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Riverine Eco-Tourism and Sustainable Development in Assam, India: Transforming the Brahmaputra Corridor

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ABSTRACT

Riverside eco-tourism is increasingly positioned as a pathway for sustainable urban development in cities located along major river systems. Despite this growing interest, tourism planning on riverbanks often overlooks the complex interactions between cultural traditions, ecological processes, governance structures, and climate change. The results reveal that tourism models are largely influenced by religious and cultural activities, particularly pilgrimage-oriented travel, while recreational, leisure, and experience-based tourism opportunities remain underdeveloped. Environmental challenges such as seasonal floods, riverbank erosion, and water level fluctuations, as well as inadequate tourism infrastructure and fragmented institutional arrangements, significantly limit both tourism's performance and long-term resilience. The local community's perspective reflects a dual narrative: while tourism is seen as a source of livelihood and economic prospects, concerns persist about environmental degradation, unequal distribution of benefits, and limited community participation in decision-making. Based on these empirical insights, the study proposes a corridor-based riverside eco-tourism framework that places tourism within a broader cultural-ecological system rather than treating it as an isolated sector. The framework emphasizes the integration of cultural activity nodes, environmental buffer zones, river-based mobility networks, and holistic governance systems, while clearly recognizing the institutional and financial constraints that exist. Instead of encouraging the development of tourism separately, the proposed approach prioritizes adaptive, climate-responsive, and socially equitable planning at the river corridor scale. Based on conceptual developments in empirical evidence, the study

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offers river tourism scholarships and provides policy-relevant guidance for sustainable tourism planning in large, climate-sensitive river systems.

Keywords: Riverine Eco-Tourism; Sustainable Tourism Development; Brahmaputra River Corridor; Cultural and Pilgrimage Tourism; Community-Based Tourism; Riverfront Planning; Assam

1. Introduction

Rivers have historically served as cultural arteries, ecosystems and economic lifelines for human settlements. In recent decades, many riverside cities have increasingly promoted river-based tourism as a strategy for economic diversification, heritage preservation and urban revitalization. While such initiatives provide potential development benefits, they pose significant challenges in a context where rivers are ecologically dynamic, culturally intrinsic and institutionally fragmented.

In South Asia, large river systems such as the Brahmaputra are not only a physical spectacle, but also a place of deep symbolism and ritual. Tourism along these rivers is fuelled by pilgrimage, seasonal festivals, ferry-based mobility and daily livelihoods. At the same time, climate variations, monsoon floods, riverbank erosion, and rapid urbanization pose constant threats to infrastructure, governance, and community well-being. Traditional site-based tourism planning methods often fail to capture these interdependencies, resulting in fragmented development, environmental pressures and unequal social outcomes.

Guwahati, the largest urban centre on the banks of the Brahmaputra, exemplifies these challenges. The city hosts major pilgrimage sites, river transport services and an emerging leisure-oriented tourism industry. Despite its strategic location and cultural importance, the development of river tourism remains locally isolated, institutionally unintegrated and environmentally vulnerable.

This study addresses these gaps by conceptualizing river tourism as part of a cultural-ecological corridor rather than as a set of isolated attractions. The objectives of the study are:

(1) To examine the structure, governance and environmental condition of river tourism on the banks of the Brahmaputra River in Guwahati;
(2) To analyze perceptions of tourists and communities about the experience and impact of river-based tourism; and
(3) To develop an empirically grounded corridor-based framework for sustainable riverine eco-tourism.

By integrating empirical analysis with conceptual development, the study contributes to the emerging debate over corridor-based planning, cultural-ecological systems, and climate-resilient tourism in the context of large riversides.

2. Conceptual and Theoretical Framework

2.1. River Tourism within Cultural–Ecological Systems

The concept of cultural-ecological systems emphasizes the inseparable interplay between human practice, cultural meaning, and ecological processes[1–3]. Rivers exemplify such systems, as they simultaneously support biodiversity, shape settlement patterns, sustain livelihoods and establish religious and symbolic practices[4, 5]. In the context of tourism, this perspective shows that visitor experiences are co-produced by cultural traditions, environmental conditions and governance systems[1, 6].

Looking at river tourism from a cultural-ecological perspective goes beyond a purely economic or recreational interpretation. It advances the ritual calendar, mobility exercises, seasonal hydrology and community management as integral components of the tourism system[7–9]. This approach is particularly relevant in areas where rivers are sacred landscapes and where environmental variability directly affects access, safety, and infrastructure performance[10, 11].

Recent scholarships place an increasing emphasis on climate-resilient tourism planning in dynamic riverside environments. The Climate-Resilient Tourism Framework advocates the integration of adaptive infrastructure design, flexible governance systems, and risk-sensitive land-use planning

to address hydrological variability and extreme events [12, 13]. In the context of rivers, nature-based solutions (NbS) such as riparian buffers, wetland reclamation, and floodplain renaturalization have been recognized as effective strategies for enhancing ecological resilience and sustaining tourism activities at the same time [14]. These approaches shift tourism planning from rigorous infrastructure expansion to adaptive, ecosystem-based management.

2.2. River Tourism as a Cultural–Ecological Corridor

Based on the concept of cultural-ecological systems, this study conceptualizes river tourism as a cultural-ecological corridor. Corridors are defined not only as a linear spatial unit, but as a continuous system of nodes (places, activities, communities) and connections (water, people, culture, and the flow of governance). In the context of rivers, corridors combine up-and-down dynamics, seasonal variations, and multi-scalar interactions.

The concept of river tourism as a corridor emphasizes connectivity rather than fragmentation. Cultural spaces, ferry routes, ecological buffers, and urban waterways are defined as interdependent elements within a shared system. This framing allows tourism to analyse river dynamics, climate variability, and institutional coordination, rather than isolated development projects.

2.3. Corridor Theory and Riverine Eco-Tourism Planning

Corridor theory has been widely applied in landscape ecology, transportation planning, and urban development to improve connectivity, resilience, and integrated management. Its application to riverside ecotourism is limited, especially in culturally complex and climate-sensitive contexts.

In tourism planning, corridor-based approaches offer a number of advantages: they support diverse visitor movements, enable adaptive responses to environmental change, and facilitate cross-sectoral governance. By incorporating tourism within the planning of the corridor, it becomes possible to align cultural preservation, environmental protection, mobility and the integration of livelihoods within a single analytical framework. This theoretical basis informs the empirical analysis and corridor-based framework proposed after the paper.

3. Literature Review

3.1. River Tourism as a Spatial and Cultural System

The river tourism profession recognizes rivers not only as environments for leisure activities, but also as integrated spatial systems shaped by hydrological dynamics, governance, accessibility and socio-cultural meanings [9]. Arlt and Feng [15] conceptualize river tourism as an interface between river management, tourism infrastructure and stakeholder coordination, and emphasize that sustainability depends on aligning navigation, conservation and tourism objectives rather than treating them as separate domains.

Studies of the revitalization of urban riverbanks in cities such as Singapore, Seoul and Copenhagen show that the success of tourism is closely linked to long-term planning, environmental restoration and public accessibility [16]. However, much of this literature is founded on relatively stable hydrology and institutional contexts. As a result, existing models often ignore the challenges faced by large, climate-dynamic rivers, where seasonal fluctuations, erosion, and flooding fundamentally shape the tourism potential. This gap highlights the need for spatial frameworks responsible for environmental uncertainty and governance complexities in river tourism planning.

3.2. Eco-Tourism and Sustainability Principles

The eco-tourism literature consistently emphasizes conservation, community participation, education, and low-impact development as core principles. In the context of rivers, these policies require special sensitivity to aquatic ecosystems, floodplain dynamics and seasonal hydrology. Poorly planned riverside tourism infrastructure increases pollution, disrupts wildlife habitat, and accelerates riverbank erosion, thereby weakening the ecological resources on which tourism depends [17, 18].

Community participation is widely recognized as an important determinant of the success of eco-tourism [6, 19]. Indigenous and river-dependent communities often have extensive environmental knowledge and cultural practices that are essential to sustainable management. However, the study

also notes that participation is often symbolic rather than significant, with benefits unevenly distributed and informal occupations marginalized. These limitations point to the need for governance frameworks that move beyond project-level participation towards integrated, corridor-scale benefit-sharing and decision-making systems.

3.3. Rivers, Culture, and Pilgrimage Tourism in India

In India, rivers serve as sacred and symbolic entities, deeply embedded in religious practices, ritual calendars, and cultural identities. Pilgrimage tourism along rivers such as the Ganges, Yamuna, Godavari and Narmada reflects the interconnectedness between spirituality, mobility and landscapes, with rivers being revered as living sacred geographical sites [4, 20]. The *ghats* serve as multifunctional spaces for worship, social interaction, and daily livelihoods, blurring the boundaries between tourism and everyday life.

Although pilgrimage tourism generates significant tourist flows and economic activity, scholars have highlighted persistent sustainability challenges, including overcrowding, waste management, environmental degradation, and infrastructure stress [5]. Existing studies focus primarily on private sacred sites or festivals, providing limited insight into how pilgrimage tourism operates along the stretch of connected rivers. This division limits the ability to address overall environmental impacts and integrated visitor management, emphasizing the need for locally integrated planning approaches.

3.4. Research Gaps in the Brahmaputra Context

Despite the growing interest in river tourism and eco-tourism in India, research on the Brahmaputra River remains limited compared to the study of the Ganges and other major rivers. This gap is significant due to the extreme hydrological variations, ecological sensitivity and cultural diversity of the Brahmaputra [10, 11]. Existing studies tend to examine isolated sites or terrestrial impacts, which provide a limited understanding of river tourism as a continuous cultural-ecological system.

Recent contributions by Mahanta and Khawzawl have begun to document the socio-cultural and environmental impact of river tourism in and around Guwahati, highlighting both livelihood opportunities and infrastructure, environmental pressures and emerging challenges associated with governance [21, 22]. However, these studies do not conceptualize the Brahmaputra as a corridor linking cultural nodes, mobility networks, and ecological processes between space and time.

Furthermore, the literature provides limited engagement with corridor-based planning methods that integrate tourism development with river basin management, climate resilience and holistic governance. Issues of social inclusion, especially the participation of women and informal river-dependent workers, have not been explored. Addressing these gaps, the present study takes a corridor-based river-side eco-tourism approach, examining how cultural practices, ecological dynamics and institutional arrangements intersect within the Brahmaputra river system using Guwahati as a representative urban segment.

4. Methodology

4.1. Study Area: Guwahati as a Segment of the Brahmaputra Corridor

Situated on the southern bank of the Brahmaputra River, Guwahati is the largest metropolitan centre in the state of Assam and the main urban gateway to Northeast India [23]. Historically known as Pragjyotishpur, the city has long served as a centre of religious learning, commerce, and political authority, a role that shapes its contemporary urban and cultural identity. Due to its strategic location, Guwahati serves as an important node connecting the regional river-based mobility system to the national and international transport networks [4, 21, 22].

The riverfront landscape of Guwahati displays a dense concentration of cultural, religious, and functional elements that illustrate its role within the broader Brahmaputra corridor. Sacred hills such as the Nilachal hills, visible from the river top and the Kamakhya Temple, attract lakhs of pilgrims annually and practice river-related rituals. The historic *ghats*, including Uzan Bazar and Pan Bazar, serve as multipurpose spaces supporting religious ceremonies, ferry services, and daily social interaction. Centrally located in the middle of the river channel, Umananda Island represents a unique combination of spiritual significance, seasonal accessibility and

river-based tourism activities[9, 24].

In parallel to this cultural treasure, Guwahati is facing severe urban and environmental pressures. Rapid and often unplanned urban expansion, traffic congestion, wetland encroachments, and deterioration of water quality have drastically altered the riverfront environment[10, 11]. Seasonal floods and persistent riverbank erosion pose ongoing risks to infrastructure, livelihoods and environmental stability. These mutual challenges underscore the resilience of hydrology and the city's vulnerability to climate-related stressors[9, 24].

In this context, Guwahati offers a particularly instructive case to examine riverside eco-tourism within the urbanized cultural-ecological corridors. The city encompasses both the opportunities offered by river-based cultural tourism and the institutional, environmental and spatial constraints that limit its sustainable development. Studying Guwahati as a corridor block allows for an integrated analysis of tourism, urban administration, ecological dynamics and cultural practices of the Brahmaputra river system.

The Brahmaputra River itself exemplifies a wide range of cultural-ecological corridors. Originating in the Tibetan Plateau and flowing through China, India, and Bangladesh, it is one of the world's most dynamic rivers in terms of drainage, sediment loads, and seasonal variability. Within Assam, the river forms the floodplain environment, agricultural livelihoods, transport networks, and structures of deep-rooted cultural and religious traditions. The rituals along the temples, *ghats*, river islands and its banks reflect the enduring sacred and symbolic significance of the Brahmaputra in Assamese society, reinforcing its relevance as a corridor for integrated eco-tourism planning.

The geographical location of greater Guwahati city within the Brahmaputra River corridor in Assam, India, is shown in urban riverfront zones considered in the study in **Figure 1**.

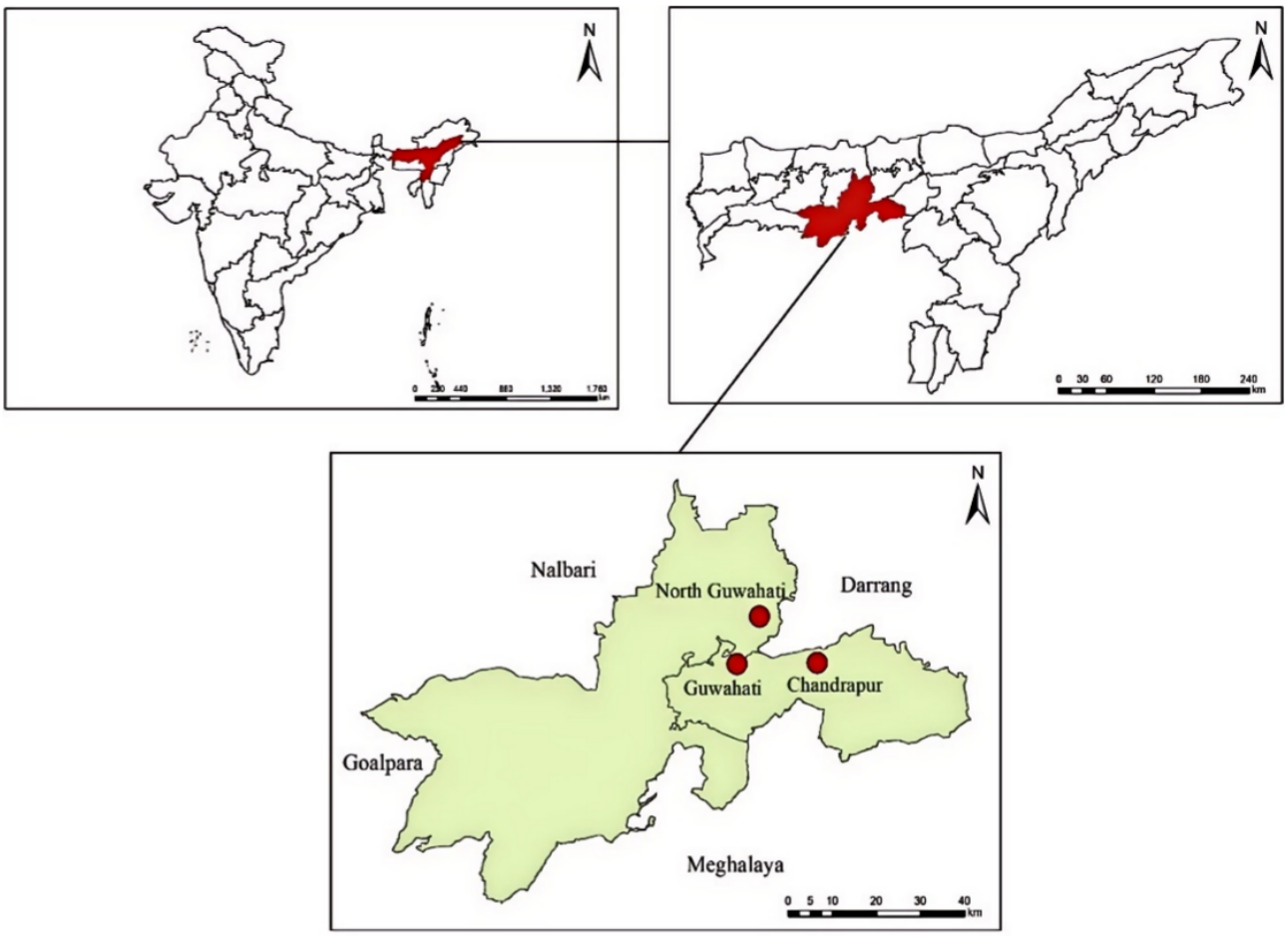


Figure 1. Location Map of Guwahati, Assam, India.

4.2. Study Period and Data Collection Sites

Preliminary data was collected between January and November 2025 at major riverside tourist destinations in greater Guwahati, such as Umananda Island, Uzan Bazaar and Pan Bazaar *Ghats* (traditional stepped riverbank, often used for rituals and boat access), Nilachal Hills (Kamakhya Temple Entry Point) and ferry terminals located along both the southern and northern riverbanks of the Brahmaputra. These sites were chosen for their focus on pilgrimage activities, river transport and leisure-oriented tourism.

4.3. Quantitative Survey

A structured questionnaire survey was conducted among tourists and residents (n = 240). The sample size was determined based on estimated visitor flows at major riverside locations and ferry terminals, where average daily peak-season visits exceed 1,000–1,500 individuals. Using standard social science sampling principles for a limited population with a 95% confidence level and an acceptable margin of error, a sample of approximately 200–250 respondents was considered statistically sufficient to capture variations in visitor motivation and community perception. The final sample of 240 confirmed representation in key user categories, including pilgrims, leisure tourists, ferry users and river-dependent residents.

Respondents were selected across multiple high-activity nodes to increase spatial representation. The survey tool included constructive questions on visitor motivation, environmental awareness, infrastructure satisfaction and sustainability attitudes. The data were analysed using descriptive statistics and comparative analysis among the tourist and resident groups.

4.4. Qualitative Interviews

Twenty-six semi-structured interviews were conducted with government officials, ferry operators, temple committee members, local entrepreneurs, informal workers, and community representatives. Participants were selected using objective and snowball sampling to ensure representation of key stakeholder groups.

Transcripts of interviews were analysed using subjective analysis. An early open coding process identified repetitive concepts associated with governance fragmentation, environmental risks, occupational vulnerability, and institutional coordination. These codes were subsequently grouped through axial coding to develop broad thematic categories aligned with the objectives of the study. Pattern identification and cross-validation with survey results and field observations strengthened interpretive reliability. This triangular approach increased analytical rigor and ensured consistency between quantitative and qualitative insights.

4.5. Field Observations

Systematic field observations were carried out during both peak pilgrimage and off-season months to record tourism activities, infrastructure conditions, environmental stress and seasonal variations. The observations were recorded through field notes and photographic documents, providing contextual support for survey and interview results.

4.6. Secondary Data and Triangulation

Secondary information was obtained from academic literature, government reports, planning documents and historical records related to river management and tourism development along the Brahmaputra. Quantitative surveys, qualitative interviews, field observations, and data triangulation on secondary sources increased the validity and reliability of the results and supported an integrated analysis of river ecotourism as a cultural-ecological corridor.

5. Results and Discussion

This section presents and explains the empirical findings from questionnaire surveys, beneficiary interviews, and field observations conducted along the Brahmaputra River in Guwahati. The findings have been structured theoretically to reflect the objectives of the study and directly inform the proposed corridor-based river cross-eco-tourism framework.

5.1. Structure and Patterns of River-Based Tourism Activity

The results of the survey indicate that river tourism in Guwahati has been overwhelmed by cultural and religious

inspirations. Nearly 65% of tourists identified pilgrimage and spiritual experiences as the primary reasons for traveling along the river, followed by scenic river landscapes (54%) and ferry-based travel experiences (41%). These findings confirm that tourism activity along the Brahmaputra is deeply rooted in long-standing cultural and ritual practices, rather than just leisure-driven consumption.

Major pilgrimage sites, including the Kamakhya Temple and Umananda Temple, serve as effective tourist spots within the river corridor. Field observations show that ferry crossings, *ghats* and access roads over hills serve as important links between sacred landscapes and river dynamics. Seasonal religious events, such as the Ambubachi Mela (Fair), dramatically intensify the flow of visitors, often exceeding the carrying capacity of the riverside infrastructure. During peak hours, 67% of surveyed visitors reported experiencing excessive congestion, congestion and delays on ferry services.

Although diversification efforts such as river cruises, ropeway services, and sightseeing boats have been launched in recent years, participation has been limited and locally fragmented. Only 28% of tourists reported engaging in more than one river-based activity during their trip. This indicates that Guwahati is currently functioning as a collection of isolated attractions rather than serving as an integrated river tourism system. The absence of curated itineraries, thematic routes, and integrated transit-tourism links limit the opportunities for long-term stays and multi-site exploration along river corridors.

5.2. Governance Arrangements and Institutional Fragmentation

Interviews with stakeholders have revealed that river tourism administration in Guwahati is fragmented and lacks coordination. Multiple government departments, including tourism, urban development, inland water transport, and the environmental agency, operate within overlapping jurisdictions, often without a common planning framework. As a result, tourism-related interventions are implemented in a fragmented manner, primarily focusing on physical infrastructure rather than the development of integrated corridors.

Responses to surveys by government officials indicate that 63% feel that interdepartmental coordination is inadequate, especially with regard to environmental management and disaster preparedness. Field observations confirm these concerns: About 66% of jetties and riverfront facilities were found to experience functional disruption during the rainy months due to flooding, sediment accumulation or access restrictions. An official in the inland water transport sector said that *"most of the infrastructure is designed for good weather conditions and is not reliable during peak monsoons."*

Private sector participation is cautious. More than 52% of local entrepreneurs and tourism operators identified regulatory uncertainty, seasonal demand fluctuations, and environmental risk as the main barriers to investment. The lack of corridor-level governance institutions further limits long-term planning and risk-sharing mechanisms. These results suggest that without institutional integration, the development of river tourism risks strengthening divisions rather than enhancing sustainability.

5.3. Tourist Experience and Community Perceptions

The perception of tourists along the banks of the Brahmaputra is shaped by a combination of spiritual symbolism, natural aesthetics and cultural authenticity. The results of the survey indicate that visitors highly value the experience of ferry rides, temple views and the extensive river landscape combining experiences. However, the level of satisfaction is greatly affected by the lack of visitor infrastructure and interpretation.

About 49% of tourists expressed dissatisfaction with the cleanliness of the *ghats*, while 44% reported poor signage, lack of information and difficulties associated with limited interpretive facilities. Many first-time visitors reported limited understanding of the cultural and ecological significance of riverside sites, diminishing the educational and experiential depth of their travels. These results highlight the gap between the symbolic significance of the river and the quality of the tourism experience provided.

The collective perception presents a more ambivalent picture. While 68% of local respondents acknowledged the economic benefits of tourism, particularly through ferry services, informal sales and small enterprises—concerns were raised about environmental degradation, seasonal overcrowding and uneven distribution of benefits. About 43% of community respondents felt that the benefits of tourism were concentrated among a limited group of operators, with in-

formal workers and marginalized groups receiving the least long-term protection. These findings underscore the importance of inclusive governance and equitable benefit-sharing mechanisms within the development of river tourism.

5.4. Environmental Stress, Climate Variability, and Tourism Vulnerability

Environmental pressure on sustainable river tourism emerged as a central obstacle. Seasonal flooding, riverbank erosion, and debris accumulation were consistently identified in surveys, interviews, and field observations. About 59% of tourism facilities reported experienced partial or full functional disruption during the monsoon season, while 45% of tourists and 47% of residents identified garbage and cleanliness along the riverbanks as the most visible environmental issues.

Climate-induced hydrological variations exacerbate these challenges. 66% of tourism operators reported frequent service disruptions during the peak monsoon months, and 60% reported frequent damage to temporary infrastructure built for festivals and pilgrimages. In contrast, prolonged low-flow conditions during dry seasons occasionally limit navigation and reduce the efficiency of cruise operations. This variation creates income instability for river-dependent workers, with 45% of respondents employed in river-based occupations reporting increased economic uncertainty.

These results show that river tourism along the Brahmaputra is highly sensitive to environmental and climatic dynamics. Without adaptive planning and climate-resilient design, tourism development risks exacerbating vulnerabilities rather than contributing to local resilience.

5.5. Social Inclusion, Informal Livelihoods, and Gender Dimensions

River tourism in Guwahati supports a wide range of informal and semi-formal livelihoods, including ferry operations, banding, handicraft production, food service, and ritual-related activities. Women play a particularly important role in sustaining cultural practices and the informal tourism economy. However, interview records indicate that these actors are often excluded from the formal planning process, the licensing system and access to financial aid.

Stakeholders highlighted challenges during the river-front beautification project, such as displacement, lack of safe operating space, and limited participation in decision-making. A community representative noted that *"development projects visually improve the riverbank but often push informal workers out without options."* This dynamic has the potential to undermine the social stability of river tourism and undermine local management of the river environment.

The results suggest that a socially inclusive tourism administration recognising informal workers as legitimate partners is essential for long-term sustainability. Integrating gender-sensitive policies and livelihood protection within river corridor planning can enhance both equity and environmental care.

5.6. Synthesis: Implications for Corridor-Based Riverine Eco-Tourism

Taken together, the results show that river tourism in Guwahati operates within a complex cultural-ecological system, shaped by religious traditions, ecological dynamics, institutional arrangements, and climatic variations. While the Brahmaputra provides a strong cultural and symbolic base for tourism, the current patterns of development remain fragmented, ecologically weak and socially uneven.

The empirical results directly inform the need for a corridor-based approach, in which tourism planning aligns with river dynamics, administrative integration and community participation. Rather than simply proposing tourism expansion, the evidence highlights the need for adaptive, holistic and ecologically sensitive strategies that respond to both cultural significance and environmental uncertainty. This synthesis forms the empirical basis for the corridor-based riverside eco-tourism framework presented in the following sections.

6. Corridor-Based Riverine Eco-Tourism Development Framework

Based on the empirical findings presented in Section 5, this study proposes a corridor-based riverside eco-tourism framework that aligns with the cultural-ecological dynamics of the Brahmaputra River bank in Guwahati. The framework does not treat tourism expansion as an underlying commodity; Rather, it conceptualizes tourism as a function within a broad river corridor system shaped by hydrological pro-

cesses, cultural practices, governance structures, and climate variability.

6.1. Rationale for a Corridor-Based Approach

Empirical results show that river tourism in Guwahati is currently fragmented into isolated nodes, temples, *ghats*, ferry routes and scenic landscapes without effective integration. Visitor movement, administrative responsibility, and environmental management work in tandem, leading to congestion during peak seasons, less use during off-peak times, and increased vulnerability to flooding and erosion.

A corridor-based approach addresses these limitations by treating the river not as a background for individual attractions, but as a continuous local, cultural, and ecological system. This approach aligns with the river corridor planning policy that emphasizes connectivity, adaptive management, and multi-scalar governance. Such an approach is particularly relevant in the context of the Brahmaputra, given the river's seasonal variations, the centrality of rituals and socio-economic dependence.

6.2. Core Components of the Framework

The proposed framework consists of four interrelated components, each informed directly by the test results.

6.2.1. Landscape of Cultural Nodes and Rituals

Cultural and religious places, including temples, *ghats*, pilgrimage routes and festival sites, form the primary tourism anchors along the corridor. The results indicate that these nodes drive most tourist flows and model seasonal demand. Rather than arbitrarily expanding infrastructure, the framework emphasizes managed convergence, where high-intensity use areas are supported by crowd management, temporal zoning, and culturally appropriate interpretation. This element recognizes cultural practices as dynamic processes embedded in space rather than sustainable heritage resources. By mapping ritual calendars and pilgrimage cycles, corridor planning can better predict pressure points and distribute visitor flows across time and space.

6.2.2. Ecological Buffers and Climate-Responsive Design

Environmental vulnerabilities particularly flooding, erosion and debris accumulation, emerged as a major obstacle to the sustainability of tourism. In response, the framework integrates environmental buffer zones along riverbanks, prioritising soft infrastructure, flood-friendly designs, and nature-based solutions. The tourism facilities within the corridor are perceived to be seasonally adaptable, allowing for partial or temporary use during high water periods. This approach acknowledges the hydrological dynamics of the Brahmaputra and avoids rigid infrastructure that increases long-term risks. Importantly, environmental protection is not seen as a trade-off against tourism, but as a precondition for its continuity.

6.2.3. Mobility, Connectivity, and Thematic Circuits

Survey and observation data show limited multi-site visits and poor integration between ferry services, tourist attractions and urban transport. The framework, therefore, emphasizes river-based mobility as both transportation and experience, connecting cultural nodes through thematic circuits (e.g., pilgrimage routes, cultural heritage trails, river environment experiences). Such circuits reduce stress on private sites as well as encourage long-lasting and diverse visitor engagement. Importantly, mobility planning is conceived at the corridor scale, as isolated transport interventions, rather than enhancing coordination and resilience.

6.2.4. Inclusive Governance and Livelihood Integration

The findings highlight the fragmentation of governance and the marginalisation of informal workers, particularly women and small-scale operators. To address this, the framework includes a multi-tiered governance system involving municipal authorities, river transport agencies, tourism departments, community groups and representatives of the informal sector. Instead of proposing a new independent entity, the framework advocates for coordinating platforms or corridor-level executive groups that align existing mandates. Livelihood integration is positioned as a key sustainability criterion rather than a secondary social benefit through safe vending zones, participatory planning, and skill development.

6.3. Feasibility Constraints and Implementation Challenges

This framework explicitly acknowledges political, institutional and financial constraints. Interdepartmental co-

ordination remains a significant challenge, especially in the absence of an administrative structure of formal corridors. Financial constraints may limit large-scale infrastructure investment, requiring phased implementation and prioritization of low-cost, adaptive interventions. Political commitments are also uneven, with river tourism often seen as a symbolic or aesthetic step rather than a long-term governance challenge. These limitations suggest that the framework should be implemented gradually, starting with the pilot expansion of the corridor and utilizing existing programs related to urban development, climate adaptation and heritage management.

6.4. Schematic Representation of the Corridor Framework

To increase conceptual clarity, the corridor-based riverside eco-tourism framework (**Figure 2**) can be envisioned as an interconnected system consisting of four integrated components:

1. Cultural Nodes (temples, *ghats*, pilgrimage routes).
2. Ecological Buffers (riparian zones, flood-adaptive spaces, nature-based solutions).
3. Mobility Networks (ferry routes, thematic circuits, multimodal access).
4. Inclusive Governance Platform (multi-tier coordination, livelihood integration).

These elements operate within a dynamic external layer representing hydrological variability and climate change pressures. Instead of acting independently, each element interacts through a reaction process—cultural calendars influence the demands of mobility; Environmental buffers increase infrastructure resilience; Governance structures mediate resource allocation and risk sharing.

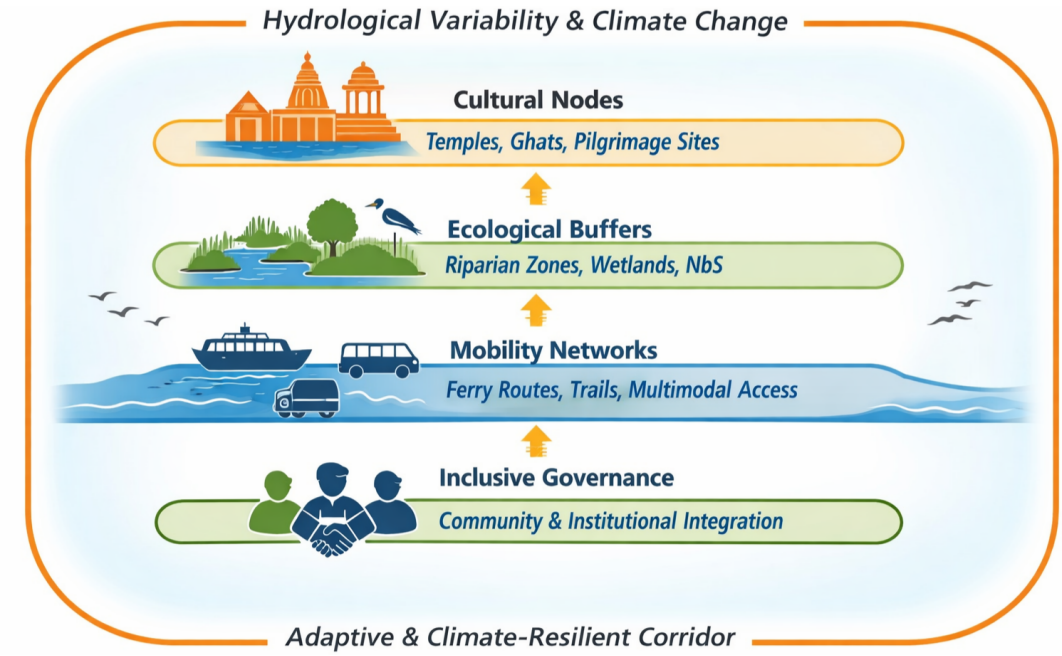


Figure 2. The Corridor-Based Riverside Eco-Tourism Framework.

6.5. Summary

The corridor-based riverside eco-tourism framework proposed in this study derives directly from empirical evidence rather than standard expectations. By aligning cultural significance, environmental resilience, mobility integration, and holistic governance, the framework provides a structured but flexible approach to managing river tourism in a dynamic and fragile river system. Its primary contribution lies in reconstructing tourism as a corridor-scale process embedded within a vibrant cultural-ecological system.

7. Conclusions

This study examined riverine ecotourism along the Brahmaputra River in Guwahati through the lens of a cultural-

ecological corridor, which combined quantitative surveys, stakeholder interviews, and field observations. The results show that tourism activity is strongly shaped by religious practices, seasonal hydrology, and fragmented governance structures. Although the river provides a strong symbolic and experiential foundation, the development of tourism remains locally isolated, environmentally unprotected and institutionally uncoordinated.

Major challenges include overcrowding during peak pilgrimages, infrastructure disruption due to flooding and erosion, limited diversity of tourism activities, and uneven distribution of economic benefits. Informal workers and women are inadequately integrated into the formal planning process. These dynamics highlight the limitations of discrete site-based interventions in dynamic river systems.

In response, the proposed corridor-based framework reimagines tourism as a function inherent within a broader cultural-ecological and hydrological system. By integrating cultural nodes, ecological buffers, river-based dynamics, and holistic governance systems, the framework provides a climate-responsive and socially equitable planning approach. Importantly, it emphasizes adaptive implementation and ecosystem-based strategies rather than rigorous infrastructure expansion.

From a policy point of view, corridor-level coordination between tourism, transport, environment and urban agencies is essential. Climate-resilient design, nature-based solutions, improved interpretation infrastructure, and formal recognition of informal occupations should be key elements of future planning. Aligning tourism management with ritual calendars and seasonal hydrology can further reduce vulnerability and enhance the visitor experience. Future research may apply comparative and longitudinal methods to different river stretches to test the portability of corridor-based eco-tourism models in large, climate-sensitive river systems.

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Institutional Review Board Statement

Ethical review and approval were waived for this study as it involved voluntary participation, anonymous data collection, and posed no risk to participants.

Informed Consent Statement

Informed consent was obtained from all participants prior to data collection. Participation was voluntary, anonymous, and conducted in accordance with standard social science ethical guidelines.

Data Availability Statement

The data supporting the findings of this study are not publicly available due to privacy and ethical restrictions.

Conflicts of Interest

The author declares no conflict of interest.

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