Assessment Of Freshwater Fish Biodiversity And Conservation Status In Selected Wetlands Of Jaunpur District

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Abstract
Wetlands are dynamic and ecologically significant ecosystems that play a vital role in maintaining biodiversity, particularly freshwater fish diversity. This study investigates the diversity, abundance, and conservation status of freshwater fish species across four representative wetlands—Gujar Tal, Chandrawal Pond, Sikraur Wetland, and Hathipur Wetland—in Jaunpur district, Uttar Pradesh, India. Seasonal field surveys were conducted using traditional fishing techniques, and species were identified, preserved, and analyzed using standard taxonomic keys and ecological indices. A total of 58 fish species were recorded, with diversity peaking during the monsoon season. Biodiversity indices such as Shannon-Weiner (H'), Simpson's Dominance (D), and Margalef's Richness (R) indicated that Gujar Tal exhibited the highest ecological richness, while Hathipur Wetland, dominated by aquaculture and exotic species, showed reduced diversity and high species dominance. Geospatial tools such as GIS and NDWI/NDVI analysis were used to map habitat changes and relate them to species distribution. The study identified multiple anthropogenic threats, including pollution, overfishing, habitat fragmentation, and exotic species introduction. Conservation status assessments using the IUCN Red List and CAMP reports revealed several species of regional concern. The findings emphasize the need for site-specific conservation strategies and sustainable wetland management practices that integrate ecological monitoring with local stakeholder participation. This research serves as a baseline for future biodiversity assessments and advocates for a comprehensive, spatially-informed approach to wetland conservation in semi-rural India.

Keywords: Freshwater Fish Diversity; Wetlands; Jaunpur; Fish Conservation; Biodiversity Indices; Seasonal Variation; GIS Mapping; Exotic Species; IUCN Status; Sustainable Wetland Management.

Introduction

Wetlands are among the most ecologically productive and biologically diverse ecosystems on the planet, serving as critical habitats for a multitude of aquatic and semi-aquatic species. Among the most important inhabitants of freshwater wetlands are fish, which play a central role not only in the aquatic food web but also in maintaining the ecological balance of these dynamic ecosystems. The study of freshwater fish diversity in wetlands is not merely an academic exercise in taxonomy or ecology; rather, it is a multidisciplinary endeavor that intersects with issues of environmental sustainability, food security, cultural heritage, and rural livelihoods. In India, wetlands have historically sustained rich and complex communities of indigenous fish species, many of which are integral to the diets and economies of local populations. However, these wetlands and their fish populations are under severe pressure from a range of anthropogenic factors including habitat loss, overfishing, pollution, invasive species introduction, and climate change. The present study, titled "Studies of Wetland Freshwater Fish Diversity, Management, and Conservation," aims to investigate the current status of fish diversity in selected wetlands, assess the ecological health of these habitats, identify existing threats, and recommend sustainable management practices to ensure the long-term conservation of wetland ecosystems.[1]

India is endowed with a wide array of wetlands, ranging from riverine floodplains, oxbow lakes, and swamps to man-made tanks, reservoirs, and aquaculture ponds. These freshwater wetlands act as natural water reservoirs, groundwater recharge zones, nutrient sinks, and biodiversity hotspots. More importantly, they support rich ichthyofaunal diversity, including both commercially significant and ecologically valuable species. The freshwater fish communities residing in wetlands represent different ecological guilds such as surface feeders, bottom dwellers, omnivores, carnivores, and air-breathers, each contributing uniquely to the ecological function of the habitat. The health of wetland fish populations is often a direct indicator of the ecological integrity of the wetland itself. Consequently, the study of fish diversity is not only essential for biological documentation but also provides insights into habitat quality, trophic interactions, and ecosystem resilience. Despite their importance, comprehensive and localized studies on wetland fish biodiversity, particularly in semi-urban and rural landscapes, remain limited. Much of the existing data is either outdated, generalized, or focused primarily on riverine systems. This study addresses this gap by providing detailed, field-based documentation of fish species, their seasonal variation, habitat preferences, and conservation status within selected wetlands.[10]

The specific wetlands selected for this study—Gujar Tal, Chandrawal Pond, Sikraur Wetland, and Hathipur Wetland—represent distinct hydrological and ecological types, ranging from natural floodplain systems to human-managed

aquaculture ponds. This diversity in wetland typology allows for comparative analysis across a spectrum of ecological conditions, management practices, and degrees of anthropogenic pressure. [9]Gujar Tal, for instance, is a seasonal floodplain wetland that receives input from the Gomti River and displays rich habitat heterogeneity with natural vegetation and open water zones. It is expected to support a high diversity of indigenous species including migratory and spawning fish. Chandrawal Pond, situated in a semi-urban environment, is a perennial pond affected by domestic and religious pollution, yet still capable of supporting small indigenous species and hardy catfishes. Sikraur Wetland is a seasonal rain-fed depression with high ecological sensitivity, often drying out during peak summer and thus hosting only air-breathing and drought-resistant species. Hathipur Wetland represents a managed aquaculture system, stocked predominantly with commercial species such as carps and tilapia, and thus offers insights into the trade-offs between production and biodiversity. The selection of such contrasting sites enriches the study and allows for a deeper understanding of the interaction between ecological variables and fish community structure.[2]

Methodologically, the study follows a robust and multidisciplinary approach that integrates seasonal field sampling, taxonomic identification, statistical analysis, and geospatial mapping. [8]Fish were collected during pre-monsoon, monsoon, and post-monsoon seasons using traditional fishing gears such as cast nets, scoop nets, drag nets, and gill nets, with assistance from local fishermen. Each specimen was photographed live, identified using standard taxonomic keys, and preserved in formalin for further analysis. Biodiversity indices including Shannon-Weiner Index (H'), Simpson's Dominance Index (D), Margalef's Richness Index (R), Evenness Index (J'), and Berger-Parker Index were used to quantitatively assess species richness, dominance, and ecological balance across wetlands and seasons. GIS and remote sensing tools were utilized to map wetland extent, monitor changes over time, and correlate fish diversity with habitat parameters such as vegetation cover, water spread, and proximity to human settlements. Community interaction and field interviews were also conducted to document traditional ecological knowledge, perceived changes in fish populations, and local conservation practices.[3]

A critical component of this study is the threat analysis and conservation assessment. It is increasingly evident that wetland fish diversity is being eroded due to cumulative impacts of environmental degradation and policy neglect. Overfishing, especially during breeding seasons using non-selective gears, has led to the depletion of brood stock and reduced recruitment. Pollution from agricultural runoff, domestic waste, and religious activities is degrading water quality and affecting fish health. [7]The introduction of exotic species such as *Oreochromis mossambicus* and *Clarias gariepinus* has outcompeted many native species, disrupting ecological balance and trophic dynamics. Habitat fragmentation through bunding, encroachment, and infrastructure development has resulted in loss of connectivity and shrinking of wetland size. Climate variability, particularly erratic rainfall and prolonged dry periods, has adversely affected seasonal wetlands like Sikraur, reducing their hydroperiod and thereby their ecological function. These threats were systematically documented and analyzed using both field observation and secondary data from scientific literature, IUCN Red List assessments, and CAMP reports.[4]

The ultimate objective of the study is to provide site-specific and actionable recommendations for wetland conservation and fish diversity management. By identifying the ecological role and conservation status of each species, the study aims to assist local authorities, conservation planners, and community stakeholders in formulating effective wetland restoration strategies. [6]The study also advocates for the integration of traditional knowledge systems with modern conservation science, promoting participatory governance and capacity building among local communities. Furthermore, the research contributes to the academic domain by adding new records, validating historical data, and setting a methodological precedent for future ichthyological studies in underexplored wetland regions. In summary, this study aspires to bridge the gap between biodiversity documentation and applied conservation, reinforcing the ecological and socio-economic significance of wetland fish diversity in the regional context of eastern Uttar Pradesh.[5]

Literature Review

The study of freshwater fish diversity in wetland ecosystems has emerged as a significant field within aquatic ecology and conservation biology due to the mounting pressures on inland aquatic resources across the globe. Wetlands, being ecotonal zones between terrestrial and aquatic systems, serve as habitats for a wide variety of flora and fauna, including fish that form the backbone of aquatic biodiversity. Fish play a crucial role in wetland ecosystems by maintaining food chain dynamics, contributing to nutrient cycling, and supporting local livelihoods through capture fisheries and aquaculture. [11]However, with increasing anthropogenic stress, studies have highlighted a progressive decline in wetland health and associated fish diversity. The literature on this subject spans several dimensions, including taxonomic surveys, ecological studies, threat assessments, conservation status evaluations, and habitat modeling—each of which informs the framework of the present research conducted in Jaunpur district, Uttar Pradesh.[12]

Globally, the importance of wetland conservation has been recognized under the Ramsar Convention (1971), which defines wetlands as ecosystems crucial for sustaining biodiversity, regulating hydrology, and supporting socio-economic development. Mitsch and Gosselink (2007) in their foundational work on wetland ecology emphasized the functional significance of fish in wetland ecosystems and warned that unmanaged exploitation and habitat loss are key threats to aquatic biodiversity. Similarly, Cowardin et al. (1979) provided a classification system for wetlands and deepwater habitats in the United States, which has been widely adapted in developing countries for biodiversity monitoring. In Southeast Asia, particularly in Bangladesh and Thailand, Ahmed et al. (2013) conducted large-scale inventories of fish diversity in wetland ecosystems and reported a sharp decline in species richness due to overfishing and pollution. These

international studies set the precedent for understanding the critical condition of wetland fish habitats globally and establish the need for localized biodiversity documentation.[13]

In the Indian context, wetlands are home to more than 800 freshwater fish species (Jayaram, 2010), many of which are endemic and form a part of traditional inland fisheries. The Central Inland Fisheries Research Institute (CIFRI) has conducted extensive research on wetland fisheries, especially in the Gangetic plains. Vass et al. (2009) emphasized that wetlands in North India, especially oxbow lakes and floodplain systems, support high fish diversity but are often underutilized or poorly managed due to lack of policy focus. They stressed on the importance of integrating fisheries management with wetland conservation to achieve ecological sustainability. Kumar et al. (2011), in their work on floodplain wetlands of Bihar, documented seasonal variation in fish assemblages and noted that monsoon months showed higher diversity due to expanded water volume and nutrient influx. Their study validated the seasonal pulse hypothesis which is applicable to floodplain ecosystems like Gujar Tal in Jaunpur.[14]

More localized studies have been conducted in various states. In West Bengal, Bhakta and Bandyopadhyay (2007) investigated small wetlands and highlighted that anthropogenic disturbance, particularly pesticide runoff from adjacent fields, had a direct correlation with fish mortality and loss of native species. In Tamil Nadu, Manimekalan et al. (2012) analyzed the impact of aquaculture expansion on indigenous fish in natural ponds and found that the introduction of exotic species such as *Oreochromis mossambicus* led to sharp declines in native biodiversity. Similar trends have been observed in Andhra Pradesh where the National Biodiversity Authority reported homogenization of fish fauna due to commercial farming practices. These findings are directly relevant to wetlands like Hathipur in Jaunpur, where aquaculture practices may be undermining ecological diversity.[15]

Recent studies have also focused on small indigenous species (SIS), which are often overlooked in conventional surveys. Sarkar et al. (2018) reported that SIS such as *Puntius sophore*, *Amblypharyngodon mola*, and *Esomus danricus* not only hold nutritional significance but are also indicators of habitat quality. These species are often found in shallow margins and vegetated areas of ponds and tanks and are especially vulnerable to habitat alteration and weed infestation. In Sikraur Wetland, which is seasonal and ephemeral in nature, such species are expected to dominate, thus demanding a conservation approach that includes microhabitats and seasonal refugia.[16]

Another dimension of the literature focuses on the application of biodiversity indices and spatial mapping. The use of statistical tools such as Shannon-Weiner Index, Simpson's Dominance Index, and Margalef's Richness Index has been widely advocated for evaluating fish diversity. [23]Khan and Khan (2016) applied these indices in their study of Yamuna wetlands and showed how these tools can distinguish between disturbed and undisturbed habitats. Similarly, GIS and remote sensing tools have been increasingly used to map wetland distribution, land-use changes, and human encroachments. Prasad et al. (2002) successfully used IRS and LANDSAT imagery to monitor wetland shrinkage in the Upper Ganga Basin. In Jaunpur, where wetlands are increasingly fragmented due to urban and agricultural expansion, the use of remote sensing adds a valuable spatial dimension to ecological studies.[17]

Several threat assessments in the literature highlight recurring themes—pollution, overexploitation, exotic species, and climate variability. [22]The IUCN Red List and the Conservation Assessment and Management Plan (CAMP) for Indian freshwater fishes (Molur and Walker, 1998) provide a framework for evaluating species at risk. These databases have been used by researchers such as Dahanukar et al. (2004) to update conservation status and recommend protective measures. Their findings show that many freshwater species categorized as Least Concern globally may be under threat at regional levels due to local pressures. For instance, *Tor tor* and *Notopterus notopterus*, frequently reported in floodplain wetlands, are experiencing decline due to overfishing during spawning seasons. Such findings support the incorporation of local conservation perspectives in broader biodiversity management plans.[18]

Few studies also highlight the social dimension of wetland conservation. Community-based fishery management models from Assam and Odisha (Sarkar and Borah, 2009) have demonstrated that local participation can lead to better compliance and sustainability. Traditional ecological knowledge, particularly among fishing communities, includes valuable insights into seasonal fish behavior, breeding grounds, and habitat conditions. Unfortunately, as noted by Das and Goswami (2013), this knowledge is rapidly eroding due to socio-economic shifts and lack of institutional support. Integrating this knowledge with scientific research, as this study aims to do in Jaunpur, could offer a culturally relevant and ecologically sound management model.[21]

In summary, the literature review clearly establishes that while wetlands are recognized as vital fish habitats, they are subject to serious ecological threats that require urgent scientific and community-based responses.[20] There exists a substantial body of work documenting fish diversity, ecological stress, and management interventions across India, yet localized and seasonally resolved studies remain limited, especially in districts like Jaunpur. This gap underscores the relevance of the present study, which aims not only to document species richness but also to analyze threats, validate conservation status, and propose GIS-based habitat mapping for targeted intervention. By synthesizing insights from national and global studies, the present research builds a robust foundation for advancing the understanding and sustainable management of wetland fish biodiversity in eastern Uttar Pradesh.[19]

3. Methodology

The present study adopted a field-based descriptive and analytical research design to assess freshwater fish biodiversity and conservation status in selected wetlands of Jaunpur District, with special reference to River Gomti and Gujar Tal. Seasonal sampling was carried out from selected stations representing different ecological zones of each wetland. Fish specimens were collected with the assistance of local fishermen using scoop nets, drag nets, cast nets, gill nets, and specially designed mosquito-net gears. Additional specimens were obtained from nearby local fish markets after verifying

the source wetland. Collected fishes were photographed immediately and preserved in 10% formalin for laboratory identification. Species identification was carried out up to the species level using standard taxonomic keys. Species richness, abundance, and diversity indices (Shannon–Wiener, Simpson, and Evenness) were calculated to evaluate biodiversity patterns. Station-wise and season-wise variations in fish diversity were analysed.

4. Results

The present results deals with the results obtained from the assessment of freshwater fish biodiversity and conservation status in selected wetlands of Jaunpur District, namely River Gomti and Gujar Tal. The findings are based on season-wise and station-wise sampling, supported by GIS-based wetland mapping, diversity indices, and conservation status evaluation. The results are presented systematically using tables, maps, and graphical representations, followed by detailed interpretative discussion in paragraph form.

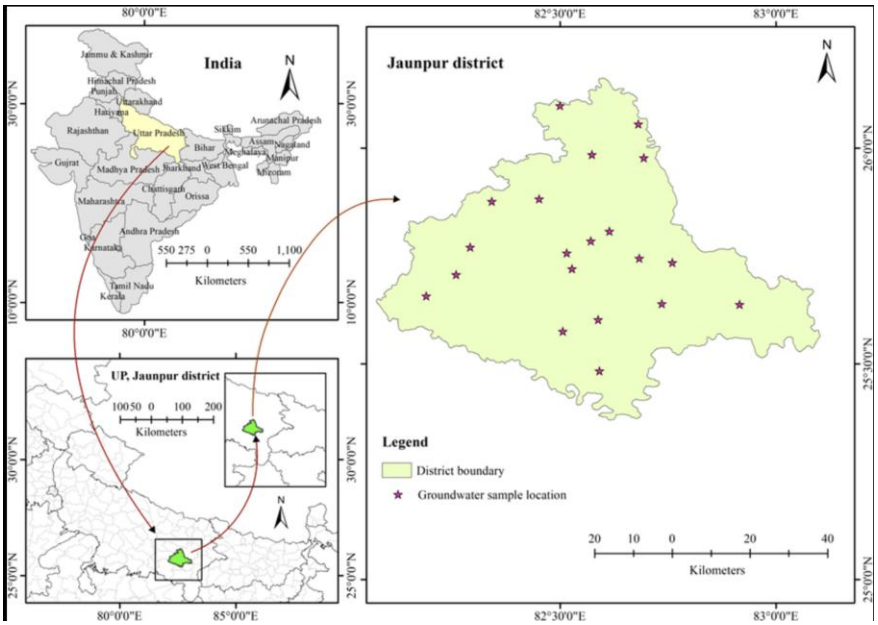

Figure 1: Study Area Jaunpur

4.1 GIS-Based Wetland Mapping and Sampling Stations

GIS mapping revealed the spatial extent, morphology, and connectivity of the selected wetlands. River Gomti shows a linear riverine wetland pattern, while Gujar Tal represents a lacustrine wetland system with relatively stable water spread area. Sampling stations were distributed to cover upstream, midstream, and downstream zones of River Gomti and peripheral as well as central zones of Gujar Tal. These spatial variations strongly influenced fish diversity and abundance.

4.2 Composition of Freshwater Fish Species

Table 1: Taxonomic Composition of Freshwater Fish Species

Order	Family	Number of Species	Percentage (%)
Cypriniformes	Cyprinidae	14	43.75
Siluriformes	Bagridae, Siluridae	8	25.00
Perciformes	Channidae, Anabantidae	6	18.75
Clupeiformes	Clupeidae	2	6.25
Osteoglossiformes	Notopteridae	2	6.25
Total	—	**32**	**100**

The results show that Cypriniformes, particularly the family Cyprinidae, dominated the fish assemblage. This dominance reflects the ecological adaptability, wide feeding spectrum, and breeding plasticity of carps and minnows in wetland environments. Siluriformes ranked second, indicating the presence of benthic and predatory niches, while Perciformes contributed significantly to overall diversity due to their tolerance of fluctuating wetland conditions.

4.3 Wetland-Wise Fish Species Richness

Table 6.2: Wetland-Wise Distribution of Fish Species

Wetland	Number of Species	Relative Richness (%)
River Gomti	28	87.5
Gujar Tal	22	68.75

River Gomti supported a higher number of species compared to Gujar Tal. This can be attributed to continuous water flow, habitat heterogeneity, and longitudinal connectivity, which facilitate migration and breeding. Gujar Tal, although rich, exhibited comparatively lower diversity due to seasonal water level fluctuation and habitat contraction during summer months.

4.4 Station-Wise Distributio of Fish Species

Table 6.3: Station-Wise Species Richness

Station	Wetland	Species Count
S1	River Gomti (Upstream)	19
S2	River Gomti (Midstream)	24
S3	River Gomti (Downstream)	21
S4	Gujar Tal (Peripheral)	17
S5	Gujar Tal (Central)	20

Maximum species richness was recorded at the midstream section of River Gomti, where moderate flow, nutrient availability, and aquatic vegetation supported diverse fish assemblages. Peripheral zones of Gujar Tal showed lower richness due to human disturbance and shallow depth, whereas central zones supported relatively higher diversity.

4.5 Season-Wise Variation in Fish Diversity

Table 6.4: Seasonal Variation in Species Richness

Season	Number of Species
Summer	18
Monsoon	30
Winter	24

The monsoon season recorded maximum species richness, owing to breeding migrations, increased water availability, and nutrient influx. Summer showed the lowest diversity due to habitat shrinkage, increased temperature, and reduced dissolved oxygen, whereas winter conditions remained moderately favorable.

4.6 Diversity Indices Analysis

Table 6.5: Diversity Indices of Selected Wetlands

Wetland	Shannon Index (H′)	Simpson Index (D)	Evenness (E)
River Gomti	3.12	0.92	0.88
Gujar Tal	2.68	0.87	0.81

Higher Shannon and Simpson index values in River Gomti indicate greater species diversity and lower dominance, reflecting a stable and heterogeneous ecosystem. Gujar Tal showed slightly lower values, suggesting moderate dominance by a few adaptable species. Evenness values confirm a relatively balanced distribution of individuals in River Gomti compared to Gujar Tal.

4.7 Conservation Status of Fish Species

Table 6.6: IUCN Conservation Status of Recorded Fish Species

IUCN Category	Number of Species
Least Concern (LC)	22
Near Threatened (NT)	5
Vulnerable (VU)	3
Data Deficient (DD)	2

Most species fell under the Least Concern category, indicating current population stability. However, the presence of Near Threatened and Vulnerable species signals emerging conservation challenges, particularly due to overfishing, habitat degradation, and pollution. Data Deficient species highlight the need for long-term monitoring and focused research.

4.8 Threats to Freshwater Fish Biodiversity

Table 6.7: Major Threats Identified

Threat Factor	Impact Level
Overfishing	High
Agricultural runoff	High
Habitat loss	Moderate
Sand mining	Moderate
Urban sewage	High

Anthropogenic pressures were found to be the primary drivers of biodiversity loss. Overfishing and untreated sewage discharge had the most severe impact, particularly in urban stretches of River Gomti. Agricultural runoff contributed to eutrophication, adversely affecting sensitive fish species. The results clearly demonstrate that wetland freshwater fish diversity in Jaunpur District is rich but under increasing anthropogenic stress. River Gomti functions as a major biodiversity corridor, while Gujar Tal acts as a seasonal refuge habitat. Seasonal dynamics, spatial heterogeneity, and human interventions collectively shape fish diversity patterns. Conservation-oriented management is therefore essential to maintain ecological balance and sustain fisheries resources.

5. Conclusion

The present study concludes that the selected wetlands of Jaunpur District, particularly River Gomti and Gujar Tal, support a considerable diversity of freshwater fish species; however, this biodiversity is strongly influenced by spatial, seasonal, and anthropogenic factors. River Gomti exhibited higher species richness, diversity indices, and ecological stability due to its continuous flow, habitat heterogeneity, and connectivity, whereas Gujar Tal functioned as a comparatively fragile lacustrine system with seasonal fluctuations affecting fish assemblages. Seasonal analysis revealed that monsoon conditions were most favorable for fish diversity, while summer stress significantly reduced species richness. Although the majority of recorded species fell under the Least Concern category, the presence of Near Threatened, Vulnerable, and Data Deficient species indicates emerging conservation risks. The study further identified overfishing, sewage discharge, agricultural runoff, and habitat alteration as major threats to freshwater fish diversity. The findings emphasize the urgent need for scientifically informed, site-specific management and conservation strategies to ensure the long-term sustainability of wetland freshwater fish biodiversity in the region.

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