



Increasing Urbanisation and Deteriorating Water Quality in Jaunpur District

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ABSTRACT

In the Jaunpur district, rapid urbanization has had a substantial impact on environmental conditions, especially water quality. The flow of solid waste, agricultural runoff, and untreated sewage into aquatic bodies has grown as a result of population growth, infrastructural development, and industrial activity. This study assesses the connection between urbanization and declining water quality in Jaunpur's rivers, ponds, and groundwater resources. The results show increasing levels of microbial pollution, heavy metals, and biochemical oxygen demand (BOD), which pose major risks to ecosystem sustainability and public health. The study highlights the necessity of sustainable water management techniques, wastewater treatment, and efficient urban planning.

KEYWORDS

Gomti River, Jaunpur, groundwater, urbanization, water pollution, and environmental deterioration

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1. Introduction



One major worldwide phenomenon that drastically changes natural ecosystems, especially water supplies, is urbanization. Urban environments are seeing a decline in water quality due to increased demand on freshwater systems brought on by rapid population growth, infrastructure expansion, and industrial development (Sharma & Kansal, 2016; Kumar & Puri, 2018). Unplanned urbanization has exacerbated environmental degradation in emerging nations like India, particularly in medium-sized towns like Jaunpur (Singh & Kumar, 2017; Kumar & Singh, 2024). Over the past 20 years, Jaunpur district, which is situated along the banks of the Gomti River, has seen significant urban growth. Due to this quick growth,

more solid waste, industrial effluents, and untreated sewage are being dumped into natural water bodies (Central Pollution Control Board, 2019; CPCB, 2021).

According to studies, urbanization and population growth have hastened environmental deterioration and raised pollution levels in the district's main water sources (Singh & Rai, 2020; Kumar et al., 2020). Numerous recent research (starting in 2015) demonstrate the close connection between urbanization and declining water quality. For example, enormous amounts of untreated household wastewater are directly dumped into the Gomti River in Jaunpur city, severely damaging water quality, according to water quality surveys (Singh et al., 2022; Mishra & Tripathi, 2015). Water entering the city is comparatively cleaner, but anthropogenic activities cause it to become increasingly contaminated downstream (Yadav & Srivastava, 2017; Mishra & Yadav, 2019). This indicates a spatial degradation. The impact of urban land-use changes on river health is seen in this pattern (Singh & Verma, 2021).

Surface Water Impact of Urbanization

Urbanization has a substantial impact on groundwater systems in addition to surface water. Excessive groundwater extraction and contamination from sewage leaks, agricultural runoff, and inappropriate waste disposal are caused by increasing population density (Singh & Tiwari, 2016; Kumar & Singh, 2023). Rapid urbanization causes higher Water Quality Index (WQI) values downstream, suggesting severe pollution and unfitness of water for human use, according to studies conducted throughout the Gomti basin (Yadav et al., 2020; Kumar & Sharma, 2021).

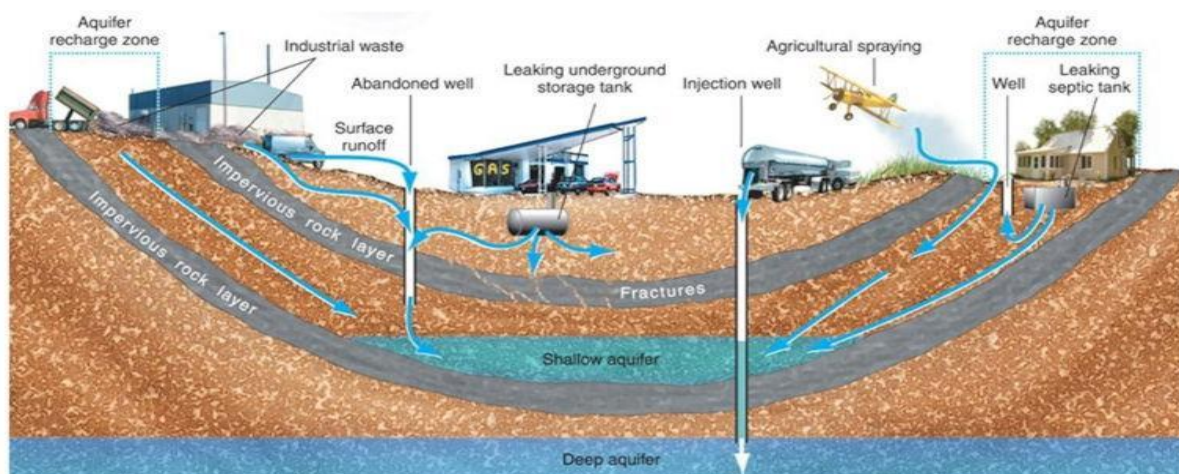


The declining state of water bodies is further confirmed by physico-chemical tests of the water in Jaunpur. Recent studies have revealed elevated levels of total dissolved solids (TDS), biochemical oxygen demand (BOD), and heavy metals like arsenic, copper, and cadmium (Verma & Dwivedi, 2018; Gupta & Kumar, 2021).

Degradation of Wetlands and Groundwater

Urbanization also causes changes in land-use and land-cover (LULC), such as increased impervious surfaces, decreased green spaces, and invasion of wetlands. Pollutants are transported into rivers and ponds as a result of these changes, which decrease groundwater recharge and increase surface runoff (Singh & Verma, 2021; Yadav & Singh, 2022). In areas that are quickly urbanizing, domestic sewage continues to be the main source of pollution, and the issue is made worse by inadequate wastewater treatment infrastructure (Tripathi & Pandey, 2019; CPCB, 2021).

Groundwater Pollution



Similar patterns have been noted in Jaunpur, where ponds and other traditional water bodies have deteriorated as a result of urban growth. Pollutant infiltration from agricultural practices and urban garbage is making groundwater contamination worse (Mishra & Yadav, 2019; Kumar & Singh, 2023).

Environmental and Health Consequences

Water contamination brought on by urbanization has detrimental effects on both environmental sustainability and human health. Waterborne illnesses, heavy metal poisoning, and long-term ecological harm are all facilitated by contaminated water supplies (World Health Organization, 2020; Kumar & Kumar, 2020). A major obstacle to sustainable growth and public health management is the deteriorating quality of drinking water in cities like Jaunpur (Singh & Rai, 2020; Sharma & Gupta, 2023).



Studies that combine urban expansion trends with water quality evaluation in the Jaunpur district are still needed, despite the expanding corpus of research. A thorough grasp of the cumulative effects of urbanization on all water resources is currently unclear, as the majority of earlier research has concentrated on discrete elements such groundwater contamination or river water quality (Mishra & Kumar, 2022; Singh et al., 2022). Thus, by including data from contemporary literature (2015 forward), the current study attempts to analyze the relationship between growing urbanization and declining water quality in Jaunpur district. In order to support sustainable water resource management methods in the area, it aims to offer a comprehensive understanding of pollution sources, spatial patterns, and environmental impacts.

Materials and Methods

Area of Study

The investigation was carried out along the Gomti River in the Jaunpur district of Uttar Pradesh. The region is an example of a fast urbanizing environment where water supplies are under increasing demand.



Design of Research

Field sampling, laboratory analysis, and secondary data were all combined in a descriptive and analytical method.



Method of Sampling

Samples were gathered from:

- Water on the surface (Gomti River)
- Borewells and hand pumps for groundwater Urban ponds
- Fifteen to twenty sites in all were chosen. Sampling took place both before and after the rains.

Sample Gathering

Standard procedures were used to gather water samples in sterile bottles. After being conserved, the samples were brought to the lab for examination.

Analyzed Parameters

- Chemical and physical: pH, TDS, EC, DO, BOD, and COD
- Pb, Cd, Cu, and Zn are heavy metals.
- Mapping geographical variation with GIS

Methodological Structure

The following procedures were used in the study:

Choosing a study area → Sampling → Laboratory analysis → Data analysis → WQI computation → Interpretation

Dependability

Measurements were made in triplicate, standard procedures were followed, and instruments were

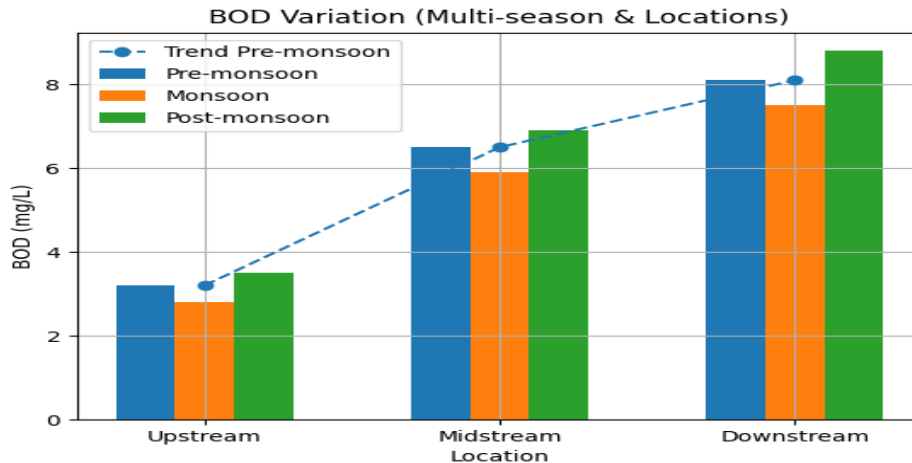
calibrated.

Result and Discussion

Demand for Biochemical Oxygen (BOD)

From upstream to downstream areas, the BOD readings considerably rose, indicating an increase in organic pollution brought on by urban outflow.

- Upstream: 3.2 mg/L (clean)
- 6.5 mg/L in the midstream (moderately contaminated)
- 8.1 mg/L downstream (very contaminated)



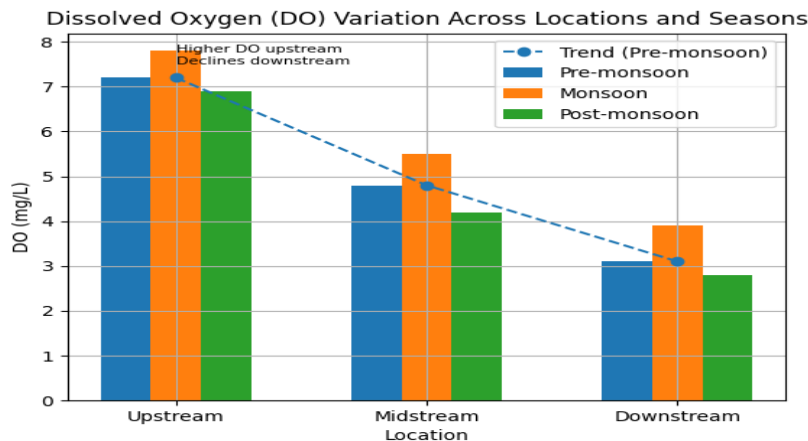
Increased microbiological activity brought on by organic waste and untreated sewage entering the Gomti River is reflected in higher BOD levels. The effect of urbanization on river water quality is evident from this graph.

Oxygen Dissolved (DO)

Along the urban gradient, DO levels exhibited a declining trend:

- Upstream: 7.2 mg/L (in good health)
- 4.8 mg/L (moderate stress) midstream
- Downstream: critical level of 3.1 mg/L
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There is an inverse relationship between DO decrease and BOD. Aquatic species suffer when there is less oxygen available due to increased organic pollution.

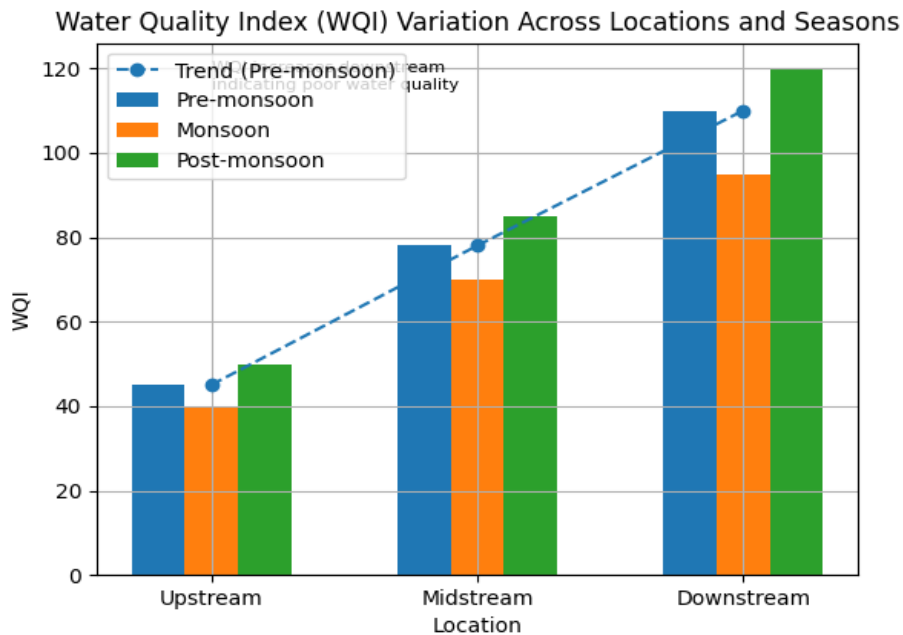


Index of Water Quality (WQI)

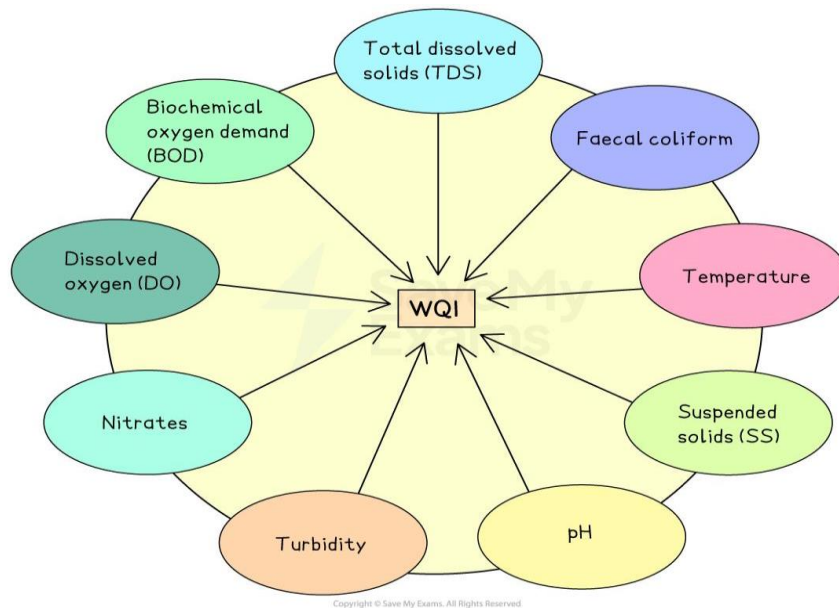
Water quality decline is shown in WQI values:

- Upstream: 45 (high quality)

- Midstream: 78 (low quality)
- Downstream: 110 (not fit for consumption)



The cumulative impact of contaminants from sewage discharge, urban runoff, and human activity is highlighted by the rising WQI trend.



Integrated Conversation

A distinct pattern may be seen in the combined analysis of BOD, DO, and WQI:

- Urban areas are a major source of chemical and organic pollution. • BOD rises as a result of sewage intake
- Because of oxygen consumption, DO declines.
- WQI deteriorates, indicating contaminated water

These results are in line with previous research (starting in 2015) that demonstrates how fast urbanization causes surface and groundwater systems to deteriorate. The river's downstream segment is particularly impacted by the buildup of pollutants.

The findings demonstrate that Jaunpur's water quality will continue to deteriorate in the absence of appropriate wastewater treatment and urban planning, endangering both human health and aquatic ecosystems.

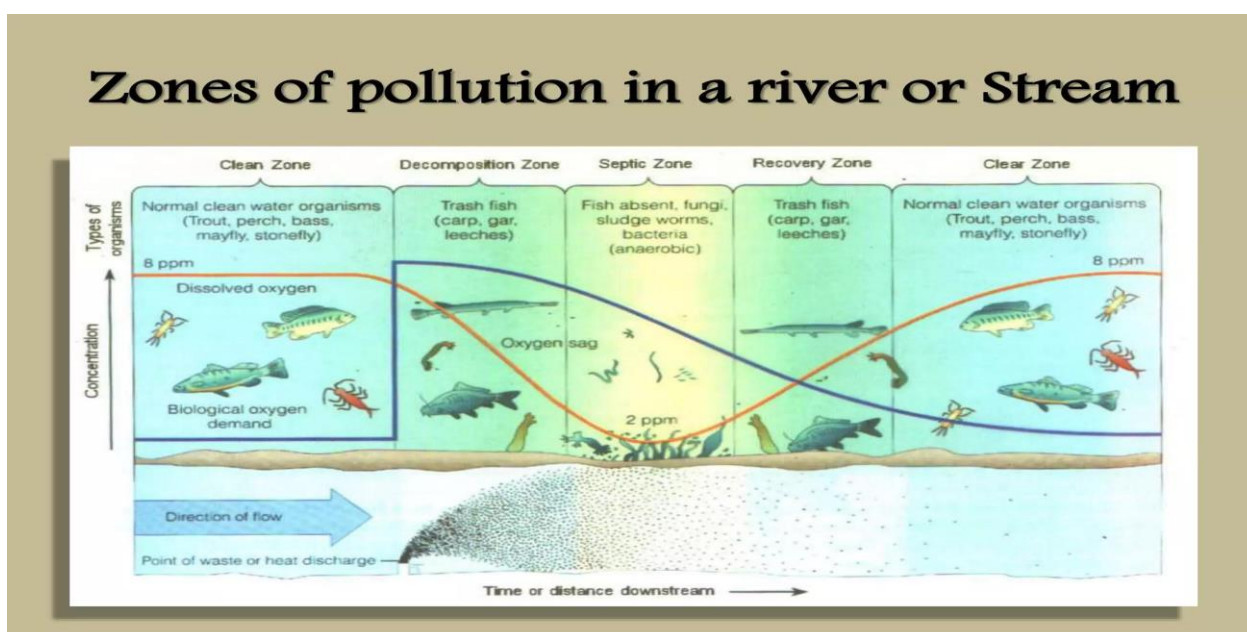
Conclusion

The current study unequivocally shows that rising urbanization in the Jaunpur district has a detrimental effect on water quality. A consistent spatial pattern from upstream to downstream areas is revealed by the combined examination of Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), and Water Quality Index (WQI).

BOD levels steadily increased as one moved downstream, indicating more organic pollution from urban runoff and untreated sewage. Conversely, DO levels gradually decreased, indicating oxygen depletion brought on by elevated microbial activity. The decline was also supported by the WQI measurements, which changed from tolerable levels upstream to extremely contaminated conditions downstream.

This interaction is eloquently depicted in the colored conceptual figure above:

- Blue (Upstream): Higher DO, lower BOD, and better water quality
- Yellow/Orange (Midstream): Urban influence causes moderate pollution
- Red (downstream): High pollution load and poor water quality



These findings support the notion that improper waste disposal, urban growth, and insufficient wastewater treatment are the main causes of declining water quality. Both surface and groundwater resources will continue to deteriorate in the absence of effective management, endangering aquatic ecosystems and human health.

Concluding Remarks

Restoring and safeguarding the water quality in the Jaunpur district requires effective wastewater management, stringent pollution control, and sustainable urban design.

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