

# Water Pollution and Its Impact on Fish Ecology in the Yamuna River, India

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**Abstract**—The Yamuna River, a major tributary of the Ganges, is a vital water source for millions of people in India. However, the river has been plagued by severe pollution, which has had a significant impact on the aquatic life, particularly the fish population. The contamination of the Yamuna River is a result of various factors, including industrial waste, agricultural runoff, and domestic sewage. This research paper aims to investigate the impact of water pollution on the fishes in the Yamuna River and the potential health risks associated with their consumption.

**Index Terms**—Yamuna River, Fish Population, Pollution, Health Risks

## I. INTRODUCTION

The Yamuna River, a sacred river in India and a major tributary of the Ganges, is facing a severe crisis due to escalating water pollution. This pollution has devastating consequences for the river's ecosystem, particularly its fish populations. This essay will explore the various sources of pollution in the Yamuna, their direct and indirect impacts on fish, and the potential implications for human health and the environment.

Untreated sewage and industrial effluents are significant sources of pollution in the Yamuna. Large volumes of wastewater, containing a cocktail of chemicals, heavy metals, and organic matter, are discharged directly into the river. These pollutants drastically reduce dissolved oxygen levels, creating hypoxic conditions that suffocate fish and other aquatic organisms (UNDP, 2025). It describes the devastating impact of low dissolved oxygen levels on fish in the Yamuna. Furthermore, heavy metals like lead, mercury, and cadmium bioaccumulate in fish tissues, posing serious health risks to humans who consume them (Dwivedi, Mishra, & Tripathi, 2018). It

discuss the bioaccumulation of toxicants in fish from polluted rivers and the associated health risks.

Agricultural runoff, infused with pesticides and fertilizers, intensifies the ecological issues in the river. These chemicals contaminate the river, poisoning fish and disrupting the delicate balance of the aquatic ecosystem. While Dwivedi, Mishra, & Tripathi, (2018) notes a reduction in pesticide levels in the Ganges in recent years, the presence of these chemicals remains a concern for aquatic life. Additionally, industrial discharge often contains high levels of organic matter, which increases the biological oxygen demand of the river. A high BOD further depletes oxygen levels, creating a hostile environment for fish.

The impact of pollution on fish in the Yamuna is multifaceted. Direct exposure to toxins can lead to fish kills, deformities, and reduced reproductive success. Indirectly, pollution alters the river's physical and chemical properties, disrupting the food web and impacting the overall health of the ecosystem. Changes in water temperature, pH, and turbidity can stress fish, making them more susceptible to diseases and parasites. The decline in fish populations has cascading effects on the entire ecosystem, impacting other aquatic organisms, birds, and even humans who depend on the river for their livelihoods.

The degradation of the Yamuna River also has significant socioeconomic implications. Fishing communities that rely on the river for their sustenance face dwindling catches and economic hardship. The contamination of fish with heavy metals poses a serious threat to human health, particularly for those who consume fish regularly. Moreover, the polluted river poses a risk to public health through the spread of waterborne diseases.

Addressing the pollution crisis in the Yamuna requires a multi-pronged approach. Enforcing more stringent

laws on industrial and sewage effluent, advocating for sustainable farming methods, and enhancing public awareness are essential measures. Investing in wastewater treatment plants and promoting eco-friendly technologies can further mitigate pollution (Paliwal et al., 2006). It discusses the use of water quality modelling to assess pollution loads and evaluate different management scenarios. Rani et al. (2013) provides data on the water quality of the Yamuna, highlighting the need for improved management strategies. Ultimately, restoring the health of the Yamuna River requires a collective effort from government, industries, communities, and individuals. Protecting this vital resource is essential not only for the survival of fish and other aquatic life but also for the well-being of present and future generations.

## II. SOURCES OF WATER POLLUTION IN THE YAMUNA RIVER

The Yamuna River faces a multitude of pollution sources, including industrial effluents, agricultural runoff, and domestic sewage. The number of factories and the population living along the river have increased rapidly due to industrialization, contributing to the high levels of pollutants in the water (Tiwari, AC, & Mayank, 2016). Water pollution levels change seasonally, with pollutant concentrations in water samples reflecting the circumstances at the time of collection (Tiwari, AC, & Mayank, 2016). The Yamuna River faces a multitude of pollution sources, contributing to its severely degraded state. These sources can be broadly categorized as:

1. **Sewage and Domestic Wastewater:** A major contributor, especially in urban stretches, is untreated or inadequately treated sewage from households and communities (Mishra, 2025). It highlights that Delhi, despite having only a short stretch of the river flowing through it, contributes a disproportionately high pollution load due to sewage and industrial discharge (Trinee 2022). It also identifies domestic wastewater as a key pollutant. The lack of sufficient sewage treatment infrastructure and the direct discharge of raw sewage into the river contribute significantly to its contamination.

2. **Industrial Effluents:** Industrial discharge, often containing heavy metals, chemicals, and other toxic substances, poses a severe threat to the river's health (Mishra, 2025). It further emphasizes the role of industrial discharge in Delhi's pollution contribution to the Yamuna. The lack of stringent enforcement of effluent discharge standards exacerbates this issue.

3. **Agricultural Runoff:** Runoff from agricultural fields carries pesticides, fertilizers, and other agrochemicals into the river, contaminating the water and harming aquatic life (Trinee 2022). It includes pesticide residue as a pollution source. This non-point source pollution is challenging to control and requires promoting sustainable agricultural practices.

4. **Religious Practices:** The immersion of idols and religious offerings, while culturally significant, introduces pollutants such as paints, plastics, and organic matter into the river (Trinee, 2022). It mentions idol immersion as a source. Managing this pollution source requires raising public awareness and promoting eco-friendly alternatives.

5. **Urban Runoff:** Stormwater runoff from metropolitan areas brings pollutants like oil, grease, and garbage into the river. Jamwal et al. (2008) points out the contribution of urban runoff to microbial pollution in the Yamuna. Improving urban drainage systems and implementing measures to reduce surface runoff can help mitigate this issue.

6. **Other Sources:** Other sources include solid waste disposal, cremation ashes, and illegal dumping, further adding to the river's pollution burden.

Addressing the pollution crisis in the Yamuna requires a comprehensive approach targeting each of these sources. Stricter rules, improved sewage treatment facilities, encouraging sustainable agricultural and industrial practices, and raising public awareness are all critical measures toward restoring the river's health. Fish varieties in Yamuna River: describes the impact of pollution on the fish population in the Ganges River, a sister river to the Yamuna, noting the presence of some exotic aquatic organisms due to the poor water quality. provides insights into the water quality modelling of the Yamuna River, which aimed to examine the influence of different pollution scenarios on the river's water quality.

Impact on fisheries near the Yamuna river: The degradation of the Yamuna River has had a significant impact on the fisheries in the region. Fishermen who rely on the river for their livelihoods have faced dwindling catches due to the decline in fish populations. The bioaccumulation of toxicants, such as heavy metals and pesticide residues, in fish tissues poses a serious health risk to humans who consume these fish (Dwivedi, Mishra, & Tripathi, 2018).

Potential solutions: To address the pollution crisis in the Yamuna River, a multi-faceted approach is required. Stricter industrial and sewage discharge laws, as well as the promotion of sustainable farming practices and investment in wastewater treatment plants, can all assist to reduce pollution. Raising public awareness and encouraging collective action from government, industries, and communities are also crucial steps in restoring the health of the Yamuna River.

### III. IMPACT ON FISH POPULATIONS

The water pollution in the Yamuna River has had a detrimental effect on the fish populations. Studies have shown significant quantities of carcinogenic chemicals in Ganga water, which is cause for alarm. The contamination of the water has led to the bioaccumulation of toxicants in the fishes, making them unsuitable for consumption and posing a potential health risk to the population that relies on the river for their food supply (Dwivedi, Mishra, & Tripathi, 2018).

The reduction in the level of pesticides in the Ganga water over the last decade is a positive development, but the levels are still high enough to pose a threat to the aquatic life. Furthermore, the Ganga River's poor water quality has allowed certain foreign aquatic creatures to thrive, further altering the environment (Tiwari, AC, & Mayank, 2016).

### IV. POTENTIAL HEALTH RISKS

The consumption of fish from the Yamuna River is a concern due to the bioaccumulation of toxicants, such as heavy metals and pesticide residues, in the fish tissues. Ingesting these toxicants can cause a variety of health problems, including cancer, neurological diseases, and reproductive troubles.

Government Regulations and Conservation Efforts:

To address the pollution crisis in the Yamuna River, the implementation of stricter regulations on industrial and sewage discharge, as well as the promotion of sustainable agricultural practices, are crucial. Investing in wastewater treatment plants and promoting eco-friendly technologies can further mitigate pollution (Tiwari, AC, & Mayank, 2016). Investing in wastewater treatment plants and promoting eco-friendly technologies can further mitigate the pollution. However, these efforts require a collective effort from the government, industries, and communities living along the river. The Yamuna River's dire pollution levels necessitate robust government intervention and concerted conservation efforts. Several initiatives and regulations are in place, though their effectiveness remains a subject of ongoing evaluation and improvement.

Key Regulations and Policies:

- National Green Tribunal: The NGT has played a significant role in addressing Yamuna's pollution. It has issued numerous directives, imposed fines on polluting industries and government agencies, and pushed for stricter enforcement of environmental laws (Mishra, 2025). It mentions the NGT's actions against entities failing to treat sewage and industrial effluent adequately.
- Namami Gange Programme: While primarily focused on the Ganges, this integrated conservation mission also addresses the Yamuna, a major tributary. It emphasizes pollution abatement, sewage treatment infrastructure development, and riverfront development (Hussain et al., 2020). It also discusses policy challenges in river conservation, including the need for integrated approaches.
- Water Act, 1974: This act provides a legal framework for regulating water pollution and establishing pollution control boards. However, enforcement challenges persist.

Conservation Efforts:

- Yamuna Action Plan: This multi-phase program, supported by the Japanese International Cooperation Agency, focuses on sewage treatment infrastructure development and pollution control measures.

- **Riverfront Development Projects:** Initiatives aimed at revitalizing the riverfront, including landscaping, creating public spaces, and improving sanitation, contribute to conservation efforts.
- **Community Involvement:** Engaging local communities in conservation activities is critical for long-term success. Public awareness campaigns, educational programs, and community-based monitoring activities all play an important role.

#### Challenges and Future Directions:

The enforcement of regulations, inadequate sewage treatment capacity, industrial pollution, and agricultural runoff continue to afflict the river. Future initiatives must focus on:

- **Strengthening Enforcement:** Stricter monitoring and enforcement of existing regulations are crucial.
- **Improving Sewage Treatment:** Expanding sewage treatment capacity and ensuring proper functioning of existing plants are essential.
- **Controlling Industrial Pollution:** Implementing stricter effluent discharge standards and promoting cleaner technologies in industries are necessary.
- **Addressing Agricultural Runoff:** To reduce agricultural runoff pollution, promote sustainable agriculture methods and reduce the usage of chemical fertilizers and pesticides.
- **Enhancing Public Awareness:** Continued public awareness campaigns and educational programs are vital for fostering a sense of responsibility and promoting behavioural change.

The regeneration of the Yamuna River necessitates a long-term, multifaceted strategy including government agencies, industry, communities, and people. While progress has been made, continued efforts and innovative solutions are crucial to ensure the long-term health and sustainability of this vital river.

#### V. CONCLUSION

The water pollution in the Yamuna River has had a significant impact on the fish populations, leading to the bioaccumulation of toxicants and posing a potential health risk to the people who rely on the river

for their food supply. The reduction in the level of pesticides in the Ganga water is a positive development, but the levels are still high enough to pose a threat to the aquatic life (Dwivedi, Mishra, & Tripathi, 2018). Addressing the sources of pollution and implementing effective water treatment measures are crucial to mitigating the impact of water pollution on the fishes in the Yamuna River and ensuring the long-term sustainability of this vital water resource.

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