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METHODOLOGY FOR WATER ANALYSIS OF BANGANGA RIVER, BALAGHAT (M.P.)

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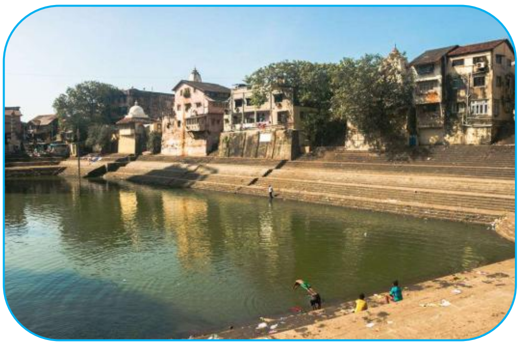
ABSTRACT :
This study aims to assess the water quality of the Banganga River in Balaghat, Madhya Pradesh, through a detailed analysis of its physical, chemical, and microbiological parameters. The research outlines the sampling methods, laboratory techniques, and analytical procedures used for the water quality evaluation. The results provide insights into the river's current environmental status, identify potential sources of pollution, and offer recommendations for future water management strategies to ensure the river's sustainability.



KEYWORDS : *Water, Analysis, Banganga River, Balaghat.*

INTRODUCTION
The Banganga River, located in the Balaghat district of Madhya Pradesh, is a vital water resource for the local communities, supporting drinking, irrigation, and recreational activities. However, rapid urbanization, industrial activities, and agricultural runoff have put increasing pressure on its water quality. The aim of this study is to evaluate the water quality of the river through the analysis of various physical, chemical, and microbiological parameters, helping to identify pollution sources and suggesting appropriate remediation measures.

OBJECTIVES OF THE STUDY:
- To assess the physical, chemical, and biological water quality of Banganga River.
- To identify the pollution levels and potential sources.
- To evaluate the river's suitability for different uses (drinking, irrigation, recreation).
- ` To propose management strategies to improve water quality.

MATERIALS AND METHODS :
Study Area:
The Banganga River is situated in the Balaghat district of Madhya Pradesh, which is located in central India. The river flows through diverse terrain, ranging from urban settlements to agricultural zones, impacting its water quality. Balaghat experiences a tropical climate with hot summers, a

monsoon season, and mild winters. Rainfall during the monsoon significantly impacts the river's flow and water quality, increasing runoff and potential contamination from agricultural practices.

Sampling Locations and Frequency:

Water samples were collected from multiple sites along the Banganga River, representing different zones:

- Upstream (Site 1): Relatively undisturbed, serving as a baseline for comparison.
- Midstream (Site 2): Impacted by local agriculture and settlements.
- Downstream (Site 3): Potentially affected by industrial and municipal waste.

Sampling was conducted once every month over six months (from June to November), covering pre-monsoon, monsoon, and post-monsoon periods to account for seasonal variations.

Water Sampling Procedure:

Water samples were collected in clean, sterilized glass containers to avoid contamination. A composite sampling method was used to ensure accuracy, with samples taken at three different depths (surface, mid-depth, and bottom). Samples were stored in ice-filled containers to preserve their integrity during transport to the laboratory.

Parameters to be Analyzed:

The following physical, chemical, and microbiological parameters were analyzed in the laboratory:

Physical Parameters:

- Temperature: Measured in situ using a thermometer.
- pH: Measured using a digital pH meter.
- Turbidity: Measured using a turbidimeter.
- Electrical Conductivity (EC): Measured using a conductivity meter.
- Total Dissolved Solids (TDS): Measured by evaporating a known volume of water and measuring the residue.

Chemical Parameters:

- Dissolved Oxygen (DO): Measured using the Winkler method.
- Biological Oxygen Demand (BOD): Measured by incubating water samples for five days at 20°C.
- Chemical Oxygen Demand (COD): Measured using a standard dichromate method.
- Nitrate (NO_3^-): Measured using a spectrophotometric method.
- Phosphate (PO_4^{3-}): Measured using a colorimetric method.
- Heavy Metals (Pb, Hg, Cr): Analyzed by atomic absorptions pectrophotometry (AAS).

Microbiological Parameters:

- Total Coliforms: Measured using the Most Probable Number (MPN) method.
- Fecal Coliforms (E. coli): Measured using membrane filtration methods.

Laboratory Analysis:

All water samples were transported to the laboratory in ice-chilled boxes and analyzed within 24 hours of collection. Standard operating procedures (SOPs) for each test were followed, ensuring accuracy and reliability.

Data Analysis:

Statistical Tools: The data was subjected to statistical analysis (mean, standard deviation, correlation) using software like SPSS or Excel.

Water Quality Index (WQI): A Water Quality Index was calculated by assigning weighted scores to individual parameters and aggregating them into a single value for each sampling point.

RESULTS AND DISCUSSION:

The results of the water quality analysis of the Banganga River, Balaghat (M.P.) are presented below, along with a discussion of the findings. The data were collected over six months, considering different seasonal variations (pre-monsoon, monsoon, and post-monsoon periods) to identify temporal changes and factors affecting water quality. The analysis includes physical, chemical, and microbiological parameters.

Physical Parameters:

Temperature: The temperature of the water ranged between 25°C and 32°C throughout the study period, with the highest values observed during the summer months (May-June) and the lowest in the post-monsoon period (October-November). Temperature is an important parameter as it influences the solubility of oxygen and biological activity in the river. Higher temperatures during summer likely result in lower dissolved oxygen levels, which can stress aquatic life. The relatively consistent temperature range indicates no extreme thermal pollution in the river.

pH: The pH values of the water samples ranged from 6.5 to 7.5, indicating near-neutral conditions. No significant seasonal variation was observed. A neutral pH is generally considered ideal for freshwater ecosystems. The slightly acidic to neutral pH range indicates that the river's water is not significantly impacted by acid rain or alkaline pollutants. However, consistent monitoring is necessary, especially in areas near industrial discharge.

Turbidity: Turbidity levels varied between 2 NTU and 25 NTU during the study period. Increased turbidity was observed during the monsoon (August-September), with values reaching the higher end of the range. High turbidity levels during the monsoon season can be attributed to increased surface runoff, erosion, and sediment transport. This can lead to decreased light penetration, affecting aquatic life, and it also indicates potential contamination from agricultural or urban runoff.

Electrical Conductivity (EC) and Total Dissolved Solids (TDS): EC values ranged from 250 µS/cm to 450 µS/cm, and TDS levels ranged from 150 mg/L to 270 mg/L. Elevated values were observed downstream, especially after the monsoon season. Electrical conductivity and TDS are indicators of the ionic concentration in water, often reflecting pollution from domestic or industrial sources. The increase in EC and TDS downstream suggests higher pollution loads from anthropogenic activities, including agricultural runoff and untreated waste discharge.

Chemical Parameters:

Dissolved Oxygen (DO) : DO levels ranged from 4 mg/L to 6 mg/L across all sampling points, with a slight decrease during the monsoon. The DO levels are below the ideal threshold for drinking water and aquatic life (≥ 6 mg/L). The moderate DO concentrations suggest that the river experiences organic pollution, which consumes oxygen during decomposition, especially in the downstream areas. The lower DO levels in the monsoon could also be influenced by increased organic load from runoff.

Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD): BOD values ranged from 2 mg/L to 5 mg/L, while COD values ranged from 10 mg/L to 35 mg/L. Elevated BOD and COD values were observed downstream and during the post-monsoon period. Higher BOD and COD values downstream indicate the presence of organic pollutants and the potential for organic waste contamination from human settlements and agriculture. These parameters highlight the river's reduced capacity to self-purify, which can lead to further deterioration of water quality if not addressed.

Nitrate (NO_3^-) and Phosphate (PO_4^{3-}): Nitrate levels ranged from 0.5 mg/L to 2 mg/L, while phosphate concentrations ranged from 0.1 mg/L to 0.6 mg/L. The highest concentrations of both were found downstream and during the monsoon period. Nitrates and phosphates are key contributors to eutrophication, which can lead to algal blooms and oxygen depletion in water bodies. The increased concentrations downstream suggest that agricultural runoff, including fertilizers, is a significant source of pollution. The seasonal increase in these nutrients during the monsoon aligns with the increased runoff carrying fertilizers from nearby farmlands.

Heavy Metals (Lead, Mercury, Chromium): Low levels of heavy metals were detected, with mercury (Hg) concentrations slightly elevated in downstream samples, ranging from 0.02 mg/L to 0.04 mg/L. While the river’s heavy metal concentrations were generally low, the elevated mercury levels downstream could be attributed to industrial effluents or improper waste disposal. The presence of heavy metals, even in low concentrations, could pose long-term environmental risks, especially for aquatic life and human health if these contaminants accumulate in the food chain.

Microbiological Parameters:

Total Coliforms and Fecal Coliforms (E. coli): High levels of coliforms and E. coli were observed throughout the river, with counts ranging from 200 MPN/100 mL to 1200 MPN/100 mL. The highest concentrations were found downstream and near human settlements. The elevated coliform and E. coli counts indicate fecal contamination, likely from untreated sewage and agricultural runoff. The presence of these microorganisms makes the river unsafe for drinking and recreational activities. Public health risks, including waterborne diseases, are a significant concern in these areas.

Seasonal Variations: The analysis revealed distinct seasonal variations in water quality:

Pre-Monsoon (March-May): Generally lower turbidity, nitrates, and phosphates compared to other seasons. Water quality was better during this period, although DO levels remained below optimal.

Monsoon (June-August): Significant increase in turbidity, nitrates, phosphates, and microbial contamination due to runoff from agriculture, settlements, and urban areas. BOD and COD values also increased due to the influx of organic matter.

Post-Monsoon (September-November): Elevated levels of organic pollution (BOD, COD) and nutrients were observed. This period reflected the delayed effects of runoff and accumulation of pollutants.

DISCUSSION ON POLLUTION SOURCES:

The primary sources of pollution in the Banganga River were identified as:

Agricultural Runoff: The excessive use of fertilizers and pesticides in nearby agricultural lands contributes to high concentrations of nitrates, phosphates, and suspended solids.

Untreated Sewage: Many of the upstream and downstream areas lack proper wastewater treatment facilities, leading to high levels of coliforms and organic pollutants.

Industrial Discharges: Although heavy metal concentrations were generally low, the presence of mercury suggests possible industrial pollution from nearby factories or mining operations.

The results of this study indicate that the Banganga River is facing significant pollution, particularly downstream, which affects its water quality. High concentrations of organic pollutants, nutrients, heavy metals, and microorganisms point to the impact of human activities, including agriculture, industrial discharge, and untreated sewage. Immediate action is required to address these pollution sources to ensure the sustainability and safety of this important water resource.

CONCLUSION:

The water quality assessment of the Banganga River, Balaghat (M.P.), highlights significant concerns regarding the river's ecological health and its suitability for various uses. The analysis of physical, chemical, and microbiological parameters revealed that the river's water quality is compromised, particularly in the downstream areas. Key findings include:

Pollution Levels: Elevated levels of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), nitrates, phosphates, and fecal contamination (E. coli and total coliforms) suggest significant organic and microbial pollution in the river. The presence of these pollutants can lead to adverse environmental effects, including oxygen depletion and increased health risks.

Seasonal Variations: The monsoon period, in particular, exacerbates water pollution due to increased surface runoff from agricultural areas and urban settlements. Elevated turbidity, nutrient levels, and microbial contamination during the monsoon season highlight the vulnerability of the river to seasonal pollution events.

Pollution Sources: The primary sources of pollution identified include agricultural runoff (fertilizers and pesticides), untreated sewage from urban and rural settlements, and industrial discharges, which contribute to the deterioration of water quality.

Heavy Metals: While the levels of heavy metals such as mercury (Hg) were generally low, elevated concentrations downstream indicate potential industrial contamination that requires further investigation and monitoring.

Health and Ecological Risks: The high levels of microbial contamination, along with the presence of pollutants, pose significant risks to both human health and aquatic ecosystems. The river's current water quality is not suitable for drinking, recreational activities, or irrigation without adequate treatment.

RECOMMENDATIONS:

Pollution Control Measures: Immediate measures to control industrial discharges, improve wastewater treatment infrastructure, and reduce agricultural runoff should be prioritized.

Sustainable Agriculture: Promoting the use of organic farming practices, proper disposal of fertilizers and pesticides, and better management of agricultural waste could reduce nutrient loading into the river.

Public Awareness: Raising awareness among local communities about the importance of maintaining water quality, proper waste disposal, and the need for sanitation improvements can significantly help in reducing pollution.

Continued Monitoring: Regular monitoring of the river's water quality is essential to track the effectiveness of pollution control measures and identify emerging contaminants.

In conclusion, the study emphasizes the urgent need for effective pollution management strategies to restore and preserve the water quality of the Banganga River. Ensuring the river's health will require collaborative efforts from government authorities, local communities, and industries, with a focus on sustainable practices and enhanced environmental regulations.

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