Water Pollution Identification and Mitigation at Several Points of Bengawan Solo River

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ABSTRACT. Water pollution is a big problem in many cities in Indonesia such as Surakarta. In this city, the water quality of the Bengawan Solo tributary is decreasing due to pollution. Therefore to analyse the water quality of the Bengawan Solo tributaries, namely the Gajah Putih River, Pepe Baru River, Sekartaji River, this research was conducted. The sampling of the research was carried out to measure parameters such as colour, temperature, turbidity, waste, pH, TDS, TSS, and odor. The data were processed using descriptive and quantitative approaches. The results of the data were compared with parameters based on water quality standards to determine the sources of pollutants, groups, and influencing factors. Based on the research, the river with the highest level of pollution is the New Pepe River. Meanwhile, the river with the lowest level of pollution is the Tirtonadi Bendung River. The river with the highest TDS value is the Pepe Baru River which is caused by high pollution. Meanwhile, the lowest TDS value is in the Tirtonadi Bendung River. The highest TSS value is in the Titronadi Bendung River. Meanwhile, the lowest TSS value is in the Gajah Putih River. Based on studies that have been done, the solution to the problem of river pollution is by making IPAL in every downstream tributary of the Bengawan Solo River. Moreover, another solution is by a socialization to factories regarding waste processing prior disposal and a socialization to the community about the importance of the environment.

Keywords: mitigation, pollution, river, quality, water.

1. Introduction

Water is an important natural resource needed for the activities and survival of living things (Hamidi et al., 2017). Water covers about 70% of the earth's surface, which makes water the largest element on the earth's surface. Disruption of water quality can certainly affect the availability of water needed by living things. The decline in water quality is caused by pollution that occurs in the waters. Pollution is the entry of something into the environment in the form of substances or energy and can cause damage to biological resources and ecological systems, damage to structures or facilities, impaired environmental function, and be harmful to human health (Harrsion, 2001).

Several activities such as domestic and industrial activities can reduce water quality, which in turn causes water resources to no longer be able to meet the increasing needs of living things (Sasongko et al., 2014). Water quality parameters are divided into chemical, physical, and biological parameters. These parameters include pH, DO, CO, temperature, and microorganisms (Qin et al., 2018). Disturbed water quality will affect the carrying capacity and carrying capacity of a waters (Hamuna, 2018). Urbanization has an effect on urban water availability (Wardhani et al., 2019). Massive urbanization in urban areas has made urban areas vulnerable to water availability (Sukmara et al., 2020). The river is a lotic ecosystem that has currents that move from upstream to downstream (Jayanti, 2020) The Bengawan Solo River is the longest river on the island of Java, which originates from Gunung Kidul and has a length of ± 640 km and flows through two provinces, namely Central Java and East Java. One of the cities that is crossed by the Bengawan Solo River is Surakarta City. In the city of Surakarta, the Bengawan Solo River has several tributaries, including the White Elephant River, the Pepe Baru River, and the Sekartaji River. Surakarta City itself is a densely populated area where the population density reaches ± 13,000 / km2. According to the Environment and Forestry Service (DLHK) of Central Java Province, the Bengawan Solo River has been polluted. The condition of the Bengawan Solo River which is close to settlements, the lifestyle of urban communities, and changes in land use are factors in the decreasing quality of the river (Setyaningrum, 2020). Apart from that, the textile industries such as batik, alcohol, and even livestock are also participating in the pollution of the Bengawan Solo River. As a result of this pollution, PDAM has experienced difficulties in processing water from the Bengawan Solo River which has caused a clean water crisis in several areas of Surakarta City. Rivers actually have the ability to tolerate pollutants that enter naturally which is called "Assimilation Capacity", where the assimilation capacity of each river is different (Dani et al., 2015). However, if the pollution has exceeded the capacity of the river, then a decrease in water quality cannot be avoided.

This research was conducted to analyse the water quality of the Bengawan Solo tributaries, namely the Gajah Putih River, Pepe Baru River, and Sekartaji River by comparing the quality of the samples taken with the water

quality standard data according to class, in order to determine the suitability of water for certain uses and determine water management programs that can be carried out in overcoming the problem of water pollution in the Bengawan Solo River and its tributaries.

2. Materials and Methods

2.1 Research Area

The research was conducted in the Gajah Putih river, Pepe Baru River, Sekartaji River, and Tirtonadi Bendung River in the city of Surakarta, Central Java, Indonesia (110 45` 15 "- 110 45` 35" East Longitude and 70` 36 "- 70` 56 "LS). The research was held on October 12th, 2019. From 01:00 pm until 05:00 pm in multiple area in Surakarta city. These rivers end into the Bengawan Solo River. The research was conducted at the periphery by taking water samples, looking at the state of the river, and recording the biotic components around the river.

2.2 Sample Collection and Research Methods

Water sampling begins by measuring the temperature and acidity level of the water using a thermometer and pH-meter in the river. Then some of water was taken to became a sample. The collected water sample was then put into a 600 ml bottle for laboratory examination. River and biotic factors were analyzed and documented and noted for a report. The Sample was brought to the lab. For TSS measurement samples, the water that has been obtained is filtered. The filter paper is put in the oven at 1050 C for 1 hour and left to stand. Samples were weighed for 20 minutes at room temperature. Then analytic calculations are carried out on the balance sheet. For TDS, the sample from the river is put in a beaker and then tested on a TDS meter after being calibrated do it repeatly for multiple sample from every river.

2.3 Data Analysis

Obtaining data from river samples and laboratory results were analyzed through descriptive and quantitative approaches. By comparing the results of the data with parameters based on quality standards, the level of water quality in each sample obtained at each research location is obtained to determine the water group, pollutant sources, and influencing factors. The water quality standard are used based on UU No.2 Years 2001 about Water Quality and Water Pollution Control. Parameters such as TSS and TDS with quantitative approach were analyzed descriptively.

3. Result and Discussion

Water quality analysis is carried out in order to determine the suitability of water for a certain designation by comparing it with the water quality standard data according to the class. Gajah Putih River, Pepe Baru River, Sekartaji River, and Sekartaji River are water class I rivers. Class I water is water used for raw water and other uses that require the same water quality as its use. Water pollution data that has been observed in several rivers is shown in Table 1 showing that there has been pollution. According to KepMenLH No. 15 of 2003 the status of water quality is the level of water quality conditions that indicate polluted or good conditions in a water source within a certain time by comparing the quality standards applied. The rivers that were observed were said to

be polluted because the river water did not comply with the established quality standards.

The parameters that have been measured in table 1 are then compared with the water quality standards for class I Government Regulation Number 82 of 2001 regarding quality management and water pollution control. Based on table 1 the colour of the river water is dominated by green and even black and the river water has an odor. In this data, it is known that the highest temperature is in the Sekartaji River and the lowest temperature is in the New Pepe River. The highest pH in the data is 5.0 on the Sekartaji River and the lowest pH is on the Pepe Baru River. In these rivers, the river water is turbid and there is also garbage. So that it can be concluded, the river that experiences the highest pollution is the New Pepe River because the river is blackish green and has an odor and temperature of 30 ° C, pH 4.6 and there is quite high turbidity, there is also a lot of garbage in the river. Meanwhile, rivers that experience low pollution compared to other rivers are the Tirtonadi Dam River because the river water is clear green, temperature 32 ° C, pH 4.8, not too cloudy (enough) and not too much garbage but the water also smells.

TDS or Total Dissolved Solid is the amount of metal solids dissolved in water. TDS was measured at four river locations in the city of Surakarta. The TDS value is shown in table 2, where the Pepe Baru River has the highest TDS value because the pollution at that point is also high and the lowest TDS value is found in the Tirtonadi Bendung River because the pollution that occurs is also quite low. TSS or Total Suspended Solid is the amount of suspended solids. The highest TSS value is in the Tirtonadi Weir River and the lowest is in the White Elephant River.

Table 1. Water Pollution Data

No	Location	Color	Odor	Temp	pH	Turbidity	Garbage
1	Gajah Putih River	Black	++	31°C	4,7	+++	+++
2	Pepe Baru River	Green-Black	++	30°C	4,6	+++	+++
3	Sekartaji River	Green	++	33°C	5,0	++	+++
4	Bendung Tirtonadi River	Clean Green	++	32°C	4,8	++	++

Note: + = low, ++ = sufficient, +++ = high
Source: Personal Data (2019)

Table 2. Water Pollution Test with TDS and TSS

No	Sample Location	TDS Value(ppm)	TSS Value(mg/ml)
1	Gajah Putih River	548	-100
2	Pepe Baru River	821	0
3	Sekartaji River	490	0
4	Bendung Tirtonadi River	463	100

Source: Personal Data (2019)

There are several environmental institutions in Surakarta that are related to water management, such as the Environmental Agency (DLH), the Regional Drinking Water Company (PDAM), the Regional Development Planning Agency (Bappeda), and the General Arrangement Service

(DPU). These various institutions hold programs that reduce the impact of water pollution. Such as programs to address water scarcity, floods, water pollution, and climate change. The success of this program requires coordination and cooperation between related institutions. However, not only instasi, the community must also support and run this program so that it can be carried out well. One of the programs is to make the IPAL channel more efficient at each downstream tributary of the Bengawan Solo River by using the cost of a consortium system that involves the government and entrepreneurs. Emphasizes more on waste management because the biggest problem of pollution from the Bengawan Solo River is the disposal of waste into the river without prior treatment and there are still people who throw garbage in the river. At this time there are already programs in progress and there are also programs in the future. For example, conducting socialization / counseling to the community so that they do not litter into the river and care more about the environment. DLH Surakarta in the water pollution control program carries out three stages of counseling, supervision, and publication (Rumaisa et al., 2019)

The obstacles to the running of this program are the lack of APBD funds for development and the lack of cooperation between the private sector. The government has also imposed sanctions for a deterrent effect on small industries that continue to dispose of waste in rivers. The imposition of these sanctions starts from supervision and guidance for those who commit minor offenses to criminal acts for parties who are contributors to liquid waste who are considered to have committed serious violations. Efforts to enforce and optimize criminal law in overcoming criminal acts of water pollution by small industries using preventive and repressive measures. preventive in case this is the creation of laws and regulations to prevent violations as well as crimes in the environmental sector while repressive measures are the creation of processing installations Wastewater (IPAL), holding outreach on waste disposal and replacing chemical dyes with natural dyes (Tambunan et al., 2014). Apart from the program, other efforts can also be made in the form of making infiltration wells (Wardhani et al., 2019).

4. Conclusion

Based on the conditions of the rivers in terms of observations, the river with the highest pollution is Pepe Baru River. Then the river with the lowest pollution is the Tirtonadi Dam River. From several rivers that have been researched, it is known that there are rivers that are polluted Programs such as overcoming water scarcity, floods, water pollution, and climate change. A program that can be carried out is to make the installations Wastewater (IPAL) channel more efficient at each downstream tributary of the Bengawan Solo River by using the cost of a consortium system that involves the government and entrepreneurs. Then the provision of socialization about caring for the environment and the culture of disposing of garbage in its place.

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