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MANGROVE ECOTOURISM AND CONSERVATION CENTRE AT PULAU KETAM, KLANG, SELANGOR

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ABSTRACT

Mangrove planting is very popular, however, many attempts to do so fall short of establishing significant, diversified, useful, and self-sustaining mangrove forests because of the community's lack of involvement, mono-species planting, and poor choices of location. The issue that inspired this project is the lack of awareness of the mangrove ecosystem and its potential benefits among the inhabitants of Pulau Ketam, in Klang. Hence, the centre presents an opportunity to explore a visionary ecosystem that redefines ecotourism for a sustainable future.

This project aims to create an ecotourism mangrove and conservation centre focusing on sustaining the future of the mangrove in Malaysia and experimenting with the mangrove potential through educative, recreational, and research approaches. There are three objectives of this research. The first objective is to propose sustainable seed cultivation techniques and research centre through advanced technology. The second objective is to establish involvement of local communities and stakeholders to promote engagement and explore new potential of the mangrove products. The third objective is to explore the potential of mangrove ecotourism as a means to promote the conservation and sustainable use of mangrove ecosystems in coastal settlement areas. The research methodologies adopted for this study are literature review, in-depth interview, case studies, and precedent studies. The proposed site is located at Pulau Ketam, Klang. The site was chosen because of the depletion of the mangrove area which needs to be revived urgently. The project will be Mangrove Ecotourism and Conservation Centre with the concept of “Interwoven Roots” with include a visitor centre, a research lab, a boat dock, an accommodation and an observatory tower that utilises advanced technology to provide visitors with an immersive experience of the mangrove forest. The centre also serves as a research and educational hub, providing visitors with opportunities to learn about the unique biodiversity of the mangrove ecosystem and the threats facing it. It is designed to engage visitors in a unique and immersive experience of the mangrove ecosystem, promoting education, conservation, and sustainable livelihoods. In addition, it promotes sustainable livelihoods and engages with the local community through programs that promote ecotourism and conservation efforts. The design incorporates local SMEs into its operations, providing economic opportunities and promoting sustainable development in the region.

Keyword: Mangrove, Ecotourism, Conservation, Wetland, Resilient
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INTRODUCTION

Mangroves are unique coastal ecosystems that are vital for the well-being of both the environment and local communities. These ecosystems provide numerous benefits such as coastal protection, carbon sequestration, and fisheries support. In Malaysia, mangroves are particularly important, as they are home to a high level of biodiversity and provide a range of ecosystem services to the surrounding communities. However, mangroves in Malaysia's coastal settlement areas face a range of environmental and human-induced issues that threaten their survival.

On the other hand, ecotourism has emerged as a potential solution to sustain mangroves while providing economic benefits to local communities. However, it can also cause negative impacts on mangrove ecosystems if not managed responsibly. Therefore, the statement emphasizes the need for sustainable and responsible ecotourism practices that do not harm the mangrove ecosystems.

The solution lies in implementing a comprehensive and integrated management approach that includes conservation and restoration efforts, responsible ecotourism development, and community engagement. It is essential to raise awareness among local communities and visitors about the importance of mangroves and the need for their conservation.

A recent study by Abdul Hamid et al. (2021) assessed the current condition of mangroves in Malaysia's coastal settlement areas and identified various issues affecting their sustainability, such as land conversion, pollution, and climate change. The study also highlighted the potential benefits of ecotourism in promoting mangrove conservation and sustainable development.

However, the authors recommended the adoption of a more integrated and holistic approach that considers the needs of the environment, society, and economy for sustainable management of mangrove ecosystems in Malaysia's coastal areas.

Figure 1: Showing the statement by IUCN on the importance of mangrove towards coastal settlement (Source: IUCN, 2022)

PROBLEM STATEMENTS

The article "Issues in Sustaining Mangroves in Coastal Settlement Areas in Malaysia" by Mohd. Shahwahid Haji Othman, Mohd. Nordin Hasan, and Abdul Hamid Ahmad (2017) addresses the vulnerabilities of mangroves in Malaysia's coastal settlement regions. Environmental and human-induced challenges jeopardize these ecosystems, urging the adoption of effective management practices for their preservation (Othman et al., 2017).

Among the significant concerns are coastal development activities that compromises mangrove habitats, driven by economic growth demands (Othman et al., 2017). Such developments disrupt the natural hydrological balance, leading to alterations in water quality and sedimentation that threaten mangrove viability. Addressing this necessitates sustainable coastal development practices prioritizing mangrove conservation (Othman et al., 2017).

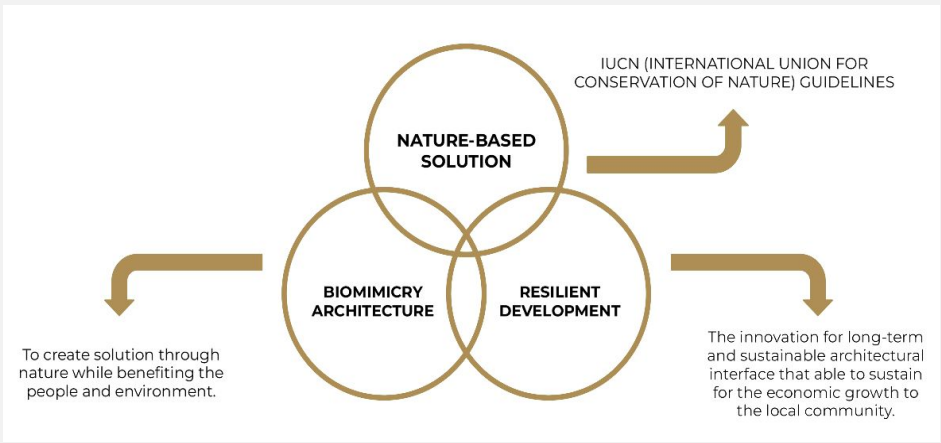

Figure 2: Showing the design thesis approach

Pollution from industrial, agricultural, and domestic sources is another menace, deteriorating water and soil quality, thereby degrading ecosystem health (Othman et al., 2017). This pollution adversely affects mangrove growth and biodiversity, mandating stringent pollution mitigation measures (Othman et al., 2017).

Human activities like overfishing, illegal logging, and unsustainable resource exploitation further imperil mangrove ecosystems (Othman et al., 2017). Overexploitation of resources through ecotourism activities poses an additional concern (Othman et al., 2017). Though mangrove ecotourism offers economic benefits and conservation incentives, its potential negative impacts on ecosystems demand cautious management (Othman et al., 2017).

Future challenges include ongoing threats from both human actions and environmental shifts, particularly due to climate change, which affects mangrove distribution and health (Othman et al., 2017). Effective management and responsible tourism practices are crucial to sustain mangrove ecosystems and local economies.

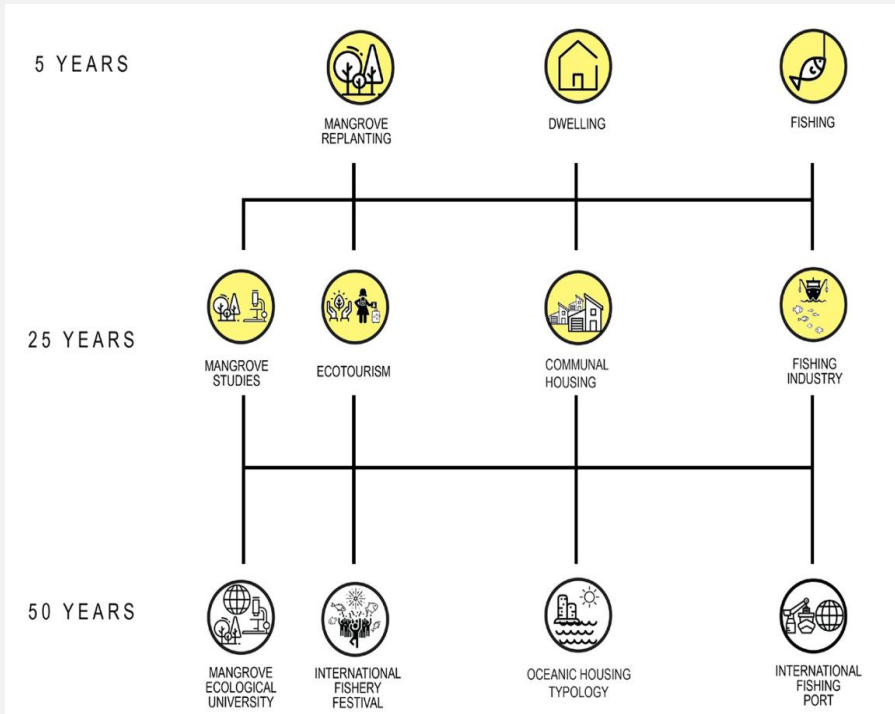

Figure 3: Showing the mangrove action plan

STUDY FRAMEWORK

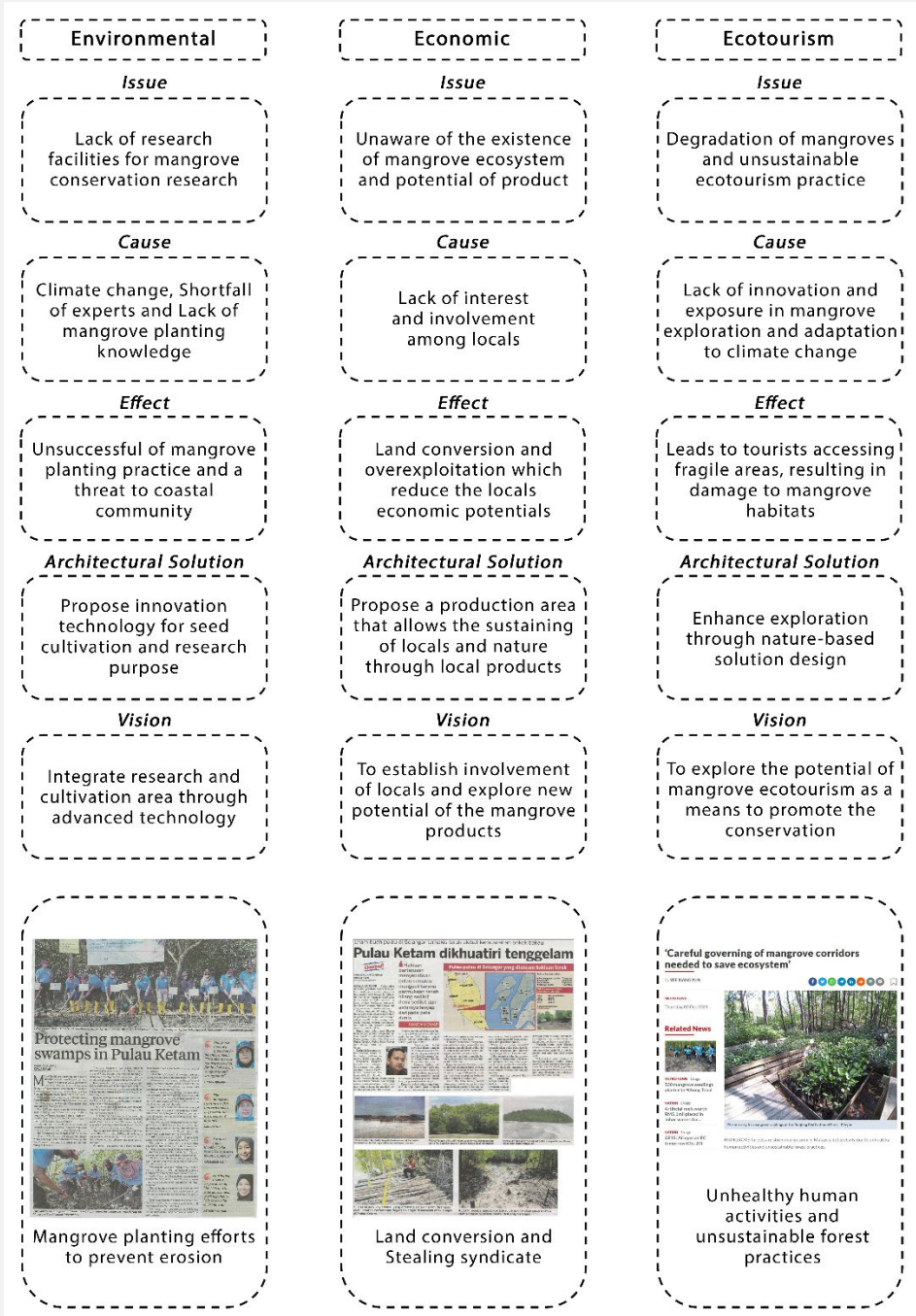

Diagram 1: Showing the design thesis issue framework

AIM

This thesis aims to create an ecotourism mangrove and conservation centre focusing to sustain the future of the mangrove in Malaysia and experiment with the mangrove potential through educative, recreational, interactive, and local content approach, as well as the welfare of the mangrove coastal community.

OBJECTIVES

To propose a sustainable seed cultivation techniques and research centre through advanced technology.

To establish involvement of local communities and stakeholders to promote engagement and explore new potential of the mangrove products.

To explore the potential of mangrove ecotourism as a means to promote the conservation and sustainable use of mangrove ecosystems in coastal settlement areas.

STUDY QUESTIONS

What are the appropriate sustainable seed cultivation techniques and research centre through advanced technology?

What are the possibility on the involvement of local communities and stakeholders to promote engagement and explore new potential of the mangrove products?

What are the potential of mangrove ecotourism as a means to promote the conservation and sustainable use of mangrove ecosystems in coastal settlement areas?

STUDY STATEMENTS

The design of an ecotourism mangrove exploration and research centre can contribute to the conservation and sustainable development of the fragile mangrove ecosystem while providing an immersive and educational experience for visitors. The project seeks to address the challenges of promoting mangrove ecotourism in coastal settlement areas of Malaysia by providing a sustainable design that minimizes the negative impacts of tourism while maximizing the positive outcomes for both the natural environment and local people. By combining ecological, social, and economic aspects of sustainable development, the thesis aims to demonstrate the potential of architecture to promote the conservation and sustainable use of natural resources, while enhancing the resilience of coastal communities to climate change.

LIMITATIONS AND SCOPES

Implementing innovative features for the project encounters challenges due to the site's profile, necessitating modern construction methods to address extreme conditions like storms and seawater corrosion. Precise data related to topography, sea depth, population, and mangrove species is elusive. The study focuses on comprehending mangrove ecosystems, ecotourism, coastal settlements, and their impacts to ascertain the design thesis significance. Mangroves are integral for safeguarding coastal settlements against vulnerabilities and physical harm. The study site is Pulau Ketam, Klang, Selangor. Data collection involves interviews with mangrove experts and NGOs.

STUDY SIGNIFICANCES

The current state of mangrove forests holds significant importance for both the tourism sector and coastal ecosystems. Prioritizing conservation and research efforts for mangroves is crucial. A key challenge lies in formulating effective strategies to enhance and sustain wetlands and coastal settlements. Prolonged mangrove restoration is essential to mitigate coastal erosion and ensure the success of planting initiatives. This design thesis aims to aid societies, architecture students, and researchers in understanding the relationship between mangrove forests and their impact on coastal areas, particularly Pulau Ketam, Klang. The study's focus is on leveraging innovative technologies and ideas to devise solutions for wave water breakers, enhancing wave erosion control and coastal living conditions. The ultimate goal is to establish a sustainable and user-friendly recreational beachfront that addresses coastline erosion and improves site conditions.

METHODOLOGIES

Data is collected from both primary and secondary data collection. Primary data are collected during the data collection phase, while secondary data are collected during the theoretical analysis and literature review phase. The four methods used to complete this research paper are literature reviews, case studies, observation, and interviews as stated:

Table 1: Showing study framework
(Source: Author, 2023)

Thesis Objectives	Thesis Questions	Thesis Methodology	Design Solution
To establish involvement of local communities and stakeholders to promote engagement and explore new potential of the mangrove products.	What are the possibility on the involvement of local communities and stakeholders to promote engagement and explore new potential of the mangrove products?	• In-Depth Interview • Literature Reviews • Case Studies	Propose a production area that allows the sustaining of locals and nature through local products.
To propose a sustainable seed cultivation techniques and research centre through advanced technology.	What are the appropriate sustainable seed cultivation techniques and research centre through advanced technology?	• Literature Reviews • Case Studies	Propose innovation technology for seed cultivation and research purpose.
To explore the potential of mangrove ecotourism to promote the conservation in coastal settlement.	What are the potential of mangrove ecotourism to promote the conservation in coastal settlement areas?	• In-Depth Interview • Case Studies	Enhance exploration through nature-based solution design.

SITE

SITE INTRODUCTION

The proposed site is located in a state with an 18,088-hectare mangrove ecosystem along the west coast of Selangor, Malaysia, extending from Sabak Bernam in the north to Sepang in the south. Notably, the mangrove forests cover key islands like Pulau Kelang, Pulau Ketam, Pulau Tengah, and Pulau Che Mat Zin, with a significant portion situated in the Klang district, accounting for about 72% of Selangor's mangrove reserves.

This region contains the largest expanse of mangrove and mudflats in Malaysia, ranking it as the third-largest mangrove forest ecosystem in the Asia Pacific region, following Indonesia and Australia. Pulau Ketam, with a population of 6,000 to 7,000, serves as Selangor's primary fishing island, inhabited mainly by Chinese fishermen who rely on fisheries and eco-tourism.

The Klang Islands Forest Reserve, a part of this ecosystem, is classified as Type IV by the International Union for Conservation of Nature (IUCN), signifying its role as a habitat and species management area, dedicated to safeguarding specific species and habitats (Zakaria, et al., 2009).

Figure 4: Key and Location plan

SITE BACKGROUND

The proposed site is located at the mangrove forest reserve at Pulau Ketam, Selangor. The proposed site area is approximately 7 acres equivalent to 28328 sqm. The location of the site is chosen based on several criteria which are:

1. Strategic Location

One of the largest coverage of mangrove reserved sites in Selangor
Ecotourism spot for fresh seafood and fisherman cultural village
The potential site to be a research center to be the role model and exchange knowledge locally and internationally.

2. Accessible from both fisherman village

2km from both Jetty Pulau Ketam and Jetty Sungai Lima connect both Kampung Bagan Teochew and Bagan Sungai Lima.

Selangor, a coastal state in Malaysia, boasts a remarkable treasure - an 18,088-hectare expanse of mangrove ecosystem. Stretching from Sabak Bernam in the north to Sepang in the south, this ecosystem encompasses the picturesque landscapes of Pulau Kelang, Pulau Ketam, Pulau Tengah, and Pulau Che Mat Zin. The significance of this ecosystem cannot be understated, as it harbors a unique blend of biodiversity, cultural heritage, and environmental importance. This article explores the potential for eco-tourism activities in this area, delves into its conservation efforts, and examines its classification as a Type IV habitat by the International Union for Conservation of Nature (IUCN).

ECOTOURISM POTENTIAL

The Selangor mangrove ecosystem presents an ideal setting for eco-tourism activities. With its diverse flora and fauna, tranquil waterways, and stunning landscapes, it offers a one-of-a-kind experience for nature enthusiasts and adventure seekers alike. Boat cruises provide an opportunity to explore this captivating environment, but with a caveat - limited entry is enforced to safeguard the delicate replanting and conservation efforts.

SUSTAINABLE CONSERVATION

The significance of this ecosystem is underscored by its classification as Type IV by the IUCN. As a habitat and species management area, this designation aims to safeguard specific species and habitats. This classification amplifies the importance of responsible eco-tourism, underscoring the need to ensure that human activities do not disrupt the fragile balance of this ecosystem.

SUSTAINABLE CONSERVATION

A proposed site, located at RM-3 in the Productive Zone (Production Forest), offers a promising avenue for eco-tourism development. The concept of sustainable utilization of resources is central to this endeavor, ensuring that activities like logging are conducted in a manner that preserves the ecosystem's integrity. The state government's commitment to protecting the mangrove reserve's biodiversity while promoting eco-tourism is a testament to the balanced approach taken toward development.

ECONOMIC AND ENVIRONMENTAL IMPACTS

The integration of eco-tourism within the mangrove ecosystem can yield both economic and environmental benefits. By developing the mangrove reserve as an international tourism attraction, Selangor state can gain economically and environmentally.

The Selangor mangrove ecosystem, with its expansive beauty and vital role in the region's biodiversity, is poised to become a prime example of sustainable eco-tourism. By carefully managing and preserving this delicate environment, while allowing controlled visitor experiences, Selangor can strike the perfect balance between economic growth and ecological well-being. With its classification as a Type IV area by the IUCN, the proposed site exemplifies the harmonious coexistence of human activities and nature, ensuring a promising future for both conservation and tourism.

Figure 5: Showing the proposed site location between both fisherman village

SITE ANALYSIS AND SYNTHESIS

This project envisions the transformation of the Pulau Ketam Mangrove Ecotourism Centre into a harmonious blend of tradition and modernity. By integrating proper infrastructure, restoration of mangrove trees, and innovative architectural design, the proposed site can cater to both the local fishing community and eco-tourists. This holistic approach not only ensures the preservation of the delicate ecosystem but also fosters economic growth and cultural exchange.

Besides, the Pulau Ketam Mangrove Ecotourism Centre presents a unique opportunity to strike a balance between the preservation of local culture and the modern demand for sustainable tourism. By combining traditional architectural elements with contemporary design concepts, and by integrating the local community into the project, a truly holistic and thriving eco-tourism destination can be established.

INFRASTRUCTURE AND ACCESSIBILITY

The success of the proposed site relies on proper infrastructure. Establishing roadways and a jetty would facilitate access for both the local fishing village and tourists. This infrastructure not only improves connectivity but also ensures that the site remains accessible while minimizing environmental impact.

MANGROVE RESTORATION

Moreover, the central to the project is the restoration of mangrove trees. This effort not only enhances the ecological integrity of the area but also provides a backdrop for the envisioned mangrove center. By thoughtfully integrating mangrove trees within the design, the site can become an immersive experience, connecting visitors with the natural world.

INNOVATIVE ARCHITECTURAL DESIGN

Furthermore, a unique opportunity lies in designing the center with elevated walkways and water features, seamlessly integrating architecture with nature. Drawing inspiration from the vernacular fisherman village architecture of Pulau Ketam, a fusion of tradition and modernity can manifest in the proposed modern + vernacular architectural style.

CULTURAL AND ECONOMIC GROWTH

The vernacular architecture of Pulau Ketam can serve as a guiding principle in creating an atmosphere of cultural authenticity. By involving the local community, their knowledge and practices can be integrated into the center's offerings. This cultural exchange not only enriches the visitor experience but also uplifts the local economy through the promotion of handicrafts, traditional performances, and local cuisine.

Hence, the envisioned transformation of the Pulau Ketam Mangrove Ecotourism Centre represents a harmonious blend of tradition and modernity. By integrating proper infrastructure, mangrove restoration, and innovative architectural design, the site can become a symbol of sustainable development. This holistic approach not only ensures the conservation of the mangrove ecosystem but also facilitates economic growth, cultural exchange, and a memorable experience for both the local community and tourists.

SUSTAINABLE CONSERVATION

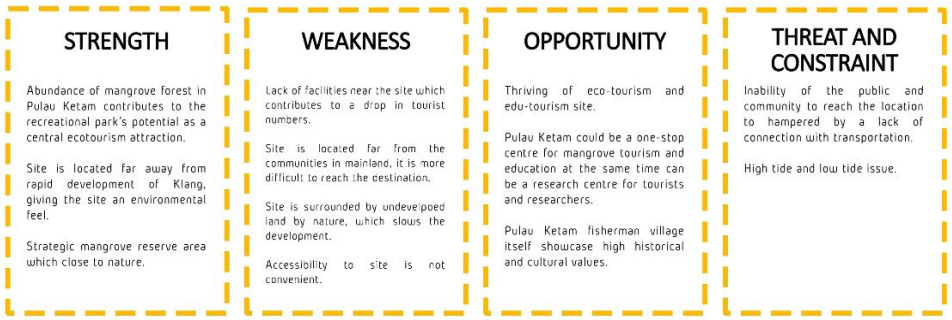

Figure 6: SWOT Analysis of the proposed site
)

DESIGN CONCEPT

"Seeding the Wetlands" envisions a harmonious blend of sustainable architecture and environmental stewardship. The concept embraces the remarkable adaptability of mangroves by integrating their resilient root systems into the design. Just as mangroves intertwine their roots to form a protective network against erosion and support diverse marine life, this concept weaves together architectural elements that mimic nature's complexity. Moreover, this concept aligns beautifully with the overarching goals of sustainable architecture and ecological conservation, showcasing the potential for mankind to be both stewards and beneficiaries of the environment.

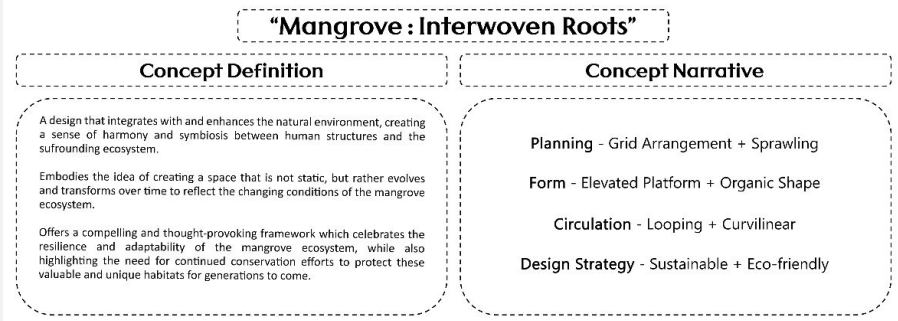

Figure 7: Study Concept Description

Besides, Pulau Ketam Mangrove Ecotourism and Conservation Centre serves as a nexus for education, awareness, and sustainable tourism. Visitors are immersed in an experience that not only showcases the aesthetic marvel of mangrove ecosystems but also underscores the critical role they play in maintaining coastal biodiversity and safeguarding against climate change impacts.

"Seeding the Wetlands" strives to be more than a physical structure; it's a living embodiment of ecological harmony. The design of the centre pays homage to the resilience and interconnectedness found in nature, symbolizing the potential for humans and the environment to coexist in a balanced, regenerative relationship. By embracing the elegance of mangroves' interwoven roots, this concept transcends conventional architectural approaches, offering a powerful testament to the potential for human ingenuity to contribute positively to environmental conservation.

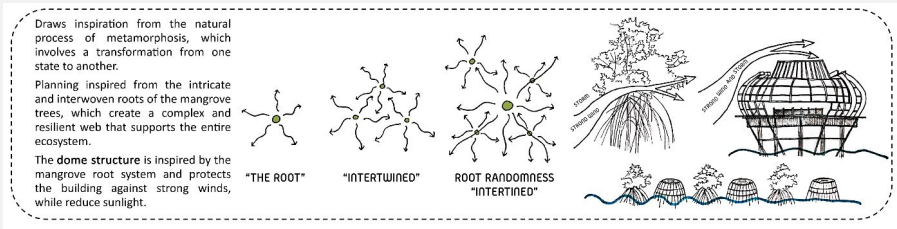

Figure 8: Study Concept Inspiration

DESIGN CONCEPT APPLICATION

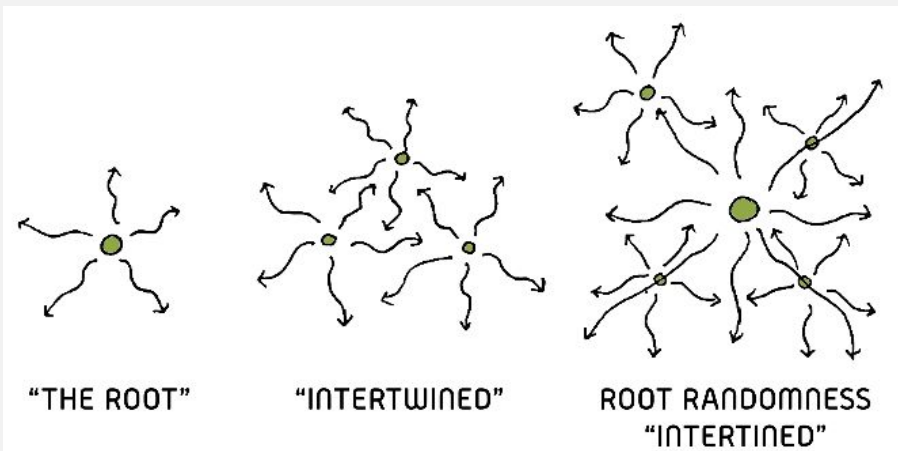

Figure 9: Study Concept Development

SPATIAL COMPONENT

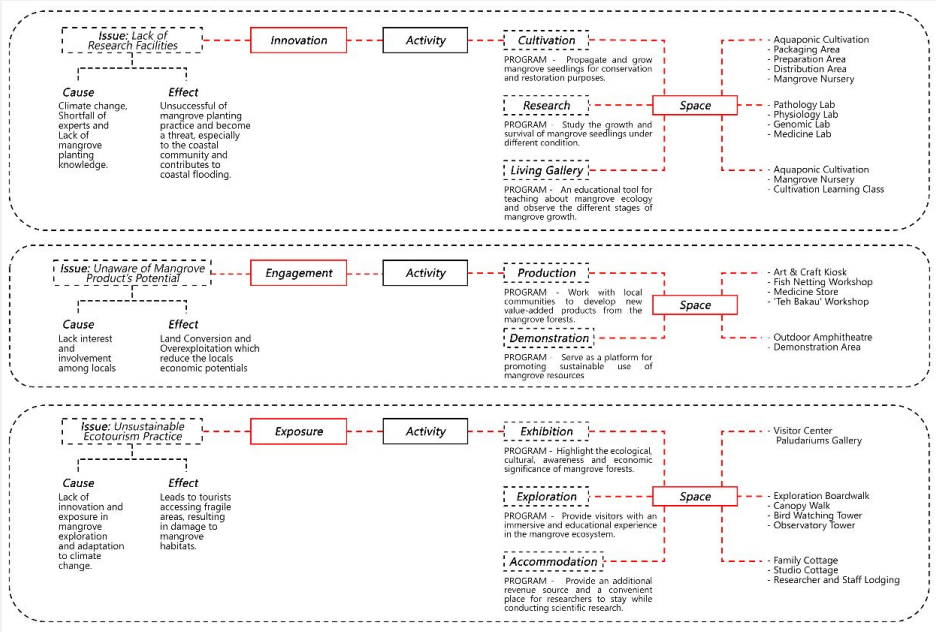

Figure 10: Spatial Component
(Source: Author, 2023)

DESIGN MORPHOLOGY

The design ingeniously weaves together the structural integrity of mangrove roots with the aspirations of modern architecture. The interwoven roots of mangroves, which anchor the trees and support entire ecosystems, become a living metaphor for the interconnectedness of ecological preservation and human experience. This design philosophy serves as the cornerstone for creating a space that nurtures both the surrounding ecosystem and the human spirit.

Furthermore, intriguing and transformative, the design narrative inspired by mangrove interwoven roots not only pays homage to the ecosystems that sustain us but also challenges the boundaries of architectural imagination. This journey encapsulates the essence of creating a place where the past, present, and future interlace in the embrace of nature-inspired design.

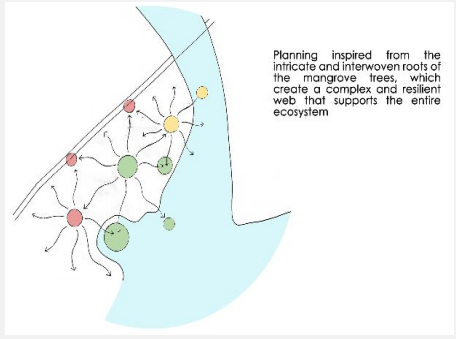

Figure 11: Design Morphology Development

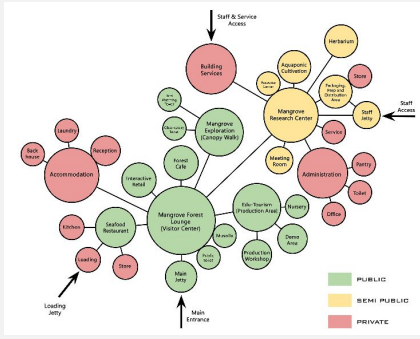

Figure 12: Space Explorential

SITE PLAN

The overall design is taken from the concept Modern Contemporary Architecture, which the form, orientation of the building and spatial planning is responding towards the site and embrace the existing facilities and natural surrounding of the site. The design planning and building program for the mangrove ecotourism and conservation center artfully translates the essence of mangrove interwoven roots into a harmonious ensemble of spaces. The programme also serve as conduits for education, research, and immersive experiences that deepen our connection to these vital coastal ecosystems.

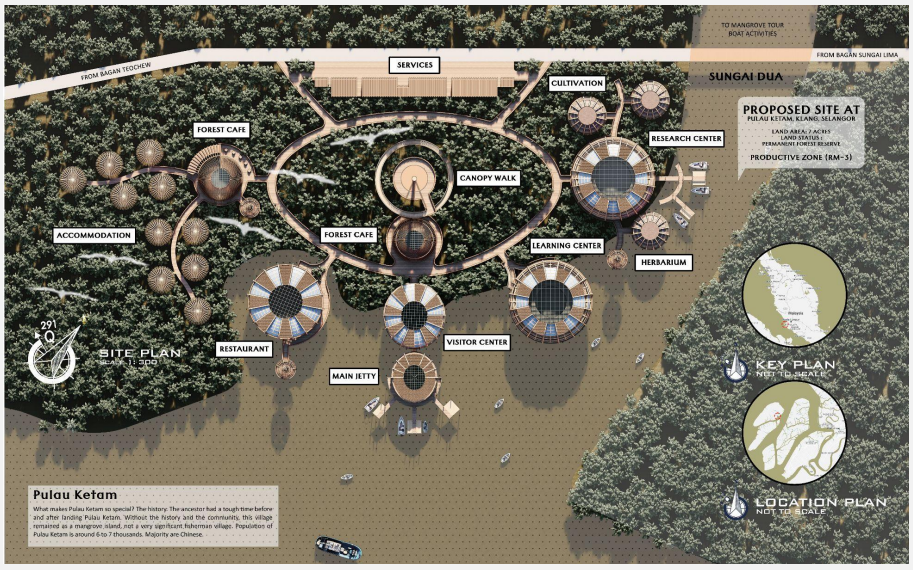

Figure 13: Site Plan

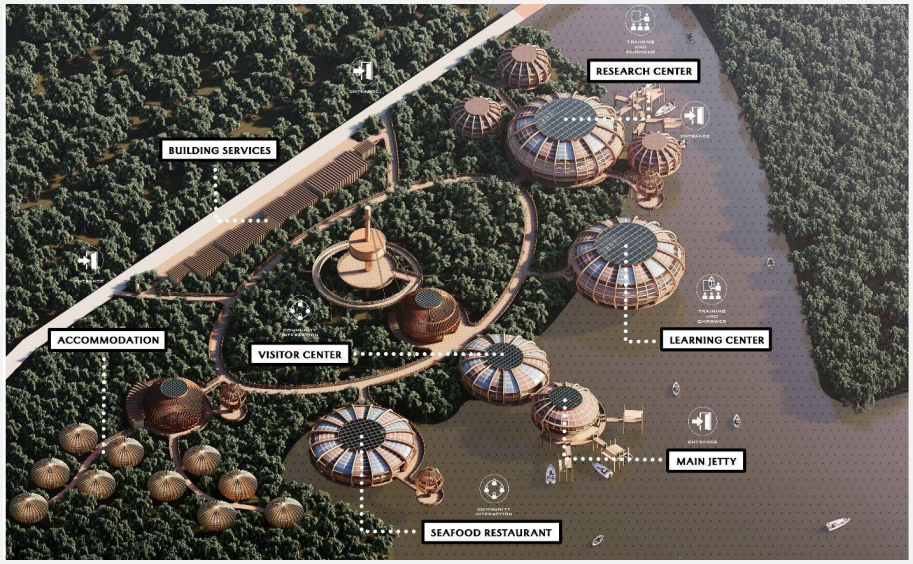

Figure 14: Building Programme

GROUND FLOOR PLAN

The design of the Mangrove Ecotourism and Conservation Center intertwines the programmatic elements which are Visitor Centre, Learning Centre, Research Centre, and Accommodation with the intricate beauty and resilience of mangrove interwoven roots. This architectural symphony seamlessly integrates ecological sensitivity with functional excellence, creating a space where human engagement, education, research, and rejuvenation resonate harmoniously with the natural world. The design becomes a living tribute to the interconnectedness of all life forms and an embodiment of your thesis's profound message of ecological awareness and preservation.

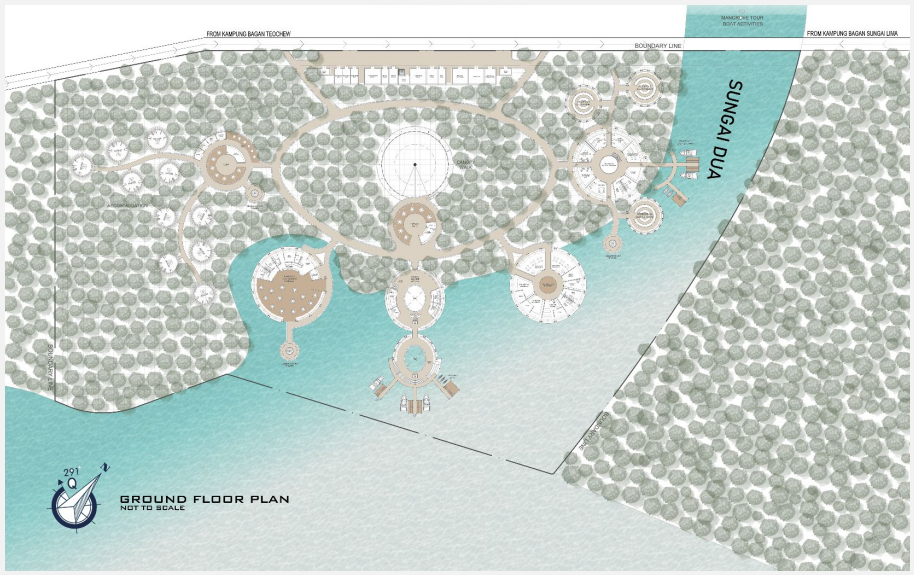

Figure 15: Ground Floor Plan

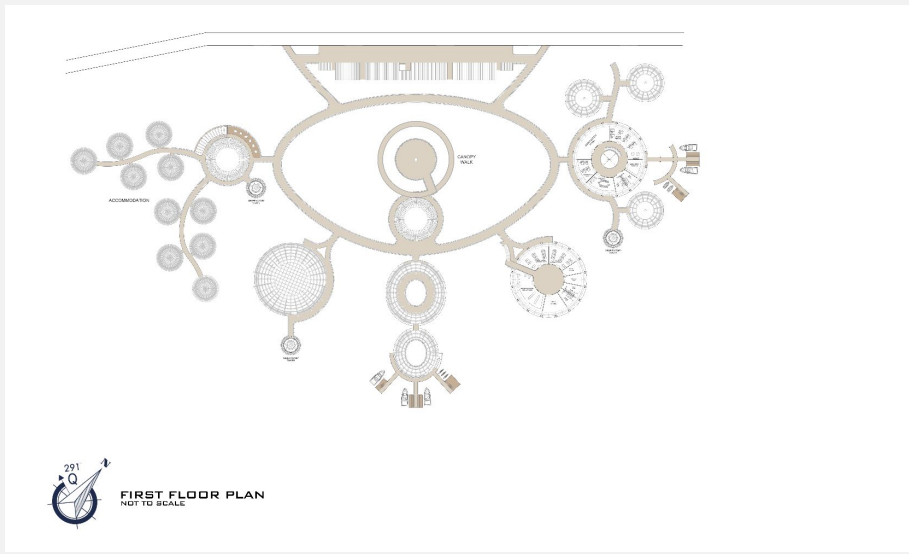

Figure 16: First Floor Plan

SECTIONS

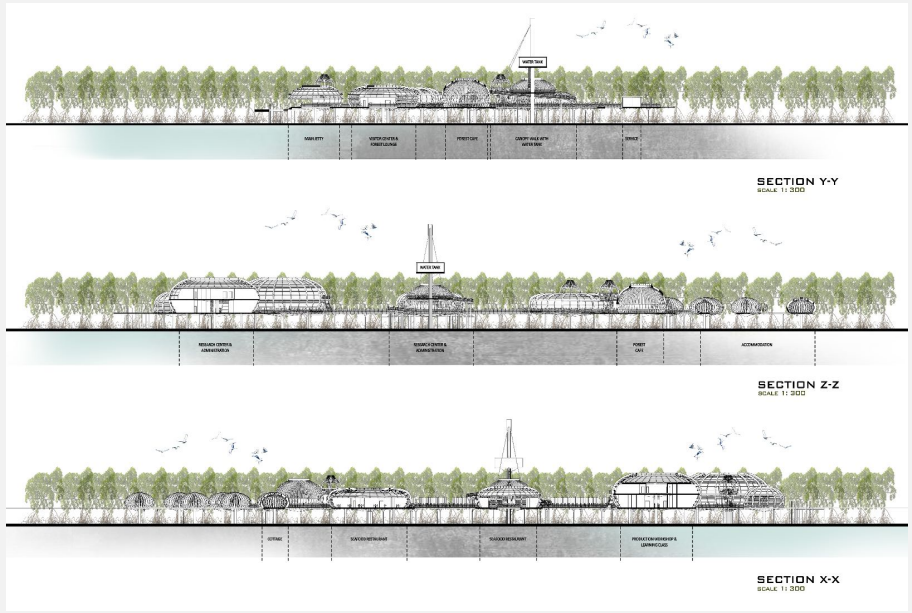

Figure 17: Section X-X,Section Y-Y and Section Z-Z

ELEVATIONS

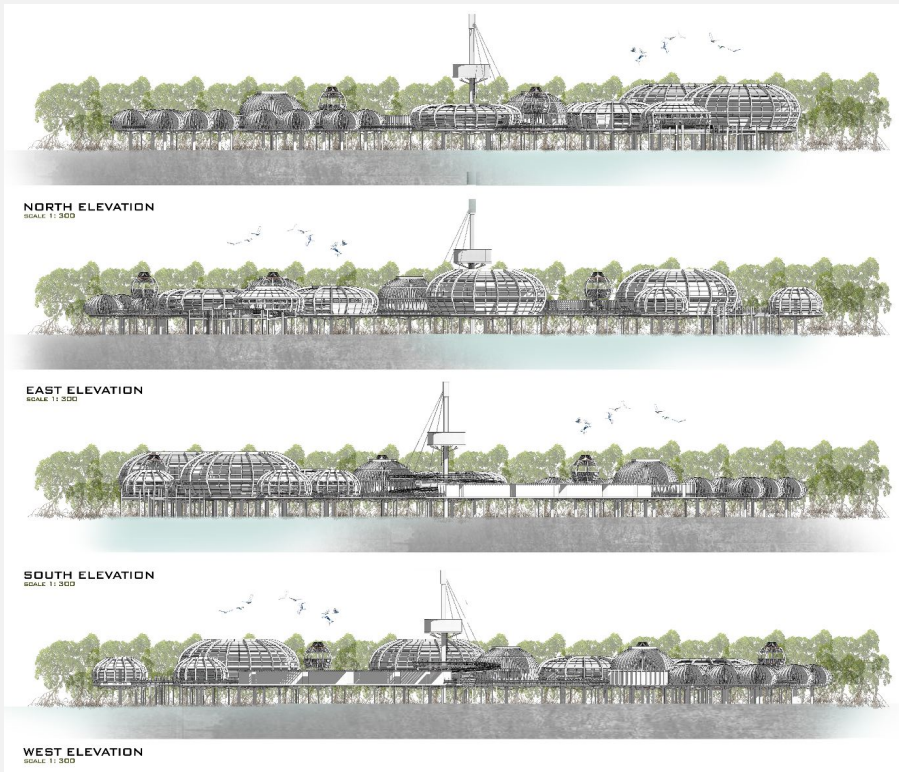

Figure 18: Building Elevations

PERSPECTIVES

The centre focuses on the innovative design showcasing a harmonious blend of ecological preservation and responsible tourism. The design embodies sustainability, environmental sensitivity, and community engagement, presenting a holistic solution to the conservation of the precious mangrove ecosystems. Moreover, the center reveals a captivating architectural vision. Nestled within the lush mangrove surroundings of Pulau Ketam, the center stands as a beacon of harmony between human intervention and nature's beauty. The design also balances modern aesthetics with a profound respect for the environment, creating a structure that complements its surroundings while offering a distinct visual identity.

Figure 19: Isometric View of the centre

Figure 20: Exterior Views

Figure 21: Interior Views

SPECIAL STUDY

Aeroponic and Aquaponic

This study introduces the concept of integrating Aeroponic and Aquaponic systems into the architecture of the Mangrove Ecotourism and Conservation Center. In this integrated building design, a centralized Building Automation System (BAS) assumes its traditional role, overseeing HVAC, security, lighting, and life safety systems. This initial configuration forms the foundation of a smart building, albeit one that is not fully equipped to autonomously capture data and alter systems.

Moreover, evolving toward true smart building functionality, the study introduces a transformative element: sensors strategically positioned to gather data from each individual system and equipment within the facility. This data undergoes a process of in-depth analysis through the application of artificial intelligence or machine learning algorithms. The outcome is a responsive, real-time adjustment of systems, optimizing operational efficiency while minimizing resource consumption.

A pivotal aspect of this study is the creation of a Rotational Planter area, ingeniously designed to accommodate six plant boxes within a single rack. This dynamic system encompasses 30 such racks, and a single floor can accommodate six integrated aquaponic and aeroponic systems, culminating in an impressive total of 432 planters.

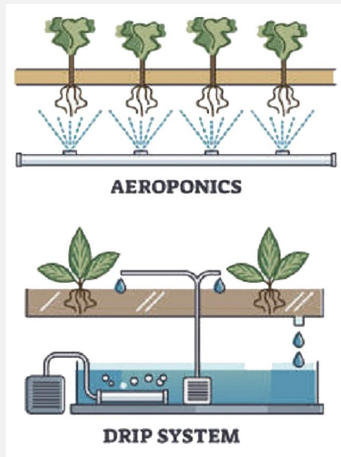

Figure 22: Rotational Planter using Aeroponics and Aquaponic System

Besides, underpinning the entire structure is the application of the "Internet of Things" (IoT), a network interconnecting devices. The comprehensive integration of IoT, in collaboration with advanced sensors, fosters dynamic live data analytics. These insights empower the operational team with information for preemptive maintenance, allowing them to proactively address potential system issues before they escalate.

Hence, embedded with the project sis on mangrove ecotourism and conservation lies a pioneering special study that intertwines sustainable design, technological innovation, and environmental consciousness. This special study seamlessly interwoven into your architecture thesis nurtures a profound synthesis of ecological consciousness, technological advancement, and sustainable design.

The integration of Aeroponic and Aquaponic systems, coupled with the principles of smart buildings and IoT-driven data analytics, envisions a future where architecture becomes a conduit for environmental harmony. This innovative approach not only resonates with conservation principles but also contributes to the delicate equilibrium between human interaction and the natural world.

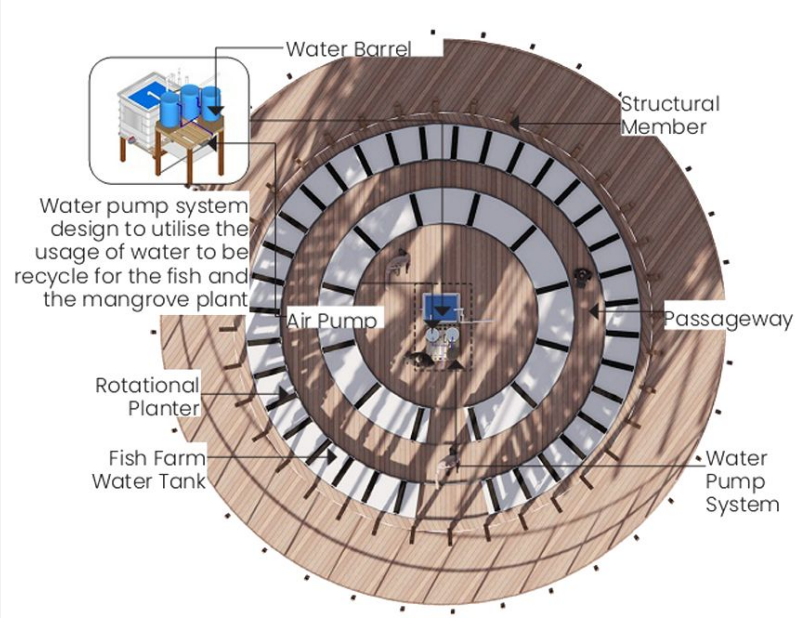

Figure 23: Rotational Planter Layout

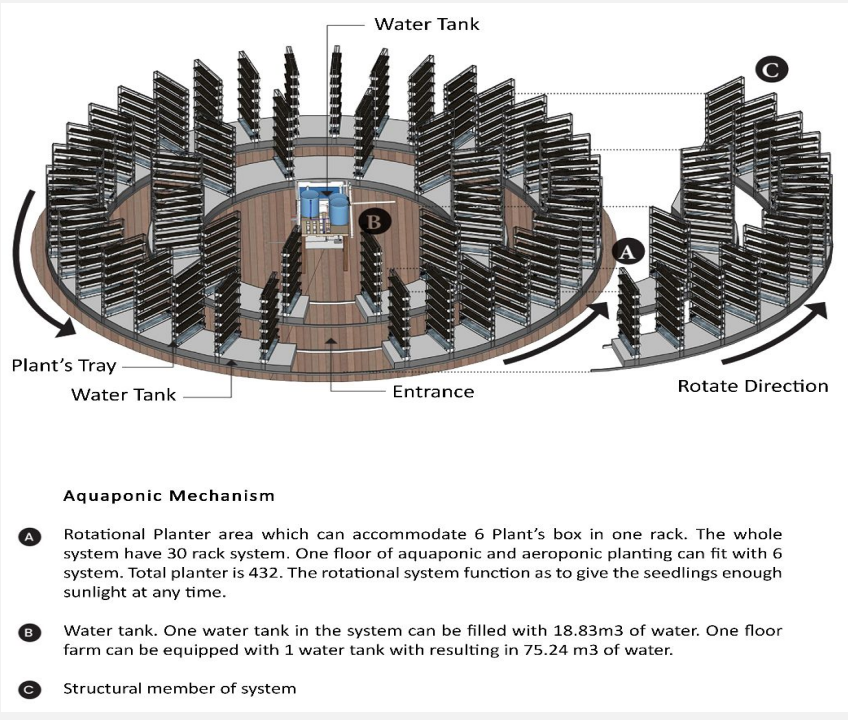

Figure 24: Rotational Planter Mechanism

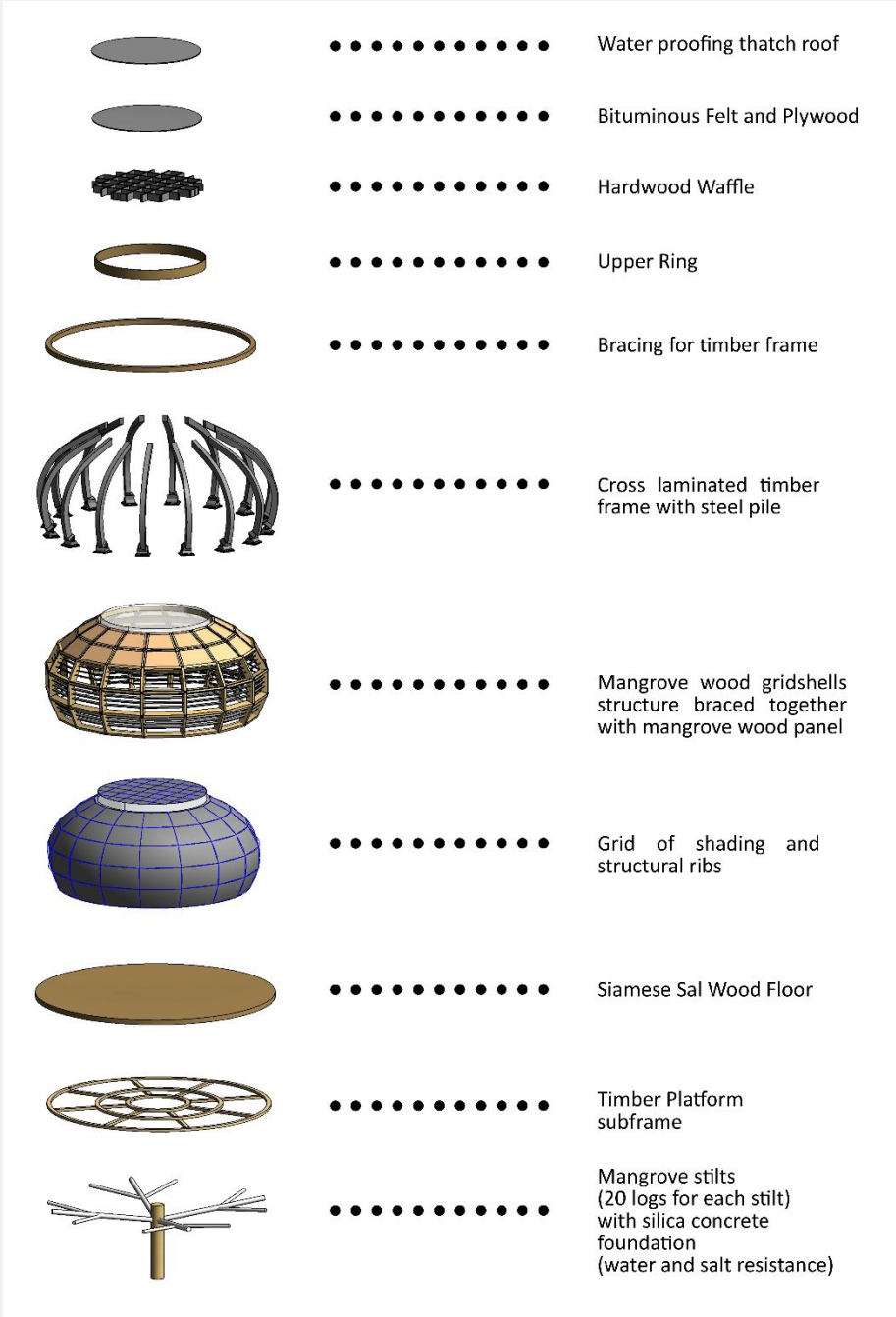

Figure 25: Exploded Diagram of Cultivation area

CONCLUSION

The proposed Mangrove Ecotourism and Conservation Center at Pulau Ketam offers a vital opportunity to blend sustainable tourism, ecological preservation, and education. This thesis delves into the significance of mangrove ecosystems, emphasizing conservation through ecotourism integration. The center harmonizes visitor experiences with safeguarding the fragile mangrove forests.

Drawing from existing conservation and ecotourism models, the design prioritizes sustainability and community engagement. It employs energy-efficient architecture, eco-friendly materials, and passive cooling techniques, minimizing its environmental impact.

The center's versatile spaces serve as education, research, and community hubs. Interactive displays and programs enhance understanding and inspire advocacy. Guided eco-tours facilitate responsible exploration, preserving habitats and biodiversity.

Besides, the community, government, and NGO collaboration is integral to success. Involving locals in decisions, offering employment, and reflecting cultural elements nurture a shared commitment to conservation.

In conclusion, the proposed center epitomizes preserving mangroves and promoting responsible tourism. It showcases architecture's role in conservation, education, and community engagement. Grounded in sustainability and community participation, it could set a global precedent for ecotourism and conservation initiatives.

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