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To cite this article: Vita Pramaningsih *et al* 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1111** 012039

View the article online for updates and enhancements.

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Abstract. Selulu Reservoir is located in Waru District, North Panajam Paser Regency. It is one of the tourist destinations in supporting the tourism sector. Land use changes and urbanization have potential impacts on the environment. This study aimed to determine Water Quality Status and Water Quality Index (WQI) in Selulu Reservoir. Hopefully, the result will become the basis for future reservoir management to keep the water quality well. The method in this study used the survey method. These research steps include surveys, water samples, laboratory analysis, and data analysis. Parameters analyzed include temperature, pH, BOD, COD, and DO. The results showed that the reservoir's water quality in all samples still met the standard, except for pH at point 3. The difference fluctuating value found in COD at point 3, although it still meets the standard. This location is close to residential areas that dump their waste into the reservoir. The Water Quality Status of the reservoir still meets the standards, and WQI is in the excellent category. This is due to the dominant land use of forest and plantations with few settlements around the reservoir, domestic waste is small, and the reservoir capacity is still supportive. Management is needed to maintain reservoir water quality in the future.

1.   Introduction

Water is a natural resource that people need; its function must be preserved and remains useful for human life and others [1]. This reservoir is in Subdistrict Waru, Panajam Paser Utara Regency. The total area of Subdistrict Waru is 553.88 km^2, with a percentage of 16.62% of the total district area [2]. The research location at 116°37'01.62" East Longitude and 01°23'22.7" North Latitude.

Selulu Reservoir has the potential to become a tourist destination if it is managed well, and the new capital city of Indonesia will be built in this district. It supports the tourism sector where the beauty and natural wealth are pretty abundant, especially types of fish. The livelihoods of the community around the Selulu Reservoir include fishing and fish cultivation in the form of cages. Most of the community employment in Panajam Paser Utara Regency is agriculture, plantation, and forestry, which fisheries by 40% and trade, restaurants, and accommodation services by 24%. Mining and quarrying sector by 2.34%, manufacturing industry by 10%, construction by 7%, community and individual services by 13%, and others 3.66% [2]. Communities around the Selulu Reservoir use the reservoir water for bathing, washing, and toileting then the wastewater flows directly into the reservoir. In addition, there

is community fish cultivation carried out by making cages. These activities influence water quality decline if it continues without management. Domestic activities influence water pollution in the reservoir to impact the water quality, and some parameters are not following the standard, such as pH, DO, BOD, COD, and Fecal Colliform [3]. Uncontrolled community economic activities can affect the reservoir water quality decline showing the water quality status [4]. Selulu reservoir is used as a source of raw water for Water Treatment Plant (Drinking Water Company) and needs to be kept to the water quality.

Status of Water Quality and Water Quality Index (WQI) is used to understand water quality and manage the resources in the reservoir and lakes [5]. WQI is adequate to calculate the lake water quality in terms of water landscape [6]. Based on several studies and conditions around the Selulu Reservoir, this study aims to determine the Status of Water Quality and WQI. It is done to know the reservoir water quality that supports welfare communities and supporters of the new capital city of Indonesia in the tourism sector. Considering development, the new capital city of Indonesia will increase urbanization and land use changes that impact the environment. The resulting study will be essential water quality information, especially for Selulu Reservoir.

2.   Methods

The research method in this study used the survey method. The steps were carried out by the preparation stage, field survey, water sampling, laboratory analysis, and data analysis. It was organized for around 6 months, starting in January 2022. The laboratory analyzing water samples is the Regional Health Laboratory of Balikpapan City. The research location is shown in Figure 1 in Selulu Reservoir, Waru District, North Panajam Paser Regency, East Kalimantan.

Figure 1. Research Location in Subdistrict Waru

Sampling uses the purposive sampling method by taking at 3 points on the right, middle and left side of the reservoir to consider that it can represent the condition of the reservoir water and accessibility of the location. The parameters analyzed were temperature, pH, BOD, COD, and DO. The Pollution Index (IP)

calculation is used to determine the Water Quality Status, in accordance with the Decree of the Minister of the Environment No. 115 of 2003 concerning Guidelines for Determining the Water Quality Status, in the formula (1).

$$PI_j = \sqrt{\frac{(C_i/L_{ij})_M^2 + (C_i/L_{ij})_R^2}{2}} \tag{1}$$

Where PIj is the Pollution Index want to know, Ci is the concentration of the measured water quality parameter, Lij is the quality standard of the measured parameter, M is the maximum value or the highest value. At the same time, R is the average value that has been calculated. The results of calculating IP values and their categories [7] are presented in Table 1.

Table 1. River Water Pollution Index Values and Categories Water Quality Status

IP	Category
$0 \leq IP \leq 1$	Good (Meets Quality Standards)
$1 < IP \leq 5$	Lightly Polluted
$5 < IP \leq 10$	Medium Polluted
$IP > 10$	Heavily Polluted

    The Water Quality Index (WQI) is calculated based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 27 of 2021 concerning the Environmental Quality Index [8]. The determination of WQI is done by multiplying the quality of the index value by the percentage of meeting the quality standard obtained from the sum of the sample points that meet the quality standard by number of samples in percent. Index value quality is presented in Table 2. WQI is obtained from the total number of Index Values per water quality and is matched with the vulnerable numbers in the Water Quality Index category in Table 3.

Table 2. Index Value Quality

Index Value Quality	Category
70	Good (Meets Quality Standards)
50	Lightly Polluted
30	Medium Polluted
10	Heavily Polluted

Table 3. Water Quality Index of Category

Index Value Quality	Category
$90 \leq x \leq 100$	Excellent
$70 \leq x < 90$	Good
$50 \leq x < 70$	Medium
$25 \leq x < 50$	Unsuitable

$0 \leq x < 25$	Very Unsuitable

3.   Results and Discussion

The results of laboratory analysis for the parameters of temperature, pH, BOD, COD, and DO from the Selulu Reservoir water are presented in Table 4. The analysis results were matched with the surface water quality standard class II following the East Kalimantan Regional Regulation No. 2 of 2011 concerning Water Quality Management and Water Pollution Control [1]. All parameters meet the Quality Standards except pH at Point 3, which is 5 with a quality standard of 6-9. The BOD and COD parameters have the same value at all points except for COD, which shows the difference in numbers at each point. The temperature is seen only at Point 1, which has a different but not very significant value. The highest COD value is at Point 3, with a value of 10 mg/L, and the lowest is at Point 1, with a value of 6 mg/L. Point 3 is close to a few residential areas, so the reservoir water still has the capacity for COD. COD values for all points still meet the standard. The COD value indicates that the waters are polluted with organic matter and become the primary pollutant in Lake Chaohu, China [9]. Dense community activities around the reservoir and waste disposal cause the pH, BOD, COD, and DO values to exceed the standard [3]. The water quality of the Selulu Reservoir for several parameters of temperature, pH, BOD, COD, and DO still meets the standard. This needs to be maintained by managing the environment around the reservoir.

Table 4. Laboratory analysis result of Water Quality Selulu Reservoir

No	Parameters	Point 1	Point 2	Point 3	Average	Standard	Method
1	Temperature	30	31	31	30.67	deviasi 3	Elektrometry
2	pH	6	6	5	5.67	6-9	Elektrometry
3	BOD	1	1	1	1.00	3	Oxydirect
4	COD	6	9	10	8.33	25	Spektrofotometry
5	DO	7	7	7	7.00	4	Electrometry

Source: Primary Data, 2022

Water quality status is the level of water quality conditions that indicate polluted or good conditions in a water source within a particular time by comparing it with the water quality standards [7]. Details of the Pollution Index (IP) calculation to determine the Water Quality Status of the Selulu Reservoir are presented in Table 5, Table 6, and Table 7. The pollutant Index value of the Selulu Reservoir is included in the category of good water quality status (meets quality standards).

Table 5. Pollution Index and Water Quality Status at Selulu Reservoir Point 1

Parameters	Result Analysis (Ci)	Standard (Lij)	Ci New	Ci/Lij	Ci/Lij New
PH	6	7	6	0.5	0.5
BOD	1	3	1	0.333333333	0.333333333
COD	6	25	6	0.24	0.24
DO	7	4	0	0	0
Ci/Lij R					0.268333333
Ci/Lij M					0.5
Pollutant Index value (IP)					0.401249784
Water Quality Status					Good (Meets Quality Standards)

Source: Primary Data, 2022

Table 6. Pollution Index and Water Quality Status at Selulu Reservoir Point 2

Parameters	Result Analysis (Ci)	Standard (Lij)	Ci New	Ci/Lij	Ci/Lij New
PH	6	7	6	0.5	0.5
BOD	1	3	1	0.333333333	0.333333333
COD	9	25	9	0.36	0.36
DO	7	4	0	0	0
Ci/Lij R					0.298333333
Ci/Lij M					0.5
Pollutant Index value (IP)					0.411705464
Water Quality Status					Good (Meets Quality Standards)

Source: Primary Data, 2022

Table 7. Pollution Index and Water Quality Status at Selulu Reservoir Point 3

Parameters	Result Analysis (Ci)	Standard (Lij)	Ci New	Ci/Lij	Ci/Lij New
PH	5	7	5	0.625	0.625
BOD	1	3	1	0.333333333	0.333333333
COD	10	25	10	0.4	0.4
DO	7	4	0	0	0
Ci/Lij R					0.339583333
Ci/Lij M					0.625
Pollutant Index value (IP)					0.502962146
Water Quality Status					Good (Meets Quality Standards)

Source: Primary Data, 2022

The highest IP value is in the measurement results of point 3, where the location is close to settlements. The pH value at point 3 does not meet the standard of 5 and is acidic. All chemical pollutants in the water will decrease along with the increase in the pH value of the water. In addition, a high pH will reduce the retention/absorption capacity of phosphorus in sediments which causes eutrophication [10]. pH value also affects the oxidation process of ammonia and nitrite. Low pH inhibits the oxidation process of ammonia and nitrite in waters where the optimal pH is 7 and 7.5 [11]. Nutrition and pH are also significant factors in eutrophication [12]. The highest COD result is at point 3 compared to all measurement points, although it still meets the standard. COD value is an indicator of organic matter pollution in the waters. Based on the study in Lake Chaohu, the COD parameter is the primary pollutant, and implemented an RCP (River Chief Policy) system to tackle the pollution of rivers and lakes in China [9].

The current Selulu Reservoir Water Quality Index (WQI), based on the results of water quality analysis, shows that it is in a suitable category at a value of 70; it is vulnerable to $70 \leq x < 90$, with the water quality of all samples meeting the standard.

Table 8. Selulu Reservoir Water Quality Index (WQI)

Water Quality Status	Number of Monitoring that meets water quality status	Percentage of Fulfillment of Water Quality	Index Value Quality	Index Value per Water Quality
Good (Meets Quality Standards)	3	100%	70	70
Lightly Polluted	0	0	50	0
Medium Polluted	0	0	30	0
Heavily Polluted	0	0	10	0
Total	3			WQI = 70
Water Quality Index Category (WQI)				Good

Source: Primary Data, 2022

Calculating the Water Quality Index is a way to determine the water quality in the lake [13] and evaluate surface water quality, including rivers, lakes, reservoirs, and estuaries [5]. An innovation that links WQI and hydrological variables, urbanization provides a multidimensional evaluation of water quality [14]. The Selulu Reservoir Water Quality Index needs to be maintained in line with the development new capital city of Indonesia. This long-term development will change land use a lot, and major urbanization will occur when a new city has been built in North Panajam Paser Regency. Urbanization has an impact on the water quality in the city. The lake water quality is inferior due to the influence of urbanization and the growth of cities around the lake [15]. Selulu Reservoir is located in Waru District, which borders Panajam District, the new capital city of Indonesia. Changes in land use area in North Panajam Paser Regency in 2010-2016 were mostly plantations of 3.55% (from 21.96% to 25.51%); Forest by 1.42% (from 34.34% to 32.92%); Bushes by 1.36% (from 10.12% to 8.76% and HTI (Industrial Plantation Forest) by 1.19% (from 18.27% to 17.09%) [16]. Land use change in Panajam Subdistrict in the oil palm plantation sector is increasing, and the forest area is decreasing [17]. Selulu Reservoir has the potential as a tourist destination that must be managed properly, especially the water quality. The pollution load capacity in the reservoir still meets good water quality standards. Tourism is one of the factors that cause water pollution in surface water, such as rivers, lakes, and reservoirs. Deterioration of lake water quality due to grazing/livestock and tourism [18].

Conclusion

The water quality status of the Selulu Reservoir still meets the quality standards, and its WQI is in a suitable category. It means the reservoir can still accommodate the pollution load that enters. There are only a few settlements around the reservoir, and plantations dominate it. The water quality is still up to standard and does not exceed the capacity. Community activities, domestic activity, urbanization, and land use influence the WQI in the river, reservoir, and lake surface water. Therefore, it must be managed, monitored, and evaluated to sustain future water quality.

Acknowledgments

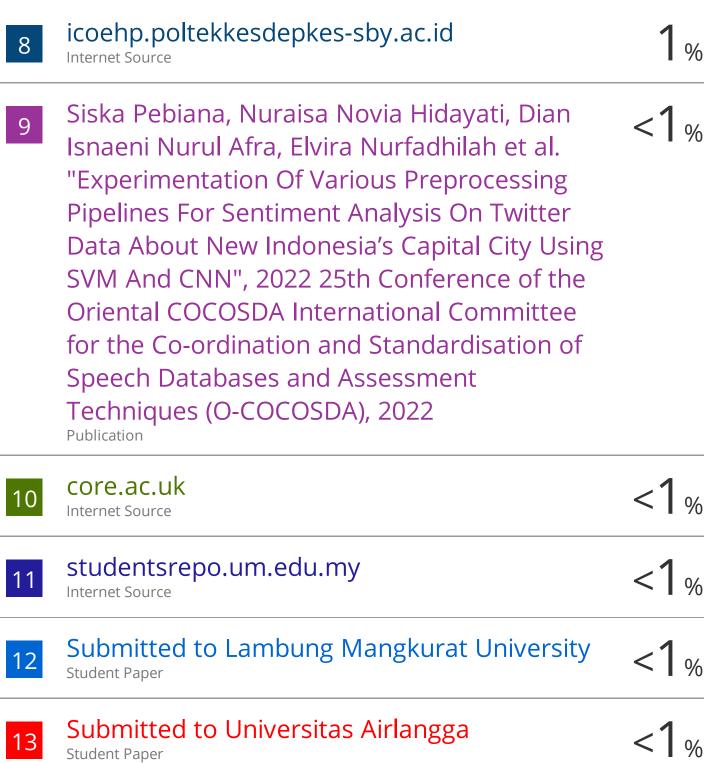## References

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