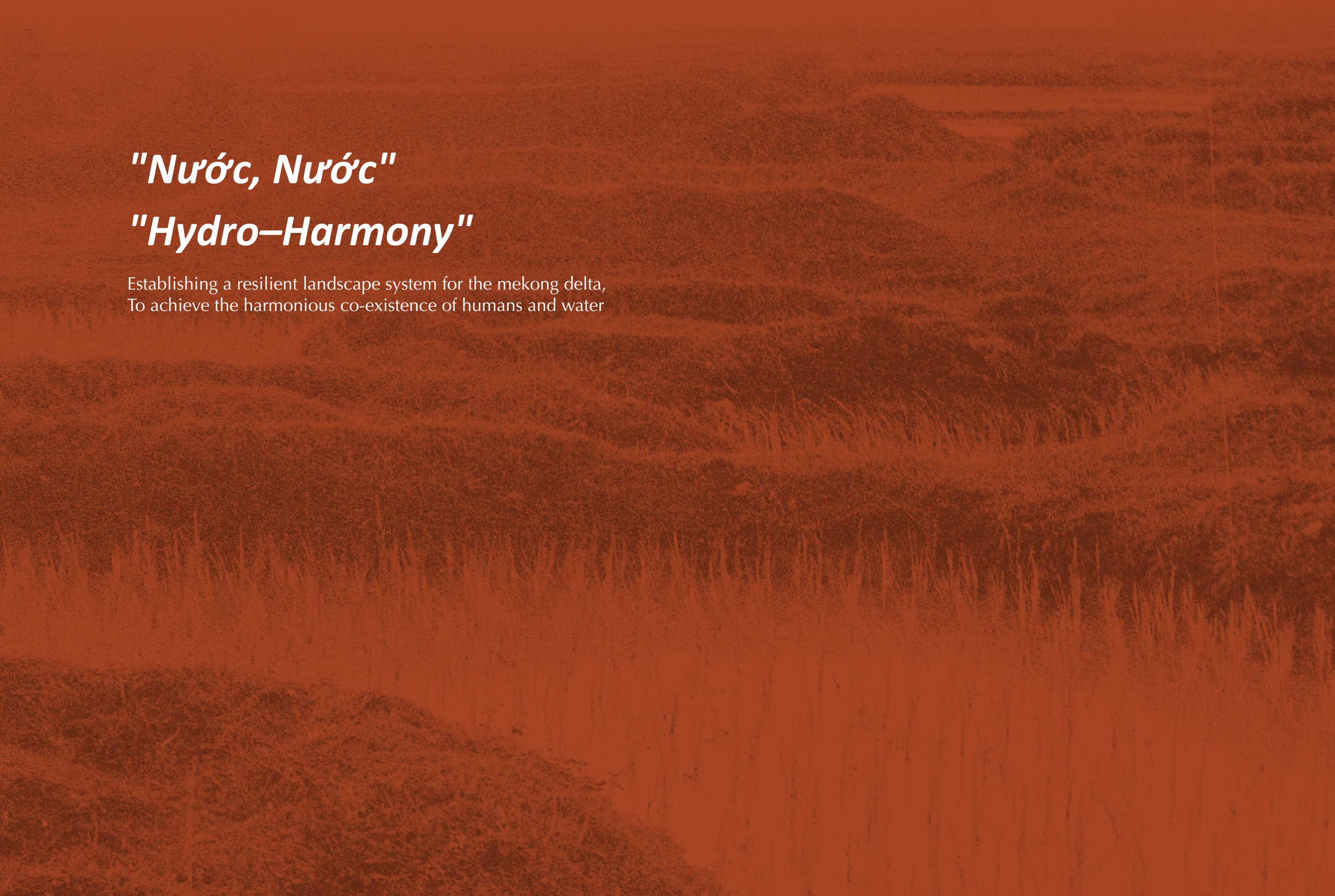
"Nước, Nước"

"Hydro–Harmony"

Establishing a resilient landscape system for the mekong delta,
To achieve the harmonious co-existence of humans and water



Master Thesis Report
MSc Architecture, Urbanism and the Built Environment
Landscape Architecture Track

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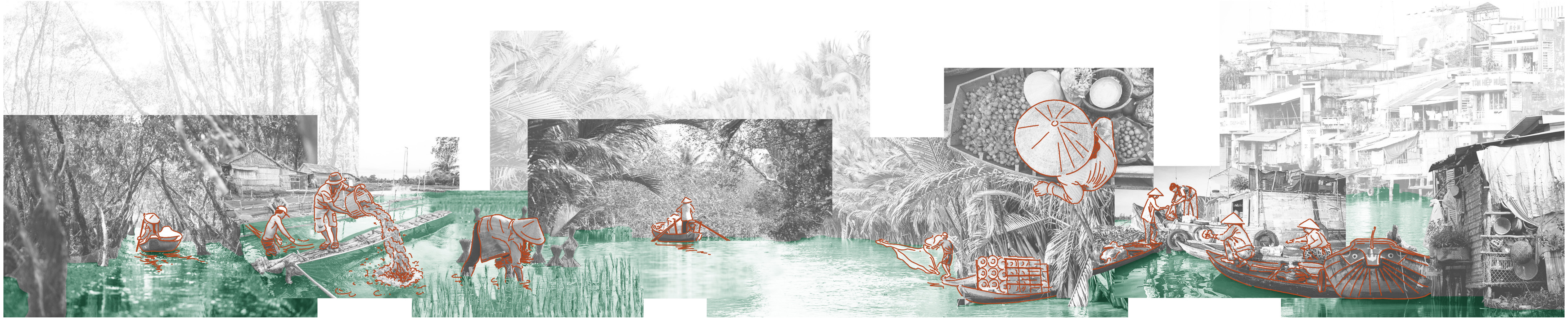
Flowscapes Studio
Resilient Coastal Landscape (RCL)

Location: Mekong delta, Vietnam

Unless stated otherwise all pictures and graphics by author

*In Vietnamese, the word for water and the word for a nation, a country and a homeland are one and the same: "**Nước**".*



CONTENT

Part I

Research Definition

Sourse: https://www.flickr.com/photos/13476480@N07/51319661496/in/album-72157719556426358/

01
Introduction

1.1 LOCATION

The Mekong Delta is a vast spread of fertile riverbeds, islets, and mangrove swamps at the end of the Mekong River, where Vietnam's coastline meets the sea. The delta covers an area of about 65,000sq km and is home to more than 20 percent of Vietnam's population.

Their livelihoods depend mainly on agricultural and aquaculture production. Often described as the "rice bowl" of Vietnam, which supplies more than half (~56%) of the country's rice. [GSOVN, 2020]

Vietnam's Mekong Delta (VMD) is one of the largest deltas with an extraordinarily flat and low elevation of about 80 cm.

1.2 PROBLEM FIELD

1.2.1 Water Issues -- Saline Intrusion

Fig. Rice field are severely affected when saltwater intrusion occurs
Photo: Thong Hai

Fig. Affected rice in in My Nhon and Thuy An communes
Photo: Thong Hai

1.2 PROBLEM FIELD

1.2.1 Water Issues -- Saline Intrusion

The problem of saline intrusion in the Mekong Delta has intensified in the last decade and has gradually attracted a great deal of attention. As can be seen from the figure, salinity at several stations along the main river channels in the VMD has increased by an average of 0.2 PPT per year over the past two decades [Eslami et al. 2019]. Some projections also suggest that salinity will reach 2 PPT in most parts of the region by 2050.

Damage to crops from saline intrusion

Saltwater intrusion often causes significant economic and crop losses as well as freshwater shortages. Most of the rice varieties grown today are damaged when water salinity reaches 4‰ or more. For salinity levels above 2‰, rice yields were found to be reduced by 20–45% when salt stress occurred during the tillering stage, and by 10–40% if salt stress occurred during the heading stage. [Paik et al. 2020]

How saline intrusion occurs

Because saline water has a higher mineral content than freshwater, it is denser and has a higher water pressure. As a result, saltwater can push inland beneath the freshwater. Therefore, salt intrusion can be divided into two categories surface saline intrusion and groundwater saline intrusion.

Surface water salt intrusion is the result of a complex interaction between river and ocean forces. Usually, during the wet season, flushing capacity limit salt intrusion from the ocean in the estuary to a few kilometers, whereas during the dry season, ocean forces push salt intrusion upwards in the river channel by tens of kilometers.

At the same time, saline intrusion can also occur in underground aquifers. To maintain the existing production pattern, water wells are built in large numbers to tap groundwater. However, Water extraction drops the level of fresh groundwater, reducing its water pressure and allowing saltwater to flow further inland.

Therefore, saline intrusion is influenced by a large number of drivers such as climate change (changes in discharge, sea level, evaporation, and precipitation), and changes in land use and land cover.

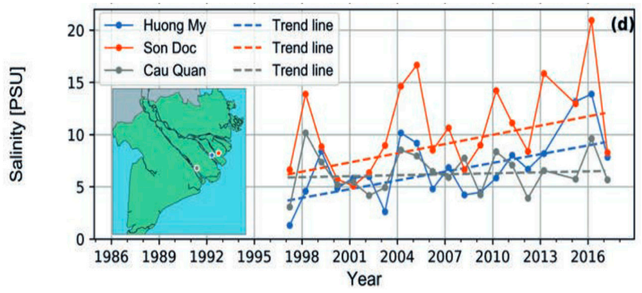


Fig. Trends of salinity variations at three different stations along the estuaries of the delta.
Sourse: Climate change in Viet Nam Impacts and adaptation

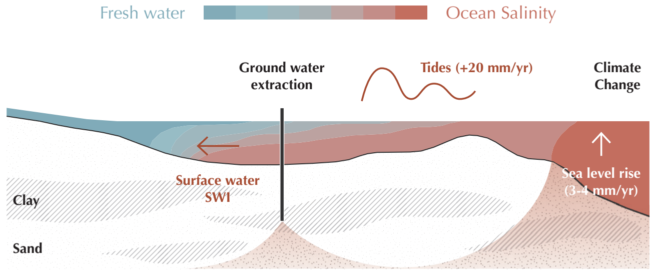


Fig. A cross-profile of a delta through its estuarine system.

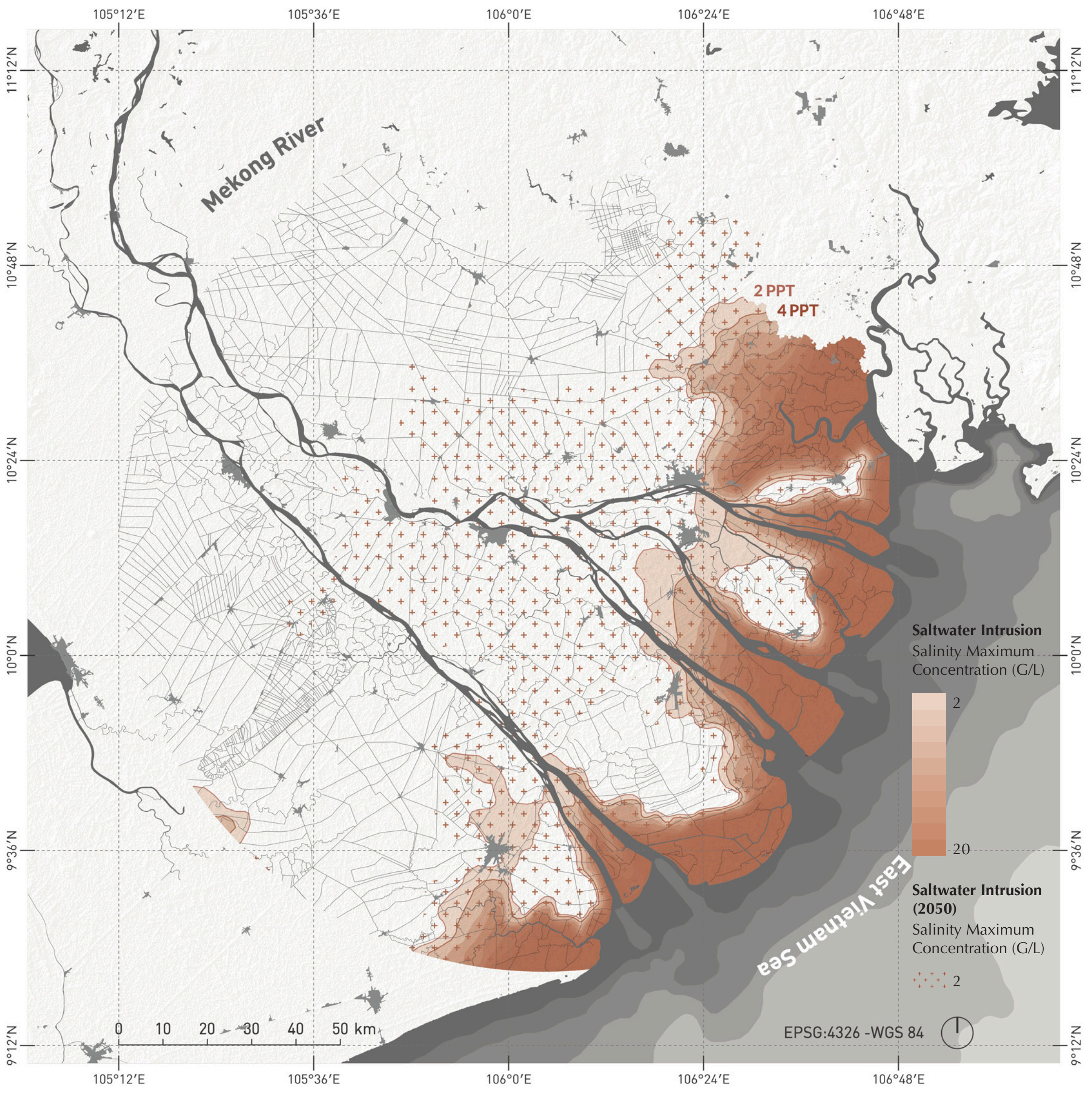


Fig. Status and prediction of saltwater intrusion in the Mekong Delta

1.2 PROBLEM FIELD

1.2.2 Water Issues -- Flooding

Fig. Flood occurred following heavy rainfall in November 2021
Photo: Cuong Tran

Fig. Flood occurred following heavy rainfall in November 2021
Photo: Cuong Tran

1.2 PROBLEM FIELD

1.2.2 Water Issues -- Flooding

The VMD has two main seasons: the wet season from May to November and the dry season from December to April. About 90% of the rainfall is concentrated in the wet season.

Historically, a dense network of canals was developed to drain wetlands and create farmland for agricultural development. Next, more and more people came to the Mekong Delta, forming villages and cities. As the population increased and the land use changed in nature, flooding gradually became a big problem for VMD.

Flooding in the Mekong Delta usually starts in June-July and ends in November-December. after May, as rainfall increases, the combination of frequent precipitation and higher water volumes upstream causes the water level to rise, peak in October, and then gradually recede until the end of the rainy season. However, during the dry season, when rainfall is insufficient and river water volume decreases, agricultural production must rely on groundwater.

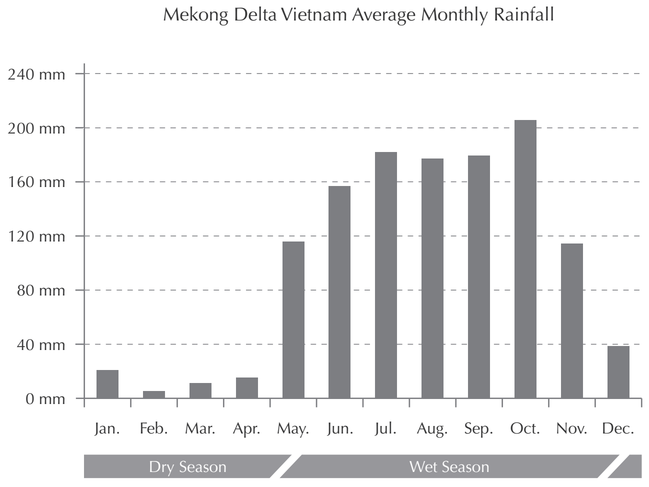


Fig. The current ten-year flood depth and average annual rainfall in the Mekong Delta
Sourse: hikersbay.com

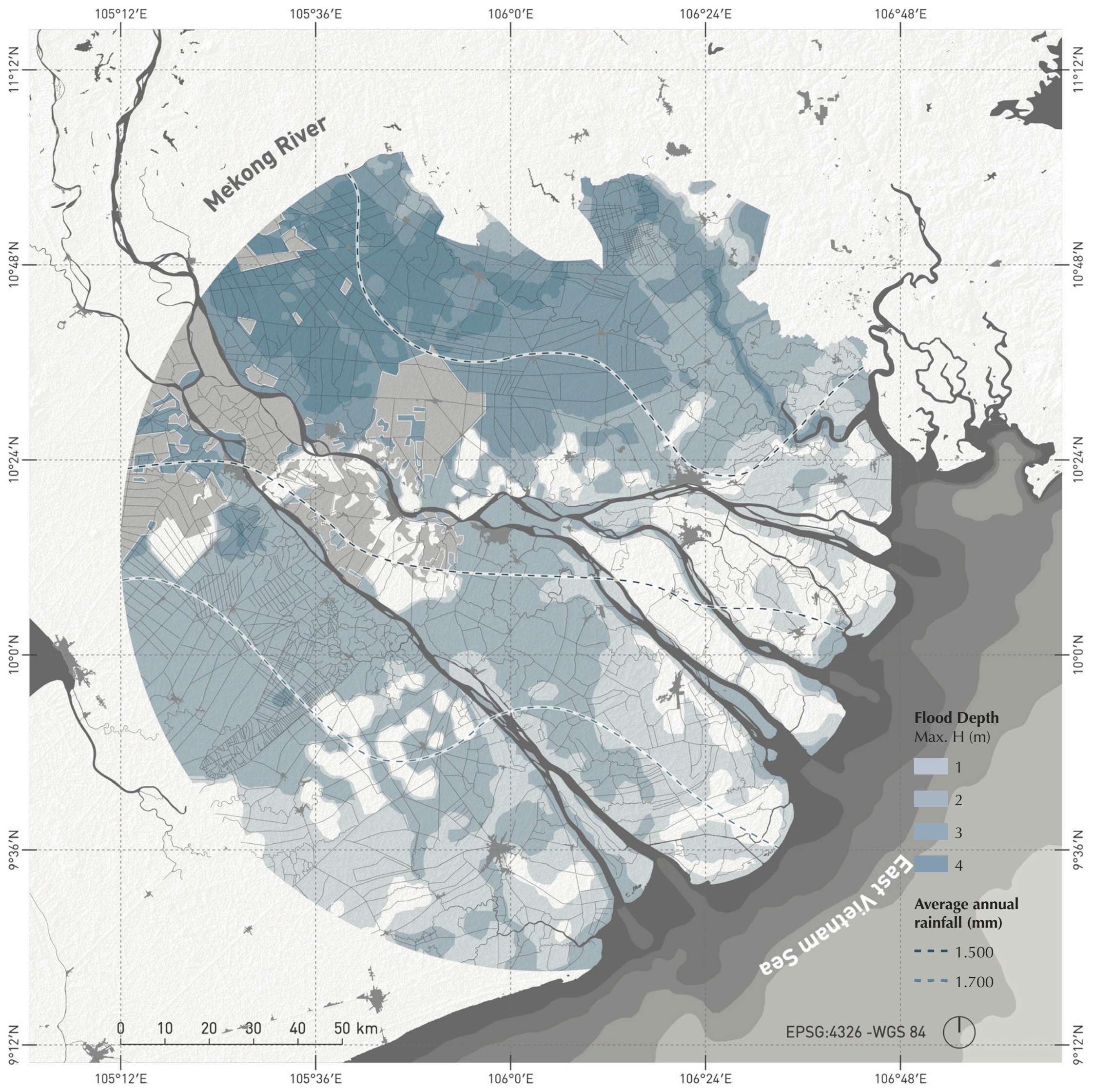


Fig. The current ten-year flood depth and average annual rainfall in the Mekong Delta

1.2 PROBLEM FIELD

1.2.3 Climate Change

Fig.Since their neighbours' house collapsed due to erosion, Nguyen Van Thuong (pictured) and his wife Lam Thi Le have been afraid they too will soon lose their home a few metres from the Tien River in southwest Vietnam
Photo: Quinn Ryan Mattingly

Fig. Pumps remain untouched along the N7 Canal in Go Cong Tay District in Tien Giang as there is no water to pump into fruit orchards
Photo: Huu Khoa

1.2 PROBLEM FIELD

1.2.3 Challenges posed by climate change

Sea Level Rise

The Mekong River delta has a low average elevation of only about 80 centimeters above global mean sea level, and the delta plain is particularly vulnerable to climate change-induced sea level rise (SLR). The current rate of global mean sea level rise is about 3.3 mm/year and is projected to accelerate during the 21st century, depending on climate scenarios. There is still considerable uncertainty about the values likely to be reached by the end of this century and beyond, but even under the most optimistic climate scenarios, global mean sea level rise could exceed 40 cm by 2100, which could put the lowest parts of the delta at risk of permanent inundation [Bamber et al., 2019; Ministry of Natural Resources and Environment (MoNRE), 2016].

However, global sea level rise is not the only cause of changes in delta elevation relative to the sea surface. The Mekong Delta is currently sinking an order of magnitude faster than global sea level rise [Erban et al. 2014; Minderhoud et al. 2017, 2020]. The subsidence of deltas is a natural phenomenon, but at the same time, human activities can trigger new subsidence processes. It has been shown that over-pumping of groundwater can lead to accelerated subsidence of the VMD [Minderhoud et al. 2017, 2020]. Under natural conditions, floods bring in new sediment, and sedimentation can partially offset sea-level rise by elevating the ground surface. However, new sediment is not available on the floodplain due to sediment retention caused by upstream dams and wet season flood control measures. As a result, the natural mechanisms for coping with relative sea level rise no longer work. In the coming decades, relative sea level rise is likely to significantly exacerbate coastal flooding, erosion, and saline intrusion, all of which are already disrupting daily life in the Delta.

Precipitation

In the modeling of different climate change scenarios, rainfall tends to decrease in the dry season and increase in the wet season. By 2050, rainfall is projected to increase by 2-5% in the wet season and decrease by 4-8% in the dry season. By 2100, dry season rainfall is projected to decrease by 10-20%. Rainfall during the wet season is expected to increase by 8-16%.

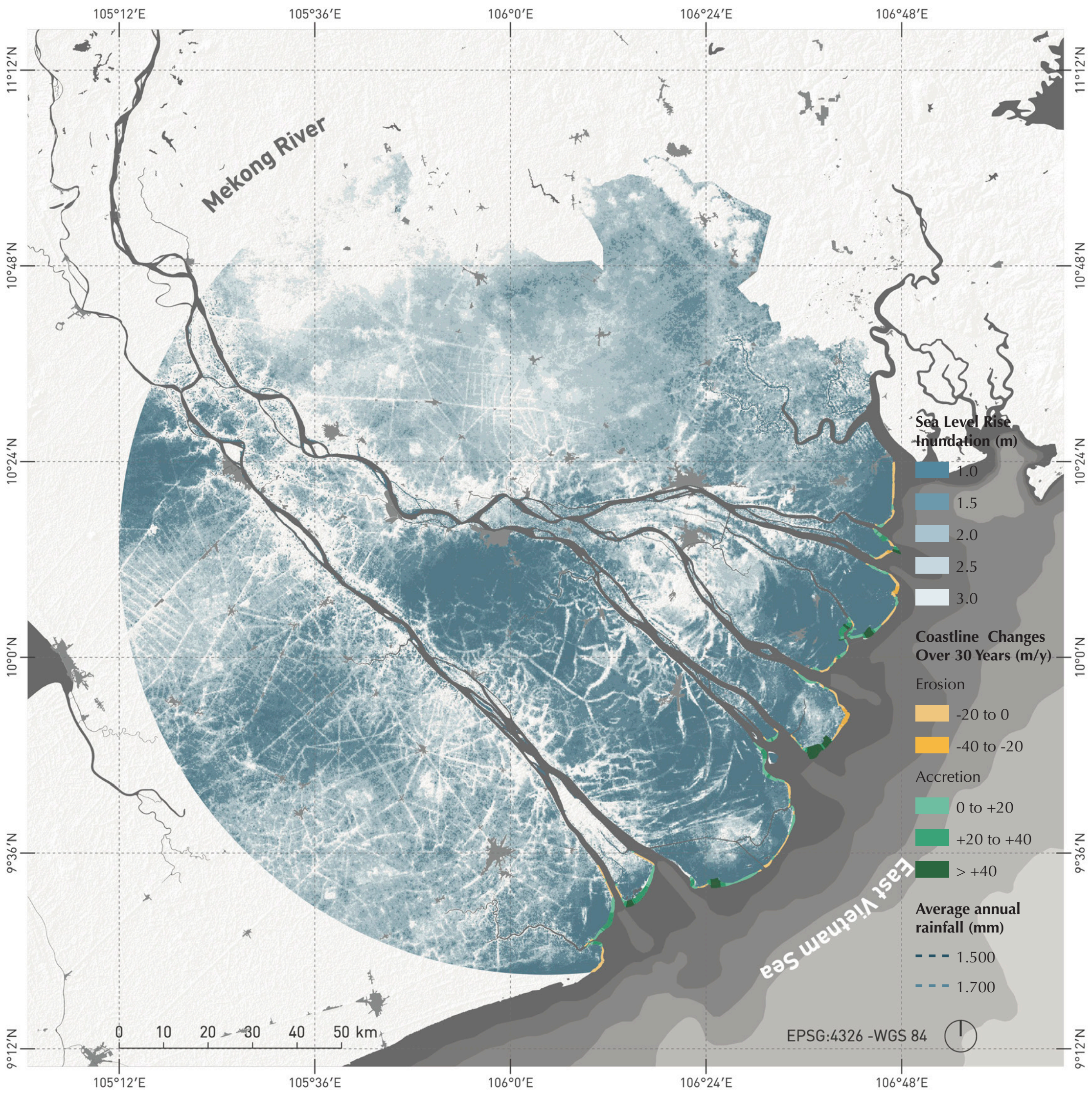


Fig. Sea level rise inundation range and coastline changes over 30 years in Mekong Delta

1.2 PROBLEM FIELD

1.2.4 Rigid Water Management

Fig. Sea Dyke at Hiep Thanh
Source: Icem

Fig. The largest Cai Lon - Cai Be saline sewer irrigation project in the West is about to be completed
Photo: Xuan Nghi

1.2 PROBLEM FIELD

1.2.4 Rigid Water Management

Water Management History

Historically, the main form of water management in the Mekong Delta has taken the form of the "Dutch dyke" strategy, whereby dykes were constructed to provide favorable freshwater conditions for agriculture through settlement, flood control, or prevention of saltwater intrusion [Biggs et al. 2009].

The first projects to build such dykes and saltwater dams began under French colonial rule in the 1930s, when the colonial government sought to open up new lands to increase the colony's rice production [Biggs et al. 2009]. in 1937, as a result of flooding, colonial planners decided upon greater flood control structures and, simultaneously, the elimination of areas that had grown a flood-tolerant variety of 'floating rice' in favor of faster-growing short-stem varieties.

In 1954, the Republic of Vietnam continued this certain "Dutch dyke" strategy with technical and financial support from America. After reunification in 1975, the Vietnamese government embarked on a "rice everywhere" campaign due to the country's severe food shortages. At the time, salt water was seen as a limitation to agriculture rather than a resource for aquaculture as farmers perceive it today, and flooding threatened and limited intensification.

A place governed by top-down policies

Indeed, if one looks back at longstanding government strategies, they did little to satisfy the needs of farmers.

During the French colonial period, local farmers were called upon to complete the arduous task of building huts, burning forests, clearing stumps and clearing fields. However, once the land was cleared and agriculturally productive, they often found that the landowner had claimed ownership of the land. They then either left to clear new unclaimed lands or else worked out some tenancy arrangement [Biggs et al. 2009].

In some cases, farmers have even strongly resisted environmental changes brought about by state projects. In February 2001, farmers in Bac Lieu province broke the new Lang Tram salinity-control dam, which was slated to close off rice-producing areas, when many had already opted to take advantage of the salinity and switch to the lucrative farming of shrimp [Hoanh et al, 2003].

How to cope with the future

To maintain existing production and life, the Government chose to construct large-scale water management facilities to regulate flooding, divide salt water from fresh water, and excavate groundwater. The establishment of these water management facilities did provide some temporary relief to the problems faced by the region. But at the same time, they have made the Mekong Delta more vulnerable to change.

Many dykes have been built on both sides of most of the rivers and canals in the Mekong Delta. Narrow embankments control the river and limit flooding, but also make the river flow faster while increasing the risk of flooding downstream. Sluices stop the salt water but also make it harder to get fresh water downstream while preventing richer productive practices upstream. In times of freshwater shortages, paddy fields within the sluice have to rely on groundwater for irrigation. This also increases the number of illegal wells in the area, which has led to a rapid increase in groundwater extraction and then land subsidence.

As the climate changes, sea levels will rise and the seasonal distribution of precipitation will become more uneven. When governments choose to rely exclusively on such methods to control water, they will need higher dykes and more sluices and wells. However, these will also exacerbate the problems facing the Mekong Delta to some extent. Therefore, this rigid top-down approach to water management is not an appropriate one.

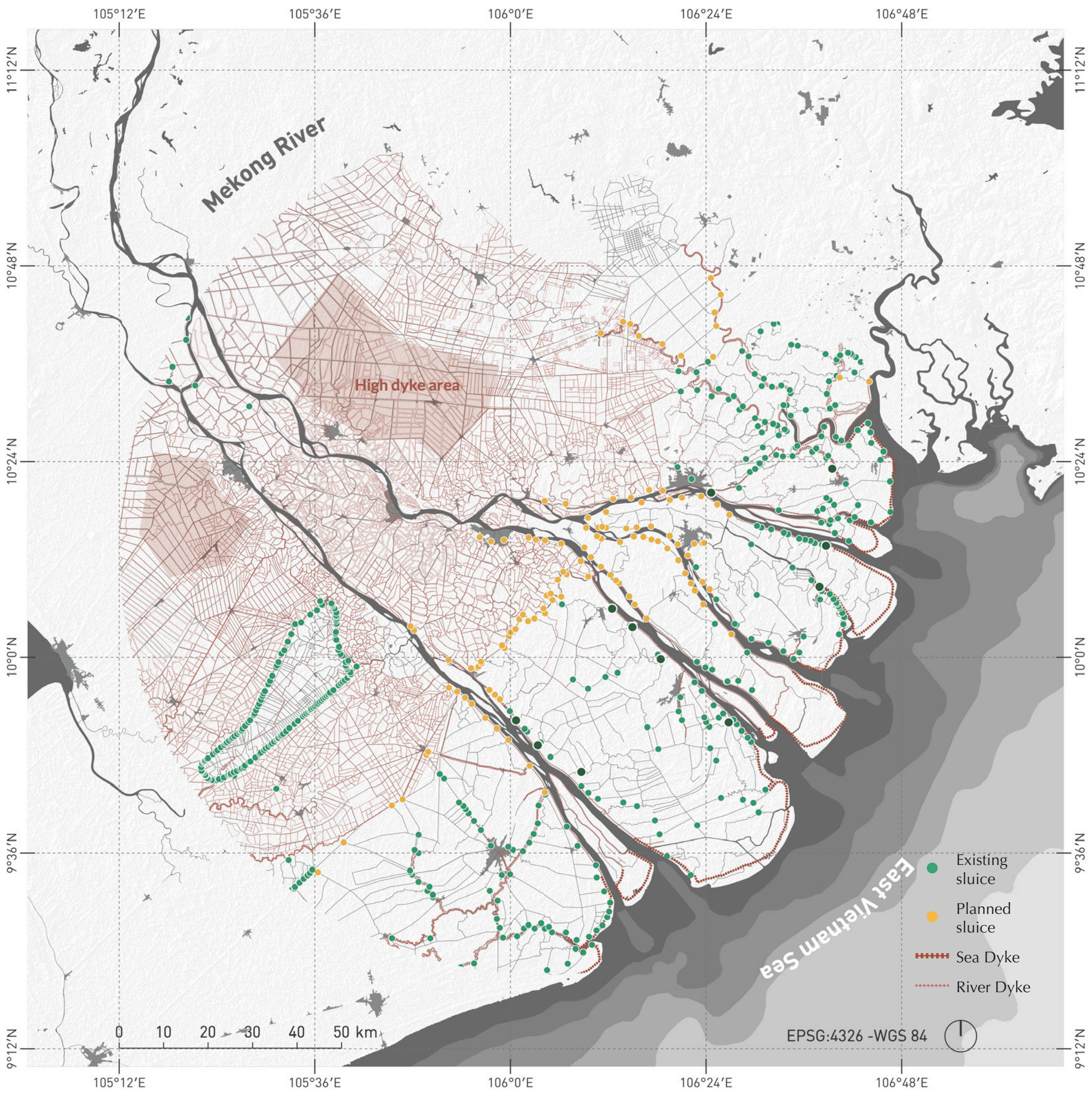


Fig. Mekong Delta Irrigation Infrastructure

1.2 PROBLEM FIELD

1.2.5 Unsustainable Production Practice

Fig. Drought and saltwater intrusion have affected about 40,000ha of rice in the Mekong Delta
Photo: Thong Hai

Fig. Saltwater intrusion affects the pH of the water, leading to fish kills or stunted growth and development
Photo: Nguyet Nhi

1.2 PROBLEM FIELD

1.2.5 Unsustainable Production Practice

The main crop in the Mekong Delta is rice, totaling about 1.8 million hectares. Fruit trees are the second most important crop, totaling about 540,000 hectares. Aquaculture comes in third at 530,000 ha. The aquaculture area has grown significantly in the last decade, mainly at the expense of rice paddies, forests (mangroves) and wasteland.

In the Delta, agriculture and aquaculture depend heavily on water quality and quantity. Water-related problems, including floods, droughts and saltwater intrusion [Nguyen et al., 2021], already challenge livelihoods in the delta and are expected to worsen in the coming decades due to climate change and anthropogenic pressures.

The Ministry of Agriculture of Vietnam estimates that the delta loses about 500 ha of land to erosion each year. Furthermore, unsustainable land use and Water management are polluting rivers and canals. Farmers and local governments then urgently need to find a way to live in greater harmony with nature.

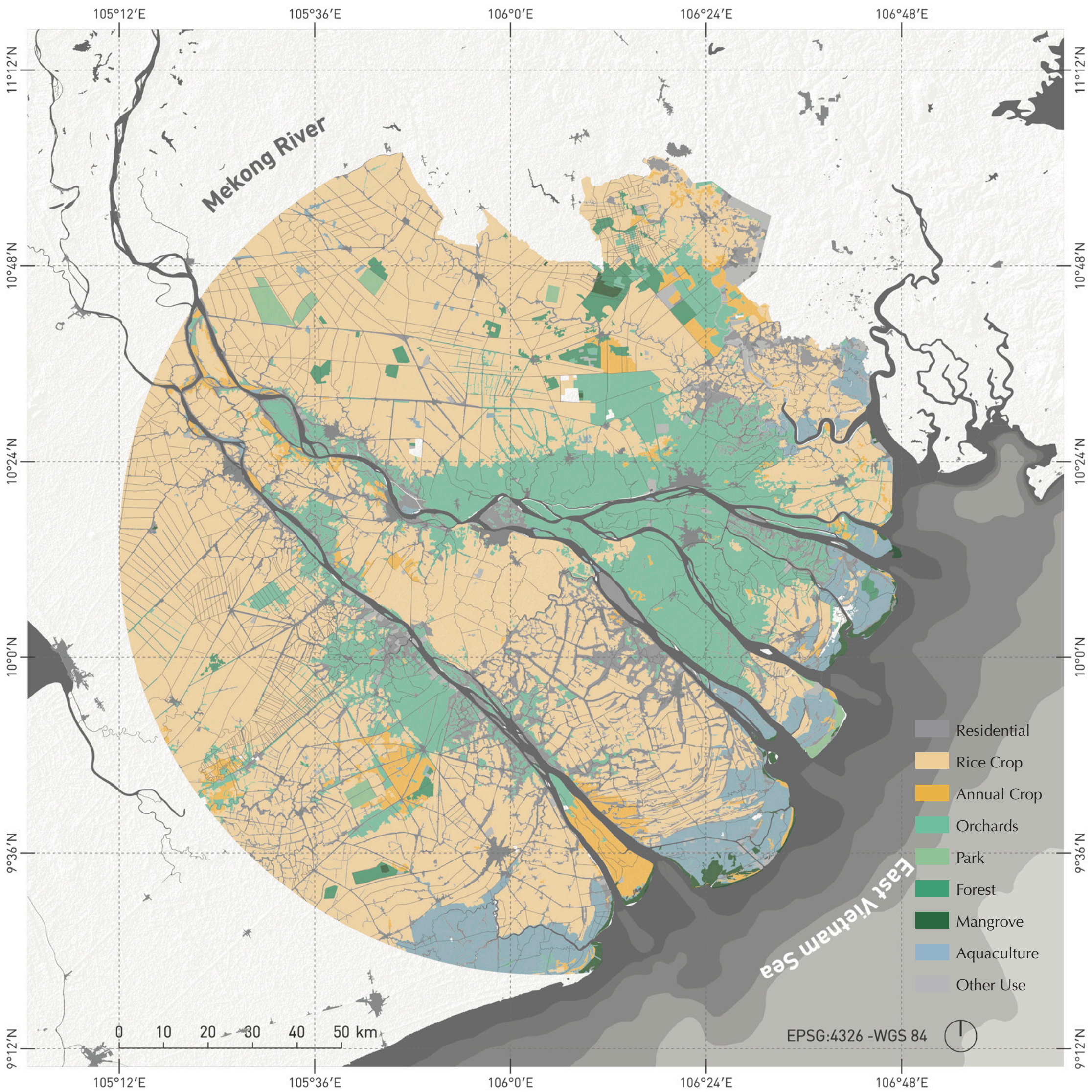
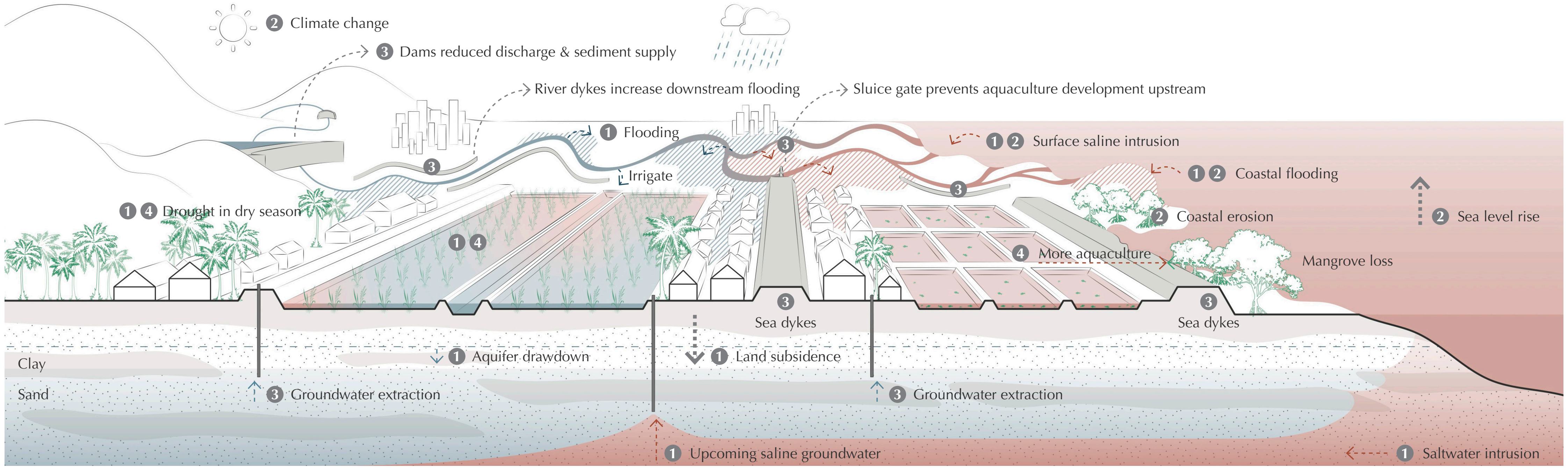


Fig. Landuse map in Mekong Delta

1.2 PROBLEM FIELD

1 Serious water issues
2 Challenges posed by climate change
3 Rigid Water Management
4 Unsustainable Production Practice



As can be seen through the figure on the left, the landscape of the Mekong Delta can be viewed as a system. The problems mentioned above are widely distributed throughout the system and also influence each other.

In the wet season, upstream dams limit flooding, but at the same time exacerbate flood risk downstream. In the dry season, upstream dams reduce the flow of the Mekong and exacerbate salt intrusion downstream. The creation of river embankments and sluice gates has made farmers only grow freshwater crops upstream, during the dry season, they had to build more wells to tap into the groundwater for pipe irrigation, which has increased salt intrusion into the groundwater and land subsidence to a certain extent. At the same time, the construction of river embankments and sluice gates makes farmers only the development of aquaculture downstream, occupying space that was originally used for mangrove forests. This made farmers more vulnerable to the tides, so sea walls were built to withstand storm surges. This further destroyed the ecosystem of the coastal area and the sea wall eroded more and more. As the climate changes, flooding will become more frequent in the rainy season, water scarcity will increase in the dry season, and the Mekong Delta will be in greater danger from the combination of sea level rise and land subsidence.

It can be seen that farmers' production practices and daily lives in the whole landscape system rely heavily on the water system. In the context of climate change, these problems arise when policymakers ignore the seasonal, holistic, and changing nature of the water system, refuse to change their way of living, and instead try to control it rigidly. It can also be argued that these problems arise because people are engaging with water in the wrong way.

1.3 PROBLEM STATEMENT

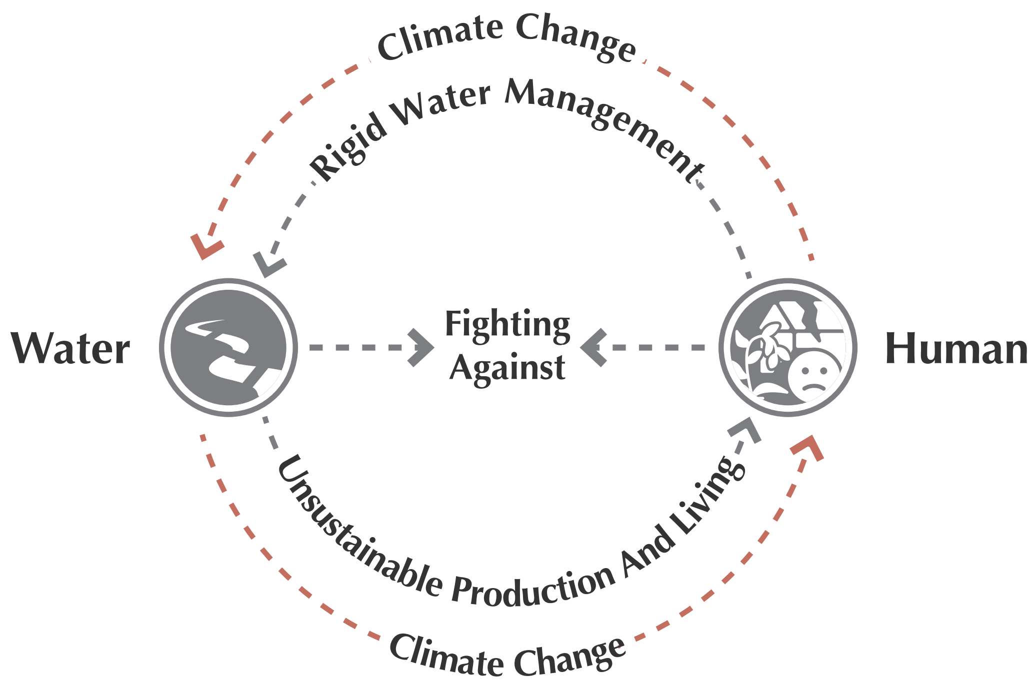
- **Rigid water management engineering ignores the potential of the landscape, destroys ecosystems, and exacerbates water problems.**

- **Serious water issues have led to significant reductions in agricultural and aquaculture yields while causing great inconvenience to inhabitants' lives.**

- **In the context of climate change, more water management facilities are being built and more serious water problems are arising.**

Over the years, the landscape of the Mekong Delta has been dramatically altered to maintain the existing patterns of production and life. When production conflicts with the natural functioning of water, a series of rigid water management techniques such as sluice gates, seawalls, river dykes, wells, etc. have been used in an attempt to control and utilize the water. However, these methods have exacerbated problems such as saline intrusion, flooding, aquifer drawdown, etc., which have had a significant negative impact on inhabitants' livelihoods. As a result, the Government has begun to build more water management infrastructure to address these issues. This creates a vicious circle between people and water, exacerbating the conflict between people and water. At the same time, in the context of climate change, this vicious circle is exacerbated by a climate of uncertainty.

In fact, the landscape, as the base of all things, has the potential to mitigate water problems in its own right. For example, using brackish water to develop natural community (animals and plants), storing excess pure water, backfilling groundwater, and so on. When these potentials are realized and a landscape approach is applied at the water management level as an alternative to rigid models, based on which production practices and forms of habitation can be adjusted, more resilient landscape systems can be constructed to mitigate water problems and even to respond to climate change.



1.4 RESEARCH OBJECTIVE & QUESTION

"To contribute to a resilient system for the Mekong Delta through exploring design-oriented landscape approaches to realize the harmonious coexistence of people and water."

Understanding

What is the relation between the landscape context and the environmental and spatial challenges in VMD? and what are the potentials to address them?

- Historical analysis;
- Cross-scale analysis;
- Challenge map;
- Potential map

Potentials

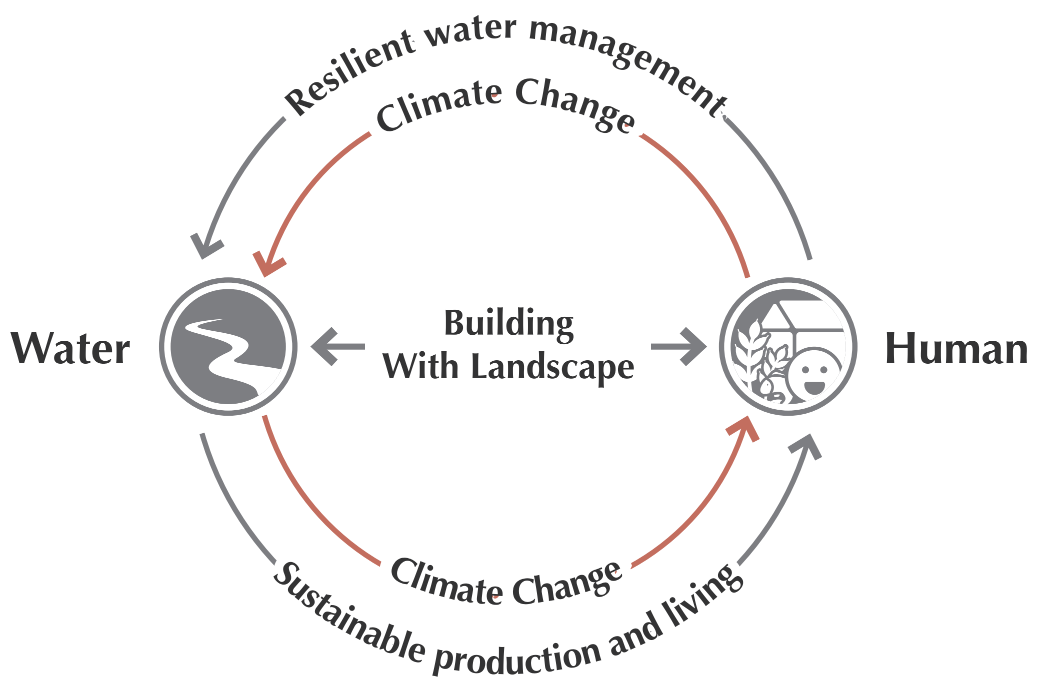
What strategies and principles can be employed in terms of water management, production, settlement, and ecological perspectives?

- Case study;
- Traditional wisdom;
- Principles;
- Vision map

Application

How to apply resilient design strategies and principles across scales?

- Design through scales;
- Scenario design



1.5 METHOD

Understanding

Mapping

Gain a deeper understanding of the landscape characteristics and categorize the types by making structural maps. At the same time, problems and landscape potentials are localized by making a map of challenges and potentials.

Layer approach

The landscape is analyzed systematically in three layers: water systems, ecology & production practices, and settlements.

Of these three layers, the water system forms the base blue network of the VMD. On top of this, ecology & production practices, as the green network, show the different levels of people's involvement in nature. The lighter ones develop into natural ecosystems, while the more involved ones are transformed into land that serves people's production practices. However, the plants and animals within the green network are inextricably linked. At the settlement level, they are attached to the green and blue networks, but they are more involved in the daily lives of the people.

Design through scales

Landscape characteristics are analyzed and categorized in a cross-scale approach so that sites with clear and rich characteristics can be selected to zoom in for deeper study.

Potentials

Case study

Research river management, eco-agriculture, mangrove restoration, and other relevant case studies, and extract design principles that can be applied to design.

Traditional wisdom

Study the local traditional production methods and settlement patterns that fit the landscape, extract the parts that can be applied to the current situation, and summarise them into design principles.

Literature review

Read articles on water management, and eco-agriculture, and distill design principles from them.

Application

Design through scales

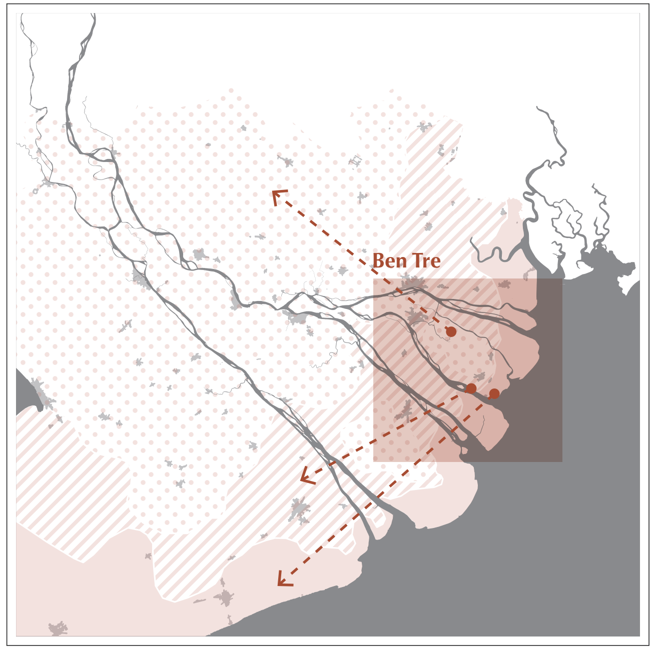
Design principles and strategies can be planned and laid out at the medium scale, and then practically applied at the small scale. Afterward, the small-scale design can be extended to larger scales to complete the establishment of a resilient system for the whole region.

Scenario design

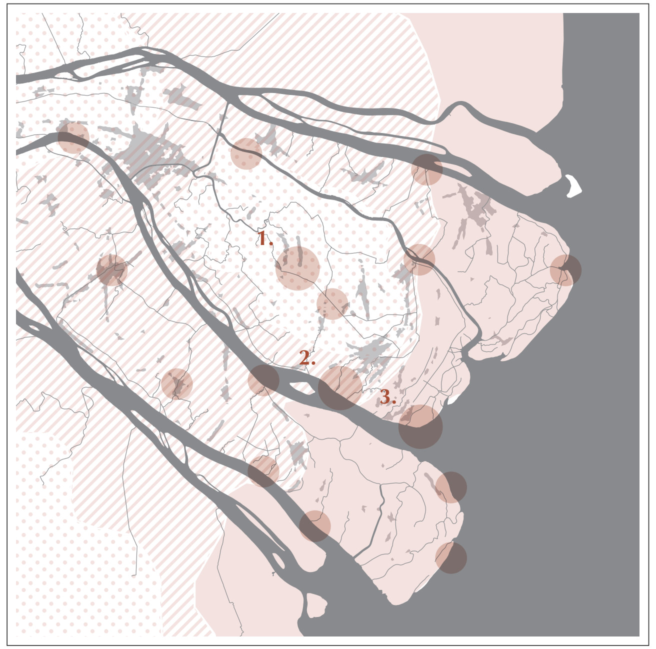
As landscapes are developing and changing, design needs to respond to different scenarios. Contexts such as seasonal water level and quality changes, sea level rise, etc. need to be considered and responded to in the design.

1.6 RESEARCH STRUCTURE

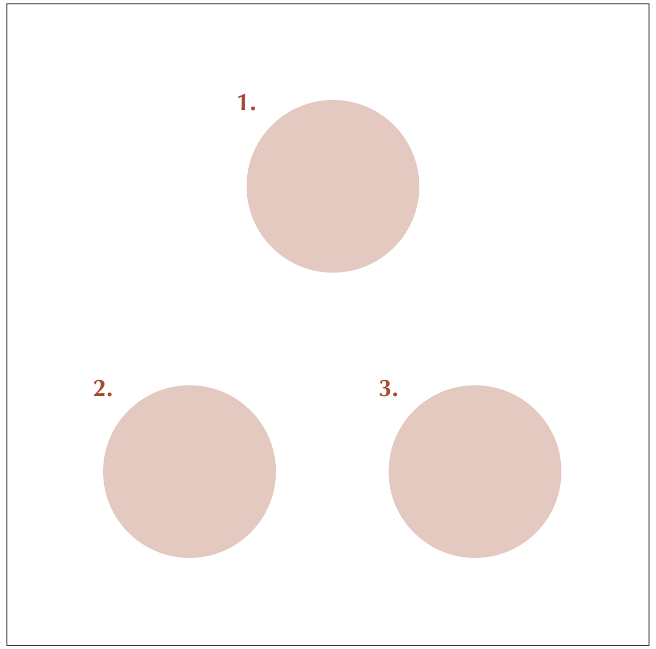
Basin Scale



Regional Scale



Local Scale



Analysis → Tpyologies → Fresh upper zone / Intersection zone / Coastal zone

Select region with rich typologies ⟷

Analysis → Water System / Ecology & Production / Settlement → Principle + Strategies → Vision

Select typical sites ⟷

Freshwater reservoir / Brackish water transition zone / Growing bank

In this project, the Mekong Delta will be studied and designed at three scales: regional, basin, and local.

The first is the **basin scale**, in which the site is divided into three different types by analyzing the problems and the current situation, Fresh upper zone, Intersection zone, and Coastal zone. Within this scale, Ben Tre, a regional scale with all three types, was selected for further in-depth study.

Historical and current analyses were conducted at the **regional scale**. During the analyses, it was found that the three typologies are in fact interconnected and influence each other. Therefore, the landscape system was analysed at the watershed scale by dividing it into three subsystems: Water System, Ecology & Production and Settlement. Through this analysis, the challenges and opportunities facing Ben Tre are summarised. Next, the design strategy is summarised through case studies and literature review, and the design principles and structure are proposed following the above three layers. Finally, the three subsystems are combined to obtain a basin-scale landscape vision.

On this basis, typical sites of all typologies are selected for **local scale** design. In this scale, the design principles and strategies will be implemented. At the same time, the design will take into account the intervention of people in the landscape, the natural development of the landscape, and the resulting spatial perception from a human perspective.

After completing the design of each type of site at the local scale, they can be applied to the basin scale and then extended to the region scale to create a resilient landscape system for the Mekong Delta.

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02

Theoretical Framework

2.1 THEORETICAL BACKGROUND

Here I will demonstrate my understanding of the main theories which compositional theoretical framework and how I have applied them to my final year project.

2.1.1 landscape as a system

The urban landscape can be understood as a complex system composed of subsystems, each with its own dynamics and speed of change. (Meyer and Nijhuis, 2013)

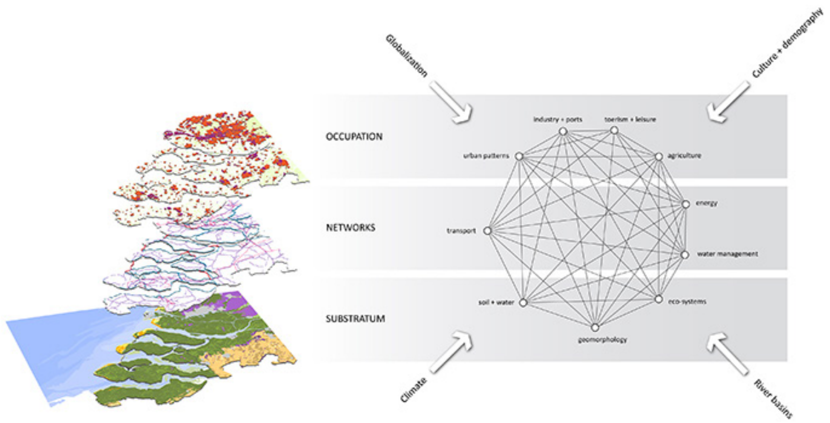


Figure: Layer approach
Source: Understanding the urban landscape as a layered and complex system (image: Steffen Nijhuis).

Urban landscapes can be understood as complex systems composed of subsystems each with its dynamics and speed of change [Otto, 2011; Portugali et al., 2012; Batty, 2013]. A complex system is never balanced stably. Especially in ecosystems and social systems, the different parts of a system are changing continuously, and these changes in the different parts influence other parts [Batty 2005; Portugali 2000; Scheffer 2009].

The American landscape architect Ian McHarg introduced the "layer cake model". He pleaded for a sound approach to landscape and ecology in planning major infrastructural work, using a layered approach to get a grip on the complex system of the landscape. This more integrative approach is a plea for the design of strong "frameworks" in the urban landscape. A framework can be regarded as a system of natural and man-made structures that can sustained for a long time and that can adapt to varied urban programs and natural developments. After, then these studies developed into a comprehensive approach to the description and analysis of spatial developments known as layers approach [RPD 2001; Van Buuren 2003]. The layers approach understands the landscape as a system layers, each with its dynamics [Meyer & Nijhuis 2013].

In VMD the landscape system includes hydrology, ecology, production, and housing. These can be regarded as subsystems of the VMD landscape system, which have different dynamics of change and influence each other at the same time. Problems in the relationship between people and water can lead to serious problems in the production and living associated with them. Therefore, in understanding landscapes, a layered approach can be used to analyze landscapes as water system, ecological and production, and settlements.

1. **Water systems**
   Water is the foundation of the landscape system in the Mekong Delta, which includes both natural and artificial interventions. It forms the basic environment of the VMD and is the bond that links all issues.

2. **Ecology and Production**
   Ecology and production can be viewed as landscapes created by human intervening in nature to varying degrees. Historically, ecology and production could exist in harmony. Nowadays, it is widely recognised that these two elements are in conflict. Of course, we cannot go back to the primitive life, but by analysing them in the same layer, it is possible to explore more possibilities of coexistence between ecology and production.

3. **Settlement**
   This layer is the human habitation layer, which includes elements of the landscape system that have been constructed entirely by human intervention (road transport networks, buildings, etc.) and are more related to humans' daily lives.

At the same time, the three layers shape each other. The water system serves as the foundation for the blue network that forms throughout the VMD, providing water resources. Historically, these natural water resources have given birth to sites that can be productive or residential. For example, in the history of the VMD, settlements were concentrated around the waterways where farming began, and the waterfront was often rich in vegetation. To some extent, the ecological & production, and settlement layers are shaped by the blue network. As the number of inhabitants increased the demand for production increased, and humans became dissatisfied with the sites provided by nature and began to artificially alter the water system to support the demands of production. These changes are affecting the water system and will in turn affect production and livelihood. Thus, water systems and ecology and production, water systems, and settlements are in a mutually shaping relationship. At the same time, the relationship between ecology & production and settlement is the same. When new production sites are developed, the number of inhabitants increases accordingly. And as the number of inhabitants increases the need for production space also increases. Therefore, in addition to the study of each subsystem, how to adjust the dynamics between them to balance their relationship is also very important.

2.1 THEORETICAL BACKGROUND

2.1.2 Resilience capacity

Resilience is the capacity of a social-ecological system to absorb or withstand perturbations and other stressors such that the system remains within the same regime, essentially maintaining its structure and functions. (Gunderson and Holling, 2002; Walker and Salt, 2006)

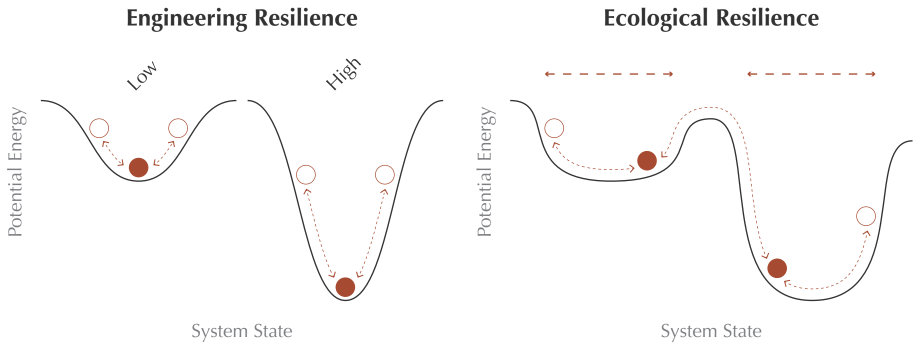


Figure: Two contrasting perspectives on resilience: (left) Engineering Resilience in closed systems (limited uncertainty and known variables); (right) Ecological Resilience in open systems (inherent uncertainty and infinite variables).
Source: Redrawn by Hao and adapted from Holling, C. S., "Engineering Resilience versus Ecological Resilience,"

'Resilience' is first defined by Holling and Goldberg, referring to the ability of a system to absorb change and persist after disturbance (Holling, 1973). Later, Walker and Salt define resilience as the ability of a system to absorb disturbance and still retain its basic function and structure in their book Resilience Thinking. (Walker and Salt, 2006).

The notion of the speed of return to equilibrium (Pimm 1991) leads to what has been termed "engineering resilience" and "ecological resilience".

Engineering resilience focuses on efficiency, constancy, and predictability. where resistance to disturbance and speed of return to the equilibrium are used to measure the property. (O'Neill et al., 1986; Pimm, 1984; Tilman and Downing, 1994) The faster the system returns to a steady state, the more resilient it is.

Ecological resilience focuses on persistence, change, and unpredictability. where instabilities can flip a system into another regime of behavior—that is, to another stability domain (Holling, 1973). In this case, the measurement of resilience is the magnitude of disturbance that can be absorbed before the system changes its structure by changing the variables and processes that control behavior. We shall call this view ecological resilience (Walker et al., 1969).

As resilience theory has evolved over the past few decades, its focus has expanded from gradual ecosystems to socio-ecological systems, with stakeholder engagement and social and economic factors also being taken into account.

Nowadays, in the Mekong Delta, due to the different rates of development of the subsystems in the landscape system, when conflicts arise there is a greater tendency to use engineering techniques to build infrastructures to enhance the engineering resilience and to solve water problems in a rigid way. However, such facilities can exacerbate water problems to a certain extent, which in turn causes more problems. In contrast, ecological resilience, which emphasises sustainability and unpredictability, gives systems more room to develop and provides opportunities for human to live in harmony with an unpredictable future. Being in the natural world, people should allow change to occur rather than fight against it. Therefore, it is important to change people's mindsets to enhance the ecological resilience of the Mekong Delta.

2.1 THEORETICAL BACKGROUND

2.1.3 Natural-based Solutions

"Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits." (IUCN defnition, Cohen-Shacham, 2015)

Figure 1: NbS as an umbrella term for ecosystem-related approaches
Figure 2: Natural infrastructure for water management
Source: IUCN Nature-based solutions to address global societal challenges

In many indigenous beliefs, ecosystems play a very supportive role for human well-being, and this idea has been reflected in traditional knowledge systems for centuries. It was not until the 1970s that the supportive role of the environment and ecosystems was established as a concept in the modern scientific literature. In the late 2000s, "nature-based solutions" first appeared, signaling a subtle yet important shift in perspective: not only were people the passive beneficiaries of nature's benefits, but they could also proactively protect, manage or restore natural ecosystems as a purposeful and significant contribution to addressing major societal challenges. (Walters, Cohen-Shacham, 2015).

Over the last decade, international organizations such as the IUCN and the World Bank have begun to look for solutions that work with ecosystems, rather than relying on traditional engineering solutions, to adapt to and mitigate the impacts of climate change, while improving sustainable livelihoods and conserving natural ecosystems and biodiversity. Throughout this time, Nature-based Solutions (NbS) has evolved into a summary overview of different approaches, all of which aim to address specific societal challenges (water security, food security, disaster risk reduction, climate change). The specific approaches are as follows

NbS approaches

i. ecosystem restoration approaches (e.g. ecological restoration, ecological engineering and forest landscape restoration);
ii. issuespecific ecosystem-related approaches (e.g. ecosystem-based adaptation, ecosystem-based mitigation, and ecosystem-based disaster risk reduction);
iii. infrastructure-related approaches (e.g. natural infrastructure and green infrastructure approaches);
iv. ecosystembased management approaches (e.g. integrated coastal zone management and integrated water resources management); and
v. ecosystem protection approaches (e.g. area-based conservation approaches including protected area management).

In the Mekong Delta, when faced with problems such as saline intrusion, flooding, and climate change, the concept of NbS has guided me to explore solutions to the problems from a natural and ecological perspective. It also provides concrete ways to enhance the ecological resilience of the Mekong Delta and to address the challenges, such as using the restorative capacity of the ecosystems, building green infrastructure, and Integrating water systems as a whole.

2.1 THEORETICAL BACKGROUND

2.1.4 Nature-Inclusive Agriculture

"Nature-inclusive agriculture is a sustainable farming approach that integrates resilient food production with ecosystem preservation. By leveraging natural processes of ecosystem development, this agricultural model reduces the strain on ecosystems and enhances biodiversity recovery." (Runhaar, 2016)

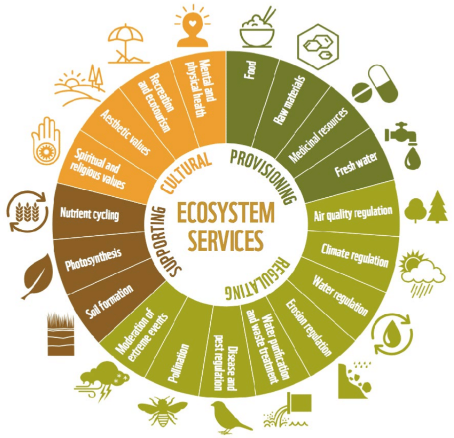


Figure: Illustration of categories of ecosystem services
Source: WWF Living Planet Report 2016

Underlying and interconnected principles

i. Employ ecosystem services rather than external inputs;
ii. Minimize environmental pressures and
iii. Contribute maximally to 'non-functional' biodiversity and landscape quality

In the Mekong Delta, where 65% of the land is used for agricultural production, it is important to improve the ecological resilience of productive land. This means that nature needs to be brought into production when improving production practices. The natural environment should be taken into account when determining production practices in order to reduce pressure on the environment. Agricultural production should also shift from intensification to diversification, using nature's services to optimise water management and soil quality to maintain productivity. At the same time, agricultural landscapes can accommodate the natural environment and provide a continuous network of habitats for a variety of species.

2.2 THEORETICAL FRAMEWORK

Understanding

What is the relation between the landscape context and the environmental and spatial challenges? and what are the potentials to address them?

Potentials

What strategies and principles can be employed in terms of water management, production, settlement, and ecological perspectives?

Application

How to apply resilient design principles across scales?

Landscape As A System

View the landscape as a complex system comprising subsystems, each subsystem having its own dynamics and rate of change.

+

Resilience Capacity

The ability of a system to absorb disturbance and still retain its basic function and structure.

Natural-based Solutions

Nature-Inclusive Agriculture

Building With Landscape

A landscape-based approach to address the problems. By transforming the way people intervene in the landscape and giving natural spaces to fulfill their potential in terms of water systems, production practices, etc. In that way, the ecological resilience of the landscape is enhanced, problems are mitigated, and it further benefits society and the environment.

+

Research Through Design

This project analyses the relationship between urban society, water systems, and ecosystems in the Mekong Delta by applying landscape principles and methods. The water system is the foundation of the entire Mekong Delta, shaping the ecosystem and providing resources for people's daily lives. On this basis, several sub-systems such as production, settlement, and ecosystems each have different rates of evolution. Over time, some of these systems have come into conflict with each other. In order to solve conflicts, people tend to apply rigid engineering facilities to enhance the engineering resilience of landscapes. However, this also exacerbates existing problems to a certain extent, which can lead to more problems. Therefore, there is a need for a shift in mindset towards nature-based slutions to enhance the ecological resilience of landscapes.

To address the problems of the Mekong Delta, the project will apply the concept of landscape as a system to analyze the relationships between multi-level and multi-scale systems and integrate them to work together. Therefore, the project integrates theories and proposes the concept of “building with landscape”.

To achieve “Building with landscape” in the course of the project, I first, the project divided the landscape of the Mekong Delta into three layers: the water system, ecology and production, and settlement, and analyzed the relationships between them and the logic of their internal operation. Secondly, to achieve “building with”, the project analyses the current problems and potentials of the landscape at different layers and examines the logic of nature's functioning. Afterward, the project will integrate the challenges and opportunities at each layer, and through appropriate interventions in the landscape, it will give nature the space to fulfill its potential, enhance the ecological resilience of the landscape, and construct a new landscape system. Through "research through design", the project will explore effective solutions to water problems in the Mekong Delta and further refine the theoretical framework.

Part II

Analysis & Understanding

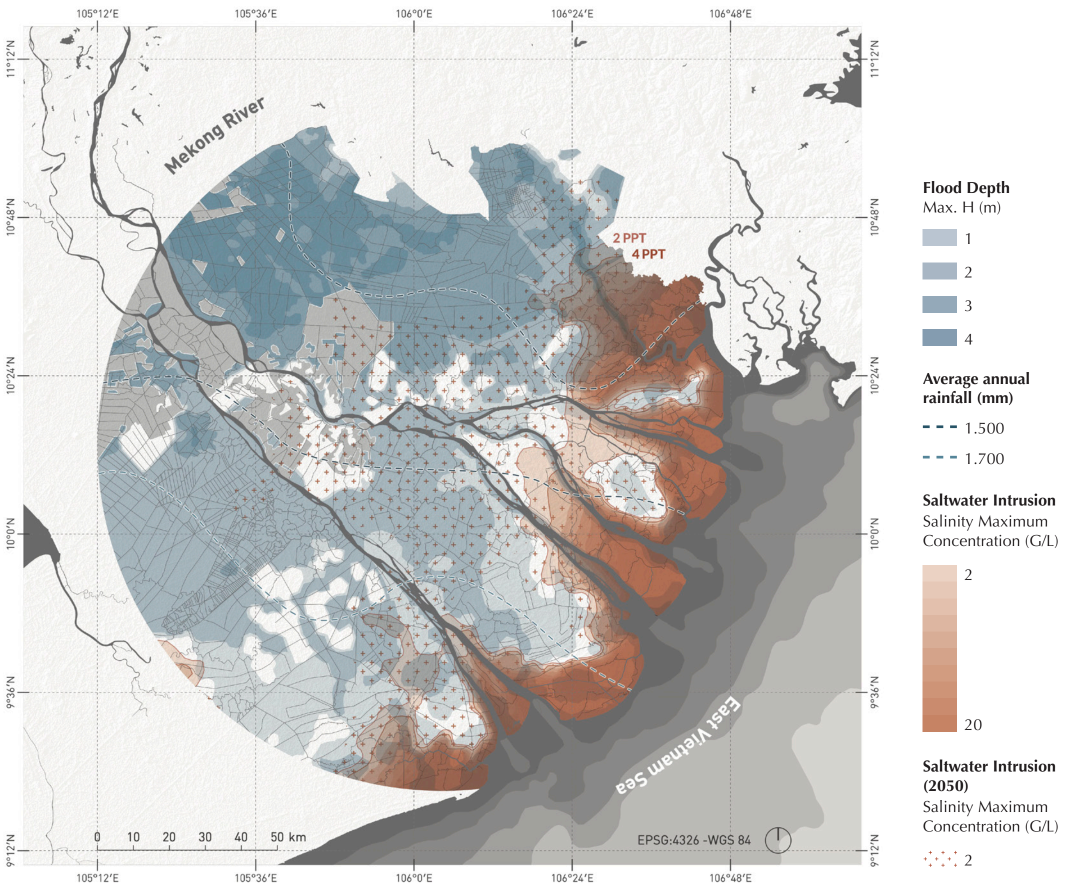
03
Basin Scale

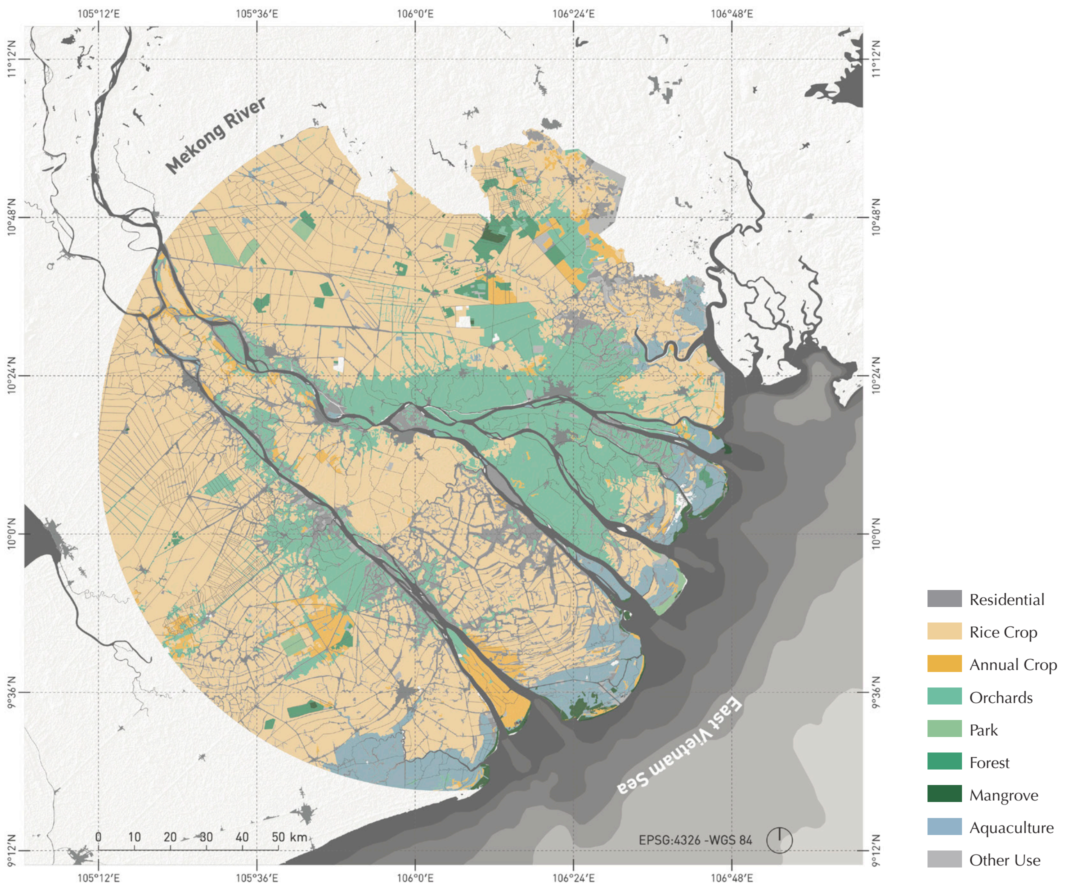
3.1 PRELIMINARY ANALYSIS

From the problem map on the right side, it can be found that in the VMD, the main problem faced by the upstream region is flooding during the rainy season, while the downstream region mainly faces flooding during the rainy season with salt intrusion during the dry season. Meanwhile, hydrological conditions can change dramatically during the year cycle due to the uneven distribution of precipitation in a year. Therefore, combining the information, it can be found that the upstream is a freshwater environment all year round and in the coastal region, it is a saltwater environment all year round. In the intermediate region, there is sufficient freshwater during the rainy season, but during the dry season, there is not enough freshwater to flush out the salty water because of the reduction in precipitation and river flow, and the salinity of the water environment will rise. This creates an environment where freshwater and saltwater interact in yearly cycles.

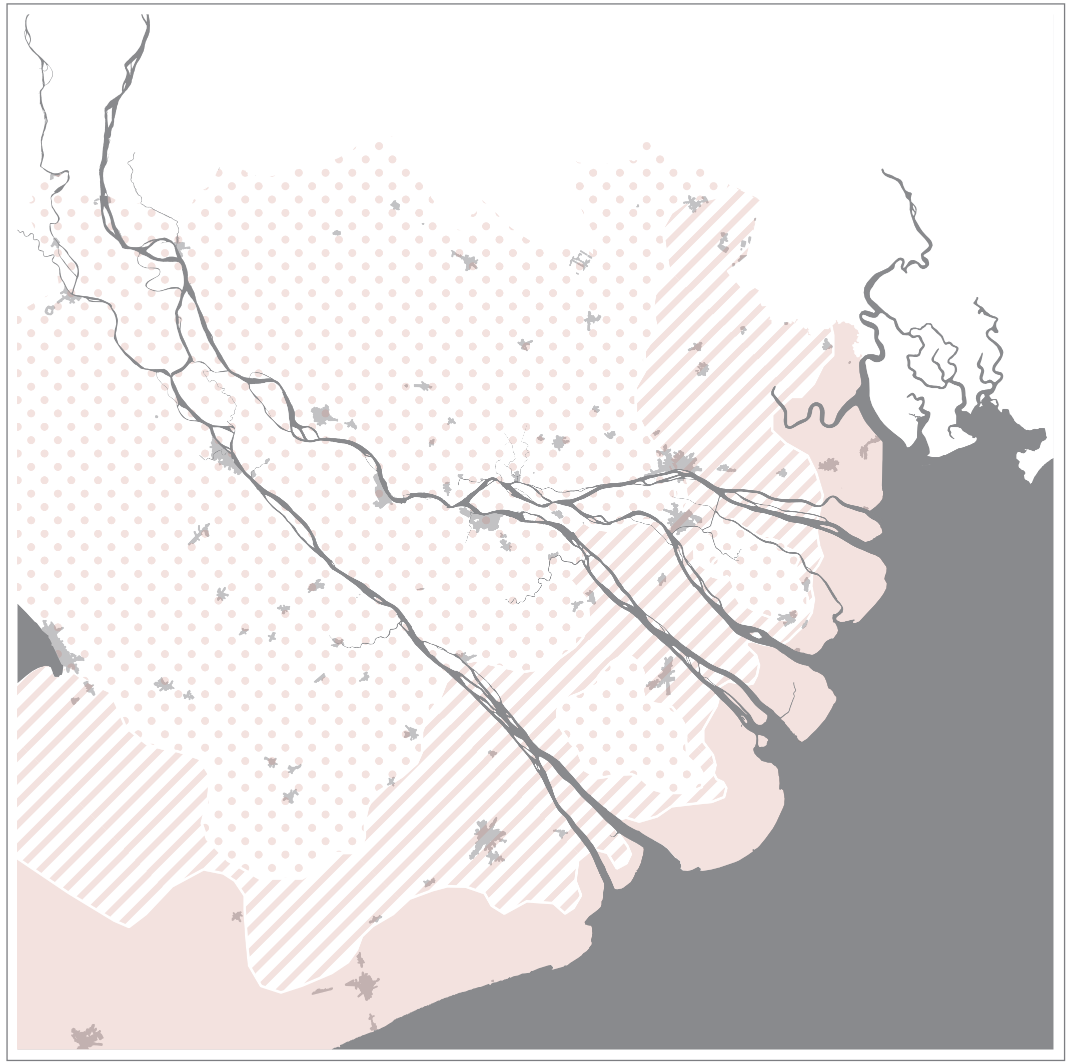
The map of land use types shows that in the upstream area, there are mostly freshwater crops such as rice and fruits, and in the waterfront area, there are mostly aquaculture and mangrove forests. In the interaction zone, the agricultural types are complex, but with a large proportion of freshwater crops.

Combining the water environment and the types of production practices, it can be found that the Mekong Delta can be categorized into Fresh upper zone, Intersection zone, and Coastal zone according to the water environment and the types of production practices.





3.2 LANDSCAPE TYPOLOGIES



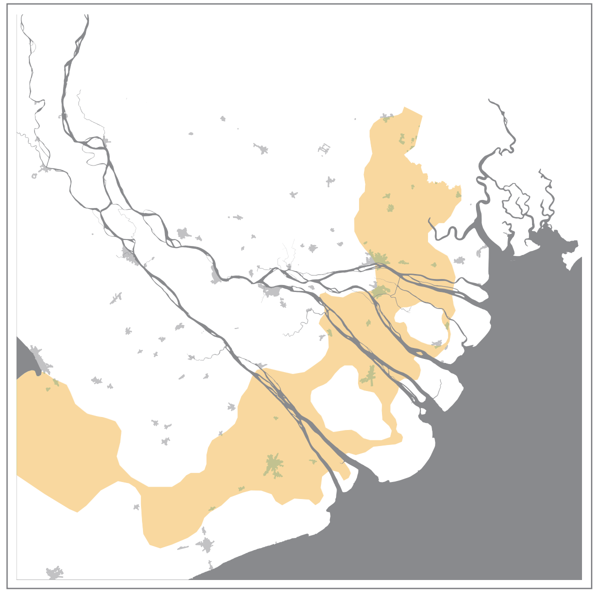
Fresh upper zone

Jan. Dec.

Dry | Wet | Dry

Freshwater supply from rivers throughout the year

- Rice
- Fresh Aquaculture
- Fruits



Intersection zone

Jan. Dec.

Dry | Wet | Dry

Mostly freshwater environment during the rainy season, but shifts to a saline/brackish environment during the dry season with the gradual intrusion of seawater.

- Rice
- Vegetables
- Coconut
- Brackish Aquaculture
- Fresh Aquaculture

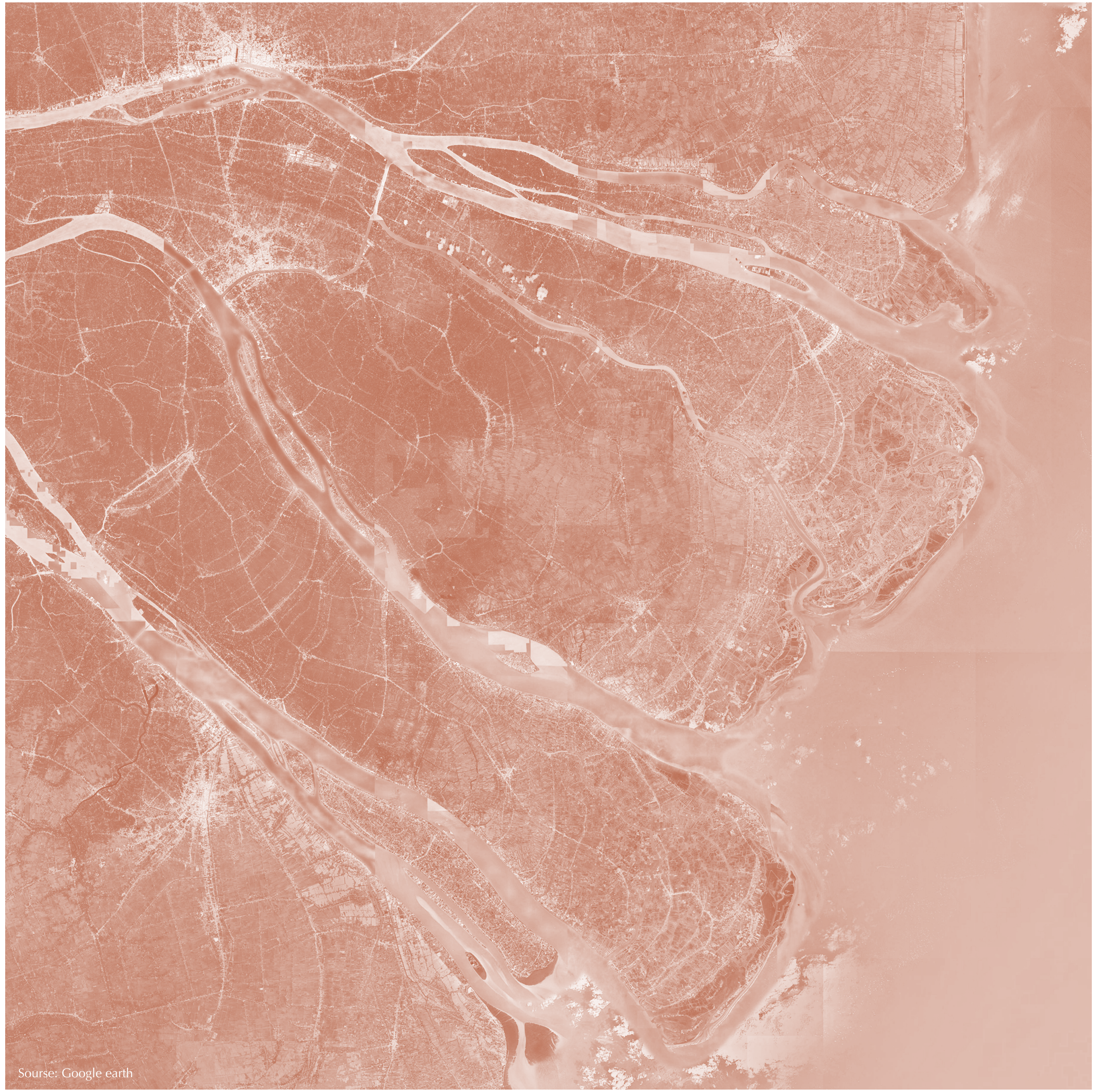
Coastal zone

Jan. Dec.

Dry | Wet | Dry

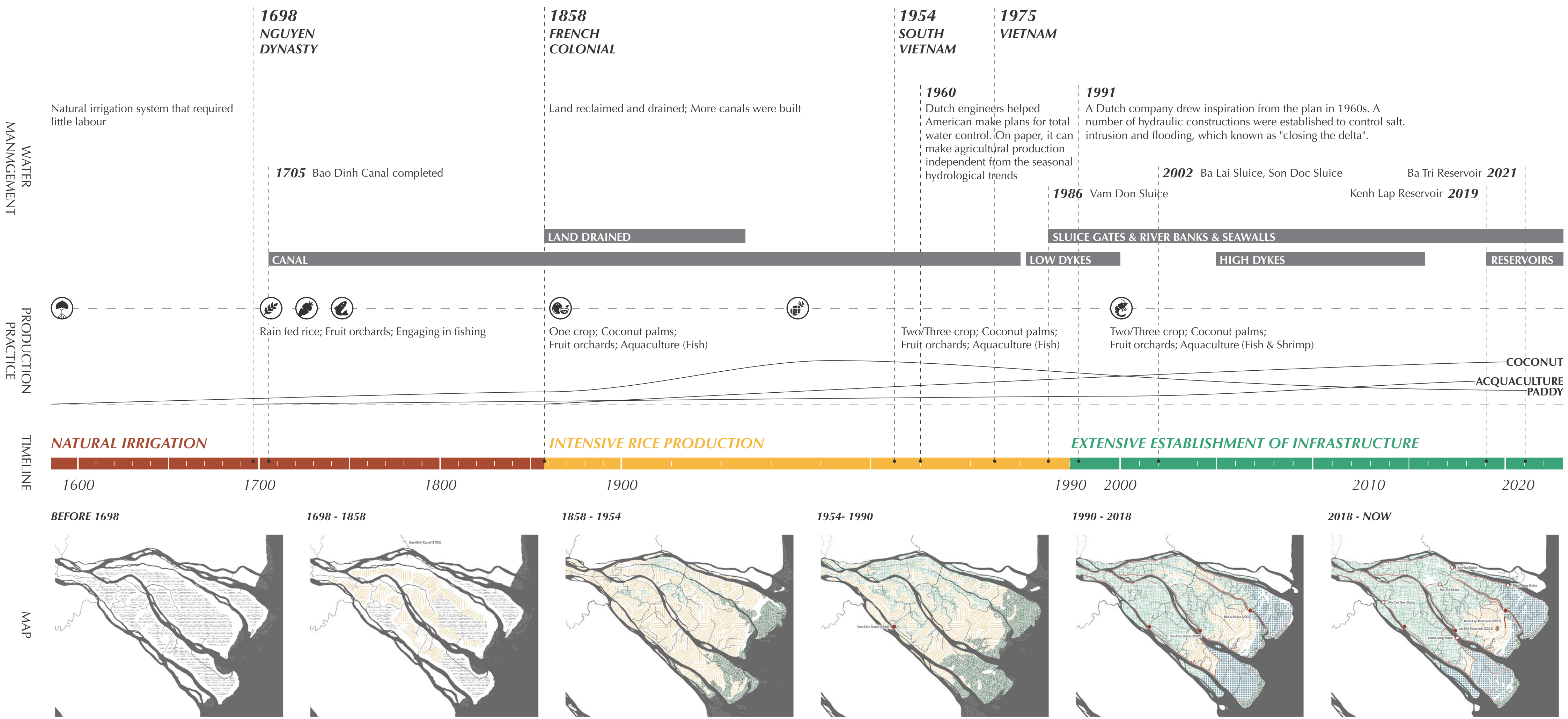
Saltwater environment from seawater throughout the year

- Brackish Aquaculture
- Harvest From Mangroves



04
Regional Scale

4.1 HISTORICAL DEVELOPMENT



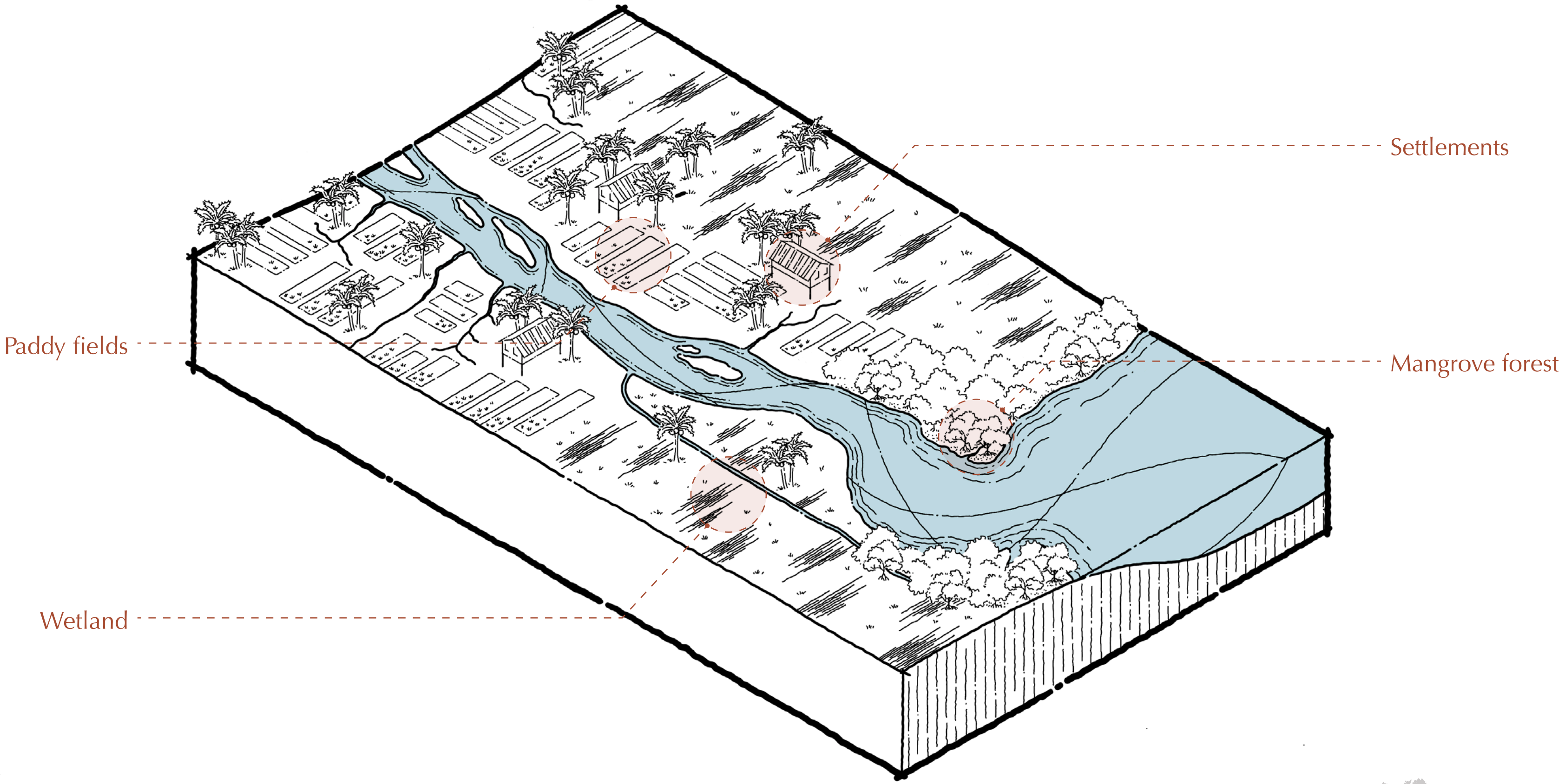
In order to gain a deeper understanding of Ben Tre, I first explored the history of its development. This included the development of the water system and agricultural practices from the early 17th century when it was inhabited by indigenous people, through the French colonial period, to the independence of Vietnam, and finally to the present day.

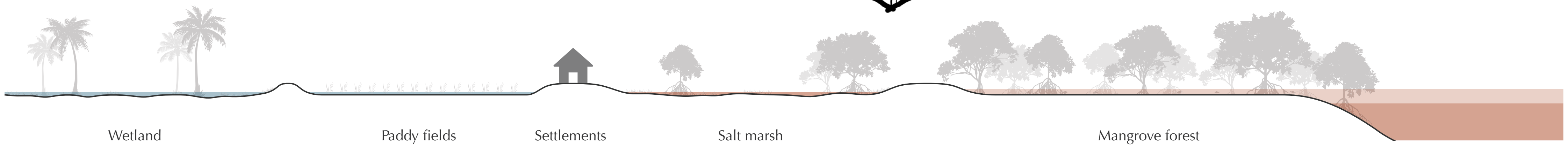
Initially Ben Tre was mostly uninhabited and nature prevailed, and as people began to settle on the site, they built a few canals to drain the site for habitation and production. At this stage, the indigenous people relied mainly on natural systems for irrigation. Later, with the arrival of the French colonisers, more and more sites were dredged by the colonial government for intensive agricultural development. At the same time, farmland was threatened by flooding and salt intrusion due to changes in the traditional irrigation system. After Vietnam's independence, the government began to continue the development of the water system by embarking on a programme of "closing the delta", building new barriers such as dykes, sluices, gates and dams. However, as the climate changed, these rigid water management facilities gradually became unable to cope with the new challenges.

Therefore, the historical development process of Ben tre can be divided into three phases, **natural irrigation**, **intensive rice production** and **extensive establishment of infrastructure**, according to the different ways of water management measures and production practices.

4.1 HISTORICAL DEVELOPMENT

4.1.1 Natural Irrigation (1600-1858)



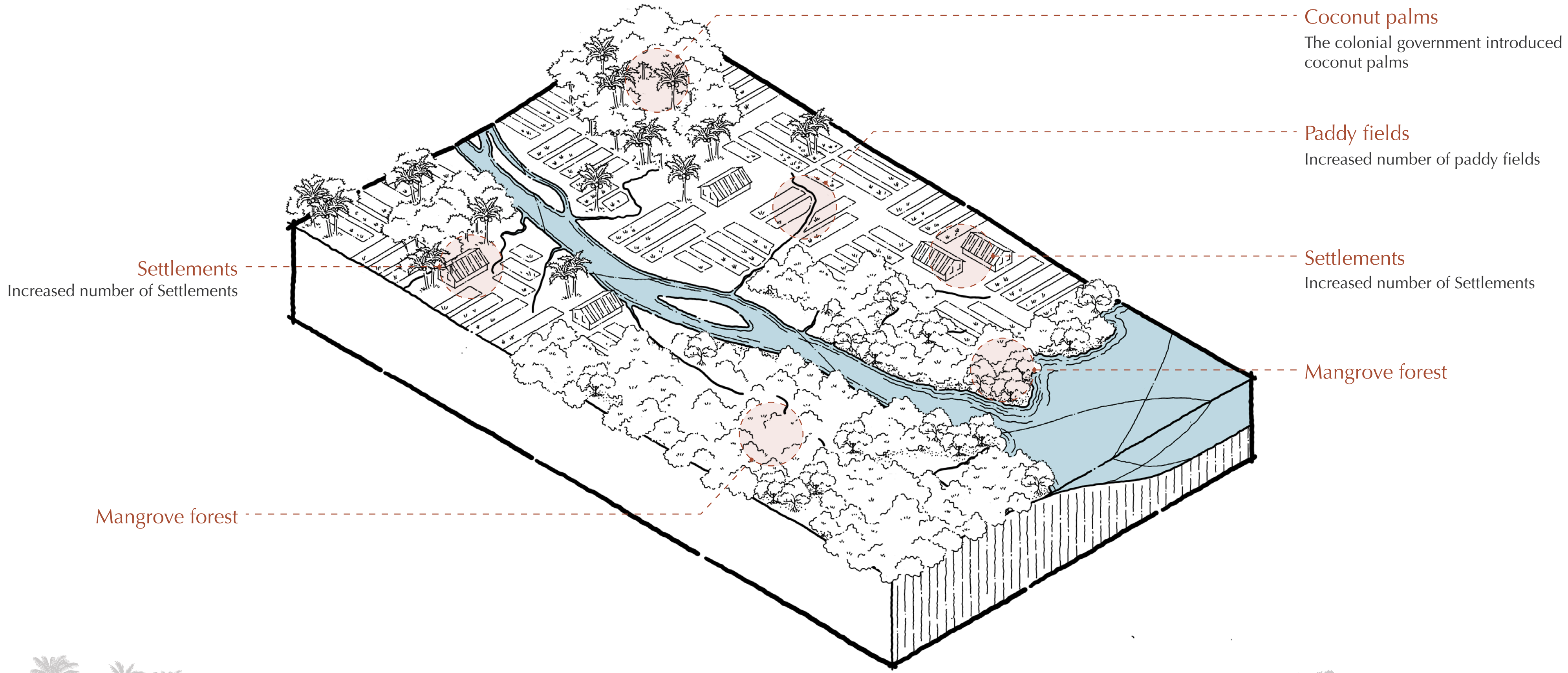


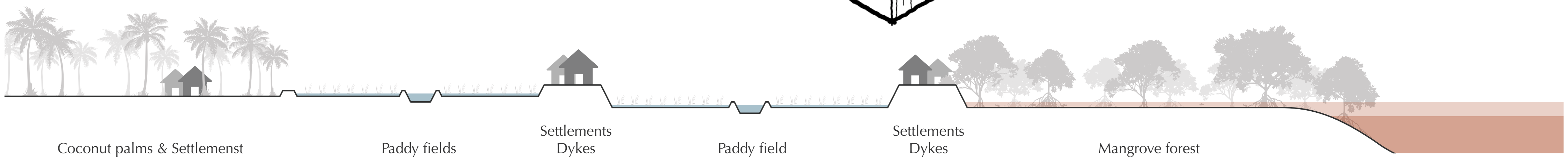
At the beginning of the 17th century, Ben Tre province was dominated by nature, with swampy woods intertwined with streams and inhabited by only a small number of Khmers. Later in the 17th century, during the expansion of the Annam kingdom, Ben Tre came under the rule of the Vietnamese, and throughout the 17th and 18th centuries, people began to settle here and farm the land.

To expand the settlement, a small number of canals were built and a small amount of land was reclaimed for rice production. Here, indigenous communities practiced traditional agriculture, growing rice, fruits, and vegetables. For the local people, rice cultivation is a natural irrigation system that requires little labor; they open the ridges in the rice paddies to drain the water at low tide, and at high tide, clean river water returns to the paddies.

4.1 HISTORICAL DEVELOPMENT

4.1.2 Intensive Rice Production (1858-1990)





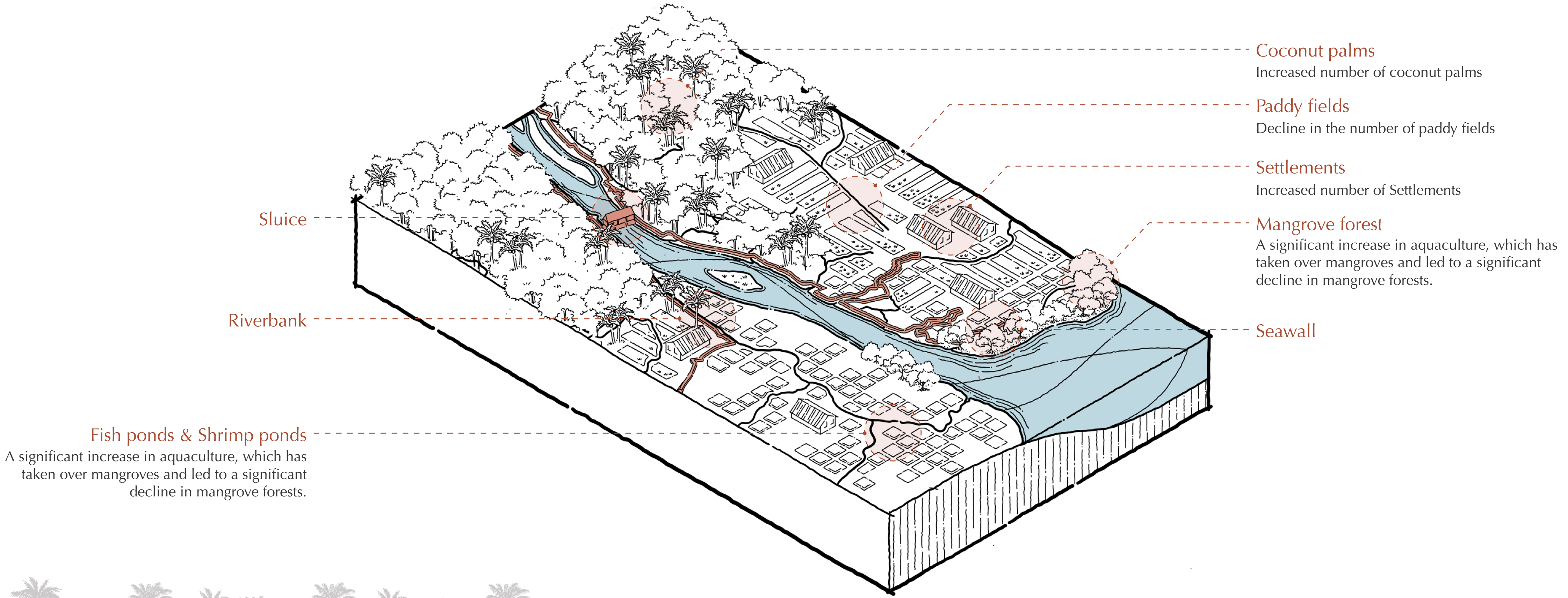
In the 19th century, the French colonized Ben Tre and decided to transform it into an important agricultural center. To increase rice production, the French government began to invest in large-scale infrastructure development, so during this period a large number of canals were dug, most of the wetlands were drained, and rice production increased massively. At the same time, the colonizers introduced the cultivation of cash crops such as coconut palms and sugar cane, but rice, fruits, and aquaculture remained an important part of the economy at this stage.

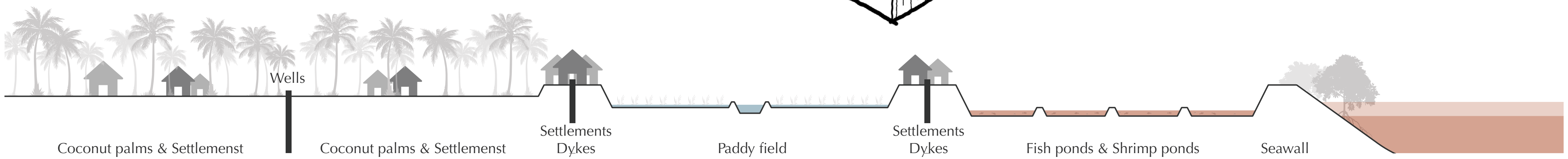
The construction of large-scale rice paddies and water projects disrupted the original irrigation system in the Mekong Delta, and the colonial government built a large amount of saltwater protection infrastructure for better rice cultivation. However, some rice fields in wide depressions were flooded due to inadequate water infrastructure. Instead of reconsidering the appropriateness of growing rice in these areas, the French decided to add flood protection. When the French left Vietnam, where 2,400 kilometers of canals were dug, more than 80 percent of the forests in the western part of the delta were deforested and 1.4 million hectares were drained.

In 1954, after the end of the French colonial period and the start of the 20-year Vietnam War between North and South Vietnam due to differing support, the Mekong Delta was located in South Vietnam, which was supported by the U.S. As a major food-providing region, the U.S. government has been heavily involved in planning and constructing infrastructure in the Mekong Delta to increase food production. in 1960, Dutch engineers helped U.S. engineers develop comprehensive water control plans for the Mekong River Delta. On paper, these plans, if realized, would insulate agricultural production from seasonal hydrological trends.

4.1 HISTORICAL DEVELOPMENT

4.1.3 Extensive Establishment Of Infrastructures (1990-Now)





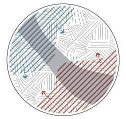
The reunified Vietnamese government continued to develop the water system inherited from the previous dynasty. The emphasis on the growth of rice cultivation led to a demand for fresh water in the rice production environment. Saline water was seen as a constraint to rice cultivation. in 1991, a Dutch company drew inspiration from the 1960 facet of the program. The company built many hydraulic projects to control salt intrusion and flooding, known as "closing the delta". During the "Closing the Delta" phase, the Vietnamese government built new barriers such as dykes, sluices, gates and dams. These prevented saline erosion and flooding and increased the area of cultivated land in some areas through irrigation.

However, as the climate changed, farmers came to realize that rice production was not suitable in the Ben Tre area, but the large irrigation projects built for rice production in the past prevented them from accessing salty water for industrial conversion. To develop aquaculture, people came beyond the dykes and converted the mangroves into a large number of aquaculture ponds. It can be seen that most of the mangroves were replaced during this phase. The loss of mangroves not only destroyed the ecosystem of Ben Tre, but also exposed the production sites to the threat of waves and triggered coastal erosion.

4.2 LAYER ANALYSIS

4.2.1 Water System

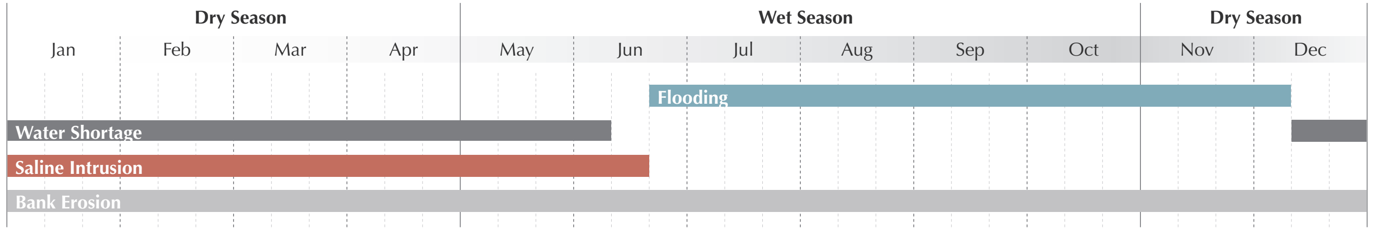
Challenge --- Water issues and climate change

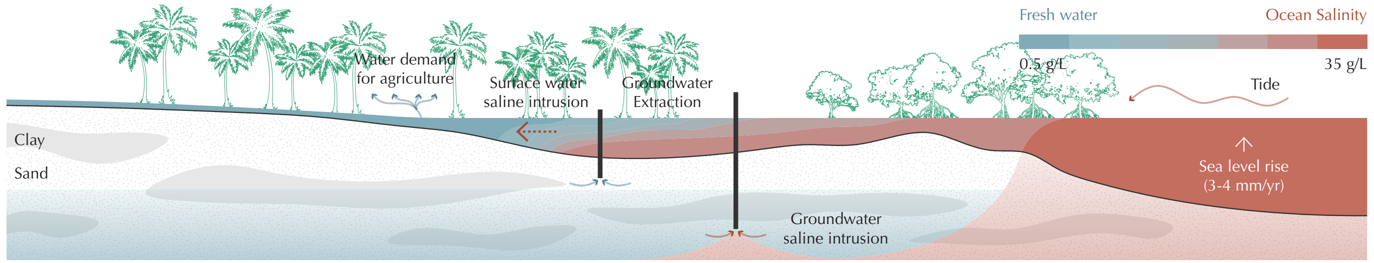


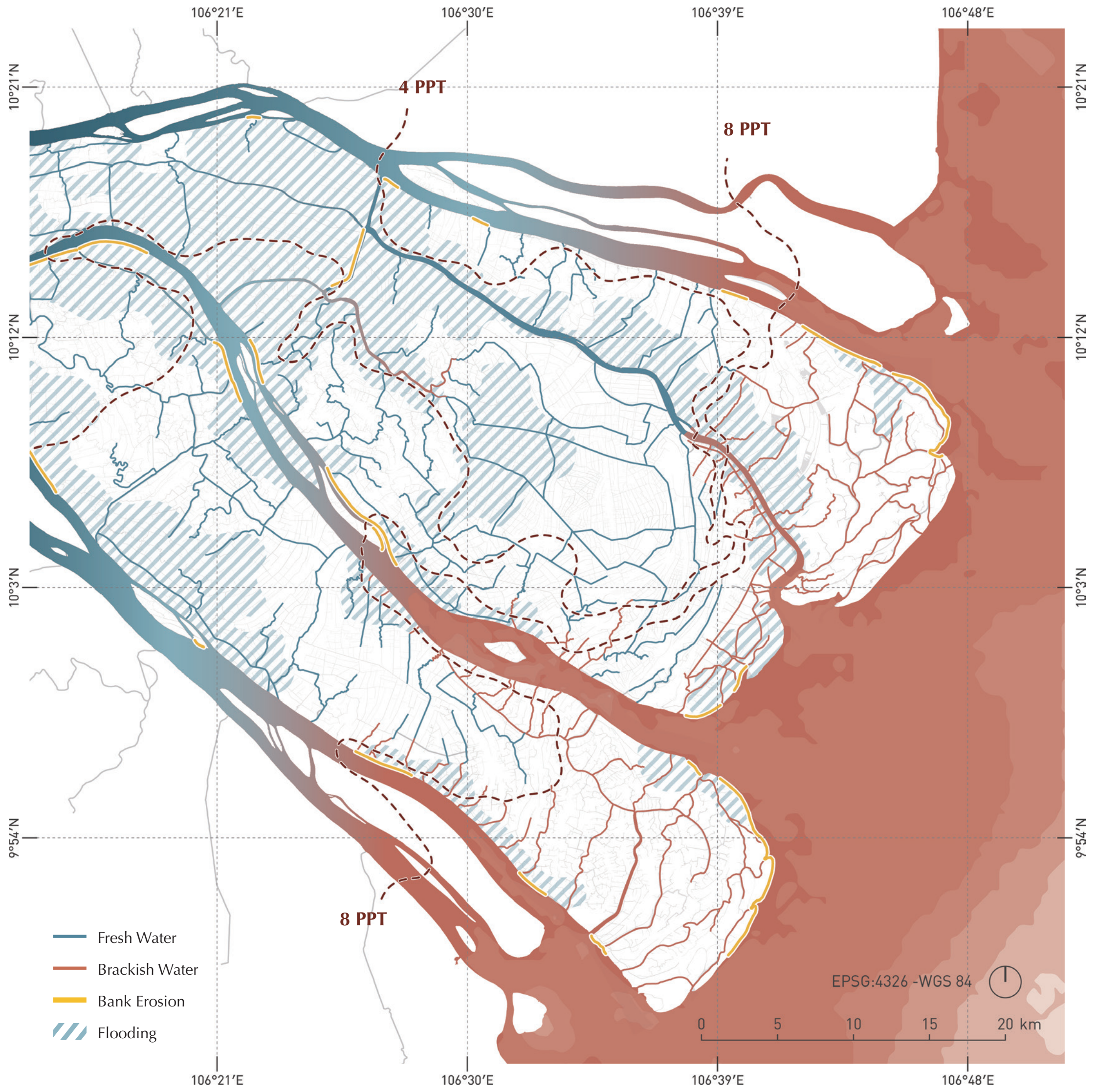
As can be seen from the previous section, the annual rainfall is very unevenly distributed, with a wet season from May to November and a dry season from December to April. About 90 percent of the annual rainfall is concentrated in the rainy season.

As a result, flooding occurs during the rainy season due to excessive precipitation in a short period. As can be seen in figure, the north-west and inland parts are at risk of flooding. At this point, people rely on infrastructure such as canals to drain the water quickly into the rivers, but this can also cause the water level to rise within the canals and rivers, increasing the risk of flooding on both sides of the river. Due to the high water volume within the rivers, fresh water from upstream can flush out the brackish water from the ocean, reducing the level of salt intrusion. In the dry season, water volume within rivers decreases due to reduced precipitation. To maintain irrigated agriculture, people not only obtain freshwater from rivers but also use wells to extract freshwater from groundwater. This further reduces the flow of freshwater, and there is not enough freshwater in the river to flush out the salt water, which increases surface water saline intrusion along the river. At the same time, groundwater abstraction also causes the freshwater table to drop, and the reduction in pressure in the freshwater table can exacerbate the groundwater saline intrusion. The extent of salt intrusion in Ben Tre during the dry season can be seen in the figure. It can also be seen that part of the area is at risk of flooding during the rainy season and saline intrusion during the dry season.

In addition to this, in coastal areas, more and more banks are being eroded due to climate change and sea level rise.







4.2 LAYER ANALYSIS

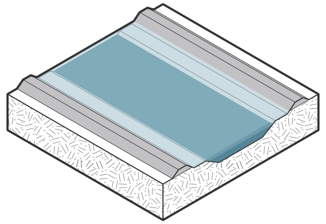
4.2.1 Water System

Challenge --- Rigid water management facilities

Similar to what was mentioned in the previous section, the construction of rigid water management facilities solves the problems faced at this stage in the short term, however, in the long term, it exacerbates the water problems and is not sustainable. In the figure below it can be seen the various types of water management facilities and the problems they cause.

As the climate changes, sea levels will rise and the seasonal distribution of precipitation will become more uneven. When governments choose to rely exclusively on such methods to control water, they will need higher dams and more sluices and wells. However, these will also exacerbate existing water problems to some extent. Therefore, this top-down approach to building rigid water management facilities is not sustainable.

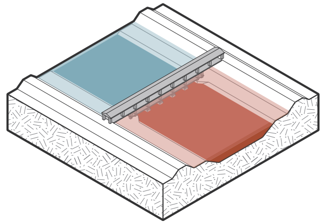
River dykes



- Control the flooding and surface saline intrusion.

- Make the river flow faster and exacerbate barge erosion.
- Increase the risk of flooding downstream.

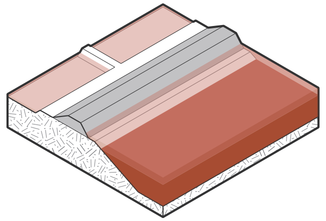
Sluices



- Separate fresh water from salt water.

- Increase the likelihood of upstream flooding.
- Exacerbate downstream water scarcity.
- Make it impossible to develop brackish-water agriculture upstream.

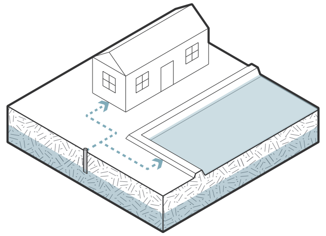
Seawall



- Protection of villages and aquaculture ponds from wave damage

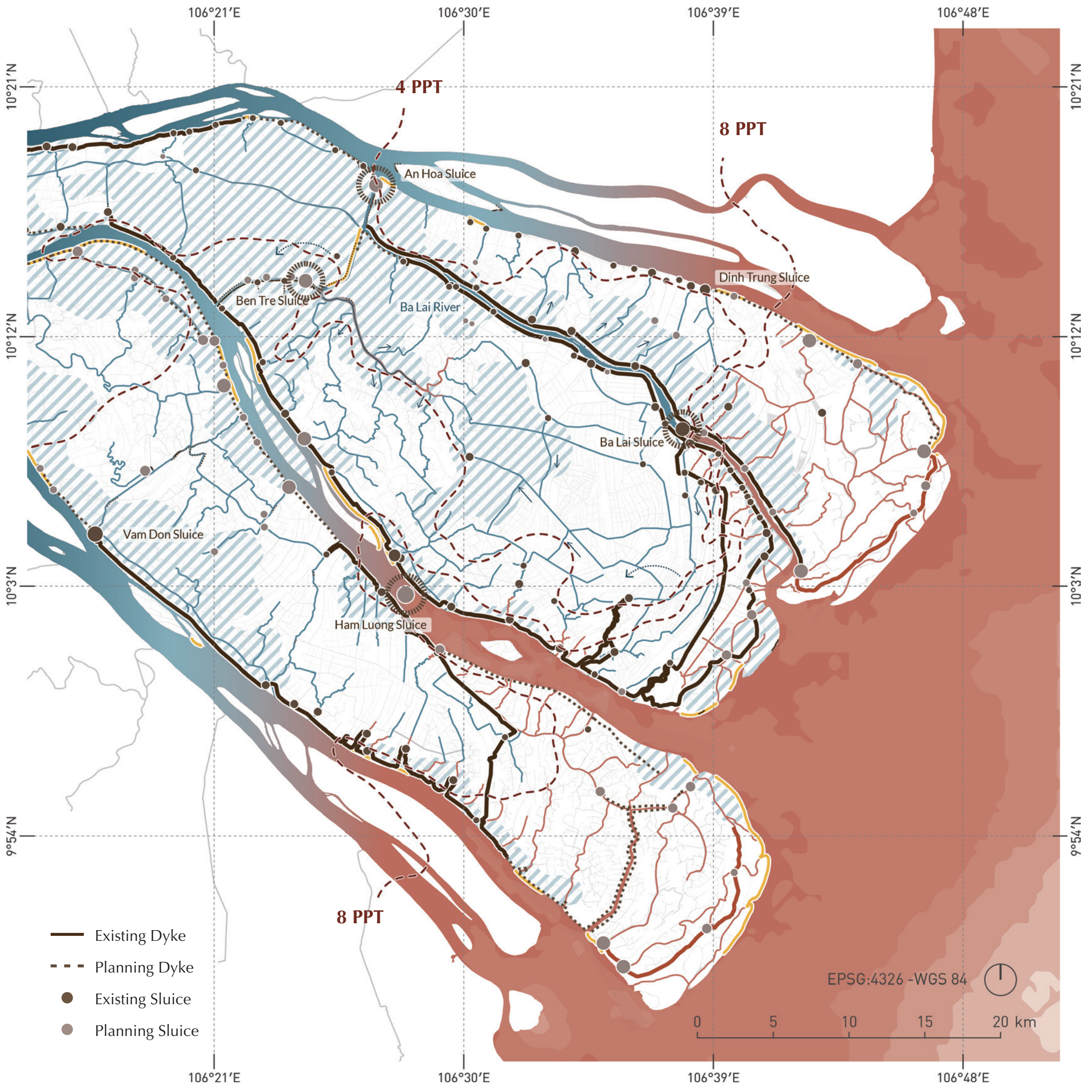
- Seawalls can limit the development of mangroves.
- Seawalls are also at risk of being breached.

Well



- Access to fresh water for daily use and irrigation of crops.

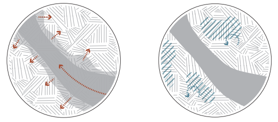
- Aquifer drawdown.
- Land subsidence.



4.2 LAYER ANALYSIS

4.2.1 Water System

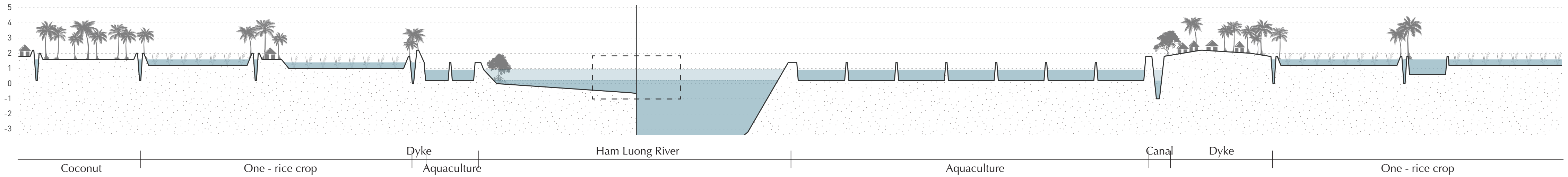
Opportunity --- Gradients & Reservoirs



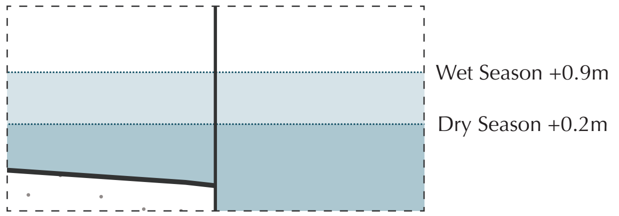
From the perspective of river and coastal sections, Ben Tre's natural water system brings seasonal water level variations (+0.2m - +0.9m), and daily tidal variations (-1.2m - +0.8m). Changes in water level heights also bring spaces with different water environments, creating a gradient in humidity. From the perspective along the river, the natural water system also brings salinity variations in a gradient. The combination of salinity and humidity with the annual precipitation creates a naturally resilient water system that presents opportunities for Ben Tre.

The building with landscape theory allows the design to utilize the gradients in salinity and humidity to develop different landscapes, as well as the creation of water reservoirs to mitigate seasonal inequalities in water distribution.

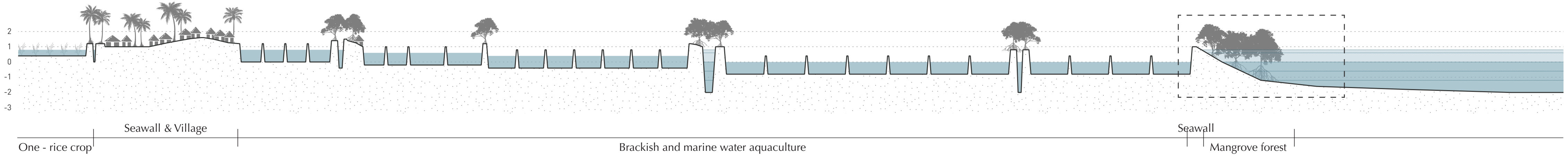
Cross section of Ham Luong River H:L=1:50



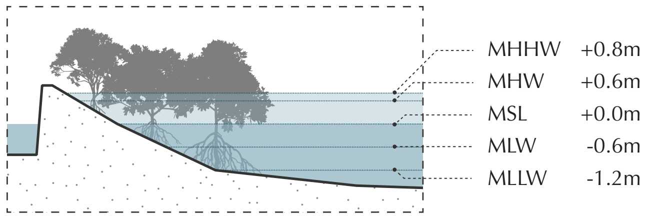
Seasonal water level changes



Coastal area section H:L=1:50



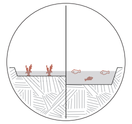
Daily tidal level changes



4.2 LAYER ANALYSIS

4.2.2 Ecology & Production

Challenge --- Decline in production & Mangrove loss



As can be seen by the mapping on the right, a large proportion of freshwater crops and freshwater aquatic products are located in areas of saline intrusion during the dry season. Crop and aquatic yields in these areas have declined significantly due to water pollution and water shortages. In the coastal and riverbank areas, many farmlands and aquatic ponds have been washed away and destroyed due to the erosion of the bank, which also has a great impact on the production and life of the farmers.

At the same time, due to the rapid development of the aquaculture industry, more and more aquatic ponds have been constructed, occupying the space that originally belonged to mangroves, resulting in mangrove loss, which in turn affects the ecological environment of the coast.

Drought & Saline intrusion

Fig. Pumps remain untouched along the N7 Canal as there is no water to pump into fruit orchards.
Photo: Huu Khoa

Water polution

Fig. Seawater intrusion has affected the pH of the water, resulting in the death or stunted growth of fish.
Photo: Hoang Nam

Damage of aquaculture ponds

Fig. Remains of a small dam at section 2, western part, viewing direction northeast.
Photo: Huu Khoa

Mangrove loss

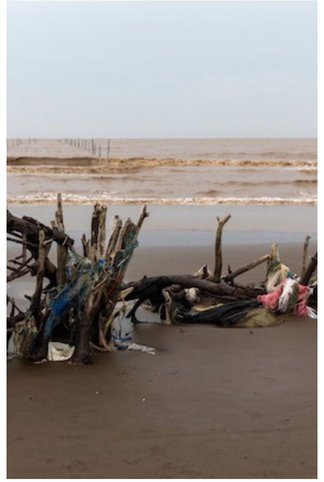
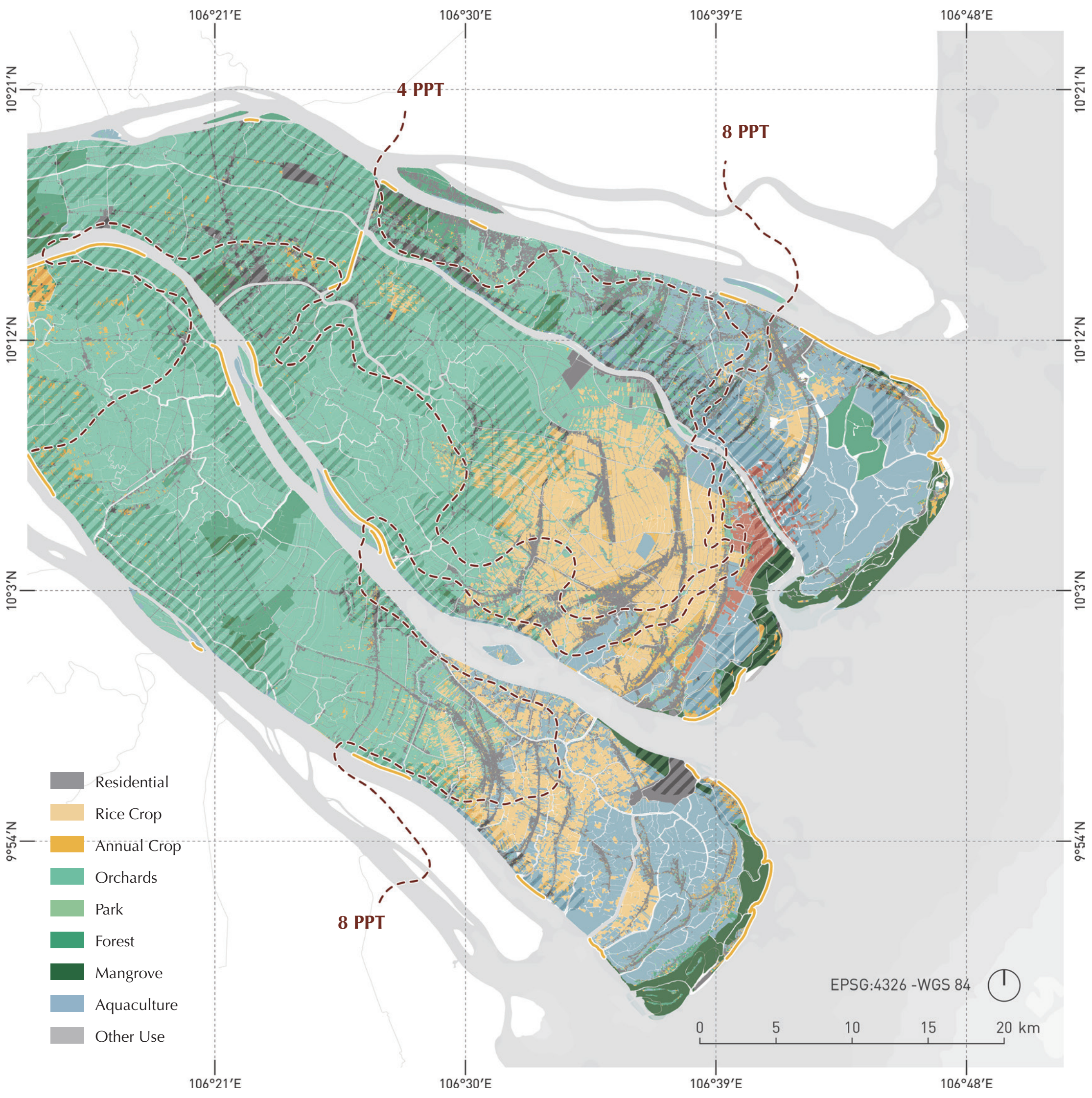


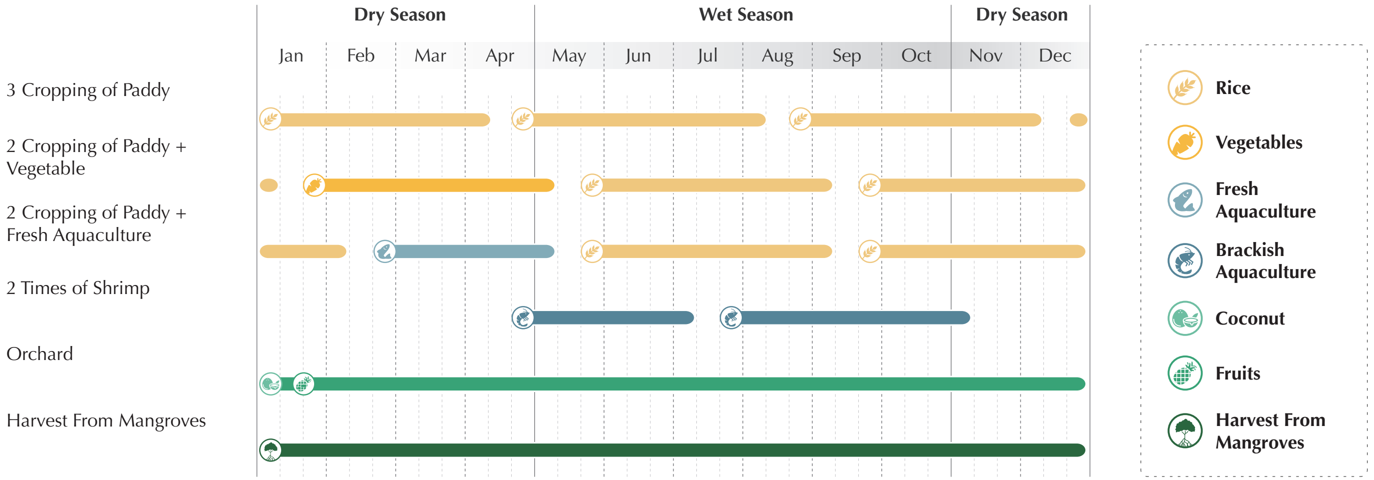
Fig. The remains of mangrove trees pierce the sandy coastline.
Photo: Luke Duggleby

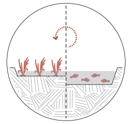


4.2 LAYER ANALYSIS

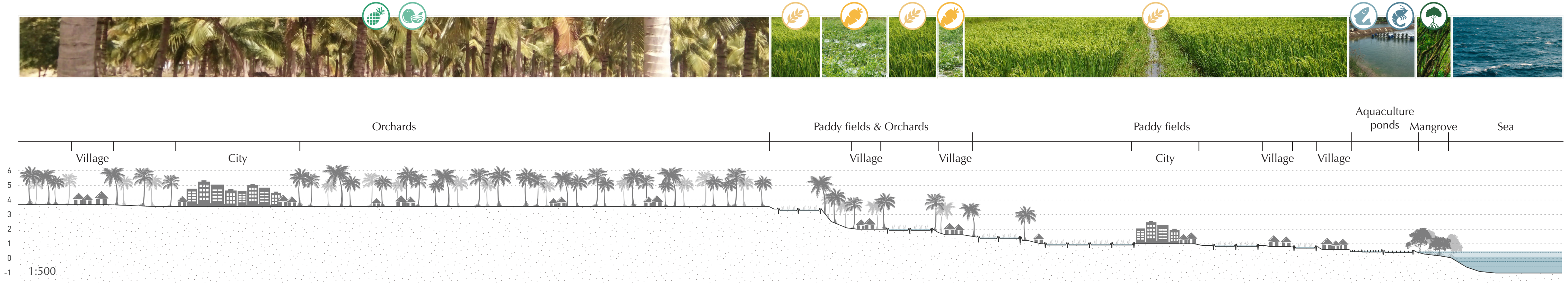
4.2.2 Ecology & Production

Opportunity --- Rich production practice



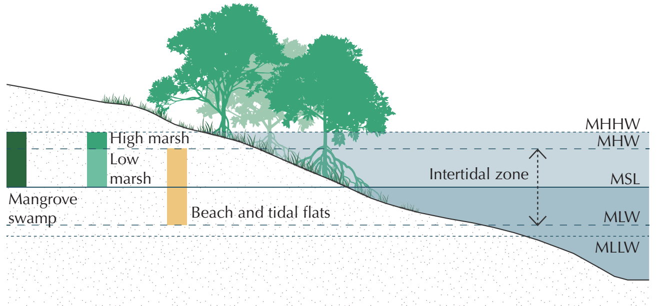


Ben Tre is rich in the types of production practices that allow for the growth of a wide range of products such as rice, vegetables, fruits, and aquaculture. Crop types can be divided into three sections from upstream to downstream, ranging from fruits with taller plants to flatter and more open rice to aquatic ponds. Meanwhile, the production calendar on the right shows that farmers here also trying to combine different types of production practices to adapt to the changing natural conditions.



Opportunity --- Natural restorative capacity

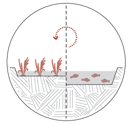
When a natural system is given enough space and proper conditions, it can grow naturally and regain its original ecology. As you can see from the diagram below, when the natural coast is given space for tidal changes, a series of mangrove, high marsh, and low marsh communities are naturally formed and provide habitats for the corresponding animals. This also opens up opportunities for Ben Tre's damaged ecosystems to recover spontaneously in some areas through slight adjustments.



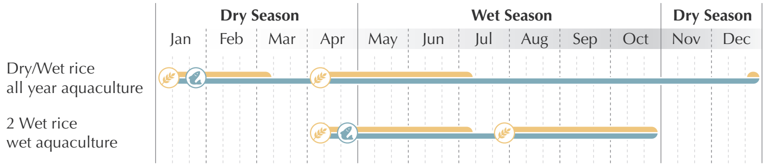
4.2 LAYER ANALYSIS

4.2.2 Ecology & Production

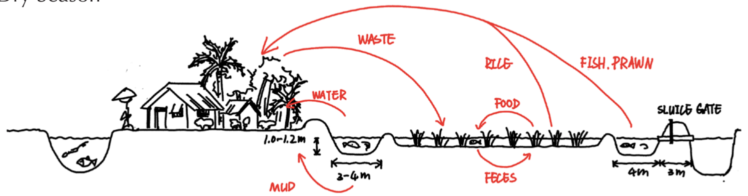
Opportunity --- Traditional wisdom



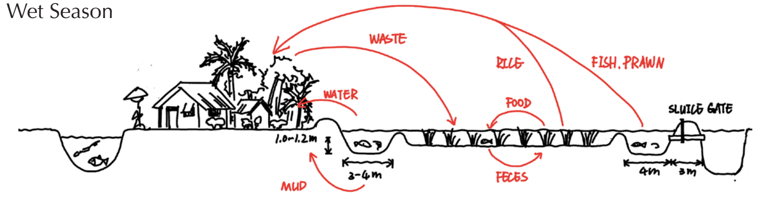
Rice-prawn culture in the Mekong Delta of Viet Nam



Dry Season



Wet Season



	River	Road.	Midland	Bund	Trench	Lowland	Trench	Dike	Canal
Crop			Mango. Nipa. Durian Coconut. Banana. Guyabano. Nangka	Cassava Maize. Mungbean		Rice. Sugarcane			
Live stock	Fish. prawn.		Carabao, Pig, Dog Chicken, Duck		Prawn. Fish	Prawn. Fish.	Prawn. Fish.		Prawn Fish.

Rice-shrimp farming is a traditional mode of production practice in the freshwater areas of the Mekong Delta, which is a way of raising shrimp and rice together at the same time and on the same site [IIRR, 1992]. Its advantage is that it can be flexibly adapted to changes in water level. At the same time, this type of farming brings about material recycling and utilization. The following shows how the system works.

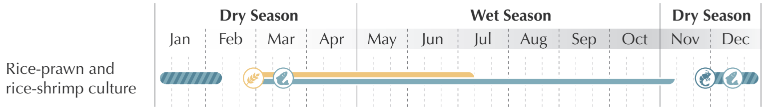
System 1 - prawn integrated in dry-wet season rice

1. Broadcasting/transplanting dry season rice crop (Nov. - Dec.).
2. Stock prawn fry 10 days after broadcasting or 5 days after transplanting.
3. Prawn will be stored in the trenches during harvesting or dry season crop or during land preparation for wet season crop
4. Broadcasting/transplanting wet season rice crop (Mar. - Apr.)
5. Allow prawn into ricefield 10 days after broadcasting or 5 days after transplanting

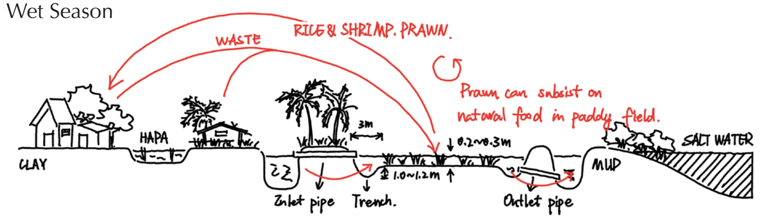
System 2 - prawn integrated in wet-wet season rice

1. Prawns are stocked in supplementary trenches in Dec.
2. Prawns are released into the field in Mar.-Apr. (10 days after broadcasting or 5 days after transplantin) and in Jul.-Aug. (10 days after broadcasting or 5 days after transplanting)
3. Prawns can be placed in supplementary trenches during harvesting of wet-season crops (Jun.-Jul.) or land preparation for trans-planted rice crops (Jul.-Aug.).

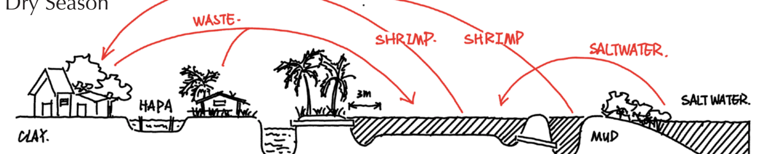
Rice-prawn and rice-shrimp culture in coastal areas of Viet Nam



Wet Season



Dry Season



	Minipond	Housing	Canal		Ricefield	Canal		
CROPS		Coconut Sugarcane Vegetable		Coconut Sugarcane Vegetable	Rice in rainy season			
TREES		Nipa Rhizaphora		Nipa Rhizaphora			Rhizaphora	
LIVE STOR.		Duck Pig.						
FISH.	Tilapia Crab		Fish Prawn		Prawn / Shrimp	Fish Shrimp	Crab. Fish Shrimp	Octopus Fish, Shrimp

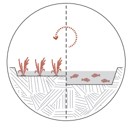
In the coastal areas of the Mekong Delta, salinity is usually higher than 5 ppt in the dry season, so most rice fields are left fallow. In the wet season, rice cultivation can only begin as salinity decreases, thus giving rise to a rice-prawn and rice-shrimp culture. This gave birth to the rice-prawn and rice-shrimp culture, a system in which freshwater prawn culture is combined with rice during the wet season and marine shrimp is cultivated in monoculture during the dry season [IIRR, 1992]. In this way, income is guaranteed throughout the year. The following shows how the system works.

1. Stock freshwater prawn 10-15 days after transplanting.
2. Harvest rice.
3. Harvest prawns after 5-6 months. Only harvest the big (more than 15 g) prawn. The small ones are reserved for the next culture season.
4. In the dry season growing prawns or shrimps in the fields.
   <10ppt (Nipa and coconut trees): Freshwater prawn
   >10ppt (Rhizophora - mangrove species): Tiger shrimp and banana shrimp

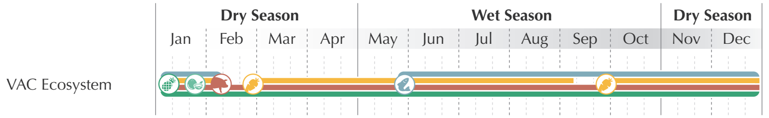
4.2 LAYER ANALYSIS

4.2.2 Ecology & Production

Opportunity --- Traditional wisdom



VAC Ecosystem



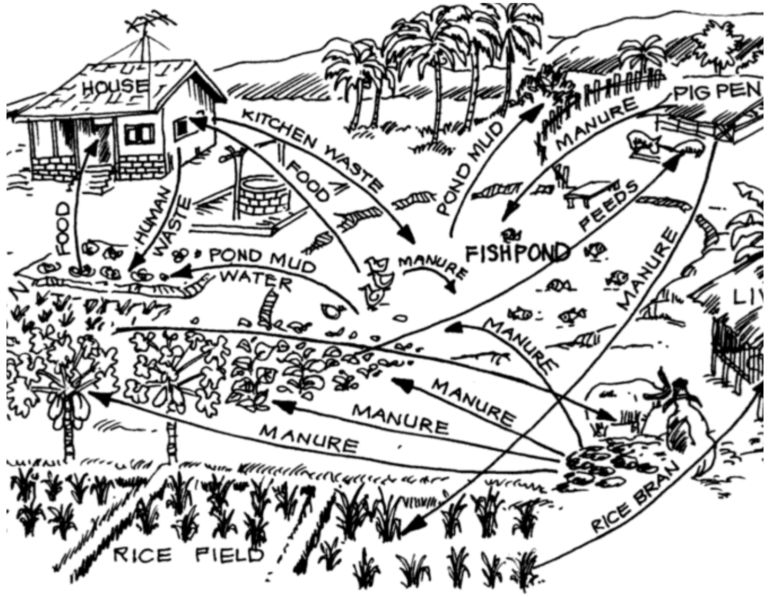


Fig. Lowland integrated farming system
Source: Farmer-Proven Integrated Agriculture–Aquaculture: A Technology Information Kit.

The VAC Ecosystem is a model of traditional production practices in Vietnamese rural villages. "VAC" is an acronym for 3 Vietnamese words: Von (garden, orchard), Ao (fishpond), and Choung (stall, pigsty). Thus, VAC indicates an ecosystem in which gardening (V), fish rearing (A), and animal husbandry (C) are closely integrated, enhancing economic effectiveness and contributing to protecting/ improving the environment [IIRR, 1992]. At the same time, through this system, farmers can generate income throughout the year. Below is the model of the system with the corresponding crops.

People make a habit of digging continuous canals to form the garden.

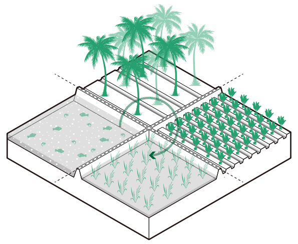
Fruit: Coconut (freshwater), Citrus trees (brackish water) Coconut tree plantations can be combined with other fruits such as banana, orange, tangerine, lemon, grapefruit, coffee, and cacao.

Aquaculture: Fish or shrimp are reared in the canals.

Livestock: Chicken coops are constructed above the canal with a pigsty close by.

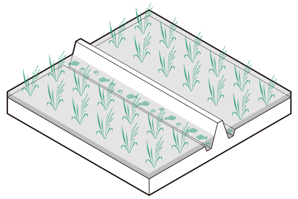
Through my research of traditional production practices, I have found that traditional wisdom can also provide opportunities for the development of Ben Tre's production practices and the establishment of natural inclusive agriculture. As a result, I summarized the following four design principles

Rotation



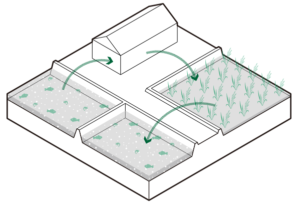
Changing production patterns in response to seasonal variations in natural conditions and planting suitable crops in different natural conditions. Crop rotation makes it possible to make the best use of natural conditions, while at the same time improving soil health and optimizing soil nutrients.

Agri - Aquaculture



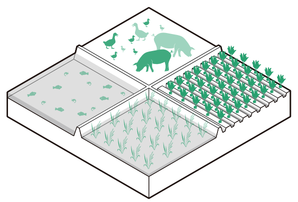
The combination of agriculture and aquaculture is achieved by digging trenches around the farmland. Such a farm not only allows for the simultaneous cultivation of crops and aquaculture but also allows for the conversion of farmland to aquaculture ponds by controlling the depth of water in the farmland during the wet and dry seasons.

Material flows and cycles



In the production process, the by-products of some industries in the process of production can be utilized in other industries, forming material flows and achieving the full utilization of materials.

VAC ecosystem

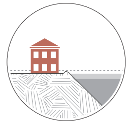


Combining practical patterns of production such as vegetables, livestock, and fish ponds to achieve full material utilization and year-round income generation.

4.2 LAYER ANALYSIS

4.2.3 Settlement

Challenge --- Houses threatened by natural disasters



The Mekong Delta is losing more and more land due to bank erosion and land subsidence. The Ministry of Agriculture estimated that about 500 hectares of land are lost to erosion in the delta every year.

In Ben Tre, many waterfront houses have been washed away and residents have been forced to move inland. And inland, huge cracks have appeared in many compounds due to land subsidence, threatening the daily lives of residents. As the climate changes, the problems of flooding, bank erosion, and land subsidence will be exacerbated, and existing forms of housing will be threatened by their inability to cope with the changing natural environment.

Fig. Flood occurred following heavy rainfall in November 2021
Photo: Cuong Tran

Fig. Two houses damaged due to erosion
Photo: Thanh Son

4.2 LAYER ANALYSIS

4.2.3 Settlement

Opportunity --- Traditional settlement patterns

Through analyses of traditional housing in Vietnam, it has been found that there is a rich variety of housing patterns and that they can be adapted to different water environments. Within a resilient landscape system, these buildings provide opportunities for urban and village development.

At the same time, because these housing types are widely distributed in Ben Tre, they also constitute a traditional landscape with high aesthetic value. Therefore, these buildings can also be used as a tourism resource, providing opportunities for further tourism development in Ben Tre.

House on stilts (inland)

These houses are usually built on stilts a few meters above the ground and are made of wood with thatched roofs. These houses were designed to deal with the threat of flooding from the outset. The most important room in the house is the kitchen in the center, a meeting place for the family at the end of the day. One or two steps below the main floor there is usually an area for drying rice. The open area below the house is either unused or used as a livestock pen.

Source: https://mekongreview.com/a-suitable-house/

House partly on gound and on water

This type of house is divided into two main parts; the main part is located on the ground and is constructed with more durable materials such as bricks or concrete. The other part extends over the water and is usually constructed using temporary materials such as reeds and leaves. This type of house enables a link between the road and the canal, and can be used either as pure residential or as residential with commercial.

Source: https://www.terragalleria.com/vietnam/picture.viet55096.html

House on stilts (river bank)

Stilts made of wood or concrete are stacked at the base of the river. Walls and space dividers are made of lighter materials, such as stripes or bricks, and roofs are made of stripes. These houses have two sides: one facing the canal and the other facing the road or both sides facing the canal. This type of house connects the road to the canal and, at the same time, can be adapted to different water levels because of its stilted structure.

Source: https://globetrottergirls.com/vietnams-mekong-delta-floating-markets-and-life-on-the-river/

Floating house

Floating houses are constructed on wooden or steel pontoons, often attached to fish farms. Some houses will have holes in the ground for feeding the fish. Also, they will float around floating markets or neighborhoods, providing them with gas, groceries, or mechanical repairs.

Source: https://yaleclimateconnections.org/2022/12/amphibious-houses-are-designed-to-float-during-floods/

Houseboat

Boats serve as the main means of transport in the Mekong Delta, which can combine living, storage, and commerce. These boats are made of steel and wood. The lower level is used mainly for living and storing food. The upper level, known locally as "mui", is used for reception and control of the boat. The boathouse could stay at the floating market for 5-7 days in order to sell off its goods. It would then travel hundreds of kilometers to buy or collect goods.

Source: https://wanderingwheatleys.com/cai-be-floating-market-how-to-visit-mekong-delta-on-your-own/

4.2 LAYER ANALYSIS

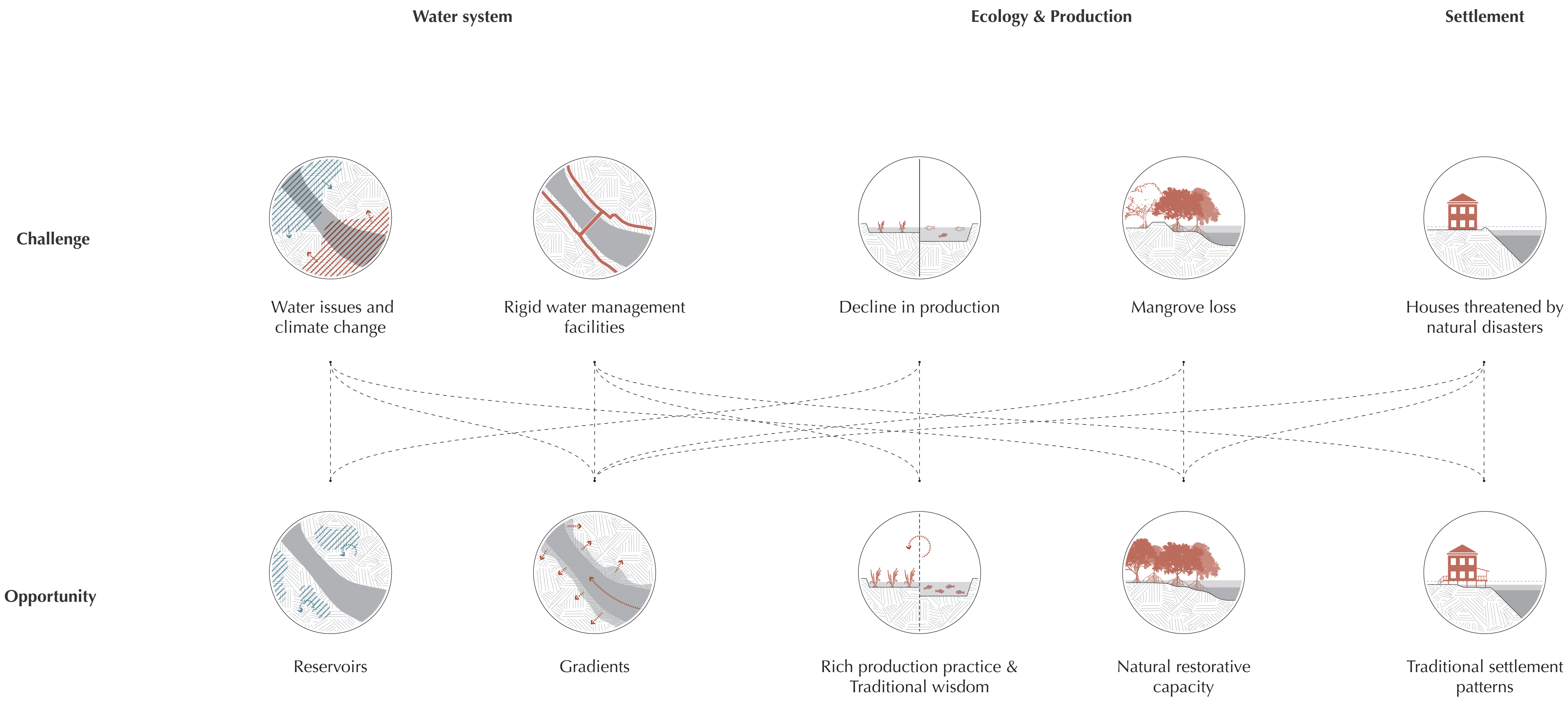
4.2.4 Summary

Integrating the analyses above shows that the three layers are interconnected and interdependent, the challenges they face are the result of mutual influences, and the opportunities can be applied to solve the challenges by applying them to each other.

In analyzing the challenges of the individual layers, it can be seen that production and settlement problems, such as declining yields and destroyed housing, are triggered by water issues. At the same time, water issues are exacerbated by the fact that the development of production and living areas makes people want to artificially control the water system.

This is also why the opportunities at each level can be mutually reinforcing. The application of rich production types and traditional wisdom at the production layer, based on the natural water environment, and the application of adapted dwellings at the settlement layer can reduce humans' artificial control of the water system and restore the natural gradient. Adapting production practices and creating water reservoirs can also balance seasonal water distribution and demand. At the same time, the restoration of the water gradient can be followed by using natural restoration capacity to mitigate problems such as flooding and bank erosion. The establishment of a natural water network, the improvement of productive landscapes, and the application of adaptive housing can also promote the development of tourism.

Therefore, in the following design process, it is necessary to consider the linkages between the three layers, integrate the opportunities, and propose design strategies that can operate on multiple layers of water-production-settlement.



4.3 CHALLENGE MAP

By situating the challenges mentioned in the previous section in Ben Tre, it can be seen that different problems are faced from upstream to downstream, and from inland to the waterfront, and are therefore divided into three sections.

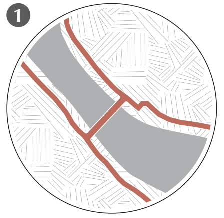
In the upstream and inland (Typology 1 Fresh upper zone), the production and daily life of the inhabitants are mainly threatened by flooding and land subsidence. They need to rely on the infrastructure to quickly drain the flood water in order to maintain their production during the wet season.

In the middle waterfront zone (Typology 2 Intersection zone), salt intrusion and bank erosion are the main problems. Because of the water management fucilities, this area is rigidly divided into freshwater aquaculture areas and brackish water aquaculture areas. In the dry season, due to the shortage of freshwater, the farmland and aquatic ponds are contaminated by salt water resulting in a decrease in production. In the wet season, more and more houses and farmland are washed away and destroyed.

In the coastal zone (Typology 3 Coastal zone), due to the overdevelopment of aquaculture, the mangrove ecosystem has been destroyed, and the seashore is exposed to the threat of waves due to the loss of the buffer zone.

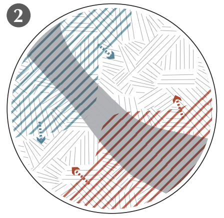
Water system

1



Rigid water management facilities

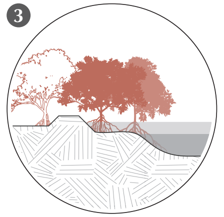
2



Water issues and climate change

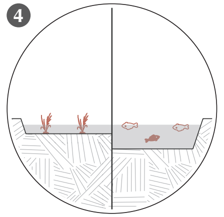
Ecology & Production

3



Mangrove loss

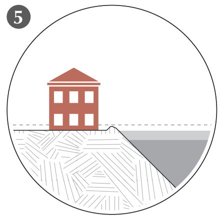
4



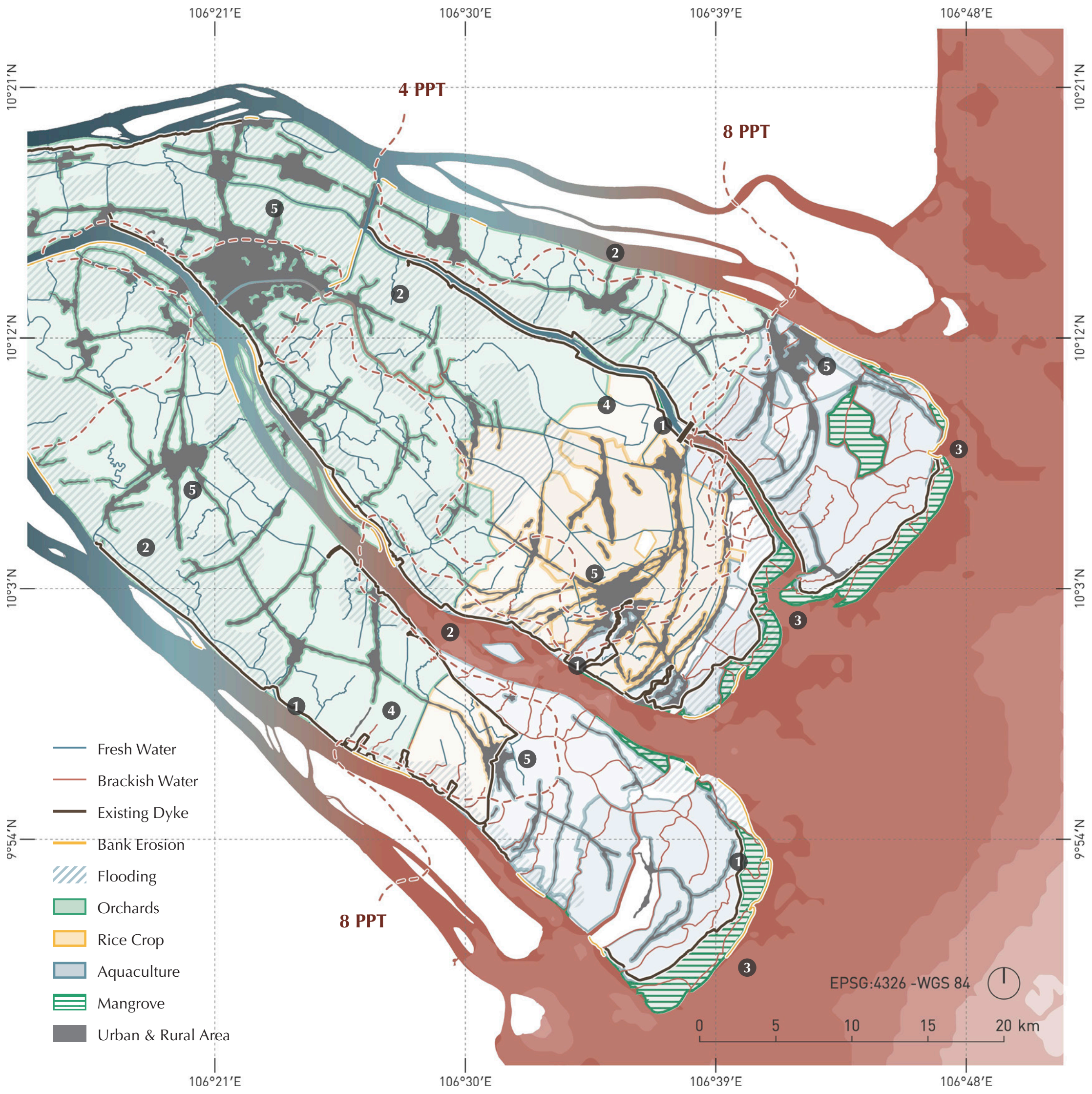
Decline in production

Settlement

5



Houses threatened by natural disasters

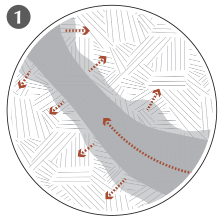


4.4 OPPORTUNITY MAP

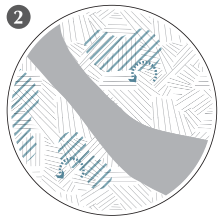
Through my studies of how natural systems work and traditional wisdom, I have discovered opportunities to address challenges. Here I have situated these opportunities in Ben Tre. In this section, I find that, unlike challenges that are specific to each region, opportunities can be combined and adapted to address different challenges

For example, precipitation collected in large reservoirs upstream and inland can be used in the dry season to flush out saltwater downstream. Precipitation collected in small reservoirs in the midstream can be used in the dry season for irrigation and daily use. Natural restorative capacity can be utilized in the coastal area to form a natural barrier to reduce wave energy, or in some purification ponds in the production practice area to purify water resources. Wisdom learned from traditional production practices can be utilized in the transformation of industries throughout the region.

Water system

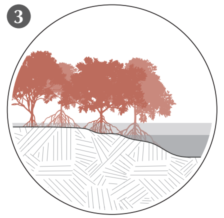


Gradient

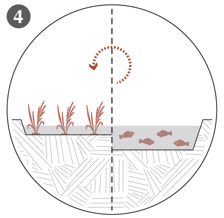


Reservoirs

Ecology & Production

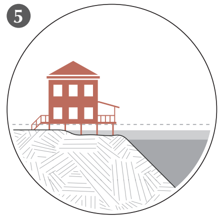


Natural restorative capacity

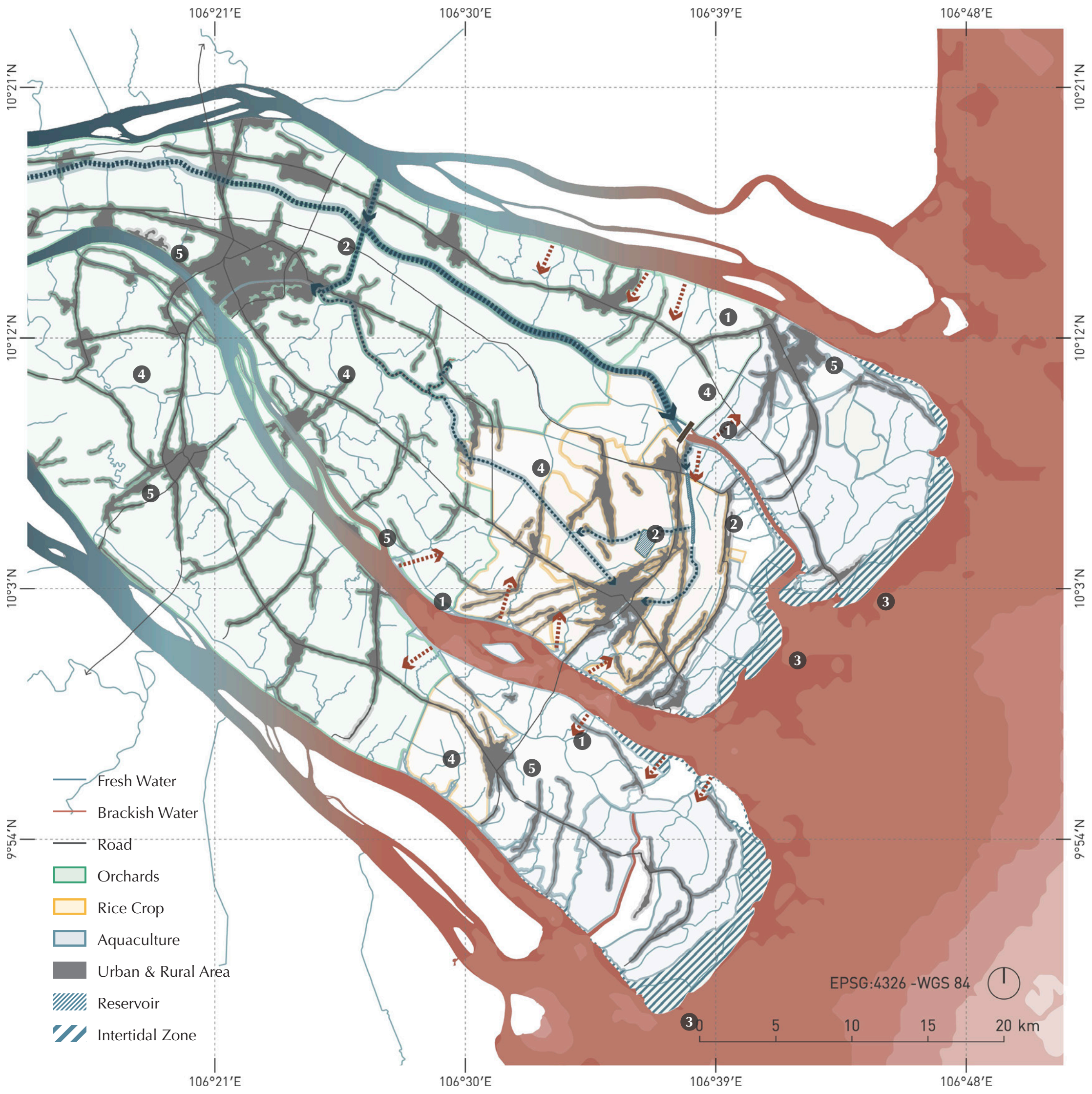


Rich production practice & Traditional wisdom

Settlement



Traditional settlement patterns



Part III

Strategy & Principle

05 Strategy & Principle

5.1 CASE STUDY

5.1.1 Wave Attenuating Willow Forest

Noordwaard, Netherlands | Deltares

Within the national Room for the River programme, the polder Noordwaard was being prepared to function as an extra river branch of the Nieuwe Merwede river in times of high discharge.

Therefore, a dam was needed to the north-east of Noordwaard to protect the inhabitants of Fort Steurgat. During the 1/2000 year discharge event, average water depths can reach 3m, and when storms hit waves near Fort Steurgat can reach up to 1m. The first 'traditional' dam around Fort Steurgat was designed as a concrete structure, reaching a height of NAP 5.5 metres, which led to protests from local residents. Therefore, the aim of the programme was to create a safe and ecodynamic design that is both natural and recreational at the same time.

The project found experimentally that vegetation can be an effective means of reducing waves. Therefore, the project utilised this property in the design process by planting willows in front of the dyke to reduce the height of incoming waves by 80%. This resulted in a dyke that was 0.7 m lower than a traditional one, and the construction of a wave protection forest allowed for a less costly clay cover that was sufficient to resist the waves without the need for a concrete revetment.

At the same time, the design draws on the typical characteristics of the area, and the use of willow as a breakwater plant is integrated into the landscape, providing additional ecological and recreational value to the dyke.

Fig. Birdview of dyke and willow forest
Photo: Robbert de Koning

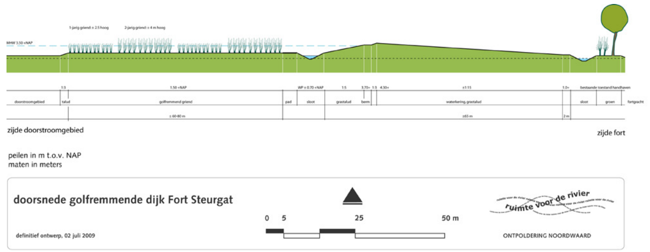


Fig. Cross profile of design for willow plantation and dyke at Fort Steurgat
Source: Dekker en De Vries, 2009

5.1.2 Associated Mangrove Aquaculture (AMA)

Demak, Central Java, Indonesia | Wetlands International

The expansion of shrimp aquaculture has led to the loss of mangrove forests globally, making tropical deltas and coastlines more susceptible to problems such as erosion, flooding, and land loss. The project introduced Associated Mangrove Aquaculture (AMA) in Demak District, Central Java, Indonesia, combining the revitalization of aquaculture productivity with mangrove restoration.

In natural systems, mangrove forests along rivers and creeks can enhance biodiversity as well as economic opportunities for local people. AMA is a system that connects aquaculture with mangrove green belts along estuarine coastlines. In this system, mangroves located outside of ponds dampen waves and build up sediments, thereby protecting rivers and dykes along ponds, reducing their maintenance costs, and lowering the risk of flooding. At the same time, mangroves can purify the water, which in turn improves fisheries production. Ideally, all farmers along the canal could benefit from this system.

In the course of the project, they first increased farmers' incomes by improving their aquatic production through field school training, which made them willing to reduce the size of their ponds. Next, the project organization constructed a new dyke, while at the same time opening the sluice gates of the old dyke more frequently or permanently, so that a new layer of 10 cm of sediment could be formed in the old dyke every year. Mangrove seedlings are brought into the site by the water flow and regenerate naturally. In the first year of the project, about 100 farmers converted about 10 % of their 104-hectare pond into mangrove habitat. Over the year, sediments were gradually deposited and the mangroves grew naturally. At the same time, according to project projections, when all the ponds along the waterway have been converted to joint mangrove aquaculture systems, the farmers can stop maintaining the old dykes or remove them, achieving an overall landscape enhancement.

Fig. Associated Mangrove Aquaculture pond
Source: Wetlands International

Fig. AMA 6 months after construction in Tambahulusan
Source: Blue Forests

5.1 CASE STUDY

5.1.3 T-shape Structures

Soc Trang, Mekong delta | Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

In the Mekong Delta, coastal erosion, flooding, and storms due to the loss of mangrove belts are affecting the livelihoods and lives of many poor farmers and fishermen. In natural situations, mangrove forests, because of their dense roots, intercept sediment and reduce wave energy, creating natural barriers to reduce erosion and limit inland flooding.

The project established a T-shaped fence on the coast of Soc Trang province. Interviews with neighborhood residents showed that wave energy was significantly reduced and houses were no longer subject to flooding after the fence was erected. Nine months after the fence was built, Avicennia seedlings appeared and grew well. A year later, a large amount of sediment had accumulated behind the T-fence and gradually began to consolidate.

Fig. Wave dampening effect of bamboo T-fences, Ca Mau Province, Viet Nam
Photo: R. Sorgenfrei 2016

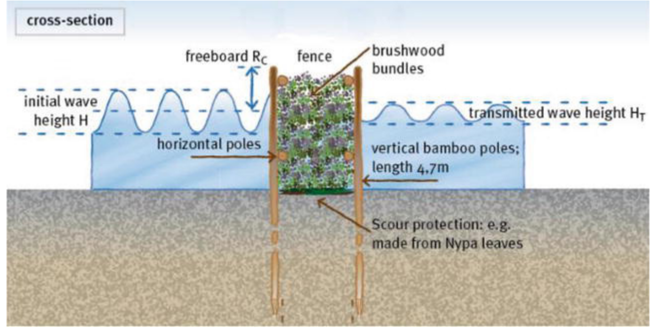


Fig.Design of the permeable bamboo fences and resulting wave transmission
Source: Thorsten Albers, 2013

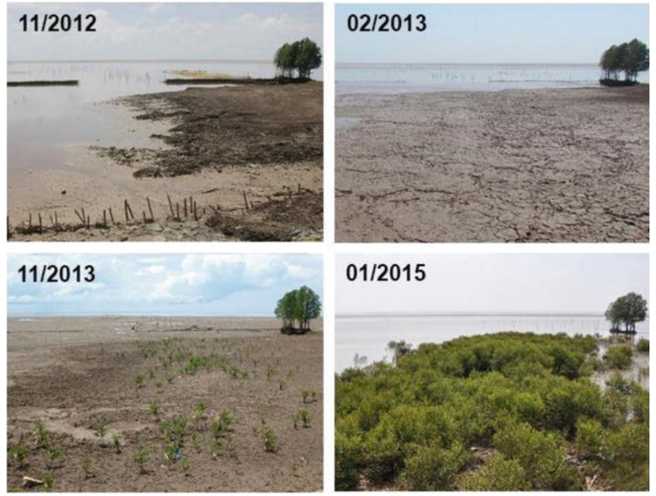
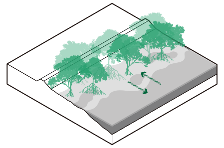


Fig. Natural regeneration of Avicennia on restored tidal flats
Photo: GIZ Soc Trang, R. Sorgenfrei

5.1.4 Principles learned from case studies

In the course of the case study, I have analysed the design practices of a number of different sites. Due to the different conditions of the sites, the design of these projects cannot be directly utilised as the design principles of this project, but some of the techniques can be refined to address the challenge that Ben Tre is facing at the moment.

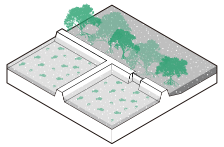
Integrating vegetated foreshores



Experiments in the Noordwaard project proved that vegetation can be an effective means of reducing waves. Therefore, willow trees were planted in front of the dyke to resist waves. In the Mekong Delta, mangrove forests, as native plants, are more suitable for wave mitigation. Therefore, the design principle of integrating vegetation in foreshore was summarised.

Mangrove planting in foreshore can enhance the resilience of dykes by dampening wave energy and intercepting sediment. At the same time, this vegetation shapes a rich ecological habitat with recreational potential. It is also a low-cost bank treatment in terms of construction and maintenance costs. However, at the same time, the growth of beachfront vegetation requires a certain amount of space and time and is a design principle that serves the long term.

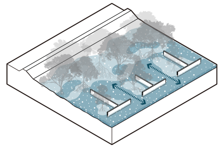
Eco-agriculture



Associated Mangrove Aquaculture (AMA) in Indonesia offers a way of combining production practices with natural ecological communities. In this system, ecology and production are complementary, with the by-products of production practices being used as nutrients to nourish the ecological communities, and the ecological communities acting as natural reservoirs or purifiers to support production.

In VMD, it is also possible to learn from Indonesia's practice of converting some species to build an AMA system with local characteristics. This practice can also be extended by giving up part of the production function to develop natural ecological communities in the process of industrial transformation, introducing nature into the production practice, and realising the co-development of production and natural habitats.

Sediment trapping

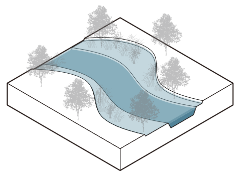


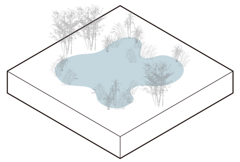
The T-shape permeable embankment combines site-specific materials with the site's natural functioning logic to promote the growth of the bank and the development of ecological communities through the capture of sedimentation. This not only reduces wave energy but also restores the mangrove ecological habitat. The context and environment of the VMD coastal area are similar to the studied case, so this design principle can be applied to address the issues VMD currently faces.

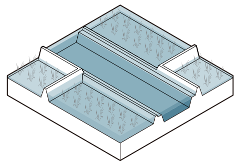
5.2 DESIGN PRINCIPLES

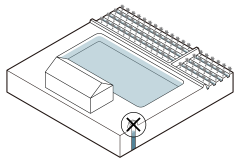
The following design principles have been summarised through the study of traditional wisdom and case studies, and are divided into three parts based on their functioning layers: water system, ecology & production, and settlement. At the same time, the design strategies "Letting Water Flow", "Letting Production And Ecology Flow", and "Letting People Flow" are summarised in each of these three layers.

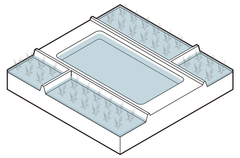
Letting Water Flow

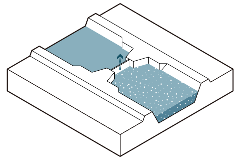

Flood plain

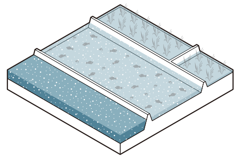

Reservoirs

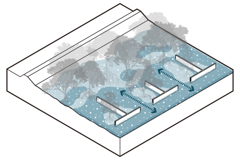

Different level of dykes

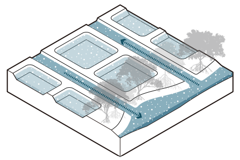

No groundwater use

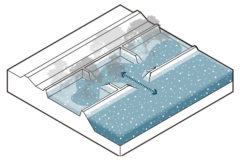

Small water retention pond


Restoring salinity gradients

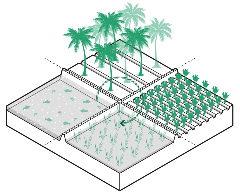

Make use of brackish water

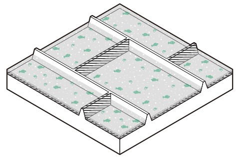

Sediment trapping

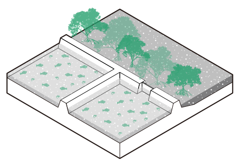

Separate in & outflow channels

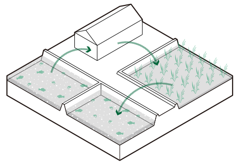

Restoring intertidal zones

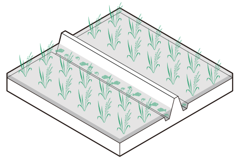
Letting Production And Ecology Flow

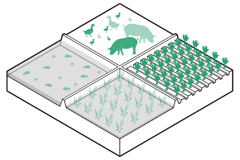

Rotation

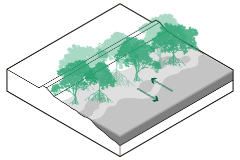

Industrial transformation


Eco-agriculture

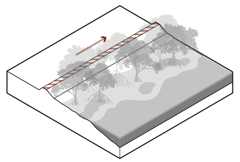

Material flows and cycles

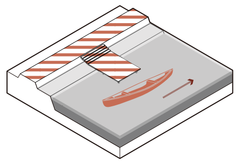

Agri - Aquaculture

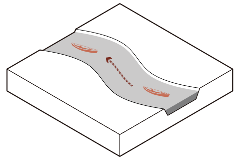

VAC system

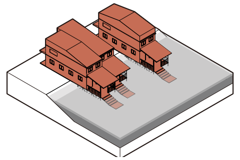

Integrating vegetated foreshores

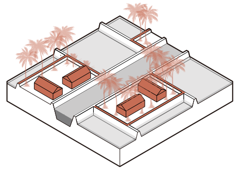
Letting People Flow

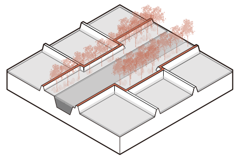

Tourist route


Quay


Waterway transport

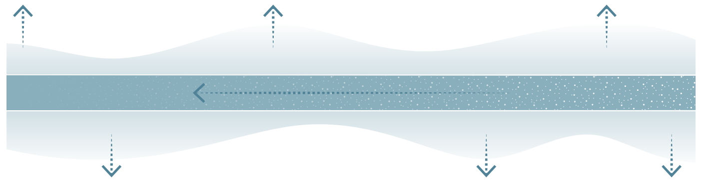

Traditional settlement


Keeping the original landscape


New waterfront spaces

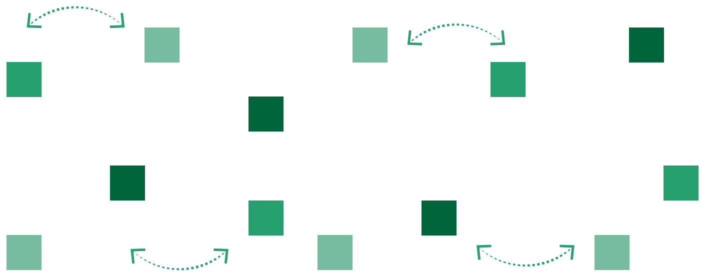
5.3 DESIGN STRATEGIES

Letting Water Flow



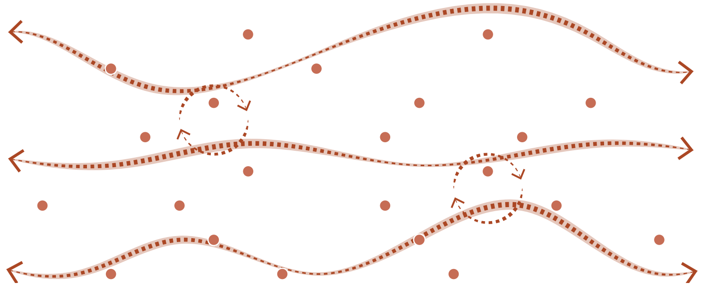
This strategy aims to reduce the use of sluices and narrow hard dykes, allowing the water system to flow following the logic of nature. The flow of different types of water resources is achieved on a spatial scale through salinity gradients, floodplains, and intertidal restoration, and on a temporal scale through the creation of retention ponds and reservoirs. Under this strategy, the resilience of the water system will be increased, enabling it to address existing issues while responding to future ones.

Letting Production And Ecology Flow



In this strategy, different types of production practices and ecological communities are divided into modules based on the water environment to which they are adapted. Thus, they can be placed according to the water environment, and when the water environment changes, they can also change and flow in time. By making production more flexible and resilient, this strategy promotes a shift in thinking towards building with nature and reduces the degree of human intervention in the water system. At the same time, more resilient production can make people more adaptable when facing unknown changes.

Letting People Flow



This strategy encompasses adaptive housing types and recreational networks. These housing typologies promote the integration of settlements into nature and reduce the control and alteration of the water environment during the development of cities and villages. At the same time, tourist routes combine traditional, natural, and productive landscapes, allowing the flow of tourists and products. This both reinforces and promotes the characteristics of the landscape and generates more income for the inhabitants.

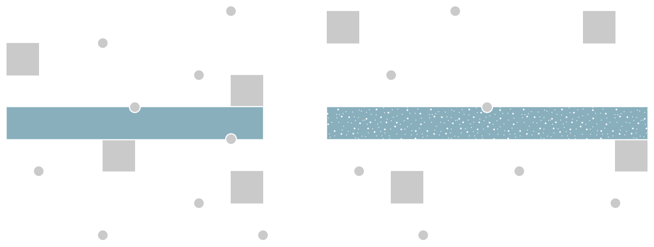
5.4 APPROACH

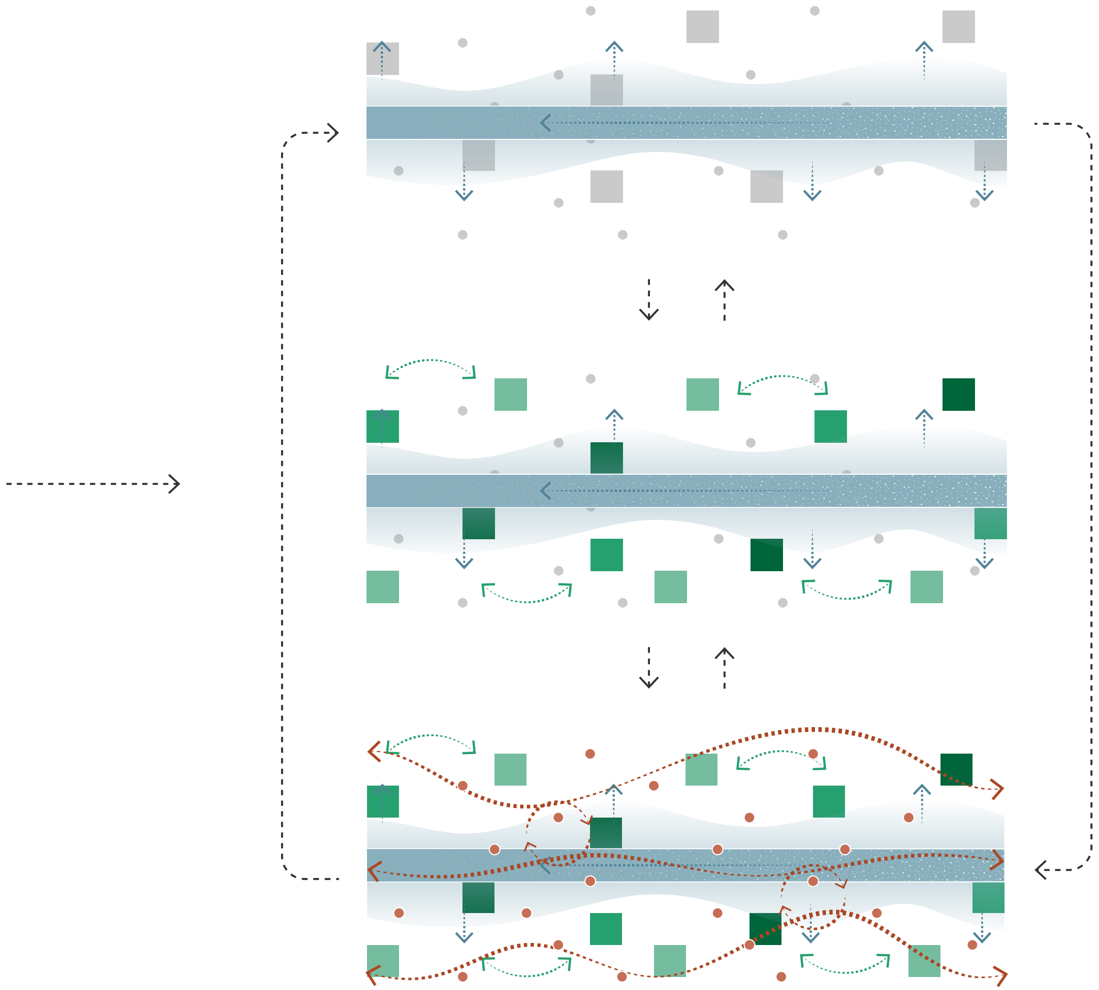
As can be seen in the figure on the right, the application of the landscape to the strategy is gradual.

In the current situation, different types of water are rigidly divided, and there are a series of issues with ecology, production, and settlement. Therefore, the creation of resilient landscapes requires first the restoration of a resilient water network, then industrial changes, and finally the improvement of settlements and tourist routes.

The application of strategies is not unidirectional either, the creation of resilient water networks affects the distribution of modular production and adapted housing, which in turn will return to drive the creation of resilient water networks through the reduction of management facilities such as locks, dams and the development of watercourses. At the same time, the distribution of productive landscape types can further influence the development of tourist routes, which in turn can come back to influence the transformation of the industry by facilitating the sale of products.

Current situation





Part IV

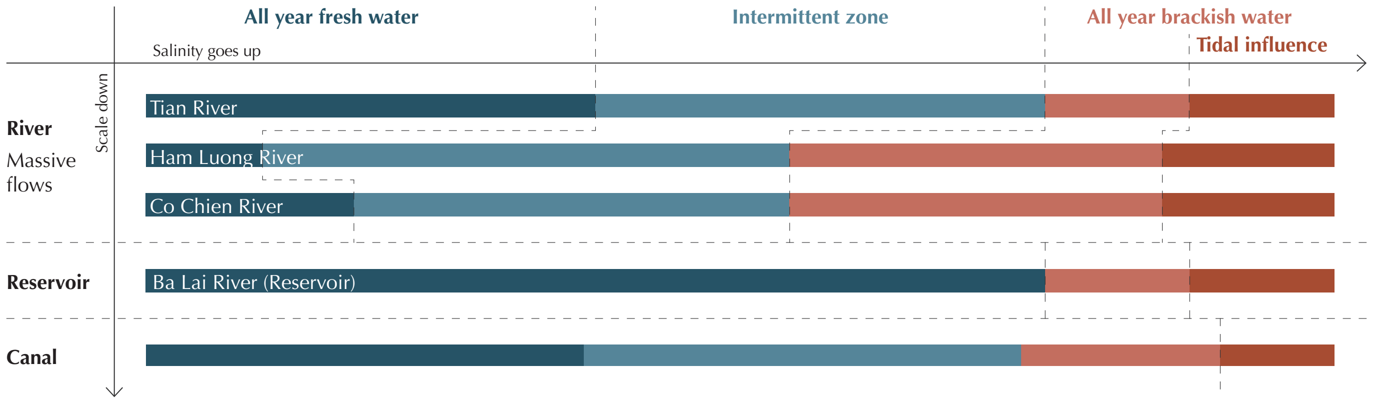
Design Exploration

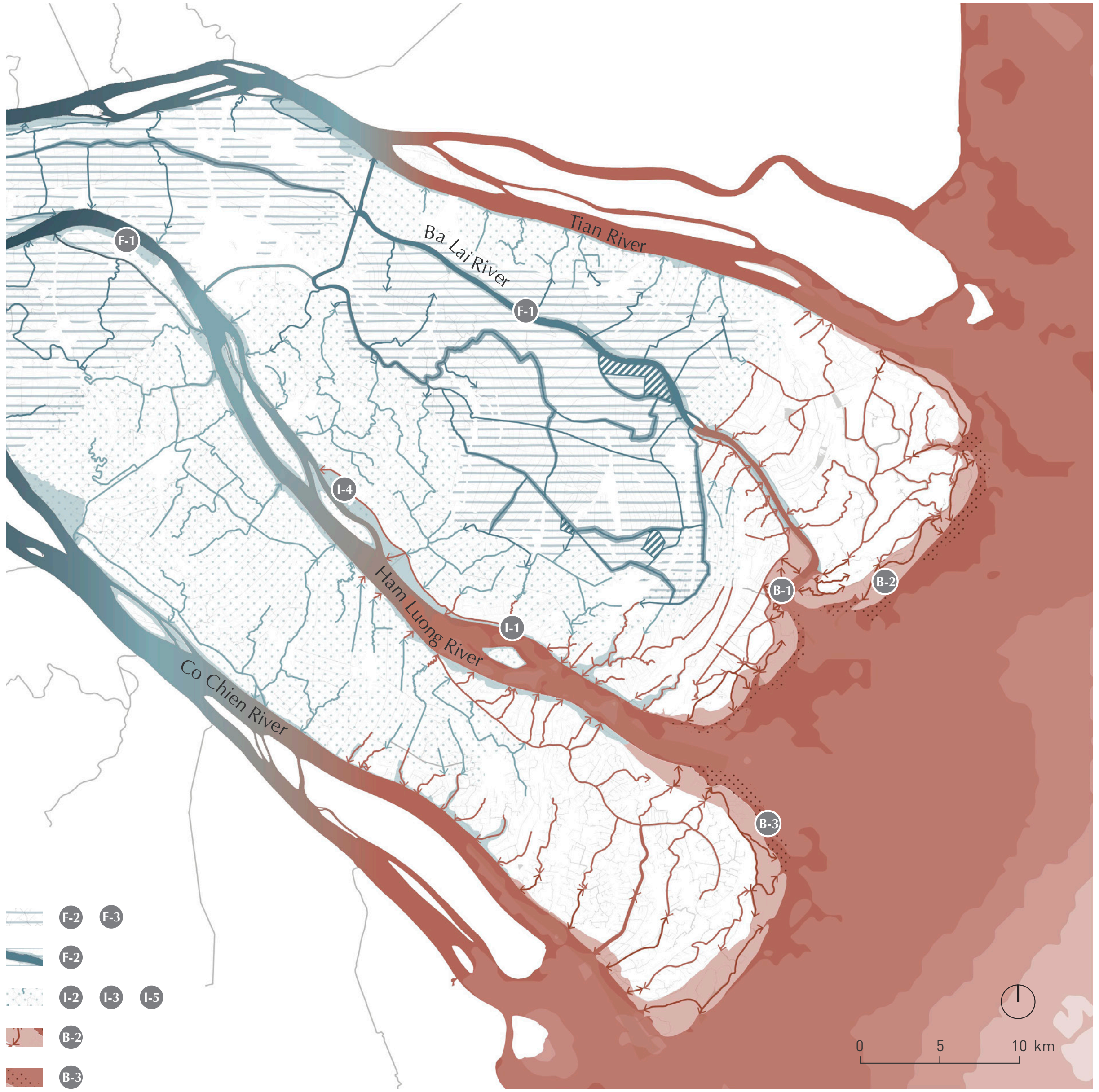
06
Regional Scale Design

6.1 LETTING WATER FLOW

Ben Tre's water system contains both larger-scale rivers with massive flows (Tian River, Ham Luong River, and Co Chien River), a complex network of canals, and a large reservoir (Ba Lai River). Although this water system is very complex, it can be viewed as an integrated flow in terms of water quality, with a gradual transition from freshwater to brackish water from upstream to downstream. Therefore, it can be divided into three parts based on water quality, namely "All year fresh water", "Intermittent zone" and "All year brackish water".

Each of these three parts has different water environments and interacts with each other. Salt intrusion goes upstream from the brackish water zone, and upstream freshwater resources can also push back brackish water through flushing. Therefore, the design strategies proposed for the different components will influence the whole water system through the water network. The following are the design strategies and design principles for each part.





6.1 LETTING WATER FLOW

All year fresh water

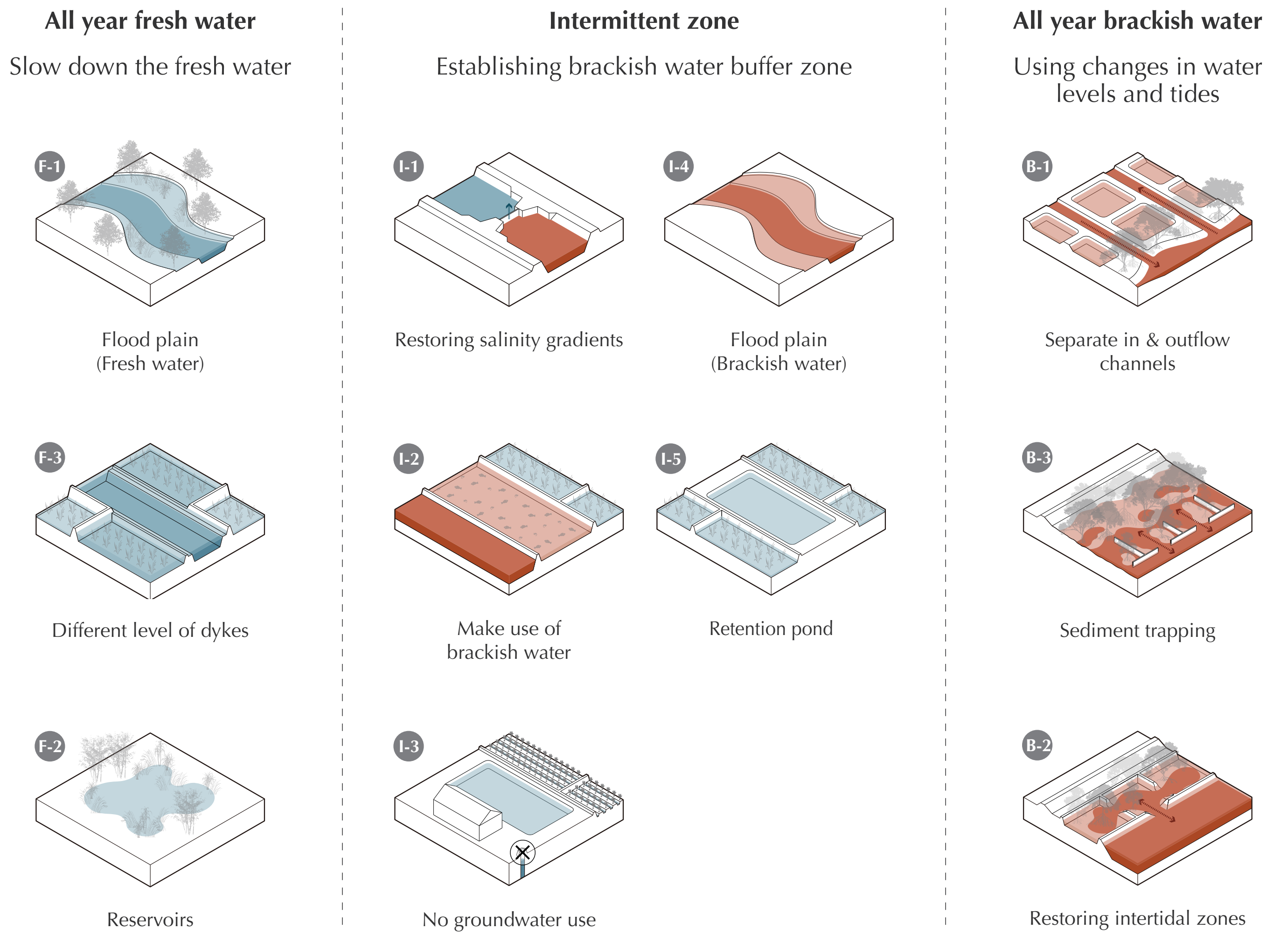
In the first part, there is a freshwater environment all year round. Typically, people here rely on a system of canals to drain the site quickly during the rainy season to stop flooding. However, during the dry season, the whole Ben Tre area suffers from the freshwater shortage. Therefore, it was decided to use the flood plain, reservoirs, and different levels of dykes to transform the upstream area into a large reservoir to store fresh water during the rainy season. This stored freshwater can be used to backfill groundwater and irrigated crops during the dry season, and can also be fed into the river during the dry season to flush out the brackish water downstream.

Intermittent zone

In the second part, due to the confluence of freshwater and saltwater, the salinity of the natural water environment is around 2-6 ppt in the wet season and 5-10 ppt in the dry season. If freshwater production practices are maintained in this area, a large number of sluice dykes and wells need to be built and groundwater extraction during the dry season is required to maintain production. Therefore, the focus here is on reducing the demand for freshwater and increasing the use of brackish water to establish a brackish water buffer zone. By restoring salinity gradients, establishing brackish water flood plains, and making use of brackish water in production, the transition zone will be able to carry more brackish water and slow its development upstream. At the same time, the collection of wet season freshwater through a small-scale retention pond can reduce the application of groundwater and mitigate salt intrusion from groundwater.

All year brackish water

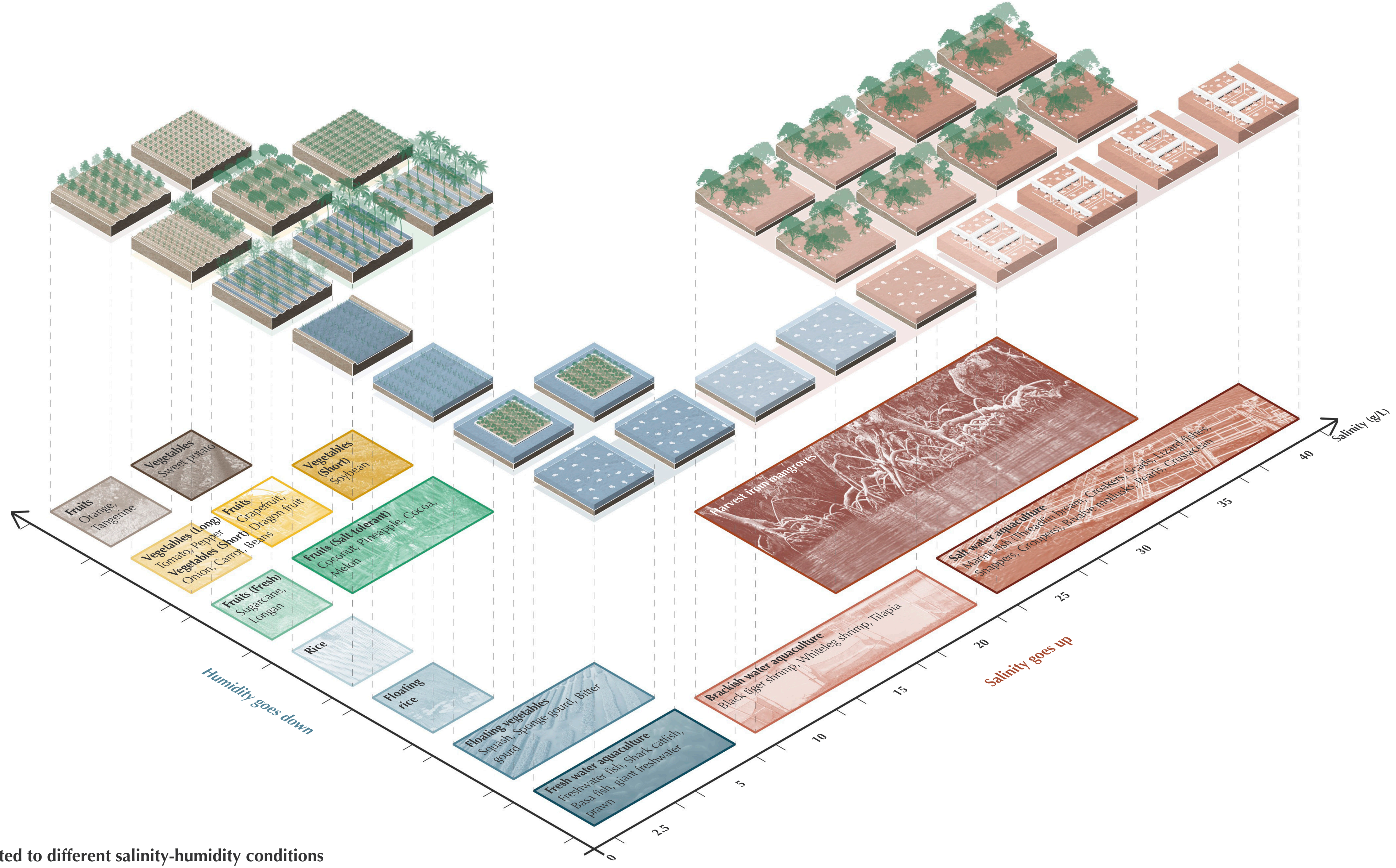
In the third section, mangroves are gradually replaced and more and more of the intertidal zone is enclosed by dykes due to aquaculture development. Therefore, the focus in this area is on using water levels and tides to restore the natural barrier. By opening up parts of the concrete dykes and creating permeable structures it is possible to restore the intertidal zone and trap sediments, which in turn promotes the growth of the bank. In this way, space is provided for mangrove growth and natural restoration. At the same time, through the separation of in & outflow channels, the aquatic production can be connected to the ecosystem, making full use of the nutrients in the tides while improving the water quality and creating a sustainable ecological production system.



6.2 LETTING PRODUCTION AND ECOLOGY FLOW

In this strategy, the project uses a modular approach in order to create flexible production systems that can be adapted to different environments.

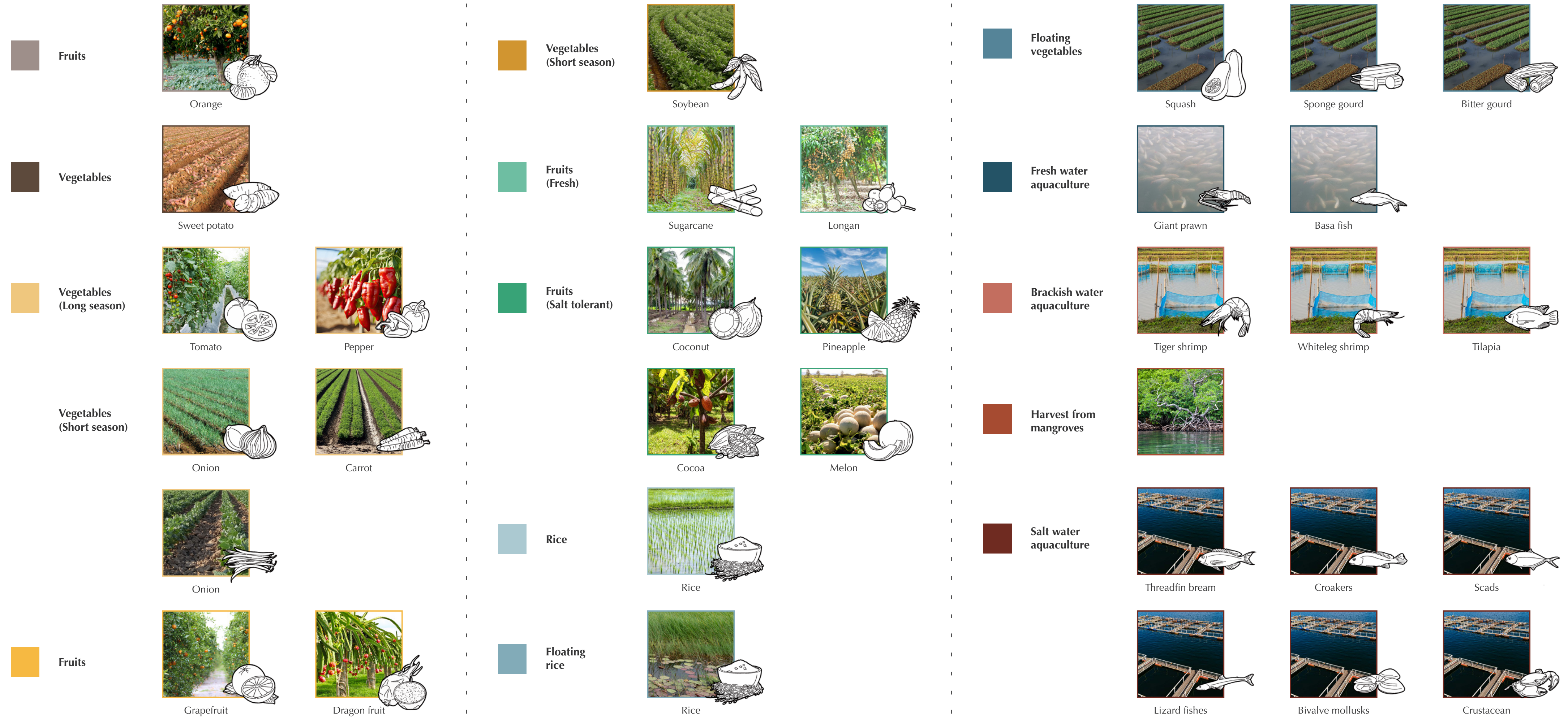
Firstly, the existing production practices were divided according to the salinity and humidity to which they are adapted. As can be seen in the figure on the right, the areas of highest humidity are the various types of aquatic products that are submerged in water all year round, and as the humidity decreases, in order of preference, there are floating vegetables that float on the surface of the water, floating rice that has a very high level of water for some of the time, normal rice that has a low level of submergence, and fruits and vegetables that have a low water requirement and are more tolerant of drought. Of course, there are salt-tolerant varieties such as soybean, coconut, and pineapple among them. At the same time, research has found that only aquatic products can tolerate high salinity, and as salinity increases, the order is freshwater aquaculture, brackish water aquaculture, and saltwater aquaculture. Among these, the mangrove forest is a more special part as the ecological community, which can be used as an ecological habitat to nurture different living creatures, and people can also harvest in the mangrove forest. At the same time, it is more adaptable and can tolerate higher salinity and seasonal submersion.



Production practices adapted to different salinity-humidity conditions

6.2 LETTING PRODUCTION AND ECOLOGY FLOW

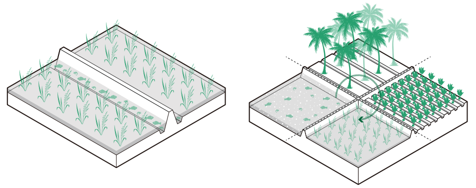
After specifying the crop and species for the monoculture module, the design puts local traditional wisdom into practice. Through crop rotation, Agri - Aquaculture and VAC system, composite modules can be formed. In these modules, it is possible to seasonally transform or industrially integrate crops from different mono-modules. In this way, the resilience of modular production practices is further enhanced.



Traditional Wisdom

Rotation & Agri - Aquaculture

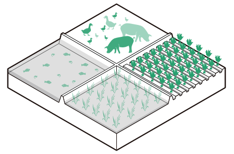
Switching production practices according to seasonal changes in natural conditions.



- Rice & Floating rice
- Rice & Floating vegetables
- Rice & Fresh water aquaculture
- Rice & Vegetables
- Rice & Brackish water aquaculture
- Fruits & Fresh water aquaculture

VAC system

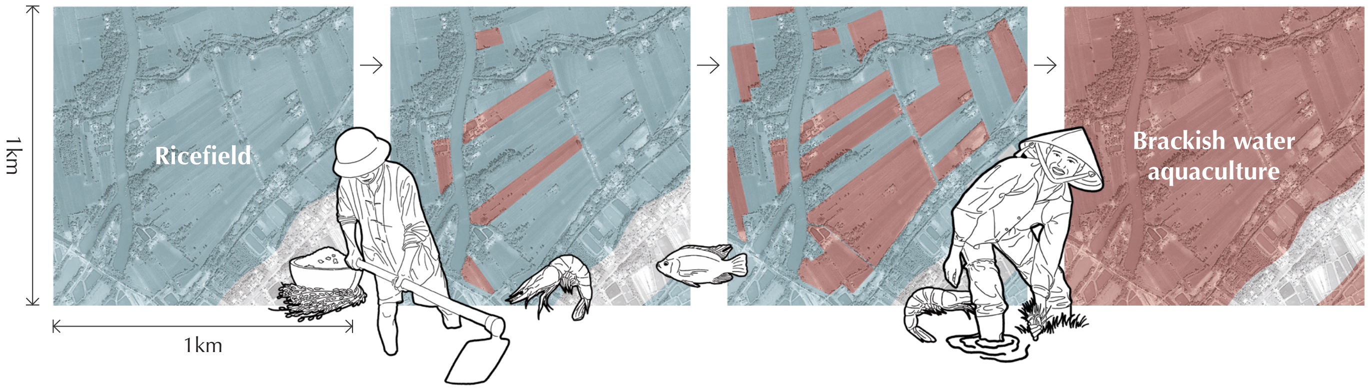
The VAC system is a traditional method of household food production in rural areas of Vietnam. In this system people combine garden, livestock and fishpond in order to achieve income in a year-round cycle. (VAC in Viet Namese is vuon, ao, chuong which means garden/pond/ livestock pen)



- Rice & Vegetables
- Rice & Fresh water aquaculture
- Rice & Fruits & Fresh water aquaculture
- Mangrove & Brackish water aquaculture

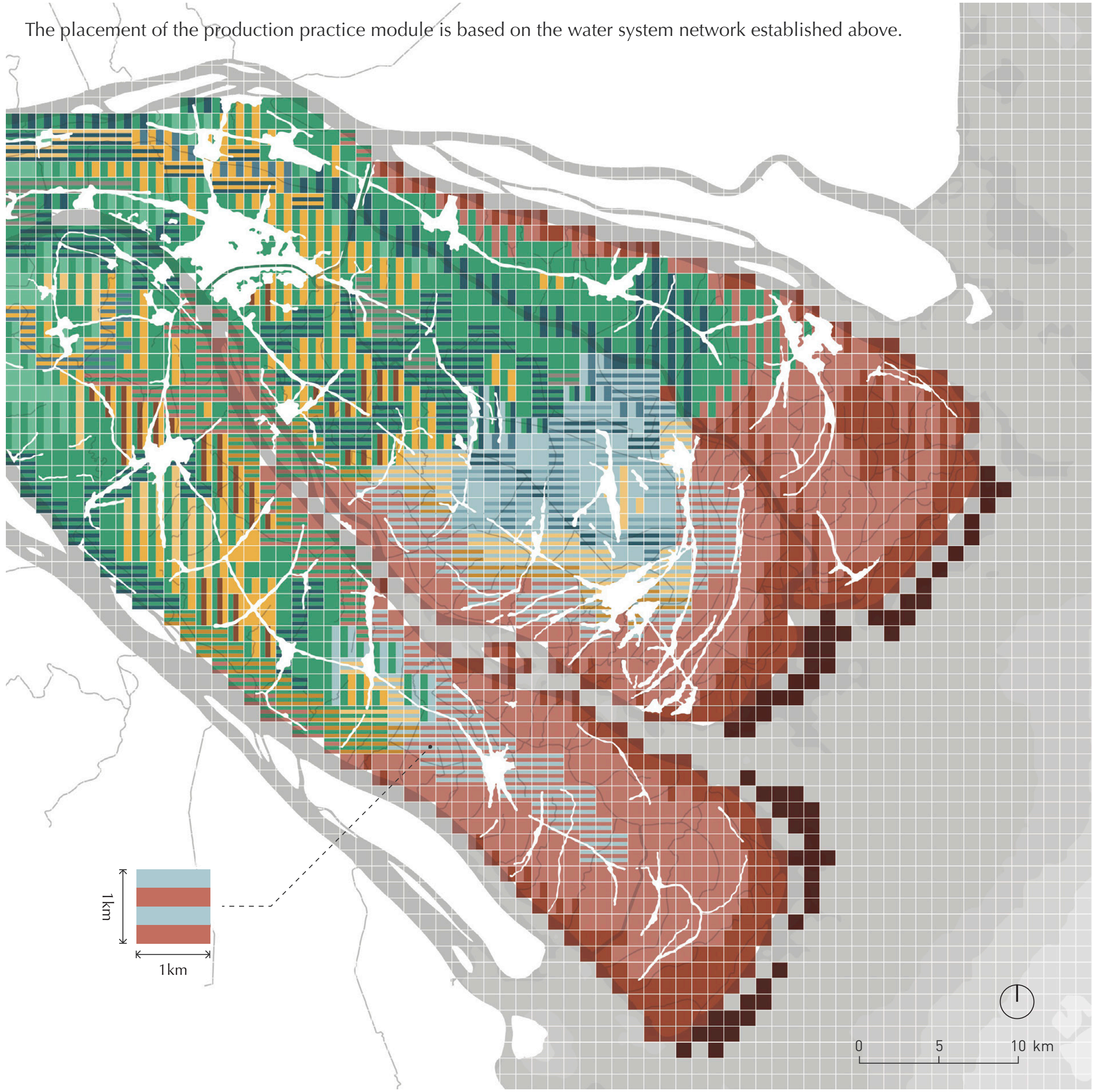
6.2 LETTING PRODUCTION AND ECOLOGY FLOW

In reality, the placement of production practice modules is a gradual process. For example, a site originally engaged in rice production needs to be converted from a freshwater industry to one that applies brackish water. At first, there are some farms started to convert rice fields into brackish water aquatic ponds. Next, through mutual learning among farms, the conversion of the industry gradually expanded. Finally, the brackish water aquaculture module was placed on this site.



The modular production practices are transformable with climate and environmental changes. Once farmers have the toolbox, they can make their own choices about how to transform their production practices according to the natural environment.

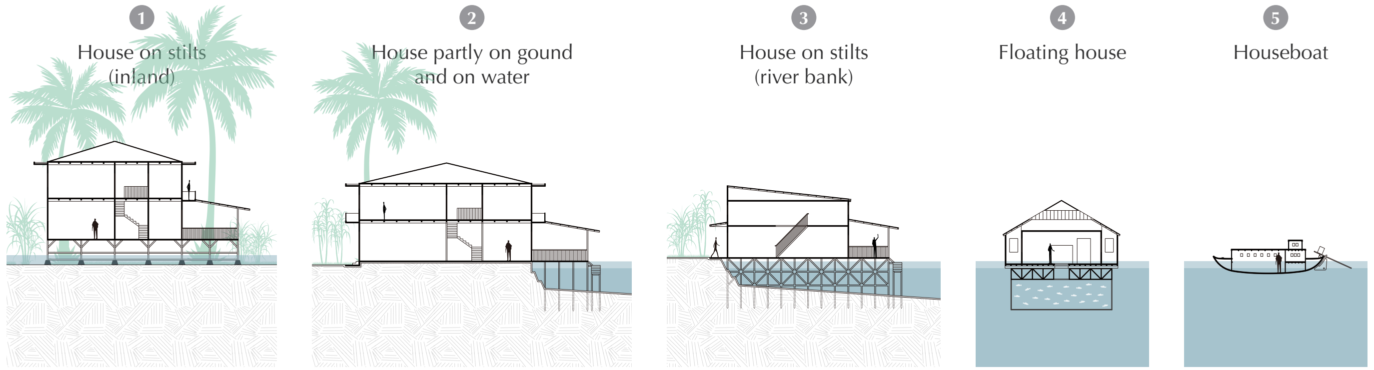
The placement of the production practice module is based on the water system network established above.



6.3 LETTING PEOPLE FLOW

Adaptive housing

Five typologies of adaptive housing have been summarised based on VMD's traditional house types.



Recreation Network

The creation of the recreational network involves the reproduction of traditional features and the integration of existing resources. In this process, the original dykes and canals are used for new functions, and the surrounding landscape is optimized with reference to the traditional landscape. At the same time, the tourist routes are planned to link the various types of productive landscapes (dense tree forests, open farms, and open aquatic ponds) with the existing historical and cultural heritage.

Through the development of tourism, selling points for agricultural products have been created around the recreational network, which also provides a better outlet for neighboring farms. On this recreational network, one can either ride along the roads to experience the different production landscapes or take a small canoe to travel between the waterways and enjoy the traditional VMD landscape with coconuts purchased at the floating market.

Historical, architectural, artistic, religious heritage

Traditional craft village

Tourist attraction

Floating market

Natural landscape

Main tourist route

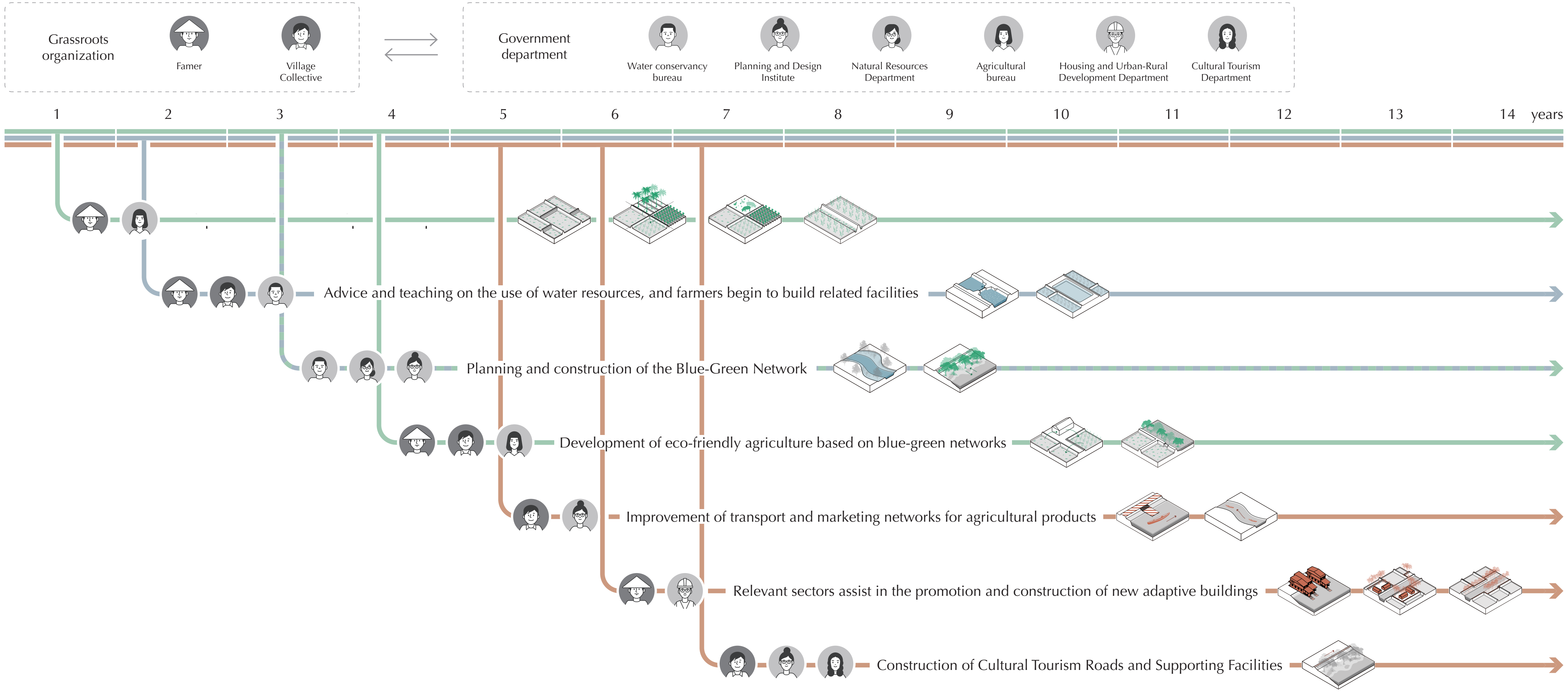
Secondary tourist routes

Boating routes

6.4 PROCESS AND STAKEHOLDER

The realization of these three strategies cannot be achieved in one go, but requires the participation and promotion of different stakeholders. The project has divided these stakeholders into two groups: the grassroots organization and the government department. The government department includes water and natural resources departments, which are smaller in number but have more knowledge and resources. They are responsible for stimulating short-term change and promoting long-term planning from the top down. Grassroots organizations are farmers and village organizations, which are larger in number but have fewer resources. However, they are the ones who are more affected by the problem. Therefore, in the process of implementing the strategies, the decision-making and operation need to ensure the participation of all stakeholders and to achieve collaboration between the top-down and bottom-up roles.

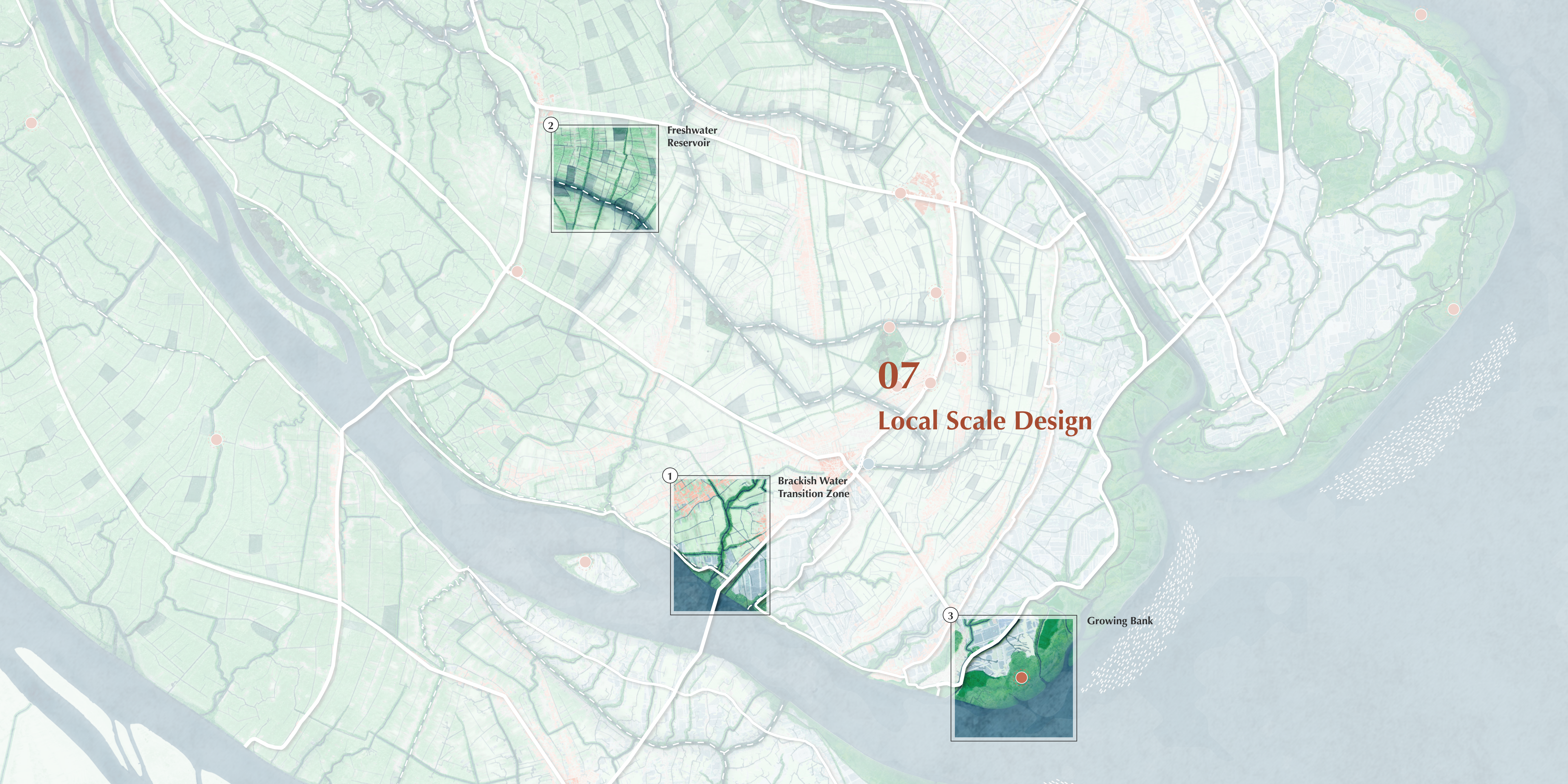
As can be seen in the figure to the right, the concrete steps were implemented progressively over ten years. Each step requires the involvement of grassroots organizations and government departments. For example, farmers are the main actors in the conversion of production practices, with the Department of Agriculture providing the relevant teaching and toolbox. When it comes to building blue-green and recreational networks at a large scale, planning and maintenance are more the responsibility of government departments.



6.5 VISION MAP

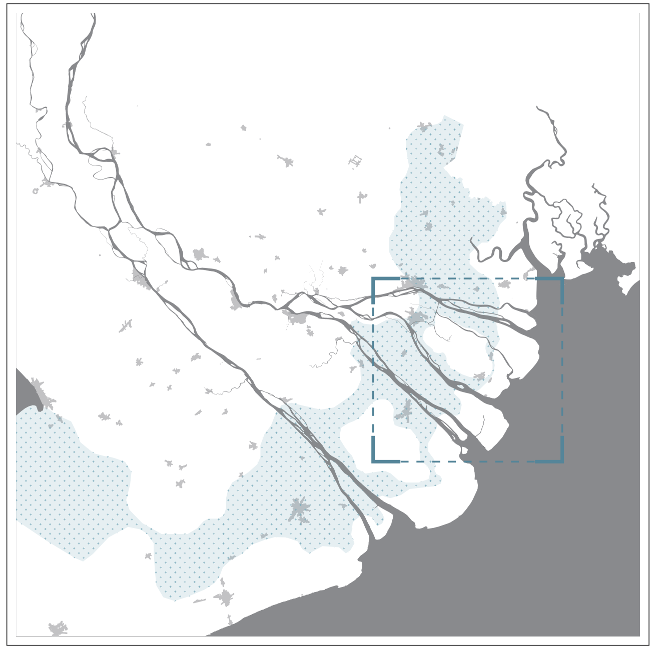
- Orchards
- Rice fields and floating farms
- Mangrove associated aquaculture
- Mangrove forest
- City and village
- Wetland
- Canal with reservoir
- Flood plain
- Sediment trapping structures with new growth mangroves
- Floating aquaculture
- Tourist routes and boating routes
- Historical heritage
- Floating market

07 Local Scale Design

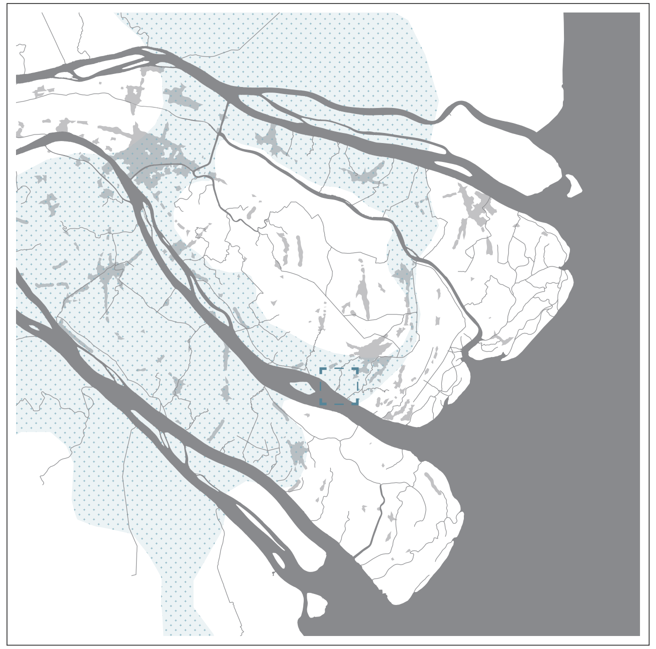


7.1 BRACKISH WATER TRANSITION ZONE

Basin Scale



Regional Scale



Local Scale

Brackish water transition zone corresponds to the Intersection zone in the landscape typology. In this area, there is a freshwater environment in the rainy season and a brackish water environment in the dry season. This type of landscape is mostly concentrated near rivers, so at the local scale, the site near the river has been chosen for in-depth study.

7.1 BRACKISH WATER TRANSITION ZONE

7.1.1 Landscape Characteristics

The landscape of the intersection zone mostly consists of a main river, a main canal and a secondary canal. There is usually a dyke on both sides of the main river, combined with a sluice gate to divide the fresh water from the salt water. The interior of the dyke consists of rice paddies lined up perpendicular to the secondary canal, and the exterior consists of aquatic ponds lined up perpendicular to the dyke. Buildings and trees are mostly around the secondary canal, where the form of tree planting follows the farmland.

At the same time, I have also refined the design language like the monkey bridge, cano, stilt house, and HAPA, which can be used to restore the traditional landscape of the Mekong River in the next detail design.

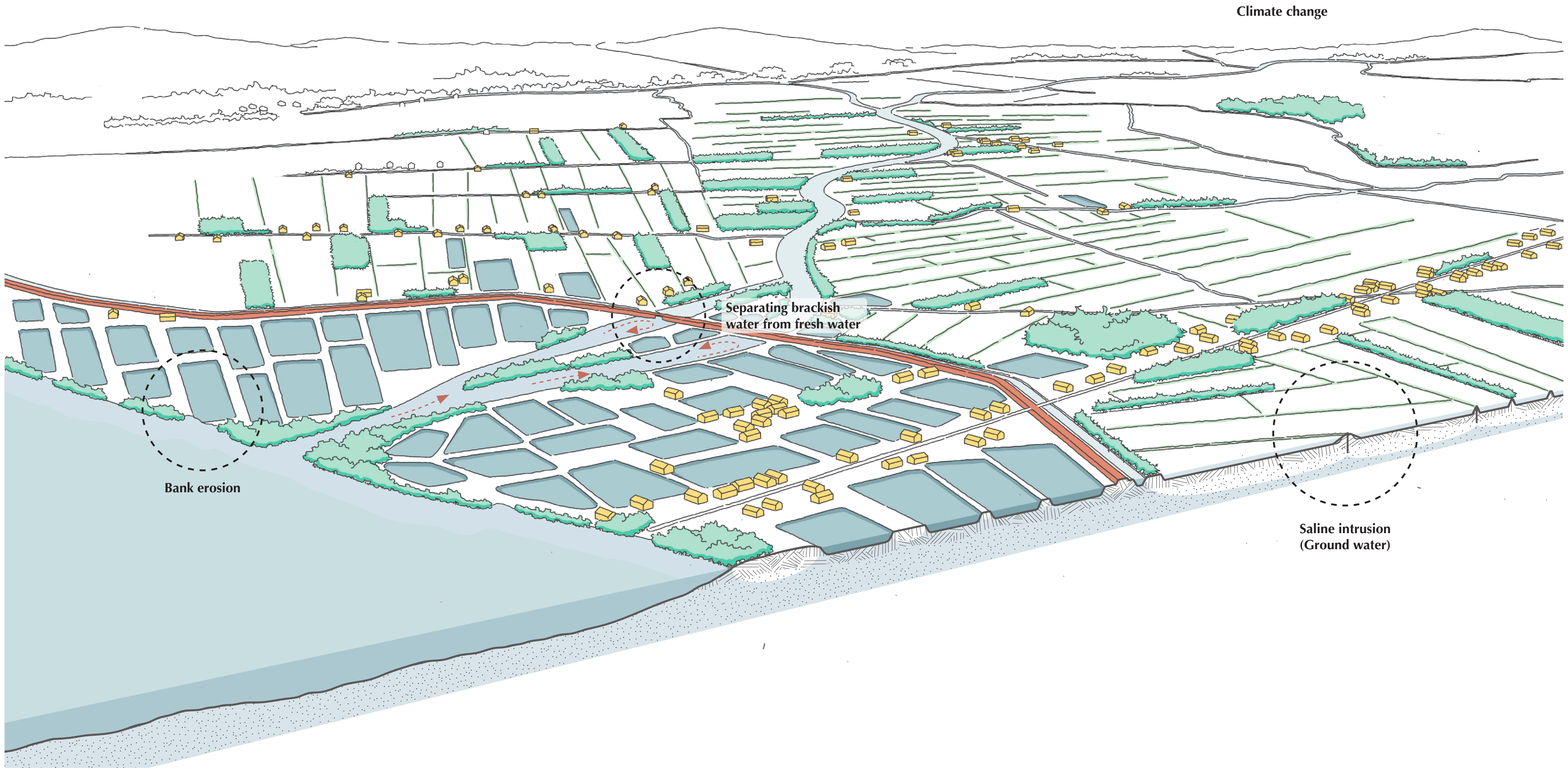
Cầu khỉ ("monkey bridge") is a traditional bridge in Vietnam. These bridges can be found all over the Mekong River, where they hang lightly from 2 to 10 metres above the canals and help to connect small local villages to the main roads. These bridges are made of coconut or bamboo, with or without handrails. There are various explanations as to the origin of the name, some believe it is because it is so difficult to cross a river that you need to be like an agile monkey in order to cross without falling off. Others believe the name comes from the position most people take when trying to cross a river. People bend over like a monkey and hold on tight to make sure they don't fall into the river below. Now, by improving some of the materials, the Monkey Bridge can be constructed to be safer and easier to cross.

HAPA is net cage, usually made of fine mesh, which can be installed in any shallow pond, canal or ditch. They are fixed on poles inserted into the bottom of the pond and are only suitable for shallow water (less than 1.6 metres). In the Mekong Delta, fishermen usually harvest only large shrimp (15g or more), with the smaller ones transferred to HAPA to be left for the next farming season.

7.1 BRACKISH WATER TRANSITION ZONE

7.1.2 Problems

As can be seen in the figure on the right, the sluice gate and the dam divide the fresh water from the salt water. In the rice-growing area inside the sluice gate, farmers need to rely on wells to obtain fresh water from the aquifer for irrigation during the dry season, leading to saline intrusion and reduced rice yields. Outside the sluice gate, some of the aquaculture ponds along the waterfront have been washed away due to riverbank erosion. In the context of climate change, sea levels will continue to rise, changes in river levels will be exacerbated, and the salinity of the aquatic environment will increase. These problems will further lead to a decline in production.



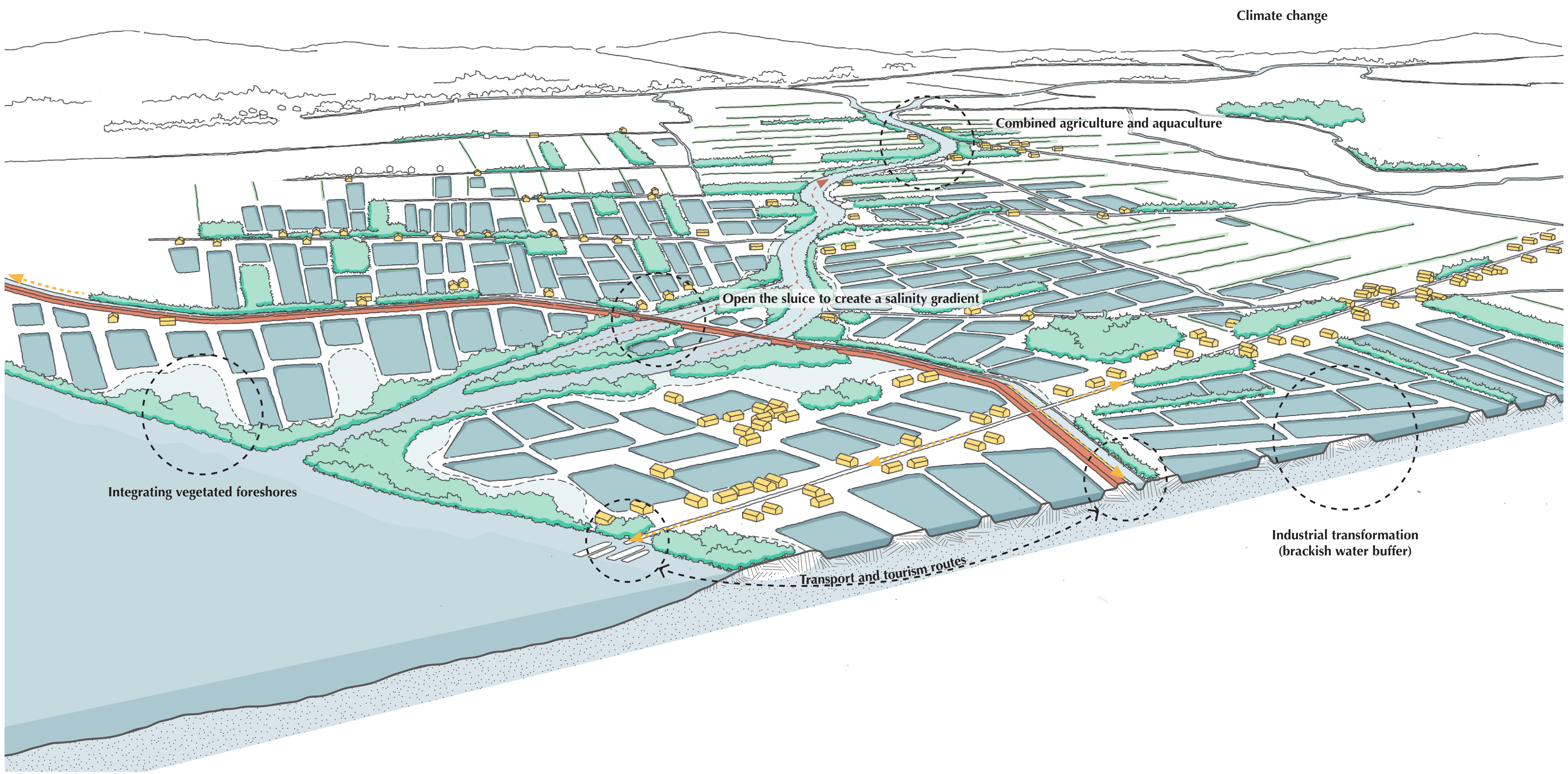
7.1 BRACKISH WATER TRANSITION ZONE

7.1.3 Goals

Therefore, the design goal of the site is mainly to change people's mindsets. From controlling nature to adapt to existing industries to changing industries to adapt to natural conditions. Applying brackish water in this area to creat a Buffer zone.

As a result, the rice paddies closer to the dyke, where the water environment is highly saline, will gradually be converted into aquatic ponds adapted to the brackish water environment. Inland areas with low salinity brackish water only in the dry season will be converted into agricultural aquaculture farms, where the production of brackish water during the dry season will reduce the demand for fresh water and the use of groundwater. On the waterfront, some of the threatened aquatic ponds were removed and the foreshore vegetation was integrated. Here, naturally growing mangrove forests will reduce bank erosion, and the combination of ecology and production will form an AMA system that is mutually reinforcing. As the climate changes, farmers can gradually adjust their industries to the salinity and humidity of the water environment.

With the conversion of the industry and the restoration of the salinity gradient, the use of the existing dykes and sluices will be reduced. Dykes, canals and roads could be utilised for the transport of agricultural products or the development of tourism.

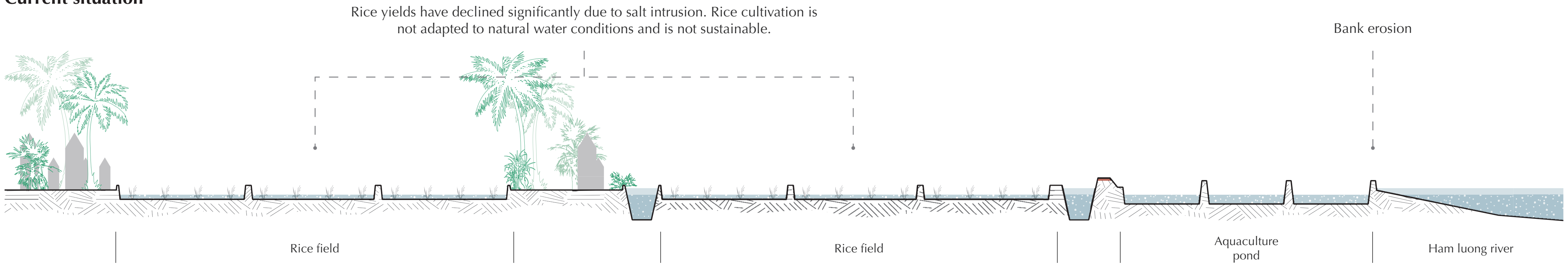


7.1 BRACKISH WATER TRANSITION ZONE

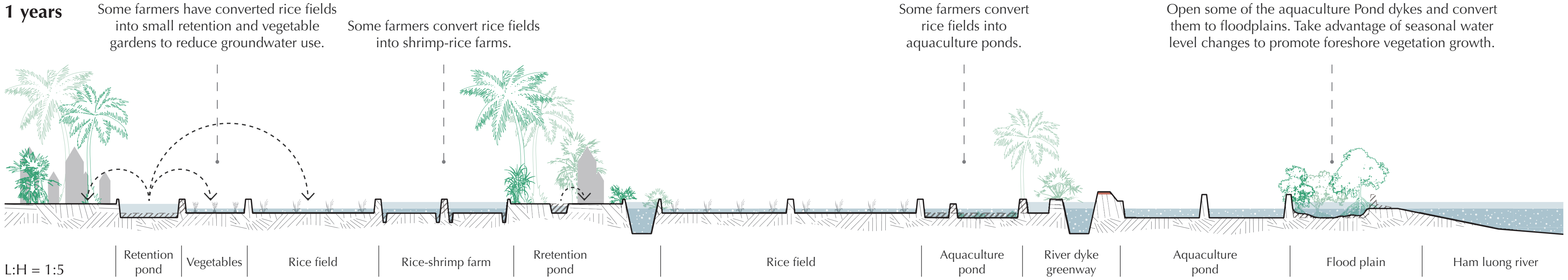
7.1.3 Salinity Gradient Section

The following profiles along the main canal show the changes in salinity from the main river to the inland. It also expresses the techniques and processes used to intervene in the landscape in different areas.

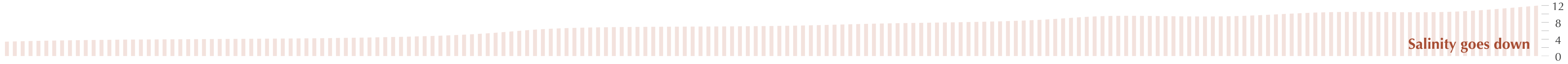
Current situation



1 years

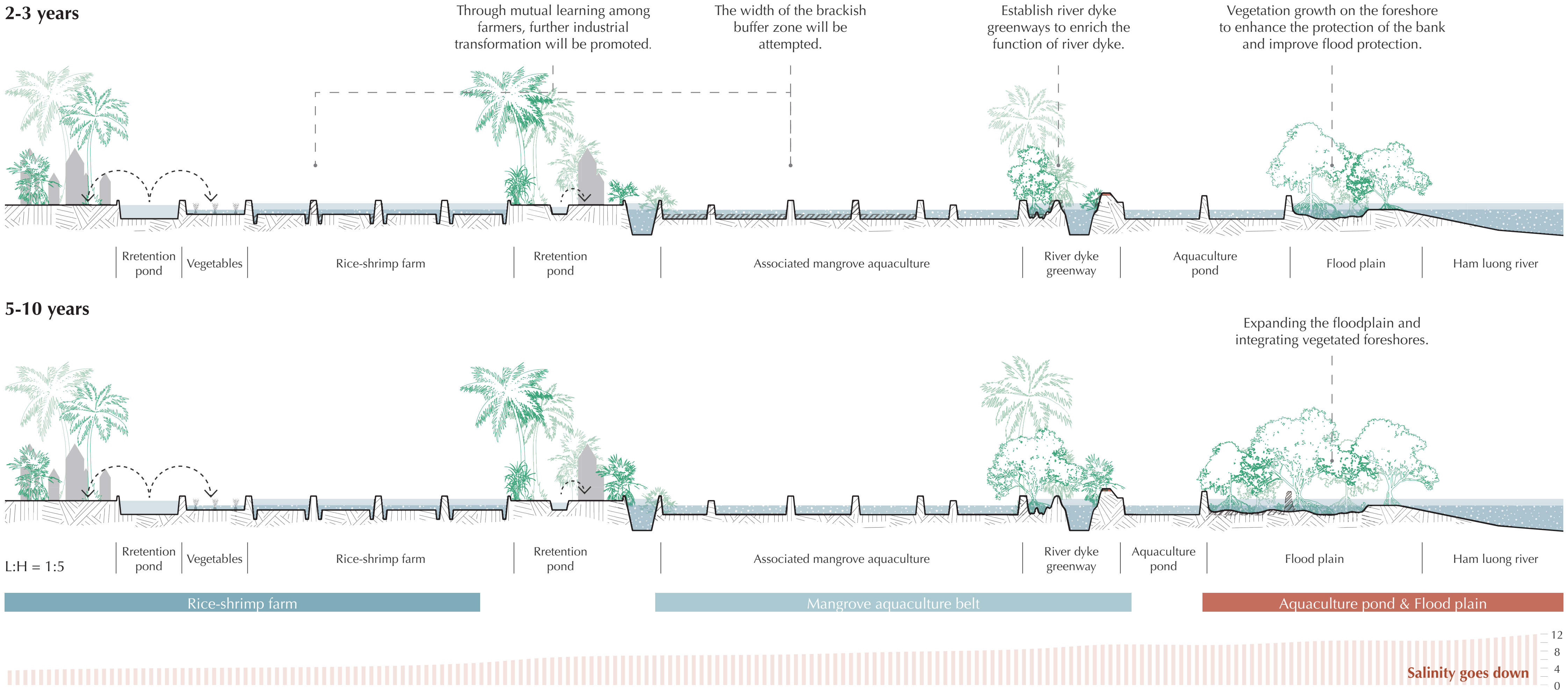


L:H = 1:5



7.1 BRACKISH WATER TRANSITION ZONE

7.1.3 Salinity Gradient Section



7.2 DETAIL 1: MANGROVE AQUACULTURE BELT

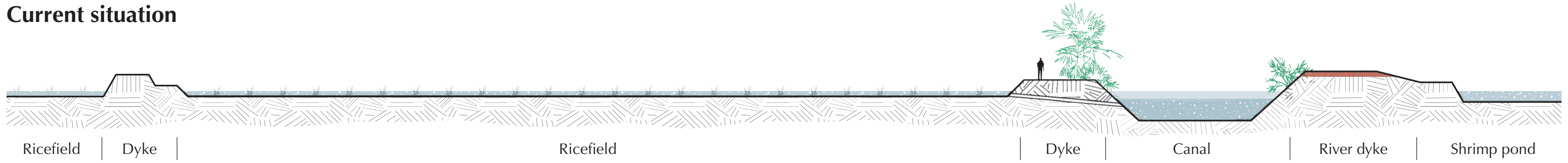
Detail 1 is located on the original dyke next to the main river. Here the original rice fields have been converted into brackish water aquatic ponds, and some small purification ponds. A small floodplain was created on the undammed side of the canal. With natural succession, mangroves and other vegetation have grown here, creating a small greenway and restoring the original landscape of the VMD. The combination of the aquatic ponds and the mangrove ecological communities of the greenway form an AMA system, which makes the greenway not only have aesthetic value, but also can be used to purify water resources.

With the creation of the new stilt house, the monkey bridge and the quay, the greenway, the canal and the dyke form part of the overall recreational network in Ben Tre. Here farmers can sell their produce or provide other services to visitors.

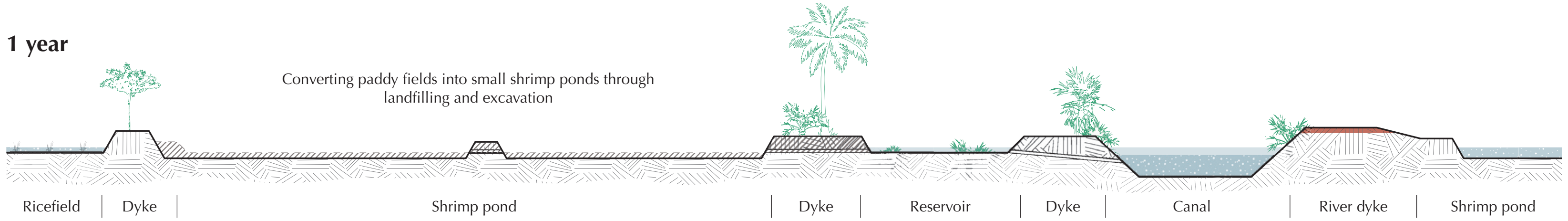
7.2 DETAIL 1: MANGROVE AQUACULTURE BELT

7.2.1 Intervention and process

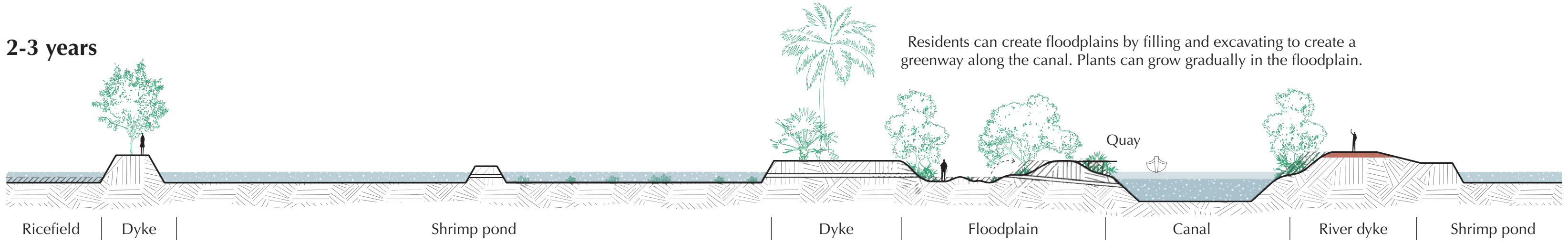
Current situation



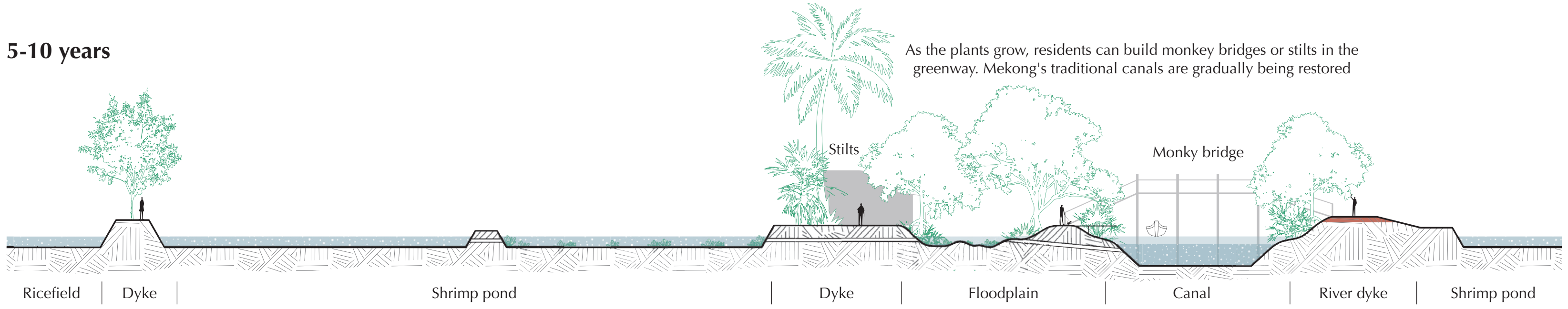
1 year

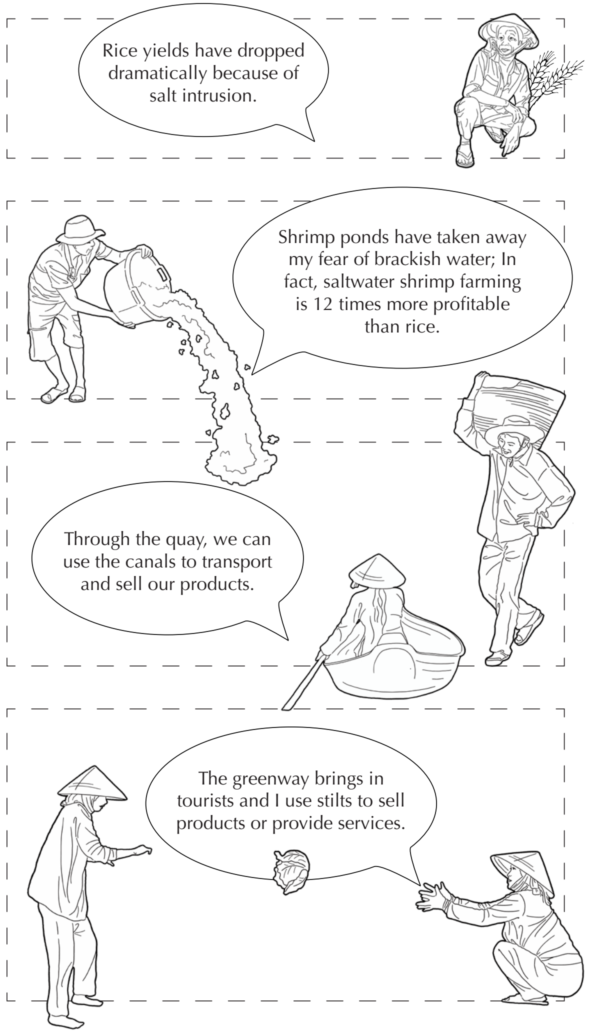


2-3 years



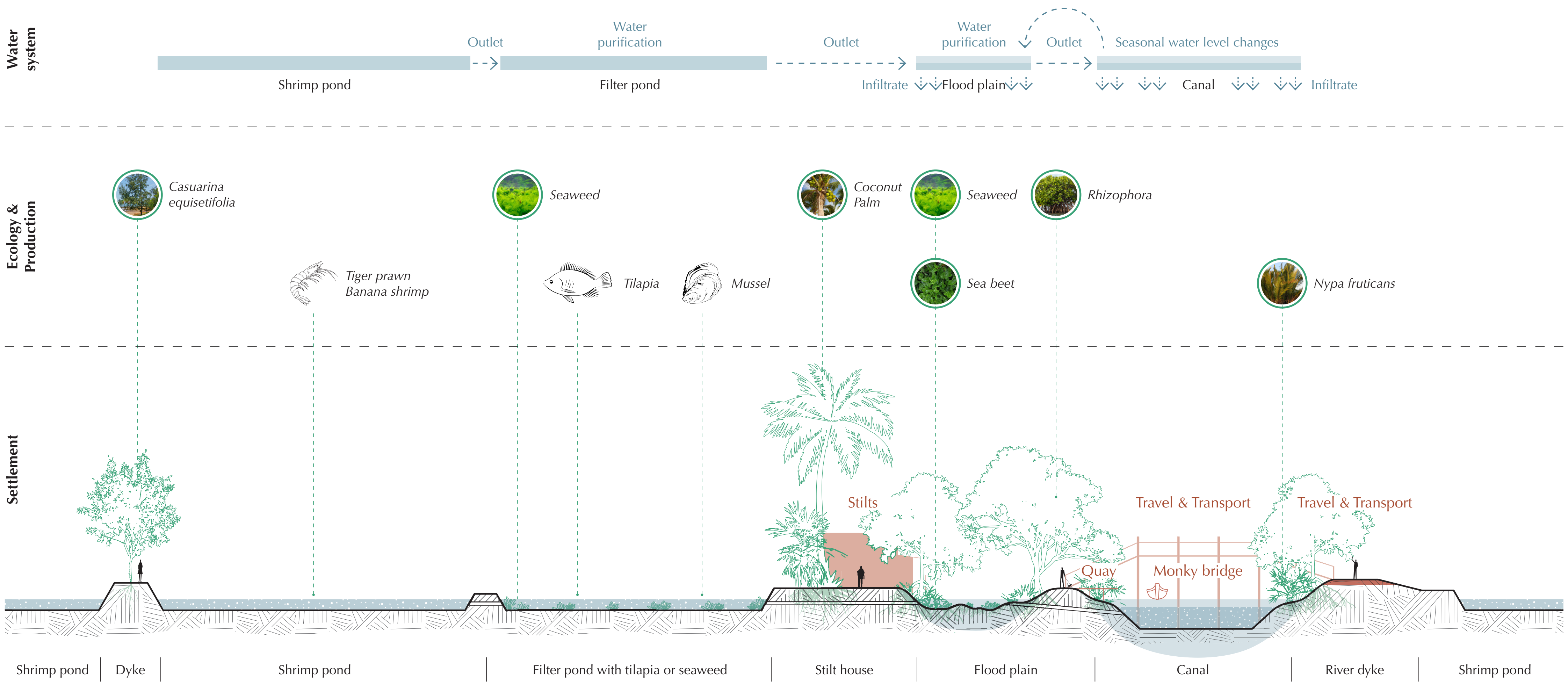
5-10 years





7.2 DETAIL 1: MANGROVE AQUACULTURE BELT

7.2.2 Operation of the landscape system

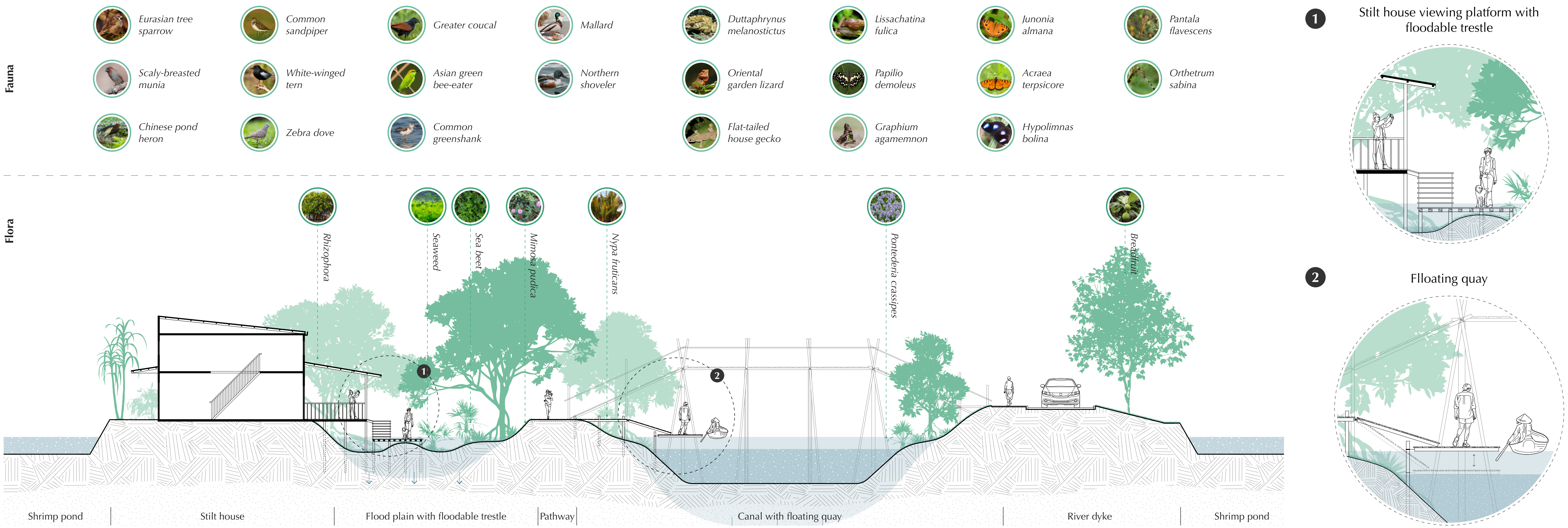


The picture on the left shows the transformed "Mangrove Aquatic Belt" in its ideal state. The section shows not only how the landscape system works within the three layers but also the synergies between the different layers.

In the water system, the water from the shrimp ponds will be discharged into small purification ponds. In the purification ponds seaweed, tilapia or mussel can be cultivated. The purified water will be discharged into a small floodplain on the canal side, where further purification of water resources and backfilling of groundwater can be accomplished, and part of the purified water will be discharged into the canal. When the natural water level is high, water from the canal can also submerge the floodplain and promote the development of natural mangrove forest within the floodplain. This vegetation will help purify water resources. As the natural vegetation grows, the floodplain combines with the canal and dykes to form a landscaped greenway. With the assistance of the government and the tourism department, village organisations can build Monkey bridges and stilt houses to restore the traditional Mekong canals.

7.2 DETAIL 1: MANGROVE AQUACULTURE BELT

7.2.3 Detail of the greenway



7.2 DETAIL 1: MANGROVE AQUACULTURE BELT

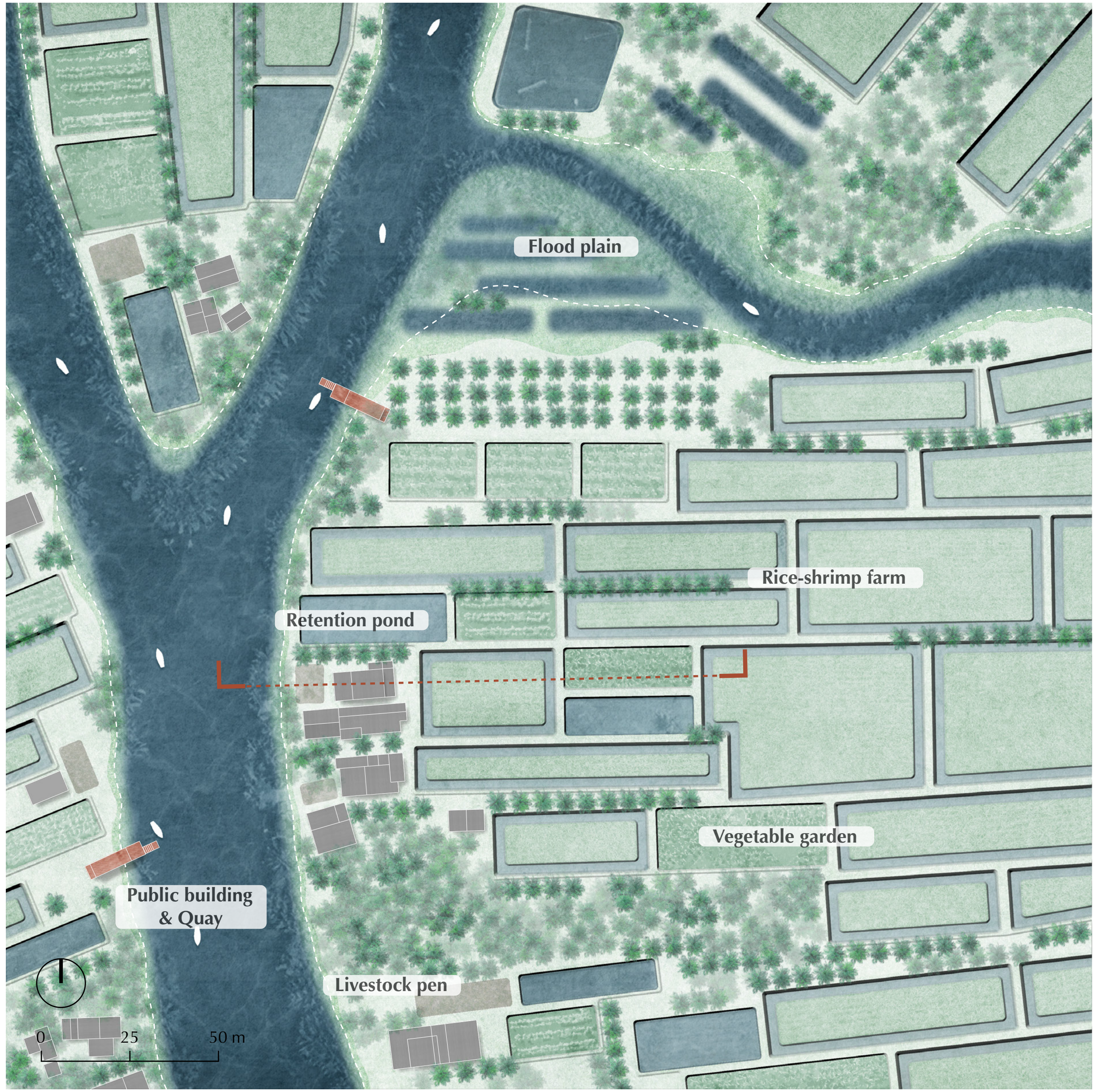
Current situation

7.2 DETAIL 1: MANGROVE AQUACULTURE BELT

Traditional Vietnamese Canal Landscapes and New Functions

7.3 DETAIL 2: RICE-SHRIMP FARM

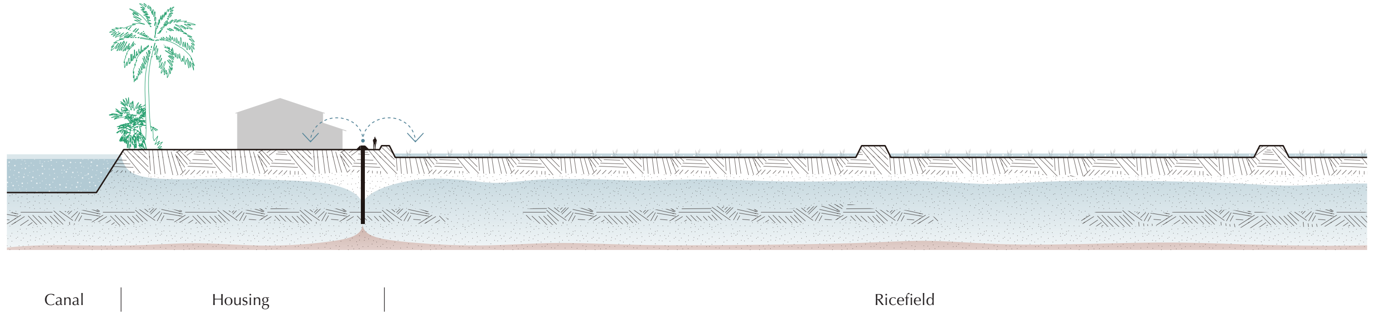
Detail 2 is located further away from the main rivers, in the more inland part. The water environment here is freshwater in the wet season and brackish in the dry season. In order to reduce the demand for fresh water in the dry season, the existing single rice field was converted into a rice-shrimp farm, vegetable garden, and water retention pond. At the same time, integrated agricultural production will be developed in the farm in combination with livestock pens to build a material cycle and ensure year-round income. At the same time, small floodplains and wetlands can be created around the waterways to do water purification.



7.3 DETAIL 2: RICE-SHRIMP FARM

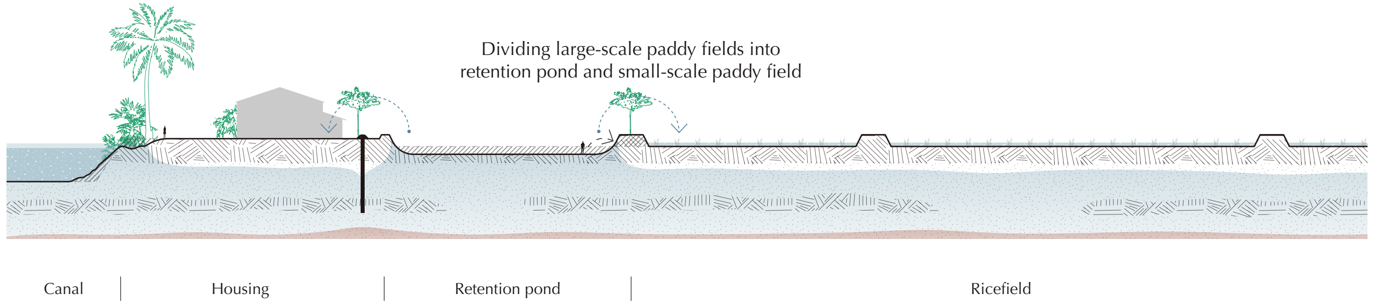
7.3.1 Intervention and process

Current situation



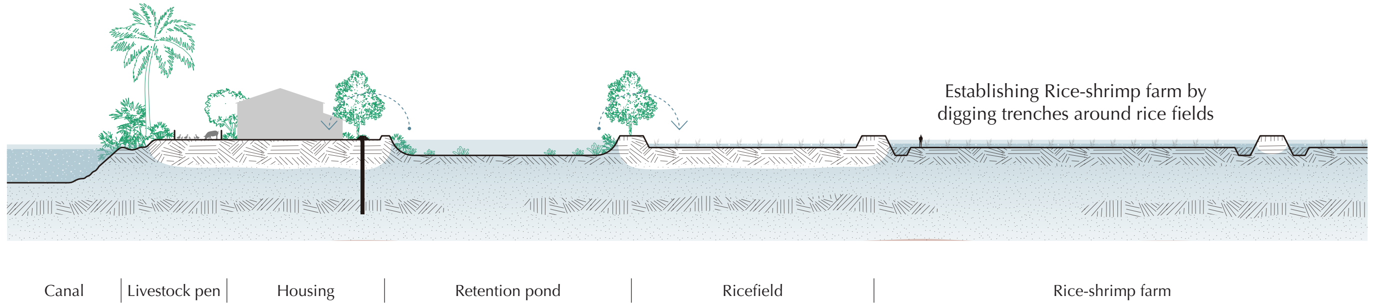
During the dry season, farmers use wells to obtain groundwater for irrigation. However, due to salt intrusion, yields have dropped dramatically.

1 year



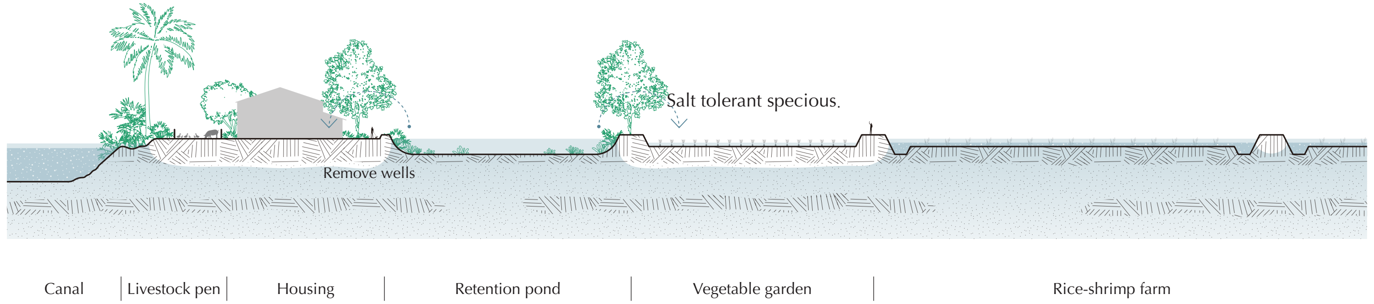
During this phase, farmers began to divide some of the large-scale rice fields to create retention ponds. During the dry season, they can be utilized for irrigation and daily use, reducing the use of groundwater.

2-3 years



At this stage, farmers can dig canals around their rice fields and convert them into rice-shrimp farms, through which they can use brackish water for aquaculture during the dry season, and the need for freshwater will be further reduced. At the same time, livestock pens can be established for integrated agricultural production to ensure year-round income.

5-10 years

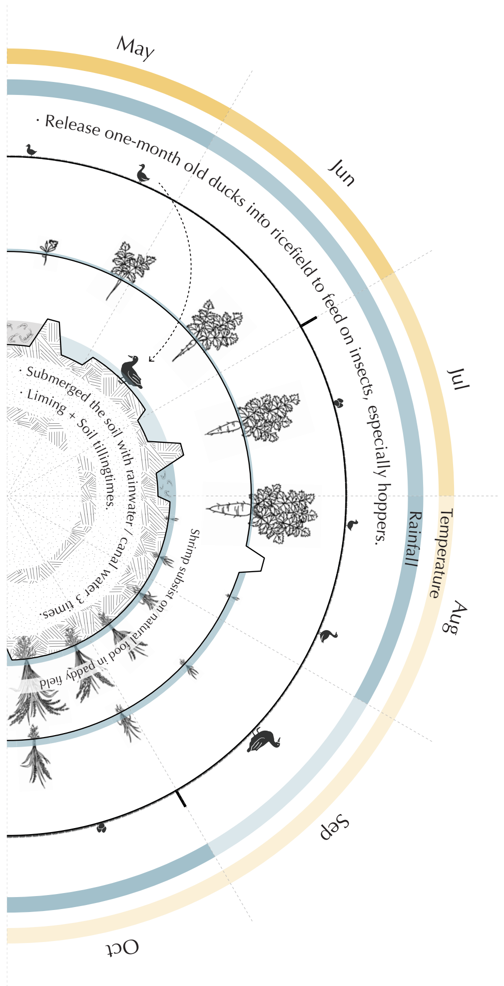


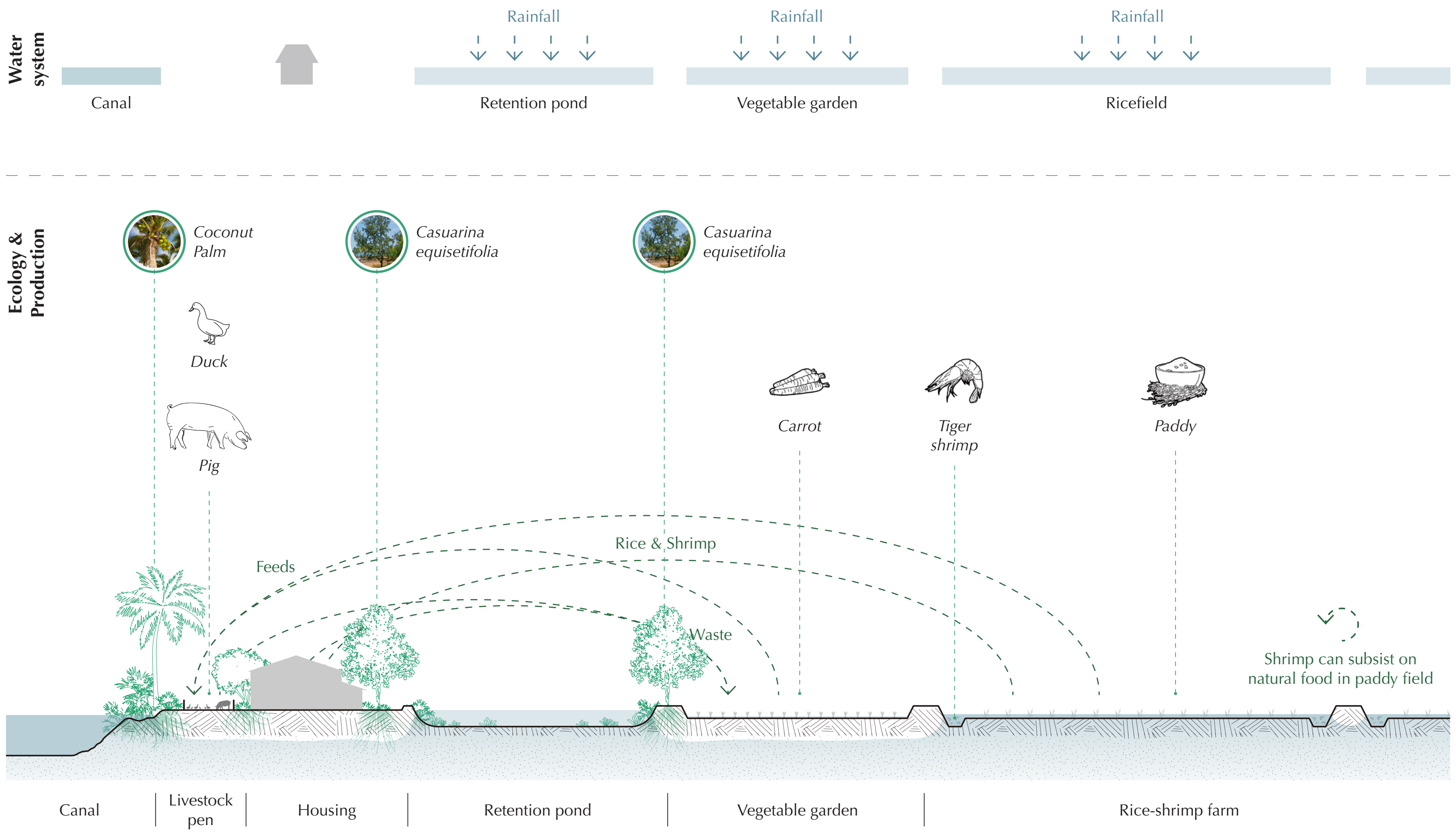
At this stage, if there is a need to further reduce the demand for freshwater during the dry season, small-scale rice fields can be converted into vegetable gardens with salt-tolerant species. At the same time, as the demand for freshwater resources decreases, people can gradually move away from their dependence on wells.

7.3 DETAIL 2: RICE-SHRIMP FARM

7.3.2 Operation of the landscape system

Wet Season (May - Oct)





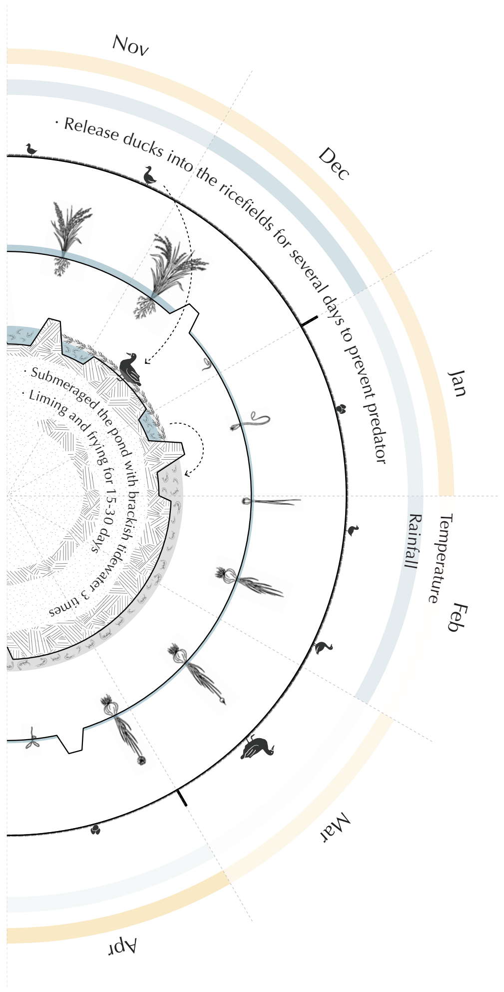
During the wet season, both the vegetable garden and the rice grown in the Rice-shrimp farm are irrigated by natural precipitation. The establishment of the Rice-shrimp farm allows farmers to cultivate aquaculture in the trenches around the rice fields at the same time. In this system there is a material flow between the aquaculture, vegetables, livestock and the farmer's livelihood. In the Rice-shrimp farm shrimp can subsist on natural food in the paddy field. At the whole farm scale, aquaculture, rice and vegetables can provide food for farmers and their by-products can feed livestock. At the same time, livestock and farmers' waste can be used as fertiliser.

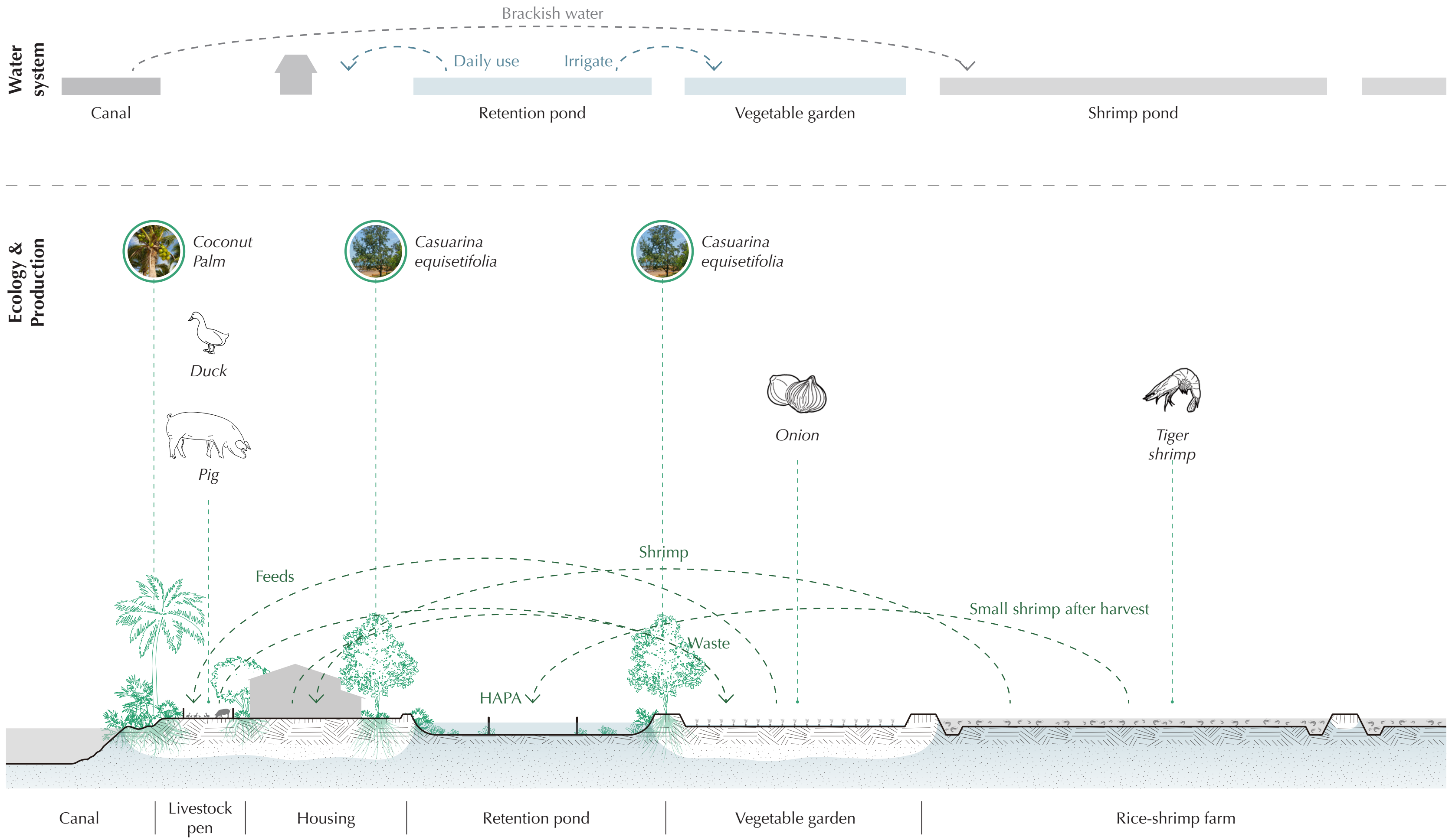
At the same time, livestock farming also serves the seasonal transformation of the industry within the Rice-shrimp farm. The dry season saltwater shrimp harvest is usually completed in May. In June, the farmer will drain the Rice-shrimp farm, flood it three times with rainwater or fresh water from the canals, then liming and tilling the soil. Next, one-month-old ducks are released into the paddy fields to remove insects, especially hoppers. The rice is ready for seeding by July.

7.3 DETAIL 2: RICE-SHRIMP FARM

7.3.2 Operation of the landscape system

Dry Season (Nov - Apr)





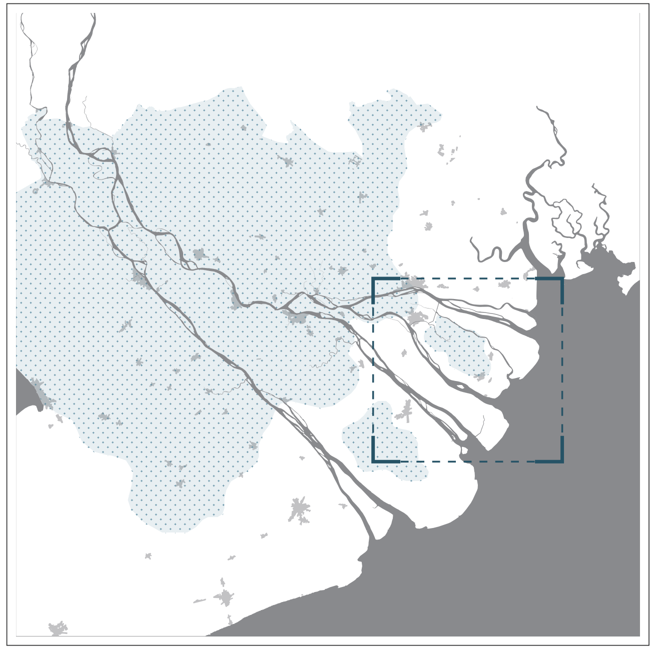
During the dry season, Rice-shrimp farm will use brackish water from the canal for brackish water shrimp farming. Rainwater collected in the reservoirs can be used for livestock feeding and irrigation of vegetables. Meanwhile, when harvesting shrimp at the end of the dry season, undersized shrimp can be temporarily cultured in temporary Hapa in the reservoirs. As in the rainy season, material flows are created during this phase.

Industrial transformation in the dry season occurs mainly in December, after the rice harvest in November, the Rice-shrimp farm is submerged three times with brackish water from the canal, then liming and frying for 15-30 days, and finally ducks are released into the farm for a few days to eliminate shrimp predators. By January of the following year, the farm will be ready for brackish water shrimp farming.

7.3 DETAIL 2: RICE-SHRIMP FARM

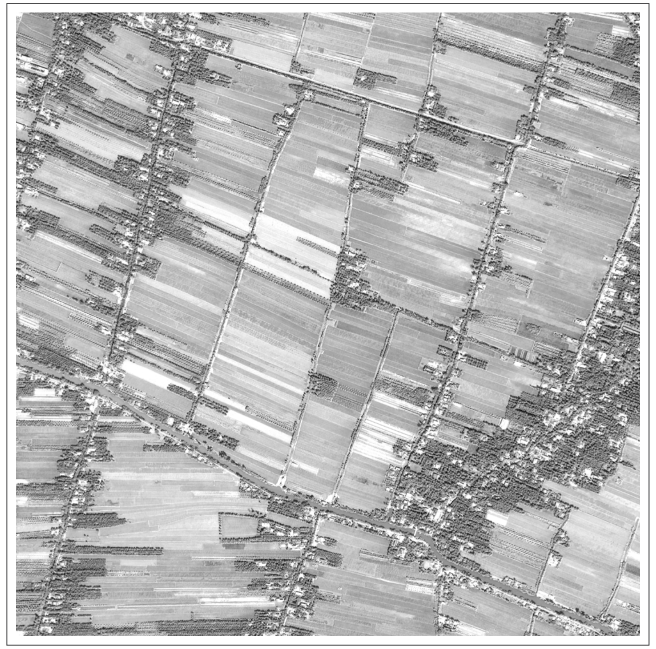
7.4 FRESHWATER RESERVOIR

Basin Scale



Regional Scale

Local Scale



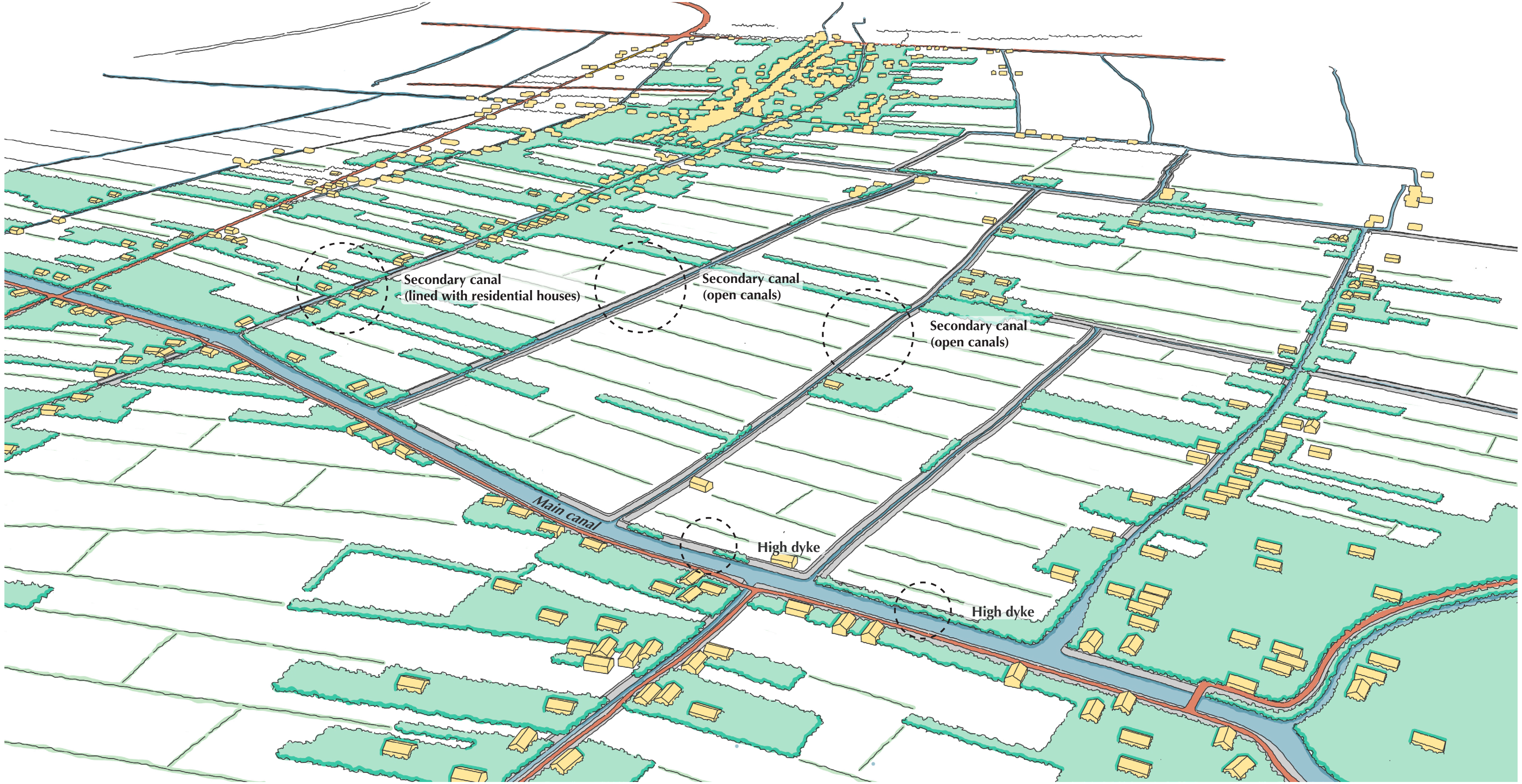
Freshwater reservoir corresponds to the fresh upper zone in landscape typology, where freshwater is available all year round. As this area is mostly used for rice production, the Ben Tre freshwater rice production site was selected for this project.

7.4 FRESHWATER RESERVOIR

7.4.1 Landscape Characteristics And Problems

The landscape in this area consists mainly of primary and secondary canals. The secondary canals can also be categorized into two types based on their landscape type, which are open canals and canals lined with residential houses. Agricultural fields are located between the canals, mostly rice fields with some coconut production fields scattered. In the site, roads are mainly concentrated on one side of the main canal.

The main problem here is flooding, people need to use the canals to quickly drain the fields for production during the wet season.



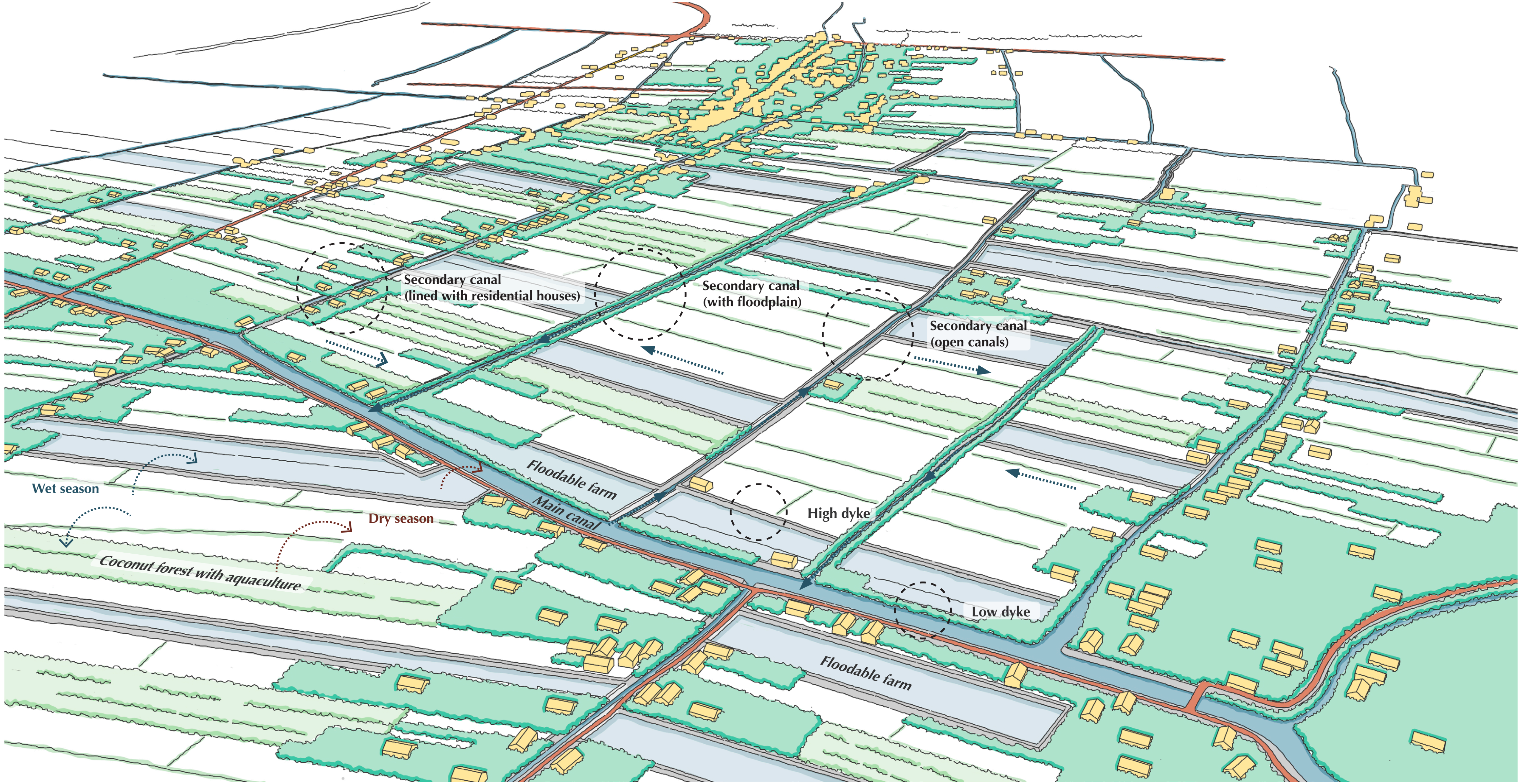
7.4 FRESHWATER RESERVOIR

7.4.2 Design Ideas

The main objective of the design here is to plan floodable areas to collect more fresh water during the wet season.

Therefore, by lowering part of the existing dykes it is possible to make a part of the farmland floodable, and floating agriculture can be carried here during the wet season. Coconut cultivation can also be combined with aquaculture within the high dykes, where water from the farmland can be drained into the coconut farms during the wet season and freshwater aquaculture can be carried out. In the dry season, the water within the low dyke can be drained away along the canal and flow downstream. While water from the coconut farms in the high dykes can be used to irrigate the farmland.

Small floodplains can also be created on both sides of some canals, where vegetation can grow not only to create new canal landscapes but also to act as biological purifiers and shaded spaces, purifying water resources and creating a better microclimate to reduce evaporation of water resources.



7.5 GROWING BANK

Basin Scale

Regional Scale

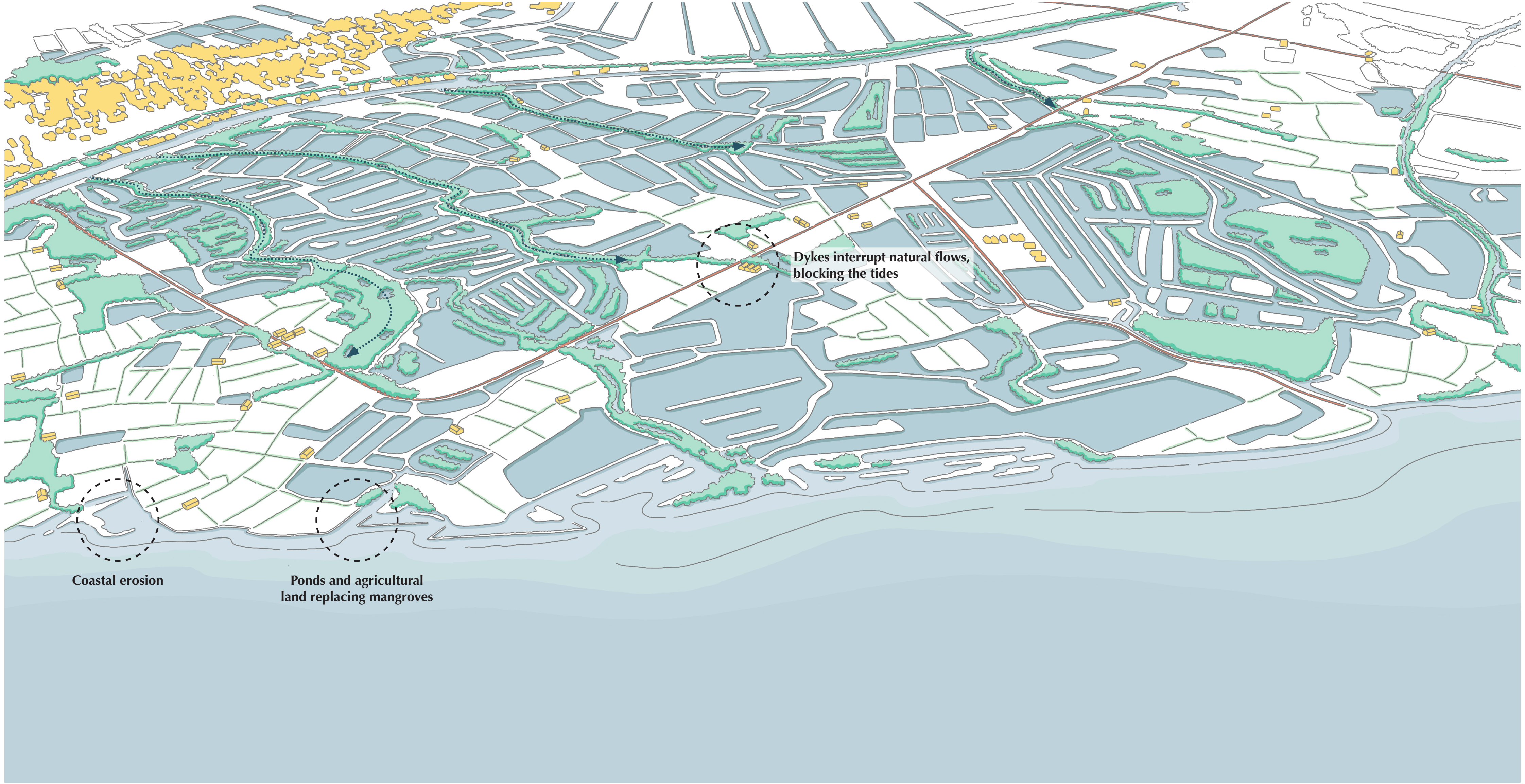
Local Scale

Growing bank corresponds to the Coastal zone of the landscape type, where brackish water is present all year round. For this project, one of the sites in the Ben Tre coastal zone that suffered from severe erosion of the bank was selected for in-depth study.

7.5 GROWING BANK

7.5.1 Landscape Characteristics And Problems

As can be seen in the figure on right, some of the naturally occurring canals remain within the current landscape and a man-made dyke interrupts these natural flows, blocking the tides. As a result of development, the interior and exterior of the dyke is occupied by aquatic ponds and agricultural land. Only a small amount of mangrove forest exists. Meanwhile, as can be seen in the figure, some of the agricultural land along the coast has been washed away.



7.5 GROWING BANK

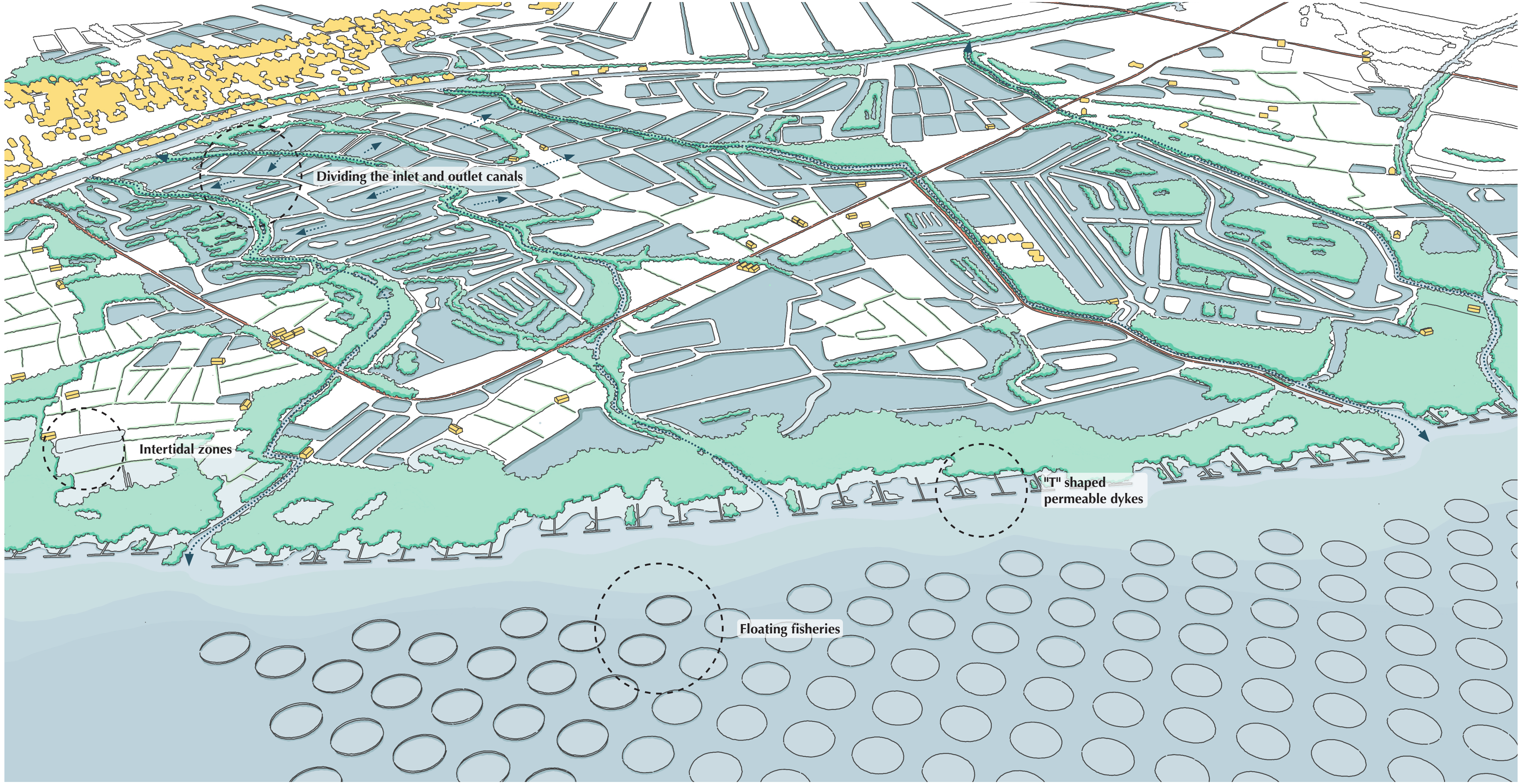
7.5.2 Design Ideas

1. Rehabilitation of intertidal zones and opening of dykes (old dykes on the coastal dykes).

2. Dividing the inlet and outlet canals by controlling the sluice gates of the aquatic ponds (nutrient cycling and disease control)
Inlet ponds: carnivorous fish (e.g. seabass) to control shrimp pathogens -- herbivorous fish (e.g. tilapia)/seagrasses/grassponds (controlling nutrients and oxygen) -- shrimp ponds -- the waste water is introduced into the mangrove forest through drainage system (nutrient cycling).

3. Construction of temporary "T" shaped permeable dykes using bamboo and brushwood to trap sedimentation. Rehabilitation of mangroves in conjunction with restored intertidal areas.

4. Development of floating fisheries along the coast, making full use of the nutrients.



7.6 OVERVIEW

1
FRESHWATER RESERVOIR
2
BRACKISH WATER TRANSITION ZONE
3
GROWING BANK

Part V

Conclusion & Reflection

08 Conclusion & Reflection

9.1 CONCLUSION

SQ1 Understanding: What is the relation between the landscape context and the environmental and spatial challenges? and what are the potentials to address them?

In the project the landscape was understood in two ways.

Firstly the landscape is understood by dividing it into different typologies. Due to the large size of the site and the complexity of the issues faced, a basic analysis of the site was used to classify the basin scale into three types based on the water environment and production practices: 1) Fresh upper zone, 2) Intersection zone, and 3) Coastal zone. Next, an area with all three types and a smaller scale (Ben Tre) was selected for further study.

Secondly, the landscape is seen as a system with three subsystems: the water system, the ecology & production, and the settlement. Each of the three subsystems has different changing dynamics and interacts with each other. The problems are raised because of the mismatches between the systems. When problems arise, local governments are accustomed to intervening in water systems through water management facilities. These facilities, combined with climate change, exacerbated the problems of the water system and further affected the other two sub-systems, triggering more problems. These are the challenges facing the Mekong Delta: 1) Water systems: Water issues and climate change, Rigid water management facilities; 2) Ecology and production: Decline in production, Mangrove loss; 3) Settlement: Houses threatened by natural disasters.

At the same time, the study of the logic of nature's functioning and local traditions revealed a potential to address challenges in each sub-system. These are 1) Water system: Reservoirs, Gradient; 2) Ecology & production: Rich production practice & Traditional wisdom, Natural restorative capacity; 3) Settlement: Traditional settlement patterns.

SQ2 Principles: What strategies and principles can be employed in terms of water management, production, settlement, and ecological perspectives?

Through preliminary analyses and theoretical research, the project focuses on transforming people's mindsets from human-oriented control of natural landscapes to incorporating nature to make changes to people's own production and life, and to build resilient landscape systems. At the same time, through the analysis of tradition, it is found that such thinking is also well reflected in the VMD traditional wisdom. Therefore, by combining traditional wisdom with case studies, the project has developed several design principles. These design principles were divided into three layers, and the design strategies were summarised separately.

From the perspective of the water system, the design strategy is 'letting water flow'. At this level, according to the logic of natural operation, the upstream, midstream, and downstream have different water environments but are interconnected and interact with each other. Therefore, the main objective of the upstream design is to slow down the fresh water, to collect more fresh water in the wet season to cope with the water shortage in the dry season and salt intrusion in the downstream. In the midstream, the design objective is to establish a brackish water buffer zone, which will reduce groundwater use by transforming the zone from resisting brackish water to applying brackish water. In the downstream, the design objective is to use changes in water levels and tides, giving space to natural water systems and shaping the landscape with them.

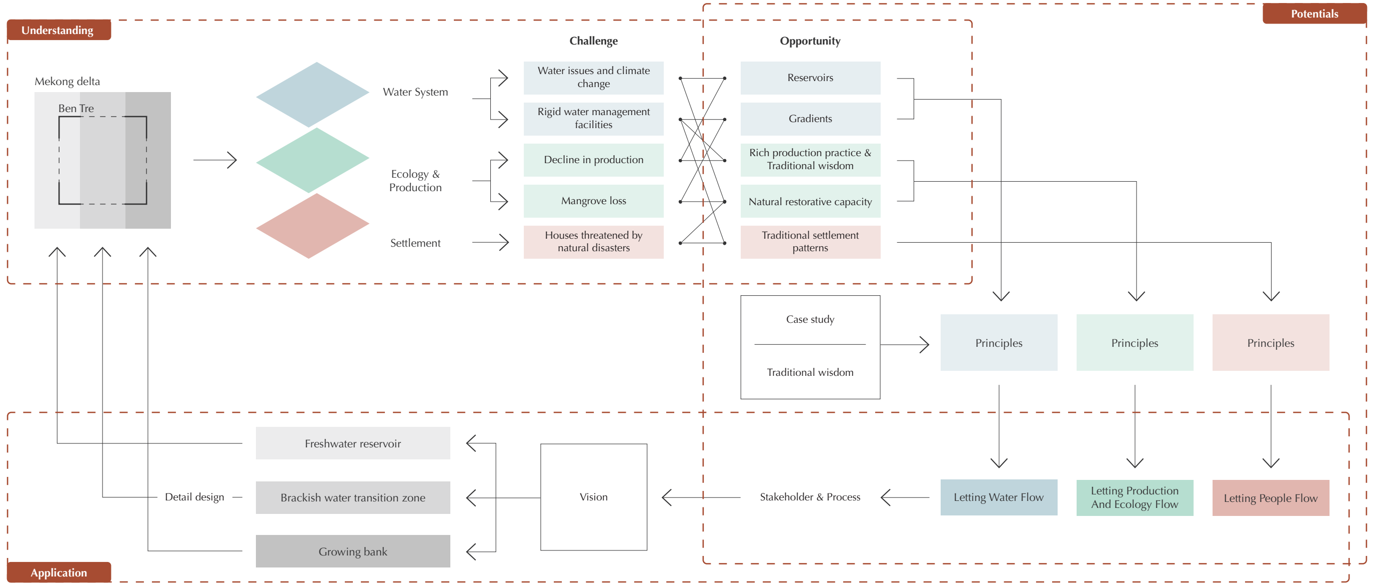
From the perspective of ecological and production practices, the design strategy is 'Letting Production And Ecology Flow'. At this level, the project draws on traditional wisdom and new experiments to develop design principles such as crop rotation, industrial integration, and material recycling. Based on these principles, a modular production system is created that can be changed according to the changes in the natural environment.

From the perspective of settlement, traditional types of housing adapted to different water environments offer opportunities for today's urban and rural development, and they also have a site-specific aesthetic value. Therefore, the project combines the development of adaptive housing with the restoration of traditional landscapes and the development of tourism, and concludes with the design strategy of "letting people flow".

SQ3 Application: How to apply resilient design principles across scales?

By overlaying water systems, ecological and production and settlement design strategies, a regional scale holistic landscape system plan is constructed, this vision also further influences the site specific design.

The site scale design requires greater consideration of the specific characteristics of the landscape, the integration of design strategies at all levels, and the specifics of the changes to be made to the landscape. Therefore, at this scale, the project was designed from the perspective of three landscape types (corresponding to the three types at the basin scale). These are 1) Freshwater reservoir: focusing on storing freshwater during the wet season in conjunction with industry 2) Saltwater transition zone: focusing on the application of saltwater with different salinity levels in conjunction with industrial conversion and the restoration of traditional landscapes. 3) Growing bank: focusing on the integration of industry and ecosystems. The most complex of these, the saltwater transition zone, is designed in detail, showing the specific ways of intervention in the landscape, the process of landscape transformation, the spatial experience of the landscape, and the implementation of seasonal resilient agriculture.



9.2 BACK TO THE RESEARCH OBJECTIVE

How does the project help VMD Landscape to create a resilient landscape system?

Cross-scale design applications

The project divides VMDs into three classical typologies at the entire basin scale. At the regional scale, the three typologies are viewed as a whole, analyzed from the perspective of the three layers, and proposed for design strategies and planning. At the local scale, the design strategies and principles of the three levels are integrated and designed, considering the site's characteristics.

As a result, regional-scale planning integrates the typologies at the basin scale and guides the design of the local scale. Local scale detailing implements regional scale planning and can be generalized within the basin scale. By designing across scales, the project not only provides a long-term plan that is more generalizable at a large scale but also provides a short-term, site-specific way of implementing strategies that promote the creation of resilient landscape systems wherever possible.

Designing for uncertainty

The VMD landscape system is changing in different ways, especially in the broader context of climate change. To cope with this change, the project proposes a modular design strategy. By integrating and categorizing the existing resources and traditional wisdom of the site, the project creates diagrams based on the natural conditions to which each mode of production and type of settlement is adapted. Such diagrams not only facilitate the improvement of the current situation but also provide a toolbox to deal with unknown changes.

At the same time, the transformation of the landscape does not happen instantly. Once people have the toolbox, how they use it is also a process that requires experimentation and adjustment. At first, there may be only a few farms trying to transform the landscape and address existing problems. Gradually, people begin to push for the transformation of the landscape by learning from each other. The extent of how much the landscape should be converted is uncertain and needs to be adjusted gradually to reach a balance, which is also a process of building with landscape.

Division of responsibilities

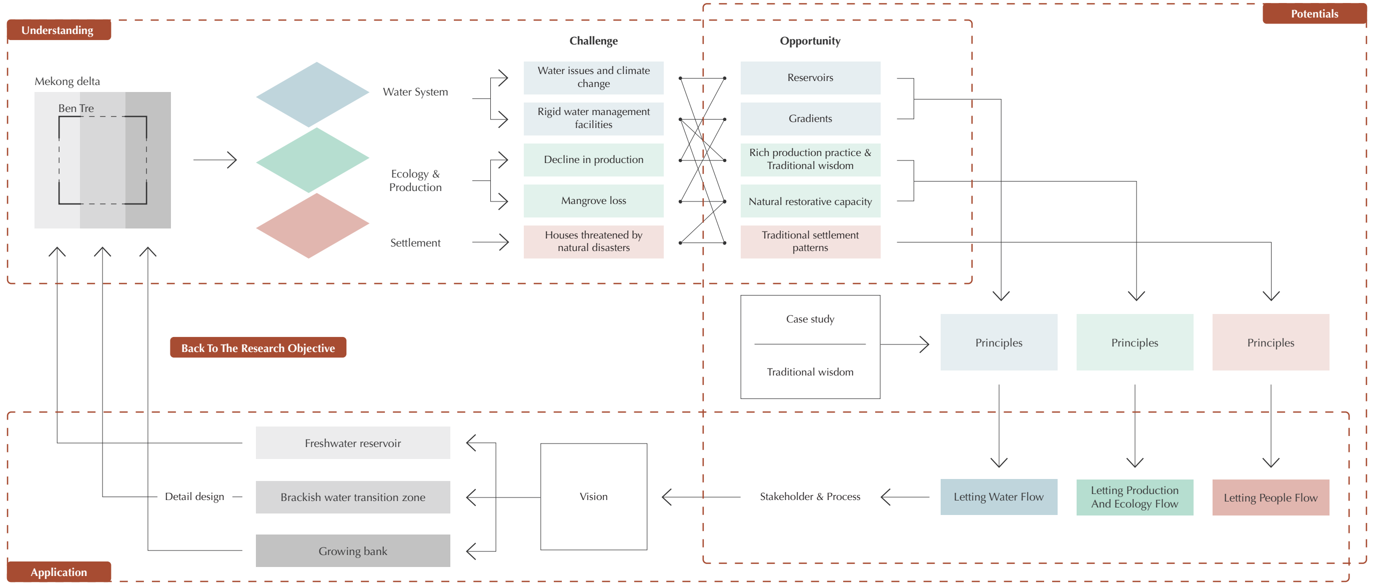
The analysis of historical problems revealed that many problems arose not only from misalignments between landscape systems but also from misalignments between top-down measures and bottom-up needs. Therefore, the project has also planned the steps for the realization of the vision and the division of responsibilities.

The government departments, as the smaller but more knowledgeable and resourceful group, are more responsible for initiating short-term changes and realising long-term plans, such as the teaching of agricultural methods, the building and maintenance of public infrastructure, and so on. The more numerous grassroots groups, farmers and village organisations, have more autonomy once they have acquired the knowledge. Under the planning framework, they can rely on the infrastructure to gradually promote industrial conversion and village development. Therefore, under such a framework, the participation of stakeholders in the decision-making and operational processes is guaranteed, which in turn creates a balance and unity between top-down and bottom-up approaches.

A change of mindset

The project's root lies in a change of mindset from fighting against nature to building with it.

The fact is that nature will continue to function according to its own inherent logic, regardless of whether humans are involved or not. Therefore, in the process of human-nature interaction, the human purpose should not always be the first thing to be discussed. When humans' needs conflict with nature, they should not simply seek effective and simple solutions to fight nature but should find ways to creatively participate in the natural process and use the wisdom of nature to address the problem. When humans start to seek changes in themselves to adapt to climate change, this may not be an efficient way in the short term, but in a long-term perspective, it is the only way to achieve a harmonious coexistence between human beings and nature.



9.3 REFLECTION ON ASPECTS

Lessons learned

- **Nature's role in shaping the landscape**

During the project, I realized that the role of nature in shaping the landscape includes not only the growth of vegetation but also the alteration of the terrain, the formation of productive landscapes, and so on. This role can be referred to as nature's intelligence, shaping the landscape while also being a low-cost sustainable way of solving problems. Therefore, taking it into account and allowing space for nature to play its role in the design is a more sustainable approach.

- **Learning from tradition and improving on the current situation**

The Mekong Delta has a long history of living with water and has left behind a lot of traditional wisdom. This traditional wisdom is often time-tested and well-adapted to the local characteristics. At the same time, there are many innovative solutions to current problems. Therefore, when designing, traditional wisdom should be combined with new experiences and optimized for the existing environment. To achieve respect for history and culture, to solve existing problems, and to cope with the uncertainty of the future.

- **Realisation of the landscape design**

In reality, landscapes are often associated with various stakeholders, hence requiring consideration not only during the design phase but also throughout the implementation process. Therefore, designing from different perspectives, providing temporal planning and division authority for the realization of the design is a way to promote the unification of top-down and bottom-up perspectives.

- **Iterative process**

The design of a landscape is not a one-direction process. When I make preliminary analyses, I usually plan and imagine the progress afterward, and as I study the site more deeply and advance the design, I need to turn around and adjust the preliminary analyses. Therefore, this also requires me to jump out and think in a different direction at the right time during the project. In this project, I experienced the impact of the specific design on the planning, and when I tried to advance and adjust from both directions, the project gradually became more unified and rational.

At the same time, there is also an iterative process in the practice of the project. The planning part of the project has planned and forecasted patterns of production practices at the regional scale, based on natural conditions. However, the results can in turn influence the planning when it is carried out in practice. For example, in the process of industrial conversion in the middle streams, the transformation of specific farm production patterns can be used as an experiment on the required width of the brackish water buffer. Based on this result, planning on a regional scale can be optimized. Thus, planning is not accomplished at one stroke but also needs to be altered on a case-by-case basis during practice.

Research and design

Research and design are two different ways of thinking about problems in a project. Research includes theoretical study, data collection, and multidisciplinary study. In the research process, I need to learn and integrate theories of landscape design to propose the theory of building with landscape, and at the same time, I need to explore the reasons for the VMD's water problems, understand the process of specific agricultural production, etc. The design is more focused on the creative application of the knowledge gained from the research in the context of a real situation.

During the project research and design were influenced and reinforced by each other. The research on how the water system works guided my design. So, I decided to restore the salinity gradient in the middle stream and create a brackish buffer zone, which further posed a problem for research about how to apply brackish water in agriculture. Then, I needed to study existing and traditional models of production practices and put the findings back into the design. After that, during the design process, experimentation and adjustment of the width of the buffer zone can further enhance the development of the research.

How the method helped me

Among the methodology, layered approach and design through scales have helped me the most. They gave me a clear way to understand, analyze and design complex landscape systems.

The layered approach allowed me to understand landscape systems in three layers. In this way, I was able to analyze and try to solve problems in the water system as a whole and optimize the other two layers on this basis. By splitting and overlapping the layers, I was able to optimize the landscape system by achieving balance and harmony between the subsystems.

By generalizing the typologies of the site within each scale. I was able to extrapolate the design at a smaller scale and then project it to a larger scale. At the same time, the change of scale also brings a change of perspective, in the regional scale is more about controlling the whole and proposing a more general planning, while zooming in to the local scale is more about the specific operation and the spatial feeling of the landscape.

Limitation

Due to time constraints, I did not do a field trip, which made it difficult for me to do research and design on a small scale. I tried my best to get the real feelings of the local residents from the news and interviews, but this is not first-hand information, which makes it hard for me to go deeper into the details of the design.

At the strategy level, I try to enhance the adaptability and resilience of the project through modular production practices and housing types. At the design level, I also try to enhance its specificity through the classification of typologies. However, in a real situation, the implementation of strategy and design needs to be examined and analyzed case-by-case. This project can only provide a methodology, toolbox, and examples.

Future research

For future research, small-scale site-specific field experiments could be selected. Explore the effects of the toolbox in specific uses and optimize the process of landscape transformation. At the same time, this research can also increase the participation of local inhabitants, so that the designers can think and design more from their perspective, and the relevant experience of farmers can further enhance the relevance and practicality of the design.

9.4 OUTLOOK

The project provides a landscape-based and resilient solution to the current problems facing the Mekong Delta in Vietnam. Unlike the previous rigid management of water systems, the landscape approach builds systems that are more adaptive and resilient. In this project, the establishment of a resilient landscape system is based on the water system. Based on the resilient water network, it provides generic strategies for production and residential areas. The new landscape system can not only address the problems of the present, but also flexibly respond to the unknown future, and at the same time serve as an example to influence the establishment of resilient landscape systems for similar sites.

Overall, the project aims to promote and advocate a shift in thinking from fighting against nature to building with nature, and to provide guidelines, toolbox, and examples for this process.

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