Jurnal Pijar MIPA
https://jurnalfkip.unram.ac.id/index.php/JPM

ISSN 1907-1744 (Print)
ISSN 2460-1500 (Online)

Integrative Approach to Evaluation of Physical, Chemical and Biological Parameters: Analysis of Mujur River Water Quality

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Received: April 28, 2024. Accepted: May 25, 2024. Published: May 30, 2024

Abstract: This study uses an integrative approach to evaluate physical, chemical and biological parameters in the analysis of Mujur River water quality. This shows the complexity of interactions between various factors in determining river water quality. The purpose of this study was to understand the integrative impact of such factors on water quality. The research method involves collecting physical, chemical and biological data from the upstream, middle and downstream locations of the Mujur River. The results showed a complex pattern of interaction between physical, chemical and biological parameters that provided a deep understanding of river conditions. The conclusion of this study is the importance of an integrative approach in evaluating river water quality. In the future, it is necessary to implement more effective management measures to ensure the sustainability of the Mujur River and the surrounding ecosystem.

Keywords: Integrative Approach; Mujur River; Water Quality.

Introduction

Rivers are vital natural resources that provide various benefits for human life and the surrounding ecosystem. One river that plays an essential role in this context is the Mujur River. The Mujur River is one of the main rivers in the Central Lombok region and supports various economic, social, and environmental activities. The Mujur River is one of the natural assets that is important for the lives of the surrounding communities and the continuity of the ecosystem in the region. However, the development of intensive human activities, such as agriculture, industry and urban areas, has raised concerns about the quality of this river water. The water quality of the Mujur River is essential to pay attention to due to population growth and industrial activity, which continues to increase in the surrounding area.

Understanding the water quality of the Mujur River as a whole encourages the need for an integrative evaluation approach, which includes physical, chemical and biological parameters. Approaches that combine physical, chemical and biological data provide a comprehensive understanding of river conditions and assist in more effective decision-making [1]. This approach allows testing to gain a more holistic understanding of river conditions and their potential impacts on the environment and human health. An integrated approach to various physical, chemical, and biological parameters is essential. Evaluation of physical parameters includes factors such as temperature, pH and water turbidity, which can provide an overview of the physical condition of the river. Evaluation of chemical parameters includes concentrations of dangerous chemicals such as heavy metals, pesticides, organic materials such as phosphate content, total suspended solids, dissolved oxygen, DO, BOD and COD, which can affect the balance of river ecosystems. Finally, evaluating biological parameters, such as the presence and diversity of aquatic living creatures, can provide important information about the level of biodiversity and health of river ecosystems, such as total coliforms and Escherichia coli.

Water quality evaluation still relies on a fragmented approach, which can lead to a lack of holistic understanding of river conditions. A holistic approach can help identify pollution more accurately [2]. This creates a gap between what is idealized in evaluating the water quality of the Mujur River and the reality that occurs. Research involving an integrative approach to the water quality of the Mujur River is essential for several reasons. First, through this approach, we can identify specific and potential sources of water pollution and their impacts on the environment and human health. Second, a deeper understanding of river water quality can be the basis for developing effective mitigation and management strategies to protect and restore river ecosystems. Third, the results of this research will make a significant contribution to scientific literature related to environmental protection and water resources management, especially in the context of developing sustainable public policies.

Thus, this research aims to investigate the water quality of the Mujur River through an integrative approach that includes evaluation of physical, chemical and biological parameters. It is hoped that the data obtained from this research will provide a more comprehensive understanding of river conditions and provide a strong basis for the actions needed to maintain the health of these river

How to Cite:
Supardiono, S., Rahayu, R. N., & Nurhidayatullah, N. (2024). Integrative Approach to Evaluation of Physical, Chemical and Biological Parameters: Analysis of Mujur River Water Quality. *Jurnal Pijar Mipa*, *19*(3), 547–552. https://doi.org/10.29303/jpm.v19i3.6786

ecosystems and protect the welfare of the humans who depend on them.

Materials and Methods

Research Location and Time

This research will be carried out on the Mujur River, a river located in the Central Lombok area, which is an important water source for the local community. The research was conducted in January 2024 with comprehensive data collection on water quality in the Mujur River.

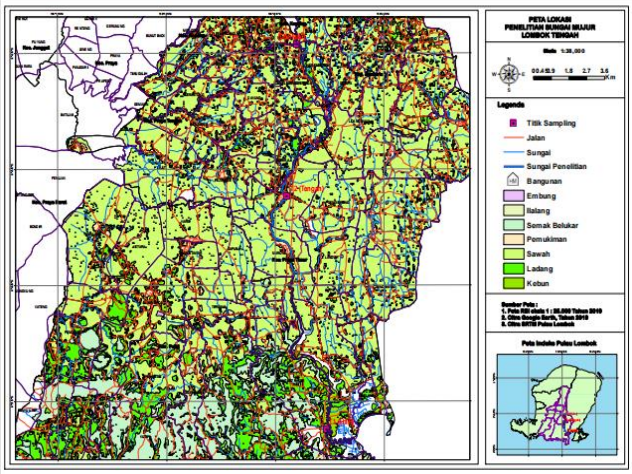

Figure 1. Map of research locations

Materials and Methods

This research adopts an integrative approach that combines the evaluation of physical, chemical and biological parameters to analyze river water quality in detail. The material used in the study was the Mujur River water samples. The physical, chemical and biological parameters that will be observed include pH. Dissolved oxygen concentration, BOD, COD, DO, TSS, total phosphate content, Total Coliform and Escherichia Coli. This type of research was carried out using a laboratory-based descriptive method approach. Test analysis was carried out at the Environmental Laboratory, Environmental Service, Central Lombok.

Determination of Sampling Points

Sampling will be carrsied out at several points representing the upstream, middle and downstream parts of the river. The selection of sampling points will be based on the topographic and hydrological characteristics of the river, as well as the influence of human activities. Upstream sampling points will be selected in areas far from potential pollution sources, such as industry or residential areas. Meanwhile, sampling points in the middle and downstream areas will be chosen, including regions that represent the influence of various human activities, including agriculture, industry, and urban areas.

Data analysis

Data obtained from measuring physical, chemical and biological parameters will be analyzed in an integrated manner to provide a comprehensive understanding of the water quality of the Mujur River. Data analysis was carried out regularly according to water quality standards Number 22 of 2021 concerning the Implementation of Environmental Protection and Management in determining river water class. The Pollution Index method is used with the aim of knowing the level of river water pollution, which is based on the Decree of the State Minister for the Environment no. 115 of 2003 [3]. The results of the analysis will be presented clearly and accurately in the form of appropriate graphs, tables and narratives to facilitate proper interpretation and decision-making.

$$PIj = \sqrt{\frac{(\frac{Ci}{Lij})_M^2 + (\frac{Ci}{Lij})_R^2}{2}}$$

Information :
Drink =Pollution Index
Lij =Concentration of water quality parameters based on standards stop allocate j
There =Concentration of water quality parameters based on laboratory test results
M =Maximum value
R =Average value

Results and Discussion

Mujur River Water Quality

The Mujur River has water quality that shows significant variations in physical, chemical and biological parameters. The laboratory test results are shown in Table 1, referring to water quality based on [4] concerning the Implementation of Environmental Protection and Management.

Total Suspended Solids (TSS)

The TSS content in Mujur River water has significant variations. This is related to regional conditions with increasing agricultural activity and development around river areas. This Concentration still shows compliance with Government Regulations Number 22 of 2021 concerning the Implementation of Environmental Protection and Management (Figure 2). Total suspended solids indicate sedimentation conditions in a body of water in the form of mud, fine sand and microorganisms originating from soil erosion processes that are carried into water bodies [5]. High TSS content can disrupt aquatic life and reduce water transparency, affecting river ecosystems. Overall [6].

Table 1. Water Quality Laboratory Test Results

Environmental parameters	Unit	Sampling Loacation			Water Quality Standards			
		T1	T2	T3	Class I	Class II	Class III	Class IV
TSS	mg/L	16	8	12	40	50	100	400
pH	-	7.7	7.7	8.2	06-Sep	06-Sep	06-Sep	06-Sep
DO	mg/L	4.91	4.39	6.05	6	4	3	1
Pospat Total	mg/L	0.11	0.35	0.25	0.2	0.2	1	-
BOD	mg/L	0.61	0.54	0.31	2	3	6	12
COD	mg/L	23	20	18	10	25	40	80
Total coliform	MPN/ 100mL	15,000	11,000	11,000	1000	5000	10,000	10,000
Escherichia coliform	MPN/ 100mL	7000	3.000	3.000	100	1000	2000	2000

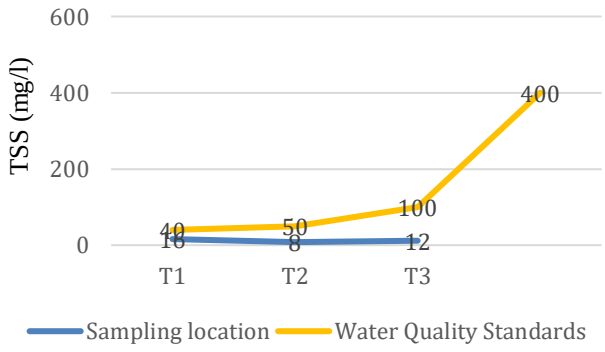

Figure 2. Results of Total Suspended Solids (TSS) Measurement Analysis

pH concentration

pH content of Mujur River water tends to vary, generally indicating neutral conditions. Anthropogenic activities and natural changes in the river environment cause this condition. Although the observed pH range is still within the limits that most aquatic organisms can tolerate, significant fluctuations can disrupt the balance of the water ecosystem [7].

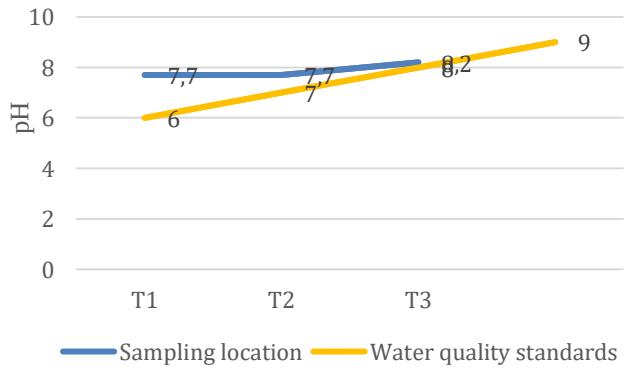

Figure 3. Results of pH Measurement Analysis

Phosphate content

The phosphate content in the Mujur River water shows the same level for the upstream, middle and downstream parts at a concentration of 0.01 mg/L. The total phosphate content indicates the total amount of phosphate in an aquatic environment that can be used to originate from natural sources. An increase in phosphate content in waters can indicate agricultural waste pollution, which can cause eutrophication and excessive algae growth, disrupting the balance of the river ecosystem [2].

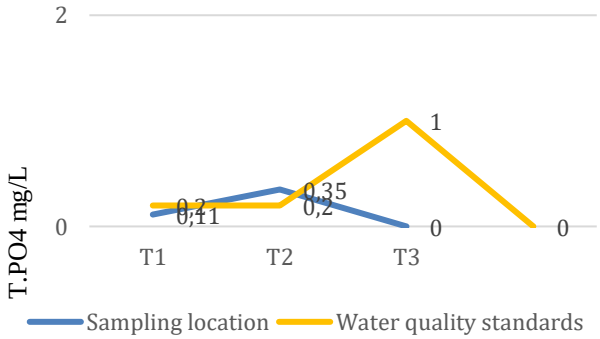

Figure 4. Measurement Analysis Results Phosphate content

Dissolved Oxygen (DO)

Dissolved oxygen is the amount of oxygen dissolved in water, which is essential for maintaining aquatic life. DO levels in water are influenced by various factors, including temperature, atmospheric pressure and biological activity. The dissolved oxygen (DO) content in Mujur River water tends to vary and shows conditions that exceed river water quality standards based on [4] concerning the Implementation of Environmental Protection and Management. Concentration conditions from the upstream, middle and downstream parts of the river have increased. The decrease in DO can be caused by excessive decomposition of organic matter and lack of water circulation, which threatens the survival of aquatic life [8].

The high DO concentration value is due to the photosynthesis process by aquatic plants, such as phytoplankton, which produce oxygen in the waters. Maintaining optimal DO levels in waters is an essential aspect of managing aquatic ecosystems to ensure the survival of organisms and good water quality [9].

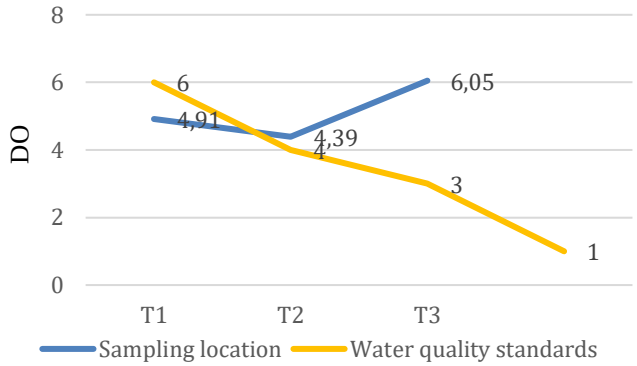

Figure 5. Measurement Analysis Results Dissolved Oxygen

Chemical Oxygen Demand (COD)

Chemical oxygen demand is an analytical parameter used to measure the total amount of oxygen needed to oxidize organic and inorganic materials in water through chemical reactions. The COD content in Mujur River water is still in a condition that meets river water quality standards. The middle location of the river shows a significant increase compared to conditions upstream and downstream of the river. This can be caused by substantial levels of organic pollution, especially in industrial and urban areas. High COD content can cause a decrease in overall water quality and pose a threat to aquatic life. The importance of controlling COD content in an effort to maintain the balance of aquatic ecosystems and good water quality [10].

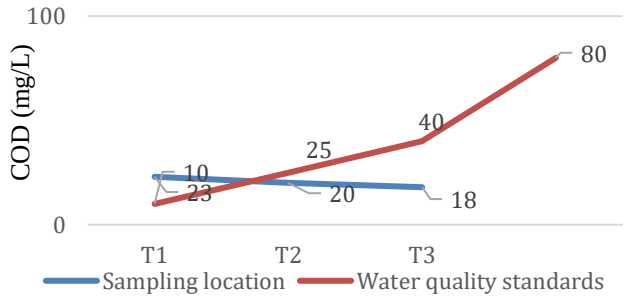

Figure 6. Chemical Measurement Analysis Results Oxygen Demand

Biological Oxygen Demand (BOD)

BOd content is used as an indicator of the level of organic pollution in water because high organic material content can increase oxygen demand in the decomposition process by aerobic microorganisms [11]. High BOD content can reduce oxygen availability for aquatic organisms and disrupt the balance of river ecosystems. The BOD content in the Mujur River water in the upstream, middle and downstream parts is still below the established river water quality standards.

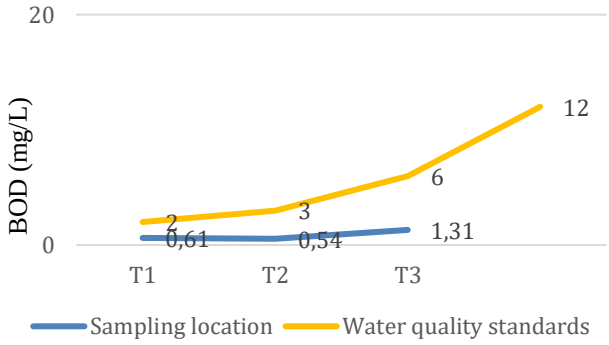

Figure 7. Results of Biological Measurement Analysis Oxygen Demand

Total Coliform and Escherichia Coli

The total content of coliforms and Escherichia coli in water can indicate contamination by domestic, aquatic or industrial waste. An increase in the Concentration of total coliforms and Escherichia coli in Mujur River water could pose a health risk for people who use river water for domestic and recreational purposes. The results of the Mujur River water quality analysis show that the total coliform and Escherichia coli contents are above the quality standards set based on [4] concerning the Implementation of Environmental Protection and Management, ranging between 8,400-32,000 MPN/100ml for the total Coliform content while for the Escherichia content coli ranges from 1,200-7,400 MPN/100 ml.

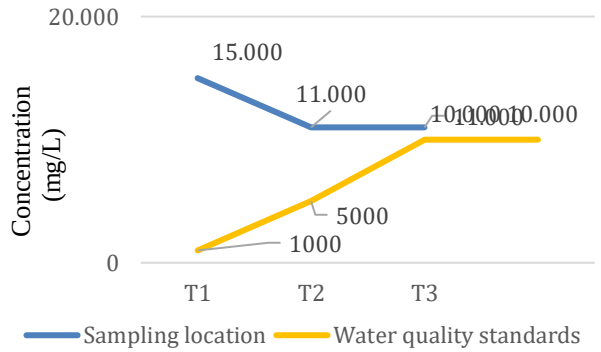

Figure 8. Total Measurement Analysis Results Coliform

Monitoring total coliforms and *Escherichia coli* in water is an essential part of efforts to maintain clean and safe water quality. Controlling pollution by total coliforms and Escherichia coli through waste treatment and protecting water sources is the primary strategy for maintaining the cleanliness and safety of the aquatic environment [12-13].

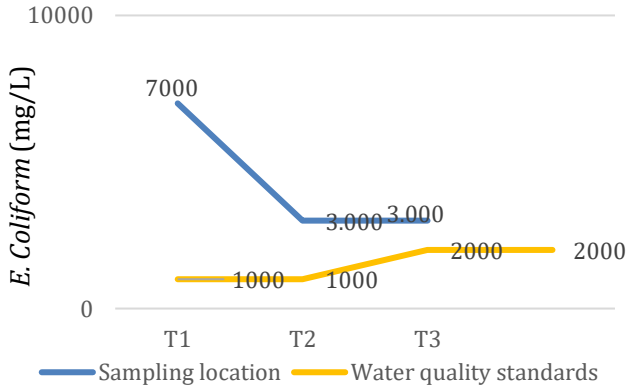

Figure 9. Measurement Analysis Results in *Escherichia coli*

Pollution Index Value

The pollution index value is a method for measuring the level of pollution in a water environment that integrates several parameters, namely physics, chemistry and biology [14-16]. The pollution index value in the Mujur River flow in the three river areas has varying values, where the value in the upstream section is 3.74, in the middle section it is 2.43, and in the downstream section it is 2.42. The water quality status of the Mujur River, based on data variations, shows that it is lightly polluted. This shows that activities in the river water flow from residential, agricultural and industrial areas result in changes to the quality of river water, especially the Mujur River. Thus, an approach is needed to identify sources of pollution and formulate appropriate mitigation strategies to reduce pollution in the Mujur River by improving environmental management by involving the participation of the surrounding community [15-20].

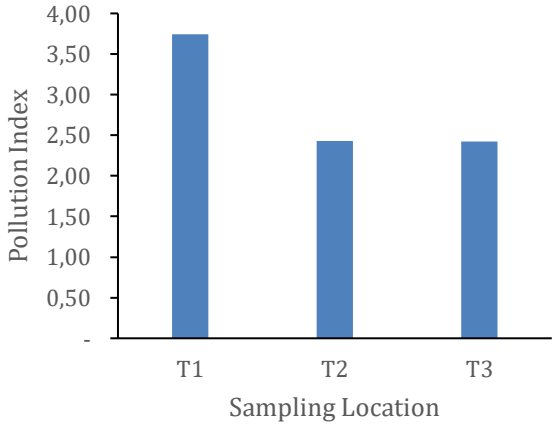

Figure 9. Pollution Index Value

Conclusion

This research aims to integrate physical, chemical, and biological parameter evaluation approaches to analyze the water quality of the Mujur River in detail. Through this approach, a holistic understanding of the condition of the Mujur River can be obtained. The research results show that physical analysis, including temperature, turbidity, and water flow, as well as chemical parameters such as pollutant concentration and pH, can provide an in-depth picture of the physicochemical conditions of river water. Additionally, the evaluation of biological parameters, such as the presence and abundance of biomonitor organisms, provides additional insight into the impacts of water quality on river ecosystems. The results of this research offer a significant contribution to a comprehensive understanding of the water quality of the Mujur River. They can serve as a basis for developing more effective environmental management and protection strategies in the future. Thus, this integrative approach provides a strong framework for understanding and managing water quality holistically, which can be applied in the context of global water resource protection.

Acknowladgement

The author would like to thank all the teams who have helped complete this research project, especially the KPBI Environmental Pollution and Remediation team and the Environmental Science Study Program at the University of Mataram, which have provided full support in completing this research activity.

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