Journal of Contemporary Urban Affairs

2026, Volume 10, Number 1, pages 217–236

Original scientific paper

Wetland Landscape Planning for Socio-Ecological Resilience and Sustainable Tourism: Evidence from Tanguar Haor, Bangladesh

* **Upama Talukder**

Department of Architecture, Faculty of Architecture & Planning, Chittagong University of Engineering & Technology, Bangladesh

E-mail: upama7152@gmail.com

ARTICLE INFO:

Article History:
Received: 20 March 2026
Revised 1: 04 May 2026
Revised 2: 19 May 2026
Accepted: 16 June 2026
Available online: 25 June 2026

Keywords:
Tanguar Haor;
Wetland Landscape Planning;
Socio-ecological Resilience;
Sustainable Tourism;
Nature-based solutions.

ABSTRACT

Wetland landscapes are exposed to ecological degradation, flood vulnerability, and tourism pressure, yet planning approaches treat conservation, livelihoods, and visitor management as separate concerns. This study addresses this gap by examining how integrated landscape planning can strengthen socio-ecological resilience and sustainable tourism in Tanguar Haor, a Ramsar-designated wetland in northeastern Bangladesh. Using a qualitative mixed method design, the research combined seasonal field investigations after the 2023 flash flood, during the 2024 post-monsoon period, and in winter 2025, with questionnaire responses from 50 residents, interviews, tourism observations, and thematic analysis. The findings show that seasonal inundation, settlement edge erosion, declining native vegetation, unmanaged houseboat tourism, and limited sanitation infrastructure intensify livelihood vulnerability and habitat disturbance. 5,089 hectares, representing 44% of the area, remain under permanent water and support fisheries, biodiversity, and seasonal economic activity. The study proposes an elevation-based landscape framework integrating native vegetation restoration, reed belts, ecological zoning, community stewardship, and regulated tourism infrastructure. These strategies can improve erosion control, public service efficiency, employment opportunities, tourism revenue, resource allocation, and urban regional economic resilience while advancing context-sensitive wetland governance for landscape planning and urban management.

JOURNAL OF CONTEMPORARY URBAN AFFAIRS (2026), ***10***(1), 217–236.
https://doi.org/10.25034/ijcua.2026.v10n1-10

www.ijcua.com

Highlights:

- Floods erode homes, weakening incomes and ecosystems across haor wetland.
- Vegetation loss exposes wetland edges, increasing erosion and flood damage.
- Reed belts reduce waves, improving erosion control and habitat quality.
- Unmanaged tourism raises waste and disturbs habitats in wetland zones.
- Planned tourism raises incomes while protecting wetland capacity and jobs.

Contribution to the field statement:

This study advances wetland planning by showing how native vegetation, seasonal water patterns, tourism control, and community action can jointly protect Tanguar Haor. Its original landscape framework fills a planning gap, supports resilient livelihoods, improves tourism governance, and strengthens the urban economy through safer infrastructure, local employment, and sustainable investment opportunities.

*** Upama Talukder**
Department of Architecture, Faculty of Architecture & Planning, Chittagong University of Engineering & Technology, Bangladesh
Email address: upama7152@gmail.com

How to cite this article? (APA Style)
Talukder, U. (2026). Wetland landscape planning for socio-ecological resilience and sustainable tourism: Evidence from Tanguar Haor, Bangladesh. *Journal of Contemporary Urban Affairs*, 10(1), 217–236. https://doi.org/10.25034/ijcua.2026.v10n1-10

1. Introduction

Wetland landscapes are among the most productive yet vulnerable ecosystems, providing essential services such as biodiversity conservation, water regulation, and climate resilience. As dynamic interfaces between terrestrial and aquatic environments, they support diverse habitats, regulate hydrological processes, and act as natural buffers against floods and environmental change. (Durigan et al., 2022) Wetlands are widely recognized for their essential contribution to ecosystem services and are frequently referred to as the 'kidneys of the landscape' and 'ecological supermarkets.' This recognition highlights their significance in global conservation and restoration efforts. (Mitsch et al., 2012) Despite their importance, wetlands are increasingly threatened by environmental degradation, land-use change, climate variability, and human intervention. As a result, the loss of wetland functions has become a growing global concern, highlighting the need for effective conservation, restoration, and management strategies. Understanding the interactions between natural processes and human activities is therefore essential for maintaining wetland resilience and supporting sustainable development. (Kundu et al., 2024)

One of the major freshwater wetland ecosystems in Bangladesh is the Haor Basin, located within the low-lying floodplains of the eastern Mymensingh and western Sylhet regions. (Bokhtiar et al., 2024) Among these wetlands, Tanguar Haor in Sunamganj is internationally recognized as a Ramsar site due to its rich biodiversity and ecological significance. The wetland supports diverse aquatic habitats, migratory bird populations, fisheries, and seasonal agriculture, making it a vital source of livelihood for the surrounding communities. The landscape undergoes dramatic seasonal transformation, shifting from a vast water body during the monsoon to exposed land used for agriculture and settlement during the dry season. In addition to its ecological and livelihood value, the unique landscape character and seasonal dynamics of Tanguar Haor have increased its attraction as a nature-based tourism destination, creating opportunities for local economic development while placing additional pressure on the wetland environment.

Despite its ecological and socio-economic importance, Tanguar Haor faces growing environmental and developmental challenges. The area continues to face multiple environmental pressures, including soil erosion, habitat degradation, illegal poaching, hydrological imbalance, and the decline of surrounding forest ecosystems. (Sultana et al., 2022) The dynamic nature of the haor landscape makes conventional engineering interventions difficult to sustain, as rigid structures often fail to respond effectively to seasonal inundation, fluctuating water levels, and continuous erosion processes. In contrast, vegetation-based approaches and nature-based interventions can improve soil stability, enhance sediment retention, and function as natural buffers against flood impacts while supporting ecosystem functions. Existing studies on Tanguar Haor have primarily focused on ecological conservation, biodiversity, hydrological dynamics, environmental degradation, and tourism potential. While these studies provide valuable insights, they often address these issues separately. Consequently, limited attention has been given to integrating socio-ecological resilience and sustainable tourism within a comprehensive landscape-planning framework that simultaneously considers hydrological processes, ecological conservation, tourism management, and community adaptation. This gap highlights the need for research that prioritizes planning and establishes stronger connections between environmental conservation and sustainable tourism development in dynamic wetland systems.

This study examines how landscape-planning strategies can enhance socio-ecological resilience and support sustainable tourism in Tanguar Haor. The research investigates the relationships among hydrological dynamics, vegetation systems, tourism activities, and community livelihoods to better understand the opportunities and challenges associated with wetland management. Specifically, the study seeks to evaluate the environmental and socio-economic pressures affecting the wetland landscape and to explore how nature-based landscape strategies can strengthen ecological stability and community adaptability. Through this approach, the research aims to develop integrated landscape-planning strategies that respond to the seasonal dynamics of the haor while supporting both conservation and sustainable tourism objectives.

The significance of this study lies in its contribution to wetland landscape planning, as it explores how ecological resilience and sustainable tourism can be integrated within a flood-prone environment. The

research highlights the potential of vegetation-based strategies and nature-based approaches to improve soil stability, reduce erosion, regulate hydrological processes, and strengthen the adaptive capacity of wetland ecosystems. Unlike hard engineering interventions, which often struggle to withstand the seasonal dynamics of haor landscapes, vegetation-based systems can function as natural buffers that respond to fluctuating water levels while maintaining ecological functions. By examining the relationships among hydrology, vegetation, tourism activities, and community livelihoods, the study provides a landscape-based framework for balancing environmental conservation and tourism development. The findings contribute to broader discussions on socio-ecological resilience and offer practical insights for the sustainable management of dynamic wetland landscapes.

2. Literature review

2.1 Wetland Landscapes and Ecosystem Services

Wetlands are broadly defined under the Ramsar Convention as diverse ecosystems that include rivers, lakes, floodplains, marshes, peatlands, mangroves, and human-made systems such as rice fields, reservoirs, and fish ponds. (Meng et al., 2017) This classification reflects the ecological diversity and multifunctional role of wetlands across different geographic contexts. The multifunctional nature of wetlands is closely associated with human perceptions and land-use decisions, as these ecosystems support both environmental sustainability and socio-economic activities. (Yan et al., 2024) Despite their ecological importance, wetlands worldwide continue to face increasing pressure from both natural and anthropogenic factors. (Abdenour et al., 2025) Although many countries have introduced legal and institutional measures for wetland conservation, the extent and ecological condition of wetlands continue to decline. Wetlands provide a wide range of provisioning services, supplying plant, animal, and mineral resources that support both subsistence and commercial activities. Among these resources, fisheries are particularly significant, serving as a major source of protein for approximately one billion people and supporting the livelihoods of millions through employment and income generation. Beyond provisioning services, wetlands perform essential regulating functions, including water purification, flood mitigation, and carbon sequestration, which contribute to environmental stability and climate resilience (Kennedy et al., 1981). In addition, wetlands offer important cultural ecosystem services through recreation, tourism, education, and aesthetic experiences, generating socio-economic benefits for local communities while enhancing public appreciation of natural landscapes. (Wood et al., 2024)

2.2 Wetland Tourism and Environmental Pressures

Wetland tourism has emerged as one of the fastest-growing segments of the global tourism industry, driven by increasing interest in nature-based experiences and environmental conservation. Environmentally responsible forms of tourism, including ecotourism, wildlife tourism, and cultural tourism, promote environmental awareness while encouraging the conservation of natural resources. (Satrya et al., 2023) Wetland environments support a diverse range of tourism activities, including bird-watching, fishing, boating, hiking, and camping. Wetland ecotourism is often concentrated in biodiversity-rich regions of the developing world, where wetlands possess significant ecological and scenic value. Although a large proportion of ecotourists originates from developed countries (Weaver & Lawton, 2007), many wetland destinations are located in developing nations that view ecotourism as a means of supporting conservation while generating economic opportunities for local communities. The growth of wetland ecotourism is closely linked to the presence of well-preserved ecological and cultural resources. However, the expansion of tourism within wetland environments requires careful planning due to the ecological sensitivity and limited carrying capacity of these landscapes. (Do et al., 2015) Existing literature emphasizes that sustainable tourism development depends on a thorough understanding of visitor numbers, seasonal changes, ecologically vulnerable areas, infrastructure capacity, and appropriate management measures to safeguard wetland ecosystems. Failure to consider these factors may result in habitat degradation, ecological disturbance, and increased pressure on wetland resources. Conversely, well-managed ecotourism can enhance environmental awareness, generate local employment, and contribute to the long-term sustainability of wetland conservation efforts. (Mahgoub, 2021)

2.3 Flood Dynamics and Ecological Vulnerability in the Haor Landscape

Haor ecosystems are characterized by strong seasonal hydrological fluctuations that shape landscape processes, ecological functions, and human activities. Seasonal inundation plays a fundamental role in maintaining wetland productivity, supporting fisheries, replenishing nutrients, and sustaining biodiversity. However, the increasing frequency and intensity of flash floods, combined with environmental degradation and human pressures, have heightened the vulnerability of haor landscapes and communities. Previous studies have shown that recurrent flooding can damage agricultural production, disrupt livelihoods, accelerate erosion, and alter ecological conditions within wetland environments (Chakraborty et al., 2021). The seasonal flood regime of haor landscapes is characterized by distinct phases that shape hydrological processes, ecological functions, and human activities.

Table 1: Seasonal flood dynamics in the haor landscape

Flood Phase	Hydrological Character	Key Landscape Impact	Ecological Response	Human Impact
Early Flash Flood (Apr–May)	Rapid water rise from upstream inflow	Crop field inundation, edge erosion begins	Vegetation stress, soil saturation	Severe agricultural loss, livelihood disruption
Monsoon Flood (Jun–Aug)	Full inundation of the haor basin	Complete landscape submergence, settlement isolation	High productivity, fish breeding, sediment deposition	Transport dependence on boats, infrastructure stress
Post-Monsoon Flood (Aug–Nov)	Gradual recession of water	Exposed mudflats, erosion-prone edges	Vegetation regeneration begins, habitat transition	Return of agriculture, settlement exposure, disease risk

In addition to growing tourism activities within wetland environments may introduce further ecological stress when not supported by appropriate management and infrastructure. Increased visitor numbers, unregulated access, and inadequate environmental controls can contribute to habitat disturbance and landscape degradation. Tanguar Haor reflects these interconnected pressures, where seasonal flood regimes, ecological fragility, and increasing tourism activity collectively determine the dynamics of landscape vulnerability and resilience.

2.4 Land Cover Change of Tanguar Haor

Recent studies on wetland systems indicate significant land cover transformations driven by both natural processes and human activities. (Adarkwah et al., 2024) The land cover dynamics of Tanguar Haor follow this broader trajectory of transformation, characterized by wetland shrinkage, vegetation decline, and the gradual expansion of human settlements under increasing anthropogenic influence. (Rumon et al., 2025b) The overall pattern of land cover transformation highlights a gradual shift in the wetland system, where hydrological variability and human activities jointly reshape the spatial composition of the landscape.

Table 2: Details of land cover class.

Land Cover Class	Description
Vegetation	Dense tree cover, evergreen forest patches, plantation forests, and hijol-dominated landscapes
Shallow Water	Low-lying seasonally inundated areas
Deep Water	Rivers, permanent open water, baors, lakes, ponds, canals, and reservoirs
Settlement	Built-up areas and associated human habitation zones within the wetland system

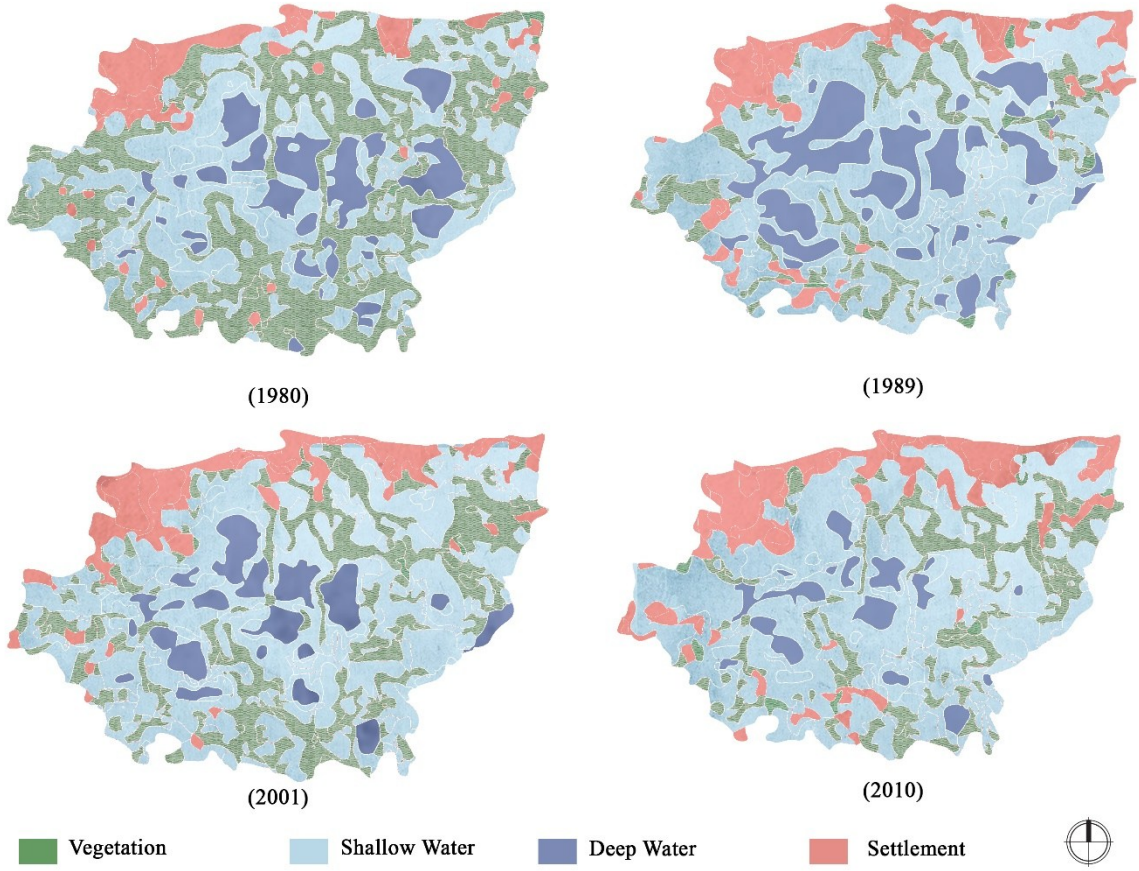

Figure 1. Land Cover Change of Tanguar Haor (Data Source: Haque & Basak, 2017b).

These chronological land cover changes indicate a gradual reduction in permanent water bodies and natural vegetation alongside increasing human occupation and hydrological modification. The conversion of ecologically sensitive wetland areas into settlement and resource-use zones has contributed to habitat fragmentation, biodiversity decline, and reduced ecological resilience. Most of the degraded deep-water bodies have gradually transformed into ephemeral shallow water zones, encouraging nearby communities to expand agricultural activities along the wetland edges and newly exposed land areas. (Haque & Basak, 2017b) Such transformations highlight the urgent need for sustainable landscape planning and adaptive wetland management strategies to mitigate environmental degradation and maintain the ecological integrity of the haor system.

2.5 Nature-Based Solutions and Landscape Resilience

Nature-based Solutions (NbS) are approaches that utilize natural systems and ecological processes to address issues such as flooding, biodiversity loss, and environmental degradation. (Anderson & Gough, 2022) They are often considered more economical alternatives to conventional engineered infrastructure while also offering multiple ecological and social benefits. NbS have been increasingly applied across different landscapes, including vegetated systems such as green roofs, vertical greening, and bio-integrated surfaces, which demonstrate their ability to reduce heat stress and carbon emissions while improving overall environmental performance in compact and high-density environments. For example, oyster reef restoration in coastal wetlands, such as the Chesapeake Bay, demonstrates how NbS can function in practice. Reefs act as natural water filters and protective buffers, enhancing biodiversity, improving water clarity, and reducing shoreline erosion. (Pfirrmann & Seitz, 2019) Unlike conventional grey infrastructure, which primarily focuses on controlling water through embankments, concrete revetments, and engineered drainage structures, NbS work with natural processes to enhance ecosystem functions and landscape resilience. Common NbS approaches include wetland restoration, riparian buffer zones, reforestation, floodplain restoration, and vegetation-based

stabilization measures. (Santos, 2025) These interventions contribute to flood mitigation, water purification, biodiversity conservation, and climate adaptation while simultaneously supporting ecosystem services and human well-being.

Table 3: Comparison between NbS and grey infrastructure in the wetland landscape.

Aspect	**Nature-Based Solutions (NBS)**	**Grey Infrastructure**
Approach	Works with natural processes	Controls natural processes
Flood Management	Water storage and flow regulation	Rapid conveyance and control
Ecological Benefits	High	Limited
Adaptability	High	Relatively low
Long-term Sustainability	High	Maintenance intensive

Compared with conventional grey infrastructure, NbS are generally more adaptive to environmental change and provide a wider range of ecological co-benefits. Consequently, they have become an important component of contemporary landscape planning and resilience-based environmental management. (Mosisa et al., 2025)

2.6 Need for Integrated Landscape Planning Frameworks

Existing studies on Tanguar Haor primarily focus on its ecological significance, biodiversity conservation, hydrological behavior, and land cover transformation. Several researchers have examined the impacts of seasonal flooding, environmental degradation, and anthropogenic pressures on the wetland ecosystem. Other studies have highlighted the tourism potential of the haor region and the importance of conservation initiatives for maintaining ecological balance. However, limited attention has been given to integrating sustainable tourism development with ecological resilience through a comprehensive landscape-based approach. Despite the growing environmental and tourism pressures within the haor system, there remains a lack of integrated landscape strategies that address hydrological dynamics, ecological conservation, community participation, and tourism management simultaneously. Existing approaches are often sector-specific and fail to establish a balanced relationship between environmental protection and tourism development. Furthermore, the application of Nature-based Solutions (NbS) and adaptive landscape planning strategies in haor environments remains insufficiently explored.

Sustainable wetland and landscape planning should integrate ecological integrity, social inclusiveness, efficient resource use, and participatory governance to ensure long-term environmental and socio-ecological resilience. (Dizdaroglu, 2021) Therefore, there is an urgent requirement for integrated landscape strategies that address the seasonal and ecological processes of Tanguar Haor while promoting sustainable tourism and enhancing community resilience. Such an approach can reduce environmental degradation, reinforce wetland conservation, and establish a structured framework for responsible tourism development in this sensitive wetland ecosystem.

3. Research Methodology

This study adopted a qualitative landscape-based research approach to investigate the ecological resilience, seasonal dynamics, and tourism-related challenges of Tanguar Haor. The research integrated seasonal field investigations, stakeholder consultations, and comparative analyses to examine the interactions among hydrological processes, landscape transformation, biodiversity, community livelihoods, and tourism activities. A multi-seasonal field investigation was conducted to capture temporal variations within the wetland system. Primary data were collected during three distinct periods: immediately after the flash flood event in 2023, during the post-monsoon season in 2024, and during the winter season in 2025. This seasonal framework enabled the observation of changing environmental conditions, settlement patterns, ecological processes, livelihood practices, and tourism activities throughout the annual hydrological cycle.

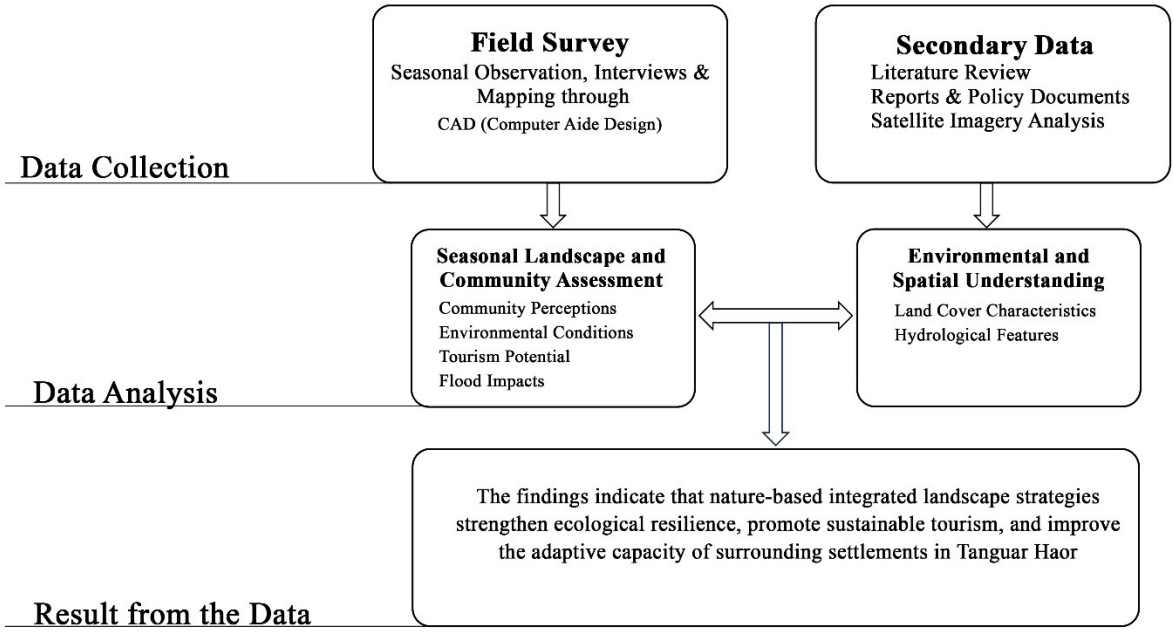

Figure 2. A conceptual model representing the overall methodological framework.

Following the literature review, primary and secondary data were collected and analysed to understand the socio-ecological conditions of Tanguar Haor. The findings were subsequently compared with relevant wetland conservation and landscape planning approaches to identify suitable strategies for sustainable tourism development, community adaptation, and ecological restoration.

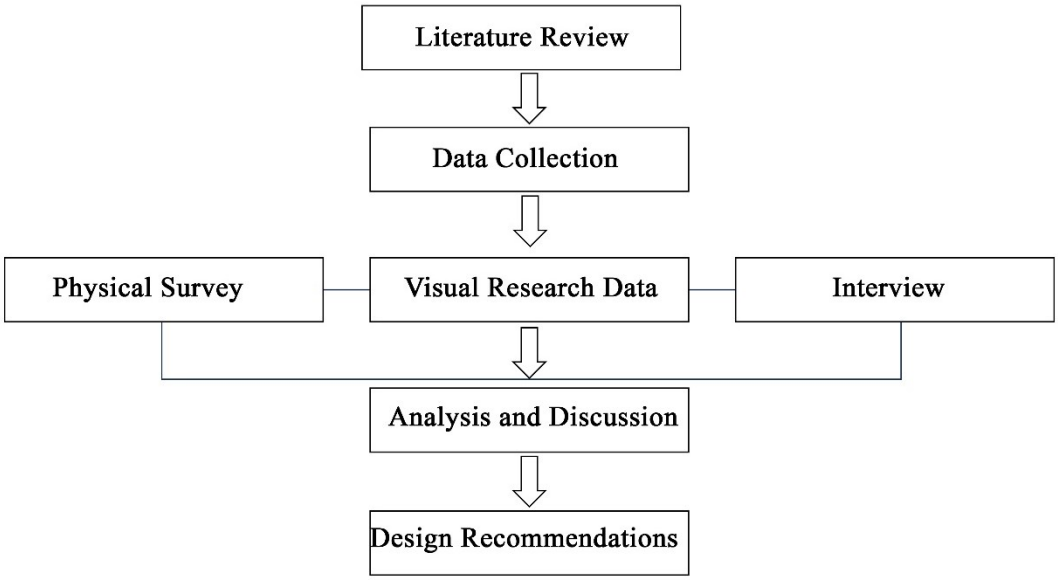

Figure 3. Research Methodology Flowchart.

3.1 Study Area

The study was conducted in Tanguar Haor, a Ramsar-listed wetland located in Tahirpur and Dharmapasha Upazilas of Sunamganj District, Bangladesh. The wetland is characterized by extensive seasonal flooding, permanent and seasonal water bodies, settlement mounds, swamp vegetation, and diverse aquatic habitats. The area supports rich biodiversity while sustaining the livelihoods of numerous wetland-dependent communities. The geomorphological formation of the haor is strongly influenced by the Shillong Plateau in Assam, India, located to the north. (Hussain & Hasibul, 2017)

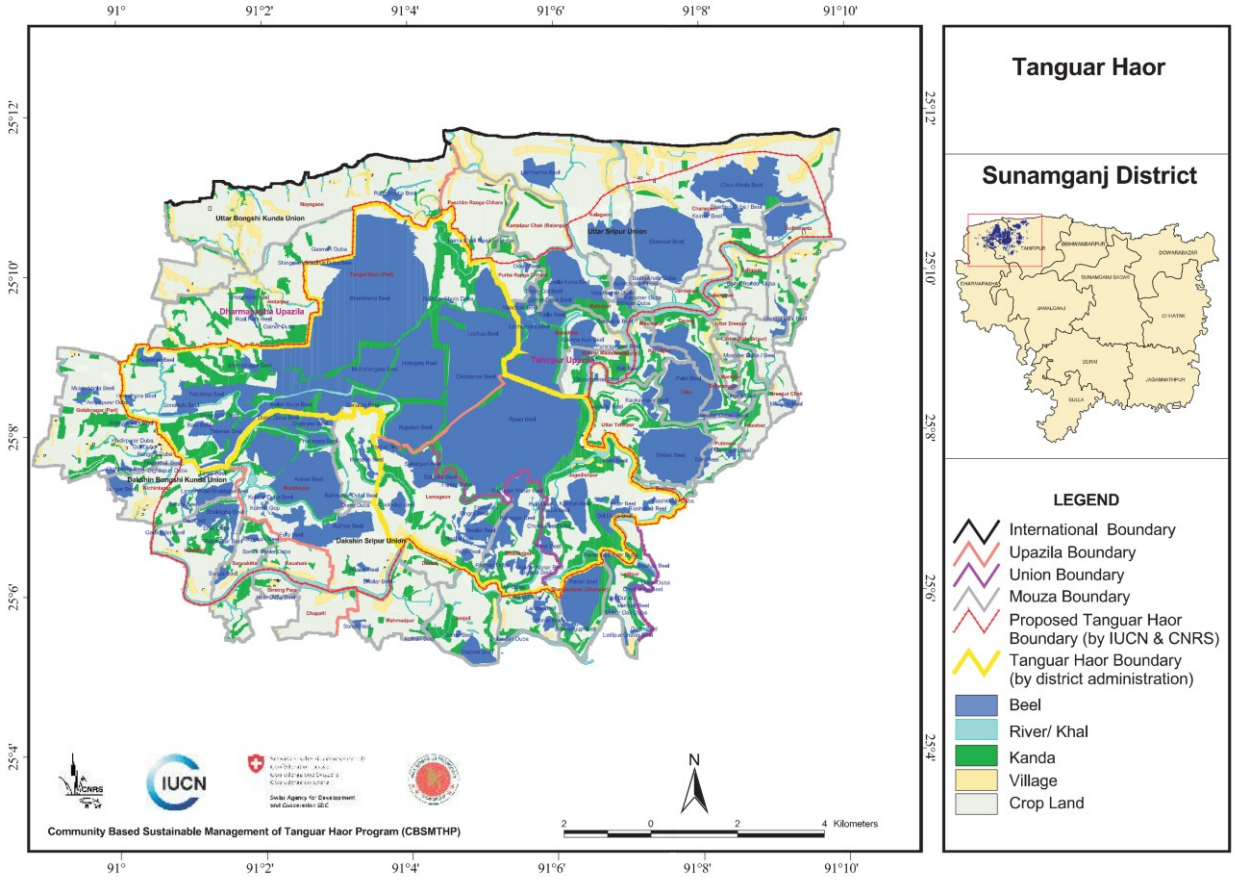

Figure 4. The map shows the Geographic Position of Tanguar Haor (Source: IUCN).

Due to its proximity to the Meghalaya Hills of India, the haor receives substantial monsoonal runoff and frequently experiences flash floods, which significantly influence its hydrology, ecology, settlement patterns, and land use. The ecological significance of the area, combined with increasing tourism pressure and environmental vulnerability, makes it a suitable case for investigating adaptive landscape planning strategies in dynamic wetland environments.

3.2 Primary Data Collection

Primary data were collected through seasonal field surveys, non-participant observation (NPO), photographic documentation, questionnaire surveys, semi-structured interviews, and informal group discussions. The field investigation focused on seasonal landscape transformation, settlement conditions, biodiversity, livelihood practices, tourism activities, and environmental challenges. Observations were conducted across settlement areas, wetland edges, agricultural lands, transportation routes, tourism zones, and ecologically sensitive habitats. Field notes and photographs were used to document environmental conditions, seasonal variations, and landscape characteristics during different hydrological phases. Semi-structured interviews and informal discussions were conducted with local stakeholders to understand flood impacts, erosion processes, vegetation change, livelihood dependency, tourism development, and community adaptation strategies. Particular attention was given to local ecological knowledge regarding historical landscape conditions and long-term environmental changes.

Table 4: Stakeholder Information Summary.

Stakeholder Group	Information Collected
Local Residents	Settlement conditions, flood impacts, adaptation practices, and community needs
Fishermen	Fisheries dependency, seasonal livelihood patterns, and ecological change
Farmers	Agricultural activities, seasonal land use, and flood-related challenges
Boat Operators	Transportation systems and tourism-related activities
Teachers and Elderly Residents	Historical landscape conditions and ecological knowledge
Local Government Representatives	Governance challenges, conservation issues, development priorities
Technical Personnel	Infrastructure conditions and environmental concerns

3.3 Questionnaire Survey

A questionnaire survey was conducted to identify community perceptions regarding environmental change, ecological degradation, flood vulnerability, tourism development, and livelihood dependency. The survey emphasized qualitative responses and experiential knowledge rather than statistical analysis. Responses were synthesized and grouped into thematic categories to identify major socio-ecological concerns and community priorities.

3.4 Tourism Observation

Tourism-related conditions were documented during seasonal field visits to understand visitor–landscape interactions within Tanguar Haor. The observation focused on visitor activities, accessibility, transportation modes, tourism infrastructure, and seasonal variations in tourism use of the landscape.

Tourism observations were conducted across the post-flood (2023), post-monsoon (2024), and winter (2025) periods to capture seasonal differences in landscape accessibility and visitor presence. Data were recorded through direct observation, photographic documentation, field notes, and informal discussions with local stakeholders, including boat operators and tourism service providers. The collected information was used to understand how seasonal landscape dynamics influence tourism activity patterns in the wetland system.

3.5 Data Analysis

Collected data were analyzed through thematic interpretation and comparative seasonal assessment. Field observations, interviews, questionnaire responses, and secondary sources were cross-examined to identify key environmental challenges, ecological vulnerabilities, and socio-economic patterns. The analysis focused on relationships among hydrological processes, landscape transformation, biodiversity dynamics, livelihood systems, and tourism activities. The synthesized findings were used to develop an integrated landscape planning framework for enhancing ecological resilience in Tanguar Haor.

4. Results of the Study Area

4.1 Seasonal Hydrological and Landscape Transformation

Tanguar Haor exhibits a highly dynamic seasonal system governed by monsoonal rainfall, upstream inflow from the Meghalaya hills, and local topography. Field observations indicate a distinct transformation of the landscape across three seasonal phases: monsoon, post-monsoon, and winter. During the monsoon season, the entire haor basin becomes inundated, forming a continuous water body, with only elevated settlement mounds remaining above water. Most agricultural land and transportation routes become submerged, and mobility is restricted to boat-based movement.

In the post-monsoon season, water gradually recedes, exposing fertile land and wetland edges enriched with silt deposits. This transitional phase supports fishing activities and creates opportunities for seasonal agriculture in shallow and newly emerged areas, marking an important period of ecological recovery and livelihood adaptation. During the dry or winter season, the landscape transforms into a mosaic of shallow water bodies, exposed land, and cultivated fields. Approximately 5,089 hectares (around 44%) of the area remains under permanent water, forming beels that sustain aquatic

biodiversity throughout the year. This season supports extensive Boro rice cultivation and becomes a key period for settlement activities on elevated lands, which also serve as grazing grounds and ecological buffers.

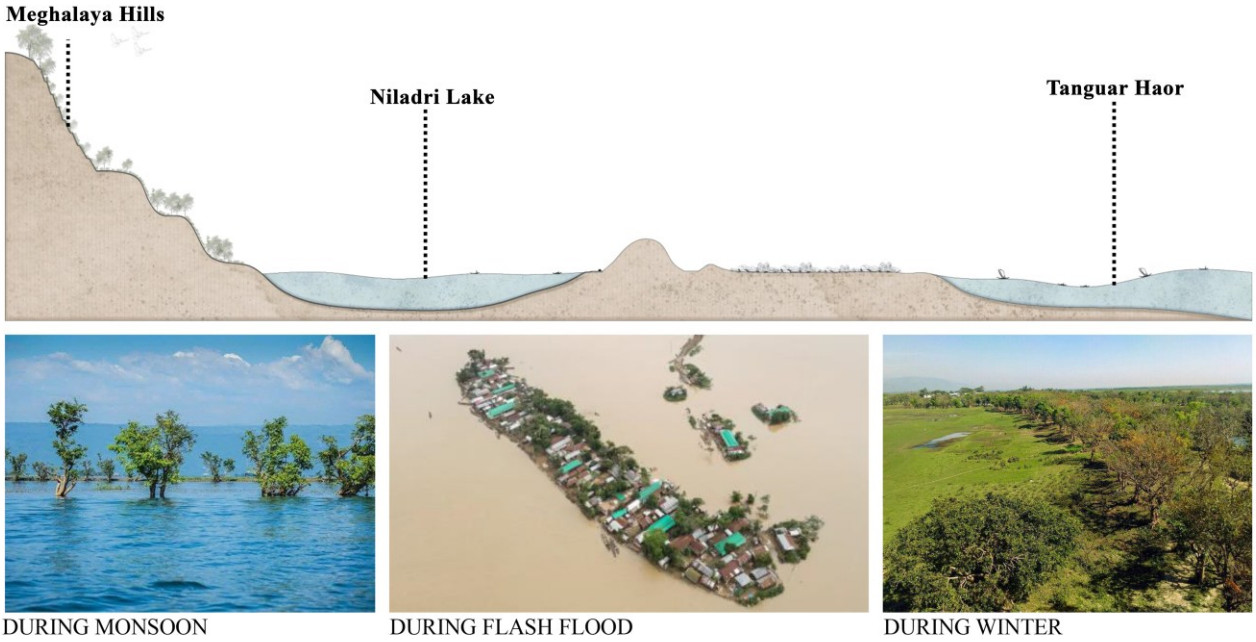

Figure 5. Seasonal Changes of Tanguar Haor.

Kandas are observed as elevated landforms within the wetland system. These areas remain partially dry during the dry season and are used for limited agriculture, livestock grazing, and temporary settlement activities. During the monsoon season, kandas are fully or partially submerged due to increased water levels.

4.2 Settlement Pattern and Landform Dynamics

Field observations reveal that the settlement pattern in Tanguar Haor is strongly dependent on naturally elevated settlement mounds, which function as the primary habitation zones within the flood-prone wetland system. Repeated seasonal flooding has significantly affected settlement stability. During the 2023 flash flood event, monsoon inundation combined with wave action and strong water currents led to severe soil erosion along settlement edges, resulting in land loss and structural damage. Lightweight housing structures, particularly those constructed with tin sheets and earthen materials, were severely damaged during the 2023 flash flood, while more permanent brick and concrete structures demonstrated higher resilience and remained largely intact. Post-flood field observations recorded highly deteriorated settlement edges in several locations, where erosion, damaged housing units, and disrupted land continuity were evident, indicating the vulnerability of settlements exposed to hydrological forces.

Figure 6. Post-flood situation of Tanguar Haor.

Additionally, a noticeable decline in protective vegetation was observed along settlement boundaries. Informal discussions with elderly residents revealed that these areas previously contained dense coverage of vetiver grass and locally known chailla bon, which played an important role in stabilizing soil and reducing erosion caused by wave action. However, these vegetation types have significantly declined over time, contributing to increased exposure of settlement edges to erosion and flood impact.

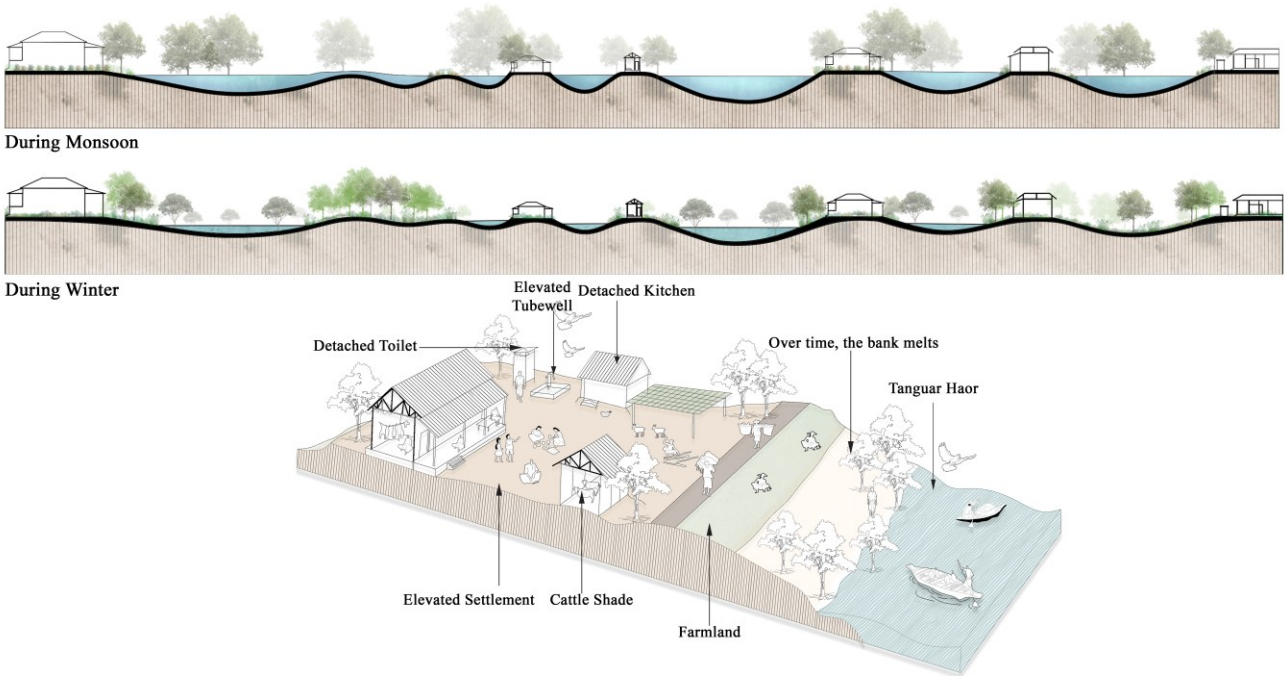

Figure 7. Settlement Pattern and Seasonal Use in Tanguar Haor.

4.3 Biodiversity Condition and Livelihood Dependence

Tanguar Haor supports diverse aquatic and wetland habitats that vary seasonally with changing water levels. Field observations recorded permanent and seasonal water bodies, reed beds, swamp vegetation, and habitats utilized by migratory birds and native fish species. Seasonal flooding and water recession create varying habitat conditions across the wetland throughout the year. The wetland contains diverse freshwater plant species, including submerged, floating, sedge, and meadow vegetation. Submerged species dominate aquatic zones during monsoon periods and contribute to

natural nutrient cycling through seasonal decomposition. Free-floating vegetation is widely distributed across water surfaces, while sedge and meadow species such as dhol kalmi, kalmi, chailla, kachu, murta, and binna grass are observed in shallow and transitional zones.

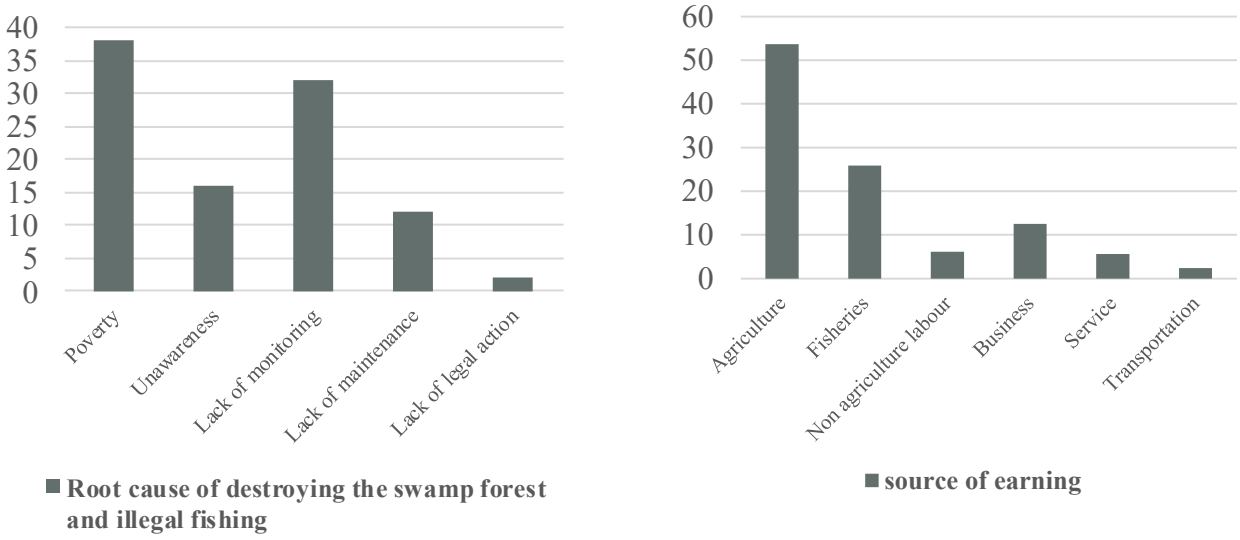

Figure 8. Community Livelihood in Tanguar Haor.

Fishing was identified as the primary livelihood practice, while seasonal agriculture, boat transportation, livestock grazing, and wetland resource collection also contribute to household income and daily subsistence. These activities were observed across different seasons and were reported consistently during interviews and questionnaire surveys. Questionnaire responses and stakeholder interviews indicated that wetland resources remain central to local livelihoods. Respondents identified fishing and agriculture as the principal economic activities, while boat transportation serves as an important means of movement and income generation within the haor. Field observations also recorded the use of wetland vegetation and other natural resources for household and livelihood purposes. Respondents identified several factors contributing to the reduction of swamp forest and wetland vegetation.

4.4 Tourism Patterns

Tourism in Tanguar Haor shows strong seasonal variation influenced by landscape accessibility and ecological conditions. Field observations indicate increased tourism activity during periods of lower water levels when larger areas of the wetland become accessible. Winter was identified as the peak tourism season, with the highest visitor concentration recorded during field visits. This period is characterized by exposed wetland landscapes, improved accessibility, and the presence of migratory bird species. Tourism activities observed include boating, bird watching, photography, and landscape viewing.

Table 5: Seasonal Tourism Characteristics in Tanguar Haor.

Season	**Tourism Intensity**	**Observed Characteristics**
Post-flood (2023)	Low	Submerged landscape and limited accessibility
Post-monsoon (2024)	Moderate	Gradual exposure of land and increasing visitor movement
Winter (2025)	High	Exposed wetland landscape, boating, and bird watching

Houseboat-based tourism was observed as a major component of visitor activity within the wetland. Houseboats were used for transportation, sightseeing, and overnight accommodation during peak tourism periods. Concentrated houseboat movement was recorded in accessible wetland zones. During field visits, solid waste accumulation was observed near houseboat anchoring areas in certain locations. Boat movement was also recorded in shallow water and ecologically sensitive wetland zones. Tourism-related infrastructure, including visitor facilities, sanitation systems, and organized transport services, was observed to be limited in several tourism zones. Informal tourism-related activities, including boating services and guiding, were also recorded as part of local livelihood practices.

4.5 Community Perception and Questionnaire Analysis

Questionnaire findings indicate that community responses regarding flooding, erosion, vegetation change, and livelihood dependency are closely associated with seasonal landscape conditions and spatial characteristics of the haor system. The survey included fifty respondents selected from different settlement areas within the haor region. The responses reflect community experiences of seasonal flooding, land conditions, vegetation change, livelihood dependency, tourism activity, and perceived ecological changes within Tanguar Haor.

Table 6: Major Themes Identified from Questionnaire Survey.

Theme	Key Observations
Flood Vulnerability	Increasing impacts of flash floods and seasonal inundation
Settlement Erosion	Gradual loss of settlement edges and land stability
Vegetation Change	Decline of native wetland vegetation, including vetiver grass, hijol, and koroch
Livelihood Dependency	Strong reliance on fishing, agriculture, and wetland resources
Tourism Development	Increasing visitor numbers and tourism-related activities
Ecological Concerns	Biodiversity decline and habitat degradation
Adaptation Needs	Demand for improved resilience and settlement protection measures

The responses demonstrate a close interdependence between human activities and landscape processes within Tanguar Haor. Community awareness of environmental change is strongly linked to lived experiences of seasonal transformation, highlighting the importance of understanding landscape processes in interpreting socio-ecological conditions.

5. Discussion and Recommendations of the Study Area

The findings of this study reveal that the functioning of Tanguar Haor should be understood as an interdependent socio-ecological system where seasonal hydrological dynamics shape not only the physical landscape but also livelihood structures, settlement behavior, and ecological stability. Rather than being isolated environmental events, seasonal changes act as the primary governing mechanism that continuously reorganizes human–nature interactions in the haor system. The study further suggests that community experiences of environmental stress are closely linked to their direct dependence on seasonal landscape conditions. This indicates that local adaptive practices are largely reactive and short-term in nature, highlighting a gap between lived experience and long-term resilience planning. Such a condition reflects the need for integrated landscape-based approaches that align ecological processes with human use systems.

Tourism development, particularly houseboat-based activities, represents an emerging pressure within this fragile system. The observed seasonal concentration of tourism activity indicates that economic opportunities are increasing, but without adequate spatial planning or environmental regulation. This creates an imbalance where short-term economic benefits may lead to long-term ecological degradation if unmanaged. Therefore, tourism in the haor system requires structured regulation based on ecological sensitivity and seasonal carrying capacity. The overall findings emphasize the necessity of shifting toward nature-based and landscape-responsive planning approaches that can integrate ecological restoration with socio-economic sustainability.

5.1 Environmental and Landscape Recommendations

To enhance ecological resilience in Tanguar Haor, this study recommends a transition from conventional, rigid flood protection measures toward nature-based and adaptive landscape strategies. Field observations indicate that existing local interventions, such as temporary flood walls and simple fencing systems, provide limited protection against prolonged inundation and strong wave action. This highlights the need for a more integrated ecological approach that works with seasonal hydrological dynamics rather than resisting them. The proposed strategy focuses on strengthening native vegetation systems as the primary ecological infrastructure of the wetland. Priority should be given to flood-tolerant and locally adapted species such as hijol, koroi, palm, vetiver grass, reeds, and swamp shrubs. These species should be strategically introduced based on elevation, flood depth, and water retention characteristics to ensure long-term landscape stability.

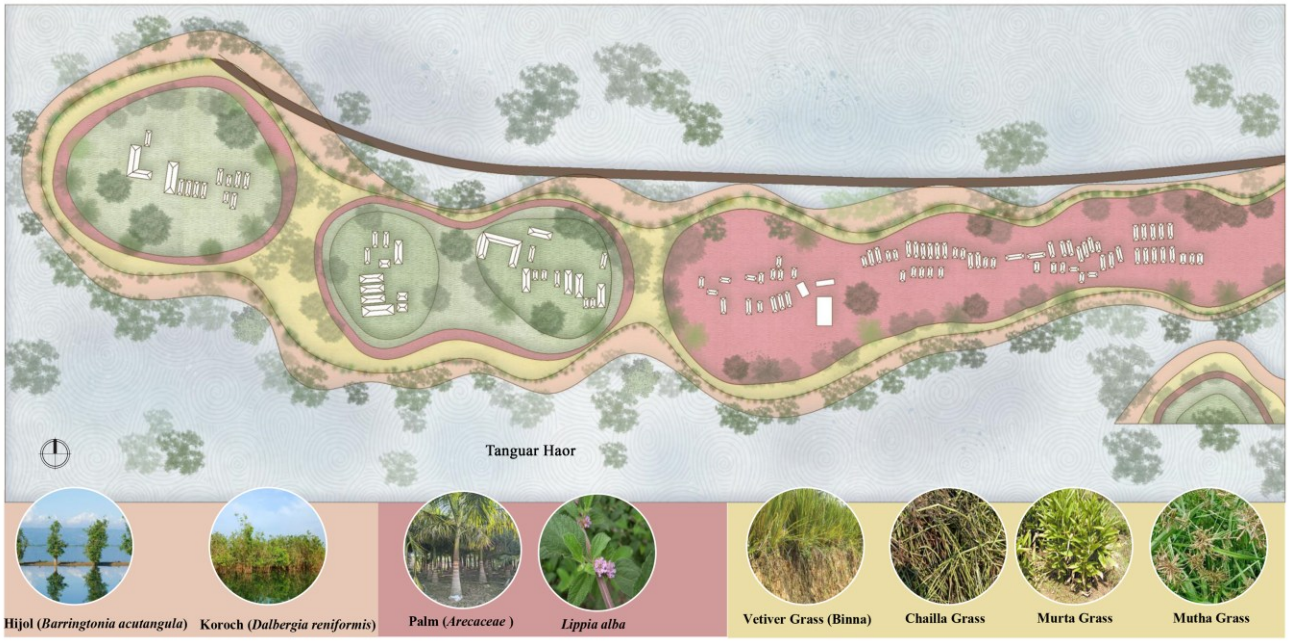

Figure 9. Proposal of an Integrated Layer-Based Landscape Framework for Tanguar Haor.

A key component of this recommendation is the development of an elevation-based ecological zoning system. High-elevation areas, such as settlement mounds, should be supported with resilient canopy vegetation to stabilize soil and reduce erosion risk. Mid-level transitional zones should integrate mixed shrub and grass species to moderate flow energy and enhance ecological connectivity. Low-lying and frequently inundated areas should be restored as continuous wetland forests dominated by hijol-based vegetation systems, while permanent water zones should support aquatic and floating plant species. Reed belts are recommended along water edges as soft ecological infrastructure. These vegetated buffer zones can reduce wave intensity, trap sediment, and minimize shoreline erosion, thereby replacing hard engineering solutions with living ecological systems. In addition, terraced landscape edges and small vegetated mounds formed through locally available soil can function as protective buffers during flooding while also supporting terrestrial vegetation and biodiversity. Overall, the ecological framework should prioritize continuous vegetation cover, alignment with natural water flow patterns, and avoidance of dense planting in active water channels. This ensures that the landscape remains adaptive to seasonal fluctuations while maintaining ecological balance and reducing erosion pressure.

5.2 Role of Native Vegetation in Ecological Resilience

A key component of ecological resilience in Tanguar Haor is the role of native vegetation systems such as vetiver grass (binna) and chailla bon in stabilizing and enriching the wetland environment. These vegetation types contribute significantly to erosion control, habitat formation, and ecological

balance within the dynamic haor landscape. Vetiver grass plays an important role in stabilizing soil along settlement edges and wetland boundaries. Its deep and dense root system strengthens the soil structure, helping reduce erosion and land collapse during seasonal flooding and prolonged inundation. (Pandey et al., 2025) These vegetated zones function as transitional buffers between land and water, supporting micro-habitats for various species while also reducing the direct impact of flowing water on exposed soil surfaces. (Duan et al., 2021)

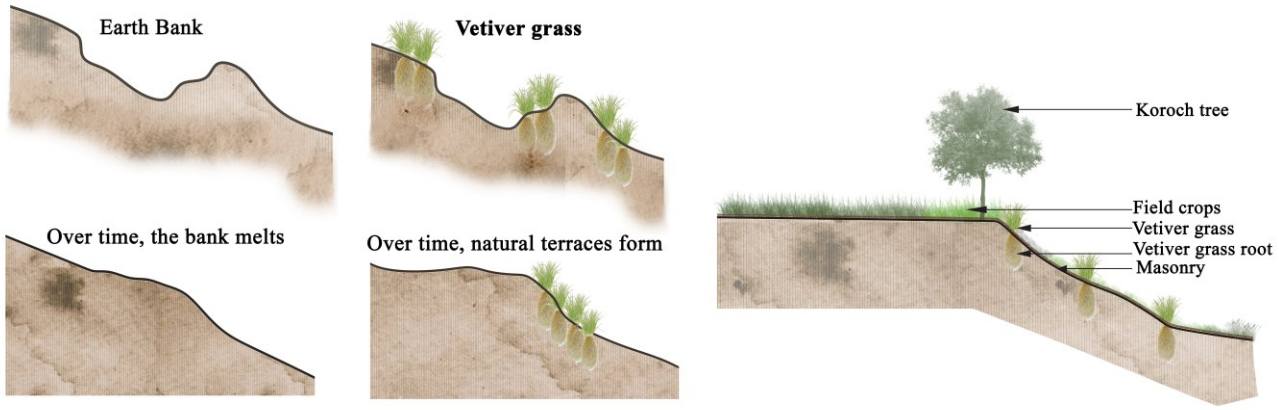

Figure 10. Vetiver Grass in Slope Protection and Wetland Resilience.

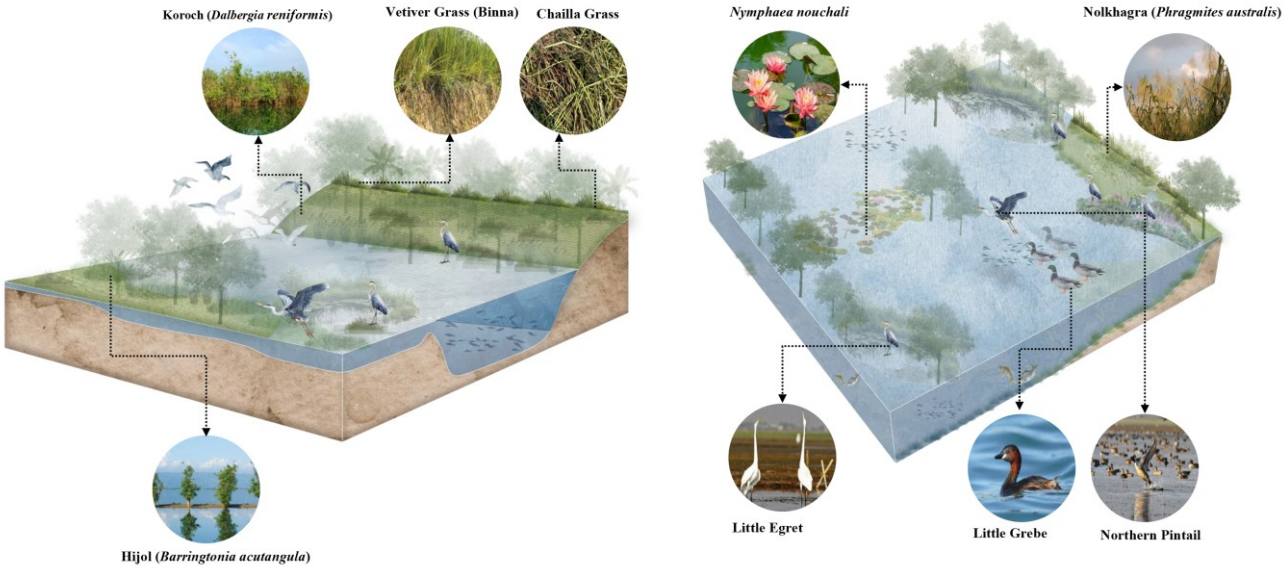

Figure 11. Ecological Relationship Between Vegetation, Fish, and Migratory Birds.

Beyond physical stabilization, native vegetation systems significantly contribute to biodiversity support. These habitats provide nesting, feeding, and sheltering grounds for wetland bird species such as egrets, herons, kingfishers, cormorants, and seasonal migratory ducks. In addition, vegetation-rich shallow water zones create favorable ecological conditions for native fish species including pabda, koi, shol, boal, tengra, and magur, which are vital for maintaining aquatic ecosystem balance and supporting local fisheries-based livelihoods.

5.3 Socio-Ecological and Community-Based Recommendations

The findings of this study indicate that ecological resilience in Tanguar Haor is closely linked to local livelihood systems. Community-based adaptation practices already exist in the form of informal flood protection measures, resource-sharing systems, and seasonal livelihood adjustments. However, these practices remain fragmented and largely reactive, limiting their long-term effectiveness in addressing increasing environmental pressures. This suggests the need to strengthen organized community

participation in ecological management and landscape planning processes. In this context, locally available resources such as murta grass hold dual significance, functioning both as ecological stabilizers and as livelihood-supporting materials for traditional handicrafts and small-scale economic activities. Strengthening the sustainable use of these resources can enhance livelihood diversification while simultaneously supporting ecosystem conservation.

The study therefore recommends the development of participatory landscape management approaches, where local communities are actively involved in vegetation restoration, monitoring, and seasonal land-use planning. Such engagement can improve environmental awareness and foster a stronger connection between ecological health and livelihood security. Overall, socio-ecological integration is essential for ensuring that conservation and adaptation strategies are not externally imposed but instead emerge through continuous interaction between local knowledge systems and ecological processes. This approach enhances both community resilience and the long-term sustainability of the wetland ecosystem. (Pienaah et al., 2025)

5.4 Tourism Management Recommendations

Tourism in Tanguar Haor should be managed through a controlled and ecologically sensitive planning approach, as field observations indicate increasing pressure on wetland ecosystems due to unregulated houseboat-based tourism. The concentration of houseboats in accessible zones, combined with inadequate sanitation and waste management, has resulted in localized water pollution, habitat disturbance, and pressure on sensitive aquatic areas. Therefore, it is recommended that the number of operational houseboats be gradually reduced and regulated according to seasonal carrying capacity to minimize ecological stress on the wetland system. In addition, the absence of structured accommodation and organized food facilities has contributed to the uncontrolled expansion of temporary houseboat-based services. To address this, designated land-based or semi-structured eco-friendly accommodation and food service facilities should be developed in suitable buffer zones outside ecologically sensitive wetland areas. This would help reduce dependency on water-based living arrangements while concentrating tourism infrastructure in planned locations. Such a strategy would allow tourism activities to continue in a controlled manner while reducing ecological disturbance, improving waste management efficiency, and maintaining the ecological integrity of Tanguar Haor.

5.5 Implementation Strategy

The proposed landscape framework should be implemented through a phased restoration approach that responds to the ecological sensitivity and seasonal dynamics of Tanguar Haor. Based on the findings of this study, priority intervention areas include erosion-prone settlement edges, degraded wetland zones, and environmentally sensitive tourism areas. These locations have experienced vegetation loss, ecological disturbance, and increasing environmental pressure.

The first phase focuses on the stabilization of vulnerable areas through the restoration of native vegetation, particularly vetiver grass, reeds, hijol, and other flood-tolerant wetland species. This phase aims to reduce erosion, improve sediment retention, and re-establish ecological buffers along settlement boundaries and wetland edges. The second phase involves the development of the proposed layered vegetation framework, including canopy, shrub, ground, and aquatic layers distributed according to elevation and seasonal inundation patterns. During this stage, reed belts, hijol-based wetland forests, and vegetated transition zones are established to strengthen ecological connectivity and habitat quality. The final phase focuses on long-term monitoring, adaptive management, and the integration of sustainable tourism infrastructure, including designated docking areas, controlled visitor zones, and environmentally sensitive service facilities.

Implementation activities should be aligned with seasonal hydrological conditions. Post-monsoon and winter periods are considered the most suitable phases for vegetation establishment, maintenance activities, and landscape restoration due to improved accessibility and reduced flood intensity. (Bruijnzeel et al., 2025) Through this phased approach, ecological restoration can gradually expand while minimizing disturbance to existing livelihood activities and wetland functions.

5.6 Feasibility, Maintenance, and Policy Linkage

The proposed framework is considered feasible because it relies primarily on nature-based solutions and native vegetation species that are already adapted to the environmental conditions of Tanguar Haor. The use of locally available species reduces implementation costs while improving ecological compatibility and long-term survival rates. Unlike heavily engineered interventions, the proposed approach works with natural hydrological processes, making it more adaptable to seasonal fluctuations and climate-related uncertainties. Long-term maintenance should be supported through community-based stewardship and seasonal ecological monitoring. Local residents can participate in vegetation management, replanting activities, and monitoring of erosion-prone areas, particularly during the post-monsoon recovery period. Such participation strengthens local ownership of restoration initiatives, improves environmental awareness, and supports livelihood opportunities associated with wetland resources. (Damastuti et al., 2023)

In terms of policy linkage, the proposed framework aligns with ecosystem-based adaptation (EbA) strategies, Ramsar wetland conservation principles, and national climate resilience and biodiversity policies relevant to Bangladesh. It also supports the objectives of sustainable tourism development and wetland protection frameworks by promoting regulated land use, ecological restoration, and community participation. Integration of the framework into local government planning, wetland management authorities, and tourism regulation policies can enhance coordination between ecological conservation and socio-economic development goals.

6. Conclusion

This study identifies Tanguar Haor as a complex and evolving socio-ecological landscape where environmental processes and human systems are tightly interlinked. The findings emphasize that long-term landscape behaviour in the haor is primarily governed by seasonal hydrological shifts, which continuously reshape ecological conditions, settlement vulnerability, and livelihood structures. The study highlights that ongoing environmental stress is expressed through the weakening of natural protective systems, particularly the decline of native vegetation buffers and increasing pressure on settlement edges. At the same time, socio-economic dependence on wetland resources intensifies exposure to environmental risk, indicating that resilience in the system is both ecological and social in nature. Tourism development has introduced additional spatial pressure within the wetland, particularly through concentrated houseboat activity and associated service infrastructure. The absence of structured spatial control and ecological thresholds suggests an emerging imbalance between economic opportunity and environmental capacity, requiring more regulated and sensitive management approaches.

In response, the study advances a landscape-based approach that prioritizes nature-based adaptation, ecological restoration, and the reinforcement of native vegetation systems as functional landscape infrastructure. This approach positions the wetland itself as a dynamic regulating system rather than a passive setting, supporting both ecological stability and community continuity. The study is limited by its qualitative and field-based analytical framework, which does not include long-term hydrological modelling, GIS-based spatial quantification, or formal tourism carrying-capacity estimation. Future research should integrate these methods to strengthen spatial accuracy, environmental prediction, and planning reliability. Ultimately, the study contributes to a broader understanding of Tanguar Haor as a dynamic adaptive landscape where ecological processes and human systems must be planned in integration, supporting a transition toward more resilient, context-sensitive, and nature-based landscape governance.

Acknowledgements

The author sincerely acknowledges the cooperation of the local communities of Tanguar Haor during fieldwork.

Funding
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of Interest
The author declares that there is no conflict of interest.

Data Availability Statement
The authors confirm that all data supporting this research are included in the article [and/or] its supplementary materials.

Institutional Review Board Statement
No clinical experiments, animal testing, or sensitive personal data collection were conducted. Therefore, formal Institutional Review Board (IRB) approval was not required for this research.

CRediT Author Statement
Upama Talukder: Conceptualization, Methodology, Investigation, Field Survey, Data Curation, Formal Analysis, Visualization, Writing- Original Draft Preparation, Writing- Review & Editing. All authors have read and approved the final manuscript.

References

Abdenour, A., Sinan, M., & Lekhlif, B. (2025). Toward Sustainable Wetland Management: A Literature review of Global Wetland vulnerability Assessment techniques in the context of rising Pressures. *Sustainability, 17(17)*, 7962. https://doi.org/10.3390/su17177962

Adarkwah, F., Awuni, S., Hajek, M., Kübler, D., Mattah, M., Gordon, C., & Owusu, E. H. (2024). Modelling the drivers of land use and land cover change of the great Amanzule wetland ecosystem to inform the development policy of the southwestern oil-rich region of Ghana. *Heliyon, 10(17)*, e36635. https://doi.org/10.1016/j.heliyon.2024.e36635

Anderson, V., & Gough, W. A. (2022). A Typology of Nature-Based Solutions for Sustainable Development: An analysis of form, function, nomenclature, and associated applications. *Land, 11(7)*, 1072. https://doi.org/10.3390/land11071072

Bokhtiar, S. M., Islam, M. J., Samsuzzaman, S., Jahiruddin, M., Panaullah, G. M., Salam, M. A., & Hossain, M. A. (2024). Constraints and opportunities of agricultural development in Haor ecosystem of Bangladesh. *Ecologies, 5(2)*, 256–278. https://doi.org/10.3390/ecologies5020017

Bruijnzeel, L. A., Peña-Arancibia, J. L., Sheil, D., Ziegler, A. D., Zhang, J., Zwartendijk, B. W., Birkel, C., Sun, G., Wang, Y., & Zhang, X. (2025). Potential for improved groundwater recharge and dry-season flows through forest landscape restoration on degraded lands in the tropics. *Forest Ecosystems, 14*, 100376. https://doi.org/10.1016/j.fecs.2025.100376

Chakraborty, D., Mondal, K. P., Islam, S. T., & Roy, J. (2021). 2017 flash flood in Bangladesh: Lessons learnt. In *Elsevier eBooks* (pp. 591–610). https://doi.org/10.1016/b978-0-323-85195-4.00007-x

Damastuti, E., Van Wesenbeeck, B. K., Leemans, R., De Groot, R. S., & Silvius, M. J. (2023). Effectiveness of community-based mangrove management for coastal protection: A case study from Central Java, *Indonesia. Ocean & Coastal Management, 238*, 106498. https://doi.org/10.1016/j.ocecoaman.2023.106498

Dizdaroglu, D. (2021). Developing design criteria for sustainable urban parks. *Journal of Contemporary Urban Affairs, 6(1)*, 69–81. https://doi.org/10.25034/ijcua.2022.v6n1-7

Do, Y., Kim, S., Kim, J. Y., & Joo, G. (2015). Wetland-based tourism in South Korea: who, when, and why. *Wetlands Ecology and Management, 23(4)*, 779–787. https://doi.org/10.1007/s11273-015-9418-2

Duan, Y., Tang, J., Li, Z., Yang, B., Yan, Y., & Yang, Y. (2021). Vegetated buffer zone restoration planning in small urban watersheds. *Water, 13(21)*, 3000. https://doi.org/10.3390/w13213000

Durigan, G., Munhoz, C. B., Zakia, M. J. B., Oliveira, R. S., Pilon, N. A., Valle, R. S. T. D., Walter, B. M., Honda, E. A., & Pott, A. (2022). Cerrado wetlands: multiple ecosystems deserving legal protection as a unique and irreplaceable treasure. *Perspectives in Ecology and Conservation, 20(3)*, 185–196. https://doi.org/10.1016/j.pecon.2022.06.002

Haque, M. I., & Basak, R. (2017). Land cover change detection using GIS and remote sensing techniques: A spatio-temporal study on Tanguar Haor, Sunamganj, Bangladesh. *The Egyptian Journal of Remote Sensing and Space Science, 20(2)*, 251–263. https://doi.org/10.1016/j.ejrs.2016.12.003

Hussain, N., & Hasibul, I. M. (2017). The Impact of spatial changes of wetlands on Bio-Diversity: A Geo-Spatial Study on Tanguar Haor- Ramsar Site, Bangladesh. *Journal of Wetlands Environmental Management, 5(2)*, 34. https://doi.org/10.20527/jwem.v5i2.142

Kennedy, V., Greeson, P. E., Clark, J. R., & Clark, J. E. (1981). Wetland Functions and Values: the state of our understanding. *Estuaries, 4(4)*, 388. https://doi.org/10.2307/1352167

Kundu, S., Kundu, B., Rana, N. K., & Mahato, S. (2024). Wetland degradation and its impacts on livelihoods and sustainable development goals: An overview. *Sustainable Production and Consumption, 48*, 419–434. https://doi.org/10.1016/j.spc.2024.05.024

Mahgoub, Y. (2021). Sustainability of Tourism Development in the city of Ain-Sukhna, Egypt. *Journal of Contemporary Urban Affairs, 6(1)*, 13–22. https://doi.org/10.25034/ijcua.2022.v6n1-2

Meng, W., He, M., Hu, B., Mo, X., Li, H., Liu, B., & Wang, Z. (2017). Status of wetlands in China: A review of extent, degradation, issues and recommendations for improvement. *Ocean & Coastal Management*, 146, 50–59. https://doi.org/10.1016/j.ocecoaman.2017.06.003

Mitsch, W. J., Bernal, B., Nahlik, A. M., Mander, Ü., Zhang, L., Anderson, C. J., Jørgensen, S. E., & Brix, H. (2012). Wetlands, carbon, and climate change. *Landscape Ecology, 28(4), 583–597*. https://doi.org/10.1007/s10980-012-9758-8

Mosisa, G. B., Bedadi, B., Dalle, G., & Tassie, N. (2025). Nature-based solutions for urban climate resilience: implementation, contribution, and effectiveness. *Nature-Based Solutions, 8*, 100245. https://doi.org/10.1016/j.nbsj.2025.100245

Pandey, K., Kumar, S., Sekar, K. C., & Roy, C. (2025). Vetiver grass as a nature based solution for soil and water conservation in the Garhwal Himalaya. *Discover Sustainability, 6(1)*. https://doi.org/10.1007/s43621-025-02014-x

Pfirrmann, B., & Seitz, R. (2019). Ecosystem services of restored oyster reefs in a Chesapeake Bay tributary: abundance and foraging of estuarine fishes. *Marine Ecology Progress Series, 628*, 155–169. https://doi.org/10.3354/meps13097

Pienaah, C. K., Kansanga, M. M., Arku, G., & Luginaah, I. (2025). Community-led nature-based solutions for enhancing climate change preparedness and resilience in semi-arid environments. *World Development Sustainability, 7*, 100237. https://doi.org/10.1016/j.wds.2025.100237

Rumon, M. D. H., Islam, S., & Afroj, S. (2025). Identification of Land Cover Changes of the Tanguar Haor over the Last 40 Years Using Landsat Satellite Image in GIS. In Advances in engineering research/*Advances in Engineering Research* (pp. 408–416). https://doi.org/10.2991/978-94-6463-884-4_49

Salimi, M., Kafi, M., & Khansefid, M. (2025). Advancing Zero-Carbon Cities through Urban Green Infrastructure in Karaj, Iran. *Journal of Contemporary Urban Affairs, 9(2)*, 566–583. https://doi.org/10.25034/ijcua.2025.v9n2-12

Santos, E. (2025). Nature-Based solutions for water management in Europe: what works, what does not, and what's next? *Water, 17(15)*, 2193. https://doi.org/10.3390/w17152193

Satrya, I. D. G., Kaihatu, T. S., Budidharmanto, L. P., Karya, D. F., & Rusadi, N. W. P. (2023). The role of ecotourism in preserving environmental awareness, cultural and natural attractiveness for promoting local communities in Bali, Indonesia. *Journal of Eastern European and Central Asian Research (JEECAR), 10(7)*, 1063–1075. https://doi.org/10.15549/jeecar.v10i7.1386

Sultana, M. A., Pandit, D., Barman, S. K., Tikadar, K. K., Tasnim, N., Fagun, I. A., Hussain, M. A., & Kunda, M. (2022). A review of fish diversity, decline drivers, and management of the Tanguar Haor ecosystem: A globally recognized Ramsar site in Bangladesh. *Heliyon, 8(11)*, e11875. https://doi.org/10.1016/j.heliyon.2022.e11875

Weaver, D. B., & Lawton, L. J. (2007). Twenty years on: The state of contemporary ecotourism research. *Tourism Management, 28(5)*, 1168–1179. https://doi.org/10.1016/j.tourman.2007.03.004

Wood, K. A., Jupe, L. L., Aguiar, F. C., Collins, A. M., Davidson, S. J., Freeman, W., Kirkpatrick, L., Magalhães, T. L., McKinley, E., Nuno, A., Pagès, J. F., Petruzzella, A., Pritchard, D., Reeves, J. P., Thomaz, S. M., Thornton, S. A., Yamashita, H., & Newth, J. L. (2024). A global systematic review of the cultural ecosystem services provided by wetlands. *Ecosystem Services, 70*, 101673. https://doi.org/10.1016/j.ecoser.2024.101673

Yan, Y., Gan, X., Zhao, Y., Liao, Q., & Huang, C. (2024). Wetland Landscape Dynamics and Multi-Functional Assessment of Wuhan City, China. *Water, 16(20)*, 2914. https://doi.org/10.3390/w16202914

How to cite this article? (APA Style)
Talukder, U. (2026). Wetland landscape planning for socio-ecological resilience and sustainable tourism: Evidence from Tanguar Haor, Bangladesh. *Journal of Contemporary Urban Affairs*, 10(1), 217–236. https://doi.org/10.25034/ijcua.2026.v10n1-10