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Ecological Setup of Wetlands in Purvanchal, India

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Abstract

Wetlands are among the Earth's most productive ecosystems, providing a multitude of ecological functions and supporting rich biodiversity. In the Purvanchal region of India, encompassing eastern Uttar Pradesh and neighbouring parts of Bihar wetlands form an integral part of the Middle Gangetic Plains, acting as critical habitats for flora and fauna, wetlands birds, and local livelihoods. This paper explores the ecology of wetlands in Purvanchal, synthesizing their biophysical characteristics, biodiversity patterns, ecosystem services, threats, and conservation strategies. The ecological significance of prominent wetlands such as Bakhira Bird Sanctuary in eastern Uttar Pradesh and floodplain wetlands like Jagatpur Lake, Ganga Prasad Lake, Ghatora Wetland, and Kanwar Taal in Bihar is discussed in detail. Based on current research and field-based studies, this paper highlights the role of these wetlands in supporting ecosystem processes, regulating hydrology, provisioning resources, and maintaining biodiversity. The paper concludes with policy recommendations for wetland conservation in the Purvanchal region.

Key Words: Wetlands, Ramsar Convention, Purvanchal, Ecological setup

Introduction

Wetlands are transitional ecosystems where water covers the soil or is present near the surface either permanently or seasonally (Ramsar Convention, 1971). They include marshes, floodplains, oxbow lakes, swamps, and shallow seasonal water bodies. Globally, wetlands are vital for nutrient cycling, hydrological regulation, climate mitigation, and biodiversity conservation. In India, wetlands occur across climatic and geographical gradients, from the Himalayan foothills to the coastal plains and inland floodplains, comprising an estimated 15.98 million hectares of surface area (IIT-Indore water quality study, 2025)

The Purvanchal region, lying largely in eastern Uttar Pradesh and north Bihar, consists of the fertile Middle Ganga Plains, where alluvial processes have created a dense network of rivers, floodplains, and associated wetlands. These ecosystems are hydrologically connected to major rivers such as the Ganga, Saryu, Rapti, and Ghaghara. Despite their ecological and socio-economic importance, Purvanchal wetlands

remain understudied compared to those in other Indian regions.

Methodology

The present study is based on primary observations & secondary data collected from various sources such as government publications, internet sources, census reports, district statistical handbooks, research journals, and government reports. Descriptive and analytical methods have been employed to examine ecological setup of wetlands in Purvanchal, India.

Defining Wetlands In Purvanchal

Wetlands in Purvanchal can broadly be classified as:

- Floodplain wetlands— formed by river overflow in monsoon, often seasonal and dynamic.
- Oxbow lakes and residual water bodies— abandoned river channels that retain water year-round.
- Natural lakes and marshes— permanent or semi-permanent water bodies, often with rich vegetation.
- Constructed and managed wetlands— including fish ponds, agricultural reservoirs, and irrigation lakes.

In the Middle Ganga Plains, floodplain wetlands are especially common due to seasonal monsoon inundation and river dynamics. These wetlands intersect with agricultural landscapes and rural settlements, making them socially significant as well.

Biophysical Characteristics

Hydrological Regime:

The wetland hydrology in Purvanchal is largely governed by the monsoon dynamics of the Ganga and its tributaries. Seasonal flooding replenishes nutrients in the floodplain soils, supports aquatic vegetation, and maintains the shallow water bodies that define wetland habitats. Many wetlands exhibit hydro period's patterns of water presence across seasons that influence species composition and ecosystem processes.

For example, floodplain wetlands such as Jagatpur Lake near Bhagalpur (Bihar) fill during monsoon and retain water into the post-monsoon months, forming a mosaic of deep water, shallow marsh, and mudflat zones, each with distinct ecological niches.

Soil and Sediment Composition:

The soils in floodplain wetlands are predominantly alluvial silt and clay, which have high water-retention capacity. These soils facilitate wetland functions such as nutrient storage and microhabitat formation for submerged, floating, and emergent vegetation. Waterlogged soils in wetland fringes often support anaerobic conditions, favouring unique biochemical cycles such as denitrification and methane production, critical components of wetland nutrient dynamics.

Vegetation and Habitat Structure:

Wetland vegetation in Purvanchal includes emergent reeds and sedges (Phragmites, Cyperus spp.), floating macrophytes like water hyacinth (Eichhornia crassipes), and submerged plants such as Hydrilla verticillata. This structural heterogeneity supports trophic complexity and species richness. A phytosociological survey of Bakhira Bird Sanctuary (a major wetland in Eastern Uttar Pradesh) documented 127 angiosperm species from 83 genera with dominance of free-floating hydrophytes, revealing high plant diversity and stratification of wetland vegetation zones.

Biodiversity and Ecological Communities

Avian Diversity:

One of the most striking aspects of Purvanchal wetlands is their role as avian habitats, particularly for migratory water birds. Wetlands in Bihar such as Jagatpur Lake

support over 160 bird species, including migratory species that travel thousands of kilometres along the Central Asian Flyway. Birds such as storks, herons, ducks, cormorants, and waders rely on these wetlands for feeding, resting, and breeding during winter months

Fish and Aquatic Fauna:

Fish diversity is also substantial. Studies on Moga Wetland in eastern Uttar Pradesh reveal 23 fish species, showing seasonal variation in diversity indices such as Shannon-Wiener and Simpson's indices, and indicating strong coupling between water quality and fish assemblages. Floodplain wetlands in Bihar and UP often support fisheries that are important to local livelihoods, though systematic surveys remain limited.

Macrophytes and Invertebrates:

Aquatic plants (macrophytes) provide critical habitat and food for wetland biota. Surveys at Salona Tal in Uttar Pradesh recorded over 110 aquatic and marshy plant species, underlining the floristic richness of Purvanchal wetlands.

Macroinvertebrates, though understudied in the Purvanchal context, serve as indicators of water quality and are integral components of wetland food webs.

Ecosystem Services

Hydrological Regulation:

Wetlands absorb floodwaters, reducing downstream flood peaks and mitigating drought impacts by slowly releasing stored water. In regions like Purvanchal where monsoon floods are common, wetlands act as natural buffers supporting flood control and groundwater recharge.

Nutrient Cycling and Water Purification:

Wetland plants and microbial communities can trap and transform nutrients, decreasing nutrient loads and improving water quality. This process enhances water purification and supports aquatic life.

Biodiversity Support:

Purvanchal wetlands sustain diverse biota, from aquatic plants to birds and fish, contributing to regional biodiversity conservation.

Livelihood and Cultural Services:

Wetlands in Purvanchal, the eastern Gangetic plain encompassing parts of eastern Uttar Pradesh and northern Bihar, are ecologically and socio-economically vital ecosystems. Defined broadly as areas of land saturated by water either permanently or seasonally, wetlands function as dynamic interfaces between terrestrial and aquatic systems and deliver multiple ecosystem services that sustain human well-being (Mitsch & Gosselink, 1993, as cited by Kumar, J & et al, 2024). In Purvanchal, major wetlands such as Bakhira Bird Sanctuary in Uttar Pradesh and floodplain systems like Jagatpur Lake in Bihar illustrate how wetland services underpin local livelihoods and cultural practices.

One of the most significant livelihood benefits of Purvanchal's wetlands arises from fisheries and aquaculture. Floodplain wetlands in the Gangetic basin harbor abundant fish stocks that local communities harvest for subsistence and income generation. Wetland capture fisheries are common, providing food security and employment to resident fishers (Agritech TNAU, n.d.). For example, Bakhira Lake supports diverse aquatic fauna and is an important source of fish for nearby villages, while fishing contributes directly to household earnings and diets (Wikipedia, 2025; JETIR, 2025). Similarly, Bihar's floodplain wetlands, including Jagatpur and Ghatora, sustain traditional fishing practices central to local livelihoods, while also being identified as

potential sites for expanded aquaculture and makhana (fox nut) cultivation, a wetland crop valued commercially (The Rise, 2025; Times of India, 2025).

Beyond fisheries, wetlands contribute to agricultural productivity by regulating hydrology and enhancing soil moisture. Seasonal inundation of floodplain wetlands supports wet-season crops and replenishes groundwater that farmers rely on during the dry months. In Purvanchal's largely agrarian economy, this form of natural irrigation reduces the need for external inputs and stabilizes crop yields, especially for smallholders who lack access to costly irrigation infrastructure (India Water Portal, 2025; MossStat, 2020). Wetlands also have subsistence provisioning through resources such as reeds and fuelwood, supplementing rural economy and household needs. In addition to provisioning services, cultural ecosystem services of Purvanchal's wetlands are socially embedded and significant. Wetlands like Bakhira Bird Sanctuary attract thousands of migratory waterfowl each winter, creating opportunities for eco-tourism and nature-based recreation (Wikipedia, 2025; JETIR, 2025). The seasonal congregation of birds has become a focal point for bird-watchers, photographers, and researchers, drawing visitors from nearby towns and contributing to local tourism economies. Plans to develop bird-watching infrastructure at Jagatpur Lake aim to further enhance tourism and create employment, illustrating how cultural appreciation of biodiversity can generate economic benefits while fostering conservation awareness (Times of India, 2025).

Culturally, wetlands are sites of aesthetic inspiration and traditional practices. In many rural communities, wetlands feature in local festivals, rituals, and collective activities related to water and nature, reinforcing community identity and social cohesion. Traditional knowledge systems govern the sustainable use of wetland resources, and rituals linked to water bodies often reflect deep cultural ties to the landscape (India Wetlands Inventory, 2020).

Despite their value, Purvanchal wetlands face threats from pollution, encroachment, and agricultural expansion, which undermine both livelihood support and cultural functions. Local communities depend on wetlands for fishing, grazing, agriculture, and ecotourism. The potential development of eco-tourism at wetlands like Jagatpur Lake underscores their socio-economic value

Threats to Wetland Ecology

Purvanchal, a region in eastern Uttar Pradesh and northern Bihar forming part of the eastern Gangetic plain, contains numerous freshwater wetlands that are vital for biodiversity, hydrological regulation, livelihoods, and cultural heritage. Wetlands such as Bakhira Bird Sanctuary in Uttar Pradesh and Jagatpur, Ghatora, and Ganga Prasad wetlands in Bihar are ecologically significant, supporting diverse avifauna, fish populations, and local economies (Wikipedia, 2025a; Wikipedia, 2025b; Wikipedia, 2025c; Wikipedia, 2025d). Yet, these dynamic ecosystems face multiple anthropogenic and environmental threats that undermine their ecological integrity, socio-economic value, and long-term sustainability.

Urbanisation and Encroachment

One of the most pervasive threats to wetlands in Purvanchal is urbanisation and encroachment. Rapid population growth, especially in cities like Patna and surrounding urban centres, has led to the conversion of low-lying wetlands into residential, commercial, and infrastructure areas. Large tracts of historically waterlogged land ("jalla") have been filled for urban expansion, reducing wetland extent and interrupting natural hydrology (TheRise, 2025). In Patna alone, reports indicate that over 60% of wetlands have been lost due to urbanisation and related encroachment (TheRise, 2025). Such land-use changes fragment wetland habitats, reduce water retention capacity,

and alter flood dynamics. Encroachment is often driven by weak implementation of wetland demarcation and management regulations, as many district wetland authorities have yet to map or protect wetlands comprehensively (DowntoEarth, 2024; TheRise, 2025). These losses not only degrade habitat quality but also disconnect communities from critical ecosystem services such as flood control, groundwater recharge, and fisheries.

Pollution and Water Quality Degradation

Pollution from agricultural runoff, domestic sewage, and solid waste disposal is another significant threat to Purvanchal wetlands. Many small lakes and ponds in the region receive untreated wastewater and agricultural chemicals rich in pesticides and fertilisers, which degrade water quality and increase nutrient loads (DownToEarth.org, 2024). Excess nutrients cause eutrophication, where dense algal blooms deplete dissolved oxygen, harming aquatic fauna and reducing biodiversity (DownToEarth.org, 2024). Similarly, high levels of faecal contamination documented in Bihar wetlands reflect severe pollution linked to untreated waste discharge (TheRise, 2025). Pollution also affects the health and life cycles of resident and migratory bird species, fish populations, and vulnerable amphibians. Over time, this degradation can impair the wetland's capacity to provide potable water, sustain fisheries, and support local agriculture.

Agricultural Expansion and Runoff

Wetlands have been contributing to agricultural productivity by regulating water and enhancing soil moisture. However, expanding agriculture are the threats to these ecosystems. The intensified use of chemical fertilisers and pesticides in these agricultural lands further compounds threats by delivering toxic runoff to wetland waters, disrupting food webs and degrading ecological functions. Moreover, this agricultural expansion frequently involves land drainage and modification of wetland boundaries, which can lead to permanent loss of wetland areas and habitat transformation. Without sustainable agricultural practices, wetland health continues to deteriorate, threatening the very services such as irrigation, fisheries support, and water storage that local communities depend upon.

Invasive Species and Weed Infestation

Invasive plants such as water hyacinth and other aquatic weeds have proliferated in Purvanchal's wetlands, often facilitated by nutrient enrichment and disturbance. These invasive species outcompete native aquatic plants, reduce open water areas, and alter habitat structure, making conditions less suitable for native fish and water bird species. Invasive weeds also increase evapotranspiration and block light penetration in water bodies, exacerbating oxygen depletion and further weakening wetland ecological balance (Wikipedia, 2025b). Weed infestation is a widespread challenge across South Asian wetlands and requires targeted management interventions such as manual removal, biocontrol, and nutrient load reduction.

Hydrological Alteration and Infrastructure Development

Wetland hydrology in Purvanchal is shaped by seasonal monsoons, river inflows, and groundwater exchange. However, infrastructure development including road building, embankments, and the construction of linear utilities can significantly alter natural water flows. In many floodplain wetlands, embankments and drainage modifications cut off water inflows that sustain wetland cycles, leading to drying or erratic water regimes (TheRise, 2025). Fragmentation caused by highways and other infrastructure disrupts connectivity between wetlands and rivers, reducing resilience to climatic extremes and degrading habitats. Furthermore, irrigation projects that divert water away from wetlands can reduce wetland area and affect wetland dynamics,

impacting biodiversity and livelihood functions.

Climate Change Impacts

Climate change poses both direct and indirect threats to wetlands. Changes in precipitation patterns, increased occurrence of extreme weather events (droughts and floods), and temperature fluctuations impact wetland hydrology and ecological stability. Erratic monsoon onset and intensity can lead to prolonged dry periods or excessive inundation, affecting water levels critical for breeding birds and aquatic life. Additionally, climate change may alter the timing of bird migrations, fish spawning, and vegetation cycles, creating mismatches in ecosystem processes. Wetlands are one of the most sensitive ecosystems to hydrological changes and environmental changes, which could act as catastrophe for wetland.

Insufficient Governance and Policy Implementation

Despite wetland protection frameworks such as the Wetlands (Conservation and Management) Rules, 2017, gaps in enforcement inhibit effective conservation. Demarcation of wetland boundaries, formation of district-level wetland authorities, and stakeholder engagement remain incomplete in many areas. The lack of adequate monitoring, enforcement of no-development zones, and integration of local communities into management weakens governance and allows threats like encroachment and pollution to persist (DowntoEarth.org, 2024). Additionally, overlapping jurisdiction between municipal bodies, environmental agencies, and water resource departments often results in fragmented decision-making and delayed protection measures (TheRise, 2025).

Loss of Biodiversity and Ecosystem Functions

Collectively, these threats translate into biodiversity loss and ecological degradation. As wetland habitats shrink or deteriorate, species that depend on them—such as migratory waterfowl, resident birds, fish, amphibians, and aquatic plants face declining populations. Habitat fragmentation isolates populations and decreases genetic diversity, making species more vulnerable to disturbances. These ecological losses undermine ecosystem functions such as nutrient cycling, water purification, flood mitigation, and carbon sequestration services that are essential for ecological balance and human welfare.

Conservation and Management Strategies

To sustain the ecological integrity of Purvanchal wetlands, integrated conservation strategies are required:

Legal Protection and Ramsar Designation:

International recognition under the Ramsar Convention helps prioritize wetland conservation. Nearby Bihar wetlands like Kanwar Taal and Nagi/Nakti Bird Sanctuaries have been designated Ramsar sites, reflecting their global ecological importance (though these are outside strict Purvanchal boundaries, they indicate conservation value in the extended Middle Ganga Plains)

Community-Led Management

Engagement of local communities in wetland stewardship supports sustainable use. Community monitoring and awareness can reduce pollution and enhance ecosystem restoration.

Ecological Monitoring:

Technological tools (e.g., satellite monitoring of water quality) and regular biodiversity surveys are essential to detect ecological change and guide adaptive management.

Restoration Projects:

Restoring degraded wetlands through re-establishing native vegetation, removing invasive species, and controlling pollution inputs can improve ecological health.

Case studies:

Bakhira Bird Sanctuary (Uttar Pradesh)

Bakhira is one of the largest natural floodplain wetlands of eastern Uttar Pradesh, spanning some 29 km². It supports significant populations of migratory waterfowl, serves as breeding habitat, and illustrates the typical floodplain dynamics in the Middle Ganga Basin. Phytosociological studies indicate high plant diversity with dominant macrophyte families that shape habitat structure, and fish surveys show diverse teleost assemblages.

Jagatpur and Ganga Prasad Lakes (Bihar)

These floodplain wetlands near Bhagalpur City illustrate ecological complexity: rich avifauna, seasonal hydrological variation, and strong connections to local livelihoods. Conservation initiatives coupled with eco-tourism development have potential to link biodiversity protection with regional development.

Ghatora Wetland (Bihar)

Located in Bihpur block of Bhagalpur district, Ghatora is an important seasonal habitat for waterfowl. Efforts to promote eco-tourism and sustainable use demonstrate innovative strategies for community engagement and biodiversity conservation.

Conclusion

Wetlands in Purvanchal, whether large floodplain systems or smaller marshes and lakes, are ecologically indispensable. They regulate hydrology, sustain biodiversity, support local livelihoods, and perform essential ecosystem services. Wetlands in Purvanchal are indispensable ecological and socio-economic assets facing a complex array of threats. Urbanisation and encroachment diminish wetland extent, while pollution, agricultural runoff, invasive species, hydrological alteration, climate change, and governance challenges accelerate degradation. Without concerted action, including improved policy implementation, community-involved conservation, sustainable land-use planning, and pollution control, these wetlands risk irreversible loss. Protecting Purvanchal's wetlands is not only a matter of biodiversity conservation but also of safeguarding livelihoods, cultural heritage, and ecosystem resilience for future generations. A combination of scientific research, policy support, community participation, and integrated management approaches is needed to ensure the long-term ecological integrity of Purvanchal wetlands.

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