Importance of Integrating Indigenous Knowledge in Heritage Sustainability of the Sundarbans

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ABSTRACT

The Sundarbans, a UNESCO World Heritage Site and the world's largest contiguous mangrove forest, represents a unique confluence of ecological richness, natural heritage and cultural heritage. While extensive research focuses on its natural heritage and its conservation through modern methods, the crucial role of its rich and distinct indigenous cultural practices, belief systems, and traditional ecological knowledge in promoting heritage sustainability remains untapped. This study observes that communities maintaining strong cultural connections to the forest, through worship of Bonbibi, traditional resource management practices, and intergenerational knowledge transfer, exhibit more sustainable interactions with the ecosystem. Hence this paper seeks to analyze the contribution of indigenous knowledge and cultural practices to the heritage sustainability of the Sundarbans and propose its inclusivity in the modern conservation measures through extensive review of existing literature. Furthermore, this paper proposes environmental recommendations, collaborating with the cultural dimensions to elevate the social fabric of the indigenous communities and the ecological integrity that these communities have helped maintain for centuries.

Keywords: Natural Heritage, Cultural Heritage, Indigenous Practices, Traditional Ecological Knowledge, Heritage Sustainability

INTRODUCTION

The Sundarbans is a living heritage that sustains biodiversity, safeguards the coast, promotes cultural practices, hoards a treasure trove of indigenous knowledge systems and generates economic livelihood for millions. This ecosystem is a large dynamic delta area of India and Bangladesh spanning around 10,200 Sq.km., formed by the intersection of the rivers Ganga, Brahmaputra and the Meghna, and is renowned worldwide for its high level of biodiversity and the strong bonding between its inhabitants and nature, accouching an absolutely unique cultural legacy. The Indian part includes areas of the North 24 Parganas and the South 24 Parganas districts in West Bengal and is bounded by the Icchamati-Raimangal-Kalindi rivers in the east, the Hooghly river in the west, the Bay of Bengal in the south and the imaginary "Dampier-Hodges Line" in the north to demarcate the government's own estate.

Indigenous communities, including the Bawalis, Mawalis, Chuniris, Jeles etc., have inhabited the Sundarbans margins for centuries, developing intricate systems of ecological knowledge and resource management embedded within cultural and spiritual frameworks. Their relationship with the forest extends beyond being just utilitarian extraction but also encompassing beliefs, rituals, indigenous livelihood practices, and social structures that regulate human-environment interactions.

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The culture of the local communities reflects a profound connection to the land, air, water, and the flora and fauna of the Sundarbans. Over many generations, the indigenous and tribal communities have thrived here by developing deep, adaptive knowledge systems attuned to its dynamic tidal ecology.

Hence, the Sundarbans presents an ideal case study for examining how cultural heritage, particularly ancient wisdom, traditions, spiritual practices, and traditional ecological knowledge, sustainable livelihood practices, directly contribute to environmental sustainability.

Research Objectives

- Study the nature and extent of indigenous knowledge systems in the Sundarbans in the field of fishing, agriculture and architecture of the region.
- Analyze the mechanisms through which cultural practices regulate resource use and promote conservation.
- Propose an integrated heritage management framework that bridges indigenous knowledge, cultural and natural conservation objectives.

LITERATURE REVIEW

The Sundarbans has been extensively studied from ecological perspectives, with research documenting its unique halophytic vegetation, tidal dynamics, species composition, and threats from climate change, sea-level rise, and anthropogenic pressures [1], [2]. However, socio-cultural dimensions have received comparatively less attention in peer-reviewed literature.

Notable exceptions include integrating traditional knowledge systems [3], [11], studies of human-tiger conflict and local perceptions , documentation of the Bonbibi cult - the forest deity worshipped across religious boundaries [4],[5],[12], [13], ethnographic accounts of the fisher folk (jeles) and their occupational culture [6], [11], role of traditional knowledge of the timber collectors (bawalis) and mangrove conservation [7], role of indigenous rice varieties [8], [14], [15], [16], [17] and their sustainability and vernacular architecture of the region [9], [18], [19], [20], [24] and its indigineity. Yet these cultural elements are rarely integrated into ecological assessments or management planning. This paper addresses this gap by systematically examining cultural-ecological linkages.

The Bonbibi Culture is deeply ingrained into the community which gives them a unique identity based on their occupations. These forest based identities were so deep-rooted that the religious distinctions often fade into the background, ensuring communal harmony. Their cuisine is mostly seafood-based, with rice as staple. Use of wild herbs and forest produce is common. Delving into the Sundarbans traditional life, their livelihoods depended on fishing, crab catching, and honey collection and agriculture, as primary occupations. Local communities possess deep knowledge of mangrove species, their medicinal uses, seasonal cycles, and flood patterns indicating their Mangrove system expertise. Fisher folk and honey collectors use traditional signs such as cloud movements, bird calls, water colour, to predict tides, storms, and safe travel windows before venturing into the sea and the forest. Knowledge of safe tiger zones, predicted by the direction of the pug marks and respectful forest use is practiced and passed down orally in the Bonbibi tradition. Practices like rotational fishing by the Jeles are implemented to help ensure regeneration of the fish population. The process of honey collection by the Mawalis is done using the smoking technique for which the locally available dried leaves are used to generate smoke so as to not damage the honeycomb. Also, while extracting honey they ensure that they leave a part of the honeycomb untouched so that the bees could rebuild the hive and return to the colonies after a month or more, depending on colony size and nearby flowering conditions. Golpata (Nypa fruticans) harvesters limit harvesting to once a year and avoiding it between June and September which is the growing season. They only cut leaves around nine feet long, preserving the central and adjacent leaves in each clump, and ensure that flowers and fruits are undisturbed. Young plants with only one usable leaf are left unharmed. Bawalis, when collecting wood, leave at least one stem in each tree clump and follow a cyclical harvesting pattern, ensuring plant regrowth. They focus on areas with abundant resources and avoid cutting young, straight trees [6]. Indigenous communities

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practiced limited agriculture adapted to saline soil. Various types of indigenous rice varieties**,** saline and flood-tolerant native rice varieties were cultivated in different types of land - high, medium, and low, by generations of farmers who knew their land intimately.

The architecture of the region boasts of traditional houses that were often built on raised platforms or stilts to protect them from tidal surges and floods. They also use locally available, flexible materials like mud/clay, locally available mangrove timber and thatch that can be rebuilt quickly after a storm.

RESULTS AND DISCUSSION

Sundarbans Ecology and Human dimensions

The timeline of Indigenous traditional knowledge systems play a crucial role in preserving and passing down knowledge through generations, allowing communities to learn from past experiences rather than repeatedly solving the same problems.

The broken history of the human settlement in the Sundarbans has led to the emergence of a rich cultural heritage for this region in various significant aspects. Their settlements evolved through natural disasters, wars and loss of populations, hence leading to a multi-layered cultural inheritance, while the influences of traders, colonials and settlers from other regions have had an enormous and inseparable impact. However, the settlements have remarkably been resilient and adaptive to the challenging environment of the Sundarbans, forming an intangible cultural heritage about itself, evident in their livelihood practices, spiritual rituals and the enormity of the indigenous knowledge held by these communities. The cyclical depletion and reoccupation of humans led to the rehabilitation of the forest, adding further to the distinctiveness of the Sundarbans as a natural environment and humanly developed cultural landscape simultaneously [10]. The Bonbibi tradition advocates guidelines to govern the environment. It was an uncompromised ritual for the honey collectors, fisher folk to perform puja (worship rituals), make offerings, and recite the Bonbibi Johura narrative recounting the goddess's victory over exploitative forces, before venturing into the forest and the waters. These rituals are not just symbolic but also inculcate behavioral ethics like limiting the extraction quantity, setting area boundaries for ethical extraction, allocating specific times of extraction, and demarcating certain areas as sacred sites or no-take zones. These practices were adept to protecting the interests of the nocturnal beings of the forest, as they were restricted from entering the forests during the night time. Their firm belief in the forest deity, Bonbibi as their protector from tiger attacks and natural disasters is more than just folklore, as it resonates with ethical values of human-nature relationship. They strictly followed the traditional protocols related to forest entry, group composition, noise levels and route selection that proved very efficient in reducing risks of tiger encounter. These rituals turned practices facilitated the regeneration of nature, as the honey collectors left portions of honey for the bees to regenerate, small-sized fish were released by the fishermen and the timber collectors avoided unnecessary destruction of vegetation. Hence the Bonbibi narrative strongly reflects respect for forest resources, greed prohibition and maintenance of spiritual integrity before entering the forest. This clearly indicates that the spiritual beliefs generate conservation mechanisms and also incorporate behavioral norms that prevent overexploitation and lead towards sustainable practices. It examines the ways in which these belief systems produce "sacred ecologies" where spiritual reverence for nature translates into tangible conservation outcomes.

Indigenous knowledge and early warning systems

The indigenous communities of the Sundarbans have an intrinsic knowledge about the tide regimes, cloud movements, bird calls, water colour and features of the local topography, the lunar cycles and seasonal changes. This knowledge is used to accurately assess and determine the levels and currents of water. These forecasts demonstrate accuracy compared to modern meteorological predictions for short-term local conditions. Such knowledge is vital for navigation, timing of fishing, and planning agriculture in the intertidal zone. People distinguish microhabitats created by variations in tidal regimes and adjust resource use to these conditions.

Indigenous knowledge also covers the knowledge of freshwater availability, such as the site of freshwater within brackish areas and seasonal fluctuation patterns of salinity levels. This knowledge has guided settlement patterns, the selection of agricultural sites and water resource management for generations.

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This indigenous monitoring generates real-time data on ecosystem dynamics that formal scientific surveys conducted intermittently cannot capture. When integrated with participatory management approaches, indigenous knowledge system enhances adaptive capacity and early warning systems for environmental change.

Indigenous livelihood practices

An indigenous livelihood system in the Sundarbans emphasizes reciprocity, humility, and respect toward non-human beings and a strong coherent presence in the ecosystem. They depict integration of multiple activities in ways that distribute pressure across resources and seasons. Households usually engage in fishing, agriculture, collection of forest products, and aquaculture in seasonal rotation, reducing dependency on single resources and allowing recovery periods. This diversification reflects both risk management and ecological sustainability principles.

Indigenous agricultural systems adapted to saline conditions involve salt-tolerant rice varieties, intercropping strategies to improve soil conditions, and integration of livestock for manure fertilization. These represent centuries of agricultural evolution under challenging environmental conditions.

Indigenous Fishing practices by the Jeles

The Sundarbans is home to the Jeles, a traditional fishing community with an intimate knowledge of the natural phenomena of the Sundarbans. Fishing has not just been a livelihood practice for the Jeles, but is deeply ingrained in their culture and social identity. The Jeles follow certain traditional norms and practices in order to ensure judicious and sustainable use of the resources and hence their approach is rooted in a profound understanding of their environment.

They use traditional nets like chawarpata and berjal with medium to large holes, which allow small fish and larvae to escape, ensuring the regeneration of fish populations. For example; the length of berjal varies from 4-5m to 90-100m and width is 7-8m. This is a massive difference in the nets used in the modern times like the chorjal and bainjal, which have very small holes that are indiscriminate in catching juvenile fish and carp larvae, destroying future stocks.

The Jeles respect the natural cycles such as the breeding cycles and the seasonal rhythms by adhering to a strict code of conduct which demands seasonal restrictions such as avoiding fishing during the ovulation period to allow fish to reproduce. Certain areas are closed for resource extraction for short periods of time (a week or two), hence allowing the ecosystem to recover and replenish itself. They understand the signs of fish spawning and high Hilsa fish production, when the water turns reddish and turbid. The current day fishing practices are insensitive to the spawning cycles and ecological indicators, as they relentlessly resort to extract fish from the water bodies, leading to a recurrent decline in the fish population and reproduction cycles of the fish.

The indigenous communities have learnt from their ancestral wisdom to align their fishing schedules with the tidal rhythms, lunar phases and wind direction. They are aware that the fish populations tend to increase during high tide and the full moon and they recognize that southern and southeasterly winds are indicative of abundant fish. Alongside, the presence of birds like egrets and kingfishers are considered sacred as they are indicative of fish-rich areas, which is a cue to the indigenous Jeles. The modern fishermen are either ignorant or reluctant to the natural cues, leading to unsustainable fishing practices. The Jeles are ingrained with the indigenous wisdom to assess the type of mud on the seabed to detect the best fishing spots and refrain from practices leading to excessive siltation, as it leads to altered aquatic topography which destroys fish habitats. In contrast, modern fishermen resort to cutting trees to clear fishing access paths which lead to significant siltation which alters the aquatic topography.

The Jeles use the traditional boats called dingi nouka [21], made from the Sundari trees, which are in tandem with the ecosystem, unlike the modern users using motor boats and trawlers that cause havoc by polluting the water and damaging the fragile marine habitats. Also, the Jeles follow a rotational system of fishing by dividing and alternating the canals and water bodies so as to enable rest periods for fish regeneration. The current usage defies sustenance through encroachment of traditional territories and disregard to the fishing grounds.

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Therefore, the traditional fishing practices of the Jeles in the Sundarbans embody a deep seated ecological wisdom and an ethos of conservation.

Indigenous Agricultural practices

The inhabitants of the Sundarbans have developed indigenous agricultural systems that contend with the ecosystem's unique challenges such as saline soils, tidal flooding, and tropical cyclones. These traditional practices are very conducive to the environment.

Traditional farmers cultivate indigenous rice varieties such as Nonabhokra, Dudheshwar, Talmugur, Matla and Hogla [8], [16]. These varieties have been developed over centuries to tolerate saline soil. These landraces keep genetic diversity and strength that the modern high-yielding varieties do not possess.

Traditional agriculture uses tidal dynamics through cleverly designed canal systems (khals) [22], [23] that store freshwater during monsoons and control saltwater intrusion during dry seasons. In contrast, modern agriculture depends on water from outside sources. Traditional sluice gates (regulators) on earthen embankments (bunds) control the flow of water based on what the locals know about tidal patterns and seasonal changes. This system, which is based on gravity, doesn't need much energy and keeps the water flow connected to the rest of the ecosystem. Traditional homesteads (baris) [20] are a good example of ecological integration because they combine farming with aquaculture, livestock, and agroforestry. The land around the raised homestead platforms are divided for rice paddies, vegetable gardens, fish ponds, and fruit orchards [25], [26]. Soil fertility was maintained through waste from livestock, cooking ash and rotational cropping with short term yield for the households. Neem (Azadirachta indica), tobacco, and other local plants act as natural pesticides in traditional methods. Current users resort to chemical pesticides and fertilizers which are unsustainable. Crop rotation plans, intercropping, and maintaining wild plants along field edges provide habitat for natural predators that reduce pest populations. In order to prevent the spread of diseases, farmers use seasonal indicators and lunar calendars to determine when to plant their crops.

Indigenous Architectural practices

The Sundarbans' traditional architectural methods have developed over many generations in direct response to one of the most fragile and dynamic landscapes on earth. Owing to its location in the delta, this region is exposed to cyclones, high salinity, intense rainfall, and tidal flooding. Hence architecture becomes more of a survival strategy and adaptation rather than just a shelter to live in. Traditional homes are typically built on raised earthen plinths for protection from the floodwaters. In areas where there is a higher risk of floodwater invasion, buildings are elevated above the ground using lightweight bamboo or wooden stilts [27]. These strategies reduce damage during seasonal flooding and help in post-disaster repairs. The choice of materials include bamboo, wood, mud, thatch, and nypa palm, as they are readily available and climate-appropriate. Sloping thatched roofs are adapted to allow rainwater to run off quickly, and woven bamboo or mud walls allow for airflow, which helps in the thermal regulation of the interior of the house by keeping it cool and dry in the tropical climate.

Typically, the homes have a linear layout with semi-open verandahs that serve as transitional areas for socializing, working, and storing. Rice was stored in cylindrical huts in the courtyard of the homesteads [27]. Traditional construction technique utilizes entirely local, renewable resources—bamboo and wood from Sundari trees for structural frames, golpata (nypa palm) thatch for roofing, mud and cow dung for wall plaster, and mangrove wood for posts and beams. These materials are harvested sustainably from managed forests and agricultural systems, creating zero carbon footprints. Bamboo's rapid growth and regenerative capacity makes it infinitely renewable compared to concrete and steel.

Traditional homesteads incorporate rainwater collection systems using roof catchments directing to earthen storage ponds (pukur) [23], [25]. These multipurpose water bodies support aquaculture, provide irrigation water, maintain groundwater recharge, and serve as fire breaks. Settlement planning is another aspect of vernacular architecture creating clustered patterns, thus reducing habitat fragmentation. Mangrove forests are preserved as a natural defence against storm surges, and villages are positioned along the embankments to prevent flooding.

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Traditional building techniques incorporated a modular design where individual components could be replaced or repaired easily using locally available materials with the help of community labour. This contrasts with modern concrete construction requiring complete reconstruction after storm damage and the escalating mangrove degradation is renedering the settlements devoid of natural defence.

RECOMMENDATIONS

Government agencies and conservation authorities should roll out inclusive policies along with substantial amount of economic backing/subsidies in recognizing and implementing indigenous knowledge systems.

Research, documentation and intergenerational knowledge transfer of indigenous knowledge: Researchers should be encouraged to document and validate the relevance of indigenous knowledge systems, oral histories, their cultural practices, traditional livelihood practices and sacred sites in the Sundarbans. This validation would encourage knowledge transmission and cultural continuity among the younger generations as they realize that such traditional knowledge has value and is relevant in the contemporary context.

Integration of Indigenous knowledge: Policies should be floated to integrate traditional indicators and indigenous observations along with the scientific metrics in the realms of environmental monitoring and adaptive management systems. Dialogues should be enabled through NGOs in resolving any epistemological differences in the conservation ethos between the modern and the indigenous ways.

Empowering the indigenous communities through co-management institutions: Establish genuine co-management structures whereby the power to make decisions is shared in a genuine manner between government and representatives of Indigenous communities. Management policies must combine traditional knowledge with scientific findings. Communities need to be assisted in organizing collective action for the protection and application of indigenous knowledge. A traditional knowledge organization within a community can promote intra-community discussion on knowledge transfer, develop community priorities, and represent the interests of the community in external negotiations.

Economic opportunities for the youth of the indigenous communities: The support of the Government and the NGOs is strongly recommended for the upliftment of the economic status thus empowering the youth of the indigenous communities, by funding for small ventures relevant to promoting the indigenous knowledge. This inclusion ensures the younger generations to reconnect with their roots and establish innovative approaches such as digital story- telling, documentary production, cultural camps and ecotourism.

Integration of the traditional methods of fishing: Support from the NGOs at the community level to recognize and integrate the Jeles' methods and way of life which offer a community-led and sustainable resource management could play a pivotal role in preserving the natural and cultural heritage of the region ensuring heritage sustainability.

Integration of traditional agriculture practices: The inclusion of salt tolerant crop varieties and canal systems that capture fresh water is strongly recommended.

Integration of the vernacular style of housing: As the tide of progress washes over the region, it has become formidable to a shift in conventional thinking and must embrace a more inclusive approach, adapt modern materials in combination with the vernacular ones to enhance the safety while retaining the character of the region. A cyclone-proof bamboo and mud house in response to the destructive cyclones that are a threat due to climate change can be blended with the modern materials for strength while retaining the language and character of the region.

CONCLUSIONS

This study establishes that the indigenous knowledge systems, cultural practices and environmental sustainability are innate in the Sundarbans. The historical timeline provides a long standing witness that the

indigenous knowledge, cultural and belief systems have regulated human-environment interactions to maintain the ecological integrity of the region while also supporting livelihoods.

The derelict of the indigenous knowledge and the cultural heritage, accelerated by the inefficient conservation policies and socioeconomic changes has a significant impact on environmental degradation. The current environmental management approaches have disregarded the indelible connect between the indigenous knowledge systems and heritage sustainability of the Sundarbans. The younger generations of the region are dismissing the indigenous practices as primitive and incompatible, as they are captivated by the urban lifestyles, modern development and industrial expansion. Hence it is even more challenging to propagate the intangible heritage through stories, rituals, techniques and beliefs that are indigenously bound to the land and water.

Bridging this gap requires an extensive inclusion of the indigenous knowledge systems, from being purely scientific management to knowledge pluralism, and stewarding nature with people by promoting the indigenous communities as custodians of nature. Hence, it is imperative in the case of Sundarbans that such integration is indispensable for its heritage sustainability.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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REFERENCES

1. Ghosh, A., Schmidt, S., Fickert, T., & Nüsser, M., "The Indian Sundarban Mangrove Forests: History, Utilization, Conservation Strategies and Local Perception", Diversity, 7(2), 149-169, 2015, https://doi.org/10.3390/d7020149.
2. Giri, C., Pengra, B., Zhu, Z., Singh, A., & Tieszen, L. L., "Monitoring Mangrove Forest Dynamics of The Sundarbans in Bangladesh and India Using Multi-Temporal Satellite Data From 1973 To 2000", Estuarine, Coastal and Shelf Science, 73, Issues 1-2, 91-100, 2007, https://doi.org/10.1016/j.ecss.2006.12.019.
3. Burman, Anushri & Rajak, Fulena & Jha, Ramakar, "Integrating Traditional Knowledge Systems for Wetland Conservation and Management A Critical Analysis", Nature Environment and Pollution Technology 24(1), 2025, DOI:10.46488/NEPT.2025.v24i01.B4212.
4. Sen, Amrita, and Jenia Mukherjee. "Bonbibi: A Religion of the Forest in the Sundarbans", Environment & Society Portal, Arcadia (Summer 2020), no. 22. Rachel Carson Center for Environment and Society. https://doi.org/10.5282/rcc/9051.
5. Jalais, Annu."Forest of Tigers: People, Politics and Environment in the Sundarbans", 2010, DOI:10.4324/9780203085516.
6. Rashed Al Mahmud Titumir, Md. Shah Paran & Mostafa Walid Pasha (Unnayan Onneshan), "The Sundarbans Is Our Mind: An exploration Into Multiple Values of Nature in Conversation with Traditional Resource Users", IPSI Case Study, 2019, https://collections.unu.edu/eserv/UNU:7506/SITR_vol5_fullset_web.pdf#page=107.
7. Rahman, Md Mizanur, Independent Research lab, " The Role of the Traditional Knowledge of the 'Bawalis' in the Conservation of the Sundarbans Mangrove", 2025, DOI:10.2139/ssrn.5435516.
8. Ghosh Santadas & Chattopadhyay Sankar Kali "A Study on Indigenous Rice Varieties in Sundarban Delta and their Role in Ensuring Local Food Security in the Face of Climate Change Threats", Agro-Economic Research Centre, Visva-Bharati, Santiniketan West Bengal, Academia, 2017, https://www.academia.edu/95589181/A_Study_on_Indigenous_Rice_Varieties_in_Sundarban_Delta_and_Their_Role_in_Ensuring_Local_Food_Security_in_the_Face_of_Climate_Change_Threats.
9. Hasan, Tanbir, "A Vernacular Architectural Learning Centre,Sundarban, Sadar Dinajpur." DOT_Art & Architecture Bangladesh Magazine, vol. Volume 09, no. Issue 1, DELVISTAA FOUNDATION, 2024,

p. 77, https://www.academia.edu/108812495/A_Vernacular_Architectural_Learning_Centre_Sundarban_Sadar_Dinajpur, https://www.inspireli.com/en/awards/detail/6532.

10. Mukhopadhyay Prama, "The Fluid Landscape of the Sundarbans", Conservation and Society, 20(3):p 234-244,Jul–Sep2022, DOI: 10.4103/cs.cs_210_20.
11. Roy, Aparna & Sinha, Archana & Manna, Ranjan & Aftabuddin, Md & Das, Sanjoy, "Traditional Knowledge of The Fishermen Community of Indian Sundarbans: An Assessment of Rationality and Effectiveness", Indian Journal Of Fisheries, 67. 94-101. 10.21077/ijf.2019.67.2.86752-13, 2020, DOI:10.21077/ijf.2019.67.2.86752-13
12. Biswas, Suptendu, "People-Nature-Culture of a Place: Understanding Festivals of the Sundarbans", In book: INTACH Lecture Series 2019-20 (pp.151-173), 2020, https://www.researchgate.net/publication/345414544_People-Nature-Culture_of_a_Place_Understanding_Festivals_of_the_Sundarbans.
13. Uddin, Md & Habib, Kazi, "Traditional Knowledge, Culture, and Biodiversity of Sundarban UNESCO World Heritage Site", Journal of Ocean & Culture. 2. 74-86. 10.33522/joc.2019.2.74, 2019, https://www.researchgate.net/publication/338579548_Traditional_Knowledge_Culture_and_Biodiversity_of_Sundarban_UNESCO_World_Heritage_Site.
14. Michael C. Gavin, Joe McCarter, Aroha Mead, Fikret Berkes, John Richard Stepp, Debora Peterson, Ruifei Tang, "Defining Biocultural Approaches to Conservation", Trends in Ecology & Evolution, Volume 30, Issue 3, Pages 140-145, ISSN 0169-5347, 2015, https://doi.org/10.1016/j.tree.2014.12.005.
15. Samanta, Sourav, Sugata Hazra, Partho P. Mondal, Abhra Chanda, Sandip Giri, Jon R. French, and Robert J. Nicholls, "Assessment and Attribution of Mangrove Forest Changes in the Indian Sundarbans from 2000 to 2020" *Remote Sensing* 13, no. 24: 4957, 2021, https://doi.org/10.3390/rs13244957.
16. Pani, Dipti & Sarangi, Sukanta & Subudhi, H & Misra, R. & Bhandari, Divya, " Exploration, Evaluation and Conservation of Salt Tolerant Rice Genetic Resources from Sundarbans Region of West Bengal", J. Indian Soc. Coastal agric. Res. 30(1): 45-53, 2012, https://www.researchgate.net/publication/284730299_Exploration_Evaluation_and_Conservation_of_Salt_Tolerant_Rice_Genetic_Resources_from_Sundarbans_Region_of_West_Bengal.
17. Mandal, Subhasis & Sarangi, Sukanta & Burman, D. & Mandal, Uttam & Maji, B. & Sharma, D, "Impact of Improved Salt Tolerant Rice Varieties on Farmers' Economy Under Coastal Salt Affected Areas of Sunderbans", Conference Paper, ICAR-Central Soil Salinity Research Institute Technical Bulletin, 2016, https://www.researchgate.net/publication/293645361_Impact_of_improved_salt_tolerant_rice_varieties_on_farmers'_economy_under_coastal_salt_affected_areas_of_Sunderbans.
18. Sareen, Rajneesh & Roychowdhury, Anumita, "Sustainable Self-Built Housing Reinventing Local Material, Techniques and Skill Case Studies from Odisha and West Bengal", Centre for Science and Environment, New Delhi, 2022, https://www.researchgate.net/publication/367220674_sustainable_self-built_housing_reinventing_local_material_techniques_and_skill_case_studies_from_odisha_and_west_bengal.
19. M.R. Alam, A.B.M.A. Kaish, M.F.M. Zain, S.K. Dev, M.S. Mahzabin, "Vulnerability Assessment and Construction Recommendations of Local Houses in the Cyclone Prone Coastal Areas of Bangladesh", International Journal of Disaster Risk Reduction, Volume 21, Pages 118-130, ISSN 2212-4209, 2017, https://doi.org/10.1016/j.ijdrr.2016.10.010.
20. Wu, Jianyong & Yunus, Mamoon & Streatfield, Peter & Emch, M, "Association of Climate Variability and Childhood Diarrhoeal Disease in Rural Bangladesh, 2000-2006", Epidemiology and infection. 142. 1-10, 2017, https://doi.org/10.1017/S095026881300277X.
21. Azam, A K M Shafiul & Saha, Debasish & Asadujjaman, Md & Mahbub, Khandaker & Minar, Maruf, " Fishing Gears and Crafts Commonly used at Hatiya Island: A coastal Region of Bangladesh", Asian Journal of Agricultural Research. 8. 10.3923/ajar2013, 2014, DOI:10.3923/ajar2013
22. Bushra Nishat, AJM Zobaidur Rahman, Sakib Mahmud, etc., "Landscape Narrative of the Sundarban", The World Bank, https://documents1.worldbank.org/curated/en/539771546853079693/pdf/Sundarban-Joint-Landscape-Narrative.pdf
23. "Inventory of Freshwater Resources in the Sundarbans Landscape, Limited to the part of Landscape Located in India", The World Bank,

https://documents1.worldbank.org/curated/en/328371562736987775/pdf/Inventory-of-Freshwater-Resources-in-the-Sundarbans-Landscape-Limited-to-the-part-of-Landscape-Located-in-India.pdf

24. Dutta, Pallabi & Rahman, Md., "Learning from the Root-Integrating Tradition into Architecture towards a Self-Subsistent Munda Community", Conference paper, 2022, https://www.researchgate.net/figure/House-pattern-of-Munda-community-in-Sundarbans-Prepared-by-author_fig5_365823186.
25. Mandal, Subhasis & Burman, D. & Sarangi, Sukanta & Bandyopadhyay, Bimal & Maji, B, "Homestead production systems in Sundarbans region of West Bengal, India – Current status and opportunites", Conference: Revitalizing the Ganges Coastal Zone: Turning Science into Policy and Practices At: Dhaka, Bangladesh, 2015, https://www.researchgate.net/publication/279940934_Homestead_production_systems_in_Sundarbans_region_of_West_Bengal_India_-_Current_status_and_opportunites.
26. Susmita Dasgupta, David Wheeler, Md. Istiak Sobhan, Sunando Bandyopadhyay, Ainun Nishat, and Tapas Paul, "Coping with Climate Change in the Sundarbans", The World Bank, https://documents1.worldbank.org/curated/en/660891605066712888/pdf/Coping-with-Climate-Change-in-the-Sundarbans-Lessons-from-Multidisciplinary-Studies.pdf.
27. Habib, Aneeka, "Vernacular learning center: a hub for sharing knowledge and research", Thesis, 2016, https://www.researchgate.net/publication/390137057_Vernacular_learning_center_a_hub_for_sharing_knowledge_and_research.
28. Bera, Sayatan (on Ar. Fournier, Laurent), "Modern-Buildings-Cannot-Breathe", Down to Earth, 2012, https://www.downtoearth.org.in/coverage/modern-buildings-cannot-breathe-38813.
29. "Vernacular architecture of Bangladesh", Rethinking the Future, https://www.re-thinkingthefuture.com/rtf-fresh-perspectives/a1634-vernacular-architecture-of-bangladesh/.
30. Jaismita Alexander, "Locals adopt new architecture to build cyclone-resistant homes in Sunderbans', https://www.telegraphindia.com/my-kolkata/places/how-sustainable-architecture-is-helping-sundarbans-villages-prepare-for-the-next-cyclone/cid/2114700.
31. "Agroecology for Food Security and Nutrition", Proceedings of the FAO International Symposium, Rome, Italy, 2014, https://openknowledge.fao.org/server/api/core/bitstreams/57388c14-f84f-4bd5-b372-0640b8b882eb/content sunderbanvillagehousing%20(2).pdf.