Biomonitoring as an Effort to Monitor River Water Quality with Parameters of BOD, DO, pH, TDS and the Presence of Macrozoobenthos in the Rolak River Area, Surabaya City

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Abstract. Many of the person who built settlements in riverbank areas, this allows residents in riverbank areas become accustomed to disposing of waste directly into the river. In the end, this waste threatens the success of river flow, polluted river water has a serious impact on the health and quality of the environment around the riverbanks, such as the negative impact caused by this pollution, for example, such as health which has an impact on the surrounding environment or others. Because it is important to understand the natural health relationship, this study chose a river area that is located around the Rolak area of Surabaya, this place was chosen because the area is around a densely populated area and an industrial area. So that it can be used as research because the area certainly has a high level of pollution. As a result of the impact of the many residential and industrial areas around the river, the biomonitoring method is carried out to identify river pollution from its physical habitat by monitoring environmental health using living organisms in the river. Therefore, the biomonitoring method can be applied because the advantages of this method can also be used including helping identify by using test parameters such as measuring pH, temperature, and oxygen content in river water. that has been done before. Then the biotic examination can be used as a guide that can represent the quality of a body of water, from observations at several points the river is known to have a color that tends to be brownish due to turbidity levels, the pH parameters at each sample point are classified as normal and for Total Dissolved Solid (TDS) there is content of 339 mg/l, this is thought to be due to the source of domestic waste pollution from residents' settlements around the river banks. For DO test results there are only five points that meet quality standards. As for the diversity of bioindicators at each point, such as the presence of weeds at the first point, while the presence of water hyacinth can only be seen at the third and fourth points, the macrozoobenthic that are commonly found in the mangrove area are from the Crustacea, Polychaeta, and Bivalvia.

Keywords: Biomonitoring, Macrozoobenthos, Rolak River, Surabaya City, Water Quality

1. Introduction

Environmental Quality is declining over time, along with the increase in population every day, impacting the higher the amount of waste produced. The source of this water pollution can be several parts based on the waste produced, including domestic waste sources and non-domestic waste sources. (Gusriani, 2014:2) Sources of domestic waste are usually produced by households (communities), factories, parchments, and others. The largest source of liquid waste generation in the country is from the results of household activities. This is because the population in Indonesia is very large. Therefore, the volume of domestic waste produced is also large (Angga, 2007). Various efforts have been made to reduce the impact of domestic waste pollution but have encountered several obstacles. One of them is the high cost of waste treatment equipment or plants so that it is difficult to reach by the community.

Domestic liquid waste is water that has been used and comes from households or settlements including those from bathrooms, washing places, toilets, and cooking places (Sugiharto, 2008). Based on East Java Governor Regulation No. 72 of 2013 concerning wastewater quality standards for industry and/or other business activities, the key parameters for domestic wastewater are BOD, COD, TSS, pH, and Fats and Oils. While many non-domestic waste sources are produced by detergents, fragrances, and the like. The increasing population is the cause of the decrease in existing vacant land, so many people have established settlements on the banks of rivers and rivers.

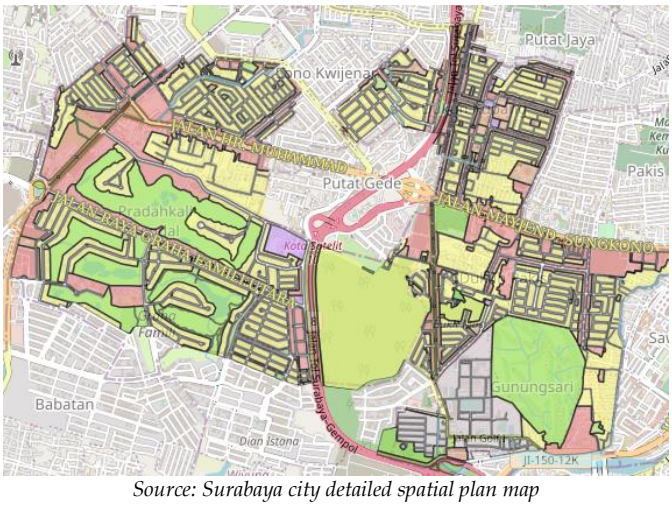
Surface water quality can be determined using a combination of physical-chemical and biological parameters. One of the monitoring of water quality with biological methods can use biomonitoring methods. The biomonitoring method utilizes the presence of bioindicators as indicators of water quality (Barus, 2004) Measurements using biological parameters can be used to monitor continuously. This is because the aquatic biota community spends their entire lives in the environment, so that if there is pollution it will be accumulation or hoarding (Widiyanto, n.d.). In order to answer the challenges and solutions to overcome river pollution, one of the offers is to conduct several studies on river water quality tests. Data from these studies are expected to open up to all circles that the river has been polluted or unpolluted. The purpose of this study is to examine the quality of the Rolak Surabaya River on Jalan Mastrip Surabaya City with the biotilic method. Biotilik is environmental monitoring using indicators of macroinvertebrates (boneless animals visible to the naked eye), such as aquatic insects, crabs, shrimps, snails, and worms. In conducting biomonitoring to identify river pollution from its physical habitat, it needs to be done carefully and using appropriate methods. This is because the river environment is very complex and vulnerable to human disturbance. Therefore, the use of biomonitoring can help to ensure the health of the river environment and prevent further pollution.

2. Materials and Methods

2.1 Materials

The tools used in this study are; (1) Dipper, (2) Jeriken, (3) Plastic container, (4) Filter, (5) pH meter, (6) TDS meter, (7) BOD meter, (8) DO meter. The research materials used are macroinvertebrates found in river sediments and water taken from river bodies.

2.2 Methods



Source: Surabaya city detailed spatial plan map

The coordinates of the research location are 7o16'21 "S, 112o41'38 "E. Sampling time was conducted on Monday, May 20, 2023 at 10:00 am - 12:00 pm.

2.2.1. Examination of the physical condition of the river

Physical examination of the river is carried out to be able to determine the physical condition of the river and its relationship with the quality of river water and the presence of living things around the river. This stage starts from the selection of locations and sampling points that will be used as research. The selection and determination of location is carried out with surveys that have been carried out and hypotheses about the condition of the river. Furthermore, observations were made on the physical condition of the river, sediment deposition in the river taken from each sampling location, vegetation around the river, and environmental conditions along the river. The results of these observations are recorded according to actual conditions.

2.2.2. Biotic examination in the river

Biotic or living things, especially in biomonitoring research, can be used as an indicator that is able to present the quality of a body of water seen from the pollutants contained. Biotic examination in this study focused on the examination of macroinvertebrates. Macroinvertebrates act as bioindicators that will show how strong or resistant to certain pollutants are. In its application, this stage is carried out by observing and counting the number of macroinvertebrates found in river sediments and then related the relationship between the presence of macroinvertebrates with water quality known through laboratory testing.

2.2.3. Examination of the content of chemical parameters

Examination of river water content is carried out so that it is known how the quality of river water. Before starting the gynecology examination, river water sampling is carried out first. In this study, sampling was divided into five points along the river. This has the aim that each point can be known for its own quality and analyze what makes the difference in quality at each point. Sample water is taken at five predetermined points and put into different jerry cans and marked for each jerry can so that it is not confused. The five water samples were tested at the Environmental Engineering Laboratory of the Department of Environmental Engineering, Adhi Tama Institute of Technology, Surabaya. The parameters measured to determine the content and quality of river water are pH, TDS, BOD, and DO. The four parameters were tested on each sample with simple tests using pH meters, TDS meters, BOD meters, and DO meters. The results of the values of each parameter are recorded and analysis of each point is carried out.

3. Result and Analysis

Physical Observation

This sampling activity was carried out at several river points in the Rolak area of Surabaya, Surabaya. The physical characteristics of the sampling location are carried out through visual observation, namely making observations on the conditions around the sampling site. The physical parameters in question are the color of the water and the presence of biota that grows around water bodies. The water along the river has the same color, which tends to be brownish. This indicates a high level of turbidity.

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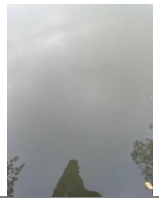
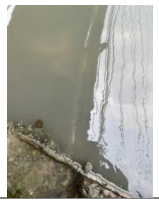
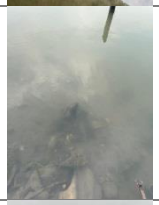
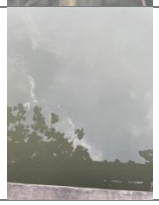
Table 1
Differences in Physical Characteristics of Sampling Sites at Three Different Points

Documentation	Physical Characteristics
	Point 1 has brownish water conditions, with invisible bottom waters so it can be indicated that the level of turbidity is quite high. The aquatic biota seen around this point are plants dominated by weeds (such as buckhorn bananas and teki grass).
	Point 2 has brownish water conditions, with the bottom of the water that is also not visible so it can be indicated that the level of turbidity is no less high. At this point, the presence of water hyacinth or Eichhornia crassipes is still not visible.
	Point 3 has water conditions that tend to be brownish in color. This illustrates the high turbidity of the water. At this point, the presence of water hyacinth or Eichhornia crassipes is quite massive. The growth of these aquatic biota tends to be clustered but still leaves room for water so that it remains visible.
	At point 4, there are several plants or weeds growing around the water body. The water condition at this point is the same as the previous points, which tends to be brownish. However, water hyacinth was no longer visible at this point.
	Point 5 has the same water conditions as points 1-4, which is brownish in color.

Chemical Parameters

In addition to physical water quality inspection, chemical water quality checks are also carried out. The level of river water pollution is measured through examination of several water quality parameters such as pH, TDS, BOD, and DO. From the results of laboratory examinations, it can be seen that the highest pH value is found at point 1 which is 9 and the lowest at point 4 which is 8.5. According to Indonesian Government Regulation No. 22 of 2021, the pH quality standard for classes I to IV is 6-9. So that This shows that river water at 5 sampling locations is normal and does not exceed river quality standards for classes I-IV. According to (Lecturer et al., 2016), aquatic organisms like pH close to neutral (7) because it can optimize decomposition processes in waters.

Total Dissolved Solids (TDS) is a solid dissolved in solution in the form of both organic and inorganic substances, namely all minerals, salts, metals, and cations dissolved in water. The highest TDS content was found at point 4 of 339 mg / L and the lowest TDS value was found at point 1 of 220 mg / L. The high TDS value at point 4 is thought to be caused by polluting sources of domestic waste originating from residential areas on the banks of rivers. This is supported by the statements put forward (Prayogo, 2015) which states that usually high dissolved solids due to the large number of solids dissolved by various human activities. Even so, the water quality at the 5 sampling locations is still fairly good because it has a content value of less than 1000 mg/L.

The next parameter tested is the Dissolved Oxygen (DO) parameter. DO is needed by all living bodies for breathing, metabolic processes or exchange of substances that then produce energy for growth and reproduction. The highest DO level is found at point 5 of 3.54 mg / L and the lowest DO level is found at point 1 which is 1.15 mg / L. When viewed from the Government Regulation of the Republic of Indonesia No. 22 of 2021, the minimum level of DO according to 3rd Class is 3 mg / L. So that from the results of the DO test, only point 5 meets the quality standards, while points 1, 2, 3, and 4 do not meet these quality standards. According to Simanjutak (2007), the higher the content of Dissolved Oxygen (DO) the better the quality of the water, and vice versa.

The last parameters tested at the five sample points are: Biological Oxygen Demand or commonly abbreviated as BOD. Power BOD indicates the amount of dissolved oxygen required by microorganisms to decompose or decompose organic matter under aerobic conditions. From the results of laboratory tests, the highest BOD value was obtained at point 5 of 3.60 mg / L and the lowest BOD at point 1 of 1.84 mg / L. From this data it can be seen that this value still meets the quality standards according to (Government of the Republic of Indonesia, 2021) that is, with a maximum level of BOD according to 3rd Class of 6 mg / L.

Table 2
water quality parameter values of Surabaya city's rolak river

Parameter	Unit	Sampling Point					Quality Standards		
		1	2	3	4	5	1st Class	2nd Class	3rd Class
pH	-	9	8,8	8,7	8,5	8,6	6-9	6-9	6-9
TDS	mg/L	220	235	243	339	237	1000	1000	1000
DO	mg/L	1,15	2,03	2,36	2,45	3,54	6	4	3
BOD	mg/L	1,84	1,97	2,37	2,44	3,60	2	3	6

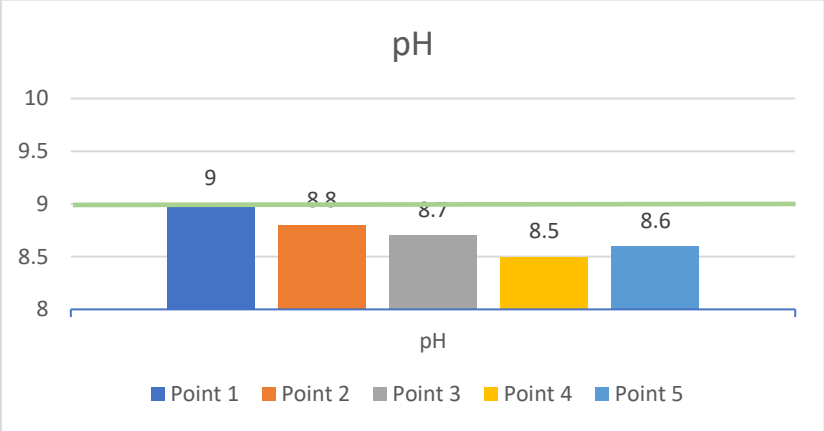


Fig. 1 pH Value

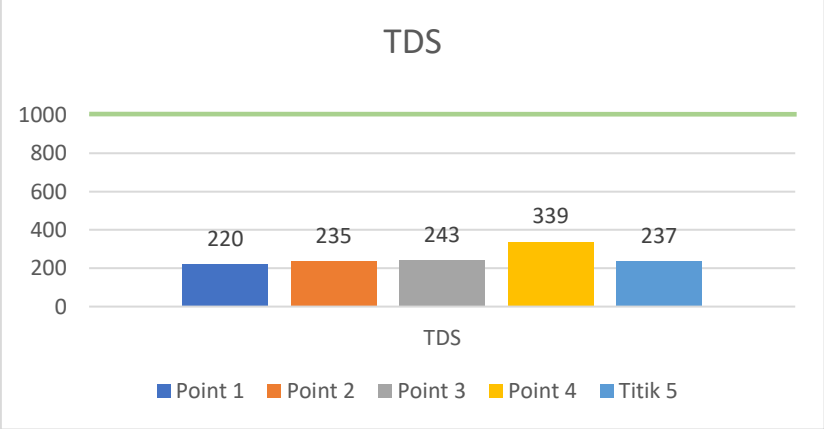


Fig. 2 TDS Value

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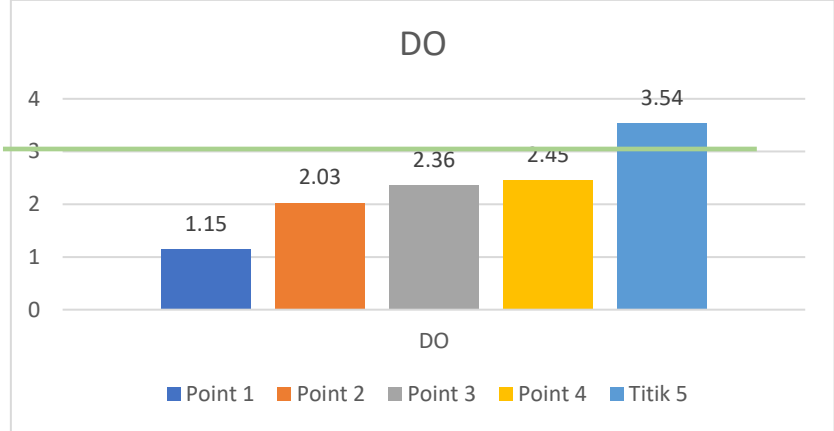


Fig. 3 DO Value

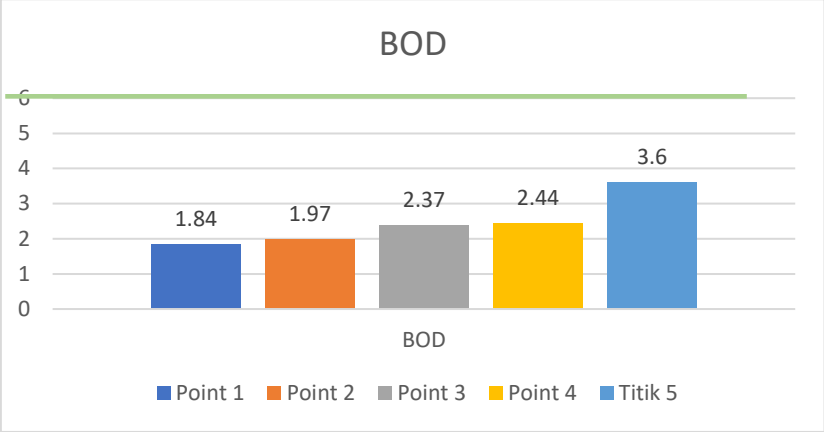
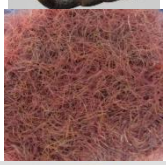


Fig. 3 BOD Value

Biological parameters

Macrozoobenthos are one of the most important groups in aquatic ecosystems due to their role as key organisms in food webs. In addition, the level of diversity found in the aquatic environment can be used as an indicator of pollution. Macrozoobenthos are organisms that live at the bottom of waters, and are part of a food chain whose existence depends on populations of lower-level organisms. Makrozoobenthos is a group of benthos that has a size of more than 1 mm and adult growth has a size of 3-5 mm. Macrozoobenthos helps to accelerate the process of decomposition of organic matter. Benthos, especially herbivores and detritors, can break down aquatic macrophytes and watershed litter into small pieces, making it easier for microbes to break down into nutrients for aquatic producers in the food chain. Various types of macrozoobenthos also act as primary consumers and some act as secondary consumers or consumers who occupy a higher place. In general, Makrozoobenthos is a natural food for bottom fish. Macrozoobenthos live attached, slithering (sesile), burrowing and immersing themselves both at the bottom of the water and on the surface of the aquatic bottom. Macrozoobenthos that live in mangrove areas mostly live on hard to muddy substrates. This animal plays several important roles in waters such as in the process of decomposition and mineralization of organic matter entering the waters, as well as occupying several trophic levels in the food chain. Macrozoobenthos commonly found in mangrove areas are from Class Crustacea, Polychaeta, Bivalves and Class Gastropoda. Macrozoobenthos animals are very sensitive to changes in environmental conditions in which they live, so they will affect their composition and abundance. The macrozoobenthos diversity index shows the condition of the waters of the river.

Table 3
the number of macrozoobenthos in the rolak river of Surabaya city

Phylum	Genus		The Number of Makrozoobenthos				
			Point 1	Point 2	Point 3	Point 4	Point 5
Mollusca	*Thiaridae*		-	2	-	2	-
	Pleurocerid		11	-	-	-	-
Annelida	*Tubifex sp*		5	5	31	84	5
Arthropoda	*Cladocera*		1	-	-	-	-
Total at each point			17	7	31	86	5

Relationship of Physical, Chemical and Biological Parameters

These physical-chemical parameters can be a reference to the pollution that occurs. Because macroinvertebrates are biota that live sedentary in a habitat, fluctuations in the value of some of these parameters can be used as a basis for determining environmental management policies (Alfarodzi et al., n.d.). From the observations from the sampling point, the largest diversity index value is found at sampling point 4, which is 0.38, this if correlated with the chemical parameters at sampling point five, the value is appropriate, except for the DO value which is not in accordance with the indigo of class 3 river quality standards Government Regulation of the Republic of Indonesia No. 22 of 2021. River waters in accordance with their designation are used for freshwater fish farming, animal husbandry, water to irrigate crops. So that in river waters these five sampling points allow macrozoobenthos to live. However, this DO value does not meet quality standards, allowing COD pollution to occur that is not tested.

From the observations from the sampling point, the lowest diversity index value is found at sampling point 5, which is 0.12, this if correlated with the chemical parameters at sampling point five, the value is in accordance with the indigo of class 3 river quality standards of Government Regulation of the Republic of Indonesia No. 22 of 2021. Where in accordance with its designation, which is used for freshwater fish farming, animal husbandry, water to irrigate crops. So that in river waters these five sampling points allow macrozoobenthos to live. However, the lowest value of macrozoobenthos diversity is thought to be in the waters of the river there are chemical parameters whose values exceed quality standards that are not tested. Looking at the physical condition of the river waters, the riverbanks are dominated by the restaurant industry and factory industries that contribute water pollutants both organic and inorganic.

4. Conclusion

Based on observations that have been made, the sustainability of habitat in the rivers of the Rolak region of Surabaya can be categorized in good condition, and from the results of the identification of species diversity and abundance *of macrozoobenthos* microorganisms in the rivers of the Rolak region of Surabaya found one phylum, namely *mollusks* in the gastropod class. The gastropod class *has a* fairly high abundance because it is caused by the body's resistance and the adaptation of the hard shell that allows it to survive. The results of the pH measurement test obtained the highest pH value, which is at point 1 with a pH of 9 and at point 4 has the lowest pH level of 8.5. The highest value of TDS measurement is found at the sampling location, which is at point 4 of 339 mg / L and the lowest TDS value is located at point 1 with a TDS value of 220 mg / L. The high value of TDS is caused by polluting sources of domestic waste originating from residential areas on the banks of the river, but from the results of TDS measurements that have been carried out at 5 points are still categorized in good condition because of the maximum limit of 1000 mg / L. Test results DO measurements obtained the highest value at the sampling location, namely at point 5 of 3.54 mg / L and the lowest DO value was located at point 1 which was 1.15 mg / L. According to the Government Regulation of the Republic of Indonesia No. 22 of 2021, the minimum level of DO according to 3rd Class is 3 mg / L. So that from the results of the DO test, only point 5 meets quality standards, while points 1, 2, 3, and 4 do not meet these quality standards. The results of the BOD measurement test found the highest value at the sampling location at point 5 of 3.6 mg / L and the lowest BOD value was located at point 1 of 1.84 mg / L. From this data, it can be seen that this value still meets the

JCEPD-ISSN: 2830-3628

quality standards according to Government Regulation of the Republic of Indonesia No. 22 of 2021, namely with a maximum level of BOD according to 3rd Class of 6 mg / L.

Acknowledgments

[1] Alfarodzi, A., Dwiki, P., Arda, S., Jalalludin, A. J., Putra, R. T., Chusnun Ni'am, A., Adhi, I. T., Surabaya, T., & Surabaya, I. (n.d.). Al-Ard: Jurnal Teknik Lingkungan BIOMONITORING KUALITAS AIR SUNGAI BUNDARAN ITS KOTA SURABAYA DENGAN BIOINDIKATOR MAKROINVERTEBRATA. In *Jurnal Teknik Lingkungan*. http://jurnalsaintek.uinsby.ac.id/index.php/alard/index

[2] Pemerintah Republik Indonesia. (2021). Lampiran VI tentang Baku Mutu Air Nasional - PP Nomor 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup. *Sekretariat Negara Republik Indonesia*, *1*(078487A), 483. http://www.jdih.setjen.kemendagri.go.id/

[3] Pengajar, S., Studi, P., Sumberdaya, M., Program, M., Manajemen, S., Perairan, S., & Tarakan, U. B. (2016). *Jurnal Harpodon Borneo Vol.9. No. 2. Oktober. 2016 ISSN : 2087-121X*. *9*(2), 143–157.

[4] Prayogo, T. B. (2015). *Analisis Kualitas Air Dan Strategi Pengendalian Pencemaran Air Sungai Metro di Kota Kepanjen Kabupaten Malang*. *6*(2), 105–114.