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ANALYSIS OF DETERMINING THE WATER QUALITY STATUS OF THE KALIOTIK LAMONGAN RIVER WITH THE POLLUTION INDEX METHOD

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ABSTRACT

Water is an important natural resource because all forms of life depend on it. Rivers are one of the sources to meet these needs, but now many rivers are indicated to be polluted, one of which is the Kali Otik Lamongan River. This study aims to determine the status of water quality to be analyzed using the Pollution Index (PI) method. The type of research used is quantitative based on the results of the measured data. The water parameters tested were TSS, TDS, pH, temperature, nitrate, ammonia, COD, and BOD with three sampling points, namely the fish market area, residential area and agricultural area. From the results of the analysis using the Pollution Index (IP) method, the water quality status of the Kali Otik Lamongan River is at a moderately polluted level in May-June 2022.

KEYWORDS: *River, Pollution, Pollution Index, IP*

1 INTRODUCTION

Water is considered as the most important natural resource. All forms of life depend on their existence (Kerich & Fidelis, 2020). Activities that people do every day do not escape the use of water such as cooking, washing, bathing, and drinking. In addition to household needs, water is also needed in industry and agriculture. Rivers are one of the sources of water to meet these needs. River water pollution is now a serious problem along with the development of various kinds of industries and the increasing population (Wijaya et al., 2013) with various levels of pollution, ranging from lightly polluted, moderate to high polluted levels. River water quality is largely influenced by community activities, especially those who live or have activities near rivers (Yogafanny, 2015).

Kaliotik is one of the 42 rivers that flow in Lamongan with a length of 12.50 km (Department of Public Works of Water, Lamongan Regency, 2016). The Kaliotik River, which is also referred to as one of the tributaries in Lamongan, is one of the watersheds that are indicated to be polluted. Pollutants that continue to enter the waters without controlling the pollutant source will change and reduce the water quality of the Kali Otik

river. The Kaliotik River is starting to show signs of pollution such as an unpleasant odor and changing water color (Shaleh et al., 2021).

Identification of pollutant sources in the Kaliotik River and analysis of the status of the water quality can be carried out in 2 types of tests. According to Purnamasari (2017), in Indonesia the method of analyzing the quality of water bodies with a water quality index is regulated in the Decree of the State Minister of the Environment (KepmenLHK) Number 115 of 2003 concerning guidelines for determining the status of water quality. In appendices I and II the determination of water quality status can be analyzed using the storet method and the pollution index. Research using the storet method has been conducted by Shaleh et al., (2021) on the Kali Otik river and the results of the analysis they get are that the water quality of the Kali Otik Lamongan river is heavily polluted. Because research using the storet method has been carried out on the Kali Otik River, in this study the analysis of the status of water quality was carried out with a different method. The pollutant index method is one of the methods regulated in KepmenLHK No. 115, this method was used by Sari & Wijaya (2019) in analyzing the water quality status of the Ogan River. From the analysis conducted, the Ogan River is included in the lightly polluted category.

2 MATERIALS AND METHODS

The study began by taking samples of the Kaliotik River at three points, namely residential points, fish market points and agricultural points. The water parameters tested were pH, temperature, DO, nitrate, ammonia, TSS, TDS, COD and BOD. Water sampling is carried out every week with four collections in May-June 2022. The collected water parameter data is then analyzed using the pollution index method.

Pollution Index (IP) or Pollution Index is a method for determining the status of water quality as regulated in the Decree of the State Minister of the Environment No. 115 of 2003 in Appendix II.

The steps of the Pollutant Index method (Decree of the State Minister of the Environment, 2003) include:

1. Choose a parameter that if the parameter value is low, the water quality increases or gets better.
2. Selecting parameter values in quality standards that do not have a range.
3. Calculate the value of Ci/Lij in each parameter.
4. Determine the theoretical value if the lower the parameter value measured, the better, such as DO.
5. Determine the new Ci/Lij if the Ci/Lij value is close to the reference value or there is a very large difference.
6. Determine the average value and maximum value.
7. The PI value is determined by the formula:

a. $$\boldsymbol{PI} = \sqrt{\frac{\left(\frac{Cj}{Lij}\right)2_M + \left(\frac{Cj}{Lij}\right)2_R}{2}}$$

8. Determine the quality status by referring to the table:

Score	Description
0 ≤ PI ≤ 1,0	Good condition
1,0 < PI ≤ 5,0	Light pollution
5,0 < PI ≤ 10	Moderately polluted
PI > 10	Heavily polluted

3 RESULTS AND DISCUSSION

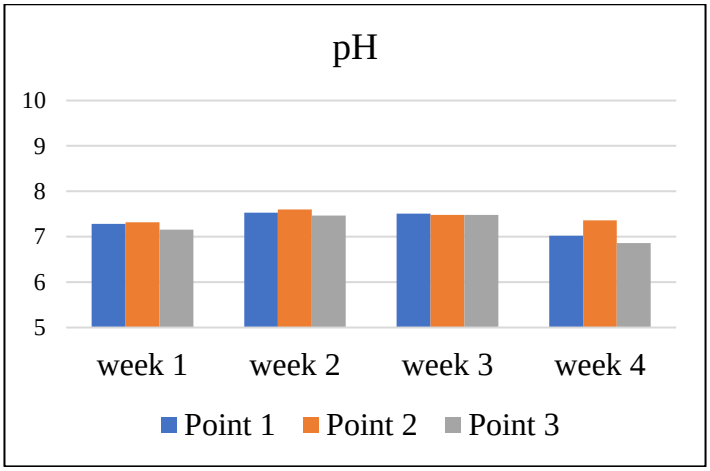

Figure 1. Power of Hydrogen (pH) in Kaliotik Lamongan River

The pH at all sampling points and all sampling times was in the range of 6-9 mg/L, which means that it still meets the class 3 river water quality standard. In line with research conducted by Esta et al. (2016) who examined the Tukad Yeh Poh River, the pH of the water also still met the quality standard with a value that was still in the range of 6-9 mg/L even though the water of the Tukad Yeh Poh River was at a moderately polluted level.

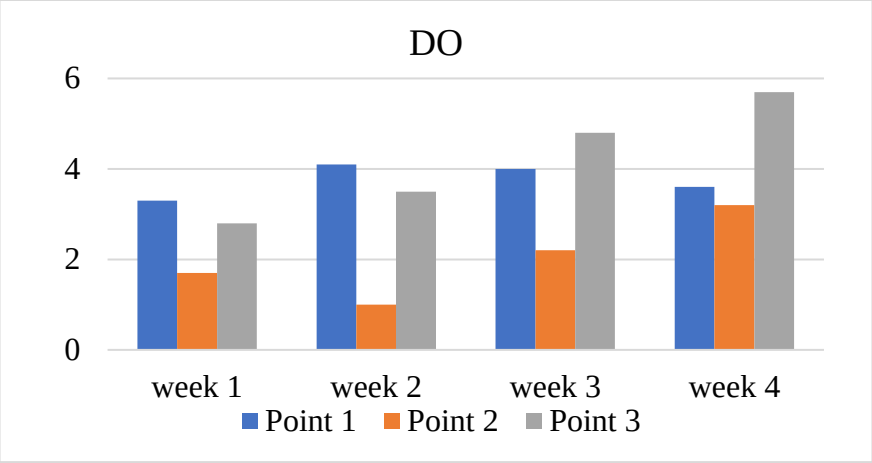

Figure 2. Dissolved Oxygen (DO) in Kaliotik Lamongan River

The lowest DO or dissolved oxygen content is at point 2 or the fish market area. In contrast to other parameters, if the parameter value is low, the water quality will be better, on DO parameter the water quality will be worse if the DO parameter value is lower. The lowest DO value was in the second week with a value of 1 mg/L. Likewise with the research conducted by Shaleh et al. (2021) who examined the Kaliotik River in 2020, the DO parameter value at station 4 (Fish Market Output) did not meet the quality standard with a value of 0.95 mg/L. The results are almost the same as this study because it has very little difference with the lowest DO value that has been tested.

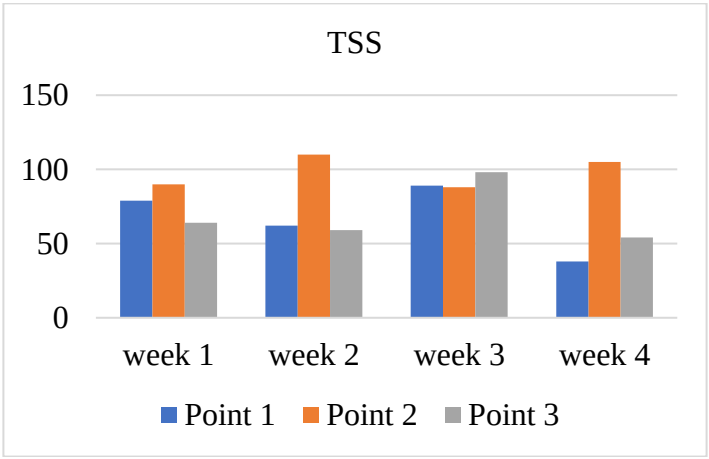

Figure 3. Total Suspended Solid (TSS) in Kaliotik Lamongan River

The highest TSS is on average in the fish market area. From all sampling times, the TSS value did not meet the quality standard only in the fish market area in the second week with a value of 110 mg/L and in the fourth week with a value of 105 mg/L. Even though it still meets the quality standards, TSS levels in residential and agricultural areas are still in the range of 30-90 mg/L. TSS levels are influenced by the number of rocks and waste deposits that can inhibit or hold dissolved particles, besides that, it is also caused by vegetation such as bushes and tree roots (Wifarulah & Marlina, 2021). this research. In

residential areas and fish markets there is plastic waste in river flows, while in agricultural areas there are quite a lot of water hyacinth plants.

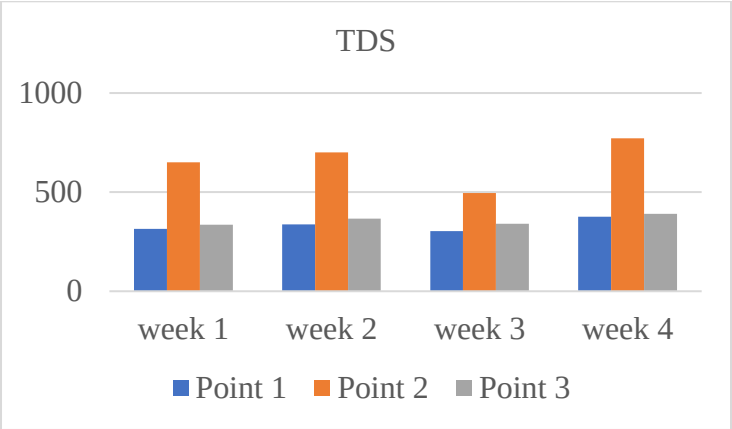

Figure 4. Total Dissolved Solid (TDS) in Kaliotik Lamongan River

The highest TDS value in the fish market area was in the fourth week reaching 771 mg/L. . The TDS in the residential area (point 1) and the fish market area (point 3) has not too much difference compared to the fish market area. In agricultural areas, the TDS value is slightly higher than in residential areas at all sampling times. However, even though it is quite high, the TDS level still meets the quality standard in all areas with a value below 1000 mg/L.

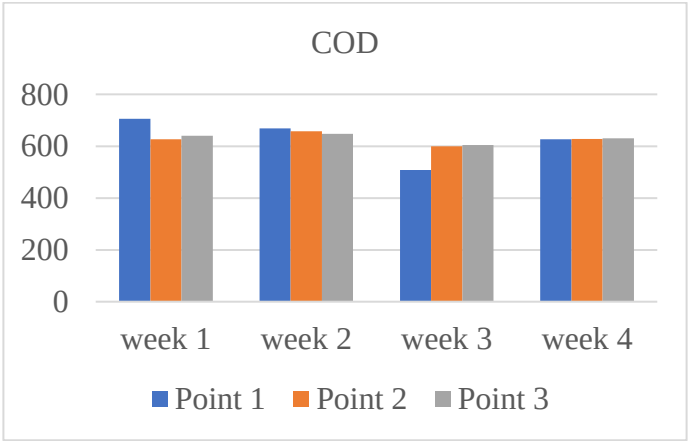

Figure 5. Chemical Oxygen Demand (COD) in Kaliotik Lamongan River

COD values at all sampling points at all times did not have much difference. The COD values at three points both have high values above 500 mg/L, far exceeding the class 3 river water quality standard. The COD value in residential areas (point 1) can be influenced by the disposal of residual washing water, detergent residue and food residue resulting from domestic activities, as well as in fish market areas the COD value in that area can be influenced by fish washing residue (Kurnianti et al. , 2020). The COD value in agricultural areas (point 3) is high but the average BOD value in the area is low, far

below the COD value. This shows that the high content of organic compounds cannot be degraded by microorganisms. The content of compounds contained in water is not biodegradable (Lestari et al., 2014). Waters with a COD value of more than 200 mg/L are considered polluted (Ali et al., 2013).

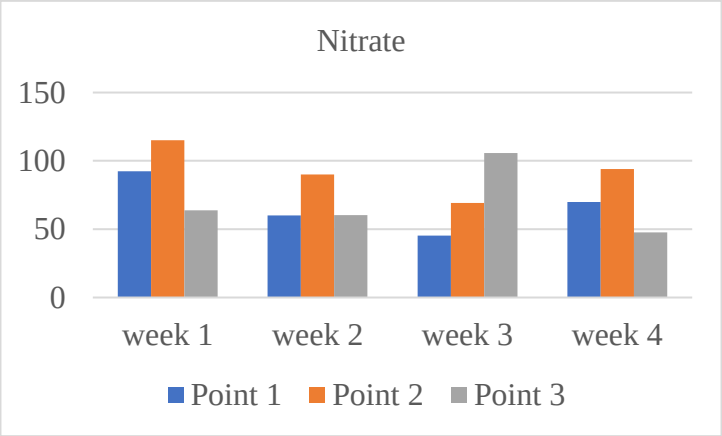

Figure 6. Nitrate in Kaliotik Lamongan River

The nitrate content in the first, second, and fourth weeks is at point 2 or the fish market area. Similar to ammonia, the nitrate value increases due to the decomposition process of fat, protein and carbohydrates in the body tissues of fishery biota (Pamungkas, 2016). In the third week, the nitrate value at point 3 or the agricultural area suddenly rose beyond the nitrate content in the fish market area reaching 105 mg/L. The increase could be affected by the influx of water from agriculture or fish farming into river water bodies. When taking water samples in the third week there were activities of draining rice fields around the river. There is a diesel engine that sucks water from the fields and then flows it into the river.

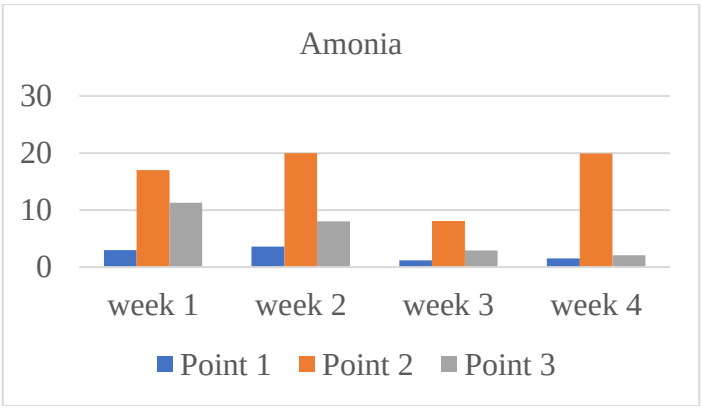

Figure 7. Ammonia in Kaliotik Lamongan River

The highest ammonia value was at point 2 or the fish market area at all times of collection. The ammonia value at point 2 had dropped in week 3 where the waste flow

only flowed slightly compared to the other 3 weeks. Even though it decreased at week 3, the ammonia concentration in the fish market area remained the point with the highest ammonia concentration. The highest ammonia value was in the third week which reached 20 mg/L, far above the class 3 river water quality standard with a limit of 0.5 mg/L. The high ammonia content in fishery activities is caused by the decomposition process of fat, protein and carbohydrates in the body tissues of fishery biota by decomposing bacteria which makes fishery waste easy to decompose. The amount of protein and fat causes the content of ammonia and nitrate to increase (Pamungkas, 2016).

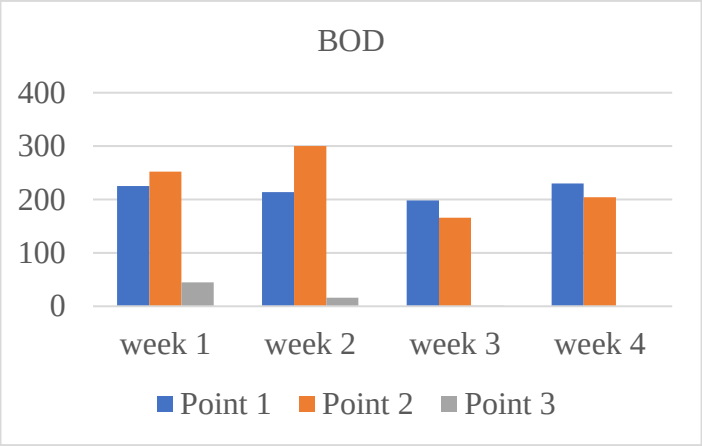

Figure 8. Biological Oxygen Demand (BOD) in Kaliotik Lamongan River

The lowest BOD levels are in agricultural areas (point 3). The low BOD value can be caused by the large number of plants. The more plants in the water, the more organic matter is absorbed and less organic matter must be degraded by microorganisms (Septiawan et al., 2014). This is directly proportional to the conditions in the field in the Kaliotik River agricultural area where there are many water hyacinth plants.

In the first and second weeks the highest BOD values are in the fish market area, while in the third and fourth weeks the highest BOD values are in residential areas. The decrease in BOD in the fish market area could occur because during the third week of sampling, there was not too much waste that came out through the sewer. In the fourth week, although the liquid waste flowing was almost the same as in the first and second weeks, the volume of water was more than the first two weeks. High or low BOD is influenced by microbial activity in the river area (Lestari et al., 2014).

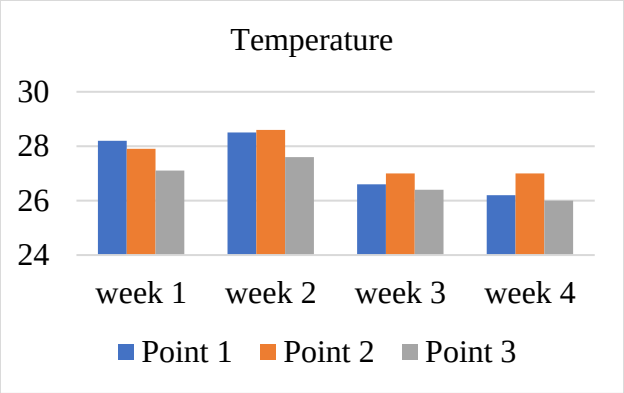

Figure 9. Temperature in Kaliotik Lamongan River

The temperature in the Kaliotik River still meets quality standards, the temperature difference between one point and another has a very slight difference, which is less than 3^{o}C. The high and low temperature can be influenced by the intensity of sunlight entering the waters. The density of vegetation around the river is also one of the things that affect the high or low water temperature (Marlina et al., 2017). This is directly proportional to the results of temperature measurements in agricultural areas which are lower than other areas because of the large number of water hyacinth plants that can block the entry of sunlight into water bodies.

Pollution Index (PI)

Table 1. Pollution Index

No.	Location	Pollution Index Value	Description
	14 Mei 2022		
1.	Point 1 (settlements)	6.663	moderately polluted
2.	Point 2 (fish market)	6.971	moderately polluted
3.	Point 3 (agriculture)	5.879	moderately polluted
	21 Mei 2022		
1.	Point 1 (settlements)	6,563	moderately polluted
2.	Point 2 (fish market)	7.258	moderately polluted
3.	Point 3 (agriculture)	5.306	moderately polluted
	28 Mei 2022		
1.	Point 1 (settlements)	6.344	moderately polluted
2.	Point 2 (fish market)	6.05	moderately polluted
3.	Point 3 (agriculture)	5.097	moderately polluted
	18 Juni 2022		
1.	Point 1 (settlements)	6.612	moderately polluted
2.	Point 2 (fish market)	6,859	moderately polluted
3.	Point 3 (agriculture)	5.097	moderately polluted

In the Decree of the State Minister of the Environment Number 115 of 2003 concerning Guidelines for Water Quality Status, IP values that are in the range of more than 5.0 to less than 10 are included in the moderately polluted category. So it can be concluded that from May to June 2022 the water quality status of the Kaliotik Lamongan River is in a moderately polluted condition. When compared with previous research conducted by Shaleh et al., (2021) who also conducted research on the Kaliotik River, the results of this study stated that the Kali Otik River was in a heavily polluted condition after being analyzed using the storet method. The research was conducted from March to September 2020 which is known to be from the rainy season to the dry season. There are differences in the results of the water quality status of the Kali Otik River in this study and this study. This difference can occur due to the difference in the season at the time of water sampling. If the research covers the dry season, this research is only conducted during the rainy season where it still rains in the sampling period, namely in May and June. Rainwater that falls adds to the volume of water mixed with river water and wastewater resulting from community activities. In addition to the season, there are differences in the quality standards of river water used. In this study, the quality standard was still used before it was updated, namely in Government Regulation Number 82 of 2001 while in this study used river water quality standards which have been updated in Government Regulation number 22 of 2021.

The use of different methods can also have an effect on different results of water quality status. As in the research conducted by Purnamasari, (2017) which examined the water quality status of the Wonokromo River using two methods, namely the storet method and the pollution index method. From the results of the study, the water quality status of the Wonokromo River was moderately polluted after being analyzed by the storet method and lightly polluted after being analyzed by the pollutant index method. The resulting water quality status is different even though the parameter values analyzed are the same.

4 CONCLUSION

The status of the water quality of the Kaliotik Lamongan River from May to June 2022 was in a moderately polluted condition after being analyzed using the Pollution Indes (IP) method.

REFERENCES

Ali, A., Soemarno, & Purnomo, M. (2013). Kajian kualitas air dan status mutu air Sungai Metro di Kecamatan Sukun kota Malang. *Bumi Lestari*, *13*(2), 265–274.

Esta, K. A., Suarya, P., & Suastuti, D. A. (2016). Penentuan status mutu air Tukad Yeh Poh dengan metode storet. *Jurnal Kimia*, *10*(1), 65–74.

Lestari, A. P., Haerruddin, & Ain, C. (2014). Karakteristik dan toksisitas limbah cair dari kegiatan perikanan di Pasar Kobong, Semarang terhadap Chlorella sp. *Management of Aquatic Resources Journal (MAQUARES)*, *3*(4), 201–207.

Marlina, N., Hudori, & Hafidh, R. (2017). Pengaruh kekasaran saluran dan suhu air sungai pada parameter kualitas air COD, TSS di Sungai Winongo menggunakan software Qual2Kw. *Jurnal Sains &Teknologi Lingkungan*, *9*(2), 122–133.

Pamungkas, M. T. O. A. (2016). Studi pencemaran limbah cair dengan parameter BOD5 dan pH di pasar ikan tradisional dan pasar modern di Kota Semarang. *Jurnal Kesehatan Masyarakat (Undip)*, *4*(April).

Purnamasari, D. E. (2017). Penentuan status mutu air Kali Wonokromo dengan metode storet dan indeks pencemar. In *Surabaya: Institut Teknologi Sepuluh Nopember*.

Sari, E. K., & Wijaya, O. E. (2019). Penentuan status mutu air dengan metode indeks pencemaran dan strategi pengendalian pencemaran Sungai Ogan Kabupaten Ogan Komering Ulu. *Jurnal Ilmu Lingkungan*, *17*(3), 486–491.

Septiawan, M., Sedyawati, S. M. R., & Mahatmanti, F. W. (2014). Penurunan limbah cair industri tahu menggunakan tanaman cattail dengan sistem constructed wetland. *Indonesia Journal of Chemical Science*, *3*(1).

Shaleh, F. R., Prihatini, E. S., & Masud, F. (2021). Analysis of water pollution in Kaliotik River, Lamongan-West Java. *IOP Conference Series: Earth and Environmental Science*, *744*(1).

Wifarulah, Y. O., & Marlina, N. (2021). Analisis daya tampung beban pencemaran BOD, COD dan TSS di Sungai Widuri dengan menggunakan software qual2kw. *Jurnal Sains Dan Teknologi Lingkungan*, *13*(1), 1–16.

Wijaya, H., Arina, F., & Ferdinant, P. F. (2013). Identifikasi sumber pencemaran permukaan air Sungai Cidurian menggunakan analisis multivariat. *Jurnal Teknik Industri*, *1*(1), 23–28.

Yogafanny, E. (2015). Pengaruh aktifitas warga di sempadan sungai terhadap kualitas air Sungai Winongo. *Jurnal Sains &Teknologi Lingkungan*, *7*(1), 29–40.