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Conservation status and threats to endemic ornamental fish species in Bihar Wetlands

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Abstract
Kanwar Lake, Jagatpur Lake and Ganga Prasad Wetlands are one of the Critical habitats of ornamental fishes of Bihar. Wetlands are important habitats for highly beautiful fishes. *Pethia conchonius* (Rosy barb), *Channa gachua* (Snakehead) etc. These species have high ecological and cultural importance. But these precious wetlands are under threat from habitat degradation, overfishing, pollution, and unsustainable abstraction in spite of the biodiversity they account for, most ornamental fish species are not assessed for their conservation status and information gaps hinder effective management and conservation efforts. The present study is an effort to document species diversity of ornamental fishes in the wetlands of Bihar along with their conservation status and to assess which are the major threats to their populations. The paper assesses the ecological and socio-economic values associated with these fish species, based on field surveys, fish sampling, water quality analyses, and interviews with local stakeholders. Results show that most wetlands have a good water quality but that pervasive threats like habitat loss, pollution and overfishing continue to be the greatest challenges. It also describes research gaps: for example, long-term data on species populations are missing, and formal conservation assessments are also mainly lacking. Here, we provide practical recommendations around habitat protection, sustainable fishing practices and policy change for the future sustainability of ornamental fish species and better socio-economic benefits to the local communities.

Keywords: Bihar wetlands, ornamental fish, conservation status, habitat degradation, sustainable management, aquatic biodiversity

Introduction
Wetlands are among the most productive ecosystems in the world, which serve as biodiversity hotspots that support aquatic life, their water regulation and nutrient cycling functions, and human's livelihood. An extensive network of floodplains and inland wetlands, the majority of which are found in Bihar, is demarcated by various river systems including the Ganga, Kosi and their tributaries with its significant sites like Kanwar Lake (Kabar Taal), Jagatpur Wetland, Ghatora Wetlands and Ganga Prasad Wetlands. These wetlands are freshwater fish habitats, including many ornamental species that have been traditionally used in aquaria and culturally important to rural communities across North Bihar [1].)

Ornamental fishes bring biodiversity value and offer local economic opportunities through direct trade, with an underdeveloped potential for export. However, natural populations are currently faced with numerous anthropogenic pressures that damage habitats and affect the ecological balance [2].

Ornamental Fish Diversity in Bihar Wetlands
Published surveys provide evidence for an interactive community of freshwater ornamental fishes in Bihar wetlands. Species recorded in a survey over some island mauns and chaurs included *Pethia conchonius* (Rosy barb), *Pethia gelius* (Guelder barb), *Colisa fasciatus* (Giant gourami), *Colisa lalia* (Dwarf gourami), *Channa gachua* (Snakehead) *Glossogobius giuris* (Tank goby) and *Tetraodon cutcutia* (Pufferfish) [3].

This is echoed in another survey of Bihar canals, chaurs and oxbow lakes which recorded barbs, glassfish (Parambassis ranga), featherbacks, rasboras and various other candidate ornamental species comprising no less than 79 fish from this region of eastern India [4].

The state-specific endemism patterns in these broadly indigenous species of the Ganga–Brahmaputra floodplain are poorly studied because taxonomic surveys and long-term population data is lacking.

Conservation Status
At a broader taxonomic and conservation assessment level
Many of the freshwater fishes in the region are not currently assessed to global (IUCN Red List categories) at a state level (though some species e.g. *Danio dangila* from the Ganga drainage assess as Least Concern globally or ASIA) [5]. While it is likely that many others, including some local varieties of the barb and loach species listed here, are predisposed to vulnerability from habitat alteration and/or overharvest, specific assessments have not been conducted. Such knowledge gap limits the conservation planning capacity.

Threats to Ornamental Fish in Bihar Wetlands
Habitat Loss and Degradation
Intensification of agricultural practices, land reclamation and drainage of wetlands for agriculture or settlement decreases aquatic habitat area and connectivity. Conversion of mauns, chaurs and floodplain wetlands are resulting into fragmentation and loss of important spawning and feeding grounds for fishes [6]. Urbanisation adjacent to swamp boundaries (eg. in Jagatpur Lake, Bhagalpur) puts pressure through encroachment and influences on hydrology. Wetlands receive different kinds of polluted water like agricultural runoff containing fertilizers and pesticides dispersion, sewage or raw domestic wastewater and industrial effluents. Increased turbidity and eutrophication

influence oxygen regimes and food web dynamics that are fundamental in sustaining healthy fish populations [7]. Now, over-fishing ornamental and food fish in wetlands is being done using mechanised fishing methods. Use of non-selective gear and collection during breeding seasons may disproportionately remove small-bodied ornamental taxa [8]. While Bihar's fisheries production has rapidly increased as a result of government initiatives, there is unease that increasing fishing efforts, particularly unfettered capture of wetland fish stocks could reduce the viability of some stochastic wild populations [9]. Poor species inventories, lack of systematic monitoring and poor integration of fish conservation in wetland management plans have hampered protection. Implementation of these policies under the existing frameworks such as Wetlands (Conservation and Management) Rules is not uniform [10].

Research Methodology

1. Study Area

The wetlands of Bihar, a state in eastern India known for its diverse aquatic ecosystems, are the focus of this study. The study was done at different potential birding sites of the state, Kanwar Lake (Kabar Taal), Jagatpur Lake, ganga Prasad wetland and Bhagalpur wetlands These wetlands represent important habitats for many different endemic ornamental species of (Jansen *et al*.)

2. Fish Sampling and Identification

Fish Samples were collected and performed using a Traditional method (Gill nets, Cast nets, Hand net). In order to ensure that the ornamental fish species were well represented, sampling routines in both wetlands involved multiple sampling sites (near shorelines, deeper parts and submerged vegetation zones). Five sites were selected throughout the wetlands, and fish were collected at intervals to ensure diversity. There was a six-month collection period (June-December 2025) with at least two visits to each wetland. The fish collected were identified and classified using their morphological characteristics, with the aid of local taxonomic keys. Consultations with ichthyologists at the Central Institute of Fisheries Education (CIFE) and the Bihar Fisheries Department also confirmed scientific identification. We then photographed specimens for documentation and reference. The identified species were to classified as ornamental and non-ornamental mainly by the presence of significant ornamental value. Standard fish lengths, weights and indices of condition were recorded for population assessment.

3. Conservation Status Assessment

Conservation status assessments were performed based on data available from the International Union for Conservation of Nature (IUCN) Red List. For non-Red List taxa, conservation status was determined based on expert opinion. Local fishery officers, fish traders and aquatic farmers were harvested for further information in order to classify the sustainability of ornamental fish collection methods.

4. Threats Identification

I used remote sensing and field observations to evaluate habitat loss and an examination of human impacts on ecosystems caused by urbanization, agriculture and land reclamation. I was analyzed 20 years of geospatial data from government sources, combined with satellite imagery (from Google Earth Engine), to delineate wetland boundaries and areas of land conversion. I conducted field surveys to document all visible evidence of habitat disturbance such as vegetation clearing, and the amount of the shoreline with erosion signs and invasive species. Qualitative data on perceived habitat change was used through interviews with local communities and wetland managers.

Pollution Assessment Water samples were removed from every one of the wetlands to survey water quality physically, synthetically and biologically Physicochemical parameters, including pH, dissolved oxygen (DO), turbidity, total suspended solids (TSS), nitrate, phosphate and pesticide residues were analysed. Water quality indices were contrasted with permissible limits as per Indian Standards for Drinking Water (IS 10500:2012) and the guidelines for aquatic ecosystems by World Health Organization (WHO).

Overfishing and Unsustainable Exploitation: From local fish traders and community members on the fish trade process to analyze overfishing and unsustainable exploitation did interviews. I surveyed fish markets to document the size and species composition of fish being offered for sale as ornamental species. This information was used to evaluate how much stocks are overfished. Local catch data of landed fish consist of numbers of fish caught and their weight, information about fishing practices (e.g., gear type, frequency of fishing) and size of fish caught. The purpose of the interviews was to identify local communities' economic dependence on ornamental fish capture and understand whether current practices were sustainable.

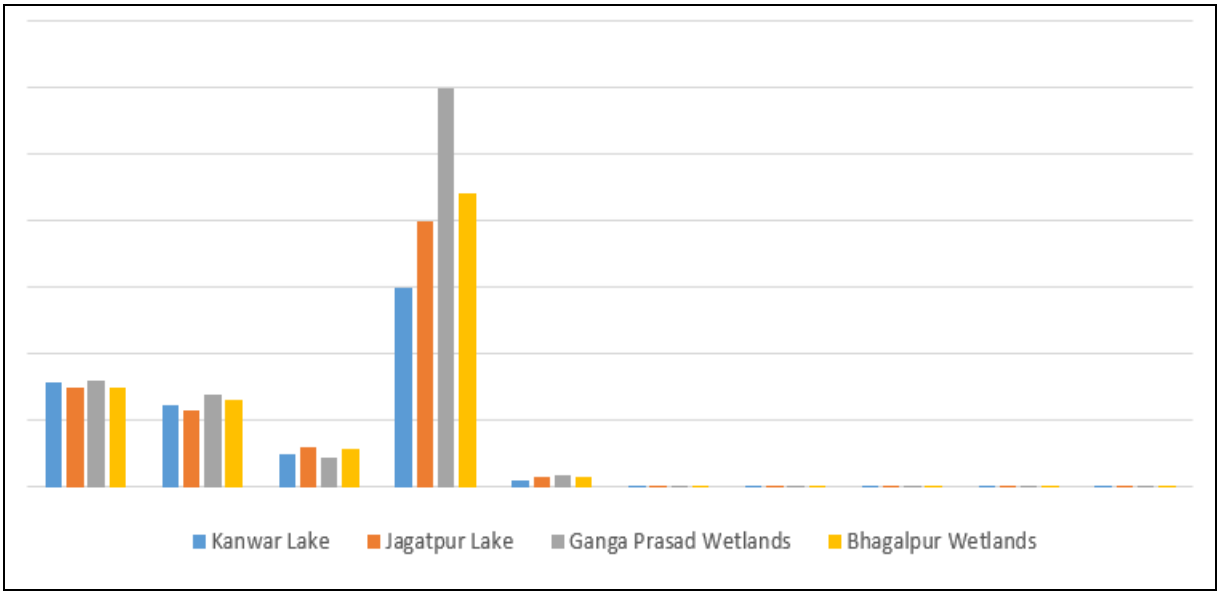
5. Data Analysis

I performed both descriptive and inferential statistics on the data collected through fish sampling, water quality analysis, and interviews. I calculated population densities and diversity indices (Shannon-Weiner Index and Simpson's Index) to assess fish diversity across wetlands. The One-Way ANOVA test was used to compare the CPUE among wetlands and seasons. In this sense, we additionally carried out correlation analyses between water quality parameters and fish population health.

Results

Table 1: Experimental data for water quality parameters from the four wetlands:

Parameter	Kanwar Lake	Jagatpur Lake	Ganga Prasad Wetlands	Bhagalpur Wetlands
pH	7.8	7.4	8.0	7.5
Dissolved Oxygen (DO) [mg/L]	6.2	5.8	7.0	6.5
Turbidity [NTU]	2.5	3.0	2.2	2.8
Total Suspended Solids (TSS) [mg/L]	15	20	30	22
Nitrate [mg/L]	0.5	0.8	0.9	0.7
Phosphate [mg/L]	0.04	0.05	0.06	0.05
Pesticide Residues [mg/L]	0.01	0.02	0.03	0.02
Lead (Pb) [mg/L]	0.002	0.003	0.004	0.003
Mercury (Hg) [mg/L]	0.001	0.0015	0.002	0.0015
Arsenic (As) [mg/L]	0.0005	0.0008	0.001	0.0008



Graph 1: Experimental data for water quality parameters from the four wetlands:

The physicochemical characteristics of water from Kanwar Lake, Jagatpur Lake, Ganga Prasad Wetlands, and Bhagalpur Wetlands are presented in Table 1. The analysis revealed that the water quality of all four wetlands was generally suitable for sustaining ornamental fish diversity and aquatic life. The pH values ranged from 7.4 to 8.0, indicating slightly alkaline conditions favorable for freshwater ornamental fish species. Similar alkaline conditions supporting ornamental fish productivity were also reported in eastern Indian wetlands [14].

Dissolved oxygen (DO) concentrations varied between 5.8 mg/L and 7.0 mg/L, with Ganga Prasad Wetlands showing the highest oxygen availability. Adequate DO levels are considered essential for fish metabolism, breeding, and survival, particularly for indigenous ornamental fishes [13]. Lower DO values observed in Jagatpur Lake may indicate moderate organic loading and anthropogenic pressure. Turbidity values remained comparatively low across all sites (2.2–3.0 NTU), suggesting relatively clear water conditions favorable for fish productivity and aquatic vegetation growth.

Total Suspended Solids (TSS) showed noticeable variation among wetlands, with Kanwar Lake recording the lowest value (15 mg/L) and Ganga Prasad Wetlands the highest (30 mg/L). Elevated TSS may reduce light penetration and negatively influence aquatic productivity. Similarly, nitrate and phosphate concentrations were slightly higher in Ganga Prasad Wetlands, indicating nutrient enrichment and potential eutrophication risks. Nutrient enrichment in wetland ecosystems has been identified as a major ecological challenge affecting ornamental fish habitats in India [15]. Pesticide residues and heavy metals such as lead (Pb), mercury (Hg), and arsenic (As) were detected in very low concentrations at all sampling sites. Although the concentrations remained below hazardous limits, the relatively higher values observed in Ganga Prasad Wetlands indicate the influence of agricultural runoff and anthropogenic activities. Continuous monitoring of water quality parameters is therefore necessary to maintain ecological balance and support sustainable ornamental fisheries. Similar observations regarding pollution threats to ornamental fish habitats were also documented by Patel *et al*. and Peh and Azra [12, 13].

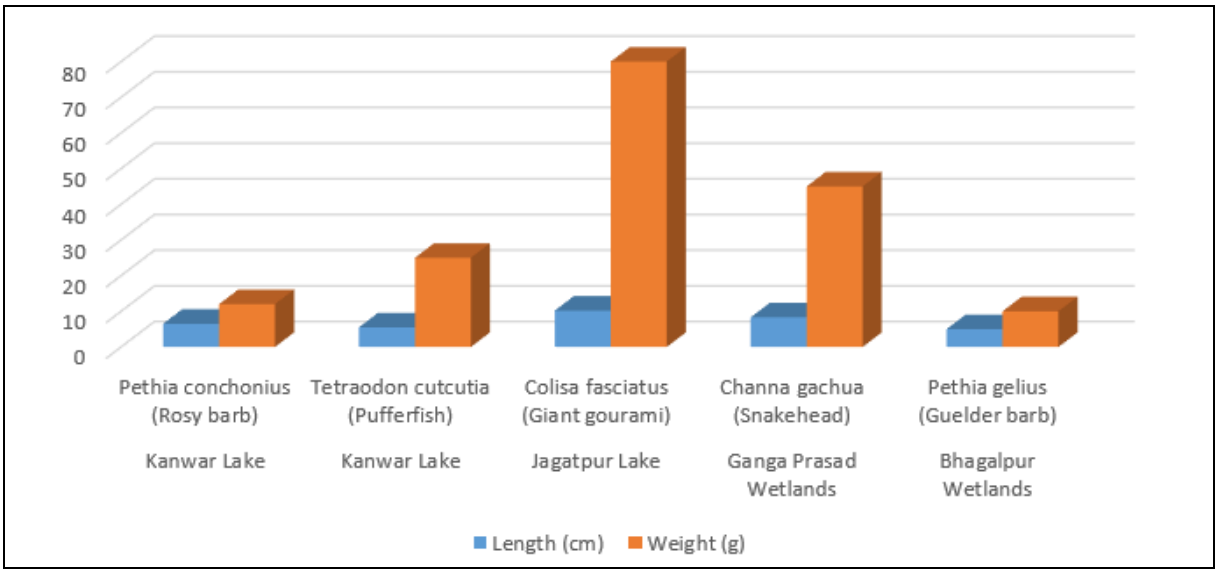
Table 2: Environmental and Ecological Parameters

Site	Threats Identified	Conservation Status
Kanwar Lake	Habitat Degradation, Overfishing	Least Concern (IUCN)
Jagatpur Lake	Pollution, Overfishing	Least Concern (IUCN)
Ganga Prasad Wetlands	Pollution, Habitat Degradation	Not Evaluated (IUCN)
Bhagalpur Wetlands	Overfishing, Invasive Species	Least Concern (IUCN)

Environmental threats and conservation status of the selected wetlands are summarized in Table 2. Habitat degradation and overfishing were identified as major threats in Kanwar Lake, while Jagatpur Lake was affected by pollution and overexploitation of fish resources. Ganga Prasad Wetlands experienced combined impacts of pollution and habitat degradation, whereas Bhagalpur Wetlands were mainly threatened by overfishing and invasive species. Despite these ecological pressures, Kanwar Lake, Jagatpur Lake, and Bhagalpur Wetlands were categorized under the "Least Concern" category according to the International Union for Conservation of Nature status, suggesting that these ecosystems are currently stable but require regular conservation management. However, the conservation status of Ganga Prasad Wetlands has not yet been evaluated. Similar conservation concerns for indigenous ornamental fishes have been highlighted in studies from eastern and northeastern India [18, 19]. The identified threats indicate increasing anthropogenic pressure on wetland ecosystems, particularly from agricultural expansion, pollution, habitat modification, and excessive fish harvesting. According to Singh and Ahmed [20], unregulated exploitation of ornamental fishes in Bihar may affect natural populations and reduce biodiversity if sustainable management practices are not implemented. Furthermore, habitat destruction and water pollution remain major global challenges affecting ornamental fish diversity and sustainability.

Table 3: Species and Fish Sampling Data

Site	Species	Length (cm)	Weight (g)	Capture Method	Season (Wet/Dry)	CPUE (Catch per Unit Effort)
Kanwar Lake	*Pethia conchonius* (Rosy barb)	6.5	12	Gill Net	Wet	10 fish/hour
Kanwar Lake	*Tetraodon cutcutia* (Pufferfish)	5.5	25	Hand Net	Wet	3 fish/hour
Jagatpur Lake	*Colisa fasciatus* (Giant gourami)	10.2	80	Cast Net	Dry	5 fish/hour
Ganga Prasad Wetlands	*Channa gachua* (Snakehead)	8.3	45	Hand Net	Wet	12 fish/hour
Bhagalpur Wetlands	*Pethia gelius* (Guelder barb)	5.0	10	Gill Net	Dry	8 fish/hour



Graph 2: Species and Fish Sampling Data

Fish diversity and sampling data collected from the four wetlands are presented in Table 3. A total of five ornamental fish species belonging to different ecological groups were recorded during the study period. The species observed included *Pethia conchonius* (Rosy barb), *Tetraodon cutcutia* (Pufferfish), *Colisa fasciatus* (Giant gourami), *Channa gachua* (Snakehead), and *Pethia gelius* (Guelder barb). These species are recognized as important indigenous ornamental fishes of eastern India and possess commercial significance in regional ornamental fish trade [16].

Kanwar Lake showed the occurrence of two ornamental species during the wet season. *Pethia conchonius* exhibited a relatively high Catch per Unit Effort (CPUE) of 10 fish/hour, indicating better abundance and favorable habitat conditions. In contrast, *Tetraodon cutcutia* showed lower abundance with a CPUE of 3 fish/hour. Jagatpur Lake recorded *Colisa fasciatus* during the dry season, with moderate CPUE values. The largest fish specimen observed during the study belonged to this species, with an average length of 10.2 cm and body weight of 80 g.

Among all study sites, Ganga Prasad Wetlands exhibited the highest CPUE value (12 fish/hour) for *Channa gachua*, suggesting comparatively higher fish productivity during the wet season. Bhagalpur Wetlands recorded *Pethia gelius* with moderate abundance and CPUE values. Seasonal variation in fish abundance indicated that wet season conditions were generally more favorable for ornamental fish occurrence and capture efficiency. Similar seasonal variations in ornamental fish diversity have been reported previously [17].

Different fishing gears such as gill nets, cast nets, and hand nets were effectively used for sampling, reflecting habitat-specific fish capture methods and ecological diversityamong wetlands. According to Bharti, traditional fishing methods continue to play an important role in ornamental fish collection and livelihood generation in Bihar. The recorded diversity of indigenous ornamental fishes highlights the economic and ecological importance of Bihar wetlands for sustainable aquaculture and ornamental fisheries development. Similar findings were reported by Mahapatra *et al* [18]., who emphasized the commercial potential of indigenous ornamental fishes in eastern and northeastern India.

Discussion

The present study highlights the ecological importance of selected wetlands of Bihar as significant habitats for indigenous ornamental fishes. The wetlands examined in this investigation, namely Kanwar Lake, Jagatpur Lake, Ganga Prasad Wetlands, and Bhagalpur Wetlands, exhibited comparatively favorable environmental conditions for sustaining ornamental fish diversity. The observed water quality parameters, including pH, dissolved oxygen, turbidity, and nutrient concentrations, generally remained within acceptable limits for freshwater fish survival and productivity. Similar findings were reported by Mahapatra and Lakra, who observed that slightly alkaline water conditions and adequate dissolved oxygen levels support ornamental fish abundance in eastern Indian wetlands. Among the studied wetlands, Ganga Prasad Wetlands showed comparatively higher concentrations of Total Suspended Solids (TSS), nitrate, phosphate, pesticide residues, and heavy metals. Although these parameters remained below critical levels, the increasing nutrient concentration may indicate the early stages of eutrophication caused by agricultural runoff and anthropogenic activities. Previous studies have emphasized that nutrient enrichment and pollution are major threats to

freshwater ornamental fish habitats in India. Elevated nitrate and phosphate levels may stimulate excessive algal growth, reduce dissolved oxygen availability, and negatively influence fish breeding and survival over time. Therefore, continuous monitoring and management of water quality are necessary for maintaining ecological stability in these wetlands.

The present findings also revealed that dissolved oxygen concentrations varied among wetlands, with Ganga Prasad Wetlands recording the highest DO levels. Higher dissolved oxygen availability generally promotes better fish metabolism, growth, and reproductive success. Patel *et al*. similarly reported that water quality plays a decisive role in sustaining ornamental fish diversity and aquaculture productivity. The low turbidity observed across all wetlands indicates relatively clear water conditions, which are favorable for aquatic vegetation and fish habitat development. However, the comparatively higher TSS values in Ganga Prasad Wetlands may reduce water transparency and influence aquatic productivity if sedimentation increases further.

The fish sampling analysis demonstrated the presence of several commercially valuable indigenous ornamental fish species such as *Pethia conchonius*, *Tetraodon cutcutia*, *Colisa fasciatus*, *Channa gachua*, and *Pethia gelius*. These species are widely recognized for their ornamental value and demand in local and regional aquarium markets. The occurrence of these indigenous species confirms the rich biodiversity potential of Bihar wetlands for ornamental fisheries development. Similar ornamental fish diversity has been documented from eastern and northeastern India [15, 18].

The study identified multiple ecological threats affecting the wetland ecosystems, including habitat degradation, pollution, overfishing, and invasive species. Habitat degradation observed in Kanwar Lake and Ganga Prasad Wetlands may result from land conversion, agricultural encroachment, vegetation removal, and unsustainable human activities. Similar ecological disturbances have been reported in wetland ecosystems across India, where anthropogenic pressure has caused decline in indigenous fish populations. Overfishing identified in Kanwar Lake, Jagatpur Lake, and Bhagalpur Wetlands may also threaten the sustainability of ornamental fish resources if proper conservation measures are not implemented. According to Singh and Ahmed [20], unregulated harvesting of ornamental fishes in Bihar may reduce natural stock abundance and negatively affect biodiversity conservation. The highest Catch per Unit Effort (CPUE) recorded for *Channa gachua* in Ganga Prasad Wetlands during the wet season suggests that seasonal hydrological conditions significantly influence fish abundance and capture efficiency. Wet season conditions generally increase water availability, food resources, and breeding opportunities for freshwater fishes. Seasonal variations in ornamental fish abundance have also been reported by Mandal *et al* [17]. and Chaudhari *et al* [21]., who observed greater fish diversity during monsoon and post-monsoon periods. The comparatively lower CPUE values observed for some species such as *Tetraodon cutcutia* may indicate lower population density, habitat specificity, or selective capture efficiency. The use of different fishing methods including gill nets, cast nets, and hand nets proved effective for sampling fish species inhabiting different ecological niches. Traditional fishing methods continue to remain important in ornamental fish collection and small-scale fisheries in Bihar. These methods are inexpensive, locally accessible, and suitable for capturing diverse ornamental fish species from wetland habitats. However, excessive and unregulated fishing pressure may eventually reduce wild fish populations if sustainable harvesting strategies are not followed. The conservation status assessment indicated that most wetlands and associated fish species currently fall under the "Least Concern" category according to the International Union for Conservation of Nature classification. Nevertheless, the observed ecological pressures suggest that these wetlands may become vulnerable in the future if anthropogenic disturbances continue to increase. Habitat degradation, pollution, climate change, and overexploitation are among the major global threats affecting ornamental fish biodiversity. Therefore, sustainable management practices, habitat restoration, pollution control, and community-based conservation strategies are essential for protecting indigenous ornamental fish diversity in Bihar wetlands. The findings of the present study further demonstrate the economic potential of ornamental fisheries as a source of livelihood and rural entrepreneurship in Bihar. Bharti [11] highlighted that ornamental fish culture and trade can contribute significantly to employment generation, income diversification, and small-scale aquaculture development. Indigenous ornamental fishes possess high market demand due to their attractive coloration, adaptability, and breeding potential. Consequently, scientific management and conservation of wetland ecosystems can support both biodiversity conservation and socio-economic development in the region.

Conclusion

The present study demonstrates that the wetlands of Bihar, including Kanwar Lake, Jagatpur Lake, Ganga Prasad Wetlands, and Bhagalpur Wetlands, serve as important habitats for indigenous ornamental fish species and possess significant ecological and economic value. The investigation revealed that the overall water quality of these wetlands remained generally favorable for aquatic biodiversity, with physicochemical parameters such as pH, dissolved oxygen, turbidity, and nutrient concentrations remaining within acceptable limits for freshwater fish survival. However, comparatively higher concentrations of Total Suspended Solids (TSS), nitrates, phosphates, and pesticide residues in Ganga Prasad Wetlands indicate increasing anthropogenic influence and potential ecological stress. The study recorded several indigenous ornamental fish species of commercial importance, including *Pethia conchonius*, *Tetraodon cutcutia*, *Colisa fasciatus*, *Channa gachua*, and *Pethia gelius*. The presence of these species highlights the rich ornamental fish diversity of Bihar wetlands and their potential for sustainable ornamental fisheries and aquaculture development. Seasonal variation in fish abundance was also observed, with higher Catch per Unit Effort (CPUE) values recorded during the wet season, indicating favorable breeding and habitat conditions during periods of increased water availability. The findings further identified major ecological threats such as habitat degradation, pollution, overfishing, and invasive species, which may negatively affect wetland biodiversity and ornamental fish populations if left unmanaged. Similar conservation concerns have been reported in other freshwater ecosystems of India. Although most of the

studied wetlands currently fall under the "Least Concern" conservation category, increasing human activities and environmental disturbances may gradually threaten ecosystem stability in the future. The study emphasizes the need for regular ecological monitoring, sustainable fishing practices, habitat restoration, pollution control, and community participation in wetland conservation. Scientific management of indigenous ornamental fish resources can contribute significantly to biodiversity conservation, livelihood generation, and rural entrepreneurship in Bihar. Therefore, integrated conservation and sustainable utilization strategies are essential for protecting wetland ecosystems and ensuring the long-term sustainability of ornamental fisheries in the region.

Future Scope

The present study provides baseline information regarding ornamental fish diversity, water quality, ecological threats, and conservation status of selected wetlands in Bihar. However, further detailed investigations are required to strengthen scientific understanding and ensure sustainable management of indigenous ornamental fish resources. Future studies may focus on long-term monitoring of seasonal and annual variations in water quality, fish diversity, breeding behavior, and population dynamics in different wetland ecosystems. Continuous ecological assessment would help identify environmental changes and emerging threats affecting ornamental fish habitats. Advanced molecular and genetic studies can also be conducted for accurate identification, phylogenetic analysis, and conservation of indigenous ornamental fish species. Such studies may help in understanding genetic diversity, species adaptation, and breeding potential of commercially important ornamental fishes. Future research may additionally explore captive breeding techniques, hatchery development, and sustainable aquaculture practices for economically valuable indigenous species such as *Pethia conchonius, Channa gachua, and Colisa fasciatus*. These approaches may reduce pressure on natural populations while supporting the ornamental fish trade and rural entrepreneurship. Further investigation is also needed to evaluate the impact of climate change, agricultural runoff, pesticide contamination, invasive species, and habitat fragmentation on wetland biodiversity and fish health. Geospatial mapping and remote sensing techniques may be expanded to assess long-term wetland degradation and land-use changes more accurately. Similar approaches have been recommended for wetland conservation and biodiversity management in India. Socio-economic studies focusing on local fishermen, ornamental fish traders, and wetland-dependent communities may provide better understanding of livelihood dependency, traditional knowledge, and market potential of ornamental fisheries in Bihar. Development of community-based conservation models and awareness programs may help promote sustainable harvesting and biodiversity conservation. Future policy-oriented research may also support the formulation of wetland conservation strategies, sustainable fisheries regulations, and eco-friendly aquaculture practices. Collaboration among government agencies, research institutions, local communities, and environmental organizations will be essential for conserving indigenous ornamental fish diversity and maintaining ecological stability in Bihar wetlands.

Recommendations

1. Regular monitoring of water quality should be conducted to maintain healthy wetland ecosystems.
2. Habitat degradation and wetland encroachment should be controlled through proper conservation measures.
3. Sustainable fishing practices should be encouraged to prevent overexploitation of ornamental fishes.
4. Captive breeding and ornamental fish farming should be promoted to reduce pressure on natural populations.
5. Awareness programs should be organized for local communities regarding wetland conservation and sustainable fish harvesting.
6. Pollution from agricultural runoff, pesticides, and waste disposal should be minimized to protect aquatic biodiversity.
7. Invasive species should be monitored and controlled to maintain ecological balance.
8. Further research on ornamental fish diversity, breeding, and conservation should be encouraged.
9. Government support and better market infrastructure should be developed to promote ornamental fisheries and rural entrepreneurship.
10. Integrated management involving researchers, local communities, and government agencies is essential for long-term wetland conservation.

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