International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 10 Issue 4, Jul-Aug 2026 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Limnological Profile, Ecological Health, and Anthropogenic Stressors of Freshwater Ponds and Wetlands in the Gangetic Plains of Bihar: A Review

Dr. Priyama Kumari

Research Scholar, University Department of Zoology, Tilka Manjhi Bhagalpur University, Bhagalpur, Bihar, India

ABSTRACT

Freshwater ponds (Pokhar or Tal) and floodplain wetlands (Chaars and Mauns) in the Gangetic plains of Bihar-particularly across the central and eastern districts of Bhagalpur, Lakhisarai, Munger, and Khagaria-serve as essential socio-ecological lifelines. They regulate microclimates, recharge groundwater, support aquaculture, and act as critical biological hotspots for resident and migratory avifauna. However, rapid urbanization, agricultural runoff, heavy siltation, and untreated municipal sewage disposal have severely degraded these lentic ecosystems.

This review synthesizes regional empirical research to present a comprehensive assessment of the hydrobiological profile, seasonal water quality dynamics, biodiversity status, and environmental stressors impacting the lentic systems in Bihar, with special emphasis on Bhagalpur and Lakhisarai districts. Water quality analysis across studied urban and peri-urban ponds (e.g., Shahjangi, Bhairwa, Jichho, and Purandaha) consistently indicates shifting trophic states from mesotrophic to hyper-eutrophic, driven by elevated Biochemical Oxygen Demand (BOD), high Total Dissolved Solids (TDS), and nutrient loading and Planktonic assemblages reveal a pronounced dominance of pollution-tolerant taxa, notably rotifers (Brachionus spp.) and cyanobacteria. To arrest habitat fragmentation and loss of aquatic biodiversity, an integrated conservation strategy incorporating nature-based eco-restoration, community-led management, and enforcement of the Wetlands (Conservation and Management) Rules is urgently required.

KEYWORDS: *Limnology, Urban Ponds, Eutrophication, Bihar Wetlands, Phytoplankton, Water Quality Index, Conservation.*

How to cite this paper: Dr. Priyama Kumari "Limnological Profile, Ecological Health, and Anthropogenic Stressors of Freshwater Ponds and Wetlands in the Gangetic Plains of Bihar: A Review" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-10 | Issue-4, August 2026, pp.681-684, URL: www.ijtsrd.com/papers/ijtsrd142062.pdf

IJTSRD142062

1. INTRODUCTION

Ponds and small freshwater impoundments represent dynamic lentic ecosystems that account for a significant portion of inland surface water in tropical regions. In the Indo-Gangetic Alluvial Plain of Bihar, eastern India, these water bodies-locally classified as Pokhar, Ahar, Chaar, or Maun-form an interconnected network with the mainstem Ganges and its tributaries. Bihar harbors over 21,900 wetlands and water bodies covering roughly 403,200 hectares. Historically, these water bodies served as decentralized rainwater harvesting structures, flood attenuation basins, domestic water supplies, and centers for traditional capture fisheries.

In central and eastern Bihar-encompassing districts such as Bhagalpur, Lakhisarai, Munger, and Begusarai-lentic systems are shaped by seasonal riverine flooding and monsoonal inundation. Despite their ecological and socio-economic importance, small freshwater ponds are among the most vulnerable aquatic habitats. Urban expansion, land-use conversion, untreated wastewater disposal, and agricultural intensified runoffs have triggered accelerated cultural eutrophication.

While major river systems (such as the Ganga) receive substantial monitoring under national programs like Namami Gange, localized lentic

systems in districts like Lakhisarai and Bhagalpur remain under-researched and under-protected. This review provides a synthesis of the physicochemical, biological, and conservation aspects of pond ecosystems in these districts, offering a foundational framework for regional wetland management.

2. Hydro-Geomorphic Classification & District Profiles

The geomorphology of Bihar's water bodies is governed by active tectonic subsidence and alluvial deposition by the Ganga river system. Lentic bodies in this region fall into three primary categories:

1. Perennial Urban/Peri-Urban Ponds (Pokhars): Man-made or excavated depressions within municipal limits (e.g., Shahjangi and Bhairwa ponds in Bhagalpur town) designated for multi-purpose community use.
2. Rural/Agricultural Impoundments: Rural ponds utilized for Trapa (water chestnut) cultivation, Makhana (Euryale ferox) farming, and community aquaculture.
3. Oxbow Lakes & Floodplain Wetlands (Mauns and Chaars): Naturally formed abandoned river meanders and floodplain depressions (e.g., Jagatpur wetland in Bhagalpur, Baraila in adjacent regions) that maintain seasonal or permanent hydrologic connectivity with nearby rivers.

2.1. Bhagalpur District

Situated on the southern bank of the Ganga river, Bhagalpur features a mix of urban ponds embedded within dense settlements and expansive floodplain wetlands along the river corridor. Prominent study sites include Shahjangi Pond (western zone) and Bhairwa Pond (central zone), alongside the ecologically significant Jagatpur Wetland situated ~12 km northeast of the city center.

2.2. Lakhisarai & Munger Districts

Lakhisarai and adjacent Munger districts occupy a transitional belt between the southern Gangetic alluvial plain and the Chota Nagpur plateau fringe. Ponds here (including traditional Ahar-Pyne storage systems) exhibit dual characteristics: shallow water depths, high silt loads from hill washes during monsoons, and heavy agricultural nutrient input from surrounding paddy fields.

3. Physicochemical Parameters and Water Quality Status

Hydro-chemical analysis of pond water across these districts demonstrates pronounced seasonal variations driven by ambient temperature, rainfall-induced dilution, and evaporative concentration.

3.1. Limnological Dynamics

During pre-monsoon (summer) months, high water temperatures combined with low volume accelerate the bacterial breakdown of organic matter. This process rapidly depletes Dissolved Oxygen (DO), dropping levels below and creating hypoxic stress for demersal species. The monsoon brings influxes of silt and organic detritus, causing a temporary spike in turbidity and Total Suspended Solids (TSS). Post-monsoon to winter transitions witness partial stabilization of water clarity, allowing submerged aquatic vegetation to regenerate.

4. Biotic Communities & Planktonic Diversity

4.1. Phytoplankton

Phytoplankton communities act as primary producers and sensitive indicators of trophic status. In studied perennial ponds in Bhagalpur (e.g., Jichho and Purandaha), Chlorophyceae (green algae) forms the dominant group (38-40%), followed by Bacillariophyceae (28-31%), Cyanophyceae (18-22%), and Euglenophyceae (10-12%).

Chlorophyceae: Represented by Scenedesmus, Chlorella, and Spirogyra.

Bacillariophyceae: Navicula, Nitzschia, and Synedra, indicating organic enrichment.

Cyanophyceae: Microcystis aeruginosa and Oscillatoria form dense surface scums during summer, synthesizing microcystins that compromise fish health.

4.2. Zooplankton

Zooplankton assemblages are dominated by Rotifera (38-44%), followed by Cladocera (35-38%), Copepoda (12-15%), and Ostracoda (5-7%). High numerical abundance of Rotifers such as Brachionus calyciflorus, Keratella tropica, and Asplanchna spp. correlates directly with organic pollution and eutrophic conditions. Among Cladocerans, Daphnia and Moina species show peak densities post-monsoon.

4.3. Macrophytes and Avifaunal Biodiversity

Natural wetlands like Jagatpur (Bhagalpur) host extensive macrophyte cover, including Hydrilla verticillata, Vallisneria spiralis, Eichhornia crassipes, Typha angustata, and Lemna minor. These plants support over 160 bird species. Notably, the Jagatpur-Ganga floodplain belt serves as a crucial breeding ground for globally threatened avian species, including:

Greater Adjutant Stork (*Leptoptilos dubius*)

Lesser Adjutant Stork (*Leptoptilos javanicus*)

Woolly-necked Stork (*Ciconia episcopus*)

Black-necked Stork (*Ephippiorhynchus asiaticus*)

Winter migratory waterfowl including Anas acuta (Northern Pintail) and Netta rufina (Red-crested Pochard).

5. Major Anthropogenic Stressors and Degradation Drivers

1. **Untreated Municipal Sewage Influx:** Urban ponds like Shahjangi in Bhagalpur act as receiving sinks for untreated greywater and blackwater. This elevates organic carbon, depleted DO, and introduces pathogenic microbes.
2. **Agricultural Chemical Runoff:** In rural Lakhisarai and surrounding regions, intensive cultivation of rice and wheat uses synthetic fertilizers and pesticides. Rainfall washes these agrochemicals into adjacent ponds, driving hyper-eutrophication.
3. **Biological Invasions:** Exotic macrophytes, particularly Water Hyacinth (Eichhornia crassipes), form dense surface mats across unsustainably managed ponds. This blocks solar penetration, suppresses phytoplankton photosynthesis, and accelerates hypoxia upon plant decay.
4. **Siltation and Volume Loss:** Deforestation in catchment areas and uncontrolled land runoff cause heavy silt deposition. This reduces average water depths (during dry seasons), lowering thermal stability and storage capacity.
5. **Solid Waste Dumping & Ritual Activities:** Ponds frequently serve as disposal sites for single-use plastics, domestic refuse, and idol immersions during festivals, adding toxic heavy metals (lead, cadmium, chromium) to bed sediments.
6. **Sustainable Management & Restoration Framework:** To prevent further degradation of pond ecosystems in Bhagalpur, Lakhisarai, and adjacent Gangetic districts, a multi-tiered conservation strategy is required

5.1. Nature-Based Eco-Restoration

Constructed Wetlands / Floating Reed Beds: Installing peripheral vegetated zones using native species (Typha, Phragmites) to trap suspended solids and absorb excess nitrates and phosphates before runoff enters ponds.

Controlled De-Siltation and Bio-Dredging: Periodic removal of nutrient-rich bottom sludge during dry months restores depth, expands storage volume, and reduces internal nutrient loading.

5.2. Policy Enforcement & GIS Boundary Mapping

Strict application of the Wetlands (Conservation and Management) Rules (2017) to prevent unauthorized construction, land conversion, and industrial discharge.

High-resolution spatial mapping using GIS and remote sensing to establish legal buffer zones around all water bodies in Bhagalpur and Lakhisarai.

5.3. Community Governance & Sustainable Aquaculture

Integrating local fishing communities and self-help groups (SHGs) under state initiatives like the Jal-Jeevan-Hariyali Abhiyan.

Promoting polyculture of indigenous carp (Labeo rohita, Cirrhinus mrigala) alongside ecological monitoring to align local livelihoods with habitat preservation.

6. Conclusion

Ponds and wetlands in Bhagalpur, Lakhisarai, and adjacent districts of Bihar are ecologically vital yet environmental threatened ecosystems. Hydrobiological evaluation demonstrates that urban water bodies are increasingly eutrophic, characterized by elevated organic loading, hypoxic summer conditions, and a dominance of pollution-tolerant plankton. Protecting these water resources requires moving away from treating ponds as urban waste sinks. Implementing ecological restoration, enforcing boundary protections, and engaging communities through schemes like Jal-Jeevan-Hariyali offer a pathway to restore the health, water security, and biodiversity of Bihar's lentic systems.

References

[1] Central Pollution Control Board (CPCB). (2020). Water Quality Criteria and Inland Surface Water Standards. Ministry of Environment, Forest and Climate Change, Government of India.

[2] Kumar, B. N. (2011). Limnology of Jagatpur wetland, Bhagalpur (Bihar), India. Journal of Environmental Science & Engineering, 53(4), 463–468.

[3] Kumari, P., & Thakur, A. K. (2022). Study of Zooplankton Abundance and Species Diversity in Shahjangi Pond of Bhagalpur, Bihar (India). International Journal of Trend in Scientific Research and Development, 6(3), 1895–1899.

[4] National Mission for Clean Ganga (NMCG). (2021). Urban Wetland/Water Bodies Management Guidelines: Bhagalpur Toolkit. Ministry of Jal Shakti, Government of India.

[5] Pandey, G. (2020). Status of Wetlands in Bihar: Degradation and Their Sustainable Management. Social Research Foundation Journal, 5(2), 37–42.

[6] Sinha, R., & Friend, A. D. (1994). River metamorphosis and environmental change in the Gangetic plains, northern India. Geomorphology, 11(3), 231–245.

[7] Tomar, S., & Singh, R. P. (2024). Comparative study of two perennial wetlands of Bhagalpur district in eastern India with special reference to water quality and phytoplankton diversity. Journal of Emerging Technologies and Innovative Research, 11(5), 365–372.

[8] World Journal of Pharmaceutical Research (WJPR). (2023). Impact of urbanization on the hydrobiology of ancient silk city ponds: A case study of Bhagalpur. WJPR, 12(8), 112–124.