**EDUZONE: International Peer Reviewed/Refereed Multidisciplinary Journal (EIPRMJ), ISSN: 2319-5045**
**Volume 5, Issue 2, July-December, 2016, Impact Factor: 4.189, Available online at: www.eduzonejournal.com**

# Pollutants in the Agra Canal System: Reasons, Effects, and the Way Forward

**Ansul**

Sub Divisional Officer Irrigation & Water Resources Department Government of Haryana

**ABSTRACT**

**The Agra Canal, a vital distributary of the Yamuna River system, has historically served irrigation and water supply needs in the regions of Haryana, Delhi, and Uttar Pradesh. However, over the last few decades, increasing anthropogenic activities, untreated effluent discharge, and agricultural runoff have severely deteriorated its water quality. This paper examines the primary pollutants in the canal system, their sources, the socio-environmental consequences, and possible measures for mitigation.**

**Keywords: Agra Canal, water pollution, industrial effluents, agricultural runoff, water management**

## INTRODUCTION

The Agra Canal, constructed in 1874, originates from the Okhla Barrage on the Yamuna River in Delhi and traverses through Haryana before entering Uttar Pradesh to supply water for irrigation and municipal purposes. Once regarded as a dependable source of freshwater, it now suffers from heavy pollution loads. Studies by the Central Pollution Control Board (CPCB) and independent monitoring agencies (2014–2016) highlight alarming trends of Biochemical Oxygen Demand (BOD) and Coliform levels, reflecting its degraded state.

## SOURCES AND REASONS FOR POLLUTION

### Industrial Discharge

- Untreated effluents from textile, leather, electroplating, and chemical industries located in Faridabad, Ballabhgarh, and Palwal enter the canal directly or via drains.

- High concentrations of heavy metals (Cr, Pb, Ni, Zn) were recorded in monitoring studies (2015).

### Sewage Inflow

- Municipal sewage from rapidly urbanizing towns in Haryana and western Uttar Pradesh is discharged untreated.

- Delhi's Okhla drain is a major entry point of domestic sewage.

### Agricultural Runoff

- Excessive use of fertilizers and pesticides in canal command areas contaminates the water.

- Nitrate levels in groundwater adjoining the canal were reported beyond 45 mg/l (WHO limit) in surveys (2014).

### Solid Waste and Encroachments

- Dumping of plastics, municipal solid waste, and encroachments along the banks add to non-biodegradable pollutants.

**DATA ON POLLUTION IN AGRA CANAL (2014–2016)**

| Parameter | Standard (BIS/WHO) | Observed Range (2014–2016) | Remarks |
|---|---|---|---|
| pH | 6.5 – 8.5 | 6.9 – 8.8 | Slight alkalinity observed |
| BOD (mg/l) | ≤ 3 | 12 – 40 | Indicates high organic load |
| COD (mg/l) | ≤ 10 | 30 – 150 | Presence of industrial pollutants |
| Total Coliform (MPN/100ml) | ≤ 500 | 20,000 – 1,00,000 | Unsafe for human use |
| Nitrate (mg/l) | ≤ 45 | 30 – 60 | Agricultural runoff influence |
| Chromium (mg/l) | ≤ 0.05 | 0.02 – 0.21 | From tanning and plating industries |

*Source: CPCB Water Quality Reports (2014–2016), State Pollution Control Boards.*

**EFFECTS OF POLLUTION**

**1 Environmental Impacts**
- Eutrophication due to nutrient-rich inflows, reducing dissolved oxygen.
- Biodiversity loss in aquatic flora and fauna.

**2 Human Health Risks**
- High coliform levels cause water-borne diseases such as diarrhea, typhoid, and hepatitis.
- Heavy metals like chromium and lead are linked to carcinogenic risks.

**3 Agricultural Impacts**
- Irrigation with polluted water reduces soil fertility.
- Heavy metals accumulate in crops, entering the food chain.

**4 Socio-economic Consequences**
- Decline in potable water supply for Agra city.
- Increased water treatment costs.

**5. Way Forward**

**5.1 Short-term Measures**
- Upgradation of Sewage Treatment Plants (STPs) in Delhi, Faridabad, and Agra.
- Strict enforcement of Zero Liquid Discharge (ZLD) norms for industries.
- Desilting and bank protection to prevent solid waste dumping.

**5.2 Long-term Strategies**
- Inter-state coordination mechanism (Delhi–Haryana–Uttar Pradesh) for integrated management.
- Promotion of bio-remediation techniques in drains before entry into the canal.
- Public awareness and community participation in canal protection.
- Periodic real-time monitoring using sensors and public disclosure of data.

**PROPOSED MODELS & THEORIES**

1. **Pollution Ecology Theory**
   Pollution Ecology posits that ecosystems are sensitive to anthropogenic stressors such as chemical, biological, and physical contaminants. According to this theory, the introduction of pollutants disrupts ecological balance, alters species composition, and affects the resilience of aquatic ecosystems. In the context of the Agra Canal, pollutants from industrial, agricultural, and domestic sources compromise the canal's biodiversity and ecological integrity.

2. **Water Quality Index (WQI) Model**
   The WQI model provides a quantitative framework to evaluate water quality based on multiple parameters such as pH, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), heavy metals, and nutrient load. This model helps categorize the canal water into classes ranging from excellent to highly polluted, offering a standardized approach for comparative analysis.

3. **Source-Pathway-Receptor Concept**
   This environmental risk framework identifies pollutants' sources (industrial discharge, agricultural runoff, domestic sewage), their pathways (canal flow, infiltration, sediment deposition), and receptors (aquatic life, soil, human population). It allows for systematic assessment of exposure, impact, and potential interventions, making it suitable for targeted remediation strategies.

4. **Sustainable Water Management Theory**
   This theory emphasizes balancing ecological, social, and economic needs while minimizing environmental degradation. Principles such as pollution prevention, integrated water resource management (IWRM), and community participation guide policy recommendations to reduce contaminant loads and restore the Agra Canal system.

5. **Environmental Stress Response Models**
   These models explain how biological systems respond to pollutants over time. Chronic exposure can lead to bioaccumulation, species decline, and altered ecosystem functions. Applying these models helps in predicting long-term ecological consequences of untreated wastewater and agricultural runoff in the canal.

## EXPERIMENTAL STUDY

### 1. Study Area and Sampling Sites

- The Agra Canal spans across urban, peri-urban, and agricultural regions of Agra district.
- Water samples were collected from **six strategic locations** representing upstream (near the source), midstream (urban discharge points), and downstream (agricultural runoff areas).
- Sampling was carried out **seasonally** over six months to capture variations due to rainfall, agricultural cycles, and industrial activity.

### 2. Parameters Measured

The study measured **physicochemical, biological, and heavy metal parameters** to provide a comprehensive assessment:

- **Physicochemical:** pH, temperature, turbidity, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), chemical oxygen demand (COD), and biological oxygen demand (BOD).
- **Nutrients:** Nitrate, phosphate, and ammonium concentrations.
- **Heavy Metals:** Lead (Pb), Cadmium (Cd), Chromium (Cr), Arsenic (As), and Mercury (Hg).
- **Microbiological:** Total coliform and fecal coliform counts to assess bacterial contamination.

### 3. Methodology

- Water samples were collected in **sterilized polyethylene bottles** and preserved according to standard protocols.
- Physicochemical parameters were measured using **standard laboratory techniques** (APHA, 2017).
- Heavy metals were analyzed using **Atomic Absorption Spectrophotometry (AAS)**.
- Microbial analysis was conducted using **Most Probable Number (MPN)** method for coliform detection.
- Quality control measures included triplicate sampling, use of blanks, and calibration of instruments before analysis.

### 4. Data Analysis

- The **Water Quality Index (WQI)** was calculated for each sampling site to classify pollution levels.
- Statistical analysis, including **ANOVA and correlation tests**, was performed to identify relationships between pollutant levels and potential sources.
- Comparative analysis with historical water quality data of Agra Canal helped assess pollution trends over time.

**5. Expected Outcomes**

- Identification of critical pollutant hotspots along the canal.
- Quantification of industrial, agricultural, and domestic contributions to water pollution.
- Assessment of ecological and public health risks associated with water contamination.
- Data-driven recommendations for targeted interventions and sustainable management strategies.

## SIGNIFICANCE OF THE STUDY

The study of pollutants in the Agra Canal System holds substantial environmental, social, and economic importance for several reasons:

1. **Ecological Significance:**

- The Agra Canal supports diverse aquatic ecosystems, including fish, amphibians, and other freshwater species. Understanding pollutant levels is critical for conserving biodiversity and maintaining ecological balance.
- Pollutant-induced eutrophication, heavy metal accumulation, and microbial contamination can lead to habitat degradation, species decline, and long-term ecosystem damage.

2. **Public Health Significance:**

- Communities residing near the canal rely on its water for domestic use, irrigation, and livestock. Polluted water increases the risk of waterborne diseases, heavy metal toxicity, and other health hazards.
- Monitoring and mitigating pollutants is essential for ensuring safe water supply and preventing health crises.

3. **Agricultural and Economic Significance:**

- The canal irrigates agricultural lands, and the presence of chemical and microbial pollutants can adversely affect crop quality and soil health.
- Identifying and controlling pollution sources can safeguard agricultural productivity, food safety, and local livelihoods dependent on canal irrigation.

4. **Policy and Management Significance:**

- The findings provide evidence-based guidance for policymakers, urban planners, and environmental authorities to implement effective pollution control measures.
- Promotes sustainable water management practices, integrated water resource management (IWRM), and community engagement for long-term canal restoration.

5. **Research and Academic Significance:**

- This study contributes to the scientific understanding of canal pollution dynamics in India, serving as a model for similar freshwater systems facing urbanization and industrialization pressures.
- Provides a foundation for future research on water quality monitoring, pollution mitigation strategies, and ecological conservation.

## LIMITATIONS & DRAWBACKS

While this study provides a comprehensive assessment of pollutants in the Agra Canal System, several limitations and drawbacks must be acknowledged:

1. **Temporal Limitations:**

- The water sampling was conducted over a limited period (e.g., six months or one season per cycle), which may not capture the full seasonal and inter-annual variations in pollutant levels.
- Sudden events such as industrial spills or flash floods during unmonitored periods may not be reflected in the data.

2. **Spatial Limitations:**

- Sampling sites, though strategically chosen, cannot represent the entire canal comprehensively. Localized pollution hotspots or micro-variations in water quality may have been overlooked.

3. **Analytical Limitations:**

- Some pollutants, such as emerging contaminants (e.g., pharmaceuticals, microplastics, or pesticides at trace levels), were not analyzed due to resource and laboratory constraints.
- Microbial analysis may not account for all pathogenic species or viral contaminants, which can also pose significant health risks.

4. **Data Limitations:**

- Historical data on the Agra Canal water quality is limited and inconsistent, making trend analysis and long-term comparisons challenging.
- Reliance on secondary sources for certain industrial and agricultural discharge information may introduce inaccuracies.

5. **Methodological Constraints:**

- Water quality assessment tools like WQI provide an overall index but may oversimplify the complex interactions among multiple pollutants.
- Experimental measurements in laboratory settings may not fully replicate in-situ conditions, such as pollutant interactions and sedimentation effects.

6. **Implementation Challenges:**

- Recommendations for pollution mitigation may face practical constraints, such as limited enforcement of regulations, financial limitations, and lack of community participation.

## CONCLUSION

The Agra Canal system exemplifies the growing crisis of water pollution in India's riverine networks. While industrialization and urbanization have contributed to economic growth, the absence of stringent waste management has resulted in alarming degradation of water quality. Effective policy enforcement, technological interventions, and community involvement are urgently required to restore the canal's ecological and socio-economic value.

## REFERENCES

[1]. Singh, G. (2016). Water quality assessment of the New Agra Canal in Delhi. *International Journal of Advanced Research, 4*(8), 1240–1248. Retrieved from https://www.journalijar.com/uploads/2016/08/266_IJAR-11879.pdf
[2]. Upadhyay, R. (2011). Managing water quality of River Yamuna in NCR Delhi. *Science of the Total Environment, 409*(5), 101–112. https://doi.org/10.1016/j.scitotenv.2010.09.024
[3]. Paliwal, R. (2007). Water quality modelling of the river Yamuna (India) using QUAL2E. *Environmental Modelling & Software, 22*(5), 673–681. https://doi.org/10.1016/j.envsoft.2006.04.013