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ARCHITECTURE FOR RESILIENCE IN THE SUNDARBANS

An Adaptive Community Infrastructure for the people of Anpur, Satjelia Island

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Bachelor of Architecture

/ PREFACE

This thesis began with a book and a journey.

While reading Amitav Ghosh's The Hungry Tide, I was introduced to the Sundarbans, a landscape unlike any I had encountered before. The region's unique relationship between land, water, ecology, and human settlement sparked a curiosity that stayed with me long after I had finished reading. What began as an interest gradually grew into a desire to experience the place firsthand.

At the same time, my visit to Kainakary, Alappuzha, as part of the Semester 04 Rural Settlement Studio, played an important role in shaping my interests as a student of architecture. Through that experience, I was introduced to the complexities of fragile ecologies and landscapes, and to the ways in which communities adapt their lives to constantly changing environmental conditions. It encouraged me to look beyond conventional architectural settings and explore landscapes where nature and human habitation exist in a delicate balance.

These experiences eventually led me to the Sundarbans, which I visited twice during the course of my architectural dissertation and thesis. There, I encountered a landscape in constant negotiation with nature, where communities continue to adapt and rebuild in the face of environmental uncertainty. The experience challenged many of my assumptions about architecture, resilience, and the relationship between people and place.

This thesis is the outcome of those experiences, observations, conversations, and reflections. It is an attempt to understand how architecture can respond to fragile ecological conditions while remaining rooted in the realities of the communities it seeks to serve.

More than a design proposal, this work has been a journey of learning. The Sundarbans taught me that resilience is not merely a response to adversity but a way of life. I hope this thesis reflects, in some measure, the lessons I learned from the place and the people who call it home!

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01

+ General

In this first part, the research topic will be introduced along with its justification. The analysis of the site and the user will determine the problem that will lead to a study opportunity for the project. Likewise, the objectives, scope, limitations and methodologies of the research will be identified.

Keywords :
Dispersed settlements, Hydrology, Morphology, Community infrastructure

When Land and Water Meets: An Adaptive Infrastructure for Community Resilience in the Sundarbans

"Resilience is not the ability to resist change, but the capacity to adapt and evolve with it."

The **Sundarbans**, one of the world's largest **deltaic regions**, represents a fragile interface between **land and water**, where human settlements exist in a constant state of **negotiation with natural forces**. Frequent **flooding, cyclones, erosion, and rising salinity levels** have made the region increasingly **vulnerable**, affecting not only the physical landscape but also the **social and economic stability** of its communities. Within this context, access to essential **infrastructure** such as **education, community spaces, and emergency support** remains **limited and inconsistent.**

India is a country of diverse geographies and cultures, and regions like the Sundarbans highlight how **environmental conditions** directly influence **patterns of habitation** and development. The **dispersed settlements** across islands, combined with **limited connectivity** and recurring **climatic disruptions**, results in **unequal access to public infrastructure.** Conventional architectural approaches, often based on **permanence and stability**, fail to respond effectively to such **dynamic and unpredictable conditions**. This calls for a shift towards **adaptive infrastructure** that responds to the **shifting realities** of the landscape.

The proposed project is situated within this context, aiming to establish an **adaptive community infrastructure** that addresses both **environmental uncertainty** and **everyday community needs**. The intervention focuses on creating a system that supports **learning, interaction, and emergency preparedness**, while remaining sensitive to the **ecological and cultural fabric** of the region. It recognizes that architecture must move beyond static enclosures and function as a **flexible and evolving framework.**

The design approach draws from principles of **adaptability, temporality, and contextual responsiveness**. Concepts such as **amphibious architecture, modular systems, and vernacular construction techniques** inform the proposal, allowing spaces to adjust to changing water levels, seasonal variations, and shifting community requirements. The use of locally available materials and indigenous knowledge systems becomes integral, ensuring that the intervention remains grounded in its context while minimizing environmental impact.

Rather than a singular, permanent structure, the project envisions a network of interconnected modules distributed across the site. These modules function both independently and collectively, accommodating various programs such as educational spaces, community gathering areas, and emergency shelters. The spatial organization reflects existing patterns of movement and living, particularly the reliance on waterways as primary connectors, thereby reinforcing the relationship between built form and landscape.

The project ultimately seeks to establish a balanced relationship between the natural environment and the built intervention, where architecture does not attempt to dominate or resist nature, but instead adapts and coexists with it. It positions the built environment as a dynamic and evolving entity, shaped continuously by environmental forces and community participation.

In doing so, the thesis redefines resilience within the context of the Sundarbans, proposing that sustainable habitation in such regions is not achieved through permanence, but through flexibility, responsiveness, and an ongoing dialogue between land, water, and people.

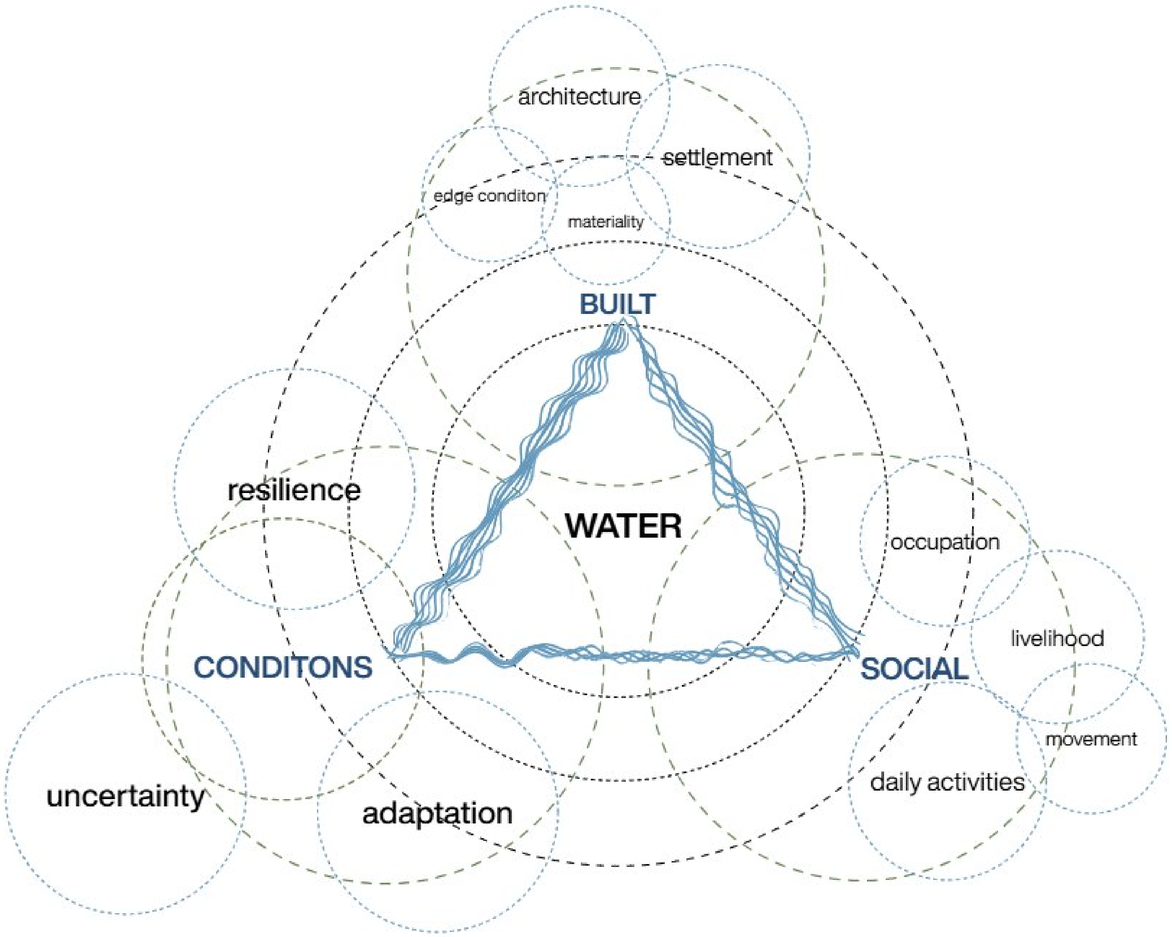


Fig. 01: Venn diagram showing the interconnection between water, built form, and social life.

From the user

Background

The Sundarbans, one of the most fragile deltaic regions in the world, is characterized by a complex network of rivers, tidal flows, and dispersed island settlements. The everyday life of its inhabitants is shaped by environmental uncertainty, including cyclones, flooding, erosion, and salinity intrusion. These conditions not only affect the physical landscape but also disrupt access to basic infrastructure such as education, healthcare, and community spaces.

To understand the problem, it is essential to begin with the primary users of the region, the local communities living across these islands. Due to the geographical isolation and poor connectivity, many settlements remain cut off, relying heavily on water-based transport systems. This results in limited and inconsistent access to essential services, particularly for children, women, and the elderly.

A comparative understanding of the region reveals a significant gap between the population distribution and the availability of infrastructure. Settlements are scattered and low-density, while existing facilities are often centralized and difficult to reach, especially during extreme weather conditions. This creates a condition where access is not defined by distance alone, but by time, season, and risk.

Key Issues Identified:

- **Dispersed Settlements:** Communities spread across islands with weak physical connectivity
- **Limited Accessibility:** Dependence on boats and tidal conditions for movement
- **Environmental Vulnerability:** Frequent disruption due to floods and cyclones
- **Lack of Infrastructure:** Inadequate access to education, community, and emergency spaces
- **Seasonal Isolation:** Certain regions become inaccessible during monsoons or high tides

In addition to spatial challenges, the region faces broader socio-economic constraints, where livelihood instability, migration, and poverty further affect access to education and community support systems. As a result, existing infrastructure often fails to function consistently, leading to interruptions in learning, lack of safe communal spaces, and limited disaster preparedness.

The issue, therefore, is not only the absence of infrastructure, but the incompatibility of static systems within a dynamic landscape.

Project Direction:

Based on these observations, the study proposes an **adaptive community infrastructure** that responds directly to the fluid and changing conditions of the Sundarbans. Instead of a single centralized facility, the intervention explores a **decentralized network of modules** that can function across different locations and conditions.

The proposal focuses on creating spaces that support:

- **Learning and skill development**
- **Community interaction and gathering**
- **Emergency response and shelter during disasters**

Approach:

The project is guided by principles of:

- **Adaptability:** Spaces that respond to water levels and seasonal change
- **Mobility and Modularity:** Structures that can shift, expand, or relocate
- **Contextual Sensitivity:** Design rooted in local climate, culture, and materials
- **Resilience:** Infrastructure that supports both everyday life and crisis situations

Concepts such as **amphibious architecture, floating systems, and vernacular construction techniques** inform the design, ensuring that the intervention remains both practical and culturally relevant.

Conclusion:

From the user's perspective, the need is not for permanent structures, but for **reliable, accessible, and adaptable systems** that can function within a constantly changing environment.

Therefore, the thesis proposes:

An Adaptive Community Infrastructure for Resilience in the Sundarbans

a system that bridges land and water, supports daily life and emergency needs, and redefines infrastructure as a **flexible and evolving network shaped by its users and environment.**

User:

When proposing any form of infrastructure within the Sundarbans, the primary user is often assumed to be a fixed community within a defined settlement. However, in this context, the **user is not static**. The region consists of a wide spectrum of people whose daily lives are shaped by **mobility, environmental uncertainty, and seasonal change.**

It becomes essential, therefore, to understand **who uses the space, when they use it, and under what conditions.** The users extend beyond a single group and include **children, fishermen, farmers, women, and the elderly**, all of whom interact differently with the landscape. Their routines are closely tied to tidal cycles, climatic patterns, and access to water routes, making their engagement with space temporal rather than permanent.

Thus, the infrastructure must respond not only to functional needs but also to the **fluid nature of occupation**, where spaces are required to accommodate **shifting activities, intermittent use, and varying intensities of occupation.**

User Analysis:

The understanding of the user can be framed through three interconnected layers:

- **Community Network**
  Local residents who depend on shared resources and collective systems for survival and daily functioning.
- **Individual User**
  People accessing spaces for **learning, gathering, livelihood, or shelter**, often with limited and irregular access.
- **Extended Community**
  Migratory populations, neighboring settlements, and users affected during **seasonal or climatic disruptions.**

These layers overlap, creating a condition where infrastructure must support both **everyday use and emergency situations,** functioning across multiple scales and timeframes.

Fig. 02: Hybrid diagram illustrating local livelihoods and everyday activities of the community.

From the place

Existing Infrastructure

In the Sundarbans, the availability of infrastructure is strongly influenced by the region's **deltaic geography and fragmented settlement pattern**. Most existing facilities such as **schools, healthcare centers, and community spaces** are limited in number and are often located in larger or more accessible islands, leaving smaller settlements underserved.

A significant portion of infrastructure is **physically vulnerable,** frequently affected by **flooding, cyclones, and erosion**. Many structures are either **temporarily built, periodically damaged, or abandoned**, leading to inconsistency in service delivery.

Additionally, basic services such as **safe drinking water, sanitation, and electricity** remain unreliable across several parts of the region. This creates a condition where infrastructure exists, but does not function continuously or efficiently.

Accessibility:

Accessibility in the Sundarbans is defined not by distance alone, but by time, season, and environmental conditions. Movement across the region depends on both road-based (embankments) and water-based transport, where boats act as the main mode of connectivity between islands. However, this access is highly dependent on **tidal cycles, weather conditions, and water levels,** making it unpredictable and often unreliable.

Travel time to reach essential facilities can vary significantly:

- Short distances may take **hours** due to indirect water routes
- Certain areas become **completely inaccessible during monsoons or cyclones**
- Emergency situations often face **delayed response due to disrupted connectivity**

Thus, the effective area of access is not fixed, but constantly shifting based on natural conditions.

Infrastructure vs Accessibility Gap:

There exists a clear mismatch between:

- **Location of infrastructure (fixed, centralized)**
- **Nature of settlements (dispersed, water-bound)**

This results in:

- Unequal service distribution
- Increased travel time and risk
- Reduced usability of existing facilities

Spatial Condition of the Region:

The Sundarbans operates as a **land–water continuum**, where:

- Land is **fragmented and unstable**
- Water is **dominant and constantly shifting**
- Boundaries between land and water are **blurred and temporary**

This creates a unique condition where conventional planning frameworks fail, as they rely on **permanence, stability, and clear boundaries.**

Conclusion:

From the perspective of the place, the challenge lies in addressing a landscape that is **dynamic, fragile, and unpredictable.**

Therefore, the need is for an approach that:

- Responds to **changing environmental conditions**
- Reduces dependence on **fixed and centralized systems**
- Adapts to **water-based movement and seasonal variations**

From the Site

Img. 02: Narrow rural paths support everyday movement, with bicycles and scooters as the main modes of transport.

Img. 03: Raised embankments act as key access routes, linking settlements to ferry points across the water.

Img. 04: Motor vans serve as an alternative mode of transport, supporting local movement along village roads.

Img. 05: Shops raised on stilts near the river edge, allowing everyday activities to continue despite changing water levels.

Img. 06: Flood shelters remain largely unused during normal conditions, standing as precautionary structures

Img. 07: Ferry ghats act as key points of connection, linking island settlements to the mainland.

Context

The Sundarbans, located in the eastern part of India along the Bay of Bengal, is one of the largest deltaic and mangrove ecosystems in the world. Formed by the confluence of major river systems, the region is characterized by an intricate network of tidal rivers, creeks, and low-lying islands. Despite its ecological richness, it remains one of the most environmentally fragile and socio-economically vulnerable regions.

The area is defined by its **unique land–water relationship**, where nearly every aspect of life is influenced by **tidal fluctuations, seasonal flooding, and climatic events.** Settlements are distributed across **isolated islands,** separated by water channels, making physical connectivity highly dependent on **boats and informal transport systems.** This geographical condition creates a clear distinction between accessible nodes and remote settlements, often leading to uneven development.

The selected site lies within this **fragmented landscape**, positioned in proximity to key settlement clusters while still remaining **ecologically sensitive and hydrologically active.** Its location reflects the broader condition of the Sundarbans, where **natural barriers such as rivers and wetlands** act as both connectors and separators between communities.

This condition results in a form of spatial isolation, where even short distances are difficult to traverse due to indirect routes, tidal variations, and changing water levels. As a result, access to essential services such as education, healthcare, and community infrastructure becomes inconsistent and unreliable.

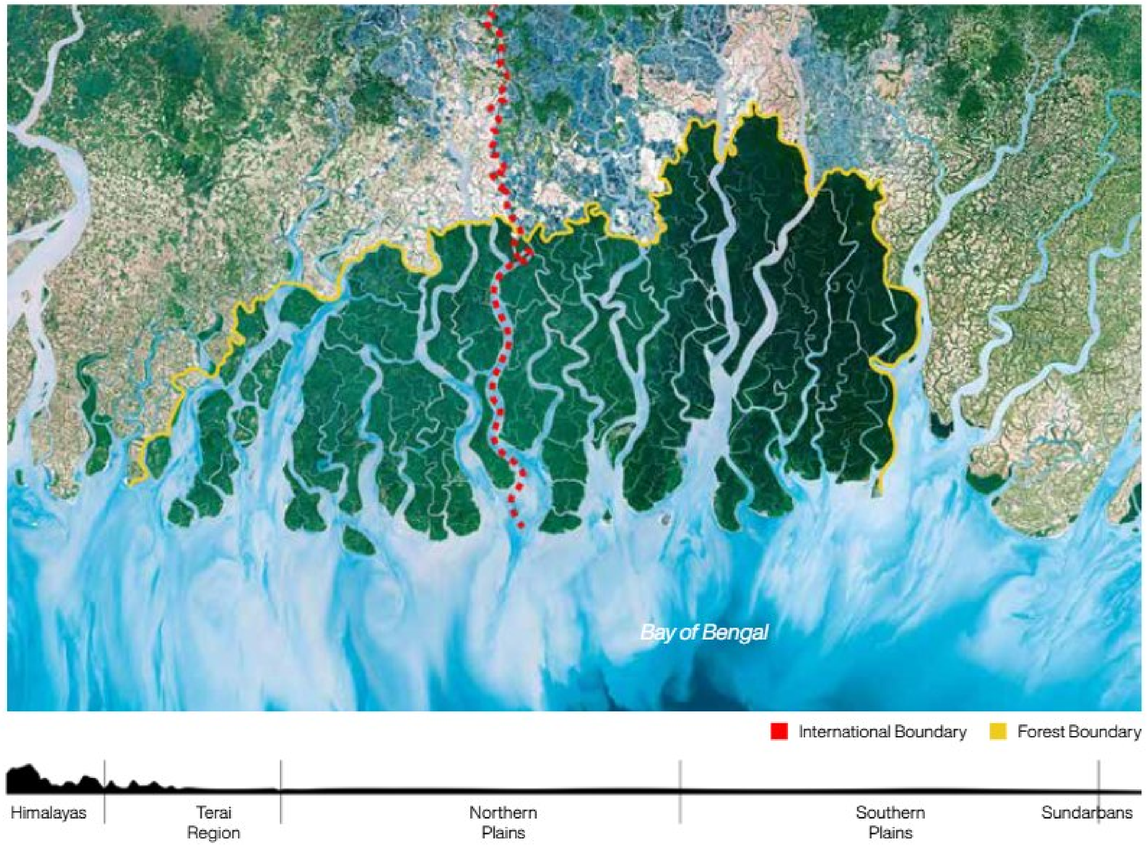


Fig. 03: Map showing the larger Sundarban delta (source: BBC Earth / Capernicus Sentinel Data 2020)

Fig. 04: Map showing the Satjelia Island in the Indian Sundarban (source: Google Earth)

Approaches

Sustainability

The approach to sustainability in the Sundarbans goes beyond conventional strategies and focuses on **long-term adaptability within a fragile ecosystem.** One of the key challenges in the region is the **lack of resilience of built forms** against flooding, cyclones, and salinity.

The proposal emphasizes the use of **climate-responsive design,** where built spaces are designed to work with **tidal variations, wind patterns, and seasonal changes.** This includes passive strategies such as **elevated structures, natural ventilation, shading, and water-sensitive planning.**

Material selection plays a crucial role, encouraging the use of **locally available, low-impact materials** such as bamboo, timber, and thatch. The aim is to reduce dependence on external resources while ensuring that construction remains **repairable, replaceable, and adaptable over time.**

Landscape

The project is grounded in the understanding of the Sundarbans as a l**and–water continuum**, where landscape is not a background element but the **primary generator of form and function.**

Instead of altering the terrain, the proposal works with the **existing topography, water channels, and ecological systems,** allowing natural processes such as flooding and sedimentation to continue without obstruction.

The design treats landscape as an active system, where built interventions are carefully placed to minimize disruption and enhance the relationship between **people, water, and land.** Open spaces, edges, and transitional zones are designed to accommodate changing water levels and seasonal transformations.

Technology

The technological approach focuses on simplicity, adaptability, and context-driven innovation rather than high-end solutions.

The project explores **modular and amphibious systems,** where structures can be elevated, floating, or semi-mobile, depending on site conditions. Construction techniques are derived from local building knowledge, combined with improved detailing for durability and safety.

Lightweight structural systems and joinery-based construction allow for easy assembly, disassembly, and repair. The integration of floating platforms, detachable components, and flexible connections ensures that the architecture can respond to water level changes and environmental stress.

Culture

One of the central approaches of the project is to respond to the cultural practices and lived realities of the Sundarbans communities.

The region reflects a deep understanding of living with water, where everyday life is shaped by fishing, agriculture, seasonal migration, and collective living patterns. The architecture draws from these practices, incorporating **vernacular spatial arrangements, material use, and construction techniques.**

The project aims to create spaces that support **community interaction, shared learning, and local livelihoods,** while also strengthening the connection between people and place.Rather than imposing a new system, the design builds upon **existing knowledge and practices**, allowing the community to actively participate in the making and use of spaces.

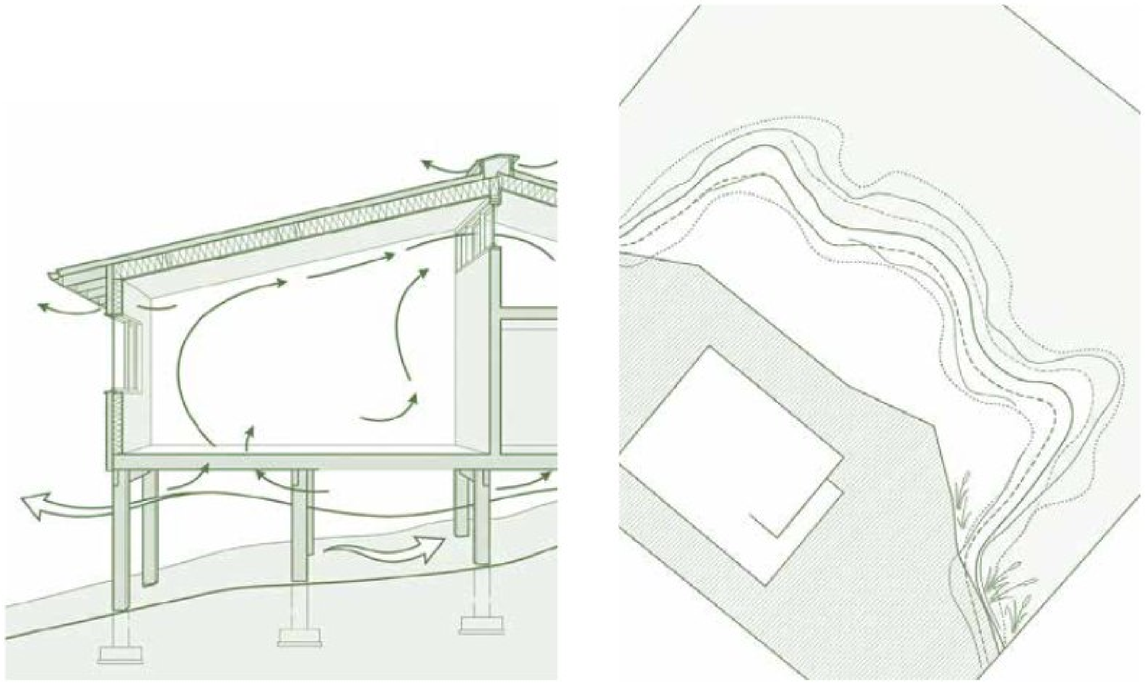


Fig. 05: different approaches

Img. 08: During floods, embankments become critical routes, with people carrying belongings while moving to safer areas. (source: downtoearth)

Img. 09: Ferries accommodate people, livestock, and vehicles together, serving as essential links for daily movement across water. (source: downtoearth)

how?

Once the conditions of the Sundarbans are understood; which are marked by frequent flooding, shifting land, and disrupted access to infrastructure, the architectural question begins to emerge:

- **How can infrastructure exist in a landscape that is constantly changing?**
- **How can spaces respond to tidal variations, seasonal flooding, and environmental uncertainty?**
- **Can architecture move beyond static forms and become adaptive to time and condition?**

The existing systems are largely fixed and land-dependent, making them vulnerable to water intrusion and climatic events. This raises the need to rethink how spaces are designed; not as permanent objects, but as flexible systems that can adjust, transform, and continue to function despite changing conditions.

where?

At the same time, questions arise regarding **access and location** within such a fragmented territory:

- **Where should infrastructure be placed in a landscape of dispersed islands?**
- **How do communities access essential services when routes are defined by water, time, and risk?**
- **What happens to learning, gathering, and daily life when movement itself becomes uncertain?**

In the Sundarbans, access is not guaranteed. During monsoons, high tides, or cyclones, routes are disrupted, and many areas become temporarily isolated. As a result, centralized infrastructure fails to serve the communities consistently.

Critical Inquiry

How can the design of an adaptive community infrastructure, integrated with floating and amphibious systems, support education, community life, and resilience in the dynamic landscape of the Sundarbans?

Img. 10: a classroom of Satyanarayanpur Vivekananda Vidya Bhawan, Amlamethi (source: author)

Objectives

+ 1.2.1 | General Objective

To develop an adaptive community infrastructure that integrates amphibious and modular systems to support education, community interaction, and resilience within the dynamic land-water landscape of the Sundarbans.

+ 1.2.2 | Specific Objectives

- Investigate the environmental conditions of the Sundarbans, including tidal patterns, flooding, and seasonal variations, as a basis for design.
- Understand the vernacular practices and local construction techniques that respond to living with water.
- Analyze the accessibility challenges related to dispersed settlements and water-based mobility.
- Develop adaptive architectural systems (floating, amphibious, or elevated) that respond to changing site conditions.
- Design flexible and multifunctional spaces that support learning, community interaction, and emergency use.
- Propose a decentralized network of modules that can function both independently and collectively across the region.

+ 1.3 | Hypothesis

An adaptive community infrastructure, integrated with floating and amphibious systems, can enhance access to education, community interaction, and resilience in the dynamic land-water landscape of the Sundarbans.

+ 1.4 | Scope and Limitations

+ 1.4.1 | Scope of the Research

- To identify **environmental and spatial characteristics** of the Sundarbans, including tidal behavior, flooding, and settlement patterns
- To study **vernacular practices and construction systems** adapted to water-based living
- To analyze **existing infrastructure gaps** in terms of access to **education and community spaces**
- To establish key **design approaches** based on adaptability, resilience, and context
- To understand the **relationship between landscape, water, and habitation**

+ 1.4.2 | Scope of the Project

- To design an **adaptive community infrastructure** rooted in the Sundarbans context
- To propose **amphibious / floating modules** responding to changing water levels
- To develop **flexible spaces** for learning, gathering, and emergency use
- To integrate **local materials and construction techniques**
- To create a **decentralized network system** connecting dispersed communities
- To explore **scalable and expandable design strategies**

+ 1.4.3 | Limitations

- The project is based on primarily on on-site data, which only addresses some parts of Satjelia Island.
- The project is limited **only to flooding and cyclone conditions,** doesn't account for human-tiger conflicts.
- Environmental conditions such as tidal fluctuations and flooding levels are variable and cannot be predicted with complete accuracy.
- The proposal remains a **prototype framework**, adaptable to different locations within the Sundarbans.

+ 1.5 | Research Design

The research is structured in two stages:

- **Understanding Phase**
  Study of context, user, environmental conditions, and existing systems through literature, case studies, and data analysis
- **Design Translation Phase**
  Transformation of insights into architectural strategies, including spatial systems, modular design, and adaptive infrastructure proposals

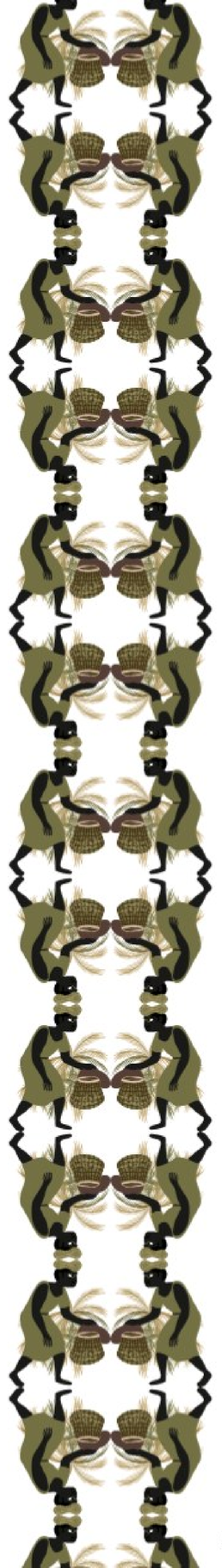
Img. 11: . (source: arka photography)

02

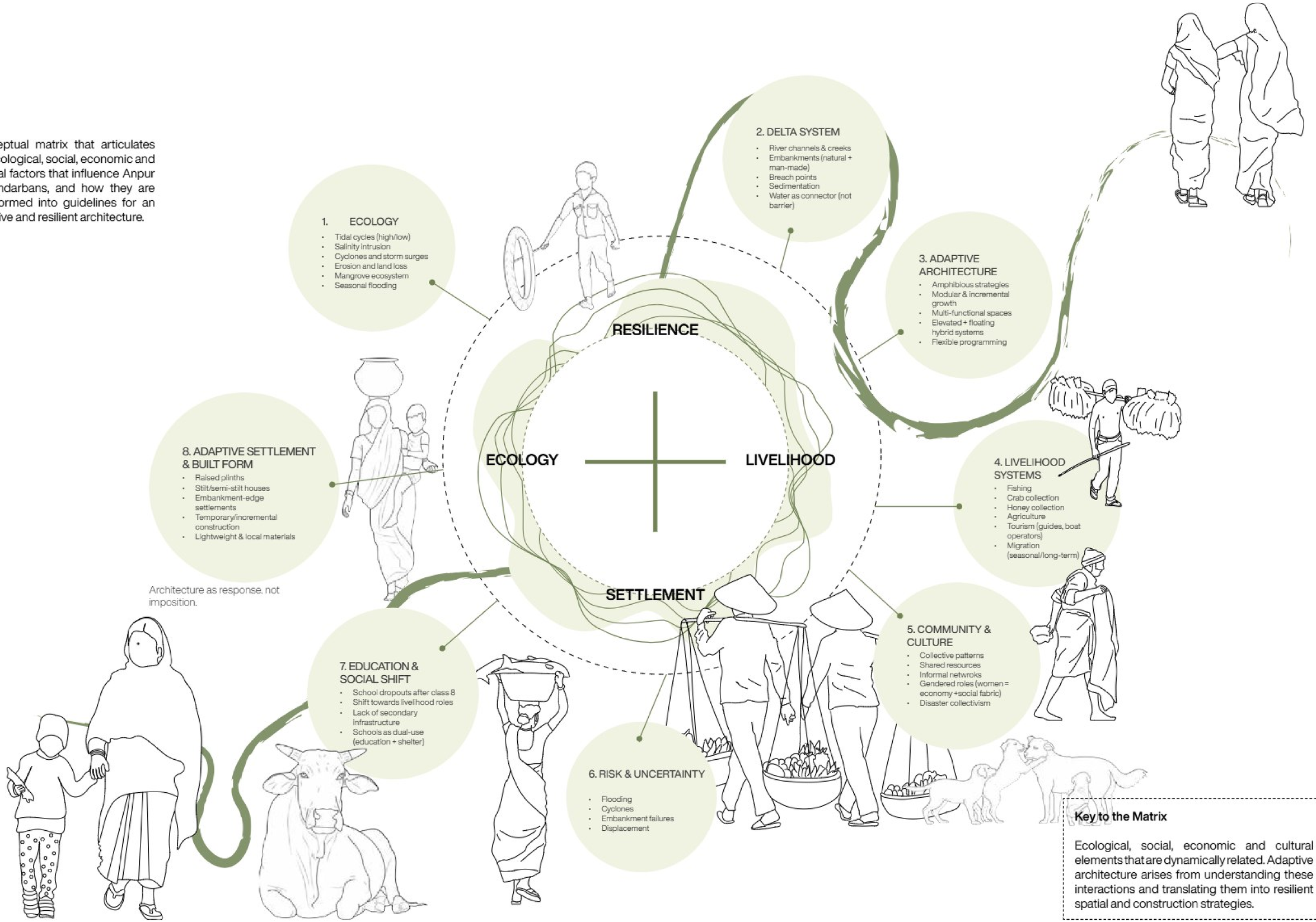
+ Matrix

The research is structured around four fundamental approaches: culture, landscape, sustainability, and technology. These dimensions form the basis for understanding the complex relationship between people, environment, and built form in the Sundarbans. Through a projective matrix, the key aspects of each approach are identified and interconnected, allowing for the development of integrated design strategies. This matrix acts as a bridge between analysis and design, translating research findings into spatial, material, and systemic responses.

Keywords :
Community infrastructure, Modularity, Adaptive Systems



Conceptual matrix that articulates the ecological, social, economic and cultural factors that influence Anpur in Sundarbans, and how they are transformed into guidelines for an adaptive and resilient architecture.



Key to the Matrix

Ecological, social, economic and cultural elements that are dynamically related. Adaptive architecture arises from understanding these interactions and translating them into resilient spatial and construction strategies.

Fig. 06: Conceptual matrix applied to the context of Anpur, Satjelia Island, Sundarbans (source: author)

03

+ Historical Context

To understand the Sundarbans, it is essential to look beyond its present condition and trace the historical relationship between land, water, and habitation. The region has evolved through continuous processes of sedimentation, tidal movement, and human adaptation, shaping both its physical form and cultural identity.

Keywords :
Morphology, Deltaic landscape, Vernacular architecture, Amphibious living, Community networks, Adaptation, Resilience

3.1.1 The Indian Sundarbans

Overview

The Sundarbans (**সনুদরবন**), an enormous mangrove forest is located in the lower Ganges River basin in south-western Bangladesh and south-eastern part of the West Bengal state in India. It is situated in a delta formed by the meeting of the Ganges, Brahmaputra, and Meghna rivers in the northern hemisphere, slightly north of the Tropic of Cancer. The term "Sundarbans" comes from the Sundari tree, or "Heritiera fomes," a type of mangrove that is widely distributed throughout the forest.

From the Hoogly River estuary in India to the western portion of the Meghna River estuary in Bangladesh, the Sundarbans geographically extend approximately 260 km from west to east along the Bay of Bengal. At its broadest point, the forest extends up to 80 kilometers inland. The Sundarbans cover an area of about 10,200 square kilometers, which includes both land and sea. The intricate web of mudflats, small islands, and tidal rivers that make up this distinct environment are all covered in thick mangrove forests. The area has brackish water habitat since it is where freshwater from the rivers and saltwater from the Bay of Bengal meet. The terrain changes to a low-lying marshy mangrove habitat along the shore, including sand dunes and mudflats. Mangrove forests cover over two-fifths of the Sundarbans, while water makes up approximately half of the total area.

The Sundarbans contains 102 islands on the Indian side, 54 of which are inhabited. The region has a large population, with over 12 million people residing here, including around 4.5 million in India and 7.5 million in Bangladesh.

The climate in the Sundarbans is subtropical Mediterranean. Every day, the area undergoes four tidal cycles: two high tides and two low tides. This dynamic tidal flow is crucial to moulding the ecology. During the summer months of April and May (Boishakh-Joishtho), the western half of the Sundarbans turns hot and dry, with temperatures over 30°C and winds gusting up to 25 km/h, moving sand and reshaping the coast. The monsoon season, which lasts from June to September (Ashar-Bhadro), produces significant rain and flooding, resulting in fertile silt deposits on the soil.

The Sundarbans is the world's biggest mangrove wetland, with water covering over 40% of its surface. The network of rivers, streams, and canals that run through this mangrove forest intricately shapes its environment and topography. Given the region's sensitive hydrological system, any disturbance in water flow can have serious consequences for the entire ecosystem, as well as the local population's livelihoods and the Sundarbans' overall development. The Sundarbans hosts 84 plant species, including 26 mangroves. It is also home to a diverse range of fauna, including 453 animal species, 120 fish species, 290 bird species, 42 mammals, 35 reptile species, and 8 amphibians.

However, the once-complex network of rivers that supported this ecosystem has changed drastically over time. Many rivers in India and Bangladesh have been cut off due to human activities upstream. This has resulted in reduced water flow, leading some rivers to dry up or transport significantly less water. As a result, the region's freshwater supply has been badly impacted, disrupting the ecosystem's delicate equilibrium.

To prevent floods, saline intrusion, and soil erosion, a number of embankments were built in the western Sundarbans during colonial times and subsequently in the 1900s.The Sundarbans' deforestation differed from that of other parts of British India because the areas cleared for rice production need temporary earthen embankments. These were built in the dry season to keep salty tidewater from destroying crops. Cultivators then undermined these embankments during the monsoon to allow for borsha floods, which swamped the area with silt-laden river water combined with rain. The silt fertilised the soil and naturally increased land levels, while the floods watered the rice fields and served as a breeding habitat for fish.

The Sundarbans' hydrological balance has traditionally been dependent on a regular flow of freshwater from upstream rivers, which serves to neutralise the salt of the tides. This delicate equilibrium is essential for the survival and reproduction of aquatic plants and animals in the region. If freshwater flow is limited or the water gets overly salty, the entire ecosystem is jeopardised. The Sundarbans mangroves are especially suited to variable salt levels in the water, which is critical for the forest's general health and survival.

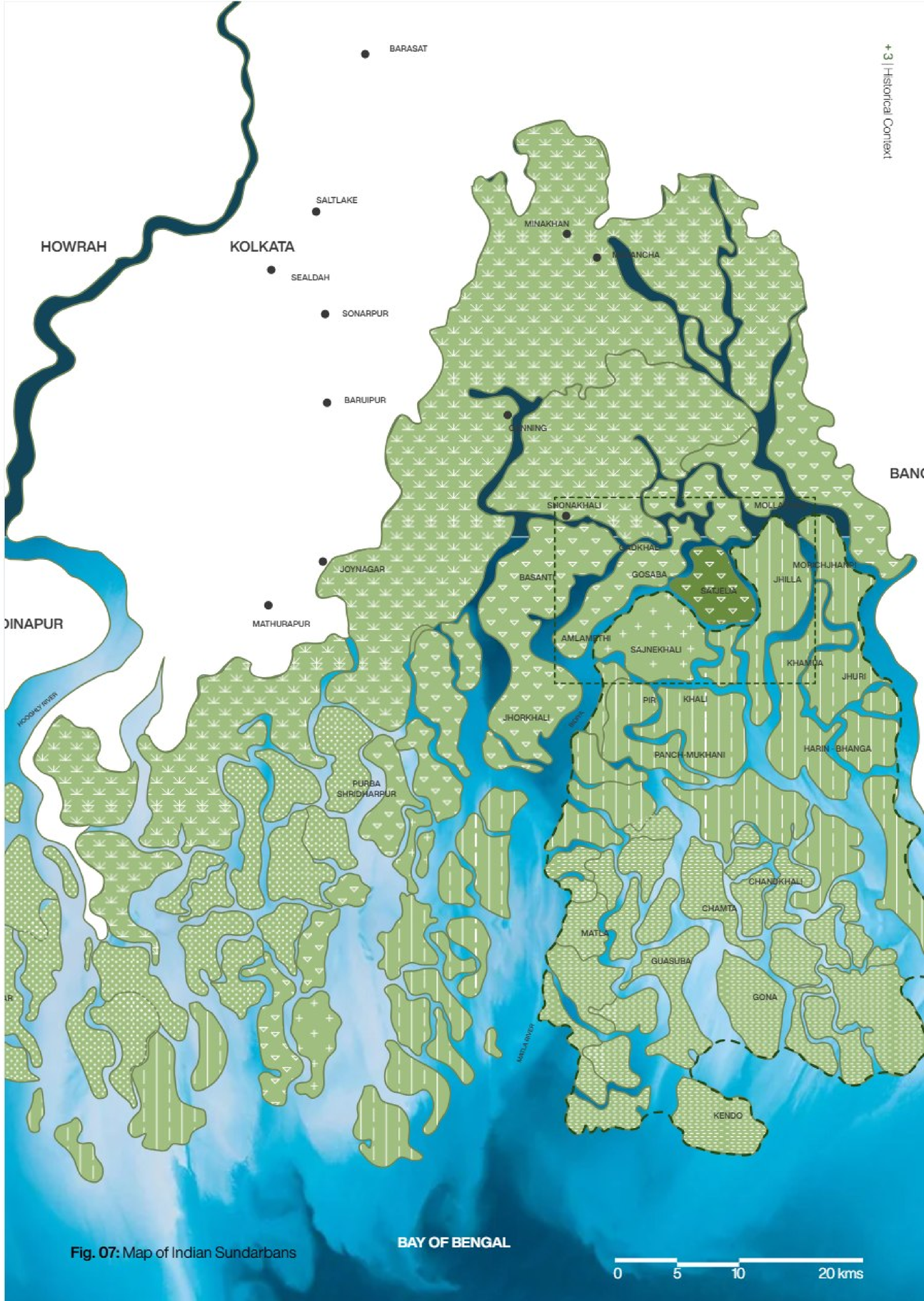


Fig. 07: Map of Indian Sundarbans

Early History

The shifting paths of rivers, cyclones, and floods have had a long-lasting impact on the land constitution of the Sundarbans, making it impossible to determine with clarity when humans first settled there. Archaeological evidence, however, suggests that human habitation in the Sundarbans dates from approximately 300 B.C. to 1200 A.D. The human population of this region was wiped out by frequent pirate attacks, natural disasters, and erosive activity.

In order to settle the revenue of the land between the Hijliof Midnapore district and the southeast plains, Emperor Akbar's appointed Diwan-i-Ashraf (Minister of Revenue) Todar Mall conducted the first survey of the Sundarbans in 1582. 'Bhati' was its previous name. Suja, the son of Emperor Shahjahan, named the area Jitratkana and Muradkhana after conducting another survey in 1652. He created several parganas, or revenue divisions, within the Sundarbans region, including Sarfarjpur, Amirabad, Madanamalla, Paihati, Jangalmahal, Nimakmahal, Sagar, Batia, Balanda etc. Later, as the idea of districts evolved, 24 of these revenue divisions, or parganas, were combined to form the district of Lower Bengal. This region is therefore referred to as the 24 Parganas. This region was recently split into the South and North districts.

The Sundarbans were noted as a significant commercial location for fish, timber, honey, paraffin, and salt between 1760 and 1761. From that time on, actual natural resource exploitation started. The 24 Parganas were given to the East India Company in 1756 after the Battle of Plassey was lost. In order to recover land for farming and timber supply, the Company leased land to individuals in 1770. For the first three years of this land lease, there was no rent; after that, the rate was two annas per bigha. However, the lack of sweet water, erratic weather patterns, and unsuitability of the land for cash crops caused people to migrate out of this area.

But in order to attract the vulnerable from neighbouring districts to relocate to the Sundarbans, the local zamindars and landowners provided a few perks. During the British era, tribes such as the Santhals, Orao, Munda, Kurmi, Bhumij, and others were transported from nearby areas to reclaim land. Additionally, about 2200 miles of embankments were built to prevent cyclones. Settlements were also encouraged by this. (The Sundarbans, 2023)

Fig. 08: Hybrid diagram illustrating local livelihoods and everyday activities of the community.

Fig. 09: Hybrid diagram illustrating the evolution of Sundarbans

321 - 226 BC

MYTHIC + EARLY HISTORIC

- Referenced in Epics (Ramayana, Mahabharata). A dangerous forested frontier, sparse settlements. Emergence of **Bonbibi (Forest Goddess)**
- Sundarbans area became a part of ancient **Maurya** and **Gupta** empires

10th - 16th century

MEDIEVAL PERIOD

- **Mughal Emperor Jahangir** recognized Sundarban's strategic importance as a source of timber and other natural resources.
- Rivers as primary transport, largely unreclaimed mangrove.

18th - 19th AD

COLONIAL INTERVENTION

- **British East India Company** took control over the Sundarbans.
- Mangroves cleared for revenue. **Embankments** to 'fix' land. Permanent inland villages.

20th AD

LATE COLONIAL

- Efforts to conserve the Sundarbans gained momentum. In **1928**, it was declared a reserved forest.
- Partition refugee influx. Embankment expansion. Forest conservation formalized, increased **Human-Tiger** conflict.

1973

POST INDEPENDENCE

- Sundarbans was designated as a wildlife sanctuary, aiming to protect its unique ecosystem and diverse flora and fauna.
- Salinity intrusion, out-migration begins.
- Conservation vs Livelihood tension.

1984

RECOGNITION

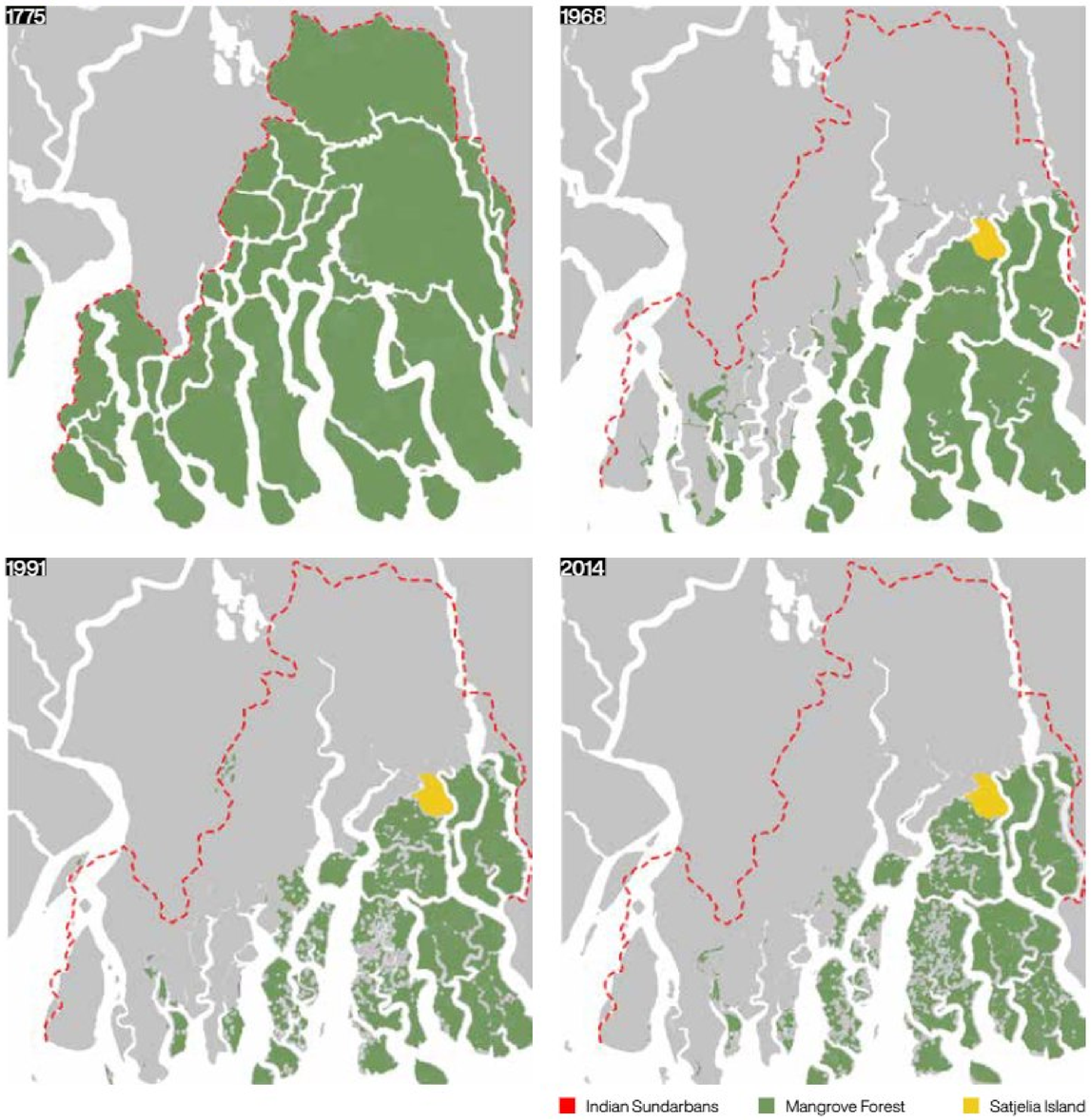
- Got inscribed as a **UNESCO World Heritage Site** in recognition of its outstanding and ecological significance.
- The wildlife sanctuary was expanded and renamed as **Sundarbans National Park.**

2000 - Present

CLIMATE CRISIS PHASE

- Accelarated island loss (Sea-level rise). Events like Alia (2009). Temporary settlements, life organised around risk.
- Cyclone Amphan (2020)
- Cyclone Yaas (2021)

Mangrove Forest Cover Change



The maps show that in 1775, mangrove forests in the Indian Sundarbans were widespread and largely continuous. Over time, especially by 1968 and 1991, large portions of these forests were cleared and broken into smaller patches. This change reflects increasing human settlement and expansion into the wetlands, with land converted for agriculture and habitation. By 2014, the mangrove cover is highly fragmented, indicating both significant forest loss and growing pressure from human activities in these fragile coastal ecosystems.

Fig. 10: Changes in mangrove forest cover in the Indian Sundarbans

Img. 12: Tidal wetland landscape in the Sundarbans with sparse mangrove cover. (source: author)

3.1.2 Satjelia Island

Overview

Satjelia Island is one of the largest inhabited islands in the Indian part of the Sundarbans delta, located in the Gosaba block of South 24 Parganas district, West Bengal. It lies at the meeting point of several tidal rivers, including the Gomdi, Bidya, and Durgaduani, and is surrounded by creeks and mudflats that flood daily with the rise and fall of the tide. The island is connected to the mainland mainly through ferry routes from Gosaba and Canning, making it accessible only by boat.

The island is home to many small villages and farming communities that depend on fishing, honey collection, agriculture, and small-scale forestry. Much of the land is protected by mud embankments, built to keep out saline water and protect crops during high tides and cyclones. However, these embankments are often damaged by floods and storms, forcing local people to rebuild them again and again.

Satjelia has a hot and humid tropical climate, similar to the rest of the Sundarbans, with distinct seasons: summer (Boishakh–Joishtho), monsoon (Ashar–Bhadro), and post-monsoon (Ashwin–Kartik). The monsoon brings heavy rainfall and frequent flooding, while the dry season leaves parts of the island saline and cracked. This constant cycle of flooding and drying shapes how people build their houses, cultivate crops, and organize community life.

The island's freshwater supply is limited, as most ponds turn brackish due to tidal influence. People rely on rainwater harvesting, shallow wells, and pond water for daily needs. Over the years, erosion and rising sea levels have reduced habitable land, forcing some families to move inland or to other islands.

Despite these challenges, Satjelia's communities show remarkable resilience and adaptability. Their way of living; building homes on raised plinths, reinforcing embankments, and adjusting to changing water levels; reflects a deep understanding of the rhythms of water and land in the Sundarbans.

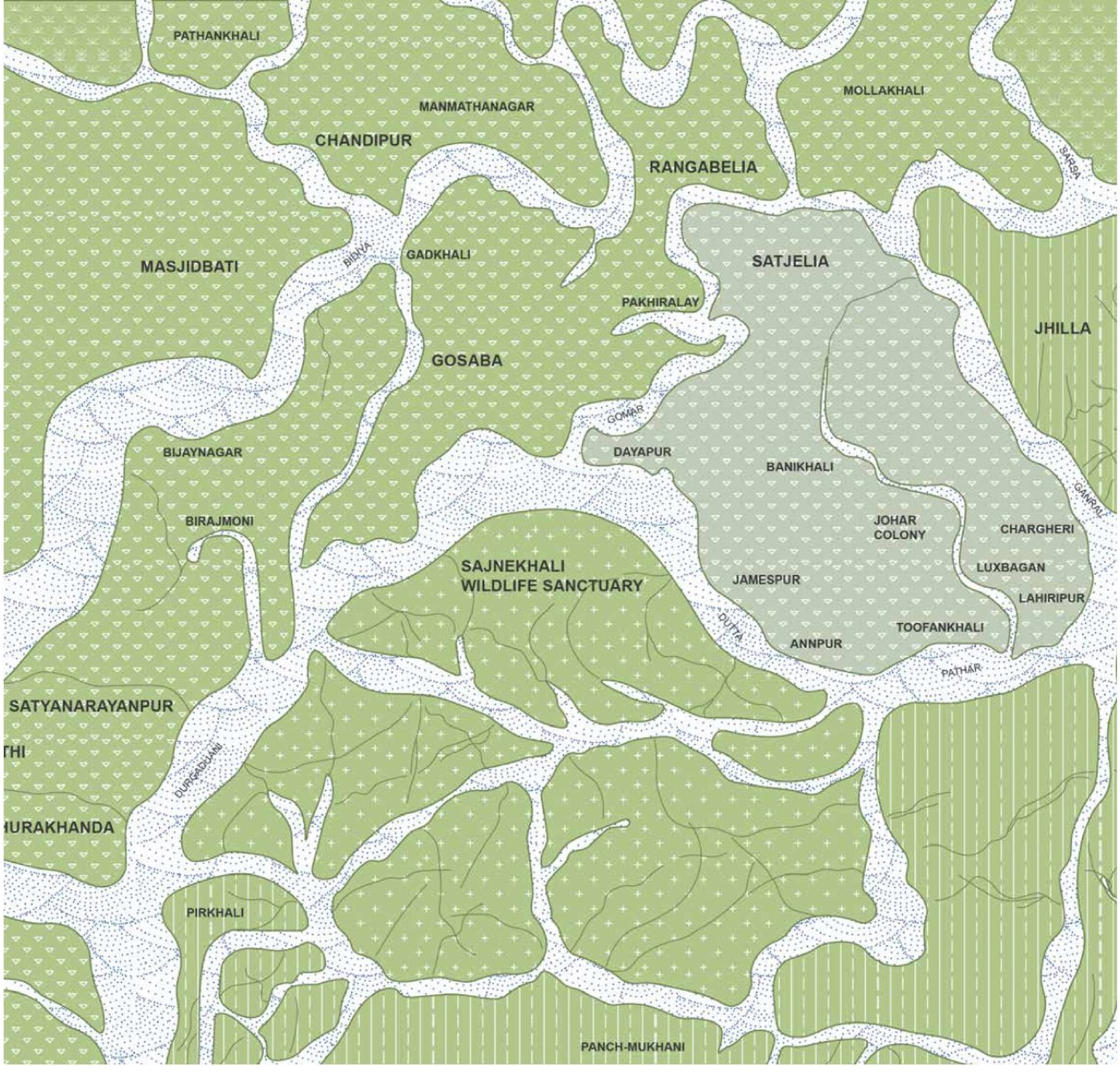


Fig. 11: Thematic Map of Satjelia Island

To reach Satjelia Island from Kolkata:

1. Local Train from Sealdah Station to Canning: **1 hr**
2. Motor Van from Canning Station to Godkhali: **2hr**
3. Ferry from Godkhali to Gosaba Ferry Ghat: **45 min**
4. Motor Auto from Gosaba Bazar to Pakhiralay Ferry Ghat: **30 min**
5. Ferry from Pakhiralay to Dayapur Ferry Ghat: **1 hr**
6. Auto from Dayapur to Anpur, Satjelia: **45 min**

LEGEND

- Satjelia Village Panchayat Boundary
- Lahiripur Village Panchayat Boundary
- Wetlands / Water Bodies, Rivers, Canals
- Agriculture Land / Crop Land / Plantation
- Built-Up / Rural
- Forest / Forest Plantation
- Forest, Swamp / Mangroves
- Wetlands / Agricultural Land
- Forest, Mangove / Swamp Area
- Market
- Ferry Ghat
- Temple
- Village
- School
- Buildings
- Road / Embankments
- Site

Fig. 12: Village Map of Satjelia Island

3.2.1 Vernacular Architecture

Vernacular architecture in water-based landscapes such as the Sundarbans is shaped by a continuous process of **adaptation to climate, hydrology, and terrain.** Unlike conventional construction, these built forms are not designed for permanence, but for flexibility, repair, and transformation over time.

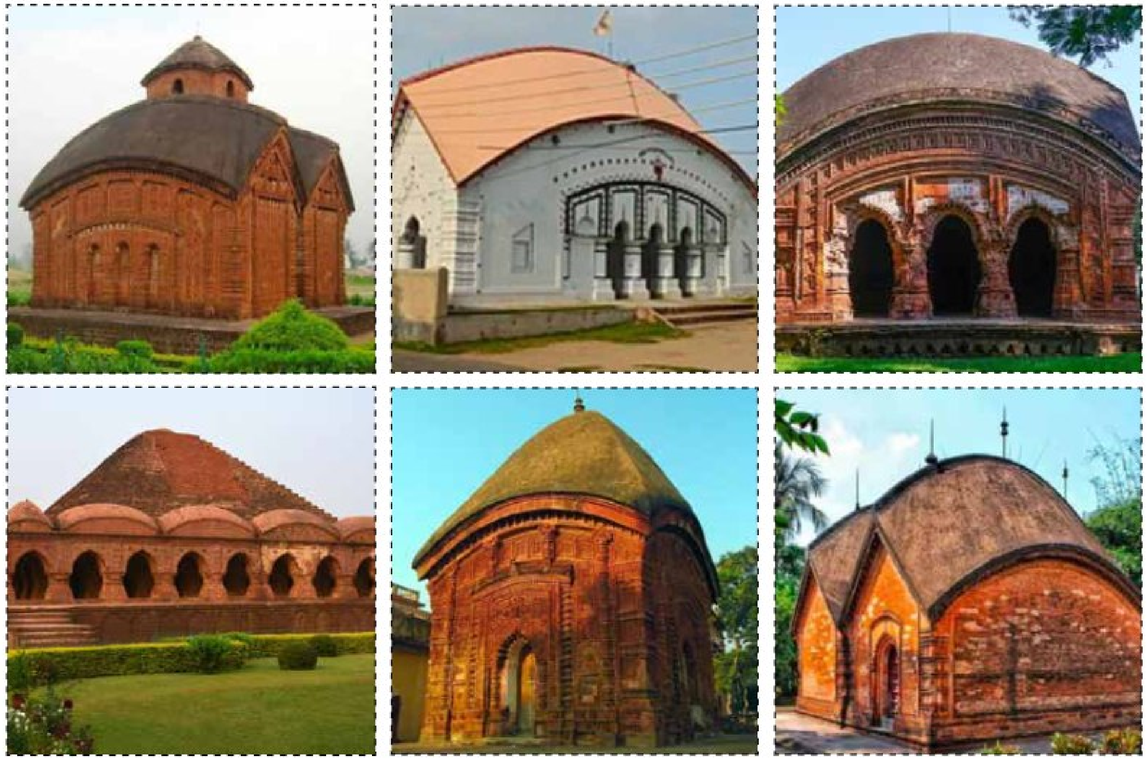
Local communities have developed spatial systems that respond directly to tidal fluctuations, flooding, and unstable ground conditions, using lightweight materials such as bamboo, timber, and thatch. These structures are often elevated, modular, and easy to reconstruct, allowing them to adjust to seasonal and environmental changes.

Spatial and Cultural Logic
The organization of space in vernacular settlements reflects a strong relationship between **community, livelihood, and environment.** Built forms are rarely isolated objects; instead, they function as part of a larger **network of shared spaces,** supporting activities such as living, learning, gathering, and working.

This results in spaces that are:
- **Multifunctional** rather than single-use
- **Open and flexible** rather than enclosed
- **Collective** rather than individual

Material and Construction Approach:
Construction techniques rely on:
- **Local availability of materials**
- **Lightweight structural systems**
- **Joinery-based connections**
- **Ease of assembly and disassembly**

This allows buildings to be incrementally built, modified, or relocated, supporting a more resilient and adaptive form of habitation.



Img. 13: Roof typologies

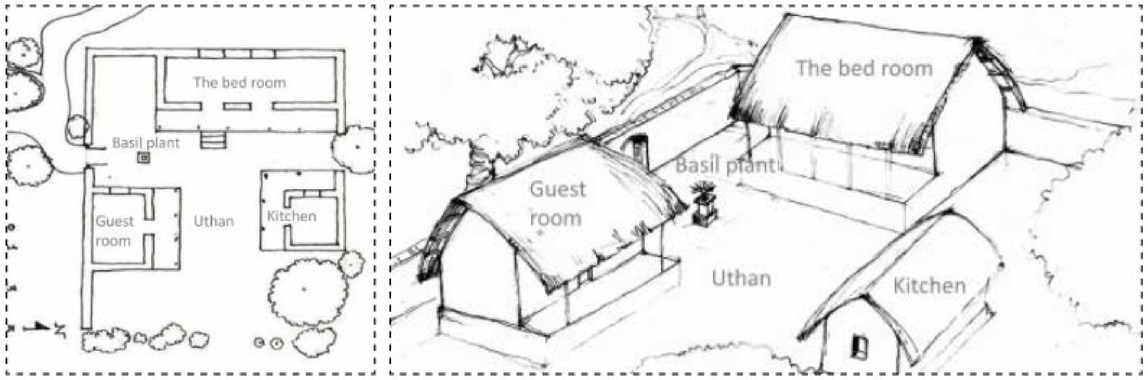


Fig. 13: Sketches showing different parts of a typical rural Bengal homestead

In the Ganges Delta region of Bengal, vernacular settlements are typically organized around a central courtyard (uthan), which serves as the focal point of daily household activities. The courtyard functions as a multifunctional space for drying agricultural produce, cooking, children's play, and social interactions. The dwelling units are arranged as separate structures around this courtyard, allowing for adequate airflow while maintaining privacy within the homestead.

A traditional rural Bengali homestead generally accommodates an extended family, with individual dwelling units assigned to different family members within a shared compound. Historical accounts suggest that this pattern of dispersed habitation has existed in the region for a long time (King, 1984). One possible reason for this arrangement is the warm and humid climate of Bengal, where detached structures facilitate cross ventilation more effectively than larger, consolidated buildings.

Based on these characteristics, the vernacular rural homestead of Bengal can be understood as comprising two primary components: the courtyard, which acts as the social and functional core of the settlement, and the surrounding dwelling units, which provide residential and ancillary spaces.

source: https://www.slideshare.net/slideshow/bengal-vernacular-architecture-of-rural-bengal/266779001

04

+ Contextual Approach

To understand the Sundarbans, it is essential to look beyond its present condition and trace the historical relationship between land, water, and habitation. The region has evolved through continuous processes of sedimentation, tidal movement, and human adaptation, shaping both its physical form and cultural identity.

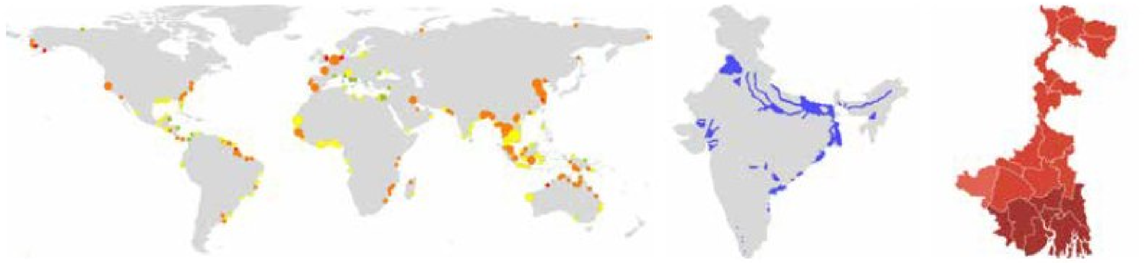
Keywords :
Morphology, Deltaic landscape, Vernacular architecture, Amphibious living, Community networks, Adaptation, Resilience

4.1.1 Why Sundarbans?

Global Inundation Hotspots

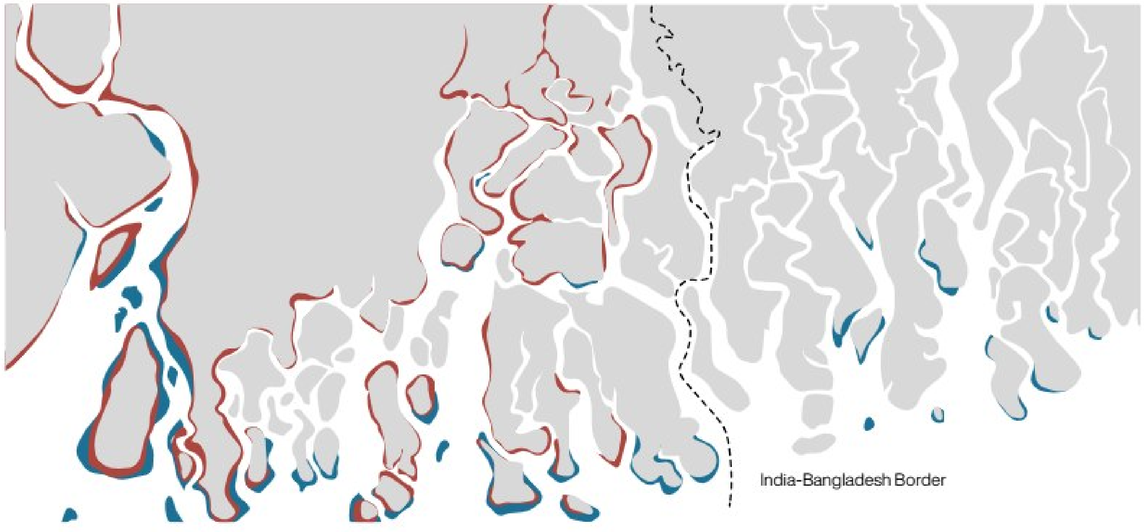
Cyclones and floods are major climate-related threats across the globe, affecting diverse regions with increasing intensity. In the United States, low-lying coastal states such as North Carolina, Virginia, and Maryland are becoming more vulnerable due to sea-level rise, storm surges, and stronger Atlantic hurricanes. Europe faces similar challenges, with regions including the United Kingdom, northern France, and northern Germany experiencing heightened flood risks driven by North Atlantic storm systems and riverine flooding.

Asia, however, bears a disproportionate burden due to high population densities and deltaic geographies. Regions in China, Bangladesh, and India experience frequent and severe cyclones and monsoon-related flooding. Among these, the Sundarbans stands out as one of the most vulnerable landscapes globally, where rising sea levels, intensifying cyclones, and tidal flooding directly threaten both human settlements and fragile mangrove ecosystems.



source: ResearchGate / Global-hotspot-regions-of-changes-in-episodic-coastal-flooding-in-2100

Fig. 14: Global Hotspots, Flood Prone Regions

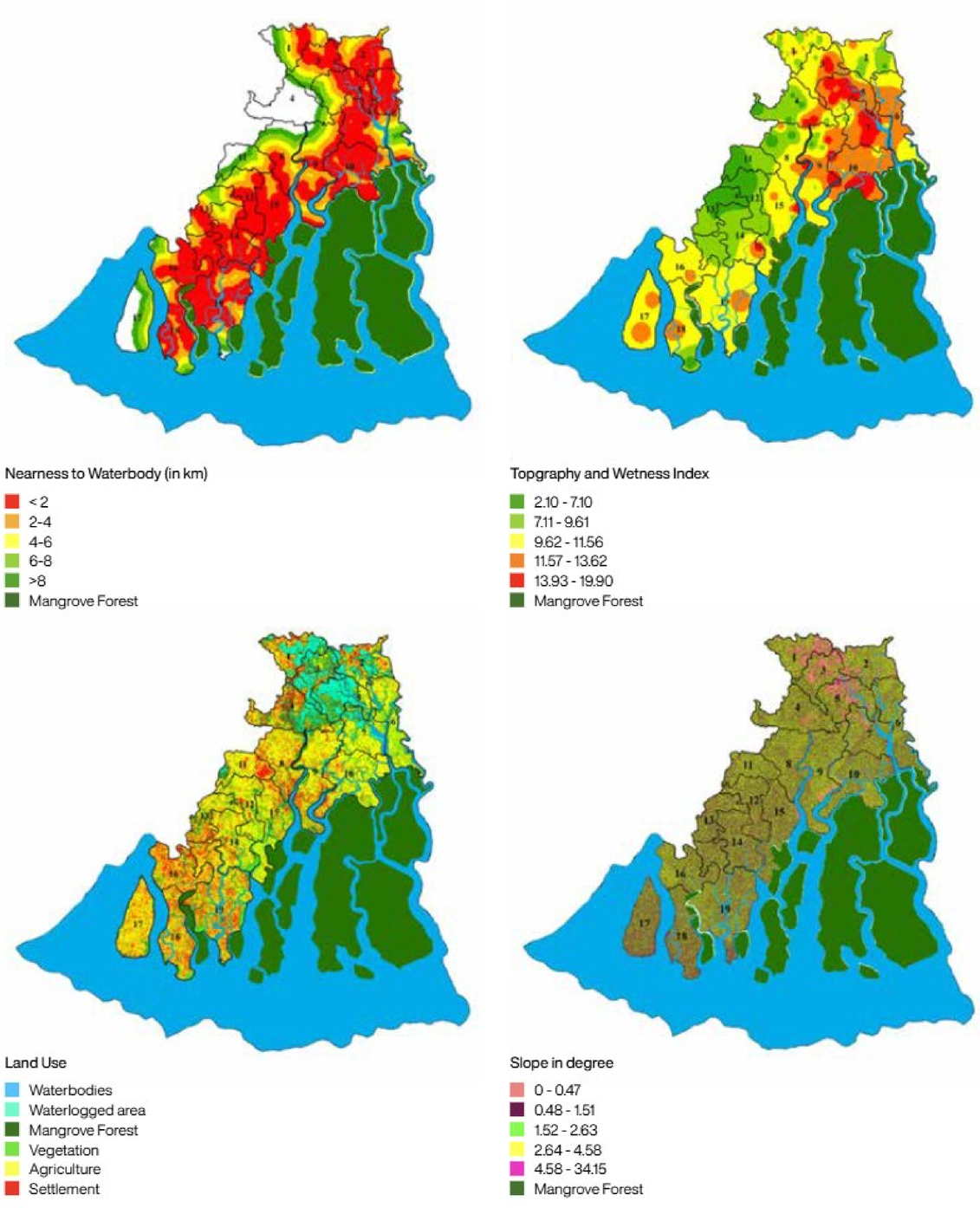


12% of the land is lost from the shoreline of the Sundarbans in the last four decades due to coastal erosion.

Land lost due to erosion and sea-level rise

Areas that are vulnerable to sinking in the next 30 years

Fig. 15: Erosion-Accretion Map



source: ResearchGate / Application of GIS-based analytic hierarchy process and frequency ratio model to flood vulnerable mapping and risk area estimation at Sundarban region, India

Fig. 16: Different Geographical and Geological maps of Indian Sundarbans

4.1.2 Climate

Overview

The Sundarbans, located within a vast deltaic system, experiences a **tropical humid climate** characterized by high temperatures, intense monsoon rainfall, and consistently high humidity levels throughout the year. These conditions create an environment where heat and moisture dominate, making comfort highly dependent on airflow, shading, and material response. The seasonal monsoon further intensifies this condition, bringing heavy rainfall that transforms large portions of land into temporarily submerged landscapes.

Within this broader context, **Satjelia Island** reflects a more localized intensification of these climatic conditions due to its **island morphology and proximity to tidal water bodies.** The presence of surrounding rivers and creeks results in increased moisture retention, frequent waterlogging during monsoon months, and limited air movement in certain areas. The climate here is not only experienced as temperature, but as a combined effect of **humidity, water presence, and reduced ventilation**, making spatial comfort a critical concern.

At the scale of the **Anpur region**, these conditions become even more pronounced. The site, being **low-lying and closely tied to tidal influence,** undergoes continuous transitions between dry, damp, and submerged states. High humidity levels often lead to discomfort in enclosed environments, while inconsistent wind patterns reduce the effectiveness of natural cooling. As a result, climate is not just a background condition, but a direct determinant of how space is occupied, experienced, and designed.

This region experiences three main seasons: Pre-Monsoon, Monsoon, and Post-Monsoon.

- The Pre-Monsoon season runs from March to June and is the hottest part of the year. Temperatures are high, and the weather is mostly dry as the region prepares for the arrival of the monsoon.
- The Monsoon season lasts from July to October and is marked by heavy rainfall. This rainfall lowers temperatures, but humidity rises significantly, staying between 70% and 80%.
- The Post-Monsoon season, from November to February, is cooler and more comfortable, making it the most pleasant time of the year.
- Humidity is highest during the months of June to October and lowest in February.
- During the months of January and February dense ground mists occur in the early morning.

JUNE / 115 mm
25 °C / 35 °C

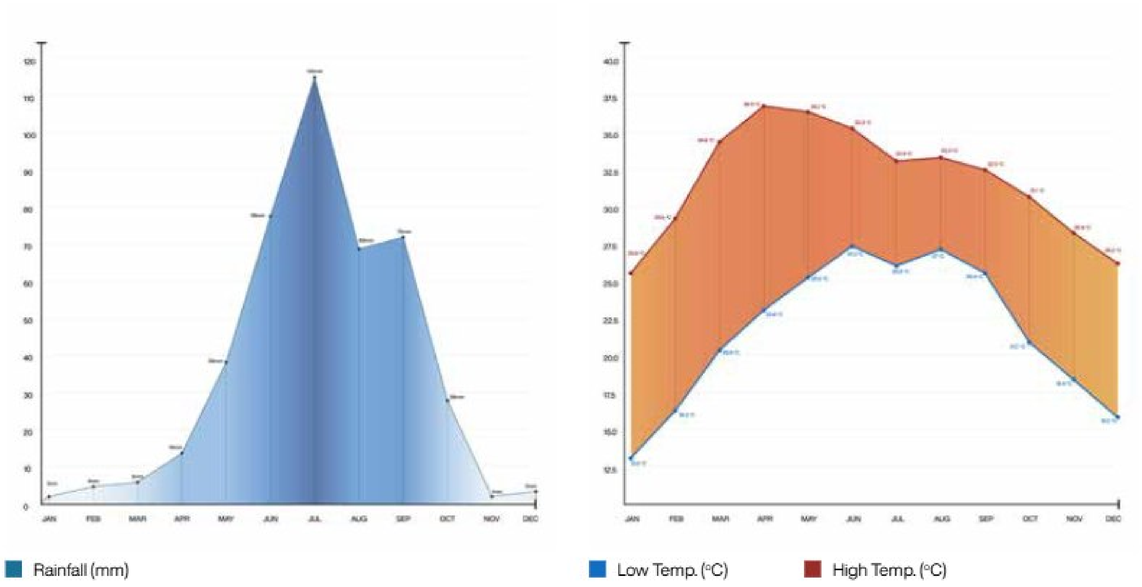
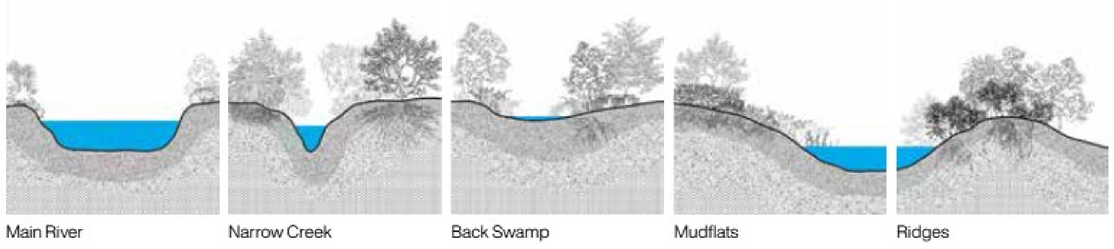


Fig. 17: Climate chart

The Sundarbans is a unique delta landscape shaped by tidal rivers, creeks, swamps, mudflats, and ridges. The main rivers form the primary channels, constantly influenced by tides that reshape the land and transport sediment. Narrow creeks branch through dense mangrove forests, providing sheltered habitats and movement routes for aquatic life and wildlife. Back swamps are low-lying, waterlogged areas that remain flooded for long periods, especially during monsoon seasons, supporting plant species adapted to saturated soils. Mudflats develop from deposited sediments and serve as important feeding grounds for birds and estuarine organisms. Slightly elevated ridges provide relatively stable ground, supporting salt-tolerant vegetation and offering refuge for terrestrial animals during floods. Together, these landforms create a dynamic and highly biodiverse tidal ecosystem.



source: CEPT Portfolio / https://portfolio.cept.ac.in/2024/S/fa/designed-ecologies-la4004-spring-2024/the-edge-conservations-at-sundarbans-threshold-spring-2024-pia22053

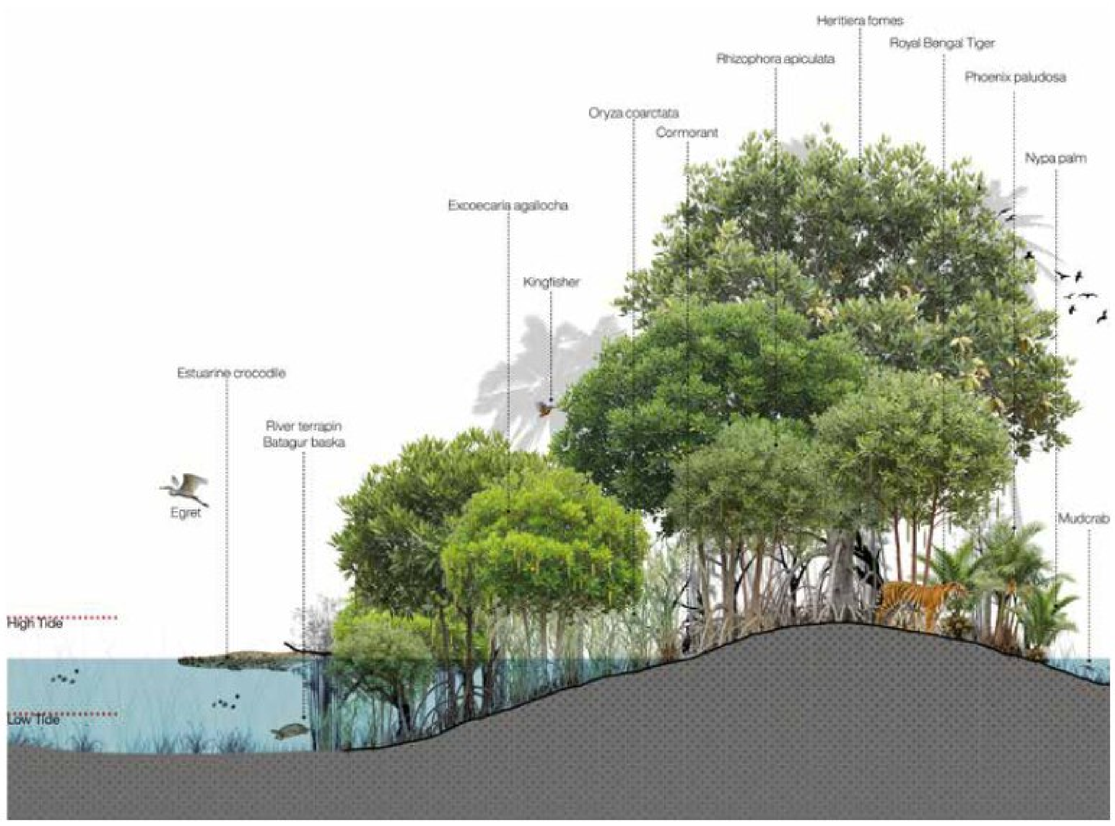


Fig. 18: Inter-relation between landform, flora & fauna

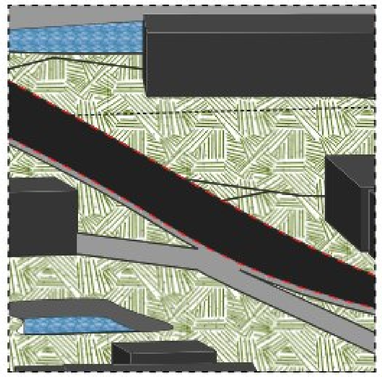
4.1.3 Anpur Region

Site Conditions

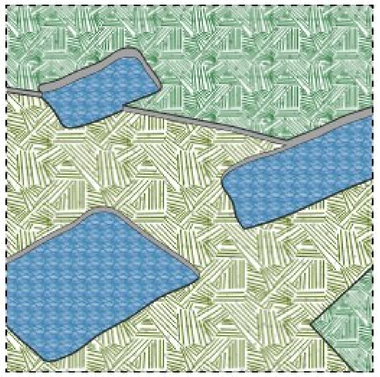
The site sits within a flood-prone coastal landscape where water levels can rise up to 1.5 to 2 meters during peak seasons, so elevation and flood resilience are not optional, they're fundamental. Mangroves along the edge act as a natural protective buffer, reducing wind impact and wave force, which means they should be preserved and integrated rather than cleared. A raised road embankment forms a strong linear boundary, shaping access, movement, and drainage while separating land from water. The buildable zone lies along the higher contours, offering a safer footprint for development and guiding placement decisions.

Aquaculture ponds are already embedded in the landscape, supporting local livelihoods, so any proposal should respect and potentially enhance this productive system. Vegetation clusters around ponds and houses contribute to soil stability and microclimate control. Views toward the water create strong visual connections that can define orientation and spatial hierarchy. Overall, the site calls for a sensitive, elevated, and dispersed intervention that works with water, vegetation, and existing settlement patterns rather than against them.

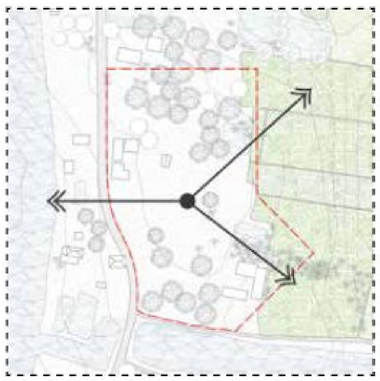
Mangrove Buffer Zone:
Dense mangroves act as a natural windbreak and storm barrier, reducing wave energy and protecting inland areas.



Road Embankment Spine:
The raised road infrastructure creates a physical edge and separates the site from the water body, shaping access and drainage patterns.

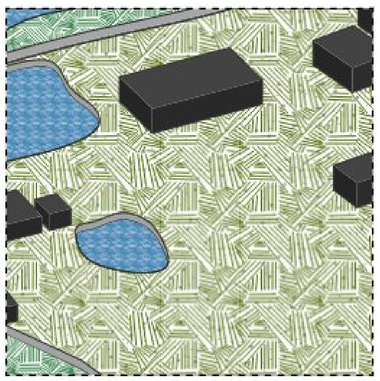


Aquaculture Pockets:
Scattered ponds are used for aquaculture, forming productive water landscapes integrated into the settlement fabric.



View Corridors:
The site opens toward key visual axes, capturing long views toward water and landscape while maintaining internal visual connections.

Highest Contour Placement:
The selected zone sits along the higher contours, minimizing flood risk and improving natural drainage.



Dispersed Settlement Pattern:
Housing clusters are loosely distributed along the water edge, reflecting an organic growth pattern

Fig. 19: Diagrams of kinds of site conditions

SWOT Analysis:

STRENGTHS

- Located in a highly climate-sensitive zone, making the project directly relevant to **real-world disaster resilience.**
- Frequent flooding, cyclones, embankment breaches, and salinity issues justify the **need for adaptive infrastructure.**
- Strong community networks and collective survival practices already exist, **supporting community-centered architecture.**
- **Existing knowledge** of local building practices, stilt structures, embankment repair, and water adaptation can inform design.
- Presence of water bodies, mangroves, and open landscapes allows **integration of ecological systems** into architecture.
- The site has the potential to function **both as a daily community space** and **as emergency disaster infrastructure.**

WEAKNESSES

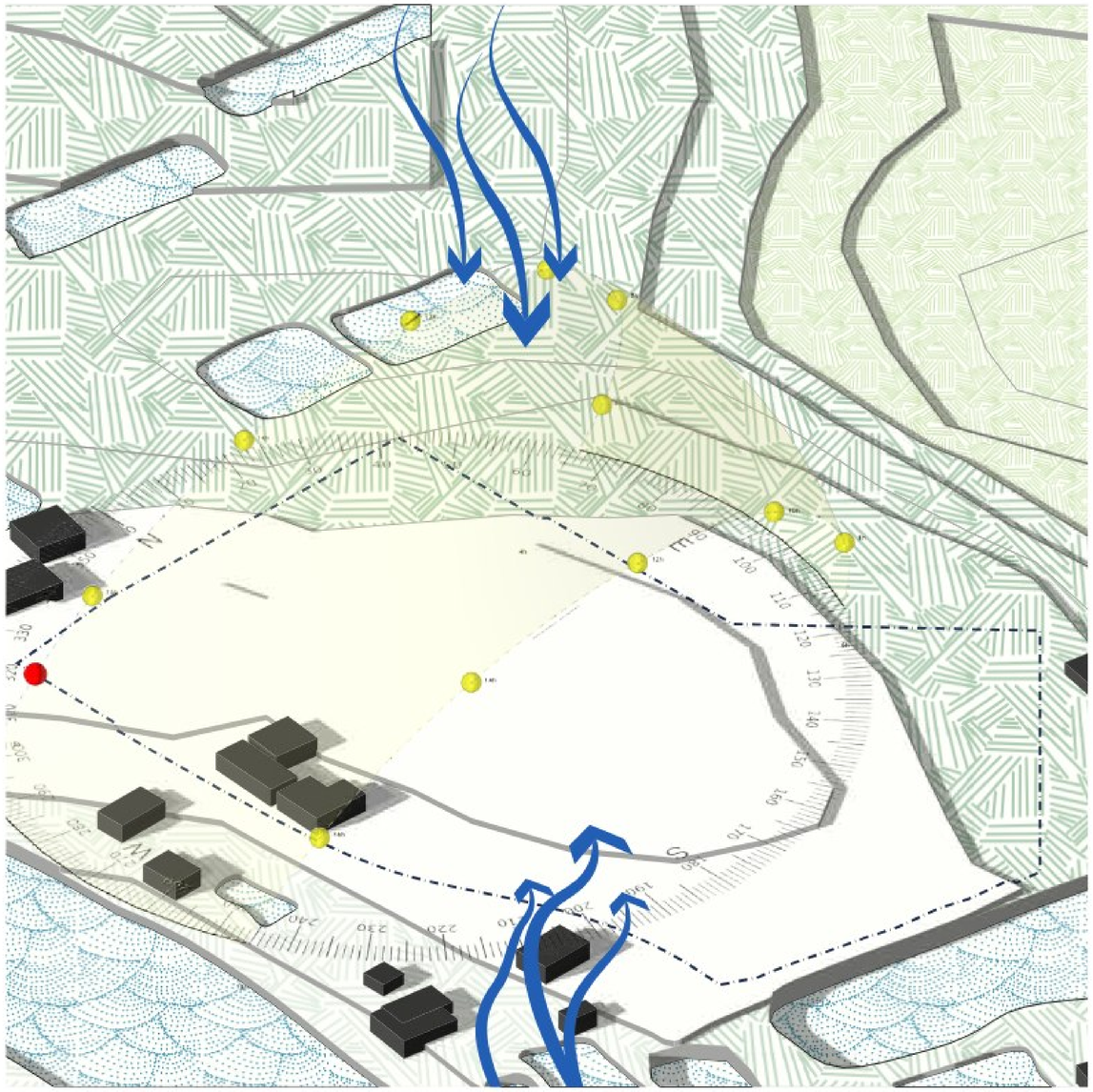
- **Remote island condition** creates transportation and construction difficulties.
- **Limited access** to healthcare, higher education, emergency infrastructure, and construction materials.
- **Poor road connectivity** and dependence on waterways affect accessibility during disasters.
- Soil instability, waterlogging, and saline conditions complicate foundations and long-term durability.
- Power supply, sanitation, and communication systems are often unreliable during cyclones.
- **Seasonal migration** and economic instability reduce continuity of local livelihoods.

OPPORTUNITY

- To create **a prototype** for climate-adaptive community architecture in deltaic regions.
- Can integrate rainwater harvesting, elevated structures, floating systems, and resilient landscapes into the design.
- Scope for combining vocational training, disaster relief, shelter, and community gathering into **one adaptive program.**
- Possibility of using local materials like bamboo, timber, thatch, and modular systems suited to wetland ecology.
- Can become a **socially driven resilience hub** strengthening local identity and reducing migration pressure.
- Opportunity to propose **decentralized infrastructure** instead of conventional mainland-based systems.

THREATS

- Increasing **cyclone intensity** and **sea-level rise** threaten long-term habitability.
- **Salinity intrusion** can damage agriculture, freshwater systems, and vegetation.
- **Embankment failures** and tidal flooding may isolate the site during emergencies.
- Continuous erosion and land loss threaten settlements and infrastructure.
- Climate migration and population displacement may destabilize the social fabric.
- Environmental regulations and protected ecosystem conditions may restrict construction interventions.



Sun Path : Summer Solistice (June)
The sun rises northeast and sets northwest, with a high solar angle. The west side receives harsh heat, while the east gets softer morning light.

Sun Path : Winter Solistice (December)
The sun rises southeast and sets southwest, following a lower path. The south side receives maximum sunlight, while the north remains diffused.

Wind Direction : April - September
Southwest monsoon prevails, with winds flowing from the southwest to northeast, bringing heavy rainfall, high humidity, and strong coastal winds.

Wind Direction : October - March
Northeast winds dominate, moving from northeast to southwest, creating a cooler and drier environment with lower wind intensity.

Fig. 20: Sun-path and Wind Direction diagram

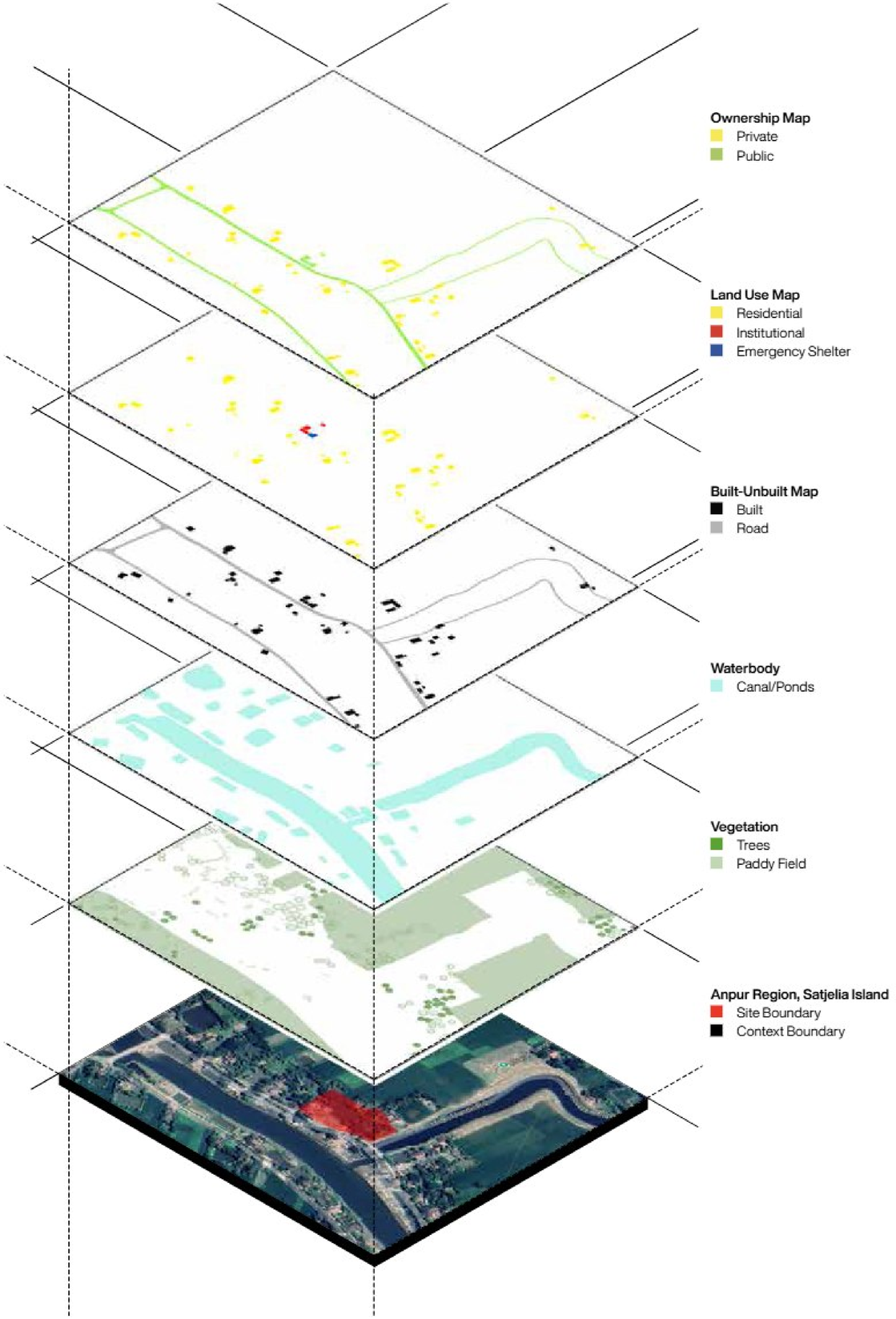


Fig. 21: Layered Mapping of the site

Anpur Flood Shelter

Anpur Adivasi Dining Hall

Udayan Sangha Playground

Anpur

Anpur Hindu Milan Mandir

Silver Jubilee Solar Power Plant

Rajat Jubilee Blood Center

Rajat Jubilee Playground

Rajat Jubilee High School

Bonbibi Temple

Fig. 22: Google Earth view of Satjelia Island

4.2.1 Waterways

River and Water Networks

In Anpur, the system of waterways is the primary structure that defines movement, access, and everyday life. The settlement is embedded within a network of tidal creeks and river channels, where water acts as both a connector and a barrier. Unlike regions with continuous road infrastructure, access here is largely dependent on boats, informal jetties, and embankment edges, making mobility inherently linked to water conditions.

Movement within and beyond Anpur is not constant, but time-dependent, shaped by tidal cycles, seasonal variations, and weather conditions. During regular periods, waterways enable connections to nearby settlements and shared resources; however, during monsoons or high tides, these routes become unpredictable, slower, and at times inaccessible. This creates a condition where distance is not measured in kilometers, but in time, effort, and risk.

Img. 14: People waiting to get into the ferry

Img. 15: Fishermen on boat in creek

4.2.2 Land Infrastructure and Roads

Land-Based Movement and Edge Conditions

In Anpur, the boundary between land and water is not a fixed line, but a constantly shifting zone of negotiation. Both natural and man-made embankments form these fragile edges, acting as transitional thresholds where everyday life unfolds. These slightly elevated strips of land simultaneously function as **circulation routes, ferry access points, and protective barriers against tidal flooding**, compressing multiple roles into a single spatial element.

However, these embankments remain highly vulnerable. Continuous tidal action, erosion, and seasonal reshaping make them unstable and temporary, placing them among the most fragile components of the landscape. Their form and usability are in constant flux, changing with water levels, weather conditions, and time.

Despite this instability, embankments in Anpur are not just infrastructural edges; they are lived spaces where mobility, livelihood, and social interaction converge. People move along them to reach ferry ghats, transport goods, and connect with nearby settlements. Daily movement across the settlement is carried out primarily through **two-wheelers, motorized vans, and on foot**, all of which depend on the condition of these narrow pathways.

The marks left by receding tides, the softening of soil, and the shifting edges of land continuously redefine these routes, reinforcing the idea that movement in Anpur is shaped by an ephemeral relationship between human activity and natural cycles.

Img. 16: Raised embankment path functioning as access route and flood edge.

Img. 17: Informal trail shaped by tides, erosion, and daily use.

4.2.3 Education Facilities

Education Facilities in Anpur

In Anpur, access to education is shaped less by distance and more by connectivity, terrain, and environmental conditions. While primary schools exist within or near the settlement, access to secondary and higher education requires movement across embankments, waterways, and neighboring settlements, making continuity in education highly dependent on daily accessibility.

The existing educational infrastructure in and around Anpur is **limited in capacity and uneven in distribution**. Primary-level facilities are relatively more accessible; however, as the level of education increases, institutions become **fewer and more distant**, requiring students to travel longer and more complex routes. This transition creates a visible drop in accessibility, particularly for older students.

Infrastructure Condition:
The physical condition of school buildings in this region reflects broader environmental and infrastructural challenges. Many structures are:

- Built using basic materials with limited climatic response
- Vulnerable to flooding, dampness, and material deterioration
- Poorly ventilated despite high humidity conditions
- Lacking adequate flexible or multipurpose spaces

In several cases, school buildings are also used as temporary shelters during extreme events, such as cyclones or flooding. While this reflects their importance as community infrastructure, it also places additional stress on already limited facilities.

Socio-Cultural Context of Education:
In Anpur, education is closely tied to the economic realities of the community, where a clear shift occurs after Class 8, with many students discontinuing formal schooling. This is largely driven by the need for household income support, as families depend on multiple livelihood sources within a fragile and uncertain environment. As a result, adolescents begin to engage in **secondary occupations** such as tourism-related work, local guiding, fishing assistance, small-scale trade, or seasonal migration. Over time, this creates a condition where **education becomes secondary to livelihood**, especially when access to higher-level schools is both physically difficult and inconsistent.

At the same time, learning continues outside formal systems through **everyday practices, skills, and community-based knowledge,** shaping a different but equally important form of education. However, this creates a disconnect between institutional learning and lived experience, reducing the perceived value of schooling. In Anpur, the issue is not just access to education, but its relevance and continuity, highlighting the need for learning environments that are flexible, locally rooted, and integrated with livelihood patterns.

Img. 18: View of Rajat Jubilee High School from Rajat Jubilee Flood Shelter

Img. 19: Community dinning during sports-festival in Rajat Jubilee High School, Anpur

Img. 20: Anpur Adibasi Primary school and dinning hall, left unused

4.2.4 Flood Shelters

Flood and Rescue Shelters

In Anpur, flood and cyclone shelters form an essential part of disaster-response infrastructure; however, their presence is largely episodic rather than continuous. These buildings remain **inactive for most of the year,** only opening shortly before an anticipated emergency. This limited use disconnects them from daily life, making them feel **detached from the community** and reducing familiarity, accessibility, and preparedness at the time of need. Instead of functioning as active civic spaces, they exist as standby structures, activated only under crisis conditions.

During extreme events, the shortcomings of this system become evident. **Capacity limitations, uneven distribution, and access constraints** often prevent these shelters from accommodating the entire population of Anpur. As a result, residents frequently turn to schools and other larger community buildings, which, despite not being designed as shelters, are capable of housing more people. This creates a reactive and strained system where infrastructure is temporarily repurposed rather than inherently adaptable.

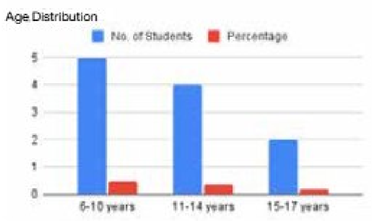
This condition reveals a critical gap in the spatial planning of Anpur: the absence of multi-functional, integrated infrastructure that serves both everyday and emergency needs. It underscores the necessity for spaces that remain active, familiar, and accessible in daily life, while being capable of transforming seamlessly into safe and resilient shelters during periods of environmental stress.

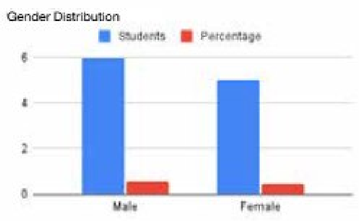
Img. 21: Rajat Jubilee Flood Shelter in Anpur

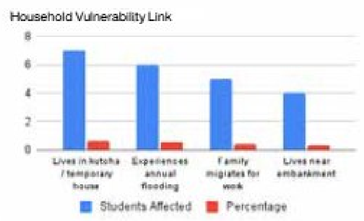
Img. 22: Rajat Jubilee Flood Shelter in Anpur (ground floor)

Img. 23: Anpur Flood Shelter, currently used as place to store construction materials

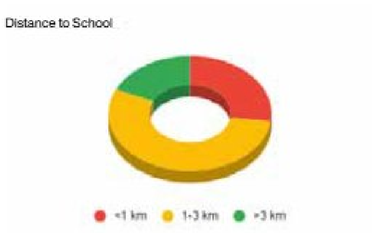
Student Demographic Profile

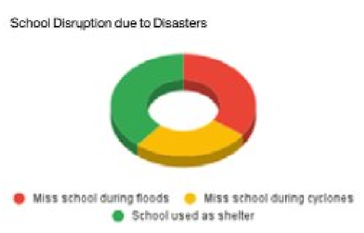




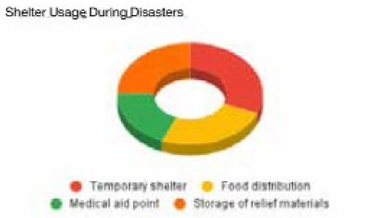


Student Access and Attendance

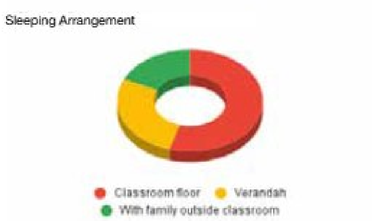


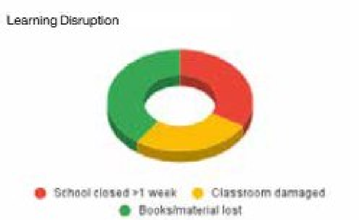


Student as a Community Shelter

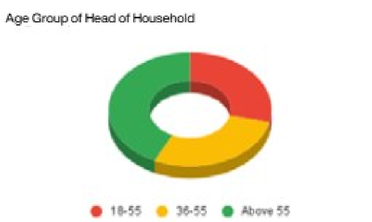


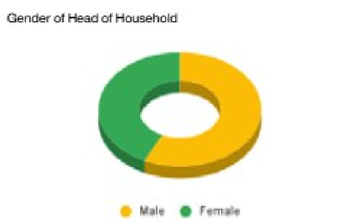
Student Experience during Shelter Use





A. Anpur Demographic Profile





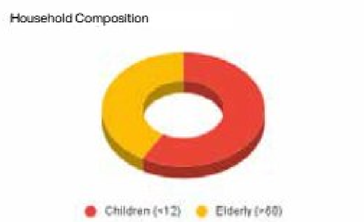
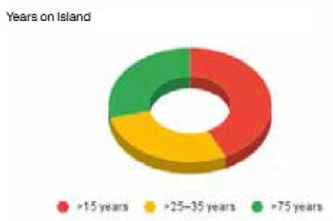
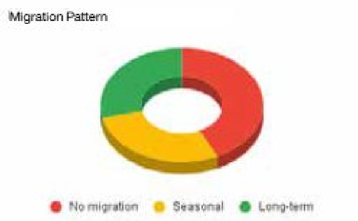
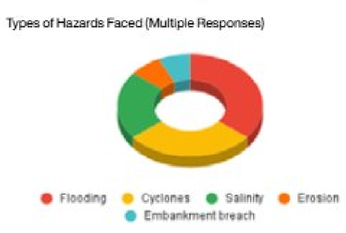


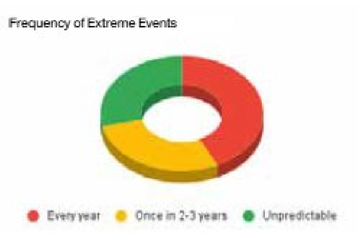
Fig. 23: Composition of survey responses from Rajat Jubilee High School and nearby households

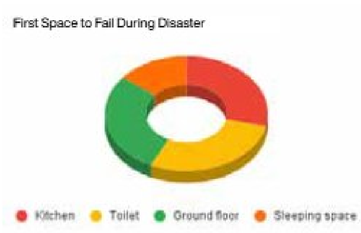




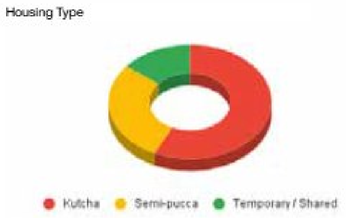
B. Environmental Experience

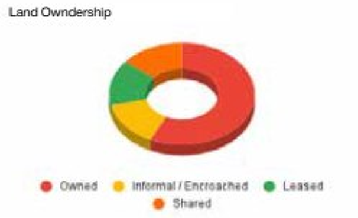


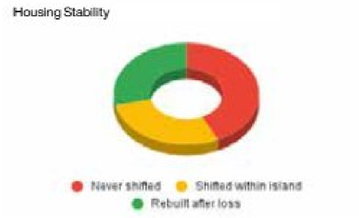




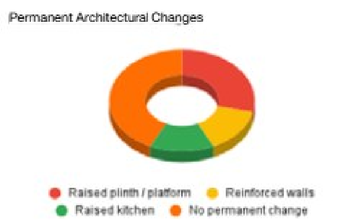
C. House, Land & Security

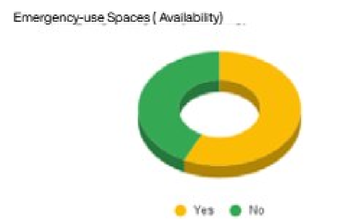




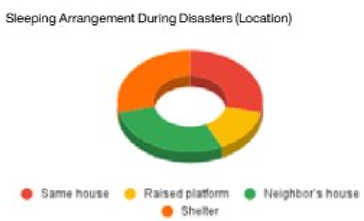


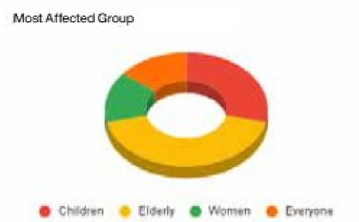
D. Spatial Adaptations





E. Daily Life Under Stress





* The data presented above is drawn from seven households.

4.3.1 Users

In Anpur, the user group is shaped by a close-knit, resource-dependent community, where everyday life is deeply connected to the surrounding landscape and water systems. The population primarily consists of local families, children, youth, and working adults, whose routines are structured around livelihood activities such as fishing, small-scale trade, agriculture, and seasonal labour. Movement, occupation, and social interaction are all influenced by tidal cycles, accessibility, and environmental conditions, making the user profile dynamic rather than fixed.

What this really means is that users in Anpur cannot be understood as stable categories, but as **constantly shifting roles.** A single individual moves between identities over time; student, worker, caregiver, or migrant; depending on seasonal demands and environmental uncertainty. The idea of a "user" here becomes a **temporal condition**, emerging from necessity rather than permanence.

Children and adolescents form a significant user group, particularly in relation to educational spaces. However, this role is often short-lived. Many students gradually withdraw from formal education after the middle school level, transitioning into income-generating activities such as fishing, tourism support, manual labour, or migration-based work. This shift is not abrupt but layered, reflecting how **education and livelihood overlap rather than exist separately,** creating a need for spaces that can accommodate both learning and working.

Adults similarly do not belong to a single occupational identity. A farmer may also fish, a fisherman may operate a ferry, and during times of crisis, all become part of a collective survival network. Women play a crucial role in sustaining this system, managing households, participating in informal economies, and maintaining social networks. Their spatial needs often revolve around shared, flexible environments that support collective interaction, small-scale work, and resource exchange. At the same time, children and elderly users require safe, accessible, and climate-responsive spaces, especially during periods of flooding or extreme weather.

Another layer of users emerges during seasonal disruptions such as floods or cyclones, when the entire community reorganizes around shelter, safety, and resource sharing. In these moments, individual roles dissolve, and the settlement functions as a **single collective user group**, occupying schools, embankments, and elevated structures as spaces of refuge. Buildings shift from being singularly programmed to becoming multi-functional, accommodating diverse and urgent needs.

Seen through this lens, users in Anpur are best understood as overlapping states of existence shaped by transition, seasonality, and uncertainty. This fluidity directly challenges conventional architectural programming and highlights the need for spaces that are not rigid, but flexible, inclusive, and capable of adapting to multiple uses over time.

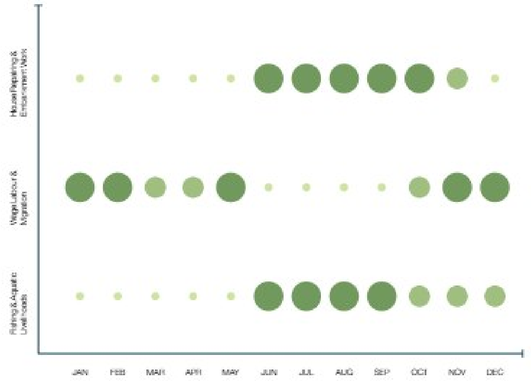
DEMOGRAPHICS (SATJELIA ISLAND):

- Total Population: ~9,000-10,000
- Male Population: ~5100
- Female Population: ~4,400

- Small, scattered rural population across multiple hamlets
- Settlements separated by creeks and embankments
- High dependence on daily or seasonal income
- Livelihoods are seasonal based

- Houses are either kutcha or semi-pucca houses
- Settlements are aligned along embankments or higher-ground.

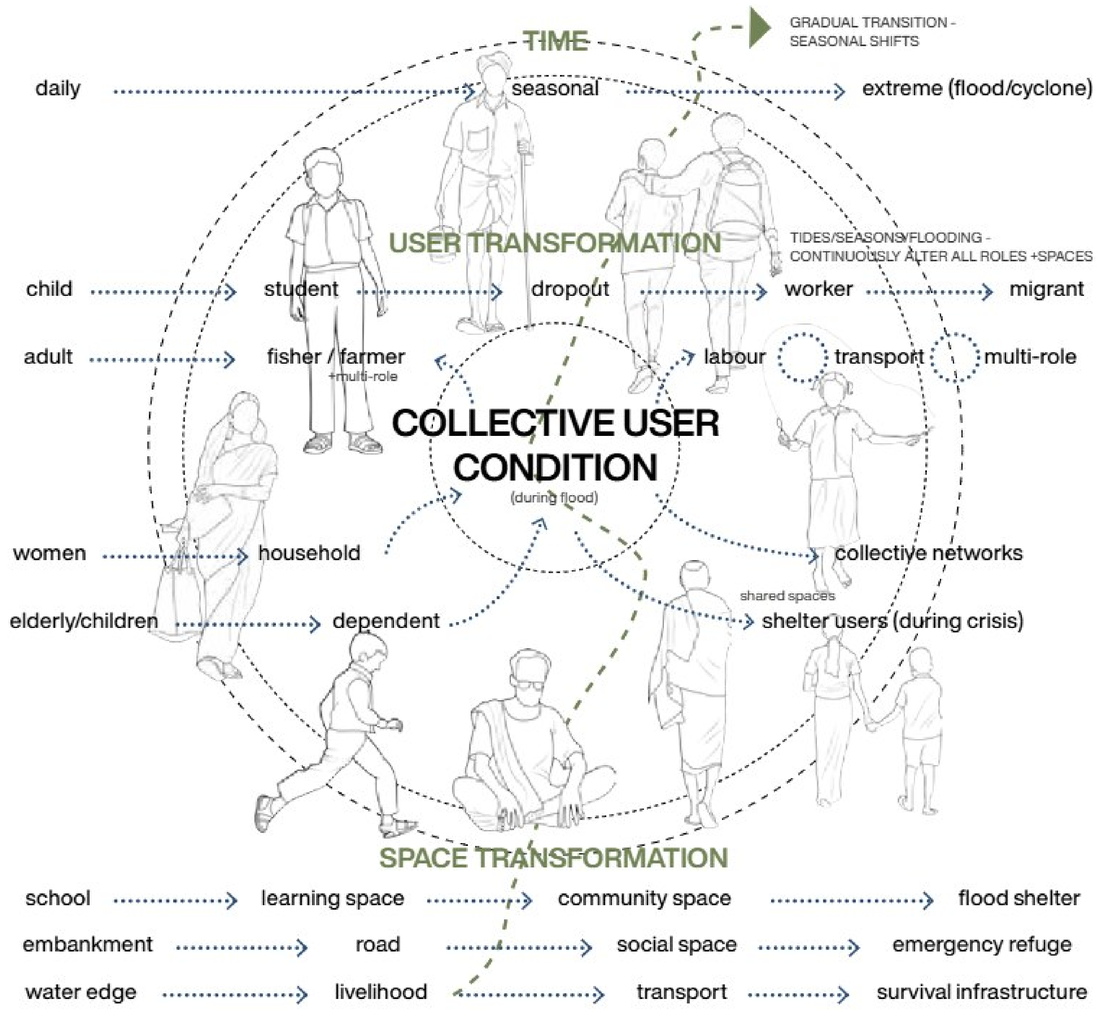
source: census 2011



LIVELIHOOD DEPENDENCE:

AGRICULTURE (Paddy-based)

- MAR-MAY : Land preparation (high salinity, low yield expectation)
- JUN-SEP : Cultivation (high flood & crop-loss risk)
- OCT-NOV : Harvest (uncertain output)
- DEC-FEB : Mostly inactive / limited secondary crops



Life and livelihood in Annpur are seasonal negotiations. People shift roles month by month, making time and uncertainty central to how architecture must operate.

Fig. 24: Collective User condition

+ Contextual Approach

Partial Conclusion

The contextual study of Anpur reveals a landscape defined by continuous negotiation between land, water, and human habitation. Rather than a stable ground condition, the settlement exists within a dynamic deltaic system where tidal fluctuations, erosion, and seasonal flooding constantly reshape both physical space and patterns of use. As seen across the site analysis, infrastructure, movement, and habitation are not fixed systems but adaptive responses to environmental uncertainty.

Mobility and accessibility emerge as critical constraints. The dependence on waterways and fragile embankments creates a time-based rather than distance-based understanding of connectivity. Movement is inconsistent, seasonal, and often disrupted, directly affecting access to education, resources, and social networks. This condition highlights that infrastructure in Anpur is not merely about provision, but about resilience, continuity, and adaptability

The study also exposes significant gaps in existing social infrastructure. Educational facilities are limited, environmentally vulnerable, and disconnected from local livelihood patterns, leading to high dropout rates after middle school. Similarly, flood shelters function as inactive, emergency-only spaces, failing to integrate into everyday community life. In both cases, buildings lack flexibility, resulting in a reactive rather than proactive spatial system.

At the community level, users are not fixed but fluid, shifting between roles based on season, livelihood, and environmental conditions. This creates a dynamic user profile where spaces must accommodate learning, working, gathering, and sheltering simultaneously. The overlap between everyday life and emergency conditions further reinforces the need for multi-functional and adaptable environments.

Climatically, the high humidity, intense rainfall, and limited airflow conditions make passive comfort strategies essential. The environmental context is not a background layer but a primary driver of spatial experience, material choice, and form. This reinforces the importance of climate-responsive and bioclimatic design approaches in the region.

Overall, the contextual analysis makes one thing clear: **the challenge in Anpur is not just lack of infrastructure, but lack of adaptive infrastructure.** The findings point toward the need for architectural interventions that are flexible, elevated, climate-responsive, and integrated with local livelihoods. Spaces must remain active in everyday life while being capable of transforming during periods of environmental stress. This establishes the foundation for a design approach that moves beyond static solutions, towards adaptive, multi-functional, and resilient spatial systems rooted in the realities of Anpur.

05

+ Regulatory Framework

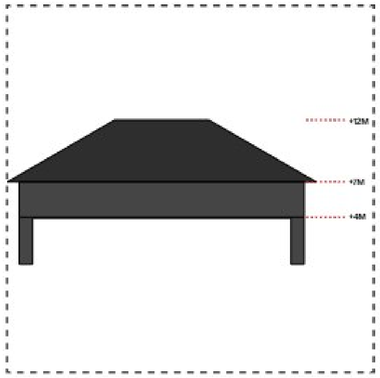
Anpur in the Sundarbans exists within a loose regulatory setup shaped by environmental risks and informal practices. This chapter reviews key policies for coastal, flood-prone, and ecologically sensitive areas, while noting a gap in guidelines for amphibious architecture. It aims to bridge formal rules with local realities to support a practical, context-responsive design approach.

Keywords :
Coastal regulation, embankments, floodplain, adaptive architecture, disaster resilience, Sundarbans, rural infrastructure

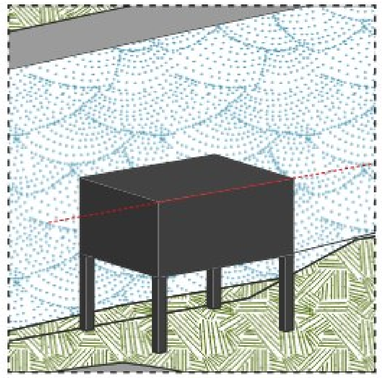
+ 5.1.1 | Coastal Regulation Framework (CRZ)

The site comes under **CRZ–III**, which applies to relatively undisturbed and rural coastal areas like the Sundarbans. This means the first 200m from the High Tide Line is treated as a No Development Zone, where construction is generally not allowed except for essential activities. Between 200m and 500m, development is permitted but remains strictly regulated. A minimum setback of 50m from creeks or tidal water bodies must be maintained. Mangrove patches are ecologically sensitive and completely non-buildable, with no construction or even pathways allowed through them. Building height is restricted to 12m, and development is limited to Ground + 1 floor.

Alongside CRZ norms, the design must follow the **National Building Code** for structural stability, fire safety, sanitation, accessibility, and services. Since the region is cyclone-prone and flood-vulnerable, the design must respond accordingly. Elevated plinth levels, wind-resistant structural systems, proper drainage planning, and safe evacuation routes are not optional features but essential requirements for the site.

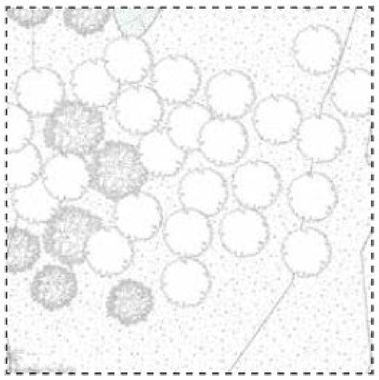


Height Control:
Maximum building height restricted to 12m above natural ground level.



Built Form Limitation:
Development limited to Ground + 1 floor only.

Coastal Buffer Zone:
No construction within 200m from HTL and 50m from creeks or tidal water bodies.



Mangrove Protection Zone:
Mangrove patches are strictly non-buildable; no construction or access paths permitted.

Fig. 25: Conditions mentioned under the CRZ-IV

+ 5.1.2 | Disaster Management Guidelines (NDMA)

The National Disaster Management Authority (NDMA) provides guidelines for cyclone and flood-prone regions like the Sundarbans.

Key principles include:
- **Elevated construction** above flood levels
- Use of **disaster-resilient materials and systems**
- Provision of **multi-purpose cyclone shelters**
- Ensuring **safe evacuation routes and accessibility**

In Anpur, where flooding is recurrent, these guidelines highlight the need for buildings that are not just protective, but also operational during crisis conditions, rather than remaining inactive.

+ 5.1.3 | Rural Housing Guidelines and NBC

The National Building Code (NBC) and rural housing schemes (like PMAY-G) provide general construction standards related to:
- Structural safety
- Ventilation and lighting
- Basic sanitation and spatial requirements

However, these codes are largely generic and do not directly address:
- Tidal flooding
- Amphibious or floating structures
- Multi-functional emergency use

As a result, in Anpur, construction often relies more on **vernacular knowledge and incremental adaptation** rather than strict code compliance.

+ 5.1.4 | Environmental and Ecological Regulations

The Sundarbans is an ecologically sensitive zone, protected under various environmental acts and conservation frameworks.

These regulations focus on:
- Preservation of **mangrove ecosystems**
- Control over land reclamation and water flow alteration
- Limiting activities that disturb **natural hydrology**

For Anpur, this means any intervention must work with the landscape, not against it; but respecting water movement, soil conditions, and ecological balance.

+ 5.1.5 | Embankment and Floodplain Regulations

Embankments in the Sundarbans act as critical protective infrastructure, but they are also fragile and constantly eroding.

Regulatory considerations include:
- Maintaining setbacks from embankment edges
- Avoiding heavy construction that may weaken the structure
- Allowing access for maintenance and emergency movement

Since embankments in Anpur also function as roads and social spaces, design interventions must acknowledge their **multi-functional and vulnerable nature.**

06

+ Project

This chapter turns research into a design proposal for Anpur, conceived as a flexible system that adapts to changing water levels and community needs. It responds to flooding and socio-economic shifts by supporting both daily life and emergency use. The design focuses on light, modular, and adaptable structures that create a strong sense of place within a fragile landscape.

Fig. 26: Site Plan of Anpur region, Satjelia Island

6.1.1 Architecture & Place

Site Plan

Macro Context : 38 acre
Site Area : 2.72 acre / 11,007.44 sqm.

22° 5'54.40"N, 88°52'2.84"E

Community Compostion:

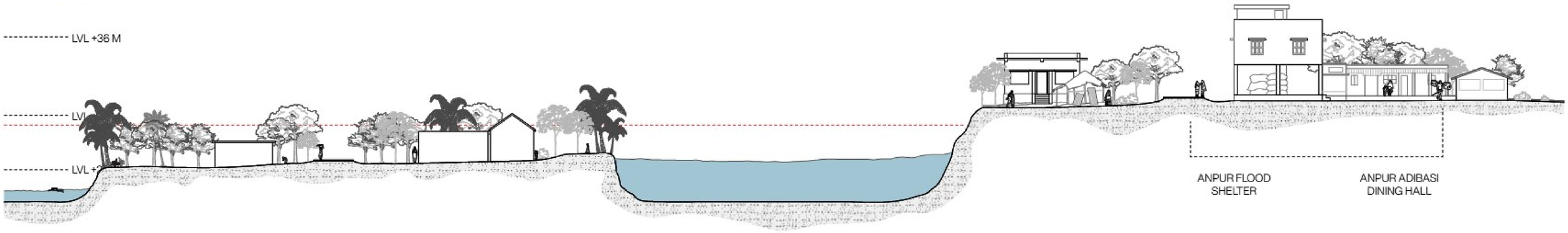
- Scheduled Caste (SC) communities - form a significant portion of the population, historically settled in low-lying and embanked areas.
- Scheduled Tribe (ST) communities - present in smaller numbers, often engaged in forest-based and river-dependent livelihoods.
- Other Backward Classes (OBC) - involved in agriculture, fishing, and allied activities.

Population & Settlements:

- approximately 6,000-8,000 people.
- Annpur region is one of the inhabited settlement clusters on the island, consisting of dispersed hamlets along embankments and interior fields.
- Linear settlements along embankments and raised edges.
- Scattered homesteads in low-lying interiors, increasingly vulnerable to flooding and erosion.
- Seasonal migration is common due to crop failure, flooding, and livelihood stress.

6.1.1 Architecture & Place

Site Sections



LEGEND

Elevation Line

Highest recorded rise in water level

Fig. 27: Site Section of Anpur region, Satjelia Island

Site Observations

Img. 25: Man-made ponds are constructed in some areas, in order to cultivate prawns and crabs

Img. 26: Embankments are considered as the highest point, which protects the island from flooding

Img. 27: Mangroves are considered as protecting barriers against surgical storms and are planted across the edges of the islands

Img. 28: Raised plinths along the embankments are constructed in order to access the public transport i.e., the ferry

Img. 29: Tea shops nearby public grounds, are often considered as a place of common leisure place

Img. 30: Small religious temples are constructed across the island

Img. 31: Most kutcha houses are either made using mud, pre-fabricated columns or bamboo, with thatch or corrugated sheets for roofing

Img. 32: Most kutcha houses are rebuilt using pre-fabricated concrete columns, and daily used spaces are constructured firmly

Img. 33: Pukurs are used on a daily-basis, used from time-to-time for various activities

Img. 34: Flood Shelters are not used during a regular day, instead it is used a place to store goods

Img. 35: People adopt new methods of construction practices to rebuild their houses

Img. 36: Newly built semi-pucca houses are constructed on raised plinths

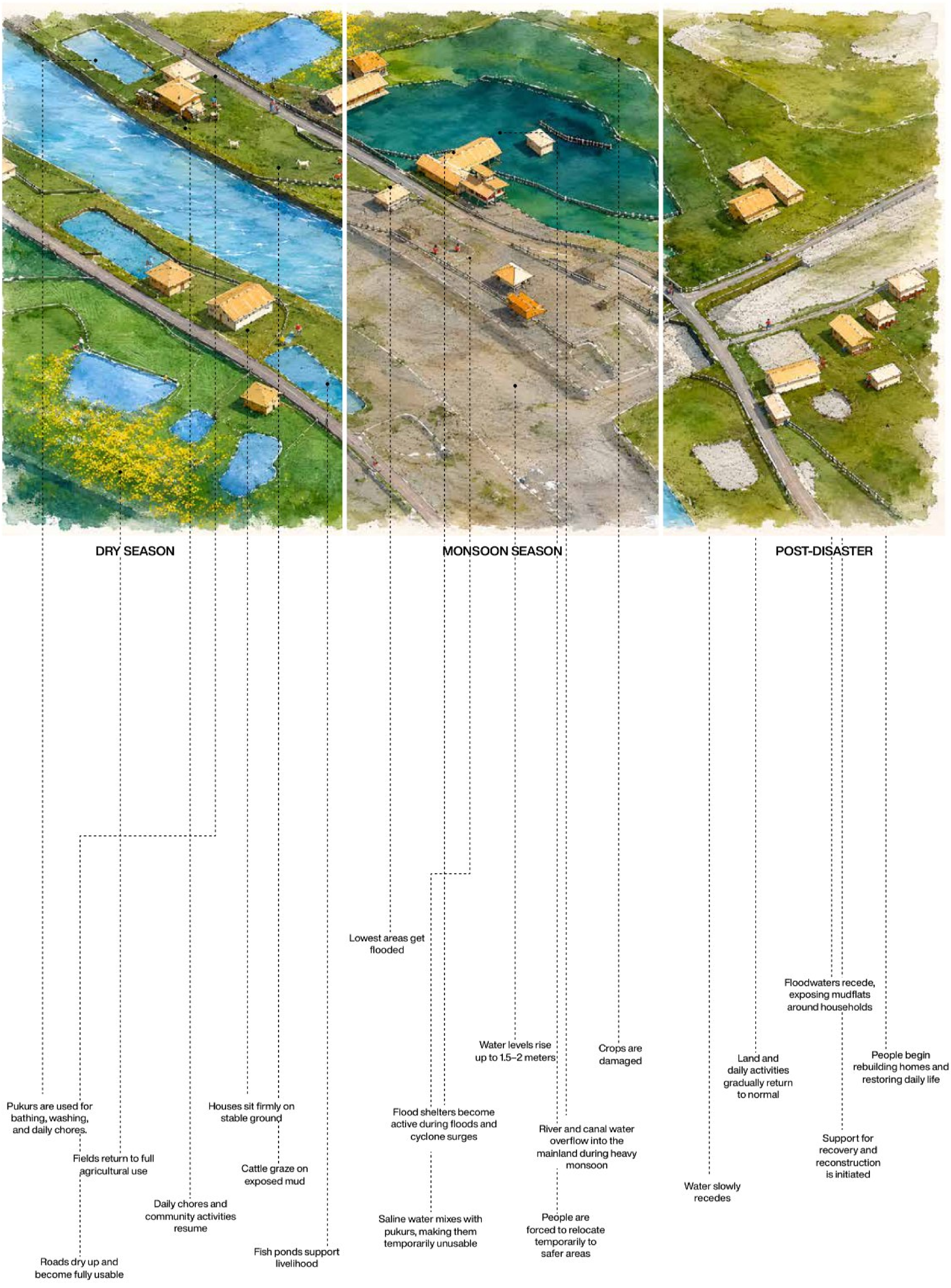


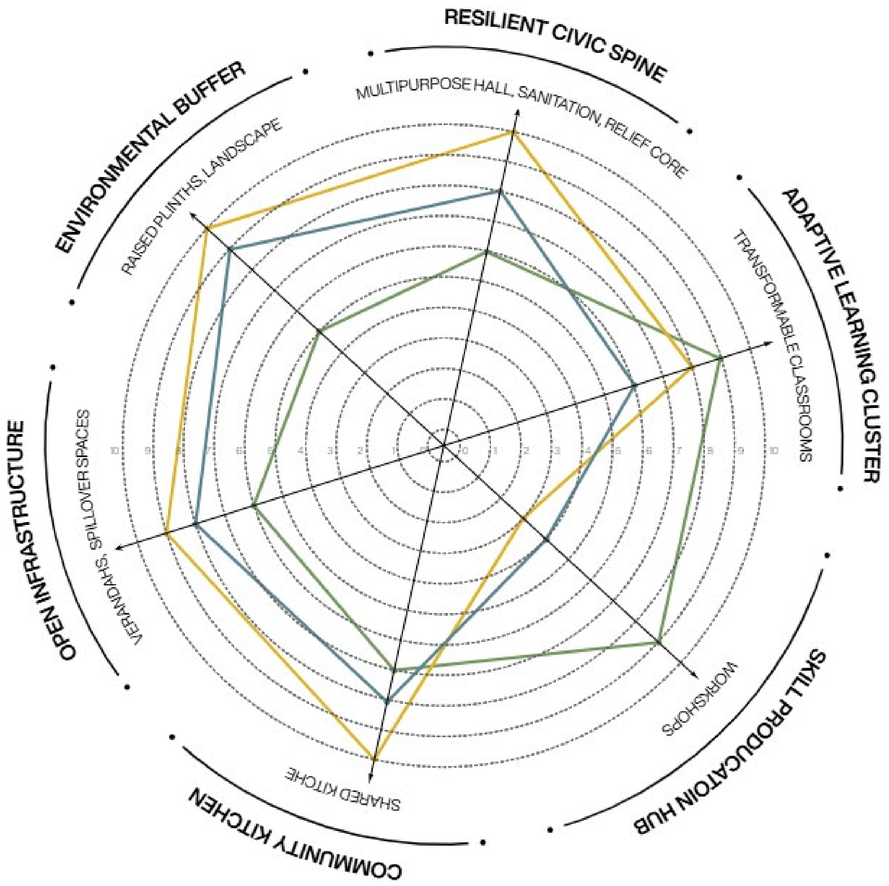
Fig. 28: A sketch of people and everyday life (across different seasons)

The land appears stable and productive. Water bodies are contained, fields are active, and movement along the road is clear and uninterrupted. Houses sit confidently on firm ground. The image expresses balance and normalcy, showing a landscape that supports daily life, agriculture, and social interaction without visible stress.

Water spreads across the terrain, softening boundaries between land and pond. The ground reads as flatter and more uncertain, with contours barely visible. The image conveys vulnerability and transformation, suggesting how the same site temporarily loses definition and demands adaptation from its inhabitants.

The water has receded but leaves behind erosion marks and disturbed patches of land. Buildings remain, yet the terrain looks scarred and uneven. The image communicates both impact and endurance, revealing a settlement that survives disruption while carrying visible traces of what has occurred.

6.2.1 User-Based Program



RESILIENT CIVIC SPINE:
- Multipurpose shelter hall
- Sanitation core
- Water storage + filtration
- Relief storage
- Medical aid room

COMMUNITY KITCHEN:
- Elevated Shared Kitchen
- Grain Storage

ADAPTIVE LEARNING:
- Transformable classrooms
- Stackable furniture
- Learning verandahs
- Storage-integrated walls

OPEN INFRASTRUCTURE:
- Raised platforms
- Courtyards
- Decks

SKILL-PRODUCTION HUB:
- Bamboo Workshop
- Carpentry Workshop
- Seasonal Market

ENVIRONMENTAL BUFFER:
- Raised plinths
- Mangrove plantation

LEGEND:

Dry Season

Monsoon Season

Disaster / Post-Disaster Season

SCALE LOGIC:

1 = Inactive / minimal relevance
5 = Functional but stressed
10 = Critical / highly active / essential

USERS:

on an average day = *70-120*

disaster / refuge time = *140-240*

Fig. 29: User-based program radar diagram

6.2.2 Area Statement

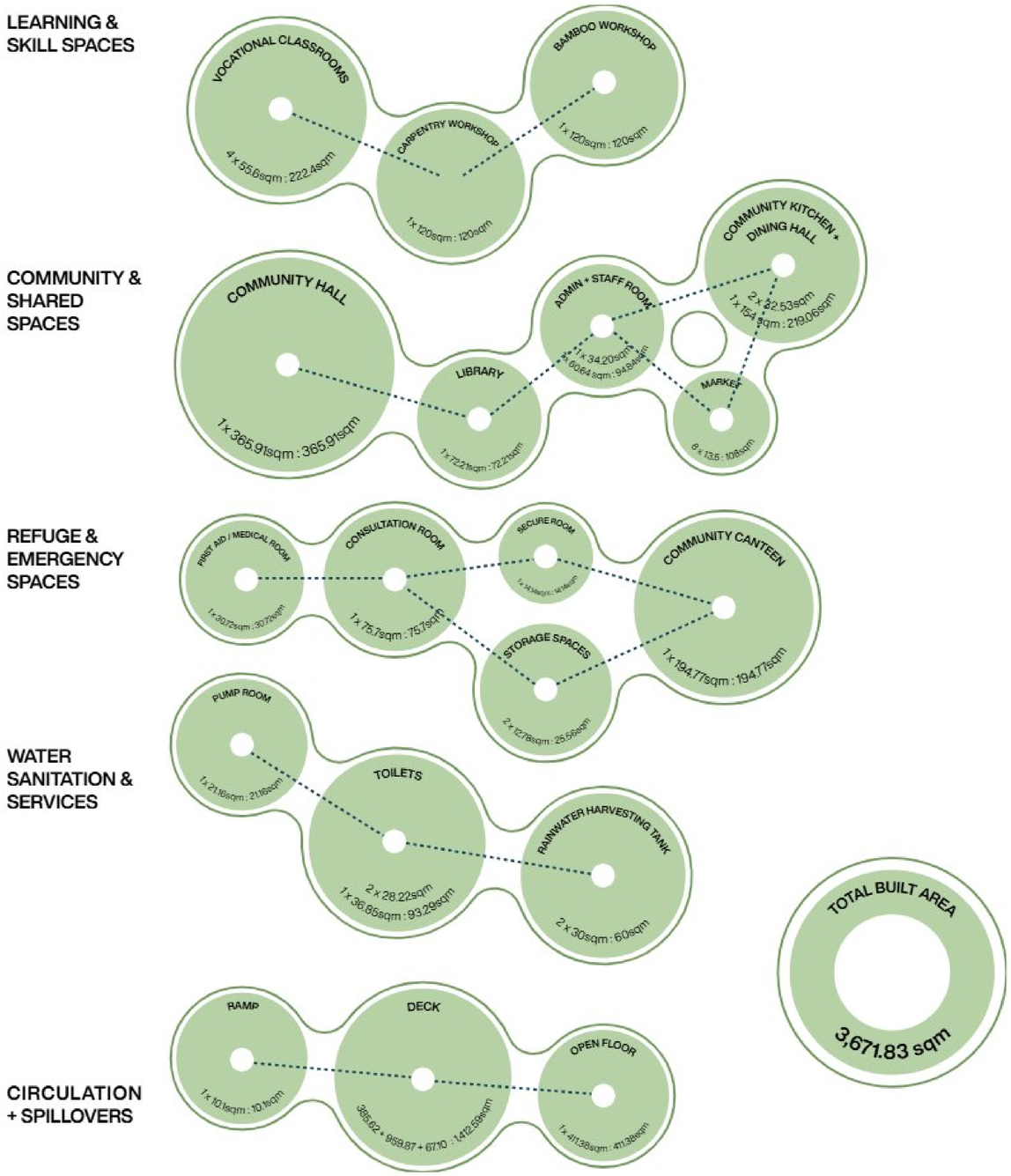
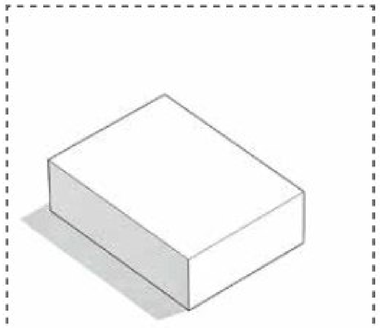


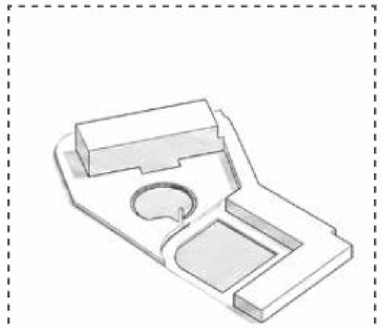
Fig. 30: Area Statement

6.3.1 Form Development

The form development begins with a simple geometric volume derived from the site boundary and program requirements. The mass is then divided into separate blocks to organize educational, vocational, and community functions while creating a central courtyard and amphitheater as shared gathering spaces. The blocks are elevated on a raised plinth to respond to the flood-prone conditions of the Sundarbans and are connected through a covered circulation spine that strengthens movement across the campus. Terraces, decks, and open spaces are introduced to encourage learning, interaction, and community activities. Finally, vernacular-inspired roof forms are integrated to provide climatic protection, enhance natural ventilation, and reflect the local architectural character, resulting in a resilient and cohesive campus that responds to both its environmental and social context.

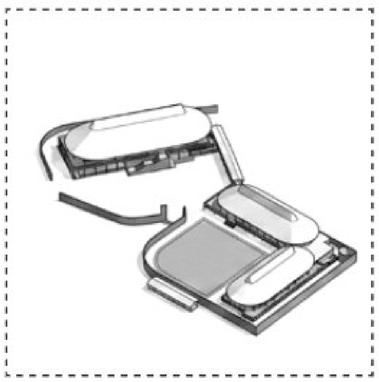


Initial Volume:
Simple geometric volume that defines the maximum building envelope.



Shift and Rotate:
The volume is extruded and elevated on a plinth to create presence and program separation.

Building Definition:
Terraces and stepped platofrms are introduced to adapt to topography and create outdoor gathering spaces.



Form and Roof Shaping:
Organic roof forms are introduced inspired by vernacular architecture, giving identity and climatic response.

Final Form:
A cohesive architectural form that unites function, context, climate and experience.

Fig. 31: Form development

6.3.2 Zonning

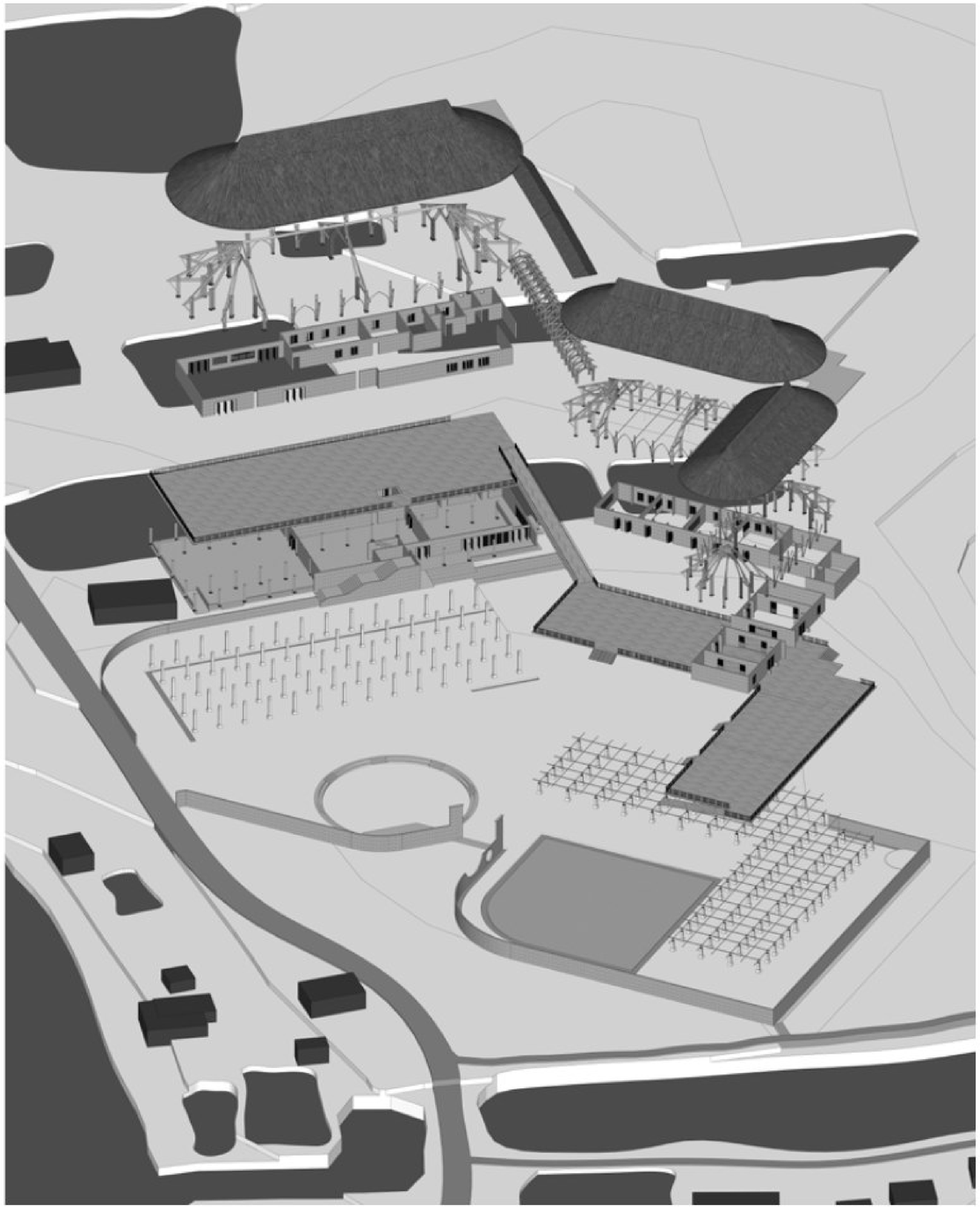
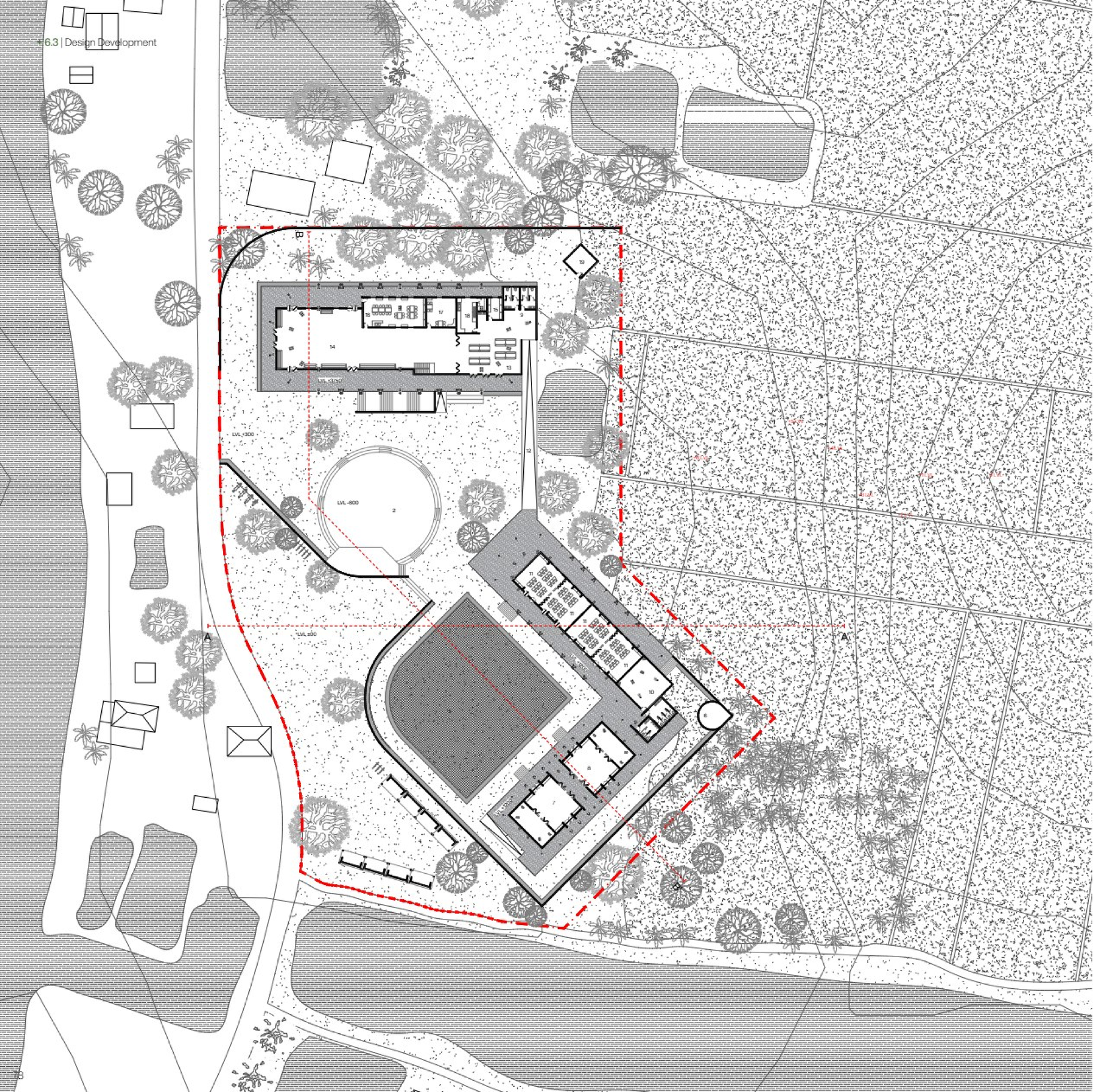


Fig. 32: Exploded Axonometric



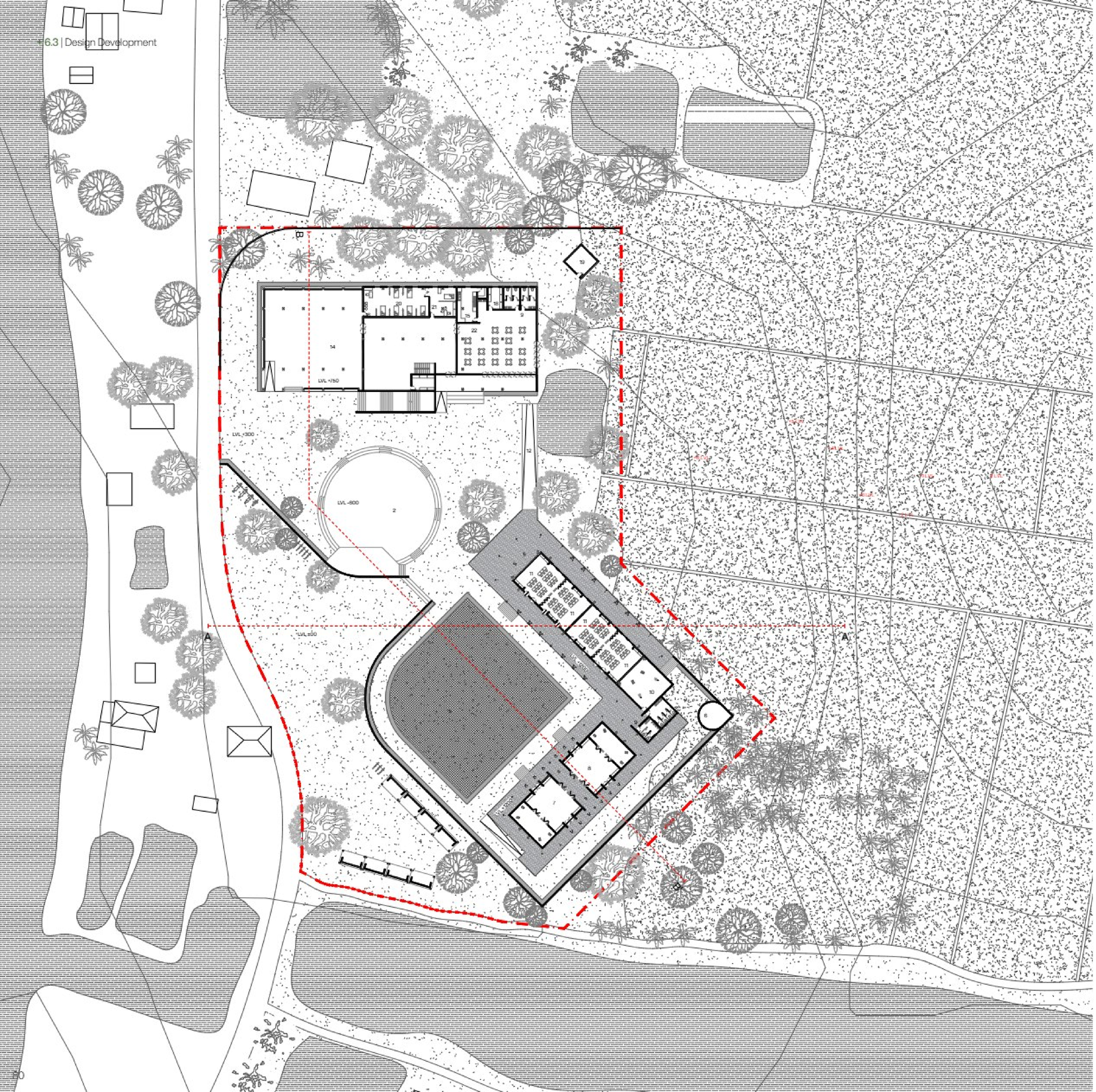
6.3.3 Masterplan

SITE AREA: 2.72 acres
BUILT AREA: 3,646.25 sqm / 39,247.9 sqft

SCALE 1:750
ALL DIMENSIONS ARE IN MM

LEGEND

1. ENTRY
2. AMPHITHEATRE
3. PARKING
4. MARKET
5. PLAYGROUND
6. RAINWATER HARVESTING TANK
7. CARPENTRY WORKSHOP
8. BAMBOO WORKSHOP
9. TOILETS
10. STAFFROOM
11. VOCATIONAL CLASSROOMS
12. RAMP
13. COMMUNITY DINNING
14. COMMUNITY HALL
15. COMMUNITY KITCHEN
16. LIBRARY
17. ADMIN SAPCE
18. STORAGE
19. PUMP ROOM



6.3.4 Ground Floor Plan

SITE AREA: 2.72 acres
BUILT AREA: 3,646.25 sqm / 39,247.9 sqft

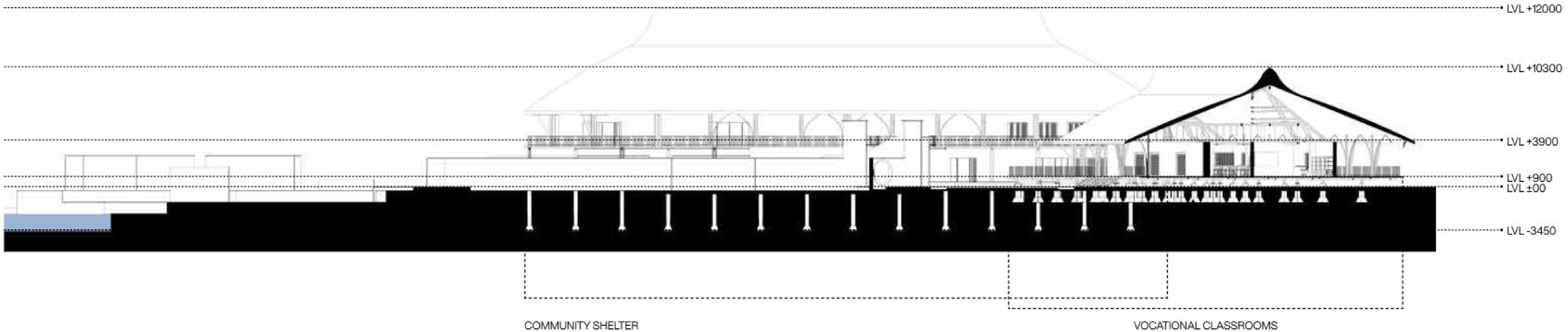
SCALE 1:750
ALL DIMENSIONS ARE IN MM

LEGEND

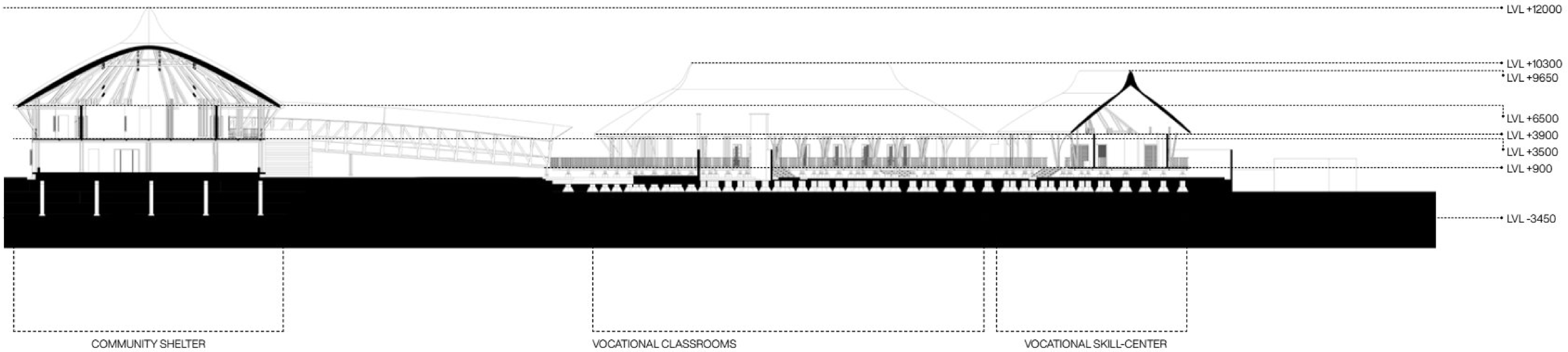
1. ENTRY
2. AMPHITHEATRE
3. PARKING
4. MARKET
5. PLAYGROUND
6. RAINWATER HARVESTING TANK
7. CARPENTRY WORKSHOP
8. BAMBOO WORKSHOP
9. TOILETS
10. STAFFROOM
11. VOCATIONAL CLASSROOMS
12. RAMP
13. COMMUNITY DINNING
14. COMMUNITY HALL
15. COMMUNITY KITCHEN
16. LIBRARY
17. ADMIN SAPCE
18. STORAGE
19. PUMP ROOM
20. CONSULTATION ROOM
21. MEDICAL ROOM
22. CAFETERIA

6.3.5 Sections

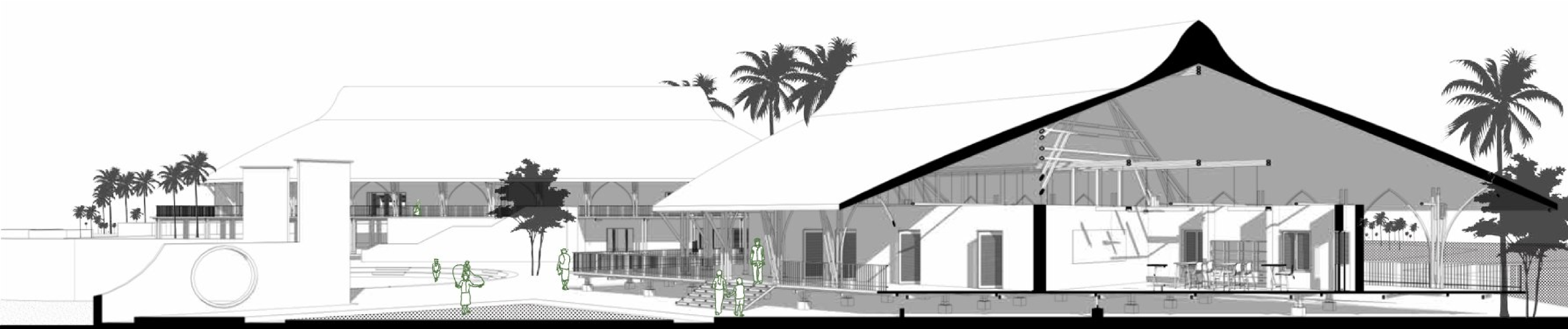
SECTION AA' / NTS



SECTION BB' / NTS



6.3.6 Perspective Section



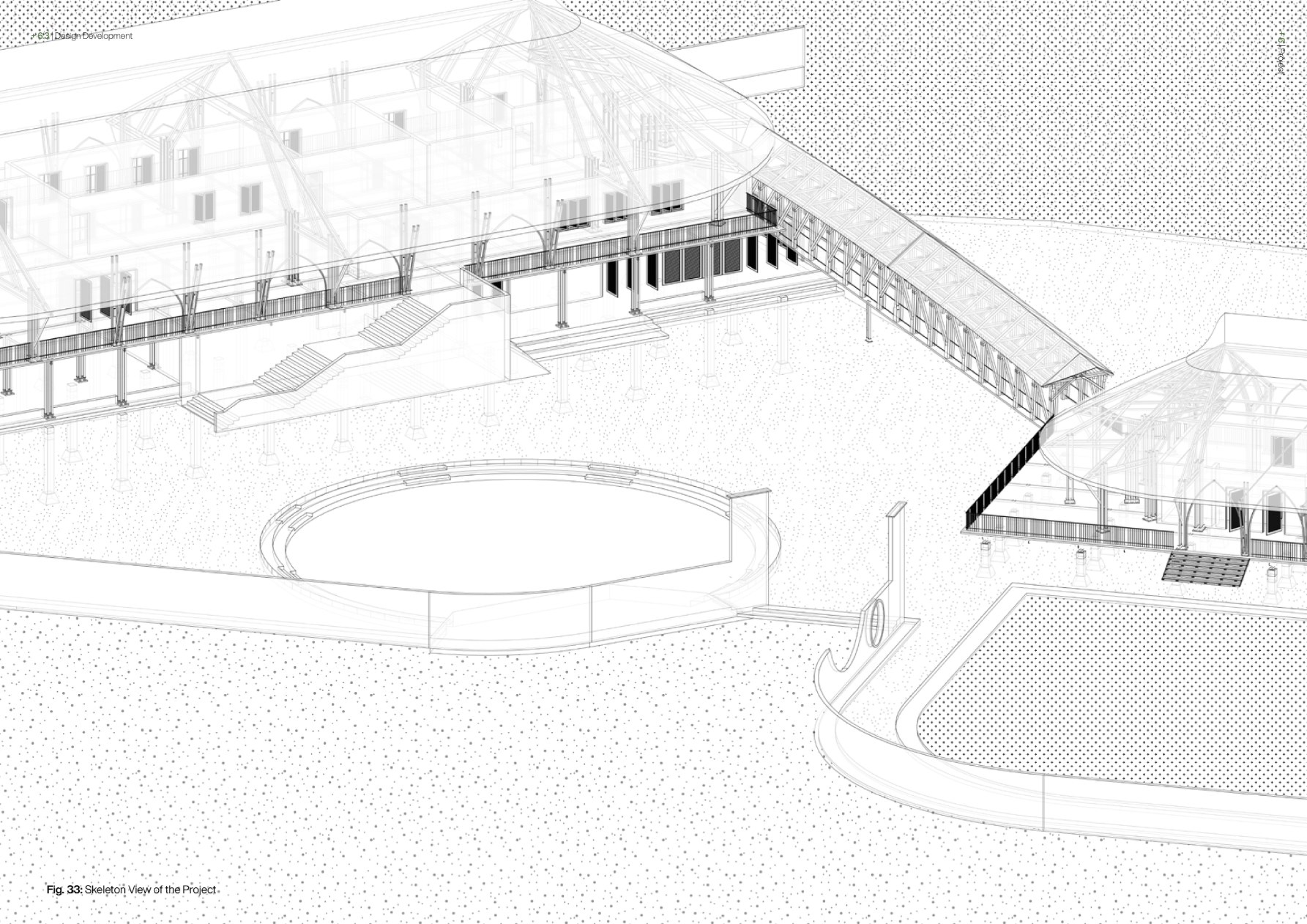


Fig. 33: Skeleton View of the Project

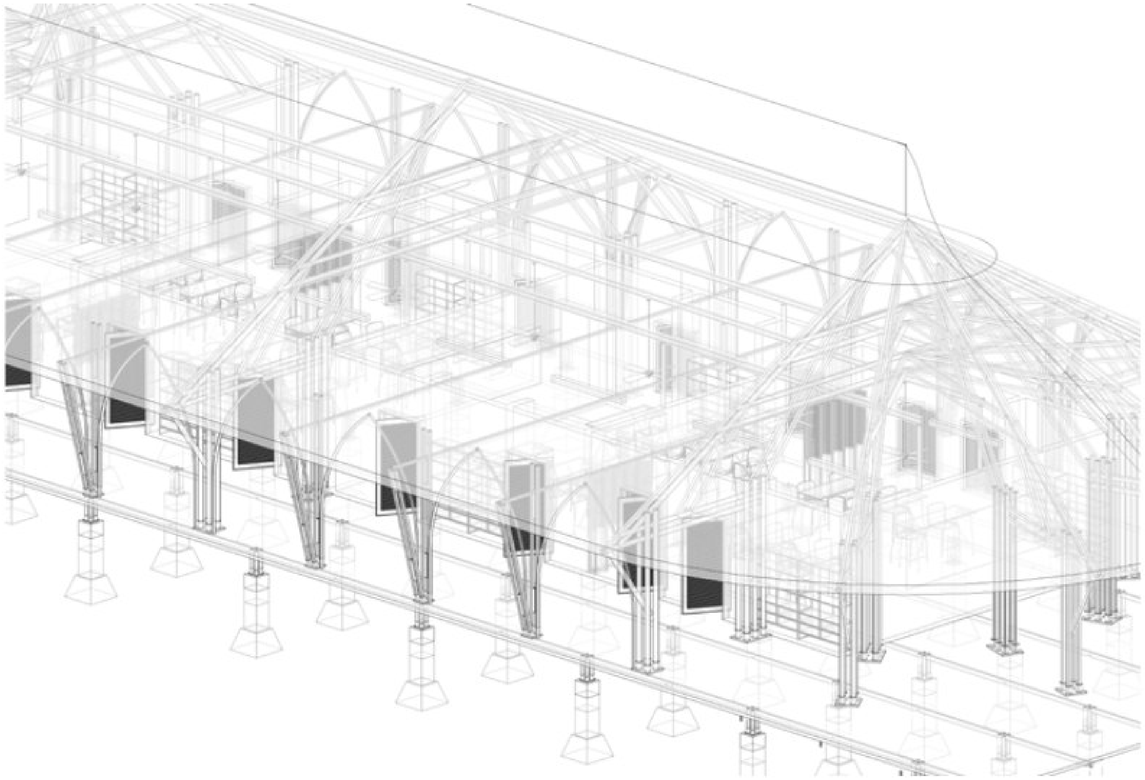
6.3.7 Part Design I

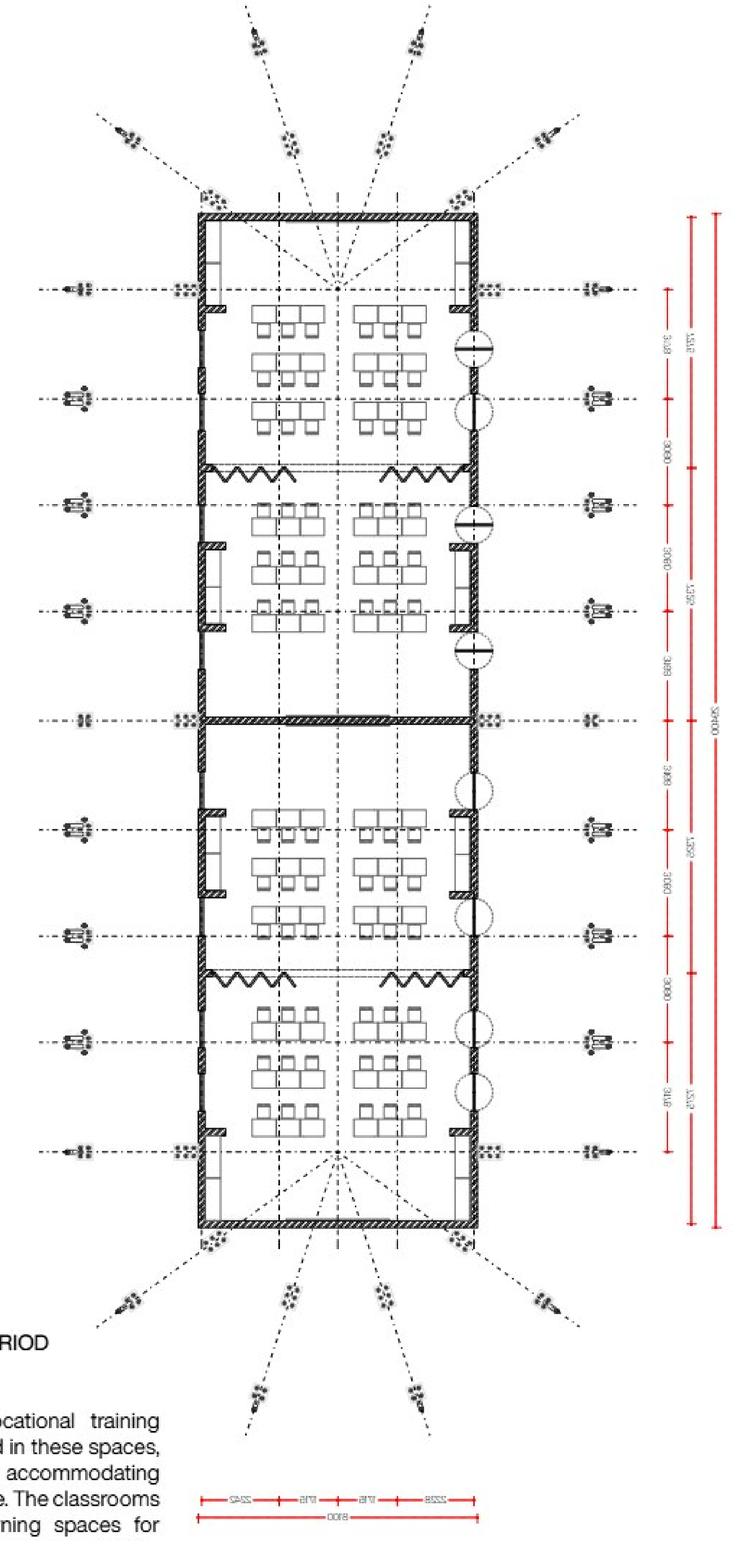
VOCATIONAL TRAINING CLASSROOMS

The vocational training classrooms are designed as flexible and adaptive learning spaces. Each classroom functions as a 55 sqm training area for vocational education, workshops, and group learning activities. A movable partition between two classrooms allows them to combine into a larger 110 sqm space when required.

During disaster situations, the combined space can quickly transform into a temporary refuge room for families and community members. This dual-purpose design ensures that the classrooms support both everyday learning and emergency community needs, creating spaces that are functional, resilient, and adaptable.

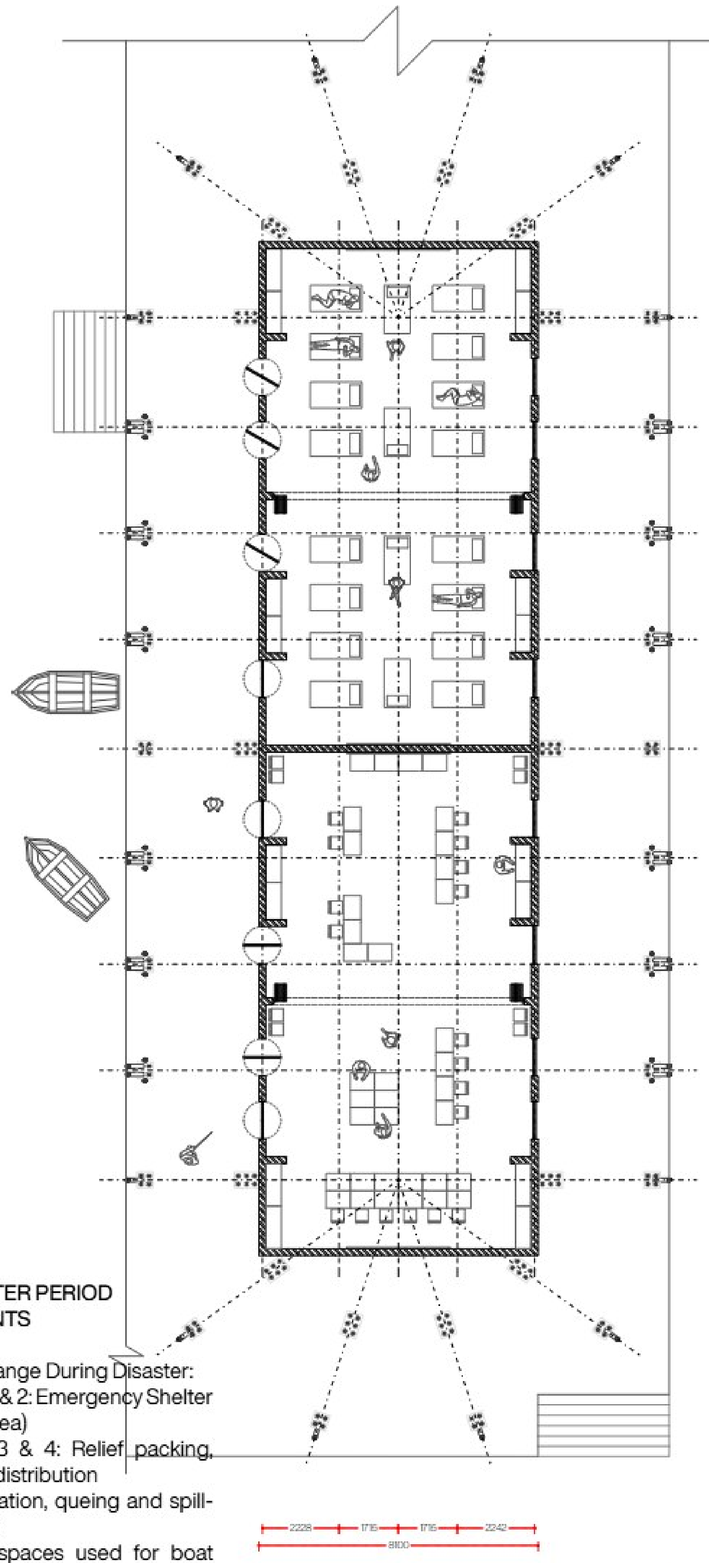
VOCATIONAL CLASSROOM (NORMAL DAYS):	55.3m²
VOCATIONAL CLASSROOM (DURING DISASTER):	110.6m²
NO.OF CLASSROOMS:	4
TOTAL AREA:	223.3m²





DURING NORMAL PERIOD
PLAN / SCALE NTS

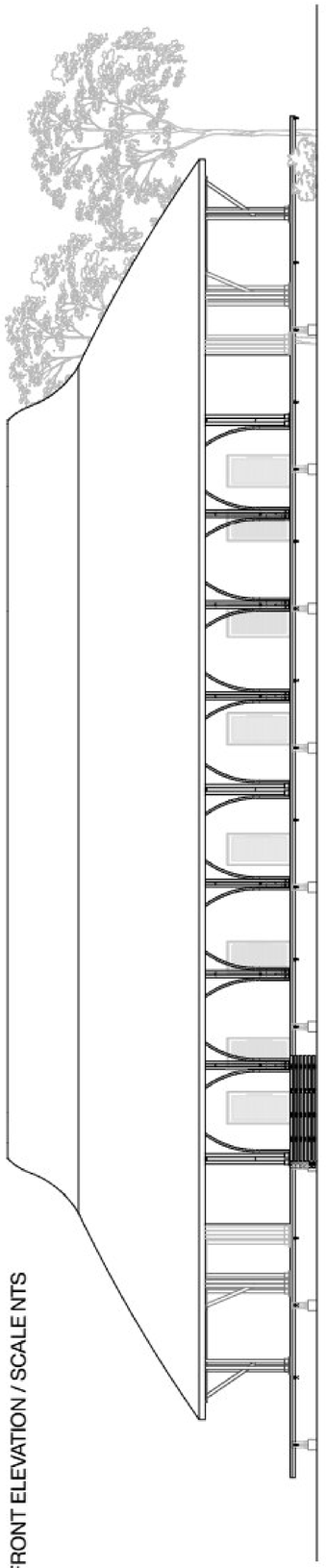
On regular days, vocational training classes are conducted in these spaces, with each classroom accommodating 15-18 students at a time. The classrooms also function as learning spaces for children and skill development activities.



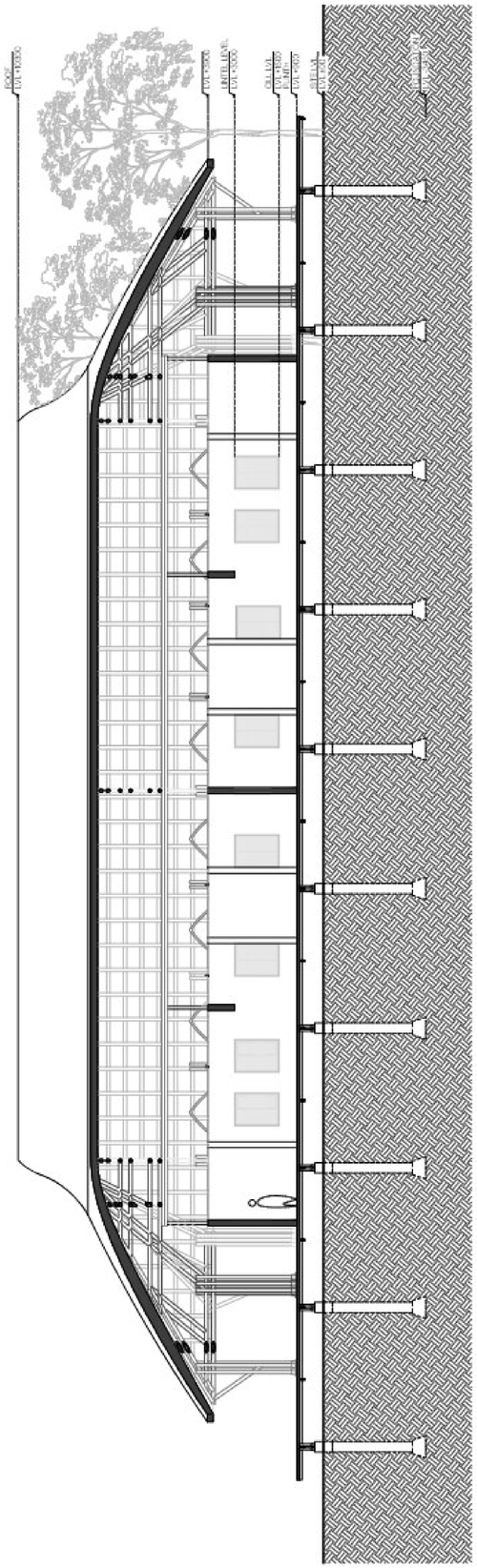
DURING DISASTER PERIOD
PLAN / SCALE NTS

How Spaces Change During Disaster:

- Classroom 1& 2: Emergency Shelter (Sleeping Area)
- Classroom 3 & 4: Relief packing, sorting and distribution
- Deck: Circulation, queing and spill-out activities
- Under stilt spaces used for boat access and temporary storage



FRONT ELEVATION / SCALE NTS



FRONT SECTION / SCALE NTS

6.3.8 Part Design II

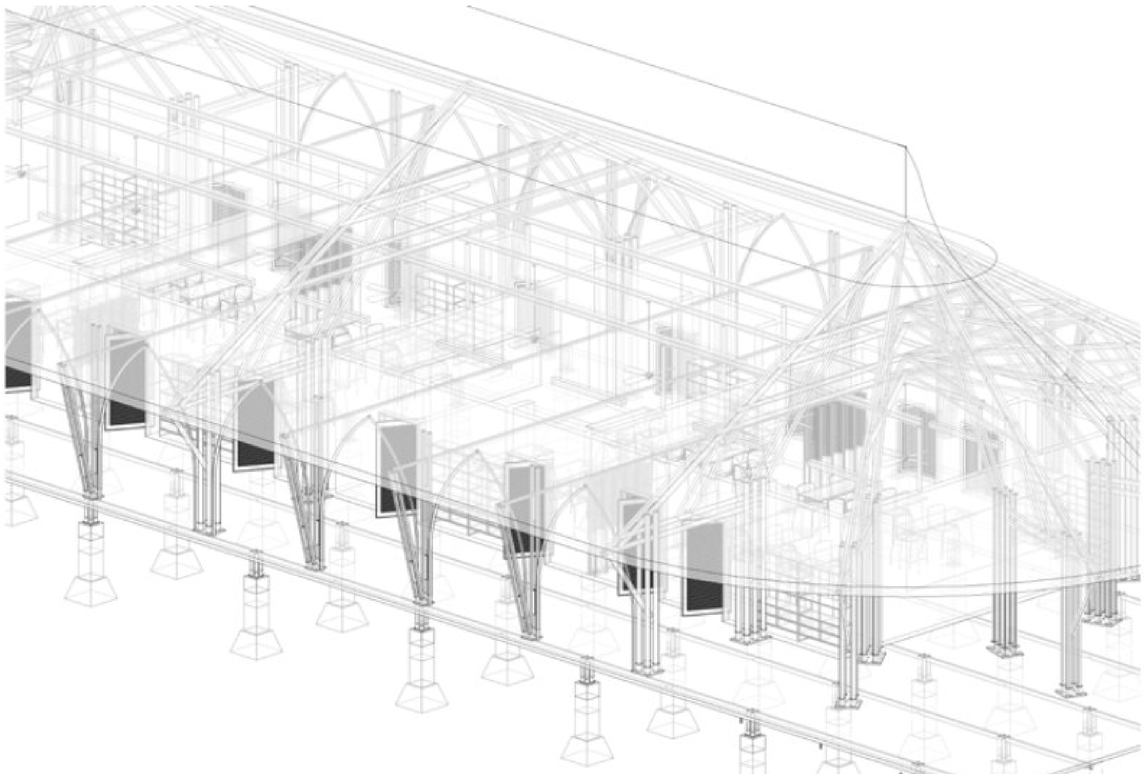
VOCATIONAL SKILL-CENTER

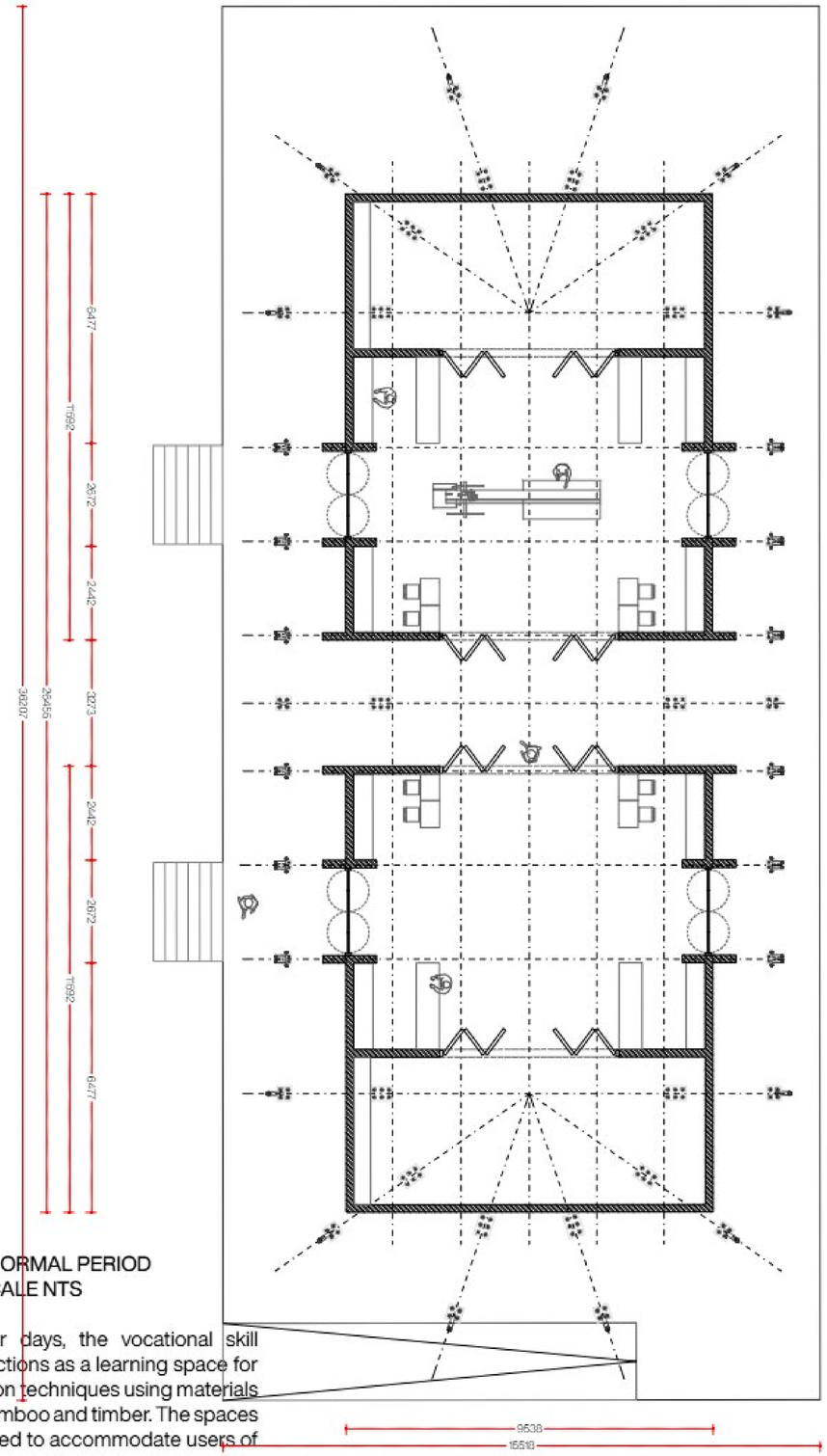
The skill center is designed as a hands-on learning environment focused on bamboo construction and carpentry. Built using bamboo, timber, and brick, the architecture reflects the skills being taught and acts as a live demonstration of construction techniques. The open-plan layout combines enclosed brick spaces for storage and focused training with larger open areas for collaborative work and fabrication. This flexibility allows adaptation to different activities and group sizes.

During disaster periods, the center can also transform into a temporary relief and distribution center, supporting emergency community needs while functioning as both a vocational classroom and active workshop.

BAMBOO WORKSHOP : 120m²
CARPENTRY WORKSHOP: 120m²

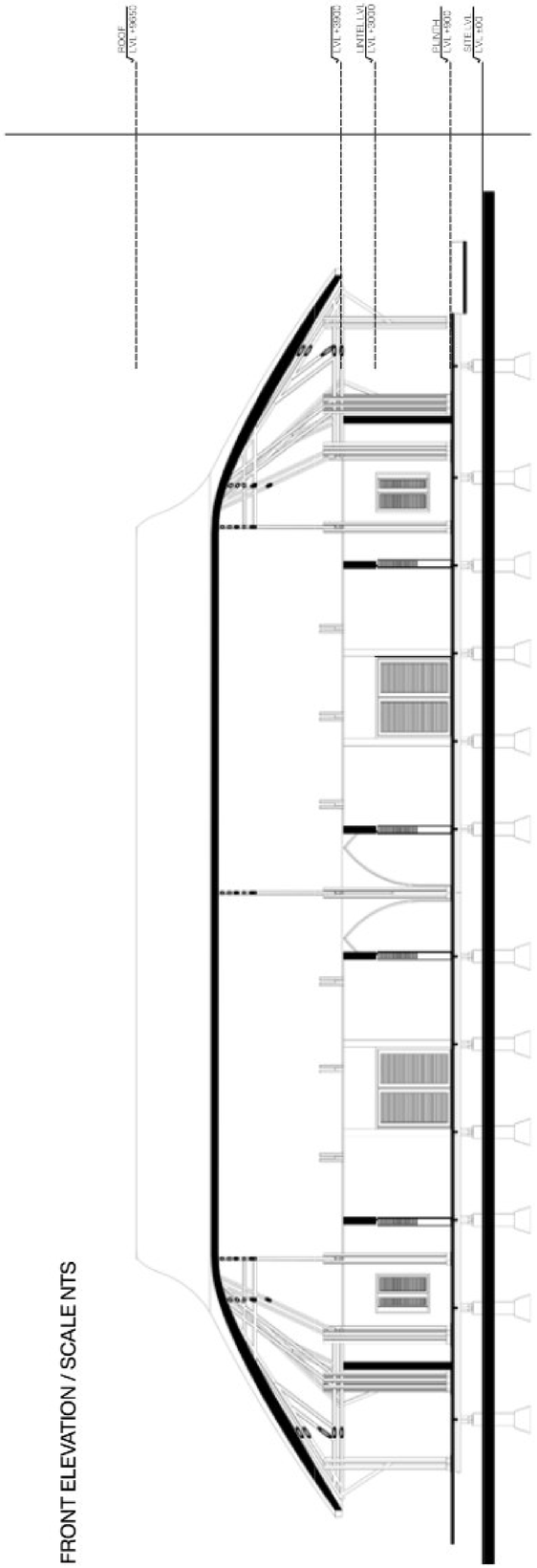
TOTAL AREA: 240m²





DURING NORMAL PERIOD
PLAN / SCALE NTS

On regular days, the vocational skill center functions as a learning space for construction techniques using materials such as bamboo and timber. The spaces are designed to accommodate users of different age groups, from children to adults, encouraging hands-on learning, collaboration, and skill development.

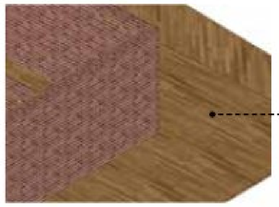


FRONT ELEVATION / SCALE NTS

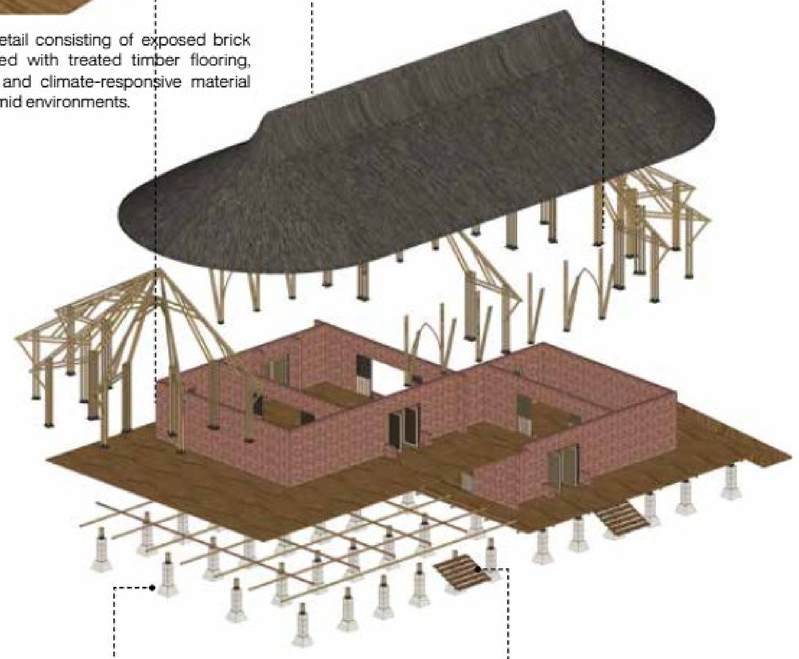
FRONT SECTION / SCALE NTS

Thatch roof inspired by the vernacular Bengal fishing boat form, designed with large overhangs and an aerodynamic profile to improve cyclone resistance, rain protection, and passive climatic performance.

Structural bamboo column system composed of 120 mm diameter reinforced bamboo members anchored to steel base plates fixed onto the timber flooring structure, supporting the lightweight bamboo roof framework through vertical and diagonal load-bearing members.



Wall and flooring detail consisting of exposed brick masonry walls paired with treated timber flooring, creating a durable and climate-responsive material palette suited for humid environments.



Foundation detail showing a 750 × 750 mm concrete pedestal with a steel plate connection supporting four 100 mm diameter reinforced bamboo columns, intersected by diagonal timber and bamboo beams.

Staircase detail composed of a lightweight bamboo and timber structural system, where timber treads are supported by bamboo members and diagonal bamboo stringers, creating a modular and elevated circulation element.

6.4.1 Iteration II

NOT TO SCALE

LEGEND

1. ENTRY
2. MULTIPURPOSE HALL
3. COMMUNITY KITCHEN
4. TOILET
5. BAMBOO WORKSHOP
6. CARPENTRY WORKSHOP
7. CLASSROOM
8. STAFF ROOM
9. STORAGE
10. LIBRARY
11. CLINIC SPACE
12. PUMP ROOM
13. RAINWATER HARVESTING
14. RAMP
15. PLAYGROUND
16. COURTYARD

6.4.2 Bamboo Joineries

The structural system incorporates a range of traditional and engineered bamboo joinery techniques, including rope lashings, nut-and-bolt connections, splice joints, bracing connections, and steel node connectors. Traditional lashing methods are primarily used where flexibility and ease of assembly are required, while bolted and steel connections provide enhanced strength, durability, and reliable load transfer at critical structural junctions. The combination of these joinery systems enables the bamboo framework to efficiently resist vertical and lateral loads, accommodate material movement, and respond to the climatic challenges of the Sundarbans. Together, these connections create a resilient, adaptable, and constructible structural system that balances vernacular building knowledge with contemporary engineering practices.

Cross-Lashing Joint (90° Cross Joint):
- Two bamboo members intersect at right angles.
- Tied using rope, rattan, or coir lashing.
- Common in bamboo wall frames, bracing, and floor grids.

Parallel Bundle Joint:
- Two parallel bamboo poles lashed together.
- Used to increase member strength or create built-up beams and columns.

Scissor / A-Frame Joint:
- Two inclined members tied together at the top.
- Used in roof trusses, bamboo arches, and portal frames.

Splice Joint:
- Two bamboo members connected end-to-end.
- Used when extending the length of a column, beam, or brace.

T-Joint (Perpendicular Connection)
- One member intersects another at 90°.
- Common for connecting rafters to beams or secondary members to main members.

Diagonal Bracing Joint:
- A diagonal member connected to a vertical or horizontal member.
- Used for lateral stability against wind and seismic forces.

Fig. 37: Different kinds of bamboo joineries

Six-way bamboo hub joint:
- A central steel, cast-metal, or engineered composite node acts as the connection hub.
- Multiple bamboo poles are inserted into sleeves or sockets around the hub.
- The bamboo is secured using bolts, pins, screws, epoxy, or friction-fit connections.

Three-Way Bamboo Hub Joint:
- The black component is a fabricated steel socket connector that transfers loads between the members and eliminates the need for complex lashing.

Bundled Bamboo Column Base:
- Increases load-bearing capacity.
- Creates a stronger and stiffer column.
- Provides redundancy if one culm deteriorates.
- Raises bamboo above ground level, preventing moisture damage and rot.
- Allows easy replacement of individual culms.

6.5.1 Views

Img. 38: Playground connecting classrooms and workshops.

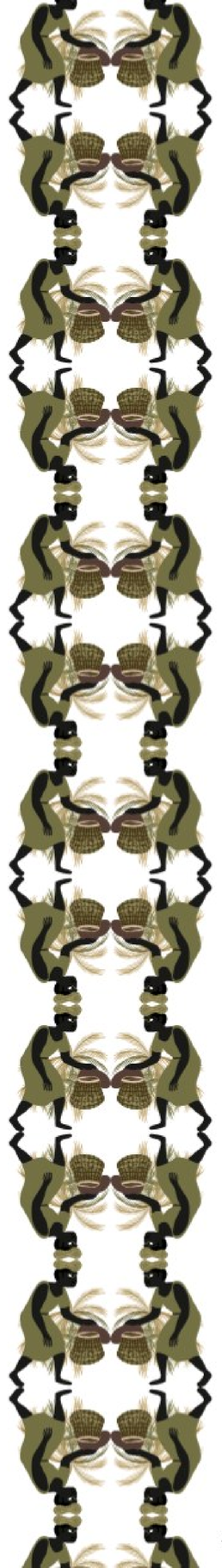
Img. 39: Community life along the learning corridor.

Img. 40: View from the verandah of the community shelter towards the amphitheatre.

Img. 41: Shared learning and gathering space.

07

+ References



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8

+ Annexure

8.1.1 Interviews

As part of the research, a series of field visits were undertaken across different regions of the Sundarbans, with a focused exploration of Satjelia Island and the Anpur area during the course of the dissertation and thesis. These visits were conducted across varying tidal conditions to understand the spatial, environmental, and social dynamics of the delta landscape. Through on-site observations and movement across embankments, waterways, and settlements, the study engaged with the lived realities of the region, particularly the constant negotiation between land and water.

During the fieldwork, interactions were held with local residents, fishermen, agricultural workers, boat operators, school teachers, and community members. These conversations provided insights into livelihood patterns, mobility systems, educational challenges, and the impact of seasonal flooding and climate variability. The study also included discussions with local authorities and informal community networks, which helped inform the understanding of infrastructure, disaster response, and settlement patterns. The findings from these visits formed a critical foundation for the research, shaping both the analytical framework and the design direction of the project.

From the Community

What activities do you engage in within the community?
- Fishing and crab collection
- Agriculture (affected by salinity)
- Tourism-related work (guides, boat services)
- Seasonal migration for labor
- Small-scale local trade

Where do these activities take place?
- Rivers and tidal channels
- Agricultural fields within the island
- Along embankments
- Near ferry ghats and landing points

How does daily movement happen within the settlement?
- Walking along embankments
- Use of bicycles and motorbikes
- Motor vans for shared transport
- Boats for inter-island movement

How do daily routines change during high tide or flooding?
- Pathways become submerged or inaccessible
- Movement shifts entirely to boats
- Reduced access to work and services
- Temporary relocation to safer zones

Where does the community gather?
- Schools
- Open spaces along embankments
- Religious/community spaces
- Expanded residential courtyards

Education & Social Transition

What is the condition of education in the community?
- Primary education is available locally
- Limited access to secondary schools
- Long travel distances discourage continuation

Why do students drop out after middle school?
- Need to support family income
- Lack of nearby secondary education
- Economic pressure on households

What do students do after leaving school?
- Fishing and crab collection
- Tourism-related work
- Daily wage labor
- Migration to cities

How are school buildings used beyond education?
- Used as flood shelters during disasters
- Act as community gathering spaces
- Support temporary accommodation

Flood Shelters & Emergency Response

How are flood shelters used in the region?
- Mostly inactive during normal periods
- Open only before or during emergencies
- Used to store construction materials

What challenges exist in these shelters?
- Limited capacity
- Poor maintenance due to infrequent use
- Lack of integration with daily life

What happens when shelters are insufficient?
- Schools become primary refuge spaces
- People move to embankments or elevated areas
- Community shares space collectively

Settlement & Built Environment

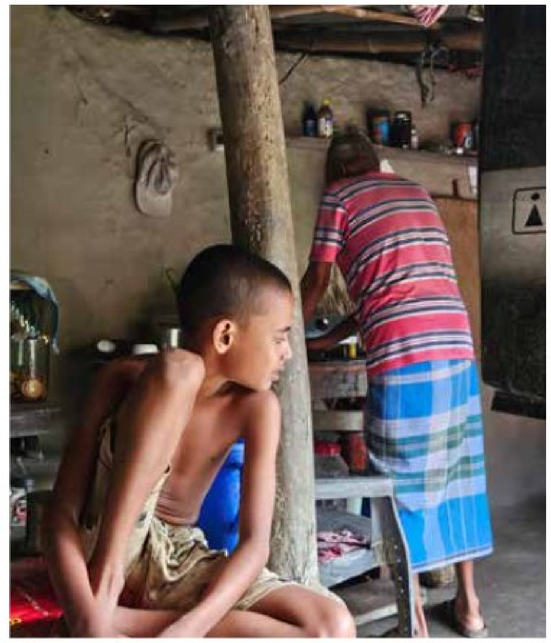
What materials are commonly used for construction?
- Concrete and bricks
- Bamboo and timber
- Mud and thatch
- Corrugated metal sheets

How are houses built in response to flooding?
- Raised plinths
- Semi-stilted or elevated structures
- Incremental construction over time

How do embankments function in daily life?
- Act as roads and circulation paths
- Provide flood protection
- Serve as social and economic spacess

"Life in Anpur is shaped by constant negotiation between land and water, where spaces, roles, and routines continuously adapt to changing environmental conditions."

8.1.2 Photographs



The Tide, the Community, and the Resilient Future

This thesis began as an exploration of resilience in the Sundarbans, a landscape defined by constant change, uncertainty, and adaptation. Through the course of this study, it became clear that resilience is not only about recovering from challenges but also about creating opportunities for growth, learning, and collective strength.

Nabojibon emerged from this understanding as a community learning and vocational hub that seeks to empower local communities through education, skill development, and shared spaces. Rooted in the ecological and cultural context of the Sundarbans, the project draws from local materials, traditional knowledge, and adaptive design strategies to create an architecture that is both responsive and meaningful.

More than a physical intervention, the project represents a framework for community resilience. It aims to support livelihoods, encourage knowledge exchange, and provide spaces where people can come together to learn, collaborate, and prepare for an uncertain future. By embracing the principles of adaptability, sustainability, and participation, the proposal reflects the enduring relationship between people and their environment.

While this thesis does not claim to resolve the complex challenges faced by the Sundarbans, it offers a vision of how architecture can contribute to long-term resilience. It is a reminder that meaningful design extends beyond buildings, shaping opportunities, strengthening communities, and fostering hope. As the tides continue to reshape the landscape, so too must architecture evolve, supporting the people who call the Sundarbans home and helping them build a more resilient future.