	mg/L	0,01	0,01	0,01	<0,005	<0,005	0,01	<0,005	0,01
Cadmium (Cd)	mg/L	0,001	0,003	0,001	<0,0005	0,005	<0,0005	<0,0005	<0,0005
Oils & Fats	mg/L	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4
hardness	mg/L	48	3186	72	71	132	40	96	59
Microbiology									
Fecal coliform	MPN/100 mL	285	4280	880	3836	3255,0	8780	3603,0	12110
Total coliform	MPN/100 mL	>24196	24066	>24197	28272	>24196	64710	>24197	57940

Quality Standards Government Regulation of the Republic of Indonesia Number 22 of 2021 Concerning the Implementation of Environmental Protection and Management for river water and similar classes I and II Based on the table above, it provides information that it can be seen that the value exceeds the quality standard, parameters that exceed the quality standard at a certain point include TSS, BOD, COD, Chloride, Manganese, Fecal Coliform and Total coliform.

Based on the table above the TSS parameter values are in the range of 22 mg/L – 227 mg/L, the lowest value is 22 mg/l at the Lower River Lake location in the second sampling (August) and the highest value is 227 mg/l at the Upper Lake location (July). The TSS value at each sampling location shows that it exceeds the Quality Standard of Government Regulation of the Republic of Indonesia Number 22 of 2021 for class I, which is 40 mg/l and class II, which is 50 mg/l. The high TSS value at the upstream point is caused by the discharge of waste from domestic or industrial activities, the presence of solids in water bodies can also be caused by soil erosion (Metcalf & Eddy, Inc, 1991).

The BOD value in the Satui River was taken at four sampling points with two repetitions of sampling. From the BOD parameter table, the results of the Satui River water quality study showed that the BOD parameter values were in the range of 3 mg/L – 23 mg/L, from all sampling point locations the values exceeded the class I

quality standard for the BOD parameter of 2 mg/L. The lowest BOD value is 3 mg/L in the downstream region in July. The highest BOD value was at the Central sampling point in July with a value of 23 mg/L. The thing that affects the BOD content in river water is the amount of organic waste dissolved in the water where the more dissolved organic waste will increase the oxygen demand needed by microorganisms to decompose and increase the BOD content in water. The process of decomposition of organic matter shows that microorganisms obtain energy from the oxidation process and eat organic matter in the waters (Pour et al., 2014).

From the COD parameter table as a result of the Satui River water quality study, the COD parameter values are in the range of 10 mg/L – 51 mg/L where there are two sampling locations that do not exceed the quality standard in the Upper August and Middle July periods. Things that indicate an increase in COD content are the flow of water from industrial activities which tend to have a high COD content towards river water flows.

Most of the chloride content in the Satui River still met the quality standards, but at the Sungai Danau location in August the chloride values exceeded the class I and class II quality standards with a value of 9,197 mg/L, while the class I and class II quality standards for the chloride parameter were 300 mg/L. The high chloride in the Lower River Lake location comes from household waste that is discharged into the river. Human waste, especially urine contains chloride in the same amount as the chloride consumed through food and water (Marwati et al, 2008).

Manganese (Mn) values in the Satui River were taken at four sampling points with two repetitions of sampling which can be seen in Figure 4.18. Based on the parameter table above the class I quality standard for Manganese (Mn) is 0.1 mg/L, the Manganese (Mn) analysis above has several exceeding the class I quality standard for Manganese (Mn) with a value of 0.13 mg/L in midpoint 2 for sampling in August and 0.16 mg/L midpoint 1 for sampling in August. The local government should pay attention to the high manganese in the waters to reduce manganese levels so that it can be used safely by the local community.

Based on the results of the study, total coliform and fecal coliform bacteria in the Satui river ranged from 285 MPN/100 mL – 12,110 MPN/100 mL. The content of fecal coliform and coliform bacteria that has exceeded the threshold of water quality standards. The presence of coliform bacteria in the waters can be pathogenic to the presence of humans around these waters. The less bacteria found in the water, the better the quality of the water. Meanwhile, the more bacteria found, the worse the quality of the water. The high abundance of Coliform bacteria indicates that the environmental conditions in the river have decreased biologically, because Coliform bacteria are indicator bacteria for pollution in the waters.

Based on the table above, the total coliform range is 24,197 MPN/100 mL –64,710 MPN/100 mL. Increased activity around these waters can also be a source of the arrival of coliform bacteria. Quality standard for class I Total Coliform 1,000 MPN/100 mL, so this value is far above the quality standard and needs attention.

Pollution Index (PI)

From the results of the calculation of the Pollution Index, the evaluation of the IP value in the period July and August for the Class I River category can be seen in the following.

Figure 1: Class I PI evaluation graph.

Figure 2: Class 2 Science evaluation graph.

The population and various types of activities/businesses carried out along the river have resulted in an increase in the need for water consumption which has the potential for the impact of river water pollution. The level of water pollution in the July period for class I river categories ranged from 5.701 – 9.042, in the August period it ranged from 6.398 – 14.799. The level of water pollution in the July period for the class II river category ranged from 3.352 – 3.921, in the August period it ranged from 3.168 – 4.701. The best water quality test parameters apparently cannot make waters free from pollution.

The increasing amount of waste that is disposed of into the river from upstream to downstream, the greater the environmental burden that will be generated, so that it is necessary to manage water quality in a sustainable manner, the form of control that is carried out from the pollution that occurs is the need to reduce the burden of pollution such as involving the community in the management river environment, densely populated settlements need public awareness in managing household waste and not throwing garbage into river bodies (Sari and Wijaya, 2019).

Water quality index

The description of the Satui River Water Quality Index is presented in table 2 below

Table 2: Satui river water quality index.

Water Quality Index July Period Class I					
No	**Status**	**Total**	**Percentage**	**Standard**	**Value**
1	Fulfil	0	0%	70	0,00
2	Light Black	0	0%	50	0,00
3	Medium Black	4	100%	30	30,00
4	Heavy Polluted	0	0%	10	0,00
Water Quality Index Value					**30,00**
Water Quality Index July Period Class II					
No	**Status**	**Total**	**Percentage**	**Standard**	**Value**
1	Fulfil	0	0%	70	0,00
2	Light Black	0	0%	50	0,00
3	Medium Black	4	100%	30	30,00
4	Heavy Polluted	0	0%	10	0,00
Water Quality Index Value					**30,00**
Water Quality Index for the Period of August Class I					
No	**Status**	**Total**	**Percentage**	**Standard**	**Value**
1	Fulfil	0	0%	70	0,00
2	Light Black	0	0%	50	0,00
3	Medium Black	4	100%	30	30,00
4	Heavy Polluted	0	0%	10	0,00
Water Quality Index Value					**30,00**
Water Quality Index for the Period of August Class II					
No	**Status**	**Total**	**Percentage**	**Standard**	**Value**
1	Fulfil	0	0%	70	0,00
2	Light Black	4	100%	50	50,00
3	Medium Black	0	0%	30	0,00
4	Heavy Polluted	0	0%	10	0,00
Water Quality Index Value					**50,00**

From the results of the calculation of the Pollution Index of 8 parameters, the quality status in the July and August categories of Class I and Class II Rivers can be seen in the following graph.

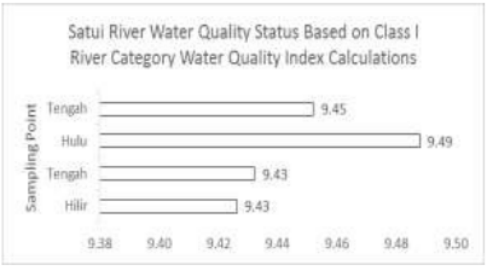

Figure 3: Water quality index july class I quality status graph.

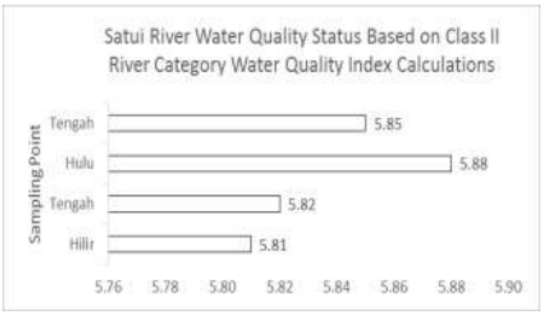

Figure 4: Graph of water quality index july class ii quality status.

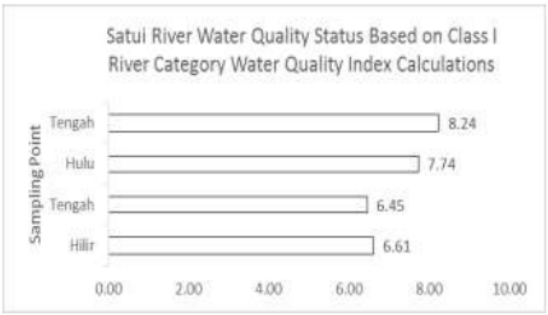

Figure 5: Graph of IKA August Class I Quality Status.

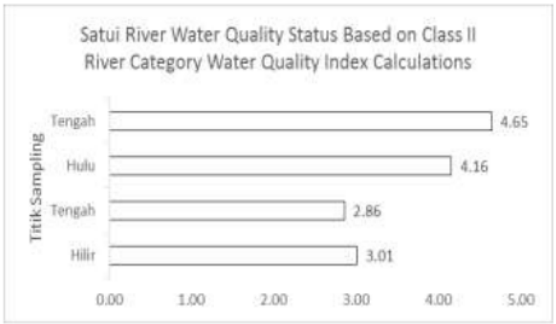

Figure 6: Graph of August Class II Water Quality Index Quality Status.

From the results of the calculation of the Water Quality Index, the quality status of the Class I River category can be seen in the following graph

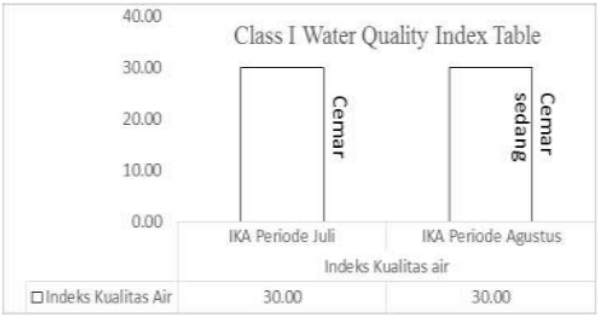

Figure 7: IKA Class I Quality Status Graph.

From the results of the calculation of the Water Quality Index (IKA), the quality status of the Class II River category can be seen in the following graph.

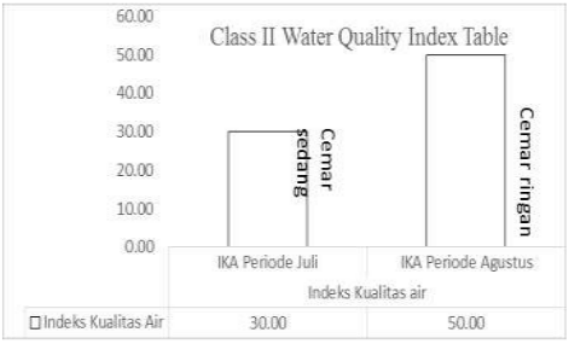

Figure 8: Graph of IKA Class II Quality Status.

In 2021 the calculation of the Water Quality Index (IKA) has changed from the weighting of the pollutant index calculation for 7 parameters consisting of TSS, BOD, COD, DO, Total Phosphate, Fecal Coliform and Total Coliform to the weighting of the pollutant index calculation for 8 parameters of the test results namely pH , TSS, BOD, COD, DO, total phosphate, Nitrate and Fecal Coliform. Calculation of the Water Quality Index (IKA) is carried out for two categories, namely class I and II river categories based on the quality standards used based on Government Regulation Number 22 of 2021 concerning Implementation of Environmental Protection and Management - Appendix VI where this aims to determine water quality according to class allotment.

CONCLUSION

Based on the analysis of the water quality status of the Satui River in terms of the Pollution Index (IP) value, the Satui River for the period of July Class I to the four sampling location points indicated moderately polluted quality status, class II indicated mildly polluted. During the August class I period, Sungai Danau was categorized as heavily polluted, while the other three locations were moderately polluted. Class II, the four locations are classified as lightly polluted. Meanwhile, based on the water quality index (IKA) for the July period Class I and II indicated moderately polluted quality status, the August Class I period indicated moderately polluted water quality status, class II indicated mild contamination.

IKA is used to simplify complex water quality data and provide initial water quality information quickly so that it can be used as a measure to reduce water pollution. Based on the calculation of the pollution index of 8 parameters, the water quality status is based on the water quality index (IKA). In July class I and class II showed moderately polluted water quality, in August class 1 water quality was moderately polluted class II, namely. slightly polluted

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