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Research Article

Study of Water Quality of Kedung Jumbleng River as A Liquid Waste Disposal of Tofu Industry and Community Behavior of The People in Krajan, Mojosongo, Surakarta

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Abstract. This study examines the water quality of the Kedung Jumbleng River which is used as a tofu liquid waste disposal site and the behavior of the surrounding community which aims to find out how the water quality of the Kedung Jumbleng River is, community behavior, and steps to control pollution. The study was identified through literature searches or field observations formulated in research questions: (1) How is the water quality of the Kedung Jumbleng river?; (2) How is the behavior of the people in Krajan Mojosongo, Surakarta and (3) What are the steps to control pollution. This study is a descriptive mix method with a sequential explanatory design approach, and uses research data collection methods with field surveys and mapping and laboratory tests with parameters such as temperature, pH, BOD, COD, DO, TSS, and NH_3. The sampling technique used was purposive sampling. The analysis used to determine water quality is the Pollution Index method. Descriptive analysis method is used to determine people's behavior in terms of knowledge, attitudes and actions. The results showed that the water quality of the Kedung Jumbleng river exceeded the quality standard in several water quality parameters. Pollution Index value for all classes of moderately polluted water. The results of the analysis of community behavior showed that the behavior of the people around the Kedung Jumbleng river had knowledge aspects of 55.1% High, 42.9% Enough, and only 2% had low knowledge. Attitude aspects 26.6% Good, 69.4% Fairly Good, and 4% Bad. Aspects of action 53% Good and 47% Poor. Based on the interpretation of the research results, it can be concluded that: (1) The water quality of the Kedung Jumbleng river is currently moderately polluted; (2) The behavior of the community in Krajan Mojosongo Surakarta is quite good in terms of the value of the aspects of knowledge, attitudes and actions.

Keywords: tofu; pollution index; community behavior

1. Introduction

Tofu industry in Indonesia uses about 2.56 million tons of soybeans every year to make out where from this amount produced liquid waste about 20 million m3/year and solid waste tofu about 1.024 million tons (Sintawardani, 2011). Tofu processing produces solid waste form of tofu dregs and combustion residues when cooking using firewood and husks and liquid waste form of whey and washing water of tofu. This liquid waste has high organic content. According to Jenie et al., (1993), liquid waste of tofu contains organic substances that can cause rapid microbial growth in water. This will cause the oxygen levels in the water to decrease. Liquid waste contains suspended matter, so make the water dirty/turbid. Environmental pollution that occurs is mostly caused by community behavior as a contributor to the burden of river pollutants. As happened in Krajan Mojosongo, Jebres, Surakarta where there is a behavior of people who dispose of liquid waste from tofu industry into the river without going through the processing first. Nothing facilities means to dispose of people assume that the behavior of disposing of waste into the river is the best step. Maritsa (2009) said that there is a meaningful relationship between the availability of facilities and people's behavior in disposing of waste in rivers.

2. Method

2.1. Research Methodology

This study is a descriptive method of combination model or design sequential explanatory design. The research scope analysis of Kedung Jumbleng river water quality analysis is limited to observed Kedung Jumbleng river water quality parameters measured and observed are BOD, COD, DO, NH_3, TSS, pH and temperature; community behavior based on behavioral indices of environmental non cariousness, for example waste management and water management. Research time is November-December 2020. Research location in Krajan, Mojosongo, Jebres, Surakarta city. The study was conducted in the Kedung Jumbleng River area, Surakarta city starting from the point before the disposal of tofu industrial waste water up to 500 meters after the outlet. The data analysis includes water quality, analysis, water quality identification, test analysis and analysis of com-munity behavior and analysis of water pollution control strategies.

2.2. Research Location

The research location in Krajan, Mojosongo Surakarta. This village is located on the north side of the city of Surakarta, as shown in Figure 1.

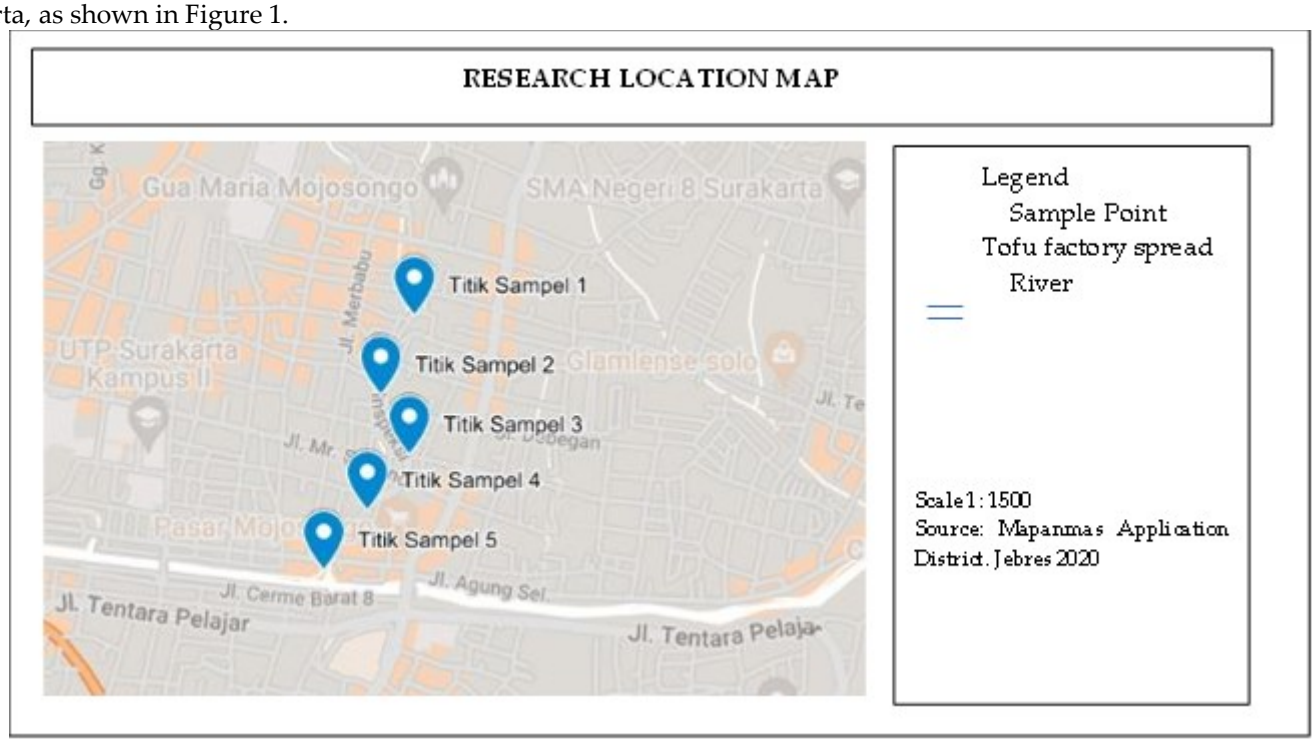

Figure 1. Research Location Map

3. Result and Discussion

3.1. Identification of environmental damage

Identification of environmental damage of Kedung Jumbleng River due to pollution of tofu industry can be shown in Table 1.

Temperature

Temperature parameters at Kedung Jumbleng River at each observation point showed that there was no large or relatively stable temperature difference. The highest average temperature is located at point IV, which is 27.2 °C, this can be caused by the condition of the sampling point, more areas exposed to direct sunlight. There is point IV is a sampling point located after point III which is the outlet of tofu waste disposal from the factory with a large volume of waste. Temperature is one of them factors that influence and can reflect the condition of a body of water. Temperature plays a role in controlling aquatic ecosystems. The optimum temperature range for the growth of phytoplankton in the waters is 20-30 °C (Effendi, 2003). The temperature Kedung Jumbleng River can be said to be still supportive for the growth of plankton.

Table 1. Laboratory Test Results

No	Parameter	Unit	Quality Standard	Test Result				
				Sample1	Sample 2	Sample 3	Sample 4	Sampele5
1	Temperature	C	Dev 3	27	26.8	26.9	27.2	26.8
2	TSS	mg/L	100	37	46	114	115	48
3	Ph	-	6-9	6.82	6.24	5.59	5.57	5.82
4	BOD	mg/L	6	15.957	84.732	237.668	233.532	181.868
5	COD	mg/L	40	51.474	273.33	766.67	753.33	586.67
6	DO	mg/L	3	1.65	1.02	1.35	1.57	1.29
7	NH_3	mg/L	0.5	19.414	30.313	38.727	32.768	39.414

Description: Sample 1: 500 meters before outlet; Sample 2: 100 meters before outlet; Sample 3: the largest outlets; Sample 4: 200 meters after the largest outlet; Sample 5: downstream

Total Suspended Solid (TSS)

The residual value of Kedung Jumbleng river water suspension can be seen in the table. From the table it can be seen that the concentration of TSS increased from 1 sample unit of 37mg/l then reached 115mg/l at sample point 4 and decreased at sample station 5 which was only 48mg/l. Generally, the level of turbidity or brightness of a body of water is strongly influenced by the content of suspension solids (Tarigan, 2010). According to Effendi (2003) high turbidity values can disrupt the osmoregulation system of aquatic organisms.

pH

From Table 6 above shows that the pH measurement results Kedung Jumbleng river water ranges from 5.57,57 to 6.82. The lowest pH value is 5.57 at the sampling point IV. The decrease in pH value from Point 1 to point 4 can be caused by the disposal of liquid waste from the tofu industry during the observation that enters the river body and transported by water run off downstream. Fluctuations in pH value is influenced by the presence of organic and inorganic waste discharge into the river (Yuliastuti, 2011).

Biological Oxygen Demand (BOD)

BOD concentration of Kedung Jumbleng river water obtained the highest concentration at the location of sample point III is 237.668 mg/l and the lowest at the upstream location of sample point 1 is 15.957 mg / l. The high level of BOD, affect the high degree of fouling of effluent derived from pollutant material (industrial effluent) that are dumped into river flow. Fatoki (2001) stated that the high content of BOD in the waters is not expected because it will reduce the content of DO. High levels of BOD, indicating a high degree of fouling of waste derived pollutants (wastewater) are discharged into the river stream.

Chemical Oxygen Demand (COD)

Point 1 is a collection point where around the sample point. There is no factory know. The highest observation at Sample Point 3, which the point where their outlet from the biggest tofu factory. Then it decreases along with the mixing of waste water with river water. High levels of COD in the water can cause an increase in the level of pollution to the waters. This is because the COD parameter is strongly related to the content of organic substances that cannot be biologically described in a body of water. Waters that have high levels of COD cannot be used for Fisheries and agriculture because of the presence of toxic substances that cause damage to plants and aquatic plants (Effendi, 2003).

Dissolved Oxygen (DO)

The results showed the value of DO at TS 1-TS 5 is very low, ranging from 1 - 1.7 mg/l. the low of the DO value indicates a high need for oxygen by microorganisms and macroorganisms. Buchari et al., (2001) stated that if the organic materials that pollute water bodies are quite a lot of the amount of oxygen consumed to decompose these materials more and more so that the dissolved oxygen content in the water drops to such a low. Based Government Regulation No. 22 of 2021 class I, II, III and IV requires water quality with the use of dissolved oxygen content (DO) between 3-9 mg/l, so that the value of DO distribution from the five sample points of Kedung Jumbleng River does not meet the quality standard criteria.

Ammonia NH_3-N

The concentration of NH_3-N (ammonia) measurement results in Table 6 shows an increase from the sampling point 1 to sampling point 5 (from upstream to downstream) and beyond the initial water quality standards from sampling point 1. The increase in ammonia concentration is indicated as a result of residential, livestock and agricultural activities. This is in accordance with the statement Effendi (2003) which states that high levels of ammonia can be an indication of organic matter pollution from domestic waste, industry and run off of agricultural fertilizers in this case is liquid waste from tofu making industry.

3.2. Significance Test

The T test is a continuation of the significance test if the data has shown a normal distribution. In the t test will be tested the difference in the average value, so it is known that the hypothesis of the data is accepted or rejected. Table 2 showed the t values of 5% confidence degrees bidirectionally and degrees of freedom dk = n1 + n2 – 2. If t count < t table then the hypothesis is accepted. Conversely, if the value of t count > t table hypothesis must be rejected.

Table 2. T test calculation results

T test	Parameter						
	Temperature	TSS	pH	BOD	COD	DO	NH_3
t count	0.802	1.605	0.034	3.325	3.178	14.598	8.739
t table	2.776	2.776	2.776	2.776	2.776	2.776	2.776
Notes	Accepted	Accepted	Accepted	Rejected	Rejected	Rejected	rejected

3.3. Environmental Pollution Index of Kedung Jumbleng River Waters Due to Tofu Waste Pollution

Proper assessment of water quality requires methods in determining the level of pollution. Therefore, the use of water pollution index method is very useful in determining the initial status assessment of water quality (Effendi et al.,2015; Li et al., 2016). The estimated value of the water pollution index presents the parameters as well as the data in a simpler way (Singh et al., 2005; Sun et al., 2016; Zeinalzadeh and Rezaei, 2017). Water quality assessment should also be followed by continuous monitoring of water quality in order to create a healthy aquatic ecosystem (Behmel et al., 2016). Calculation of pollution index in this study based on 5 points with predetermined parameters, namely, pH, temperature, TSS, BOD, COD, NH_3, using water quality standards according to PP No. 22 year 2021. The result of pollution index calculation at each sampling point can be seen in the following Table 3. Calculation based on pollution index value is known the highest pollution index value at sampling point 3, while the lowest pollution index value is at sampling point 1. Based on the category of Kedung Jumbleng river water quality status is classified in moderately polluted conditions in all water classes. Based on the category of quality status, Kedung Jumbleng River Water has a moderate pollution index value, this is because the parameters of TSS, BOD, COD have exceeded the threshold of quality standards so that this condition Kedung Jumbleng river water flow is not suitable for the allocation of irrigation resources.

3.4. Identification of Community Behavior Around Kedung Jumbleng River to Environmental Pollution of Kedung Jumbleng River Due to Industrial Pollution Based on Questionnaire Results

The behavior of the people around Kedung Jumbleng river based on the results of the questionnaire had a fairly high knowledge of, but did not show good attitudes and actions. According to an interview with the community around Sungai Kedung Jumbleng, there is indeed a Waste Treatment Plant (WWTP) but the facility is not feasible to use and abandoned. In accordance with The Theory of Planned Behavior perception of behavioral control is determined by the individual's beliefs about the availability of resources in the form of equipment, compatibility, competence and opportunities that support or inhibit behavior. The stronger the belief in the availability of resources, the stronger the perception of individual control over the behavior (Mahyarni,2013). Therefore, people still tend to ignore the disposal and waste management due to inadequate facilities.

Table 3. Kedung Jumbleng River Pollution Index Calculation Results

No	Sampling point	pollution index							
		Class I		Class II		Class III		Class IV	
1	1	6.79	moderately contaminated	6.68	Moderately contaminated	6.56	contaminated moderately	6.49	Moderately contaminated
2	2	7.56	Moderetlly contaminated	7.66	Moderatly contaminated	7.49	Moderately contaminated	7.37	Moderately contaminated
3	3	9.09	moderately contaminated	8.38	Moderately contaminated	8.08	Moderately contaminated	7.93	Moderately contaminated
4	4	9.05	moderately Medium	8.35	Moderately Contaminated	7.83	Moderatly contaminated	7.67	Moderately Contaminated
5	5	8.57	Medium Contaminated	8.23	Moderately Contaminated	8.05	Moderately Contaminated	7.9	Moderately Contaminated

4. Conclusion

Kedung Jumbleng river water quality based on the water pollution parameter test changes that parameters on TSS, BOD, COD, DO, NH_3 at sampling points 2, 3 and 4. Water quality based on the assessment of water quality status with pollution index method shows that Kedung Jumbleng River Jumbleng is moderately polluted. The behavior of the people around Kedung Jumbleng river based on the results of the questionnaire had a fairly high knowledge, but did not show good attitudes and actions.

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