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Enhancing fishers' livelihood through wetland fisheries management in Bihar

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Abstract

Bihar possesses one of India's richest wetland ecosystems, encompassing floodplain wetlands (mauns and chauras), oxbow lakes, and riverine floodplains that span approximately 403,209-941,000 hectares, depending on classification. These water bodies support capture fisheries and culture-based fisheries (CBF), providing livelihoods to over 600,000 traditional fishers, primarily from marginalized communities such as Sahni and Mallah. However, low productivity (often 50-160 kg/ha/year against a potential of 1,500-2,000 kg/ha), encroachment, siltation, pollution, and climate-induced variability threaten sustainability. This paper analyzes the current status of wetland fisheries in Bihar, identifies key challenges, reviews successful interventions like ICAR-CIFRI's participatory management in Kothia maun (East Champaran), and evaluates state and central schemes under PMMSY and the Blue Revolution. Through case studies of Kanwar Lake (Kabartal) degradation and targeted CBF enhancements, it demonstrates how scientific stocking, co-operative models, and subsidies can triple yields and extend fishing seasons. The study recommends integrated ecosystem-based management, community-led leasing reforms, skill development, and climate-resilient practices to achieve sustainable livelihood enhancement, targeting a doubling of fishers' income while conserving biodiversity. Findings underscore that participatory, science-driven wetland management can transform under-exploited resources into engines of rural prosperity in Bihar.

Keywords: Wetland ecosystems, encompassing floodplain wetlands, gangetic plains

Introduction

Bihar, located in the fertile Gangetic plains, is endowed with extensive inland water resources shaped by the Ganga and its tributaries (Ghaghra, Gandak, Kosi, Burhi Gandak, Bagmati, and Mahananda). These include rivers, reservoirs, ponds, and floodplain wetlands locally known as *mauns* (oxbow lakes) and *chauras* (seasonal saucer-shaped depressions). Wetlands cover significant portions of the state, with estimates ranging from 403,209 ha to over 9.41 lakh ha identified for potential development, including 2.5 lakh ha deemed premium for fisheries. These ecosystems serve multiple functions: flood control, groundwater recharge, biodiversity hotspots, and critical habitats for fish spawning and nursery grounds.

Fisheries in Bihar contribute substantially to the rural economy, with the sector (alongside agriculture and forestry) accounting for about 23.1% of Gross State Value Added (GSVA) in recent years. Fish production has shown robust growth, rising nearly 9.9% between 2023-24 and 2024-25, building on earlier increases from 288.91 thousand metric tonnes (TMT) in 2010-11 to 761.2 TMT in 2021-22. Inland fisheries dominate, with wetlands playing a pivotal role in capture and culture-based production. Traditional fishers, numbering around 603,647 (2003 census, with co-operatives enrolling over 410,000 members), rely on these resources for sustenance, yet many face seasonal unemployment, low catches, and migration pressures.

The title theme "Enhancing Fishers' Livelihood through Wetland Fisheries Management" addresses a dual imperative: boosting economic returns while ensuring ecological sustainability. Under-exploited wetlands offer untapped potential through CBF, pen culture, and integrated farming. Government initiatives under Pradhan Mantri Matsya Sampada Yojana (PMMSY), the Central Sector Scheme (CSS) Blue Revolution, and

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state schemes like Mukhyamantri Samekit Chaur Vikas Yojana have demonstrated pathways to higher productivity. This research paper draws on secondary data from ICAR-CIFRI reports, Bihar Fisheries Department statistics, peer-reviewed studies, and field-derived case examples to propose actionable strategies. Objectives include: (1) assessing wetland fisheries status; (2) identifying challenges; (3) evaluating interventions; and (4) recommending policy measures for livelihood security.

Literature Review

Existing literature highlights Bihar's wetlands as vital for small-scale inland fisheries yet vulnerable to anthropogenic pressures. Aklakur (2022) ^[1] notes Bihar's 403,209 ha of wetlands as major water resources supporting fisheries and aquaculture, emphasizing ecosystem management for sustainability. Chand (2021) ^[3] reviews aquaculture potentials, reporting doubled fish production over a decade due to state efforts, but stresses gaps in seed supply and technology adoption.

Floodplain wetland studies (e.g., from CIFRI) reveal average yields of just 50 kg/ha/year against 2,000 kg/ha potential, with CBF raising it to 400 kg/ha through stocking and habitat improvement. Socio-economic surveys, such as those on Baraila wetland, underscore the role of co-operatives in improving fishers' conditions via organized leasing and marketing. ICAR-CIFRI policy papers advocate co-management, weed control, and stock enhancement under the Bihar Fish Jalkar Management Act, 2006.

Recent works on Kanwar Lake (Kabartal) document shrinkage from 6,786 ha (1984) to ~2,032-2,620 ha by 2012-2025 due to agriculture expansion and encroachment, severely impacting 15,000+ fishers' catches (from 10-12 kg/day to 1-3 kg/day). Global parallels from Ramsar Convention literature stress integrated management for biodiversity and livelihoods. Gaps persist in climate resilience, gender-inclusive approaches, and value-chain development. This paper bridges these by focusing on evidence-based enhancement models.

Status of Wetland Fisheries in Bihar

Bihar is richly endowed with dynamic inland water resources, particularly floodplain wetlands that form an

integral part of the Gangetic alluvial plains. These wetlands, locally classified as *mauns* (permanent or semi-permanent oxbow lakes) and *chaurs* (seasonal, saucer-shaped depressions that retain water mainly during and after the monsoon), play a critical role in capture fisheries, culture-based fisheries (CBF), biodiversity conservation, flood moderation, and groundwater recharge. They support a diverse assemblage of over 90-100 fish species, including commercially important Indian Major Carps (IMC: *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*), exotic carps, catfishes, and small indigenous species such as *Gudusia chapra*.

According to the National Wetland Atlas, Bihar harbours approximately 21,998 wetlands covering 403,209 hectares, accounting for about 4.4% of the state's geographical area. Broader estimates, including potential and identified resources, place the total wetland area at up to 9.41 lakh hectares, with the Water Resources Department and Fisheries Department identifying around 2.5 lakh hectares as premium water bodies suitable for fisheries development. Floodplain wetlands alone are estimated at around 209,000-500,000 hectares in various studies, concentrated in the northern and central districts along the Ganga, Gandak, Kosi, Burhi Gandak, Bagmati, and Mahananda rivers.

The Bihar Fish Jalkar Management Act, 2006, governs the management of these water bodies (*jalkars*). Key resource inventory includes:

- Transferred revenue *jalkars* under Fisheries Department control.
- Surveyed private *jalkars*.
- Additional ponds, tanks, and reservoirs.

Fisheries cooperatives play a central role in leasing and managing many of these water bodies. As of recent data (up to 2023-24), there are around 494 registered fisheries cooperative societies in Bihar with approximately 5.39 lakh fisherman members. Earlier figures indicated around 477 societies with over 4.29 lakh members, reflecting steady organizational growth. These cooperatives, along with self-help groups (SHGs), manage leasing for short- or long-term periods, particularly for *mauns* and developed *chaurs*.

Table 1: Key Wetland and Fisheries Resources in Bihar

Category	Approximate Area/Number	Remarks/Source Highlights
Total Wetlands (National Wetland Atlas)	403,209 ha (21,998 wetlands)	Includes lakes, ponds, oxbows, riverine, and waterlogged areas
Identified/Potential Wetlands	Up to 9.41 lakh ha	State government estimates, especially in North Bihar floodplains
Premium Water Resources for Fisheries	~2.5 lakh ha	Identified by Water Resources Department
Floodplain Wetlands (Mauns & Chaurs)	209,000-500,000 ha	Major contribution to capture and culture fisheries
Rivers & Canals	3,200 km	Support riverine fisheries
Reservoirs	0.60 lakh ha	Additional culture potential
Tanks & Ponds	0.95 lakh ha	Intensive aquaculture base
Developed Chaur Land (under schemes)	>1,933 ha (across 22 districts); 510 ha in 2024-25	Mukhyamantri Samekit Chaur Vikas Yojana; integrated fish farming
Fisheries Cooperatives	~494 societies (2023-24)	~5.39 lakh members
Traditional Fishers	~6 lakh (active ~3.7-5 lakh)	Primarily from Sahni, Mallah, and other marginalized communities

Note: Figures are compiled from government reports, economic surveys, and scientific assessments; slight variations exist due to seasonal water spread and survey methodologies.

Bihar's overall fish production has shown impressive growth, reaching a record 9.59 lakh tonnes (959,760 MT) in 2024-25, marking nearly 9.9-10% growth over the previous year and securing the state 4th position nationally in inland/freshwater fish production. Inland fisheries dominate the sector, with wetlands and associated water bodies contributing substantially through both open-access capture and managed culture systems. Fish seed production infrastructure (hatcheries and nurseries) supports this growth, though quality and quantity gaps persist in some areas. Per capita fish availability in the state has improved but still has scope to rise further to meet nutritional demands.

Prominent wetland examples include

Kanwar Lake (Kabartal): Asia's largest freshwater oxbow lake and Bihar's only Ramsar site (designated 2020). It historically spanned ~6,786 ha (1984), shrinking to ~6,043 ha (2004), ~2,620 ha or lower (2012-recent estimates) due to siltation, agricultural encroachment, and hydrological changes. It supports over 50 fish species and livelihoods of thousands of fishers, though catches have declined sharply (from 10-12 kg/day to 1-3 kg/day in affected zones). The lake also serves as a vital habitat for migratory birds.

Other significant *mauns* and complexes: Baraila wetland, wetlands in East Champaran (e.g., Kothia maun), Vaishali, Supaul, Saharsa, and Madhubani districts. These vary in size from a few hectares to several hundred, with water retention from 3-12 months annually.

Productivity in unmanaged or open-access wetlands remains low (often 50-265 kg/ha/year), far below the potential of 1,500-2,000 kg/ha under scientific CBF with stocking, weed control, and habitat improvement. Successful pilots, such as in Kothia maun, have demonstrated yields rising to 160 kg/ha or higher with interventions, extending fishing seasons from ~30 to 90 days and boosting cooperative incomes.

Livelihood dependence is high: Wetlands provide seasonal to near-year-round employment for traditional fishers, who use gill nets, cast nets, bamboo traps, and small boats. Many families combine fishing with agriculture, livestock, or wage labor. Women participate in post-harvest activities like fish processing and marketing, though their role in decision-making remains limited. The sector contributes to rural employment, food security, and the state's Gross State Value Added (GSVA) in the primary sector.

Recent government efforts under the Fourth Agriculture Roadmap (2023-28), Mukhyamantri Samekit Chaur Vikas Yojana, and convergence with PMMSY have focused on developing *chaurs* for integrated fish farming, with subsidies for pond construction, seed, feed, and inputs. In 2024-25 alone, 510 ha of chaur land were developed with ₹24.67 crore expenditure. These initiatives aim to convert flood-prone low-lying areas into productive assets while enhancing fisher incomes.

In summary, wetland fisheries in Bihar represent a significant but under-utilized resource base. While overall fish production has grown robustly, the shift from low-yield traditional capture to sustainable, science-based management of *mauns* and *chaurs* holds the key to further productivity gains, biodiversity conservation, and improved livelihoods for hundreds of thousands of fishers. The status

reflects both ecological richness and the urgent need for integrated restoration and development to realize full potential.

Challenges Facing Wetland Fisheries

4. Challenges Facing Wetland Fisheries Despite potential, several barriers hinder productivity and livelihoods:

- **Encroachment and Habitat Loss:** Agriculture expansion has converted wetlands; Kanwar Lake shrank dramatically due to farming, infrastructure, and siltation, reducing open water and fish habitat. Over 64% global wetland loss trends mirror Bihar's issues.
- **Low Scientific Management:** Open-access capture fisheries yield only 50-160 kg/ha; poor stocking, weed infestation, and overfishing degrade stocks.
- **Pollution and Water Quality:** Agricultural runoff (nitrates, phosphates), idol immersion, and solid waste affect parameters like DO and BOD.
- **Climate and Hydrological Variability:** Erratic monsoons, floods, and droughts alter water spread; *chaurs* retain water only 5-6 months.
- **Socio-Economic Issues:** Fragmented co-operatives favor elites; small fishers migrate seasonally. Marketing inefficiencies, inadequate infrastructure (cold chains, transport), and limited credit access constrain income. Women's participation remains low.
- **Institutional Gaps:** Weak enforcement of leasing policies and limited monitoring under the 2006 Act.

These reduce daily catches, force livelihood diversification, and threaten food security for ~6 lakh fishers.

Strategies and Case Studies for Enhancement

5. Strategies and Case Studies for Enhancement Successful models demonstrate pathways forward.

ICAR-CIFRI Intervention in Kothia Maun (East Champaran): Initiated in 2018 under CSS Blue Revolution (NFDB-funded), this participatory project targeted a 60-ha oxbow lake supporting 200 fisher families via Tetaria Block Co-operative. Interventions included scientific stocking (IMC and exotic carps), habitat improvement, weed management, and COVID-19-safe fishing protocols (social distancing, masks). Results: Fish yield rose from 55 kg/ha to 160 kg/ha; fishing days extended from 30 to 90; catch per unit effort increased multifold. During lockdown, 3.6 tonnes harvested in 10 days generated Rs. 4 lakhs for the society. Fishers reduced migration, with diversified species (Rohu, Catla, Mrigal, Amur carp, Grass carp). This model proves science-led CBF can enhance productivity and income in under-exploited *mauns*.

Kanwar Lake Lessons and Restoration: As a Ramsar site, it highlights failures encroachment and drying reduced catches drastically but also opportunities for integrated management: community mapping, anti-encroachment drives, and eco-tourism-fisheries linkages.

State Schemes: Mukhyamantri Samekit Chaur Vikas Yojana develops *chaurs* with 40-70% subsidies (up to Rs. 5 crores for entrepreneurs). PMMSY funds hatcheries, biofloc, cage/pen culture, and FPOs. Subsidies include 100% for training, 50% for inputs/seeds, and 90% for

transport vehicles. JEEViKA's ultra-poor graduation approach integrates fisheries for SC/ST/women.

Technologies: Pen culture (target 2 t/ha/year), CBF stocking, and integrated models (fish-cum-poultry, rice-fish) boost yields. Co-management via strengthened societies ensures equitable access.

Policy Framework and Recommendations

6. Policy Framework and Recommendations: The Bihar Fish Jalkar Management Act (2006) governs leasing; PMMSY (₹548 crore invested in Bihar for 38 projects) and Blue Revolution provide central support. State roadmaps target 25,000 ha wetland development by 2028.

Recommendations

- 1. Adopt Participatory CBF Models:** Scale Kothia-type interventions statewide via ICAR-CIFRI-Department collaboration, aiming for 400-1,000 kg/ha yields.
- 2. Strengthen Co-operatives and Leasing:** Reform to long-term, community-led leases with anti-encroachment GIS monitoring; prioritize small fishers and women.
- 3. Infrastructure and Value Chain:** Invest in cold chains, FPOs, and digital marketing; subsidize biofloc/RAS for chauras.
- 4. Capacity Building:** Expand 100% subsidized training (target 40,000+ fishers); include climate-resilient practices and biodiversity conservation.
- 5. Ecosystem Restoration:** Enforce Ramsar guidelines for sites like Kanwar; integrate wetlands into flood management and agriculture roadmaps.
- 6. Monitoring and Finance:** Establish wetland health cards (as in national WISER framework); converge NRLM, PMMSY, and state funds for ultra-poor graduation.
- 7. Diversification:** Promote ornamental fish, tourism, and solar-fisheries hybrids.

Conclusion

Wetland fisheries management in Bihar holds transformative potential for fishers' livelihoods. From low-yield open-access systems to science-backed CBF successes like Kothia maun, evidence shows that targeted interventions stocking, co-operatives, subsidies, and restoration can triple productivity, extend seasons, and curb migration. Challenges of encroachment, pollution, and climate variability persist but are addressable through integrated, community-centric policies. By aligning PMMSY, state schemes, and ICAR expertise, Bihar can harness its 9+ lakh ha wetlands for sustainable growth, biodiversity conservation, and rural prosperity. Urgent implementation of recommendations will secure food security, economic resilience, and ecological health for future generations.

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