

A Case Study on Characteristics of Panchaganga River from Kolhapur to Ichalkaranji

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Abstract – The Panchaganga River is a vital water resource in the Kolhapur region, supporting agriculture, domestic activities, and industrial growth. However, rapid urbanization, untreated sewage, industrial waste, and surface runoff have heavily impacted the river's water quality. This study assesses the physical, chemical, and biological characteristics of water samples collected from five key locations: Shivaji Pul, Kasaba Bawada, Hupari, Ichalkaranji, and Narsinhwadi. Parameters analyzed include pH, turbidity, total dissolved solids (TDS), total hardness, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), nitrate, and oil and grease. Results were compared against Bureau of Indian Standards (IS 10500:2012) and World Health Organization (WHO) limits. Findings reveal a serious decline in water quality at downstream locations, particularly at Ichalkaranji and Narsinhwadi. Extremely high turbidity, abnormal pH, elevated BOD and COD, and low dissolved oxygen indicate significant organic and industrial pollution. The study concludes that river water is not suitable for direct domestic use without treatment and emphasizes the urgent need for wastewater management, industrial discharge control, and continuous river health monitoring.

Key Words: Panchaganga River, water quality, BOD, COD, dissolved oxygen, turbidity, pollution, BIS standards, WHO guidelines.

1. INTRODUCTION

Water is one of the most essential natural resources for human survival and ecological balance. Rivers provide water for drinking, irrigation, and industrial purposes, and they support aquatic ecosystems. The Panchaganga River is a significant tributary of the Krishna River system, flowing through major urban, agricultural, and industrial areas of Kolhapur district. In recent years, population growth, urban expansion, industrial waste, and untreated sewage have negatively impacted the river's water quality.

The Panchaganga River collects domestic sewage, industrial waste, agricultural runoff, and suspended solids along its route. These pollutants severely affect the physical, chemical, and biological features of the river water. Hence, regular water quality monitoring is vital for tracking pollution trends and environmental conditions.

This study focuses on evaluating the water quality characteristics of the Panchaganga River from Kolhapur to Ichalkaranji using standard laboratory testing methods and comparing the results with BIS and WHO permissible limits.

2. OBJECTIVES

The specific objectives of the present study are:

- To analyze the physical, chemical, and biological characteristics of Panchaganga River water.
- To compare water quality results with BIS (IS 10500:2012) and WHO standards.
- To identify pollution variations at different sampling locations.
- To investigate potential sources of pollution including industrial discharge, sewage, and urban runoff.
- To suggest appropriate treatment and restoration measures for improving river water quality.

3. STUDY AREA

The study was conducted at five major locations along the Panchaganga River selected to evaluate changes in water quality from upstream to downstream (Fig. 1):

1. Shivaji Pul (upstream reference point, Kolhapur)
2. Kasaba Bawada
3. Hupari
4. Ichalkaranji
5. Narsinhwadi (furthest downstream)

Urban activities, industrial discharge, agricultural runoff, and sewage mixing significantly affect water quality at these sites. The sampling stretch spans approximately 45 km from Kolhapur city to Narsinhwadi.

4. METHODOLOGY

Water samples were collected from each of the five selected locations using sterilized sampling bottles in accordance with standard procedures for sample collection, storage, and transport. The samples were analyzed for physical, chemical, and biological parameters using the following instruments and methods:

- **pH** – digital pH meter
- **Turbidity** – turbidity meter (NTU)
- **TDS & Total Hardness** – gravimetric and titrimetric methods
- **DO** – Winkler's method / DO probe
- **BOD** – five-day BOD incubator test (BOD₅)
- **COD** – open reflux / COD digester method
- **Nitrate** – spectrophotometric method
- **Oil & Grease** – solvent extraction method

Obtained readings were compared with BIS (IS 10500:2012) and WHO drinking-water guidelines to evaluate the suitability of river water for domestic use.

5. RESULTS AND DISCUSSION

Analysis revealed significant deterioration in water quality at several downstream locations. Table 1 summarises all measured parameters across the five sampling sites.

5.1 Turbidity

Turbidity values were extremely high at Kasaba Bawada, Hupari, Ichalkaranji, and Narsinhwadi compared to the acceptable limit of 5 NTU. The highest value was recorded at Hupari (1107 NTU), while Shivaji Pul showed comparatively lower turbidity (35 NTU). The sudden increase near Kasaba Bawada is attributable mainly to polluted water and suspended solids entering through Jayanti Nala, compounded by soil erosion and surface runoff.

5.2 pH Analysis

Most locations had pH values within the acceptable range of 6.5–8.5. However, Narsinhwadi exhibited highly acidic water (pH 4.5), while Ichalkaranji reported highly alkaline water (pH 11.7), indicating strong industrial and chemical contamination in the downstream region.

5.3 Dissolved Oxygen (DO)

Dissolved oxygen values at all sampling locations fell below the standard minimum of 5 mg/L. The lowest DO was recorded at Ichalkaranji (2.8 mg/L), indicating poor environmental conditions and reduced oxygen availability for aquatic life. Low DO levels also inhibit the river's natural self-purification capacity.

5.4 Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

BOD and COD values at all locations surpassed permissible limits, indicating severe organic and industrial pollution. Ichalkaranji recorded the highest BOD (22 mg/L) and COD (110 mg/L). The disproportionately high COD relative to BOD suggests the presence of non-biodegradable industrial pollutants such as dyes, chemicals, and synthetic substances from textile industries.

5.5 Oil and Grease

Oil and grease levels exceeded the permissible limit of 0.3 mg/L at all locations. The maximum value of 8 mg/L was found at Ichalkaranji, reflecting pollution from industrial discharge, vehicle runoff, and urban waste.

6. CONCLUSIONS

This study demonstrates that the water quality of the Panchaganga River has been severely degraded by domestic sewage, industrial discharge, urban runoff, and soil erosion. Most water quality parameters exceeded the permissible limits set by BIS and WHO across all five sampling locations.

Extremely high turbidity, abnormal pH values, elevated BOD and COD, low dissolved oxygen, and excessive oil and grease indicate significant environmental degradation of the river ecosystem. Among all locations, Ichalkaranji was identified as

the most polluted site due to strong industrial influence. Kasaba Bawada and Hupari showed extremely high turbidity caused by suspended solids and sewage input from Jayanti Nala and surface runoff.

The study conclusively establishes that the river water is not suitable for direct domestic use without treatment. Effective wastewater treatment, industrial waste management, continuous monitoring, and public awareness campaigns are vital to restore and protect the Panchaganga River.

FUTURE SCOPE

- Install advanced wastewater treatment systems and effluent treatment plants (ETPs) at key discharge points.
- Implement continuous water quality monitoring using IoT-based sensors and digital data platforms.
- Identify and strictly regulate industrial discharge points in Ichalkaranji and surrounding areas.
- Implement riverbank plantation and erosion control to reduce suspended solids and turbidity.
- Conduct detailed studies on heavy metal contamination and groundwater interaction.
- Launch public awareness campaigns on river pollution, wastewater management, and environmental conservation.

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Table 1: Water Quality Parameters at Sampling Locations vs. BIS/WHO Standards

Parameter	Unit	Standard (BIS/WHO)	Shivaji Pul (Kolhapur)	Kasaba Bawada	Hupari	Ichalkaranji	Narsinhwadi
pH	–	6.5 – 8.5	6.77	7.52	6.7	11.7	4.5
Turbidity	NTU	<5	35	1087	1107	1102	1102
TDS	mg/L	<500	58	52	159	415	314
Total Hardness	mg/L	<200	79	65	120	240	180
BOD	mg/L	<3	14	12	14	22	18
COD	mg/L	<10	75	70	78	110	95
Dissolved Oxygen (DO)	mg/L	>5	4.2	4.5	4.1	2.8	3.2
Nitrate	mg/L	<45	20	18	22	35	28
Oil & Grease	mg/L	<0.3	4	4	5	8	6

Bold values indicate exceedance of permissible limits set by BIS (IS 10500:2012) and WHO (2017).

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