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Analysis of the Water Quality of Padolo River, Bima District

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Abstract: A river is a body of water characterized by a current flowing from upstream to downstream to the estuary. River water quality is influenced by both natural and human factors, as rivers serve as a venue for various activities. The purpose of this research is to assess the water quality of the Padolo River, as measured by chemical parameters. This type of research is descriptive quantitative. the chemical parameters tested in this study were pH, BOD, COD and DO. pH testing on water samples was conducted using the pH meter method, while BOD, COD, and DO testing were performed using the Winkler method. The research results indicate that the pH levels in the upstream, middle, and downstream sections are the same, specifically 6.9. The BOD value in the upstream section is 10.8 mg / L, the middle section 9.5 mg / L and in the downstream section 18 mg / L, while the COD value in the upstream section is 28 mg / L, the middle section 24 mg / L and in the downstream section 32 mg / L and the DO value in the upstream section is 5.8 mg / L, the middle section 6.8 mg / L and in the downstream section 7.9 mg / L.. Based on the measurement results and government regulation no. 22 of 2021 concerning river water parameter standards, it is stated that the BOD and DO values do not meet the specified quality standards. It is hoped that the local government will conduct routine water quality measurements in the Padolo River, considering that the water is used by residents for bathing, washing, and toilet purposes.

Keywords: BOD; COD; DO; pH; Padolo River.

Introduction

Water is a fundamental necessity for humans and other living organisms, as it is a vital requirement for survival. Clean water is water used for daily needs that meets health requirements [1]. Clean water is obtained from various water sources; however, not all water sources meet these needs due to pollution caused by both human activities and natural processes. The Earth's water area is larger than its land area, making water issues a significant problem, including the provision of clean water, water pollution, and water distribution [2].

Rivers are highly dynamic systems, where human activities in the river basin can affect water quality from upstream to downstream. Activities in the river basin, such as residential areas, agriculture, and industry, result in the release of pollutants into the river flow. River water suitable for use and safe for human health is water that meets the quality standard requirements for physical, chemical, and biological parameters stipulated in Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management. To meet these quality standards, raw water must be processed into clean water before it can be used as potable water [4].

River water generally provides a significant portion of the water supply, both quantitatively and continuously. However, its quality is vulnerable to environmental pollution. River water quality, which is often raw water that does not meet health requirements, can lead to waterborne diseases, including dysentery, typhoid, gastroenteritis, and other illnesses [5].

A river can be defined as an inland aquatic ecosystem that serves as a reservoir for water flow originating from springs or rainfall. Rivers serve as habitats for various aquatic organisms, reflecting the ecological relationships within them, including changes resulting from human activities. The use of rivers for various purposes causes changes, particularly a decline in the quality of river water. Water use without prudent measures and a lack of proper management will damage water resources [6]

Water also stems from ensuring water quality meets clean water specifications. Good water is clean, meaning it is odorless, clear, not cloudy, and does not leave sediment. While various minerals found in water are essential for the body, some are not necessary for human health and can even be harmful [7].

There are three groups of measures used to assess water quality in a water system: physical, chemical, and biological. Furthermore, water pollution is also influenced by the influx of liquid waste from agro-industry and organic waste from residential or household activities [8].

Human activities, such as dumping household waste, industrial and urban waste, and agricultural runoff into rivers, degrade water quality and cause water pollution. Solid and liquid waste, as well as human waste, dumped into rivers cause significant water contamination, often containing bacteria that are potentially harmful to human health. River water pollution not only negatively impacts humans, but also affects the reproductive capacity of fish species in rivers, potentially leading to the extinction of fish populations in the future [9].

Water pollution refers to a deviation from normal water properties, not its purity. Water on Earth is never found in its pure form. However, this does not mean that all

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water is polluted. For example, even in remote mountainous or forested areas with clean, pollution-free air, rainwater always contains dissolved substances, such as CO_2, O_2, and N_2, as well as suspended substances such as dust and other particles carried by the rainwater from the atmosphere [10].

Water usually contains certain levels of chemicals, both inorganic and organic. If these chemicals are present in excessive amounts, the water can become a source of disaster that can harm the survival of all living things around it. Nowadays, with water pollution from factories and households, the chemical content in water is increasing, ultimately decreasing the water quality. Therefore, water analysis is necessary to determine and quantify the chemicals contained in the water, so that it can be determined whether the water is harmful to health, suitable for consumption, or polluted [11].

Environmental pollution is the introduction or introduction of living things, substances, energy, and/or other components into the environment through human activities or natural processes, resulting in reduced environmental quality or a loss of its intended function. Liquid waste is a significant problem, as it can pollute rivers due to its high organic content and low pH levels. Therefore, waste must be treated before being discharged into rivers [12].

BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand) examination in river water is a way to measure the level of organic material pollution to assess water quality, where BOD measures oxygen for biological decomposition by microorganisms, while COD measures oxygen for total chemical oxidation (organic & inorganic), both of which are important for maintaining aquatic ecosystems and regulatory compliance, with high values indicating poor water quality and potential reduction in Dissolved Oxygen (DO).

The Padolo River is one of the major rivers in Bima City, flowing north through 21 villages in three sub-districts and emptying into Bima Bay. The river's water is also widely used by local residents for clean water needs, including bathing, washing clothes, and fishing. A problem that arises is that the river water becomes a dumping ground for various types of waste, including organic, inorganic, and liquid waste, which is deposited in the riverbed. Based on this background, researchers wanted to conduct a study analyzing the water quality of the Padolo River using chemical parameters.

Research Methods

Sampling locations were established at three points: upstream, middle, and downstream. The tools used in this research include a pH meter, a beaker, filter paper, a furnace, an analytical balance, a 100 mL Erlenmeyer flask, a glass funnel, a 100 mL graduated cylinder, and a crush cup. The materials used in this study were 4-30 mesh zeolite, 5-30 mesh silica sand, activated carbon, and foam filter mat and river water sample, Tissue, Manganese sulfate MnSO4 40% 1 ml, Alkali/potassium iodide azide (NaOHKl) 1 ml, Concentrated sulfuric acid (H_2SO_4) 1 ml, Titration solution Sodium thiosulfate(Na2S2O3) 0.25 N, Ferrous indicator, BGLB 2% media, LBDS media, LBSS media, sterile distilled water, 70% alcohol, and matches [13].

Research Design

This research uses a Quantitative Descriptive Design. Quantitative descriptive research is a method for describing and analyzing phenomena or populations using numerical data (numbers), answering the question "what", not "why" or "how", with the aim of describing the situation systematically and accurately, often using surveys and questionnaires to produce statistical data such as frequency, average, median, mode, and correlation between variables without the need to test complex hypotheses, only focusing on the picture as it is.

River Water Sampling Technique

River water sampling uses the grab sampling technique (instantaneous sampling), which is not affected by the season. Samples are taken at three points using the following sampling procedure: Prepare sterilized equipment before use in river water sampling, Rinse equipment or containers twice with the water sample to be collected, Place the sample bottle into the river water at a 45° angle against the river current and close the bottle cap, Label the bottle and place it in a cool box. The samples are ready to be taken to the laboratory for testing on the filtration equipment and for subsequent water quality testing before and after treatment [14].

Chemical Testing Methods

pH

Place a water sample whose pH will be measured in a container. Turn on the pH meter and insert the probe into the water sample. Wait until the pH reading is stable and record the pH value displayed on the screen. Make sure the pH meter is calibrated before use. The working principle of a pH meter involves a glass electrode and a measuring instrument [5].

COD

Prepare a river water sample. Pipette 10 ml of the water sample into a 100 ml Erlenmeyer flask. Add 5 ml of K2Cr2O7 to the 100 ml Erlenmeyer flask. Add 10 ml of concentrated H2SO4 and cover with a watch glass. Let it stand for 30 minutes. After 30 minutes, add 7.5 ml of distilled water. Add a drop of ferroin indicator and mix until the sample turns slightly greenish. Titrate with 0.1 N ferrous ammonium sulfate solution (from the green solution to orange). Note and record the titration volume [16].

BOD and DO

Prepare river water samples. Incubate for 5 days in a dark room for the DO5 sample and without incubation for the DO0 sample. Each sample is 125 ml. Add 1 ml of 40% manganese sulfate (MnSO4) solution, homogenize, and let stand for several minutes. Add 1 ml of alkali/potassium iodide azide (NaOHKl), then let stand for several minutes until a brown sediment appears. Transfer 12.5 mL of the test sample, containing a large amount of sediment, to a new Erlenmeyer flask. Add 1 ml of concentrated sulfuric acid (H2SO4) solution until the sediment dissolves. This is done in a fume hood. Titrate with 0.25 N sodium thiosulfate (Na2S2O3) solution until a light-yellow color forms. Add starch indicator until a bluish color appears. Titrate again until the bluish color disappears. Record the total titration volume [17].

Results and Discussion

The Padolo River is one of the rivers that crosses the city of Bima, especially in the Dara sub-district of West Rasana'e district. The upstream area of the river is located in a higher elevation in Bima Regency, while the downstream area is situated in the urban area. The Padolo River basin covers an area of approximately 291.16 km2 with a river length of approximately 36 km. Its flow passes through at least 21 villages from 3 sub-districts. This river is located at the coordinate point 118^{o}21" OO"-118^{o}48" OO" East Longitude and 8^{o}20'OO"-8^{0}30'OO" South latitude.

The results of measuring the chemical parameters of the Padolo River water are presented in the table below.

Table 1. The result of measuring the chemical parameters of the Padolo River

Parameter	Result			Unit	PP RI No. 22 year 2021 (class III)	Information
	Upstream	Middle	Downstream			
pH	6.9	6.9	6.9		6-9	Eligible
BOD	10.8	9.5	18	mg/L	6	Not Eligible
COD	28	24	32	mg/L	40	Eligible
DO	5.8	6.8	7.9	mg/L	3	Not Eligible

Based on the table above, the pH value at the three sampling points, both upstream, middle, and downstream, is 6.9. The BOD value in the upstream section is 10.8 mg/L, the middle section is 9.5 mg/L, and the downstream section is 18 mg/L. The COD value in the upstream section is 28 mg/L, in the middle section 24 mg/L and in the downstream section 32 mg/L, and the DO value in the upstream section is 5.8 mg/L, the middle section 6.8 mg/L and the downstream section 7.9 mg/L. It can be seen that the pH and COD values still meet the requirements set forth in Government Regulation No. 21 of 2021, whereas the BOD and DO values do not meet the requirements stipulated in the regulation.

High BOD levels mean that there is a lot of organic material that needs to be broken down by microorganisms, so that DO (Dissolved Oxygen) becomes low, causing dead zones (hypoxia) that kill fish and other aquatic biota, triggering eutrophication (algal blooms), changing nutrient cycles, destroying habitats, and making the water smell bad and unfit for human use, even though high DO is actually a sign of clean water.

pH

Acidity is a crucial factor in water treatment processes that improve water quality. The acidity level affects the toxicity or poisoning potential of heavy metals in water. At a low or acidic pH, heavy metals dissolve more easily and become more toxic to living organisms. Conversely, at high or alkaline pH levels, heavy metals tend to precipitate and become less hazardous [18].

Based on the results of pH measurements from the three gizzard sampling locations, it was 6.9. These results indicate that the pH of the Padolo River still meets the quality standards set by Government Regulation No. 22 of 2021.

This indicates that the pH of the Padolo River waters is still ideal for supporting the life of its biota. The optimal pH value for aquatic biota is in the range of 7-8.5[19]. The pH value of a body of water can be influenced by the decomposition of organic matter at the bottom of the water, resulting from the direct discharge of organic andinorganic waste into the river [20].

Research on water quality was also conducted in the Iwan River, Darmaji Village, Kopang District, Central Lombok Regency, with the following results. The pH measurements on water quality at the three sample points showed that sample 1 had a pH of 7, sample 2 had a pH of 6, and sample 3 had a pH of 7. From the three sample points, the pH of the Iwan River water in Darmaji village was still within the safe range, making it a suitable source of clean water based on health quality standards. environment for water media for agricultural purposes and washing, referring to Government Regulation No. 22 of 2021 concerning Standard Standards for Class 4 (four) water quality, which is water that can be used to irrigate crops and/or other purposes that require the same water quality as the intended use [21].

BOD

Another important parameter for determining water quality is BOD. BOD indicates the amount of organic matter in water that can be biologically degraded. BOD is the amount of biological oxygen (ppm or mg/L) required for bacteria to decompose organic matter, thereby returning the wastewater to its clear state [22].Based on the BOD test results, the upstream BOD level was 10,8 mg/L, the middle of the river was 9,5 mg/L, and the downstream BOD level was 18mg/L, Referring to Government Regulation No. 22 of 2021, these results do not meet quality standards and require further testing.

The high BOD value in the Padolo River water is due to the large amount of household waste and garbage being dumped directly into the river [23]. Furthermore, the Padolo River is located in densely populated areas, making it a frequent dumping ground for various domestic waste, including human waste, food scraps, detergents, and other organic and inorganic waste. These organic materials trigger the activity of microorganisms in the water, which require oxygen for decomposition [24]. This results in increased oxygen consumption and a drastic decrease in dissolved oxygen levels. High BOD levels in river water can be influenced by low numbers of microorganisms. The number and activity of microorganisms significantly influence the value. When microorganism numbers are low, biochemical breakdown processes do not occur [25].

Research on water quality was also conducted in the Iwan River, Darmaji Village, Kopang District, Central Lombok Regency, with the following BOD results. Laboratory test results of upstream, middle, and downstream river water samples show varying values, with the upstream river having a result of 0.5 mg/L, the middle river having a result of 1.1 mg/L, and the downstream river having a result of 0.5 mg/L. Based on PP Number 22 of 2021, the Class 4 quality standard for BOD is 12 mg/L; therefore, the Iwan River water in Darmaji Village, Central Lombok Regency, at the upstream, middle, and downstream sections is declared safe because it remains below the quality standard [26].

COD

COD is the amount of oxygen required to oxidize organic substances in a water sample. COD is a measure of water pollution caused by organic substances that can naturally be oxidized through microbiological processes, resulting in a reduction in dissolved oxygen in the water. COD test results showed varying results [27]. The COD levels in the upstream area were 28 mg/L, in the middle of the river 24 mg/L, and downstream 32 mg/L. Referring to Government Regulation No. 22 of 2021, these results comply with the quality standards of PP No. 22 of 2021 Class III.

Research on water quality was also conducted in the Iwan River, Darmaji Village, Kopang District, Central Lombok Regency, with the following COD results. From the results of laboratory tests conducted on samples from the upstream, middle, and downstream rivers polluted by various human activities, the value for the upstream river was 8 mg/L. In comparison, the middle river samples had a concentration of 4 mg/L, while the downstream river samples had a concentration of 12 mg/L. In PP Number 22 of 2021 class 4, there is a river water quality standard for the COD parameter, namely 80 mg/L, while in the Iwan River water in Darmaji Village, Central Lombok Regency, the upstream, middle, and downstream samples from laboratory tests are stated to be still below the quality standard [28].

DO

Dissolved oxygen (DO) is the amount of oxygen dissolved in water and is essential for the life of aquatic organisms. Based on the measurement results, the DO values in the upstream section, middle section, and downstream section were 5.8 mg/L, 6.8 mg/L, and 7.9 mg/L, respectively. The values obtained did not meet the requirements according to Government Regulation No. 22 of 2021.

Human activities such as washing clothes can lower DO levels in water. Detergents contain phosphates, which can stimulate the growth of aquatic weeds. Excessive weed growth inhibits oxygen exchange in the water, resulting in very low DO levels, a condition known as microaerobic [29].

A decrease in DO levels will increase the Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) values, which indicate increased pollution. In addition, low DO levels are also inversely proportional to the concentration of heavy metals in water. Heavy metals in water can disrupt the respiratory system of aquatic organisms [30].

Conclusion

Based on the research results, it was concluded that the water quality of the Padolo River still meets the quality standards stipulated in Government Regulation No. 22 of 2021, except for the BOD and DO parameters. Initial laboratory test results included a pH measurements from the three gizzard sampling locations, it was 6.9, Based on the BOD test results, the upstream BOD level was 10,8 mg/L, the middle of the river was 9,5 mg/L, and the downstream BOD level was 18mg/L, The COD levels in the upstream area were 28 mg/L, in the middle of the river 24 mg/L, and downstream 32 mg/L and DO value in the upstream section was 5.8 mg/L, in the middle section 6.8 mg/L, and in the downstream 7.9 mg/L. According to Government Regulation No. 22 of 2021. The pH and COD values have met the requirements for river water quality, and the BOD and COD values have not met the requirements, so the Padolo River is declared not to have met the quality standards of class III of Government Regulation No. 22 of 2021. It is hoped that the relevant government will continue to monitor the water quality in the Padolo River, considering that the water from the Padolo River is used by the community for daily activities.

Author's Contribution

Tina Melinda: Conducting Data, Processing and analyzing data and compiling aresearch article. M. Majdi: Conducting sampling and Conducting Water quality parameter

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