LIVING LANDSCAPES: INDIGENOUS NATURE-BASED SOLUTIONS THROUGH HUMAN–MAMMAL COEXISTENCE IN SOUTHERN BANGLADESH

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Abstract: This paper explores the indigenous practice of otter-fisher community as mammal conservation through livelihood integration. Bangladesh, one of the largest deltas, is shaped by dynamic river network that has sustains diverse water-based livelihood. Over centuries, fishing has evolved with diverse techniques, influencing not only economic practices but also settlement morphology. One such unique method is otter-assisted fishing, where trained smooth-coated otters (Lutrogale perspicillata) are used to chase fish towards nets. This ancient practice exemplifies a deep-rooted coexistence between humans and a semi-domesticated mammal, which has contributed significantly to the conservation of otters in the wild. However, this practice is now in sharp decline due to climate-induced changes, youth migration to alternative livelihoods, and adoption of alternative fishing methods. Therefore, the number of active otter fishers has drastically reduced, threatening both the species and traditional knowledge system. This study assesses how Nature-Based Solutions (NbS), as defined by the International Union for Conservation of Nature (IUCN), can restore this biodiversity. Through case study analysis, this research examines how spatial dynamics at settlement, clusters, and homestead scale align with NbS principles. The findings can develop community-centric policy that strengthen ecological conservation and socio-economic resilience, contributing to the restoration of nature-based ecosystems under IUCN framework

Keywords: *Nature-based practice, Otter fisher community, Mammal conservation, Spatial practices, Deltaic landscape*

1. Introduction

Bengalis are often described by the saying "Mache Bhate Bangali"—"fish and rice make a Bengali"—capturing the deep cultural and economic ties between people and aquatic ecosystems in Bangladesh. As a low-lying, riverine deltaic country with more than 230 rivers, Bangladesh's inland waters sustain one of the world's most productive inland fisheries (Rahman, 2005). Situated in the Ganges–Brahmaputra–Meghna (GBM) Delta, the fisheries sector which is the second most valuable agricultural crop in Bangladesh, contributes substantially to national and agricultural GDP, and supports the livelihoods and food security of millions of rural households (FAO, 2018; DoF, 2018; Shamsuzzaman et al., 2017; Rahman et al., 2020)

Within this broader river-dependent economy, a wide range of indigenous fishing techniques has evolved over centuries, shaping not only livelihood strategies but also settlement morphology and everyday spatial practices. Among them, otter-assisted fishing stands out as an exceptionally rare form of human–mammal cooperation in which trained smooth-coated otters (Lutrogale perspicillata) are used to drive fish into nets. In Bangladesh, this practice survives only in a few locations in the south-west, particularly in Narail District, where the Malo Jele community trains and breeds otters as part of their household economy (Feeroz et al., 2011; Khatun et al., 2024).

In recent decades, however, this living tradition has come under pressure. Upstream hydrological interventions, declining dry-season flows, river pollution, and wetland degradation have collectively reduced fish availability and altered riverine ecologies (Shamsuddoha & Chowdhury, 2007; Rahman & Navera, 2018; BDP 2100, 2018). At the same time, socio-economic change—including youth migration to urban jobs, adoption of more intensive fishing technologies, and the growing but uneven role of eco-tourism—has weakened incentives to maintain otter-fishing as a primary livelihood (Siddique & Surovi, 2021; Khatun et al., 2024). As a result, the number of active otter-fishing households who transmitted the traditional ecological knowledge of the mammal conservation has significantly declined.

These dynamics arise direct questions for contemporary debates on Nature-Based Solutions (NbS). Global NbS frameworks, including those promoted by the International Union for Conservation of Nature (IUCN), highlights the potential of ecosystem-based approaches to address climate risks, biodiversity loss, and livelihood insecurity (Cohen-Shacham et al., 2016; IUCN, 2020). Yet, indigenous livelihood systems that already depend on close human-nature relationships are rarely studied in spatial detail, particularly in deltaic rural contexts of the Global South. There is a limited understanding of how the everyday spatial practices of communities such as the otter-fishers of southern Bangladesh work as de facto NbS, and how these practices might inform planning, conservation, and rural development policies.

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This paper addresses that gap by analyisng the otter-fisher (Malo Jele) community of Gobra village in Narail District as a living landscape of indigenous Nature-Based Solutions. It focuses on how settlement patterns, homestead organization, and boat-based transient dwellings are configured across macro (settlement), meso (cluster), and micro (dwelling) scales in relation to deltaic riverine and wetland ecologies.

The study has three main objectives:

1. To document how the otter-fisher community is shaped spatially and morphologically at macro, meso, and micro scales.
2. To analysis these spatial practices under the lens of the IUCN Nature-Based Solutions framework and its core principles.
3. To identify implications of this indigenous practice for biodiversity conservation, rural planning, and policy-making in deltaic regions..

By framing otter-assisted fishing as an indigenous NbS, the research shows how human–mammal coexistence can simultaneously work for mammal conservation, ecological resilience, and livelihood security in a climate-vulnerable delta.

The findings are expected to offer actionable nature-based planning recommendations and policy directions that integrate indigenous conservation knowledge with the Sustainable Development Goals (SDGs)—particularly SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), SDG 14 (Life Below Water), and SDG 15 (Life on Land). Ultimately, the research seeks to contribute to a more inclusive and sustainable rural livelihood framework for river-dependent communities in Bangladesh.

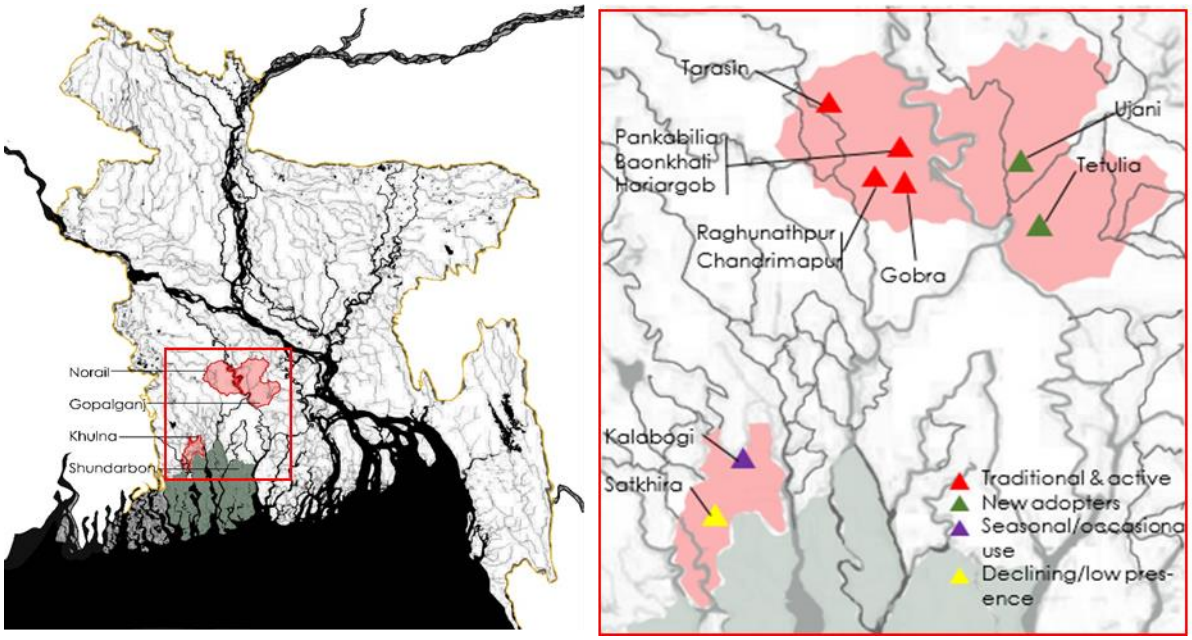


Figure 1: Location of Otter fishers in Norail,Gopalganj and Khulna district of Bangladesh
(source: author)

2. Literature

2.1. HUMAN–MAMMAL COEXISTENCE AND INDIGENOUS CONSERVATION

Human societies have relied on relations with animals for subsistence and protection. These ties are embedded in traditional ecological knowledge, where communities act as custodians of biodiversity (Gadgil et al., 1993; Brumm, 2021). In South Asia, coastal and riverine groups conserve plants and animals through taboos, rituals and livelihood practices (Mitra & Kabir, 2009). Bangladesh, a culturally and religiously diverse country with resources under pressure, shows how belief systems shape conservation. Teachings in Islam and Hinduism encourage care for life, and in localities the survival of species such as the common langur (Semnopithecus entellus) and the Bostami turtle (Aspideretes nigricans) is linked to religious reverence.

Otter-assisted fishing is another form of human–mammal cooperation. Historical records note trained otters used for fishing in Asia and Europe (Gudger, 1927; Gabriel et al., 2005). A parallel is cooperative fishing between bottlenose dolphins and net-casters in southern Brazil (Simões-Lopes, 1991). In Bangladesh, smooth-coated otters (Lutrogale perspicillata) have been part of fishing systems, in southwestern districts near the Sundarbans (Feeroz et al., 2011). Bred, trained and cared for

within fisher households, their presence is coupled with river health and fish abundance, making otter-fishing communities partners for mammal conservation and river monitoring (Zhang et al., 2018).

2.2 OTTER-FISHING IN BANGLADESH: STATUS AND CHALLENGES

Empirical studies of otter-fishing in Bangladesh document both its conservation value and its precarious status. Feeroz et al. (2011) and Khatun et al. (2024) show that captive breeding success rates are high and that many captive-bred otters can survive in the wild, thereby contributing to both ex-situ and in-situ conservation. Travel narratives and media reports further highlight the cultural distinctiveness of otter-fishing and its emerging attraction for eco-tourism (Travel and Explore BD, n.d.; AinaWGSD, n.d.).

However, the vulnerabilities of otter-fisher livelihoods are also highlighted by recent research. According to Siddique and Surovi (2021), declining incomes, competition with mechanized fishing, and ecological changes due to policy and climate change all contribute to lower fish catches. According to Khatun et al. (2024), only a few families in Narail and the surrounding areas still engage in otter-fishing, whereas thousands of people used to do so in several districts. These trends are consistent with larger concerns in otter conservation, where populations throughout Asia are threatened by infrastructure projects, habitat loss, and water pollution (Zhang et al., 2018; Planet Life Foundation, n.d.; Wild Otters, n.d.; Mhadei Research Center, n.d.).

Despite this, very few studies analyse the spatial dimension of otter-fisher settlements—the layout of homesteads, clustering along riverbanks, and adaptive boat design—through a conservation or planning lens. This limits the ability of planners and conservation agencies to recognize and support the practice as a place-based conservation strategy.

2.3 NATURE-BASED SOLUTIONS (NBS) AND RIVERINE LIVELIHOODS

Nature-Based Solutions have emerged as a key paradigm for addressing interconnected challenges of climate change, biodiversity loss, and socio-economic vulnerability. IUCN and related scholars define NbS as actions that protect, sustainably manage, and restore ecosystems in ways that address societal challenges while providing human well-being and biodiversity benefits (Cohen-Shacham et al., 2016, 2019; IUCN, 2020). The IUCN Global Standard articulates eight principles centred on biodiversity gains, site-specific design, inclusive governance, landscape-scale thinking, and explicit management of trade-offs.

While the NbS discourse includes examples from watershed management, coastal protection, urban greening, and agricultural landscapes, fewer studies examine indigenous livelihood systems that already function as NbS without being labelled as such. Riverine and deltaic contexts—such as the GBM Delta—are particularly under-represented, even though they are priority areas in national strategies like Bangladesh Delta Plan 2100 (BDP 2100, 2018).

In Bangladesh, existing work on the GBM Delta emphasizes hydrodynamics, salinity intrusion, climate-related disaster risk, and macro-scale water management (Rahman et al., 2020; Shamsuddoha & Chowdhury, 2007; Rahman & Navera, 2018). However, there is limited integration of these macro perspectives with the micro- and meso-scale spatial practices of fishing communities, especially those involving human–wildlife cooperation. As a result, NbS planning often overlooks how existing settlements, homesteads, and boats are already adapted to ecological rhythms and could serve as reference models for context-specific NbS design.

3. Methodology

This research adopts an interdisciplinary and qualitative approach to conduct a comprehensive morphological analysis of the otter-fisher community in Bangladesh, with a focus on nature-based practices and spatial dynamics at the levels of settlement, cluster, and dwelling. The study emphasised on a critical contextual understanding of spatial organization through a combination of ethnographic fieldwork, visual analysis and theoretical grounding in Nature-Based Solutions (NbS).

After an initial pilot survey, Gobra village in the Narail district was selected as the primary case study due to its long-standing tradition of otter-assisted fishing and its rich spatial and cultural patterns. The research follows a qualitative ethnographic approach, outlined by Groat & Wang (2013) and Creswell & Poth (2016). Data were collected through in-depth, one-on-one interviews and focus group discussions, utilizing semi-structured questionnaires to uncover personal stories, local knowledge, and community values.

A Random Purposeful Sampling method (Creswell & Poth, 2016) was applied to select diverse participants based on occupation, gender, age, and role within the community. This allowed the study to reflect the views of key actors such as elderly fishers, otter trainers, boat builders, and younger residents.

Alongside the interviews, visual research tools were used to record and analyse the physical form of the settlement, helping to connect its morphology with everyday practices and the surrounding riverine landscape.

These included:

- Field sketches and spatial drawings of homesteads, boats, ghats, and fishing zones.
- Photographic documentation of housing typologies, material use, and ecological interfaces.
- Video recordings of otter-fishing practices and community interactions with their landscape.

For Gobra village, a parallel methodological process was followed, integrating secondary data from academic literature and government sources with a comprehensive physical survey to triangulate findings.

The theoretical framework guiding this research is grounded in the Theory of Nature-Based Solutions (NbS), particularly the 8 principles outlined by IUCN, which include contextual appropriateness, biodiversity benefits, and inclusive governance. This framework supports the interpretation of spatial forms as ecologically embedded and culturally resilient practices.

4. Findings: Nature Based Practice of the Otter Fisher Communities

The otter-fisher communities of southern Bangladesh exemplify a living model of human–nature coexistence visible at macro-scale in settlement, meso-scale in cluster, and micro-scale in dwelling. Their daily practices align with the IUCN NbS framework, contributing to biodiversity conservation, preservation of cultural heritage, and livelihood security. From breeding and training smooth-coated otters to use of semi-wet homestead zones and eco-adaptive boats, every spatial and functional element supports an indigenous conservation ethic that sustains both ecosystem health and community well-being.

4.1. NBs IN MACRO SCALE (SETTLEMENT)

The **Ganges–Brahmaputra–Meghna Delta** forms the ecological foundation for the tradition of otter-assisted fishing in southern Bangladesh (Figure 1). This large deltaic landscape—formed by interconnected river basins, floodplains, and wetlands—historically sustained abundant fish populations and stable otter communities, creating the ecological conditions for this unique form of human–mammal correlation. As Malo Jele Shambo Biswas explains, *"The otters help to spot fish among the wetland plants, when the fish swim away ,we stay close with our nets. If we did it without them, we wouldn't be able to catch as many fish."*

In recent decades, this equilibrium has been disrupted by large-scale hydrological interventions, particularly the Farakka Barrage in India, which has reduced dry-season river flows into downstream Bangladesh. This has led to declines in fish populations, especially in the Chitra River and associated canals—the primary otter-fishing grounds in Narail—where water levels drop sharply in winter and pollution levels rise (Islam et al., 2020). Research by Khatun et al. (2024) documents how these hydrological changes, combined with embankment construction and river engineering, have contracted otter-fishing zones from five districts to only two, weakening the intergenerational transmission of knowledge essential for sustaining the tradition. As Bimol, son of Shambo Biswas, adds, "*Due to lack of fish, what we get in one day is not enough. After feeding the otters, we are left with nothing. Sometimes we even have to buy extra fish for the otters.I don't think I will continue to do this"*

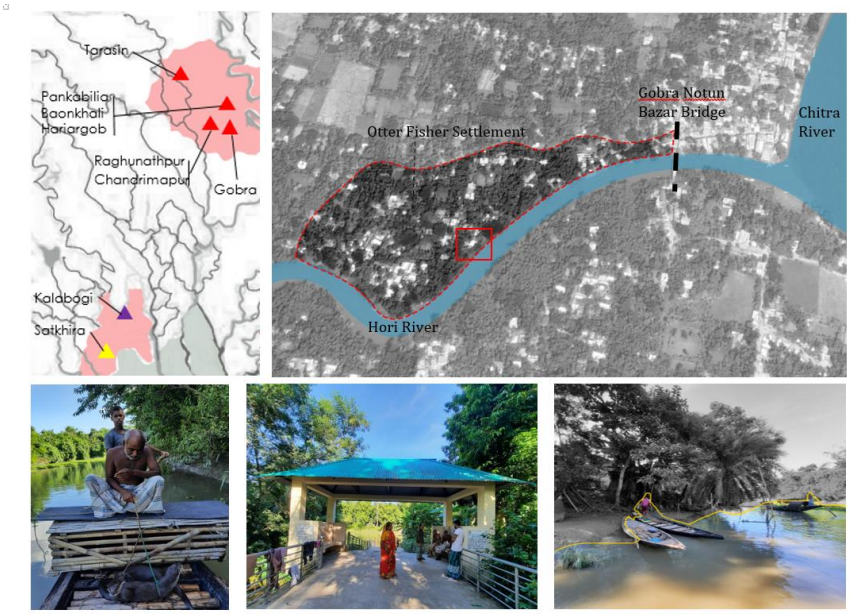


Figure 2: a. River-canal based water network b. Linear settlement configuration of the Malo Jele Para,Gobra village and Photographs *(Source :Author)*

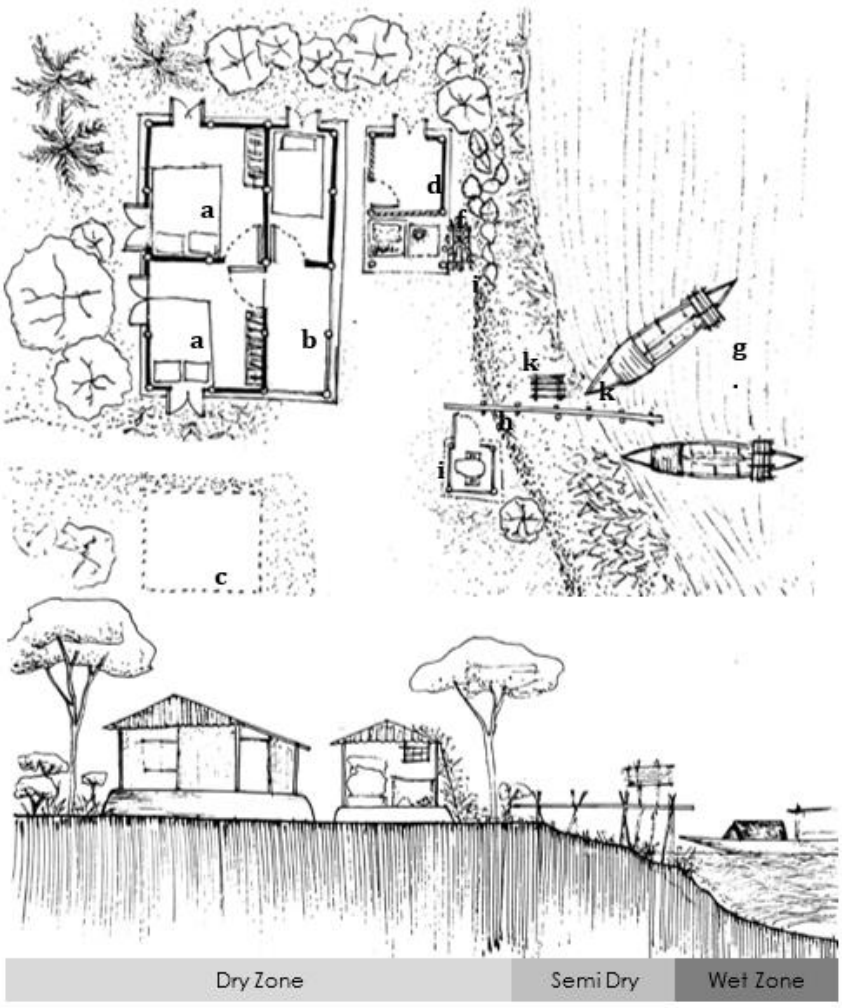
Otter-fishing communities in Khulna and Narail districts maintain a deeply rooted nature-based practice at a macro spatial scale. Settlements are strategically situated along the Chitra, Bhairab, and Nabaganga rivers—key waterways connected to the Sundarbans, the world's largest mangrove forest (Figure 2) This proximity to rivers shapes seasonal fishing patterns, influences settlement grow, and reinforces close relationships between people and their environment (Feeroz et al., 2011). Most houses built with bamboo and tin, is oriented to cope with seasonal flooding, boat access, otter care, and fishing activities. (Figure 2)

Tourism has become an additional source of income, with visitors often from abroad taking boat trips from the villages to the Sundarbans. As one resident stated, "*This ghat was sponsored by a foreign NGO to support otter fishing. It has now turned into a vital community space*." The smooth-coated otter (Lutrogale perspicillata) is the heart of this natural system, trained over generations to drive fish into nets, a practice entirely dependent on ecosystem services like clean water, healthy wetlands, and abundant fish stocks.

At the macro level, these villages are not isolated but an integral part of a larger nature-based spatial system. Their long-term survival depends on the ecological health of river networks and the ecosystem of Sundarbans mangrove. Without intervention, industrial pollution, riverbank erosion, and climate change will continue to erode both the ecological and cultural foundations of these indigenous river-dependent communities.

4.2. NBs IN MESO SCALE (CLUSTER)

At the meso scale, community-scale spatial practices structure the socio-ecological embedment of otter-fishing settlements. All these villages are situated near rivers like Goalbari, Rathodanga, and Chandibarpur and exibit clustered housing patterns due to proximity to fishing grounds. According to Siddique and Surovi (2021), dwellings are mostly constructed with bamboo and tin, a testament to how affordable the building materials are to cater for seasonal flooding from mass rivers. The spatial arrangement within the com- munity for fish drying, otter cages, and perceptualizations of net storage demonstrates 92 part iii River People how infrastructure is physically and functionally interwoven with the riverine ecosystem that it surrounds.



a. Bedroom
b. Varanda
c. New Construction
d. Kitchen
e. Store
f. Chicken Coop
g. Canal
h. Bamboo bridge (sako)
i. Toilet
j. Vegetation
k. Otter Cage

Figure 3: (top) Plan of the homestead (Bottom) Sectional Elevation of the homestead *(Source: Author)*

Gobra village, along the bank of the Chitra River in southern Bangladesh, has developed a particularly distinctive cluster-based settlement pattern within the otter-fisher community. The clusters are not randomly placed; they have grown following the curve rhythm of the river, forming a linear pattern of homes that maintain direct visual and physical contact with the water (Figure 3). At this meso scale, spatial organization shows a clear example of Nature-Based Solutions (NbS), balancing ecological processes with daily routines.

Each homestead in Gobra is organised in three main layers shaped by the river's influence. The wet zone directly connects to the water and includes the ghat (riverfront steps).Just above it stands the semi-wet zone slightly elevated, where the native community cultivates nolkhagra, a wetland reed used for making daily usable mats and home-based crafts. Further inland the dry zone includes the uthan, the courtyard, where families conduct everyday activities like drying or repairing nets, poultry rearing, and domestic chores.

The ghat serves as an important multifunctional space. It is used for bathing, fish processing, docking boats, and receiving visitors. During winter, foreign tourists visit to watch the rare otter-assisted fishing, making the ghat an informal cultural and eco-tourism hub. In response, some foreign guests have helped fund and rebuild the ghat, strengthening the bond between nature-based livelihood and tourism. (Figure 3)

Within this system, the otter acts as a living indicator of ecological health as its presence reflects river vitality and fish abundance. The community's spatial choices from clustered housing to multi-use wetlands embody a meso-scale NbS framework, where homestead design, local materials, seasonal rhythms, and eco-tourism merge into a self-sustaining environmentally rooted lifestyle.

4.3. NBs IN MICRO SCALE (DWELLING)

At the micro scale, everyday life of otter-fisher communities in southern Bangladesh shows a close integration of nature-based practices within the design of both their boats and homesteads. This study identifies two core types of spatial dynamism: (1) the static unit — the homestead and (2) the transient unit — the boat. These are not just tangible structures but functional ecosystems, shaped to address both livelihood needs and environmental conditions. The homestead acts as the primary social and economic unit of the otter-fisher community, where domestic life and fishing activities are closely interconnected. The unique fishing technique using trained otters creats a distinctive morphological character to these dwellings influencing their spatial formation, functional zones, and the integration of work and living spaces.

(i) The Static Unit: Homestead

Figure 4 : Homestead and housing pattern *(Source :Author)*

The homestead (dwelling) serves as the core social and economic unit for otter fishers. It supports essential livelihood activities such as rearing and breeding smooth-coated otters (Lutrogale perspicillata), preparing nets in open courtyards, maintaining poultry and ducks, and processing fish. Gender-based division of labor is evident—women manage household chores, poultry care, and assist in net maintenance, while men focus on fishing-related preparations. (Figure 4)

Structurally, homes are compact—often two small rooms with a kitchen and a front veranda (baranda), which may double as a sleeping space in warmer months. Building materials are primarily bamboo, sometimes supplemented with brick walls and tin roofs for durability. The courtyard acts as a multipurpose transitional zone—for drying nets, repairing gear, keeping temporary otter enclosures, or as an extension space for the household.

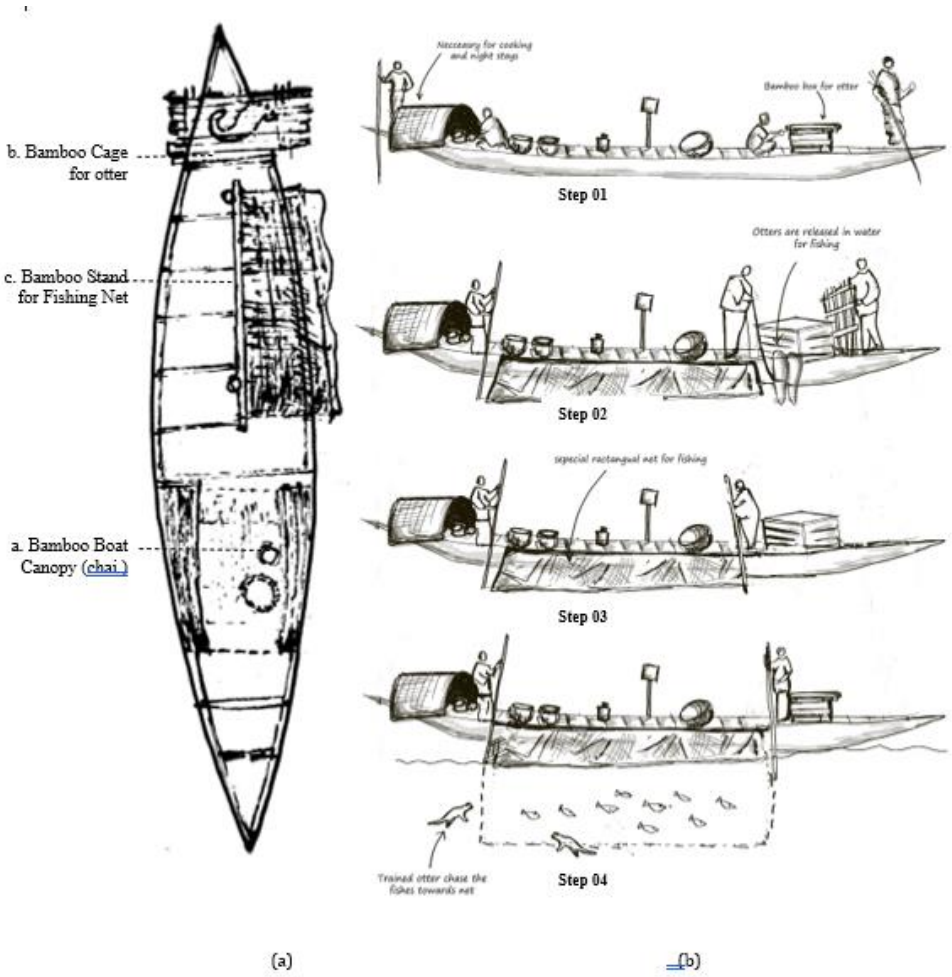


Figure 5: Bachari Nouka Boat as Transient dwelling unit a. Adaptive zoning of Boat b. Otter fishing tech-niques *(Source : author)*

(ii) The Transient Unit: Boat

The otter-fishers navigate an extensive river network for fishing, often traveling to the Sundarbans where they temporarily reside on their boats. For this reason, the boat is identified as a transient dwelling. Locally known as Bachari Nouka, these fishing boats are constructed from bamboo and wood and are specifically adapted for maneuvering in shallow river channels. Each boat is spatially organized into distinct functional zones:

a. **Chai**: a sheltered compartment usually made of bamboo canopy used for overnight stays during extended fishing trips, providing sleeping space, a small cooking area, and storage for fishing gear and personal belongings (Figure 5)

b. **Otter Cages:** bamboo enclosures securely tied to the exterior of the boat, well-ventilated and elevated to keep the trained otters safe and calm when not in use. (Figure 5)

c. **Fishing Zone Setup:** During fishing operations, two adult otters are tethered with ropes to poles positioned on either side of the net, while a juvenile is released to drive fish toward the trap. This spatial arrangement creates an approximately 40 m^2 controlled fishing zone, improving catch efficiency while reducing labor demands. (Feeroz et all.,2011)

The boat functions as an economic asset with a floating micro-habitat, capturing sustainable human–animal collaboration. Both homestead and boat designs reflect a nature-based design principle using local materials, adapting to seasonal changes, and embedding ecological functions into daily living. Every spatial decision maximizes utility while ensuring coexistence between human livelihood and biodiversity conservation.

5. Discussion

The livelihood of otter-fishing in southern Bangladesh demonstrates a multi-scalar nature-based practice that connect ecological conservation with socio-economic resilience. As documented by Feeroz et al. (2007), the community's long-standing relationship with smooth-coated otters (Lutrogale perspicillata) has played important role to their protection. The captive breeding shows success rate over 90%, and many captive-bred otters have proven capable of surviving in the wild.

This combination for ex-situ conservation (through captive rearing) and in-situ conservation (through reintroduction) makes otter-fishing as an exceptional, community-led biodiversity safeguard.

From a Nature-Based Solutions (NbS) perspective this practice aligns with the eight principles set out by the IUCN Global Standard (2020):

(i) Macro scale (Settlement) — Villages of otter-fisher are located along key rivers such as the Chitra, Bhairab, and Nabaganga, maintaining ecological links to the Sundarbans. The long term engagement of the fisher community in caring otter, water quality monitoring, and seasonal migration of fish reflects Principle 1 (embracing nature conservation) and Principle 6 (landscape-scale application) (Table 1)

(ii) Meso scale (Cluster) — Cluster based settlement patterns follow the river's edge, with ghats acting as socio-ecological hubs that bring together fishing, tourism, and everyday community life. These spaces demonstrate Principle 2 (linking with other societal challenges) and Principle 5 (inclusive governance through community decision-making). (Table 1)

(iii) Micro scale (Dwelling) — The dual dwelling typology—static homesteads and transient fishing boats shows local ecological design. Homesteads incorporate semi-wet zones for plant cultivation and otter care, while *Bachari Nouka* boats are spatially organised for living, otter housing, and fishing operations. This addresses Principle 3 (site-specific contexts) and Principle 7 (managing trade-offs between livelihood needs and ecosystem health). (Table 1)

Table 1: NBs Principles Proposed for Otter-Fishing Livelihoods Across Macro, Meso, and Micro Scales *(Source: Author)*

	NBs Principle	Macro Scale (Delta–River–Sundarbans Linkages)	Meso Scale (Village Cluster & Ghat System)	Micro Scale (Homestead & Boat)
P1	conservation	Long-term ecological monitoring of otter populations, water quality, and fish stocks across delta rivers; conserving wetlands that connect inland rivers to the Sundarbans.	Maintaining healthy village water networks and community-managed wetlands that support otter habitats.	Caring for otters, maintaining cages, and ensuring boat-based fishing practices minimize harm to ecosystems
P2	Synergies	Integrating otter conservation with regional water management, flood control, and fisheries policy.	Designing ghats, fish landing sites, and settlement patterns to integrate human use with otter activity zones.	Design homesteads with semi-wet zones for resource harvesting. Include spaces for otter care and maintenance.
P3	Site specific context	Recognizing large-scale riverine ecology, seasonal fish migration, and traditional knowledge across connected water systems.	Valuing the Malo Jele community's knowledge of local fish movement and otter behavior in village water systems.	Incorporating household-level ecological knowledge into otter care and fishing schedules.
P4	Transparency and broad participation	Ensuring equitable benefits for fishing communities in multiple districts through sustainable river basin management.	Supporting fair distribution of fishing rights and ghat access within and between villages.	Ensuring equitable income from fishing trips among household members.
P5	Diversity and evolvement over time	Preserving migratory fish routes and otter habitats across the delta, maintaining cultural identity tied to river landscapes.	Encouraging community festivals, rituals, and shared fishing practices that strengthen ecological and cultural ties.	Keeping traditional craftsmanship of boat-making and otter cage-building alive.
P6	Landscape scale	Planning conservation at the entire river basin and deltaic landscape level.	Managing otter and fish conservation within the shared wetland and river stretches used by the cluster.	Planning fishing trips in sync with seasonal water changes and otter breeding cycles.
P7	Trade-offs	Balancing hydropower/irrigation projects with the need for sustaining fisheries and otter habitats.	Balancing tourist access to ghats with the need to minimize disturbance to otter habitats.	Balancing short-term fishing needs with otter welfare and habitat use.
P8	Policy integration	Embedding otter-fishing conservation into national river basin planning and delta management strategies.	Incorporating otter habitat zones into local development plans and village spatial layouts.	Embedding eco-sensitive homestead and boat designs into community norms.

The IUCN NbS framework emphasizes that effective implementation must deliver biodiversity gain and human well-being. The otter-fishing system does both by supporting species conservation while sustaining livelihoods through fishing, tourism, and traditional ecological knowledge. However, macro-scale threats such as upstream water diversion (Farakka Barrage), wetland degradation, and climate change—are contracting otter-fishing zones (Khatun et al., 2024). Without

targeted interventions, the intergenerational transmission of knowledge and the ecological foundation of this practice are at risk.

Methodologically, framing the otter-fisher settlement as a "living landscape" of NbS extends NbS research beyond project-based interventions towards everyday spatial practices. It suggests that spatial analysis at multiple scales—settlement, cluster, and dwelling—can reveal how indigenous communities internalize ecological knowledge into built form and daily routines. This has implications for planners and conservation practitioners, who could treat such communities not only as beneficiaries of NbS projects but as co-designers and long-standing implementers of NbS grounded in local ecologies. Finally, the case also points at limitations. The research focuses on a single village and depends initially on qualitative methods. While this enables a deep rooted contextual understanding, further work is required to quantify ecological outcomes (e.g., otter population trends, water quality indicators) and to compare spatial patterns across multiple otter-fishing sites. Nonetheless, the findings provide a grounded starting point for integrating indigenous NbS into broader delta planning and biodiversity conservation strategies.

6. Conclusion

The indigenous otter-fishing tradition of southern Bangladesh is a rare example of everyday human–mammal coexistence. Through the sitting of settlement along river networks, cluster-based homestead organization, and adaptive boat and dwelling design, the otter-fisher community of Gobra shows how livelihoods can be closely aligned with riverine and wetland ecosystems. From the IUCN Nature-Based Solutions framework, these practices collectively support biodiversity, cultural continuity, and local livelihoods even without formal NbS designed projects.

However, this indigenous NbS is under threat by upstream hydrological interventions, climate-induced ecological change, and shifting socio-economic aspirations. Declining fish stocks and uncertain economic returns risk the abandonment of otter-fishing, with consequences for smooth-coated otter conservation and the loss of traditional ecological knowledge.

The study suggests that otter-fishing communities should be engaged as partners in conservation and river monitoring, and that their spatial practices offer useful references for eco-sensitive rural planning and climate-resilient housing. Critically planned eco-tourism have potentials to improve both incomes and recognising their role. Future research should measure ecological impacts, compare different sites, and involve interdisciplinary and participatory approaches to co-create NbS that build on existing indigenous practices. Recognizing otter-assisted fishing as a living landscape of NbS highlights that such traditions are active, place-based strategies for living with dynamic deltaic environments. Incorporating otter-fishing communities into national conservation strategies would also advance the Sustainable Development Goals—notably SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), SDG 14 (Life Below Water), and SDG 15 (Life on Land)—ensuring this globally relevant NbS model endures for future generations.

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