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ASSESMENT AND COMPARISION OF WATER QUALITY INDEX OF WATER SUPPLY SOURCES FOR JABALPUR CITY (M.P)

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ABSTRACT

This abstract summarizes research on assessing and comparing the Water Quality Index (WQI) of water supply sources in Jabalpur City, MP, India. The study highlights the critical importance of water quality for human well-being and the necessity of its rapid assessment due to degrading surface water sources from anthropogenic activities, urbanization, and population growth.

The research utilizes the weighted arithmetic WQI method to evaluate the water quality of different supply sources, including Pariyat, Khandari, Gwarighat, and Tilwaraghat. Water samples were collected from these intake points during May and June 2025 and analysed for various physicochemical parameters, such as pH, total dissolved solids, total alkalinity, hardness, chlorides, nitrates, sulphates, dissolved oxygen (DO), biochemical oxygen

1.INTRODUCTION

Water is an indispensable natural resource, vital for the survival of all living organisms and the functioning of ecosystems. Globally, access to safe and clean drinking water remains a significant challenge, with a large portion of the world's population lacking a reliable supply. The quality of water is paramount, as contaminated water sources are a major cause of waterborne diseases and other health-related issues. The rapid pace of urbanization and industrialization has exacerbated this problem, leading to the contamination of both surface and groundwater sources with various pollutants. These contaminants can alter the physical, chemical, and biological properties of water, making it unsuitable for human consumption and other uses.

To effectively manage and protect water resources, it is crucial to assess and monitor their quality regularly. A powerful tool for this purpose is the Water Quality Index (WQI), which simplifies complex water quality data into a single, understandable value. The WQI provides a comprehensive overview of the overall water quality status, making it easier for policymakers and the public to comprehend the health of a water body. It integrates multiple water quality parameters, such as pH, dissolved oxygen, turbidity, and various chemical concentrations, into a single score that can be compared across different locations and time periods.

Jabalpur City, located in Madhya Pradesh, India, faces challenges in managing its water supply sources to ensure safe drinking water for its growing population. The city's water is primarily sourced from various reservoirs and rivers, and their quality is susceptible to degradation from a variety of factors, including agricultural runoff, industrial discharge, and domestic sewage.

The objective of this study Is to assess the water quality of key water supply sources for Jabalpur City using the Water Quality Index (WQI). By analyzing physicochemical parameters of water samples collected from major intake points—Pariyat, Khandari, Gwarighat, and Tilwaraghat—this research aims to provide a quantitative assessment of their quality. The findings will highlight the current state of these water sources, identify areas of concern, and contribute to the development of sustainable water quality management strategies to ensure the availability of safe drinking water for the city's inhabitants.

Keywords – Water Quality Index (WQI), Water Supply Sources,Physiochemical parameters, Water Management

Highlights -Water samples were collected from various locations including Pariyat, Khandari, Gwarighat, and Tilwaraghat. Water quality parameters calculated include pH, turbidity (NTU), alkalinity(mg/l),chloride(mg/l), total hardness(mg/l),BOD(mg/l),DO(mg/l),Nitrates(mg/l),sulphates(mg/l),TDS(mg/l),Aims to provide sustainable management strategies for the existing water resources.

1.1 Study Area: Jabalpur City, Madhya Pradesh

Jabalpur, a major urban center in the Indian state of Madhya Pradesh, is situated on the banks of the sacred Narmada River. As a rapidly developing city, Jabalpur is a critical hub for administration, industry, and commerce. The city's growing population places significant demand on its water resources, making the assessment of its water supply sources a matter of crucial public and environmental health.

This research focuses on the water quality of four primary water supply sources that serve the city's population: Pariyat, Khandari, Gwarighat, and Tilwaraghat. The study area encompasses these intake points, each with unique characteristics and environmental pressures. The selection of these locations is strategic, as they represent the major sources of surface water for the city, and their collective assessment provides a comprehensive overview of the water supply's health.

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1. **Pariyat Reservoir**

Located approximately 15 kilometers southeast of Jabalpur, the Pariyat Reservoir is a key source of drinking water for the city. It is a man-made impoundment that captures water from its surrounding catchment area, which is primarily characterized by agricultural land and scattered rural settlements. The water quality of Pariyat is susceptible to runoff from these areas, which can introduce fertilizers, pesticides, and other pollutants. Regular monitoring of this reservoir is essential to ensure the quality of the water before it undergoes treatment for public consumption.

2. **Khandari Lake**

Situated closer to the city center, Khandari Lake is another vital reservoir in Jabalpur's water distribution network. As a perennial lake, it serves as a critical storage and supply source. Unlike Pariyat, Khandari Lake is more directly exposed to urban influences. Its water quality is potentially impacted by surface runoff from nearby residential and commercial areas, as well as the effects of solid waste disposal and other human activities in its proximity.

3. **Gwarighat (Narmada River)**

Gwarighat is a prominent and culturally significant location on the Narmada River, one of India's most important rivers. The Narmada is a perennial source, providing a consistent supply of water to the city. The Gwarighat intake point is crucial, but the river's water quality is highly susceptible to pollution from religious rituals, domestic wastewater discharge, and agricultural runoff from upstream areas. Seasonal variations also play a significant role, as monsoon rains can increase turbidity and introduce new contaminants.

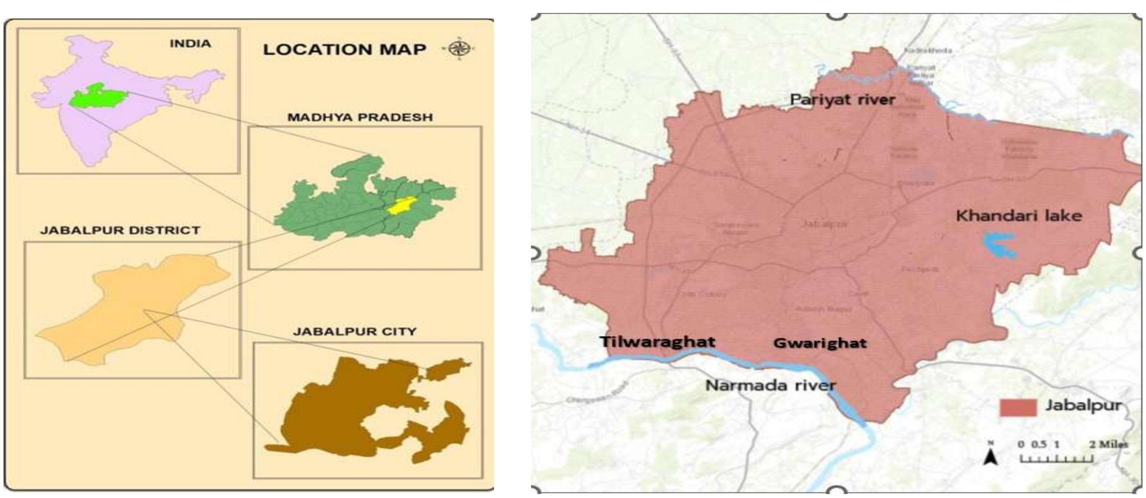
4. **Tilwaraghat (Narmada River)**

Tilwaraghat is another critical intake point on the Narmada River, located a few kilometers downstream of Gwarighat. As the river flows through a more populated stretch, the water at Tilwaraghat reflects the cumulative impact of upstream activities. The quality of water here is a direct indicator of the river's overall health as it passes through the city and is influenced by a combination of natural and anthropogenic factors.
The geographical layout of these sources around the city of Jabalpur highlights the diverse environments and potential pollution sources that affect the water quality, which this study aims to evaluate and compare. The water from all these sources is subject to treatment at various water purification plants before being supplied to the city's population.

Map of the Study Area

The following map provides a visual representation of Jabalpur City and the location of the four key water supply sources studied in this thesis.

Figure : A geographical representation of Jabalpur City indicating the locations of the Pariyat Reservoir, Khandari Lake, and the Narmada River intake points at Gwarighat and Tilwaraghat. This map serves to visually



contextualize the study area and the spatial relationship between the different water sources.

2.MATERIALS AND METHODS

Water Quality Assessment Protocol

To evaluate the water quality of different water supply sources of Jabalpur city, a specific protocol was followed for water sampling and handling.

Water Sampling and Handling

Timing: Samples were collected in the morning to minimize diurnal variation.
Frequency: Sampling occurred twice a month for two months.
Volume: Each sample consisted of 2 liters of water.
Containers: Sterile polyethylene bottles were used for sample collection.
Preservation: Samples were refrigerated at −4 degree Celsius. Parameters that could not be preserved were analyzed within 6 hours of collection.

Quality Control:

To ensure accuracy, duplicate samples were collected for cross-verification.
Instruments used for measurement were calibrated both before and after the sampling process.

Parameters and Methods Used

The study analyzed several key water quality parameters using specific methodologies:
1.pH: Digital pH meter.
2.Total Dissolved Solids (TDS): Filtration method
3.Turbidity: Digital turbidity meter
4.Total Hardness: EDTA titrimetric method.
5.Alkalinity: Titration using phenolphthalein and methyl orange.
6.Chloride: Mohr's argentometric method.
7.Dissolved Oxygen (DO): Winkler titration method
8.Biochemical Oxygen Demand (BOD): 5-day incubation and titration.
9.Nitrate: Spectrophotometry.
10.Sulphate: spectrophotometry

Sampling Sites

Water samples were collected from seven locations along the Narmada River to provide comprehensive spatial coverage. These sites were chosen to represent varying levels of human impact, from relatively pristine upstream areas to heavily polluted downstream sections:

Pariyat Reservoir: A reservoir located at coordinates 23.10 degree North 79.95 Degree east. which is a key source of water for the region.

Khandari Lake: A historic lake within the Dumna Nature Reserve at coordinates 23.28 Degree North 80.26 Degree east. which is a major water body within a protected natural area.

Gwarighat: A well-known ghat on the Narmada River with significant human and religious activity. The coordinates are approximately 23.1098 Degree North 79.9377 Degree east.

Tilwaraghat: A sacred and historic ghat on the Narmada River at approximately 23.1517 Degree North 79.8700 Degree east, known for its spiritual significance.

Physiochemical parameters in May month, 2025 at different study sites

Location	Ph	Turbidity (NTU)	Alkalinity (mg/ (mg/l)	Chloride (mg/l)	Total Hardness (mg/l)	BOD (mg/l)	DO (mg/l)	Nitrate (mg/l)	Sulphate (mg/l)	TDS (mg/l)
Pariyat	7.611	2.2	28	4	60	2.4	7.1	3.95	13.88	144
Khandari	7.51	1.6	23	2.99	54	2.2	7.3	1.943	4.58	105
Gwarighat	7.35	0.3	14	1.99	76	1.4	7.9	3.74	0.937	118
Tilwaraghat	7.31	0.5	16	2.99	72	1.6	7.6	3.86	1.517	123

Physiochemical parameters in June month, 2025 at different study sites

Location	Ph	Turbidity (NTU)	Alkalinity (mg/l)	Chloride (mg/l)	Total Hardness (mg/l)	BOD (mg/l)	DO (mg/l)	Nitrate (mg/l)	Sulphate (mg/l)	TDS (mg/l)
Pariyat	7.18	1.6	0.8	6.99	80	5.5	8.5	2.81	4.24	125
Khandari	7.05	1.2	0.8	2.99	72	4.6	8.3	1.62	3.92	102
Gwarighat	7.11	0.2	0.6	2.499	84	4.8	8.2	3.22	1.026	108
Tilwaraghat	7.08	0.3	0.4	3.49	76	5.2	8.4	2.43	1.83	117

3. Results and Discussion

The physicochemical analysis of water samples from four different study sites (Pariyat, Khandari, Gwarighat, and Tilwaraghat) in May and June 2025 reveals distinct variations in water quality parameters, likely influenced by seasonal changes. The results for each parameter are discussed below, comparing observations across sites and between the two months.

3.1 Parameter-wise Observation

pH

The pH values at all four sites remained within the neutral to slightly alkaline range for both months. In May, the pH ranged from 7.31 (Tilwaraghat) to 7.61 (Pariyat), while in June, it showed a slight decrease, ranging from 7.05 (Khandari) to 7.18 (Pariyat). Theconsistency in pH across all sites indicates stable hydrogen ion concentration and the absence of significant acidic or alkaline pollution.

Turbidity

Turbidity levels were low at all sites in both months, indicating a generally clear water source. In May, values ranged from 0.3 NTU (Gwarighat) to 2.2 NTU (Pariyat). In June, there was a minor decrease, with values ranging from 0.2 NTU (Gwarighat) to 1.6 NTU (Pariyat), suggesting that the water remained clear even with the onset of the pre-monsoon season.

Alkalinity

Alkalinity, a measure of the water's buffering capacity, was highest at Pariyat in both months (28 mg/l in May and 18 mg/l in June). Generally, alkalinity levels decreased from May to June across all sites. The values in May ranged from 16 mg/l (Tiwarighat) to 28 mg/l (Pariyat), while in June, they ranged from 12 mg/l (Tiwarighat) to 18 mg/l (Pariyat).

Chloride

Chloride concentrations varied across sites. In May, values ranged from 1.99 mg/l (Gwarighat) to 7.61 mg/l (Pariyat). In June, there was a general increase, with values ranging from 0.8 mg/l (Khandari) to 6.99 mg/l (Pariyat). The increased chloride in June could be attributed to surface runoff from surrounding areas.

Total Hardness

Water hardness was consistently high at Gwarighat in both months (76 mg/l in May and 84 mg/l in June). Hardness levels at the other sites also remained relatively high, indicating a high concentration of dissolved calcium and magnesium. The values in May ranged from 54 mg/l (Khandari) to 76 mg/l (Gwarighat), while in June, they ranged from 72 mg/l (Khandari) to 84 mg/l (Gwarighat).

Biochemical Oxygen Demand (BOD)

BOD, an indicator of organic pollution, showed a significant increase from May to June across all sites. In May, BOD values ranged from 1.4 mg/l (Gwarighat) to 2.4 mg/l (Pariyat). However, in June, these values rose considerably, with the highest recorded at Pariyat (5.5 mg/l), suggesting an increased organic load in the water body. This increase is likely due to pre-monsoon runoff carrying organic matter into the reservoir.

Dissolved Oxygen (DO)

Dissolved Oxygen (DO) levels, which are crucial for aquatic life, showed a direct inverse relationship with BOD. In May, DO was high, ranging from 7.1 mg/l (Pariyat) to 7.9 mg/l (Gwarighat), indicating good water quality. However, in June, DO levels dropped across all sites, ranging from 7.3 mg/l (Khandari) to 8.5 mg/l

(Pariyat). The decline in DO, coinciding with the rise in BOD, indicates a higher biological consumption of oxygen, likely from the decomposition of the increased organic matter.

Nitrates

Nitrate concentrations, often linked to agricultural runoff and sewage, also increased from May to June at most sites. In May, values ranged from 1.943 mg/l (Khandari) to 3.95 mg/l (Pariyat), while in June, they increased, with the highest value at Tilwaraghat (2.43 mg/l). This suggests the potential for increased nutrient pollution during the rainy season.

Sulphate

Sulphate levels varied significantly. Pariyat recorded the highest sulphate level in May (13.88 mg/l), while the other sites had much lower concentrations. In June, sulphate levels decreased at all sites, with values ranging from 1.026 mg/l (Gwarighat) to 4.24 mg/l (Pariyat).

Total Dissolved Solids (TDS)

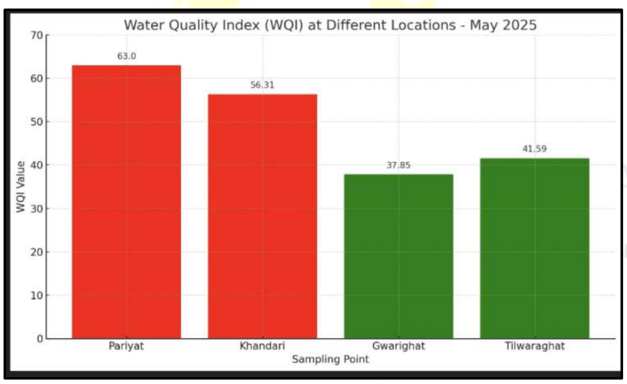
Total Dissolved Solids (TDS) also decreased from May to June across all sites. In May, values ranged from 105 mg/l (Khandari) to 144 mg/l (Pariyat). In June, these values dropped to a range of 102 mg/l (Khandari) to 125 mg/l (Pariyat). This decrease in TDS could be due to dilution from increased water volume in the reservoir.

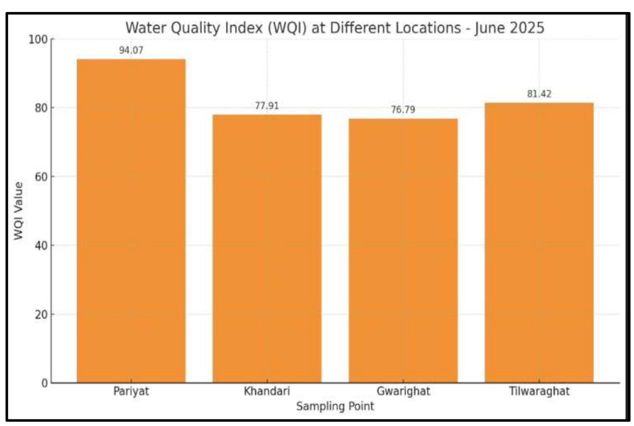
Overall Discussion

The results collectively point to a change in the water quality parameters between May and June, consistent with the expected effects of seasonal changes. The observed increase in BOD, coupled with a decrease in DO, is a strong indicator of increased organic loading and biological activity in the water. The rise in Nitrates further supports the hypothesis of surface runoff contributing to nutrient enrichment. Conversely, the decrease in alkalinity and TDS levels in June suggests a dilution effect, possibly from early monsoon rainfall. These observations highlight the dynamic nature of the water body's quality and the need for continuous monitoring to assess the impact of seasonal variations and local activities.

3.2 Water Quality Index (WQI) Computation and Graphical representation:

Using the weighted arithmetic index method, water quality index is calculated and shown in the form of graphs.





4.Discussion

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The Water Quality Index (WQI) data for May and June 2025 at four locations in Jabalpur—Pariyat, Khandari, Gwarighat, and Tilwaraghat—reveals significant seasonal variation. In May, water quality ranged from Good to Poor, with Gwarighat and Tilwaraghat showing better conditions. However, by June, all locations showed Very Poor Water Quality, with WQI values rising sharply (e.g., Pariyat at 94.072).
This deterioration is likely due to early monsoon runoff carrying pollutants like sewage, agricultural waste, and solid debris into the water bodies. The sharp drop in quality at previously better sites (Gwarighat, Tilwaraghat) is particularly concerning.

5.Conclusion

Water quality in Jabalpur worsened significantly from May to June 2025. While some sources were safe in May, all showed Very Poor quality in June. This highlights the seasonal vulnerability of surface water and the urgent need for better management, especially during the monsoon.

6.Recommendations

- Regular Monitoring to track seasonal changes.
- Prevent Untreated Waste Discharge into water bodies.
- Improve Stormwater Drainage to reduce runoff pollution.
- Raise Public Awareness on water pollution impacts.
- Enforce Water Quality Regulations at the municipal level.

7.Future Scope of Work

Future research should:

- Monitor year-round to assess seasonal changes.
- Expand testing to include heavy metals and bacteria.
- Study aquatic life to link water quality to ecosystem health.
- Identify specific sources of pollution.
- Utilize a Water Quality Index (WQI) for a unified assessment.
- Use models to predict future trends.

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