INTERNATIONAL JOURNAL OF RESEARCH CULTURE SOCIETY ISSN(O): 2456-6683
Monthly Peer-Reviewed, Refereed, Indexed Journal [Impact Factor: 9.241]
Volume - 10, Issue - 3, March - 2026

DOIs:10.2017/IJRCS/202603015 --:-- Research Paper / Article / Review

Spatio-Temporal Dynamics of Physico-Chemical Water Quality in Freshwater "Chaurs" of Bihar: Implications for Sustainable Aquaculture

Dr. Madhav Kumar
Department: Zoology
Area of Specialization: Freshwater Ecology and Environmental Toxicology
Location: Haveli Kharagpur, Munger, Bihar

Abstract: *The "Chaurs" (floodplain wetlands) of Bihar are vital hydro-biological resources that support regional food security through the production of air-breathing fishes. However, these ecosystems are increasingly susceptible to seasonal fluctuations and agrochemical influx from neighboring agricultural lands. This study investigates the spatio-temporal dynamics of water quality in the Chaurs of Haveli Kharagpur, Munger, over a two-year period (2018–2020). Parameters including temperature, pH, Dissolved Oxygen (DO), Free CO_2, and alkalinity were monitored alongside benthic soil profiles. Findings reveal a significant "summer stress window" characterized by high FCO_2 (up to 21.5 mg/l) and thermal peaks (36.0^\circ\text{C}). Despite these fluctuations, the buffering capacity of the water remains high (Alkalinity 130–210 mg/l). The study concludes that while current conditions support hardy species like Channa punctatus, strategic management of agricultural runoff is essential for long-term sustainability.*

Keywords: *Bihar Chaurs, Wetland Ecology, Physico-chemical Parameters, Spatio-Temporal Dynamics, Sustainable Aquaculture, Agrochemical Runoff, Munger.*

1. INTRODUCTION

Freshwater wetlands, locally known as "Chaurs," are shallow, saucer-shaped depressions prevalent in the Indo-Gangetic plains of Bihar. These bodies are primarily fed by monsoon rainfall and surface runoff from surrounding agricultural lands. In the Haveli Kharagpur region of Munger, Chaurs are ecological hotspots for indigenous air-breathing fishes such as Channa punctatus (Garai), Anabas testudineus (Kawai), and Clarias batrachus (Mangur).

The intensification of agriculture in the Middle Gangetic Plain has led to an increased reliance on biochemical fertilizers and pesticides. Recent research by Sahay and Kumar (2025) highlights that the connectivity between agricultural fields and these wetlands facilitates the influx of nitrates and phosphates, leading to accelerated eutrophication and potential genomic instability in aquatic biota. Furthermore, Kumar and Singh (2024) have observed that climate-induced temperature shifts in Bihar are narrowing the "thermal comfort zone" for freshwater species, making them more vulnerable to the toxicity of chemical pollutants.

As seasonal rainfall occurs, residues from these agrochemical wastes are flushed into the Chaurs. Previous literature has focused on the behavioral changes in fish, but as noted by Edward et al. (2024), there is a critical need to monitor the shifting "chemical signatures" of these wetlands, as high CO_2 and low oxygen levels often precede mass mortality events in non-specialized species. This study, conducted by Dr. Madhav Kumar, provides a longitudinal analysis of water and soil quality to determine the suitability of these wetlands for continued aquaculture amidst increasing anthropogenic and climatic pressure.

2. Materials and Methods

- Study Site: Representative Chaurs in Haveli Kharagpur, Munger, characterized by their proximity to the Ganga river and intensive farming zones.
- Sampling: Monthly water and soil sampling was conducted from August 2018 to July 2020.
- Analysis: Water temperature and pH were recorded in-situ. Dissolved Oxygen (DO), Free CO_2, and Total Alkalinity were determined using standard titrimetric methods (APHA).

- Soil Analysis: Benthic soil samples were analyzed for pH, Organic Carbon, and Phosphorus to evaluate the accumulation of agricultural residues.

3. Results

Table 1: Seasonal Mean Values of Physico-Chemical Parameters (2018-2020)

Parameter	Winter (Nov-Feb)	Summer (Mar-Jun)	Monsoon (Jul-Oct)	Ideal Range (ICAR)
Temperature (ºC)	21.6 ± 1.2	34.2 ± 1.8	28.8 ± 1.1	24.0 – 30.0
pH (Unit)	7.7 ± 0.1	8.1 ± 0.2	7.3 ± 0.3	6.5 – 8.5
Dissolved Oxygen (mg/l)	7.5 ± 0.4	4.6 ± 0.6	6.2 ± 0.5	> 5.0
Free CO2 (mg/l)	10.3 ± 0.9	19.8 ±1.7	13.9 ± 1.4	<15.0
Total Alkalinity (mg/l)	162 ± 10	198 ±12	140 ± 15	60-230

Table 2: Benthic Soil Characteristics and Nutrient Status

Parameter	Range Observed	Mean Value	Status
Soil pH	6.10 – 6.85	6.44	Slightly Acidic
Organic Carbon (%)	5.32 – 5.95	5.62	Highly Productive
Phophorus (mg/100g)	14.5 – 18.2	16.3	Enriched

4. Discussion

The data indicate a high productivity potential but highlight a Spatio-Temporal "Stress Window" during the summer months. The peak temperature of in summer accelerates metabolic rates while reducing oxygen solubility. The rise in Free CO_2 is likely due to the decomposition of organic matter, a phenomenon recently identified by Mishra et al. (2023) as a primary driver of benthic stress in North Bihar floodplains.

However, the robust alkalinity acts as a vital buffer. According to Das (2025), such high buffering capacity is essential in agro-impacted wetlands to prevent lethal pH swings that would otherwise occur due to high CO_2 and chemical runoff. The soil enrichment in phosphorus further confirms the influx of agricultural fertilizers into the Chaur basin.

5. Conclusion

The "Chaurs" of Haveli Kharagpur remain viable for aquaculture, but they are transitioning toward a state of biochemical stress. To ensure the safety of fish for human consumption and protect rural employment, I recommends the installation of decentralized sewage treatment plants and the regulation of fertilizer runoff in the catchment areas.

REFERENCES

1. Edward, J., et al. (2024). Revised Water Quality Standards for Tropical Inland Fisheries: A Review of Agrochemical Impacts. ICAR-CIFRI Technical Bulletin.
2. Kumar, A., & Singh, R. K. (2024). Climate Change Impacts on Freshwater Wetlands and Thermal Dynamics of the Middle Gangetic Plain. International Journal of Environmental Research.
3. Mishra, S., et al. (2023). Nutrient Dynamics and Buffering Capacity of Floodplain Wetlands in Eastern India. Journal of Aquatic Ecosystem Health.
4. Sahay, R., & Kumar, P. (2025). Anthropogenic Threats and Groundwater-Surface Water Connectivity in North Bihar Wetlands. Journal of Hydrology: Regional Studies.
5. Sadanand, M., et al. (2023). Analyses of water quality using different physico-chemical parameters: A study of Gangetic connected floodplains. Scientific Temper, 14(1).
6. Das, P. K. (2025). Sustainable Management of Air-Breathing Fish Populations in Agrochemical-Stressed Environments. Fisheries Research Quarterly.