WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Evaluation of Dissolved Oxygen, Biochemical Oxygen Demand, and Chemical Oxygen Demand in the Narmada River, Jabalpur: A Study from 2021-2022

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ABSTRACT :

This study provides a comprehensive assessment of Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) levels in the Narmada River at Jabalpur from October 2021 to September 2022. Monthly water samples were analyzed to evaluate temporal variations and identify factors influencing water quality. The results revealed significant fluctuations in DO, BOD, and COD levels, reflecting the impacts of seasonal dynamics, anthropogenic activities, and natural processes. DO levels ranged from 7.3 mg/l to 9.1 mg/l, with higher values observed during the winter months and lower values during the summer. BOD values varied between 2.2 mg/l and 3.8 mg/l, peaking in June due to increased organic pollution and microbial activity. COD levels ranged from 29 mg/l to 45 mg/l, with the highest values during the summer months, indicating substantial chemical pollution from industrial discharges and agricultural runoff. The study highlights an inverse correlation between DO and BOD/COD, emphasizing the impact of organic and chemical pollutants on the river's oxygen balance. The findings underscore the need for continuous monitoring and effective pollution control measures to maintain the river's ecological health and water quality. This research provides valuable insights into the Narmada River's water quality dynamics, emphasizing the importance of addressing pollution sources and implementing sustainable strategies to protect this vital freshwater resource. Future efforts should focus on collaborative initiatives involving government agencies, local communities, and industries to ensure the river's long-term health and sustainability.

Keywords: Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Water Quality, Narmada River

1. INTRODUCTION :

Rivers are vital freshwater resources, providing essential ecological services, supporting biodiversity, and serving as crucial sources of water for domestic, agricultural, and industrial uses [1-3]. The Narmada River, one of India's major rivers, holds significant cultural, economic, and environmental importance [4,5]. Originating from the Amarkantak Plateau, the Narmada flows westward across central India, traversing several states before emptying into the Arabian Sea. This study focuses on the section of the Narmada River passing through Jabalpur, a region experiencing rapid urbanization and industrialization, which potentially impacts the river's water quality.

The health of a river ecosystem can be gauged through various water quality parameters, among which DO, BOD, and COD are critical indicators. DO represents the amount of oxygen available in water for aquatic organisms. BOD measures the oxygen required for microbial decomposition of organic matter, reflecting organic pollution levels. COD quantifies the oxygen needed to chemically oxidize organic and inorganic matter, indicating the presence of both biodegradable and non-biodegradable pollutants. [6-9]

Monitoring these parameters provides insights into the river's ecological status, potential anthropogenic impacts, and seasonal variations in water quality [10,11]. This study aims to assess the DO, BOD, and COD levels in the Narmada River at Jabalpur from October 2021 to September 2022, offering a comprehensive overview of the river's health and identifying temporal trends that could guide future conservation efforts.

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted at the Jabalpur station of the Narmada River, located in the central Indian state of Madhya Pradesh. Jabalpur is an important urban center with diverse industrial, agricultural, and domestic activities, which can influence the river's water quality. The selected monitoring site is strategically located to capture the cumulative impacts of upstream activities and provide representative data on water quality dynamics.

2.2. Sampling and Data Collection

Monthly water samples were collected from the Narmada River at Jabalpur between October 2021 and September 2022. Standard protocols for sample collection, preservation, and transportation were followed to ensure data accuracy and reliability. Water samples were analyzed for DO, BOD, and COD using methods outlined by the American Public Health Association (APHA).
Analytical Methods

2.3. Dissolved Oxygen (DO)

DO levels were determined using the Winkler titration method, a widely accepted and accurate technique for measuring oxygen concentration in water. This method involves adding reagents to the water sample to fix the dissolved oxygen, followed by titration to quantify the oxygen content.
Biochemical Oxygen Demand (BOD)
BOD was measured by incubating water samples at 20°C for five days in the dark, simulating the conditions for microbial decomposition of organic matter. The difference in DO levels before and after incubation provided the BOD values, indicating the amount of oxygen consumed by microorganisms during the decomposition process.

2.4. Chemical Oxygen Demand (COD)

COD was determined using the dichromate reflux method, which involves oxidizing the organic and inorganic matter in the water sample with a strong oxidizing agent (potassium dichromate) under acidic conditions. The amount of oxidizing agent consumed during the reaction was used to calculate the COD values, reflecting the total oxygen demand for chemical oxidation of pollutants.

2.5. Data Analysis

The collected data were compiled and analyzed to identify temporal variations and trends in DO, BOD, and COD levels over the study period. Statistical analyses, including mean, standard deviation, and correlation coefficients, were performed to interpret the results and assess the relationships between different water quality parameters.
Here introduce the paper, and put a nomenclature if necessary, in a box with the same font size as the rest of the paper. The paragraphs continue from here and are only separated by headings, subheadings, images and formulae. The section headings are arranged by numbers, bold and 9.5 pt. Here follows further instructions for authors.

3. RESULTS AND DISCUSSION :

3.1. Dissolved Oxygen (DO)

Table 1 presents the monthly observations of DO levels in the Narmada River at Jabalpur from October 2021 to September 2022. The data indicate significant variations in DO levels, ranging from a minimum of 7.3 mg/l in June to a maximum of 9.1 mg/l in January.

Table 1: Monthly Observations of Dissolved Oxygen (mg/l)

Month	Dissolved Oxygen (mg/l)
October	8.6
November	8
December	7.6
January	9.1
February	8.5
March	8.2
April	8
May	7.8
June	7.3
July	7.5
August	7.7
September	7.9

The observed fluctuations in DO levels can be attributed to various factors, including temperature, flow rate, and organic pollution load. Higher DO levels during the winter months (November to February) may be due to lower water temperatures, which increase oxygen solubility, and reduced microbial activity, leading to lower oxygen consumption. Conversely, the lower DO levels during the summer months (April to June) could be due to higher temperatures, which decrease oxygen solubility, and increased microbial activity, leading to higher oxygen consumption.

The monsoon season (June to September) typically shows lower DO levels due to increased organic matter input from surface runoff, leading to higher microbial decomposition and oxygen consumption. The data highlights the seasonal dynamics of DO levels, emphasizing the need for continuous monitoring to understand the river's ecological health better.

3.2. Biochemical Oxygen Demand (BOD)

Table 2 presents the monthly observations of BOD levels in the Narmada River at Jabalpur from October 2021 to September 2022. The BOD values range from a minimum of 2.2 mg/l in September to a maximum of 3.8 mg/l in June.

Table 2: Monthly Observations of Biochemical Oxygen Demand (mg/l)

Month	Biochemical Oxygen Demand (mg/l)
October	3
November	2.8
December	2.6
January	2.4
February	2.3
March	2.4
April	2.6
May	2.9
June	3.8
July	3.3
August	2.7
September	2.2

The BOD data indicate variations in organic pollution levels, with the highest BOD values observed during the summer months (May to July) and the lowest during the post-monsoon period (August to September). The peak in June (3.8 mg/l) suggests a significant increase in organic pollution, likely due to agricultural runoff and increased microbial activity in warmer temperatures.

Lower BOD values during the winter months (November to February) reflect reduced microbial activity and lower organic matter input. The seasonal variations in BOD highlight the influence of anthropogenic activities and climatic conditions on the river's organic pollution levels, emphasizing the need for effective pollution control measures to maintain water quality.

3.3. Chemical Oxygen Demand (COD)

Table 3 presents the monthly observations of COD levels in the Narmada River at Jabalpur from October 2021 to September 2022. The COD values range from a minimum of 29 mg/l in August to a maximum of 45 mg/l in June.

Table 3: Monthly Observations of Chemical Oxygen Demand (mg/l)

Month	Chemical Oxygen Demand (mg/l)
October	38
November	36
December	34
January	32
February	31
March	32
April	34
May	38
June	45
July	42
August	29
September	31

The COD data depict variations in the river's chemical oxygen demand, with the highest values observed during the summer months (May to July) and the lowest during the monsoon and post-monsoon periods (August to September). The peak in June (45 mg/l) indicates a substantial increase in chemical pollutants, likely due to industrial discharges, agricultural runoff, and reduced dilution capacity during the dry season.

The lower COD values in August (29 mg/l) reflect the dilution effect of increased river flow during the monsoon season, which reduces pollutant concentrations. The observed seasonal variations in COD highlight the influence of anthropogenic activities and natural processes on the river's chemical pollution levels, underscoring the importance of regular monitoring and pollution control measures.

3.4. Correlation Between DO, BOD, and COD

The relationship between DO, BOD, and COD was analyzed to understand the interdependencies between these water quality parameters. The data indicate an inverse correlation between DO and BOD/COD, with higher BOD and COD values corresponding to lower DO levels (Figure 1). This relationship reflects the impact of organic and chemical pollutants on the river's oxygen balance, where increased pollution leads to higher oxygen consumption and reduced availability for aquatic life.

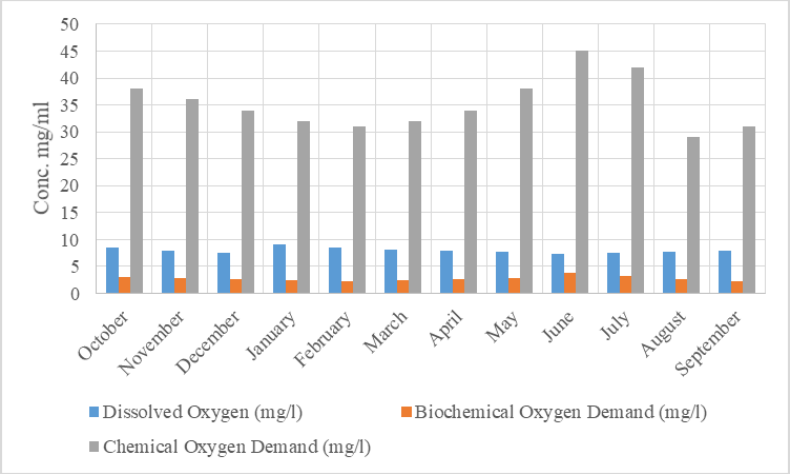

Figure 1: Correlation Between DO, BOD, and COD.

4. CONCLUSIONS :

The study provides a comprehensive assessment of DO, BOD, and COD levels in the Narmada River at Jabalpur from October 2021 to September 2022. The data reveal significant temporal variations in these water quality parameters, influenced by seasonal dynamics, anthropogenic activities, and natural processes. The observed fluctuations in DO, BOD, and COD highlight the need for continuous monitoring and effective pollution control measures to maintain the river's ecological health and water quality. The study underscores the importance of addressing organic and chemical pollution sources, particularly during the dry season when pollutant concentrations are higher and the river's dilution capacity is reduced. Future research should focus on identifying specific pollution sources, evaluating the effectiveness of existing pollution control measures, and exploring sustainable strategies to enhance the Narmada River's water quality. Collaborative efforts involving government agencies, local communities, and industries are essential to protect and restore this vital freshwater resource for future generations.

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