CULTIVATING COMMONS

Reclaiming the Dike-fishponds for People and Ecology in Pearl river delta area

Colophon.

Cultivating commons

Reclaiming the Dike-fish ponds for People and Ecology in Pearl river delta area

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Birdview of Dike-fish ponds, 2023



Photo of Dike-fish ponds, 2024

I would like to express my heartfelt gratitude to my university for giving me the opportunity to study in the Landscape Architecture program. This field has always been a deep personal interest of mine, and being part of it has been an invaluable experience. I am sincerely thankful to my parents and family for their unwavering support and encouragement, which enabled me to continue my academic journey.

I would like to extend my deepest thanks to my mentors. Inge, who was not only my first studio tutor but also my graduation project mentor, has played a crucial role throughout these two years. From her, I learned not only professional knowledge in landscape architecture but also a positive, dedicated attitude toward life and study. Inge guided me with care and patience—not just as a teacher, but also as a mentor and a friend—and I am truly, deeply grateful for her support.

My second mentor, Daniele, provided me with meticulous and professional analysis based on my site from the very beginning. His expertise in spatial thinking and analytical frameworks helped me build a much stronger foundation and broadened my perspective in dealing with complex issues. After I failed my P2, it was thanks to both Inge and Daniele's encouragement and their dedicated efforts in helping me restructure my project that I was able to continue and eventually graduate smoothly.

I also want to thank all the other landscape architecture tutors who helped me develop my skills in design, analysis, drawing, and model-making. Your guidance has been instrumental in shaping my growth.

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This journey was never a solitary one, and I feel incredibly lucky to have had such supportive and inspiring friends beside m
.

Lastly, I want to thank my two beloved cats, Yumi and Meibao. Without their companionship, I truly wouldn't have made it through.

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Water?

Water is the essence of life. About 71% of the Earth's surface is covered by water, and approximately 70% of the human body is composed of water. As the most dynamic element in nature, water can be tranquil or aggressive, encountering power to nourish life among creatures. It is flexible, continuously changing forms in the natural cycle in every moment.

In my view of Chinese culture, water embodies philosophical meanings. Laozi said, "The highest good is like water," praising water's humility and adaptability while advocating the wisdom of softness overcoming hardness. Confucius said, "The wise find joy in water," associate water with the fluidity of thought and intelligence. In poetry, water witnesses the passage of time and symbolizes the ups and downs of life. Always, water shapes the geography, advocating living condition and represent the sprit and culture of people living in China.

For a landscape architect, water is more than a natural element or a cultural metaphor. It is a spatial shaper and an ecological regulator. Water bodies weave through urban fabrics, forming dynamic public spaces. In the context of Climate adaptation and ecological restoration, water management is a vital issue which give back power to the nature and guide people to create a harmony livelihood in the landscape. Therefore, water is not just a source of design inspiration but also the object of design challenges.

Here begins a story which understands water, feeling water and establish coexistence with water from the perspective of a designer, who has been studying landscape architecture for 7 years and now would like to tell you the story of living in a waterscapes.

Foreword

1.1 Position as a landscape designer

1.2 Fascination

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1.5 Glossary

Water management in Landscape architecture

Position as a landscape designer

Water, as a natural resource utilized over long periods for social production, not only plays a crucial role in ecological regulation but also plays as a connector between ecological and social relations, shaping the progress of human civilization.

The relationship between the water environment and the social environment is complex and mutually shaped. However, it can be understood from two perspectives. On the one hand, the water environment is not entirely a natural endowment but rather the result of the intertwined actions of humans and non-humans (Barnes & Alatout, 2012; White, 1995). In this sense, the water environment reflects the co-evolution of nature and society through long-term interactions. On the other hand, hydraulic infrastructure transformed by human intervention is not merely a physically constructed entity but also plays a significant role in social management and everyday use. Therefore, understanding the formation and operation of water management system must be rooted in the work model and lifestyles of social groups (Bijker, 2012; Bakker, 2012).

This understanding provides a new research perspective by positioning social aspect as the starting point for water system management. Xinglong (2007) proposed the concept of the "hydraulic society(水 利 社 会)," emphasizing that China's hydraulic system should be seen as an organic combination of political, economic, cultural, environmental, and kinship elements. He argued that contemporary research should focus on the regional social relationships derived from the hydraulic society (Xv, 2020). This theoretical approach has been acknowledged within sociology and has inspired a series of studies, generating extensive research on hydraulic systems, their construction and management, and their roles in agricultural production, urban development, and industrial progress.

However, in many studies related to water management, this social perspective is often overlooked or downplayed (Schulz & Gros, 2024). This phenomenon is also highly evident in the field of landscape architecture. In fact, examining water management solely as technical engineering projects or material cultural resources fails to capture their multifaceted nature and complexity as socio-natural assemblages. Throughout China's long developmental history, water management system have been through multiple construction phases, with different social groups managing and using them at various times, resulting in diverse spatial organization patterns. These water management systems not only serve specific industrial needs but are also deeply embedded in daily life, reflecting a high degree of integration between productive and living spaces. As a core element of regional development, the spatial structure of water management systems is linked to social practices and plays a significant role in the development of local cultural industries. This organizational form of spaces provided by the water management system not only reveals the modes of social production within specific historical contexts but also reflects the interaction and co-evolution of local cultural characteristics and social relationships.
In recent Chinese landscape research and design practices, the transformation and utilization of water management systems generally exhibit two main trends. On the one hand, many projects tend to regard water management systems as extensions of engineering technology, focusing on their functional value as spatial elements while overlooking their attributes as social components. This inclination often emphasizes the role of water infrastructure

within spatial layouts but fails to fully consider its comprehensive characteristics as public space, an object of social management, and a carrier of social activities. On the other hand, some research and design projects tend to view water management systems merely as cultural heritage to be preserved and maintained, without revitalizing their essential function as an integral part of water resource management. This phenomenon has received some attention and improvements through these years. For example, in the "Pearl River Delta Regional Spatial Plan (珠江三角洲全域空间规划)(2016-2020)," a comprehensive approach was proposed for coordinating infrastructure, industrial layout, environmental protection, and public services, emphasizing the integrated optimization of systems, including water management systems and public spaces. This planning concept gradually reflects an initial recognition of the social attributes of water management systems. However, in the "Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area"(粤港澳大湾区空间规划) (2019), although it suggests expanding public participation during the planning process, the specific measures mainly focus on gathering public opinions and lack practical approaches to deeply consider the relationship between social activities and the spatial organization of water management systems.

Therefore, further exploration of water management system should place greater emphasis on its social embeddedness and its multiple roles in social production and management practices. Water management systems are not only infrastructure for ecological regulation and water resource management but also carry the function of public spaces, holding significant social and cultural value. In this context, landscape designers, when intervening in the renovation and spatial renewal of water management systems, should not only focus on their physical functions and spatial layout, but also delve deeper into their social attributes and public nature. They should pay close attention to the manifestation of human activities, social interactions, and cultural expressions within water management spaces.

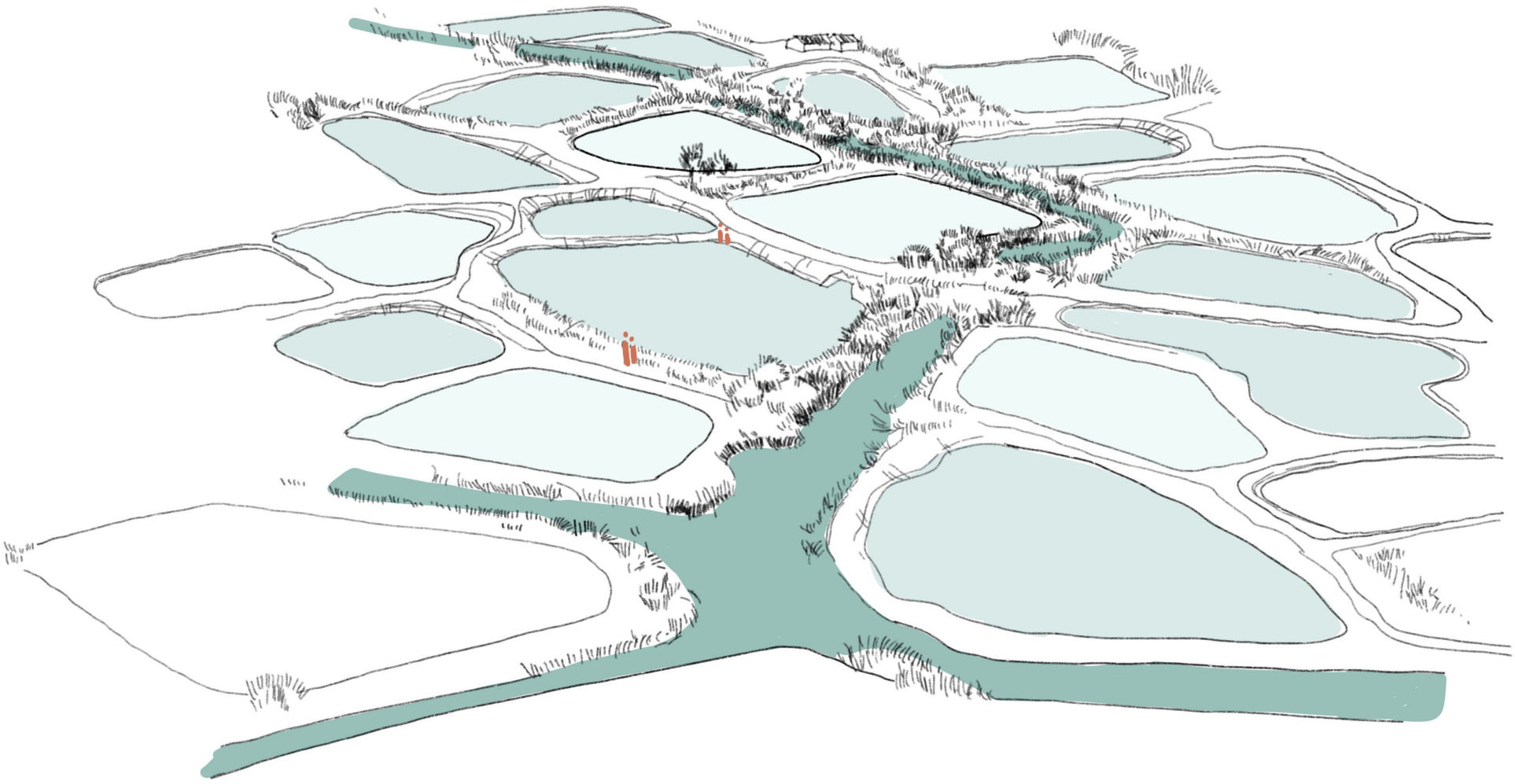
In this process, landscape designers need to move beyond a singular focus on functional design thinking and instead consider ecological restoration, spatial renewal, and social activation in a holistic manner. By employing multi-layered and multidimensional design approaches, they can reshape the spatial order of water management systems and create complex landscapes that integrate social participation and cultural significance. In doing so, the water management system not only restores its natural functions on an ecological level but also becomes a public platform for community cohesion and cultural heritage promotion on a social level. This re-recognition of the comprehensive value of water management systems is a crucial pathway to achieving the revitalization of water culture and the sustainable development of landscapes.

Fascianation

Reflecting on my study on the Landscape architecture, For me, Landscape architecture holds a critical position at the intersection of ecology, urbanism, and culture, offering unique strategies to restore the fragmented relationship between people and non-human environment.

My passion for water systems has been deeply shaped by my academic journey. During my undergraduate studies, I participated in many water-related projects, including my bachelor's thesis, which focused on Quanzhou's historical water systems and their integration into urban renewal. These experiences sparked my interest in understanding water not just as a physical resource but as a critical element of spatial and cultural systems. Coming to the Netherlands for my master's studies at TU Delft was a natural step, given the country's renowned expertise in water management and its innovative approaches to integrating water into landscape architecture. For landscape designers, water management offers a unique lens through which we can engage with global development from both spatial and technical perspectives. To my understanding, by integrating ecological restoration, public engagement, and cultural activation, landscape design has the potential to transform degraded water systems into multifunctional spaces that inspire awareness, education, and action. Position as a landscape designer.

Having conducted studies on water systems and public spaces in various regions of China, I have a deep appreciation for the region's rich cultural heritage. This project provides an incredible opportunity to delve deeper into the water systems of the Pearl River Delta, exploring how design interventions can bridge tradition and modernity, and contribute to sustainable development



Birdview drawing of Dike-fish ponds in Sangyuanwei

Intoduction

Dike-pond agriculture system is a traditional, integrated production model originating from southern China, known for its ecological wisdom and efficient resource recycling. This system not only provides strong ecological regulation but also offers a stable source of food and economic support for local communities, reflecting the adaptive integration of farming and fishing (Chen, 1995). It also creates daily spaces for residents to interact with water, supporting the social and productive life of water-based communities (Hou, Li, & Sun, 2023).

However, with the rapid pace of urbanization and the rise of intensive fishing industry, this traditional model is under serious threat. Large areas of farmland and traditional fishponds have been transformed into residential and industrial zones. In the remaining fishponds, the original "dike" used for growing crops has largely disappeared, resulting in a much higher proportion of ponds and a severely imbalanced structure. The ecological balance once sustained by the system is being lost (Tian, 2019). At a deeper level, the self-organized water management practices that once supported local communities are being replaced by commercial aquaculture systems controlled by local governments and outside contractors. This shift not only changes how water is used but also breaks the social relationship between communities and water, weakening the role of the dike-pond system as a "social water body."

From the perspective of the sociology of water, this ecological and spatial imbalance stems from the loss of water's social qualities. As Karen Bakker points out, water is never a neutral natural resource—it is deeply embedded in social structures, governance systems, and cultural practices, carrying both political and biopolitical significance. The rise of modern aquaculture has reduced water's role to one of maximizing production efficiency, overlooking its importance in public health, cultural identity, and community relationships. This process of "de-socializing" water not only adds pressure to the environment but also cuts off emotional and practical connections between people and water.

The central Pearl River Delta is a typical example of this transformation. Take Sangyuanwei(Mulberry garden dike), for instance—a historically water-rich area where the integrated system of "mulberry–dike–fish–pond" enabled the joint management of natural resources and social life. Water served not only as an ecological infrastructure but also as a cultural and governance medium, supporting a way of life where agriculture and fishery were closely linked. Today, this community-based model of water management has been pushed aside, with traditional spatial order and water culture fading away.

In the face of the ecological and social challenges caused by intensive fishing industry, we need to return to the social dimension of water and rebuild the relationships between people, water, and society. This calls for an integrated water management approach that brings together social governance, ecological restoration, and spatial renewal. Landscape architects should play a key role in this process—not only by restoring ecological balance through blue-green infrastructure, but also by designing spaces that revive emotional and everyday connections to water, turning water systems once again into foundations for social interaction and public life.

This project aims to propose a landscape infrastructure design approach grounded in the social nature of water, responding to the question of how landscape architects can engage with water renewal and social repair across different scales. Focusing on the Sangyuanwei area in the central Pearl River Delta, the project

will reorganize water systems and production zones at the regional scale to rebuild a network of blue-green infrastructure that supports both ecology and economy. At the medium scale, it rebalances the dike-to-pond ratio to restore ecological functions and water diversity. At the small scale, it activates water spaces that can be experienced, used, and participated in, weaving tourism, production, ecology, and community life together again to explore a landscape renewal path that integrates local culture, ecological sustainability, and social engagement.

Ultimately, the project raises a central question for future practice: How can a landscape structure be implemented to mitigate the impacts of the monoculture fish industry while supporting local polyculture practices, creating a healthier, more sustainable, and visually attractive environment that enhances local livelihoods?



Birdview of Dike-fish ponds, Foshan, 1953

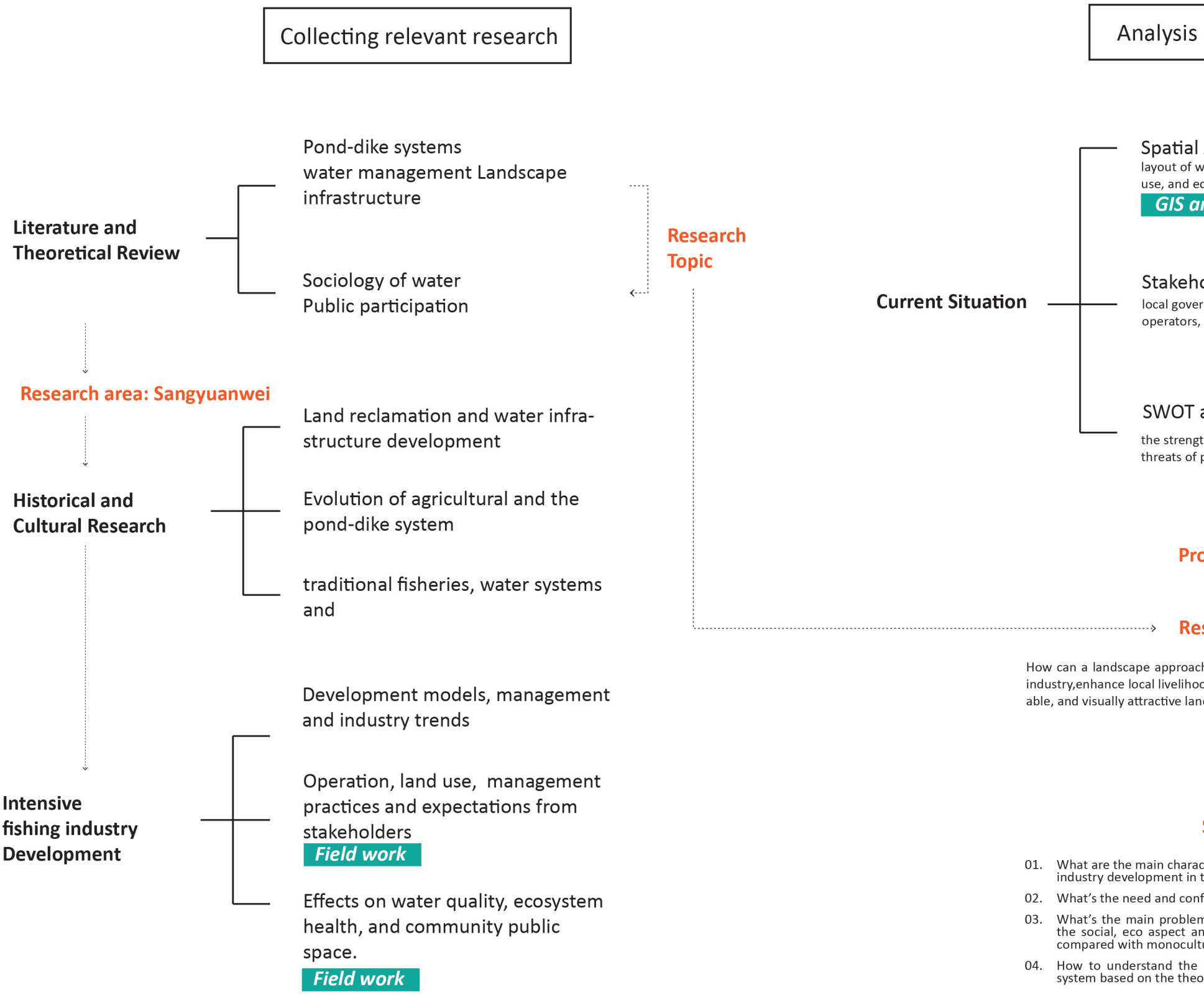
The agricultural patches in the distance are clearly visible, reflecting a harmonious relationship between the living environment and the production landscape."



Birdview of Dike-fish ponds, Foshan, 2024

Although the productive landscape is separated from the living environment, it still holds significant ecological potential

Research Framework



of a specific site

Analysis

ater networks, pond-dike layouts, land
cological quality.....

nd Mapping

older Analysis

nments, fishers and farmers, tourism
and residents.....

analysis

hs, weaknesses, opportunities, and
ond-dike system transformation

oblem statement

search questions

n mitigate the negative impacts of fish
od, and create a healthier, more sustain-
dscape though local participation

Sub questions

teristics and impacts of intensive fishing
he Pearl River Delta region

licts between different stakeholders

n of monoculture within fishing area in
d what's the advantage of polyculture
ure

relationship between social and water
ry sociology of water

Key Issues

Design Practice

Design concept

Bring back diversity to both dike-fish ponds
and local people livelihood

Design Principle

1. Ecological regulation and sustainable development
2. Social interaction and
3. Cultural heritage and economic growth

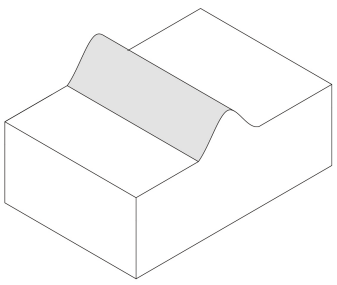
Design Questions

What kind of landscape infrastructure needs to be implemented
What is a healthier, more sustainable, and visually attractive landscape in this area
How to improve the local livelihood in economic, ecological and social aspects
.....

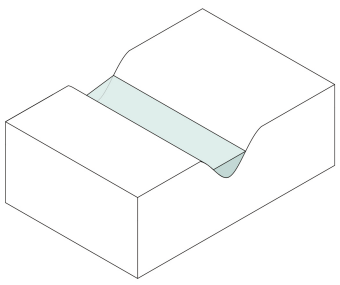
Design In scales

Regional Scale → Zoom in
Meso Scale → Zoom in
Micro Scale → Zoom in
Details

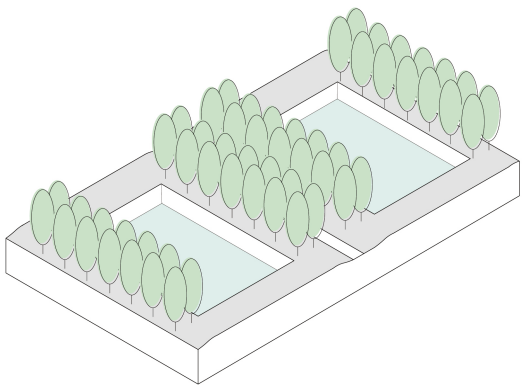
Glossary



Dike

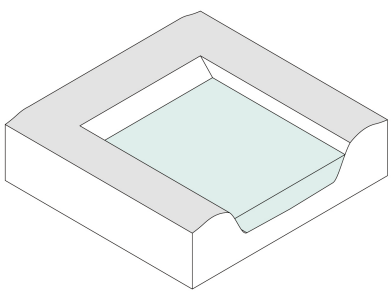


Ditch

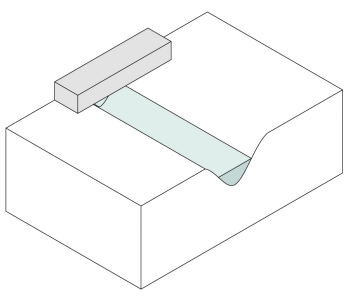


Mulberry dike-fishponds

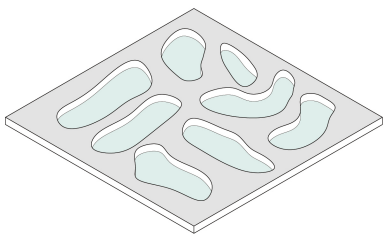
Mulberry dike-fish ponds are a traditional agro-ecological system widely practiced in the Pearl River Delta, China. The system integrates mulberry cultivation on raised dikes with fish farming in surrounding ponds, forming a cycle of nutrient reuse and sustainable production.



Dike-ponds/Dike-fishponds



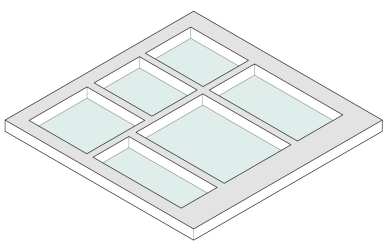
Water Gate





Organic dike-fishponds

Organic dike-fish ponds are characterized by their natural pond morphology and high ecological value. They are often managed by local residents, preserving traditional knowledge and sustainable practices.





Formal dike-fishponds

Formal dike-fish ponds feature regular, geometric shapes and significantly reduced dike areas. These ponds were mostly reconstructed in the 1990s to maximize aquaculture productivity and are often managed by non-local contractors.

"What is of interest is not merely the pump, but rather the articulation between the pump, the water, the river, the land, and farmers – as a socio-natural assemblage. Similarly, in developing a concept of 'natural infrastructure', and in asking how we might theorize infrastructure ecologically....."

——Karen Bakker, 2012

The Social Life of Water: A Landscape-Based Agenda

2.1 Research statement

2.1.1 Water as a Social infrastructure

2.1.2 Challenges in Production dike-fish ponds landscape

2.1.3 Rethinking Fishscapes: From Monoculture to Multivalue

2.1.4 Methodology

2.1.5 Statement of Research area

Water as a Social infrastructure

Sociology of water

Water is not only a material that supports life, but also an element deeply embedded in social and political structures. The concept of the sociology of water emphasizes that water systems are not just natural phenomena or engineering elements, but social practices shaped by social relations, management, and governance mechanisms.

Bijker (2012) points out that understanding modern society requires studying how technology and society are built together, which means in water management, dams, pumps, and canals are not just technical devices—they also reflect social systems. In history, water control has often been linked to political power. For example, Pritchard (2012) introduced the ideas of hydroimperialism and hydrocapitalism, showing how water was used as a tool for control and development during colonial expansion and modernization. These views suggest that if local communities can regain power in water management, it may be possible to break away from centralized systems and rebuild a balance between ecology and society.

Water infrastructure is not simply constructed; it is formed through interactions between technology, communities, and institutions. Barnes (2012) suggests that a water pump not only supplies water but also helps build the community around it. Water systems reflect social relationships. Carse (2012) further proposes the idea of nature as infrastructure, where rivers, wetlands, and water bodies are part of the system. Their function depends on cooperation among nearby communities. In complex systems like the Panama Canal, nature, waterworks, and human institutions together form a broad water management network. This kind of "organic machine" connects social systems and natural environments.

Water manegement is complicated for both social and biological aspects. Karen Bakker (2012) explains that water operates under both political and biopolitical logics. On the one hand, water is controlled by the government and becomes a tool of power. On the other hand, water shapes human life as a socio-natural assemblage, affecting bodies, labor, and space.

Today's water problems are not only caused by physical shortages but are deeply social (Schulz & Gros, 2024). Concepts like hydrosocial territory and waterscape show how human and water interactions are complex. Water has political, ecological, and cultural meanings. This requires not just focus on large-scale, centralized engineering solutions, but also toward local and community-based water management. For example, building small water management components and local participation can help avoid the unfair water resource distribution. As White (1995) said, modern rivers have become "organic machines," and designers and planners must learn to work with them, not just control them.

The sociology of water offers a new viewpoint to understand the relationship between people, society and water. In this view, water is not only a resource or a natural element—it carries social meaning and helps shape space. Looking forward, water landscape design should be based on the meeting point of technology, ecology, and culture. It should support public participation and build water systems that are both resilient and meaningful to society.

The concept of the "Sociology of Water" discussed in this article mainly comes from a special issue of Social Studies of Science (Vol. 42, Issue 4, 2012). In this issue, scholars discuss water governance, infrastructure, technology, and social relationships, using the perspectives of social constructivism and Science and Technology Studies (STS). They reveal that water systems are not just natural or technical issues, but are deeply embedded in social processes involving power, institutions, culture, and daily life. This research provides an important theoretical foundation for understanding the relational, participatory, and political aspects of water infrastructure.

The construction of water infrastructure promotes social activities



The inauguration ceremony for the completion and water flow of Mailizhou River,
January 18, 1952. Image from 《光辉岁月》

Water shapes living spaces.



Fengmen, a water gate in the south-east of Suzhou
University of Bristol - Historical Photographs of China reference number: OH01-034.

Public Participation in Landscape

In landscape design and urban planning, water facilities are not only basic physical infrastructure but also carriers of social relationships and public values. Elements such as water bodies, fountains, and rivers function as physical elements that directly support urban ecology, microclimate regulation, and aesthetic experience; at the same time, through their accessibility, openness, and symbolism, these spaces become important sites for community interaction, memory construction, and the formation of public identity (Sharp, 2017).

However, modern urban water management has become increasingly technical and professionalized, often neglecting its public character and gradually diminishing the social significance of water facilities. To reawaken the public nature of water management, public participation must be established as a core principle. The public are not only users of water resources but also co-creators and custodians of the meanings attached to water spaces (Clark, 2021). Through public participation, design and management can better reflect the diverse needs of society and reposition water facilities as symbolic nodes of urban public life.

Public participation can enrich both the functions and forms of water facilities while enhancing social recognition and a sense of belonging. Mechanisms such as community forums, co-design processes, and volunteer activities allow different groups to express their memories, values, and expectations regarding water spaces, transforming water facilities into open places where "everyone can tell their story." This process not only stimulates residents' sense of ownership but also turns the management and maintenance of water facilities into a practice of community co-governance, promoting a shift in water management from "expert-driven" to "collaborative governance," and revitalizing its public nature (Sharp, 2017; Clark, 2021).

Therefore, in both design and management, landscape facilities should be regarded as public spaces constructed through both physical and social processes. Designers and managers should actively embrace public participation, respect and integrate local knowledge and emotions, and promote water facilities as "public symbols" that connect individuals, communities, and urban memory—truly awakening and strengthening the social character and public value of water management and water spaces.



As part of our river and wetland restoration work volunteers have created berms and deflectors to narrow the over-wide river channel and encourage Bankside vegetation on a section of the Tillingbourne near Guildford..

Image from: https://www.youtube.com/watch?v=nRO53Ib0TAA



Tillingbourne

The power of the community shapes a complete residential area



Quinta Monroy Incremental Housing, Iquique, Chile

Educational landscape design.



Hillside Eco-park, China, designed by ZT landscape

Challenges in Production dike-fish ponds landscape

The Pearl River Delta area serves as a significant example of the evolution of China's water culture and settlements-based water facilities . It is currently undergoing a transition from a once landscape of human–water coexistence to a modern society focused on production efficiency. The once intricate and dynamic water network supported multiple ecological functions such as agricultural irrigation, fisheries, and flood regulation. It also sustained social practices like community governance, collective cooperation, and water rituals, forming a highly integrated socio-ecological system.

Today, this composite structure is being restructured, exposing multiple challenges such as ecological pressures, conflicts over land use, fragmented spatial governance… The area of fishponds has decreased due to urban and industrial development. The remaining dike-ponds, where dikes were originally used for crop cultivation alongside fisheries, have seen a sharp reduction in dike areas, severely unbalancing the dike–pond system. In response to increasing product demands, modern fishery production heavily relies on electricity and chemical agents to maintain water quality and yield. This shift not only exacerbates issues like water pollution caused by excessive nutrients, sediment pollution, and food safety but also diminishes ecological sustainability, drastically reducing green open spaces.

More importantly, the community's way of living and working around water is slowly breaking down. Daily social interactions, festive rituals, and water cultural practices are increasingly squeezed, leading to a growing detachment between people and water. This change signifies not just ecological degradation but also the weakening of water system social interaction. From a "sociology of water" perspective, this transformation reflects the systematic detachment of water's social significance. In the past, water spaces such as fishponds, ditchs, and rivers were critical mediators connecting local individuals and communities, ecology and society, nature, and culture. Their spatial forms and governance models embodied specific social structures and cultural orders. However, as water spaces are simplified into purely productive spaces and technical control objects, their political and biopolitical characteristics are suppressed.

As Karen Bakker (2012) points out, water is not just a natural resource but deeply embedded in political, economic, cultural, and daily practices as a socio-natural hybrid. The current spatial and institutional transformations in the Pearl River Delta exemplify the process of water being disconnected from community life. In this process, water systems are reshaped into isolated, functionally efficient resources aimed solely at production goals, breaking the traditional socio-ecological structure. As land development and spatial function redistribution proceed, the production and daily life order originally organized around water are disrupted, local knowledge and water culture marginalized, and residents' interaction space with water greatly reduced. Traditional social interactions, festivals, and labor practices are gradually lost, weakening the perception and emotional connection to water.

Under the dominance of land capital and policy logic, the multifunctionality and social connectivity of water systems are severely weakened, ecosystems face tremendous pressure, spatial governance trends towards fragmentation, and local social participation mechanisms are increasingly absent. Faced with these multidimensional issues, there is an

urgent need to introduce landscape design as an intervention tool to explore spatial strategies that achieve a balance between ecological restoration, community participation, and cultural reconstruction. This strategy should restore water ecological functions while responding to residents' production needs and cultural memories, rebuilding a water-centric living order and local identity.



Research question

Main question

How can a landscape approach mitigate the negative impacts of the fish industry, enhance local livelihoods, and create a healthier, more sustainable, and visually attractive landscape though local participation ?

Sub question

What are the main characteristics and ecological-social impacts of the intensive fishery model in the Pearl River Delta?

How have land and water systems transformed historically, and how did they shape traditional dike-pond landscapes and human-water relationships?

What are the major needs and conflicts among different stakeholders in the current aquaculture system (e.g., local farmers, non-local contractors, government)?

What are the spatial, ecological, and social limitations of monoculture in aquaculture areas, and how can polyculture offer a more resilient and multifunctional alternative?

How can landscape design strategies reconnect ecological functions, social practices, and local knowledge to restore a sustainable water-based production landscape?

Methodology

Previous Research

Background Investigation and Stakeholder Analysis

Literature Review
Historical documentation, policy papers, chorography and fisheries statistics

+

Policy Analysis
land-use , water management, and local economic transitions

Stakeholder research
Interview outline for Residents, non-local contractors, policy-makers, and consumers

+

Relationship Analysis
To identify interests and power dynamics in ecological, economic, and social domains in matrix analysis

Field Trip

Dike-fish pond distribution, water management, and land changes, by mapping, on-site observations

Perspectives from stakeholders by inter-view

Analysis and conclusion

Spatial Analysis and Concept Development

Spatial Analysis

GIS, Satelite, policy map, guideline map.... → Land-use, water manegement, fishponds topology...

News reports, policy documents → Water quality and environmental issues

Socio-Eco Analysis

Theoretical concept: Sociology of water & Public participation → Interactions between human activities and water manage-ment.

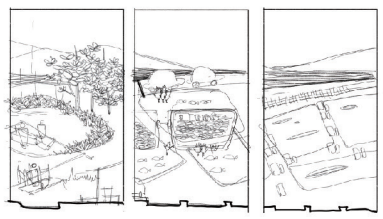
Traditional intelligence → Compare with Monoculture and Polyculture

Design Concept

Design Practice

Multi-Scale Landscape Design

Scenario parctice
Principle and scale



→ **Design practice**



Statement of Research area

Sangyuanwei is one of the most representative large-scale dike systems in the Pearl River Delta, embodying the historical transformation from traditional water management to a regionally distinctive fish–agriculture integrated production model and jitang (pond-dike) landscape (Wang & Huang, 2023). Among the many dike systems in the region, Sangyuanwei stands out for its structural integrity and clearly legible landscape pattern.

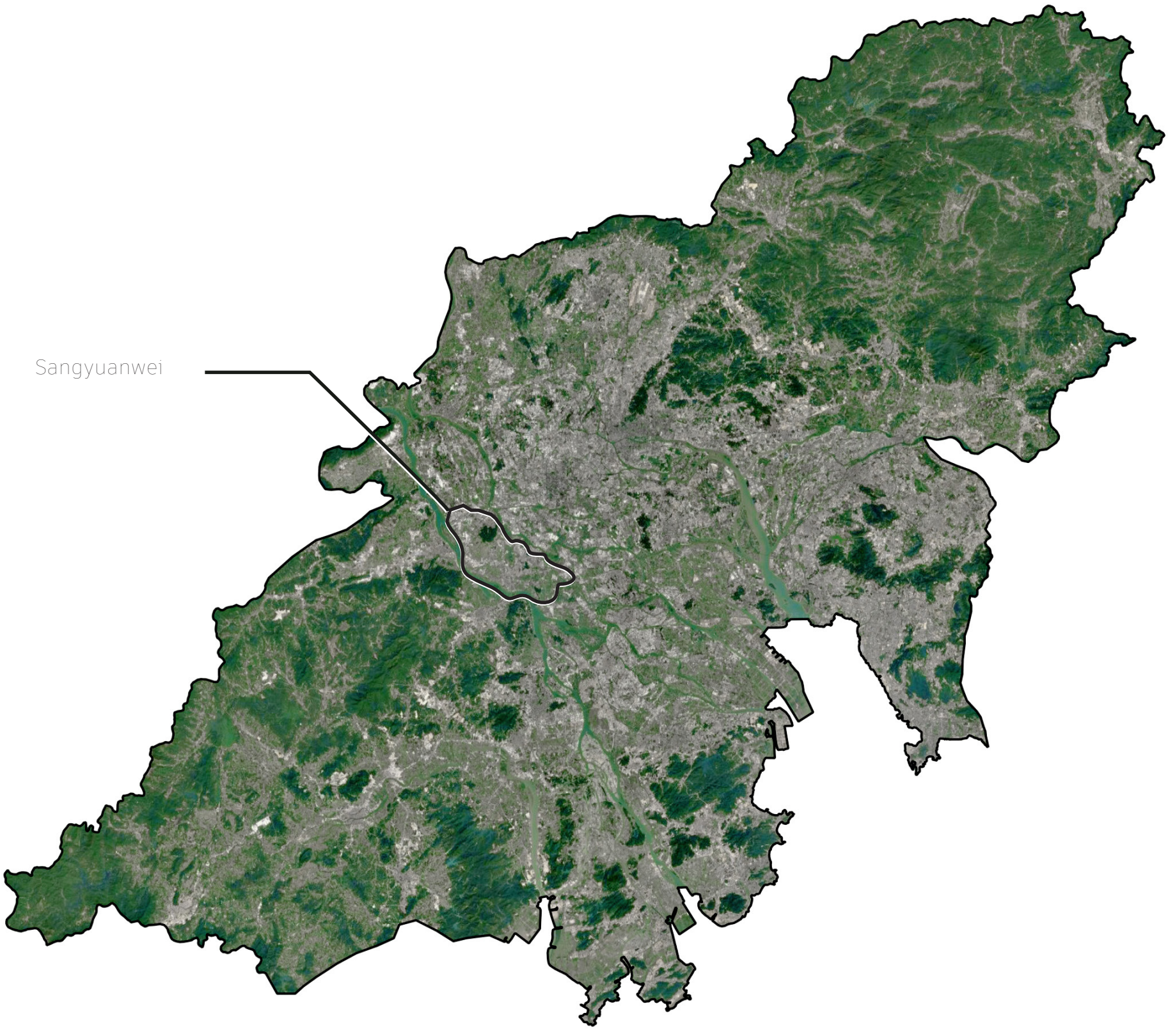
The area features a varied topography, combining low-lying water networks with elevated landforms, making it ideal for analyzing the relationship between terrain and dike systems. The jitang landscape is particularly prominent and spatially recognizable, providing a solid basis for integrated studies of spatial form, ecological function, and production logic. Supported by both satellite imagery and historical dike maps, the research confirms the regional significance and analytical value of Sangyuanwei, justifying its selection as the primary case study site.

Location of Pearl river delta cactchment

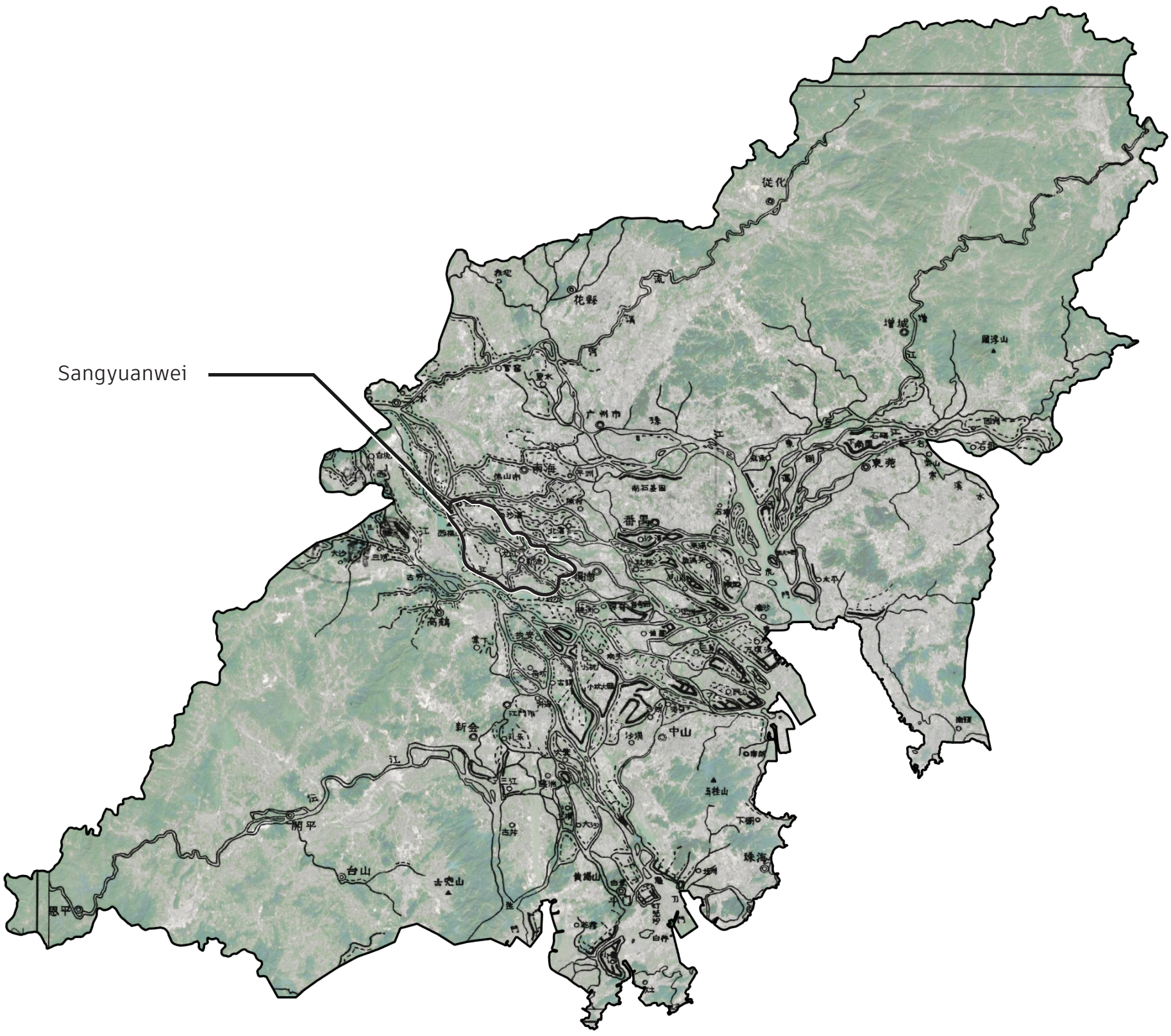


The image shows the central Pearl River Delta with a dense and well-developed water network. Sangyuanwei is located in this area, illustrating typical dike-based hydraulic features.

Location of Sangyuanwei



This map illustrates the distribution of historical dike systems in the Pearl River Delta, with Sangyuanwei clearly marked, highlighting its significance in the region's hydraulic development.



Sangyuanwei, located in the central region of the Pearl River Delta with a dense water system, is a representative example of dike-based hydraulic systems. The area features a well-preserved dike structure and an intricate water network, where hydraulic engineering and agricultural production are closely integrated, showcasing a fish–agriculture mixed production model. The region's varied topography, with both low-lying water network areas and elevated landforms, makes it ideal for studying the relationship between dike systems and terrain, as well as their impact on water management and agricultural production. Furthermore, the jitang (pond-dike) landscape of Sangyuanwei is highly representative and recognizable within the Pearl River Delta, serving as an important case for studying the evolution of water management and land use patterns in the region. Choosing Sangyuanwei as a research site not only offers insights into the development of dike systems in the Pearl River Delta but also provides valuable data to explore the spatial and ecological values of the fish–agriculture mixed production model.







The Landscape Shaped by Society

The Pearl River Delta is located in the southern coastal region of China, at the mouth of the Pearl River Basin, formed by the sediment deposition from three major rivers: the West River, North River, and East River. The overall terrain is characterized by a northwest-high, southeast-low gradient, with the landscape being influenced by river sedimentation, tidal action, and human activity. The main landforms in the delta include plateau hills, river alluvial plains, delta, and coastal plains. Among these, the river alluvial plain is the most typical landform of the Pearl River Delta, with fertile soil that is suitable for agricultural production, particularly for mixed farming systems like mulberry-dike fish ponds.

This productive landscape is commonly referred to as sand fields(沙 田). The definition of "sand fields" has undergone multiple revisions, initially defined by natural geological processes, but gradually incorporating human activity, especially water management infrastructure and administrative boundaries. In early studies, scholars like Tan Dihua (1993) and Wu Jianxin (1987) defined shatian based on natural formation processes. However, as research progressed, scholars began to recognize that shatian was not just a product of the natural environment, but also the result of human activities, particularly the construction of water management systems. Wu Weifeng (2024) and others further argued that shatian is a landscape co-shaped by humans and nature, reflecting not only a way of life symbiotic with water but also the interaction between social activities and water interventions. Today, the definition of shatian integrates both natural landscape features and human activity traces, reflecting the profound role of society in shaping the landscape of this region, particularly in terms of water management, and highlighting the complex relationship between humans and nature in shaping the landscape.

A local fishery landscape shaped by water system

3.1 Site introduction

3.2 From sea to cultivation land: Land transformation and water system evolution
- 3.2.1 Landform, soil: Land reclamation as a foundation
- 3.2.2 Early hydrological process
- 3.2.3 Water system in Sangyuanwei
- 3.2.4 Contemporary construction of water system

3.3 Dike-ponds system as a hybrid production landscape
- 2.3.1 Agriculture evolution
- 2.3.2 Formulation and diversity of the dike-fish ponds layout
- 2.3.3 Echological value of the traditioanl dike-fish ponds
- 2.3.4 Circularity in mulberry garden dike

3.4 Live with water
- 3.4.1 Water as a power : The socio-political logic of water management
- 3.4.2 Layout of settlement near the water system
- 3.4.3 Water system as a daily life infrastructure

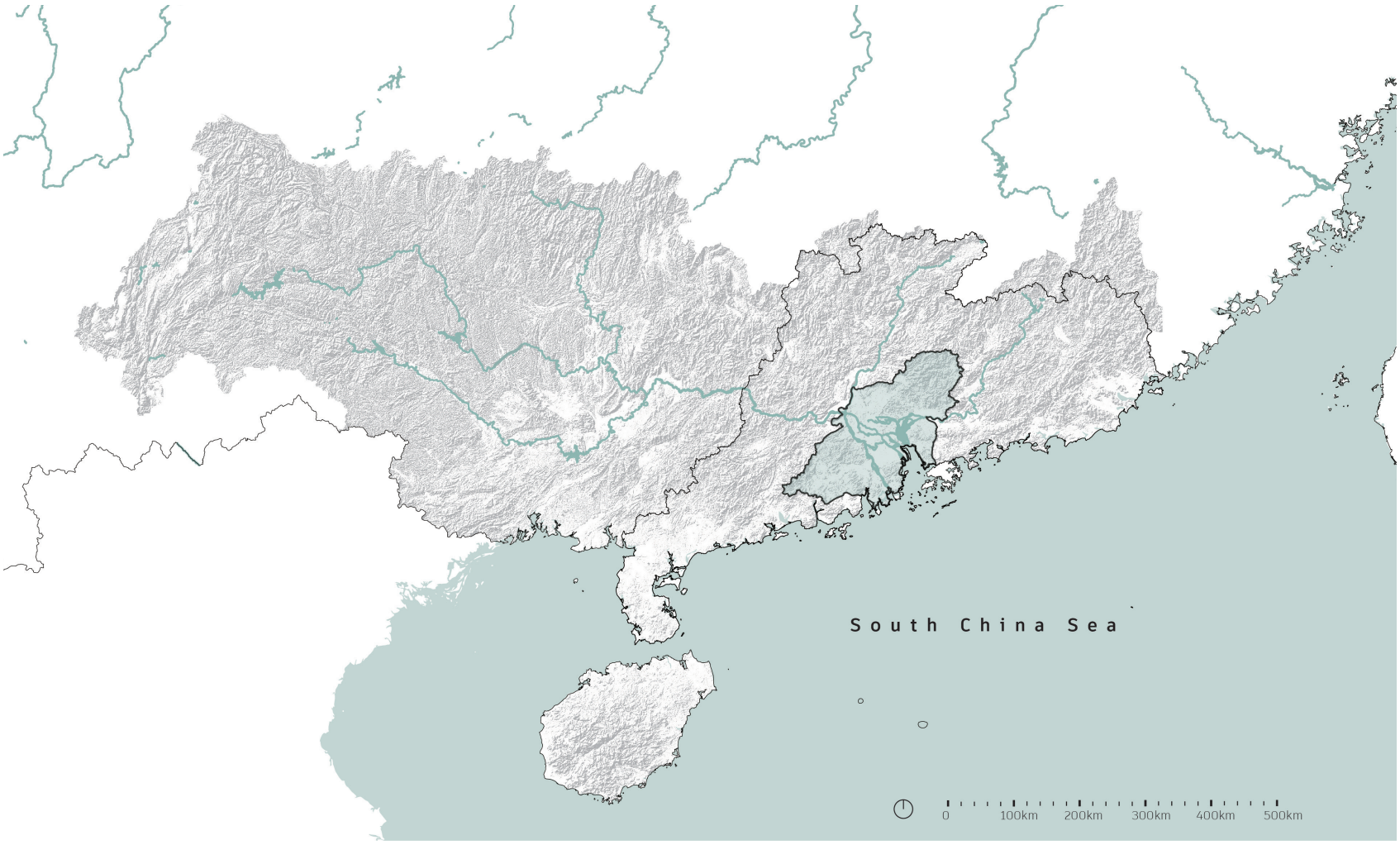
Site introduction



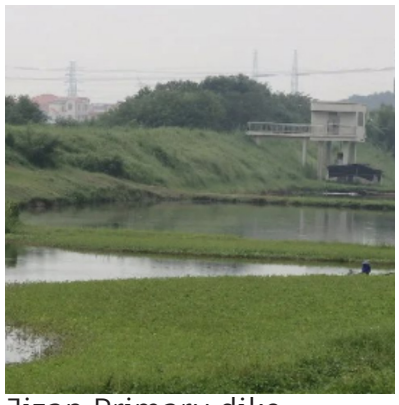
Site location

The Pearl River Delta (PRD) is an important delta plain in southern China, located along the coastal areas of Guangdong Province, adjacent to the South China Sea and neighboring Hong Kong and Macau. This region is formed by the convergence of the three main tributaries of the Pearl River Basin—Xijiang, Beijiang, and Dongjiang—at its estuary, shaped over time by extensive alluvial deposition into a flat and densely interconnected delta plain.

Due to the highly developed Pearl River water system, the region's rivers crisscross and intertwine, providing ideal natural conditions for agriculture, aquaculture, daily life, and inland navigation. Benefiting from these hydrological characteristics, the Pearl River Delta has historically developed a rich and systematic water management and irrigation system, including traditional river network governance, polder development, embankment systems, and drainage facilities. These hydraulic infrastructures have not only supported the prosperity of the regional agricultural society but also laid the foundation for later urban development and industrial expansion.



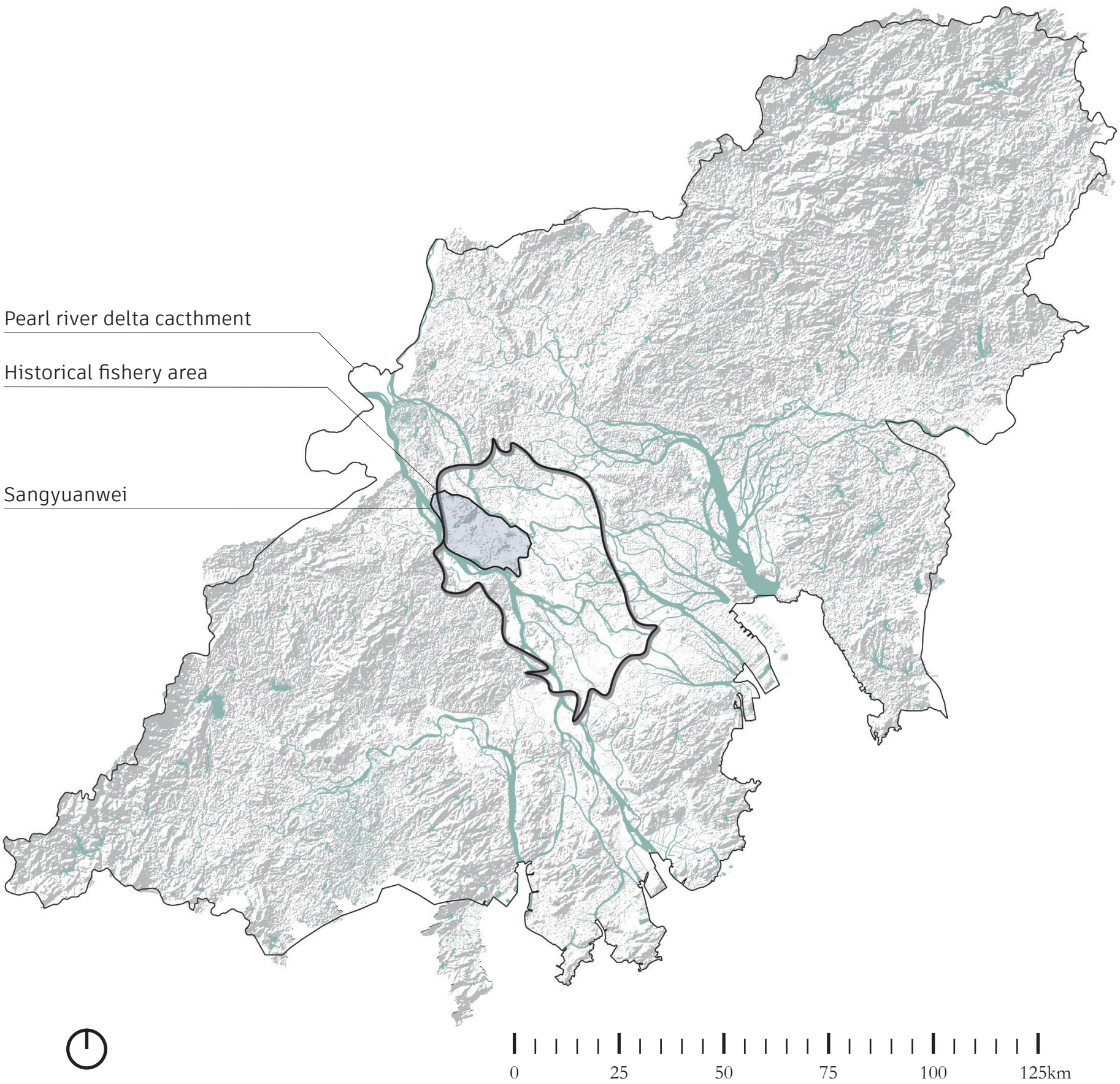

Dike-fish ponds


Jizan Primary dike


Minle sluice gate



Tanhua Bridge



Moreover, leveraging its favorable geographical location and natural harbor conditions, the Pearl River Delta region has gradually developed a regional economic system centered around aquaculture, handicraft processing, and local trade, built upon its rich water resources and fishing traditions. With an intensive network of waterways and flat terrain, local residents have long engaged in industries such as fish pond aquaculture, salt production, and weaving, forming a livelihood and production model rooted in water. Cities like Guangzhou, Foshan, and Dongguan have evolved into local economic centers supported by traditional handicrafts and regional markets, laying a solid foundation for the early socio-economic prosperity of the Pearl River Delta.

Sangyuanwei, located in the Pearl River Delta region, is a typical waterside community renowned for its unique hydrological conditions and abundant aquatic resources. Here, relying on dense water networks and flat terrain, the community has long been dedicated to traditional industries such as mulberry-dike fish pond aquaculture, and silkworm industry. These activities have not only supported local residents' livelihoods but also played a crucial role in promoting regional economic development and cultural heritage preservation.

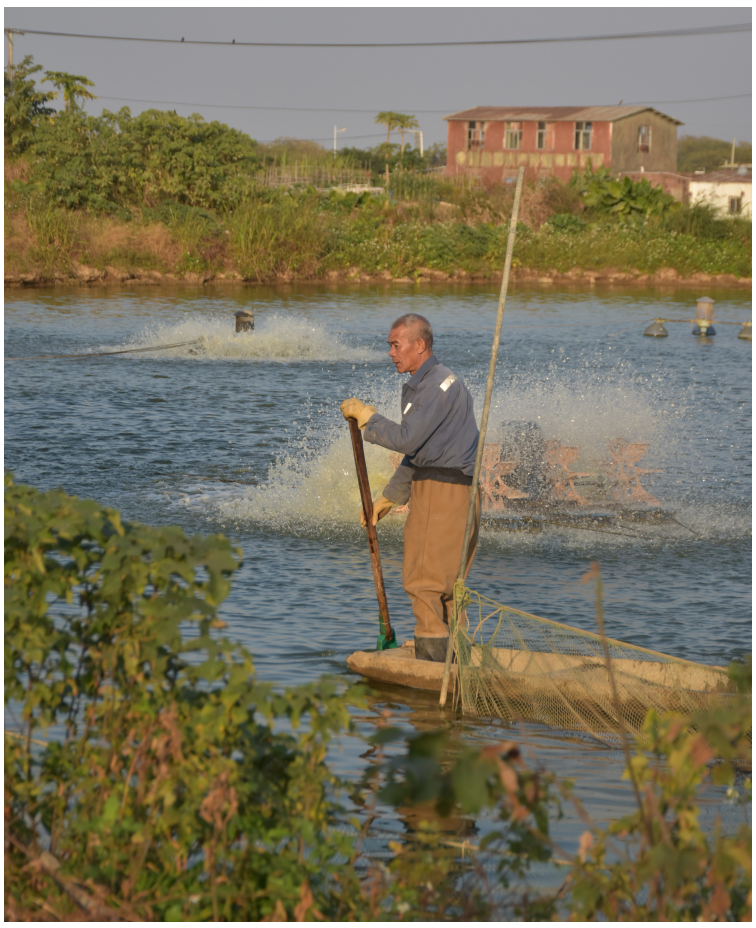
As of 2020, the total aquaculture area in Guangdong Province reached 474.1 thousand hectares (approximately 474,100 hectares). Among this, freshwater aquaculture accounted for 309.38 thousand hectares (around 309,400 hectares), making up 65.3% of the total. This indicates that aquaculture in Guangdong is primarily based on freshwater farming, with pond culture being one of the main methods.

——《2022 年广东省水产养殖业发展现状及市场规模分析》

(Analysis of the Development Status and Market Scale of the Aquaculture Industry in Guangdong Province in 2022)



Birdview of fishing industry area



Non-local workers at fish ponds



Birdview of Sangyuanwei

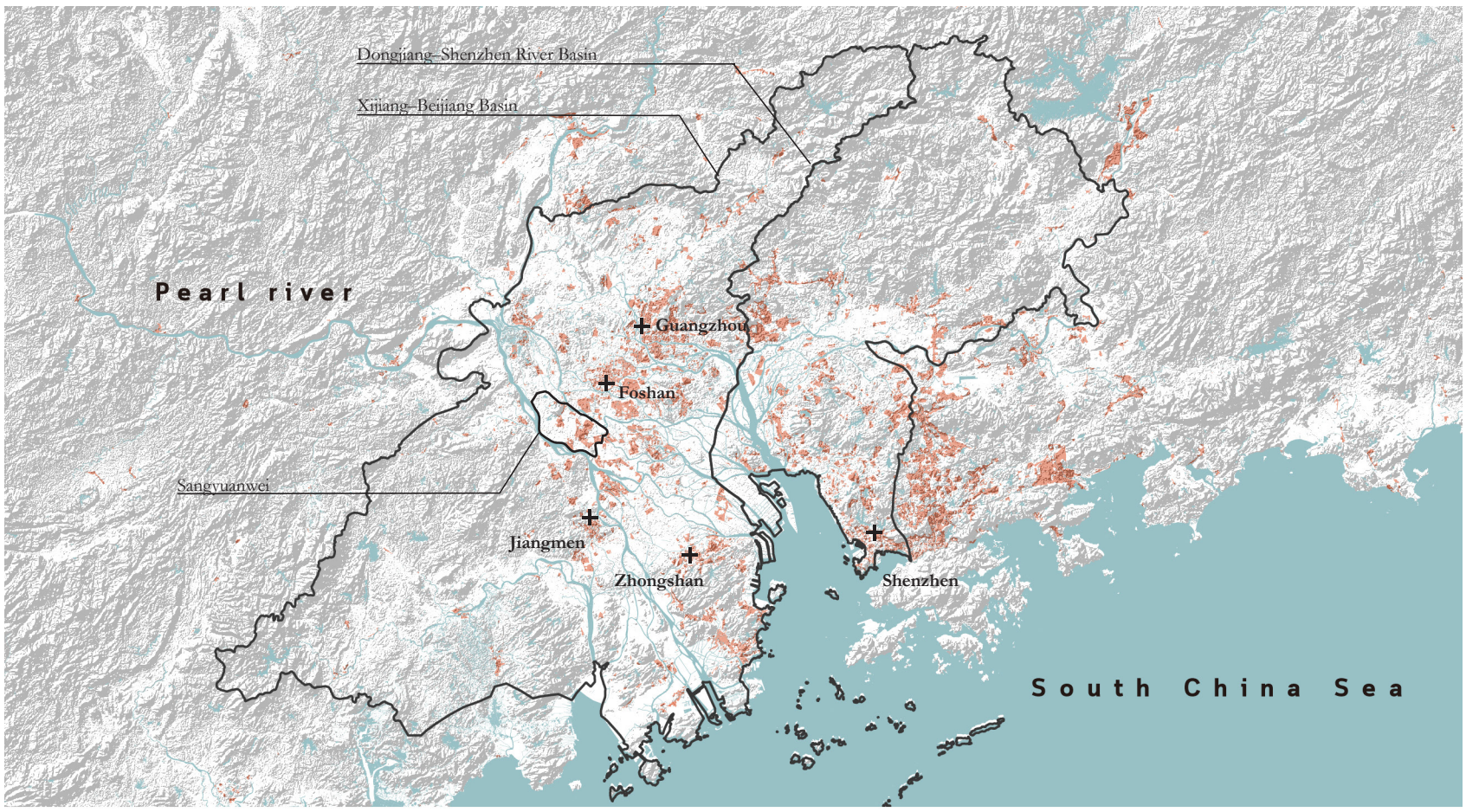
Catchment

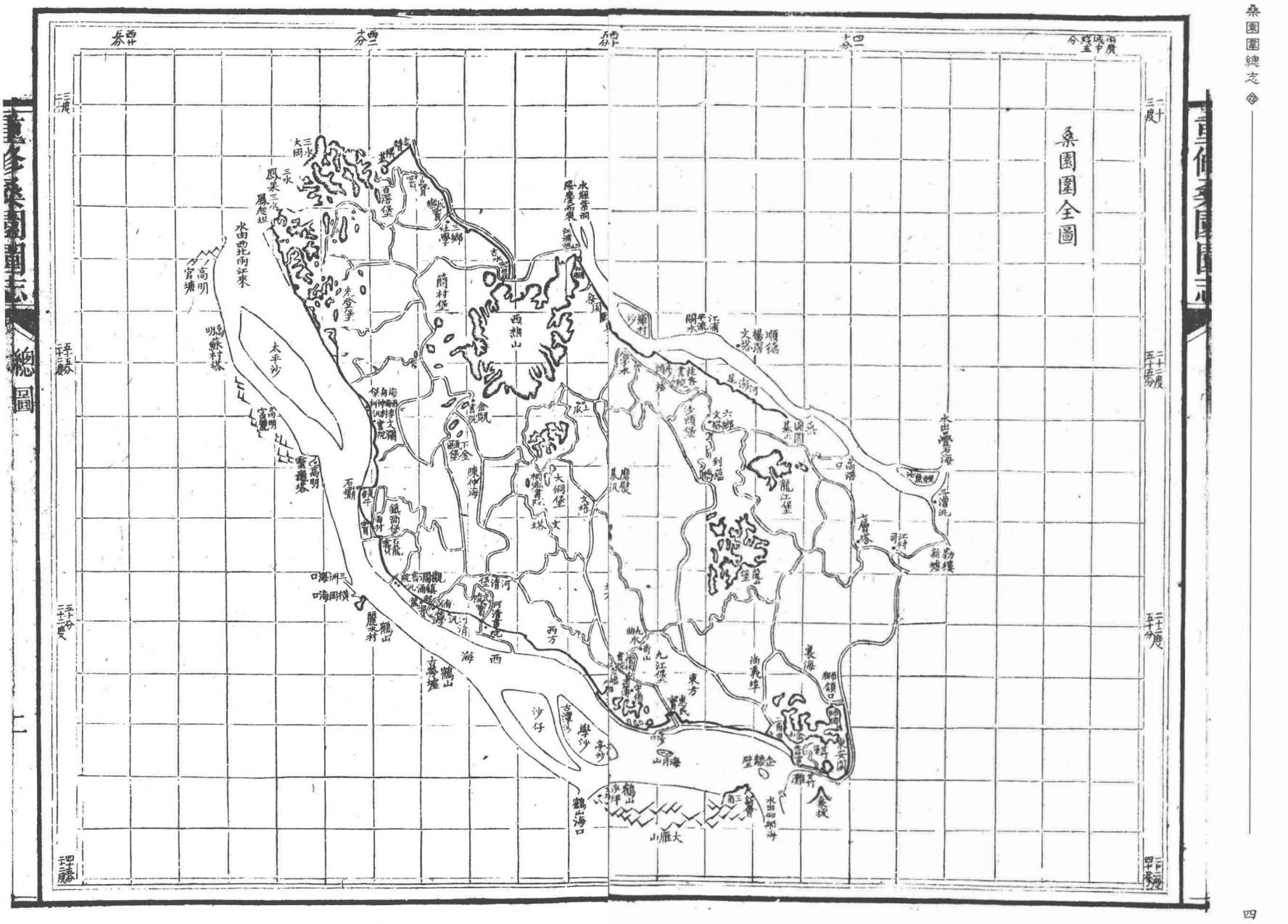
The catchment area of the Pearl River Delta is one of the largest and most complex river drainage systems in southern China. It forms the downstream portion of the Pearl River Basin and is created by the confluence of the Pearl River's three main tributaries—Xijiang (West River), Beijiang (North River), and Dongjiang (East River). This area primarily covers the south-central region of Guangdong Province, including cities such as Guangzhou, Foshan, Dongguan, Zhongshan, Jiangmen, Shenzhen, and Zhuhai, ultimately discharging into the South China Sea through the Pearl River Estuary.

The Pearl River Delta is typically divided into two major sub-basins: the Xijiang–Beijiang Basin and the Dongjiang–Shenzhen River Basin. This division reflects internal differences in water sources and geographic characteristics. The Xijiang–Beijiang Basin mainly receives inflow from the western and northern parts of the Pearl River Basin and flows through areas including Foshan, western Guangzhou, Zhongshan, and Jiangmen. This sub-basin has a complex river network with numerous tributaries. It serves as an important foundation for agricultural irrigation and fisheries development, retaining a relatively complete network of irrigation infrastructure and traditional aquaculture practices such as the mulberry-dike fish pond system. Historically, the region has been prone to flooding, making it a focal area for water resource management and flood control.

Since the Song Dynasty, extensive hydraulic engineering projects have been carried out in the Pearl River Delta, including the anthropogenic reorganization of naturally divided catchment areas. The term "wei"(围) is used locally to refer to reclaimed and managed polder-like agricultural areas. Sangyuanwei, located in the central part of the Pearl River Delta, is surrounded by three rivers: the main course of the Xi River to the west, the Deshui Channel—part of the Bei River system—to the east, and the Ganzhu Stream to the southeast, which connects the two rivers. These three rivers form the main dike boundaries of Sangyuanwei. Within the polder, the dense river network includes 23 major watercourses totaling 131.26 kilometers, along with numerous smaller tributaries and canals, forming a unique Lingnan water village landscape (according to the "Conservation and Utilization Plan for the Sangyuanwei World Heritage Irrigation Project in Foshan").

Although Sangyuanwei is managed as a single water system, its internal water network can still be categorized into three sub-systems: the Xi River system, the Bei River system, and the Southern Tidal Water system.




桑園圍全圖
桑園圍總圖
西樵山
太平沙
龍江堡
九江堡
尚義埠
鶴山
大雁山
沙仔
海
西
東方
裏海
水出三江口合流入海
水由思賢江來
水經常德隆慶而來
水出三水大河
水出順德大良
水出順德龍江
水出順德江浦
水出順德楊滘

Climate

Climate zone:	Humid subtropical climate with dry winters (Köppen: Cwa)
Sub-climate:	Marginal tropical humid area

Climate & Weather Averages

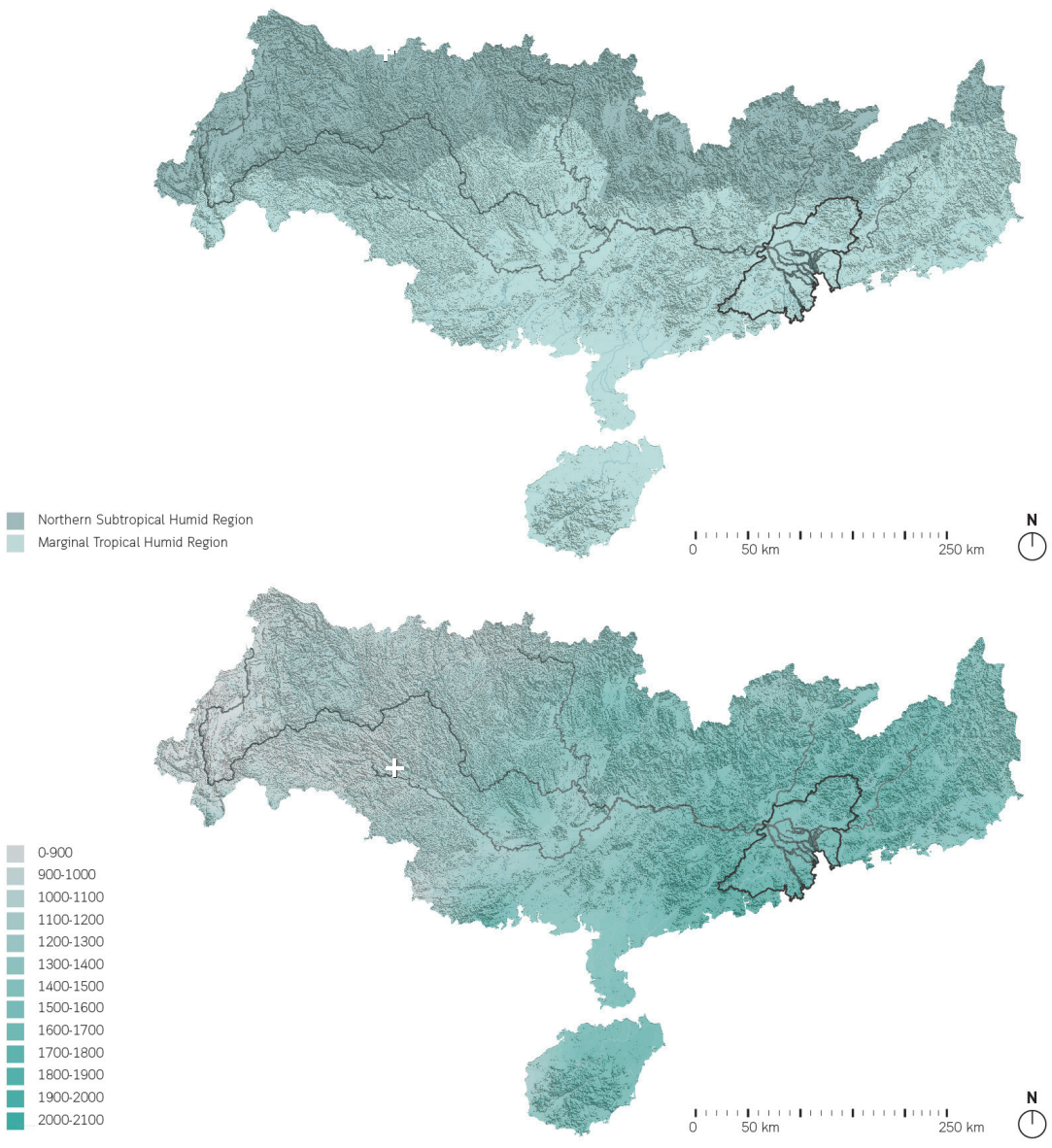
High tº:	28–33 °C (July–August)
Low tº:	10–14 °C (January–February)
Mean tº:	21–23 °C (Annual average)
Precipitation:	1600–2600 mm/year
Humidity:	75%–85% (Relative humidity average)
Wind:	2–4 m/s average, stronger during typhoon season
Pressure:	~1005–1015 hPa
Hottest Months:	July–August
Coldest Month:	January
Wettest Months:	May–September
Windiest Months:	July–September
Annual Rainfall:	2000 mm

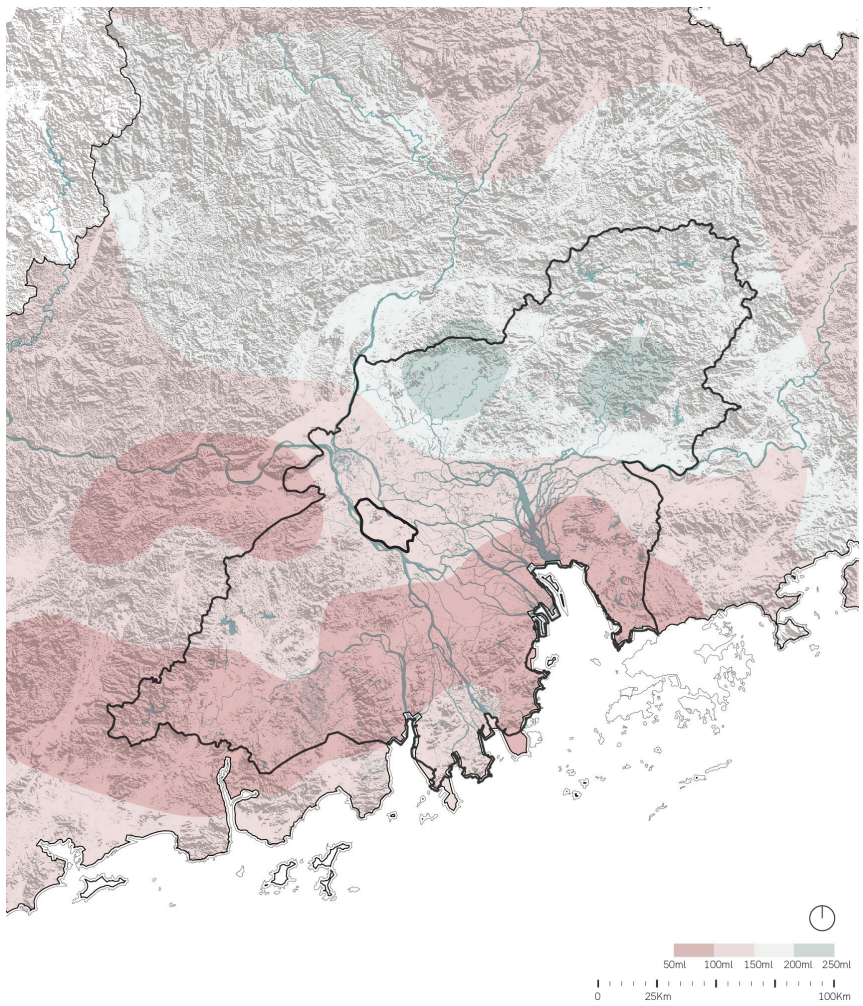
In the Chinese climatic regionalization system, this area is classified as a marginal tropical humid region, lying at the northern edge of the tropics. This classification highlights its transitional nature, where tropical climatic characteristics—such as high temperatures and abundant rainfall—gradually shift toward subtropical patterns. Such conditions support long growing seasons, year-round biological productivity, and favorable environments for water-based agricultural systems.

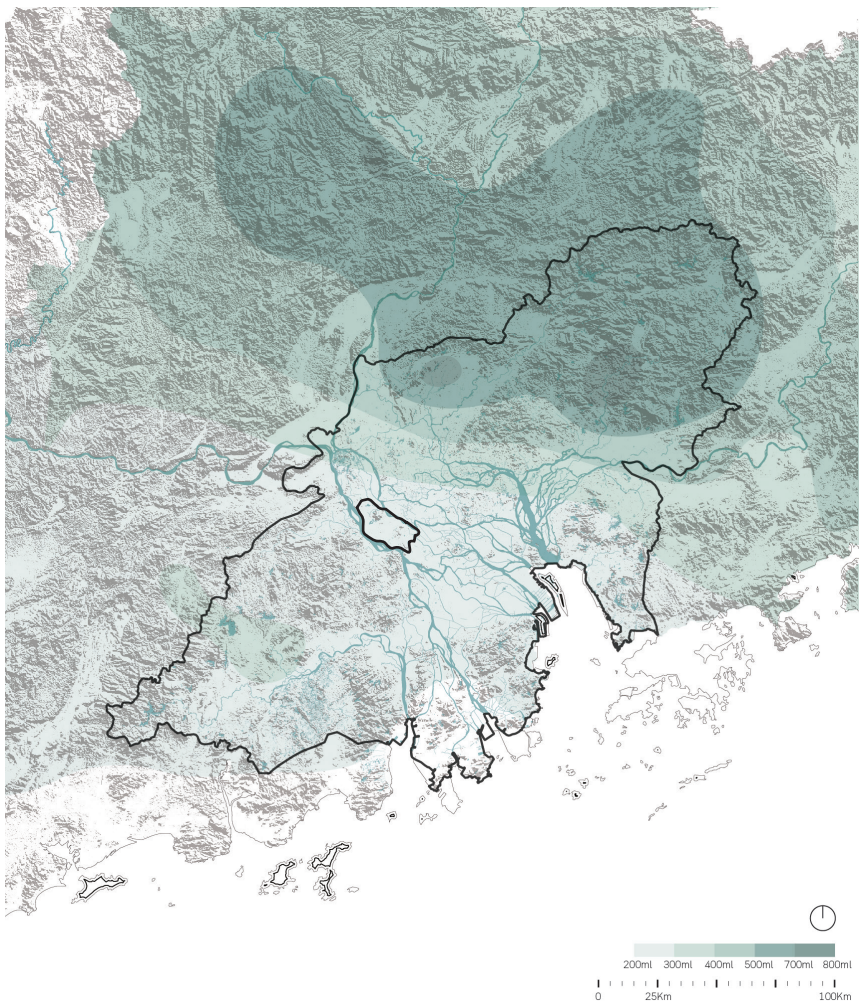
The annual average temperature ranges between 21°C and 23°C, and extreme low temperatures are rare. Annual precipitation typically falls between 1,600 and 2,600 millimeters, with over 70% of the rainfall occurring during the rainy season from April to September. Intense rainfall in spring and early summer, along with typhoons in late summer and autumn, are the primary causes of heavy rainstorms and flooding in the region. Due to significant maritime influence, the air is highly humid, with an annual average relative humidity of approximately 75% to 85%. The heavy rains during the spring–summer transition are locally referred to as “Dragon Boat Water” (Longzhou Shui), coinciding with rising water levels and traditional dragon boat racing activities held during this period.

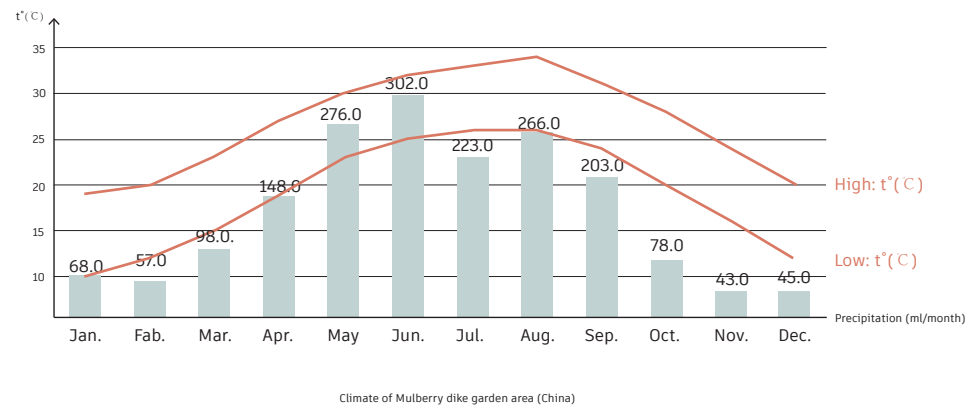
Given the region’s climatic conditions, seasonal rainfall—particularly during the rainy season—constitutes a vital water source for both agricultural cultivation and aquaculture in Sangyuanwei. This climate provides Sangyuanwei with abundant water resources and favorable agricultural conditions, while also supporting the development of a dense river network and a dynamic estuarine ecosystem.

Sangyuanwei lies on the flat alluvial plain of the Pearl River Delta, where moisture easily accumulates, leading to frequent rainfall. Influenced by humid air from the South China Sea, the area is warm and rainy throughout the year. Its low elevation makes it prone to waterlogging and flooding during rainy and typhoon seasons, affecting farming and fishery.









Climate of Mulberry dike garden area (China)

Sangyuanwei, located in the water-rich and flat Pearl River Delta, experiences heavy rainfall and is prone to waterlogging. Therefore, effective drainage and water storage systems are crucial for water management and flood control.



Dragon Boat Competition (赛龙舟)



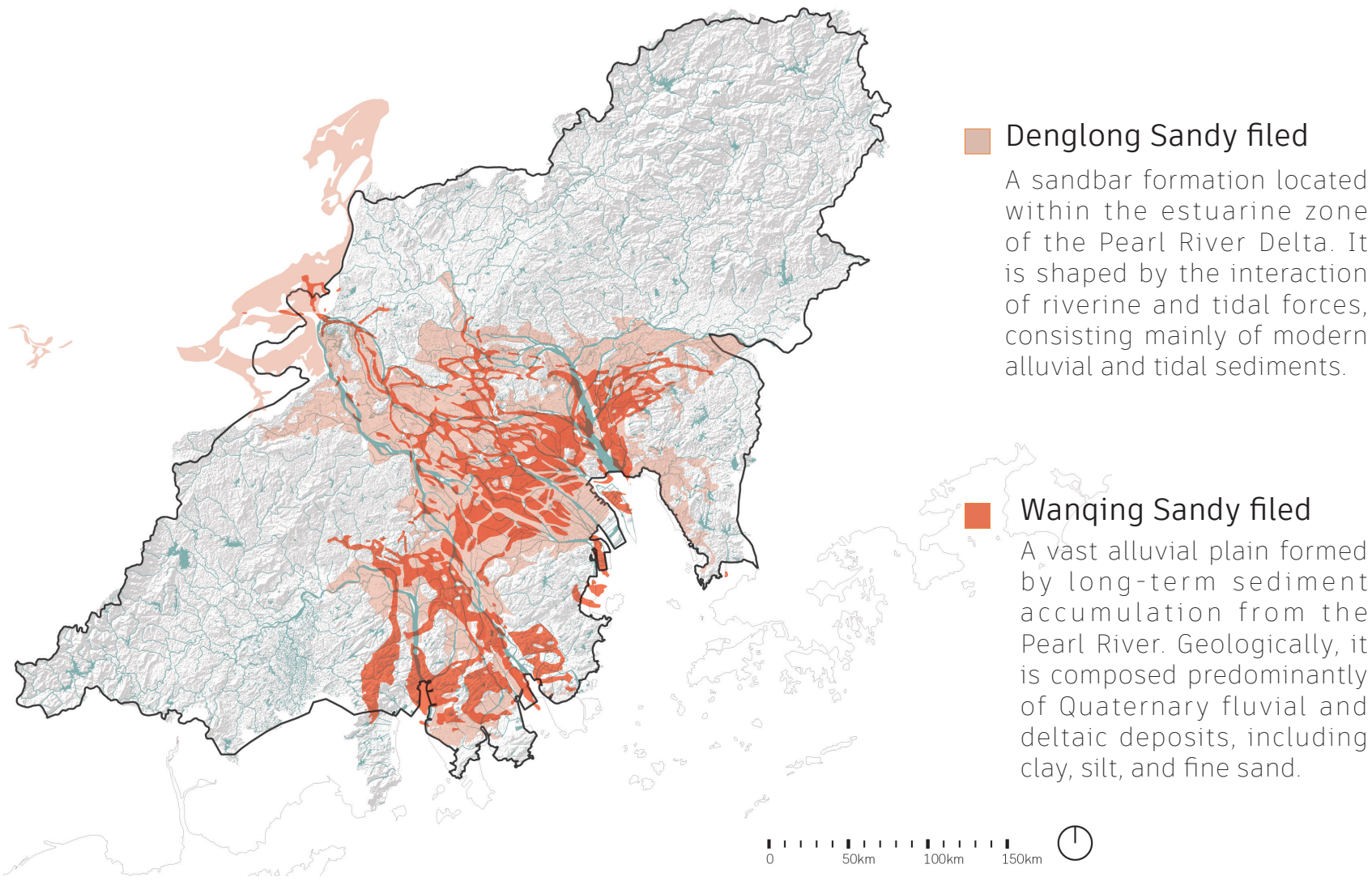
From sea to cultivation land: Land transformation and water system evolution

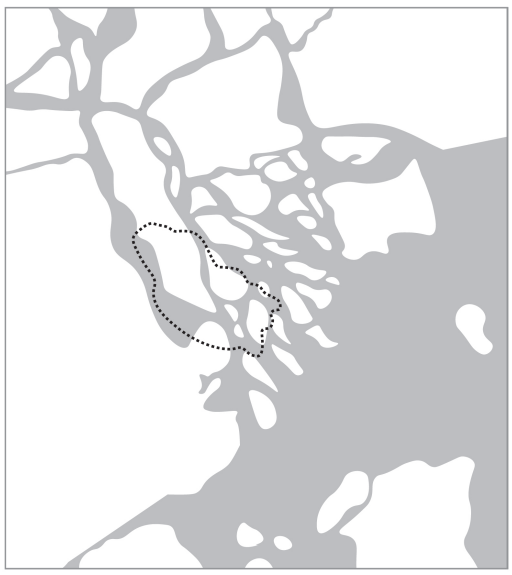
Landform, Soil as a Foundation for Future Reclamation

Soil

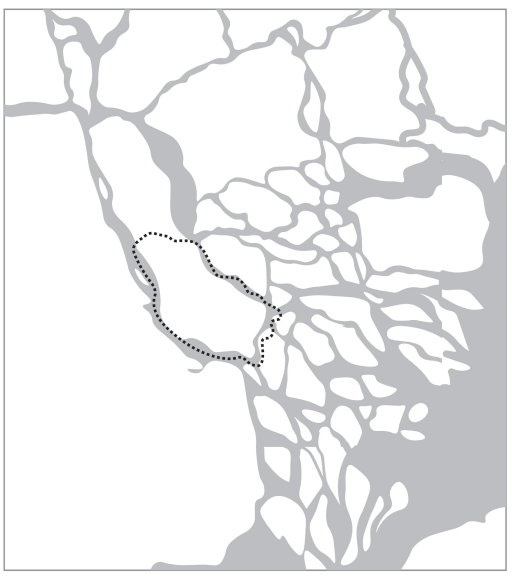
The Pearl River Delta region gradually developed from an ancient shallow bay, where prolonged land-sea alternation left behind a large amount of sediment, forming a delta plain that is a combination of various historical marine and land plains. This process provided a complex yet fertile soil foundation for agricultural development (Zhao, Yang, 2011). According to the classification of hills, river alluvial plains, and coastal deltas, soil types vary due to climate, topography, hydrology, parent material, vegetation, and human activities (Luo, 2012). The sandfield area, where agricultural activities are densely distributed, is mainly concentrated in the river alluvial plain area (Wu, Zhang, Xv, 2024).

The Pearl River Delta has abundant water resources, a suitable climate, and fertile soil, making it highly suitable for agricultural development (Zhao, Yang, 2011). The soils in the Pearl River Delta along the river plains, including the Sangyuanwei area, range from the riverbank to the hills, and are characterized by paddy soils and lateritic red soils. Paddy soils and rice soils are significantly influenced by human activity, especially long-term rice cultivation and water management practices (Xiong, 1987). The paddy soils in the river alluvial areas of the Pearl River Delta can generally be classified as river alluvial retention paddy soils and flood alluvial retention paddy soils. The early basic soils were primarily alluvial soils formed by river deposition (Alluvial Soil) and long-term waterlogged retention soils (Gley Soil). Although they have their advantages and disadvantages, both types provide a good basis for cultivation. The soil in Sangyuanwei is generally dominated by alluvial soil, and through the construction of embankments and irrigation facilities, water retention is achieved and soil structure is improved. Typically located in low-lying river network areas, the soil is often moist alluvial soil. After years of cultivation and rice planting practices, the soil gradually transforms into paddy soil, making it suitable for rice growth.

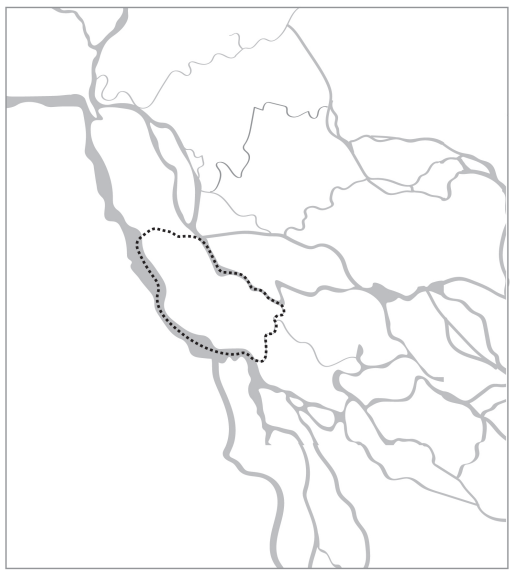




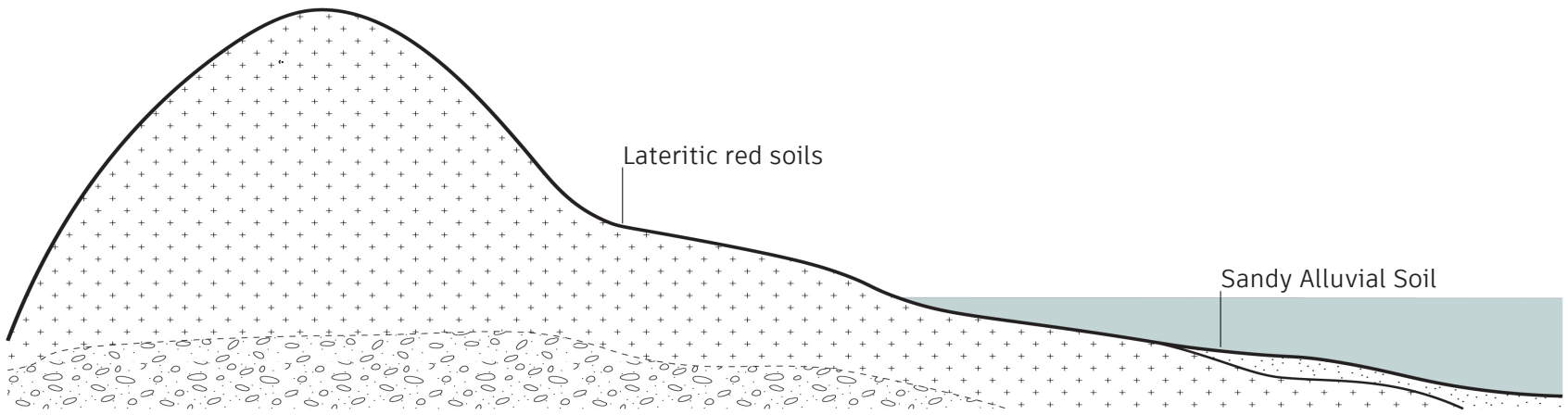
Neolithic period

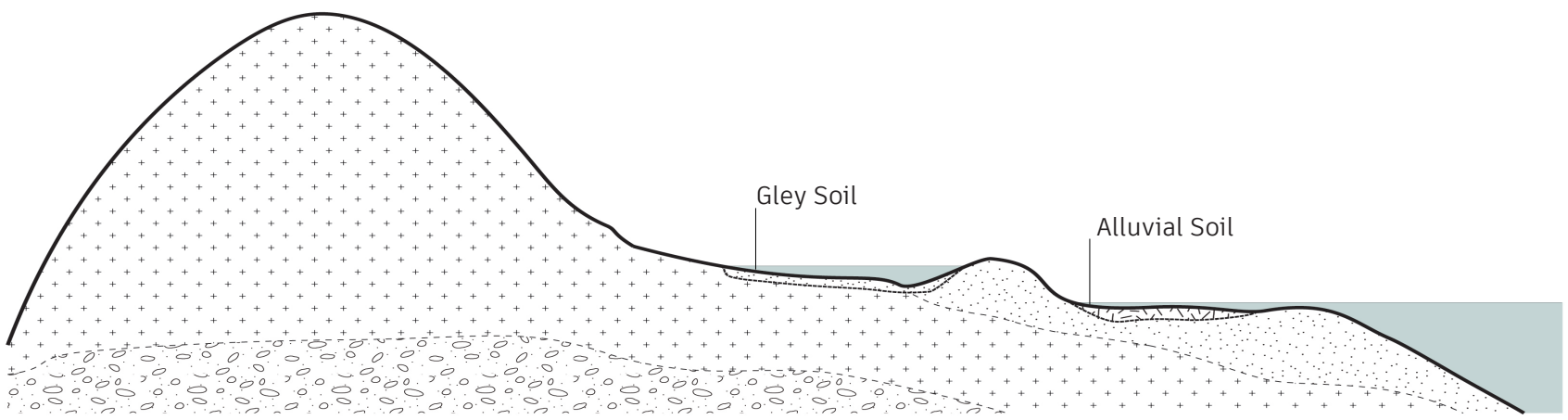


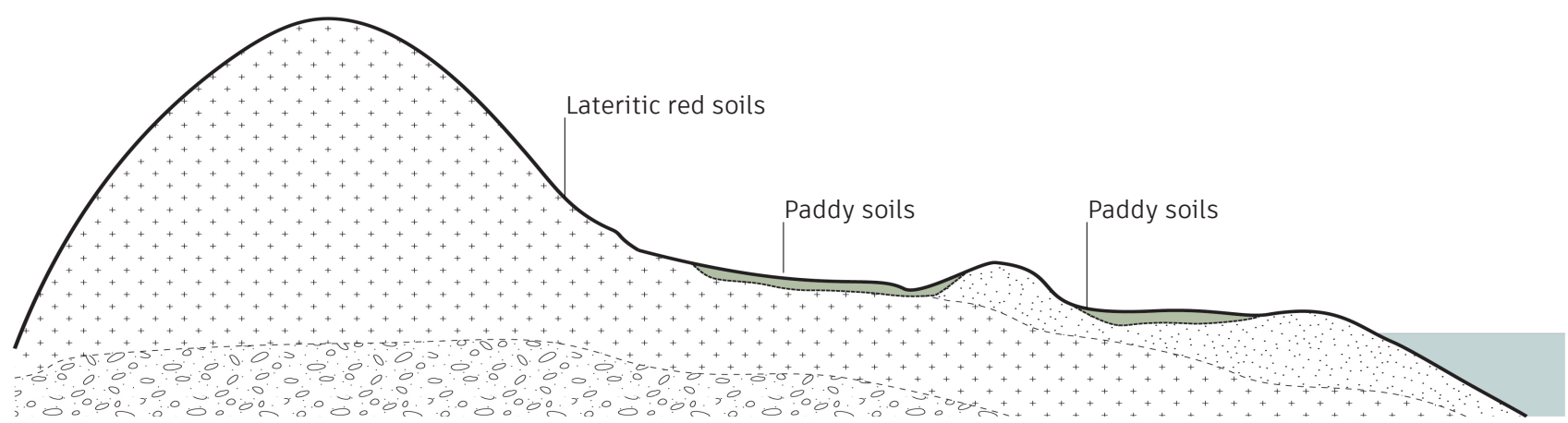
12th century

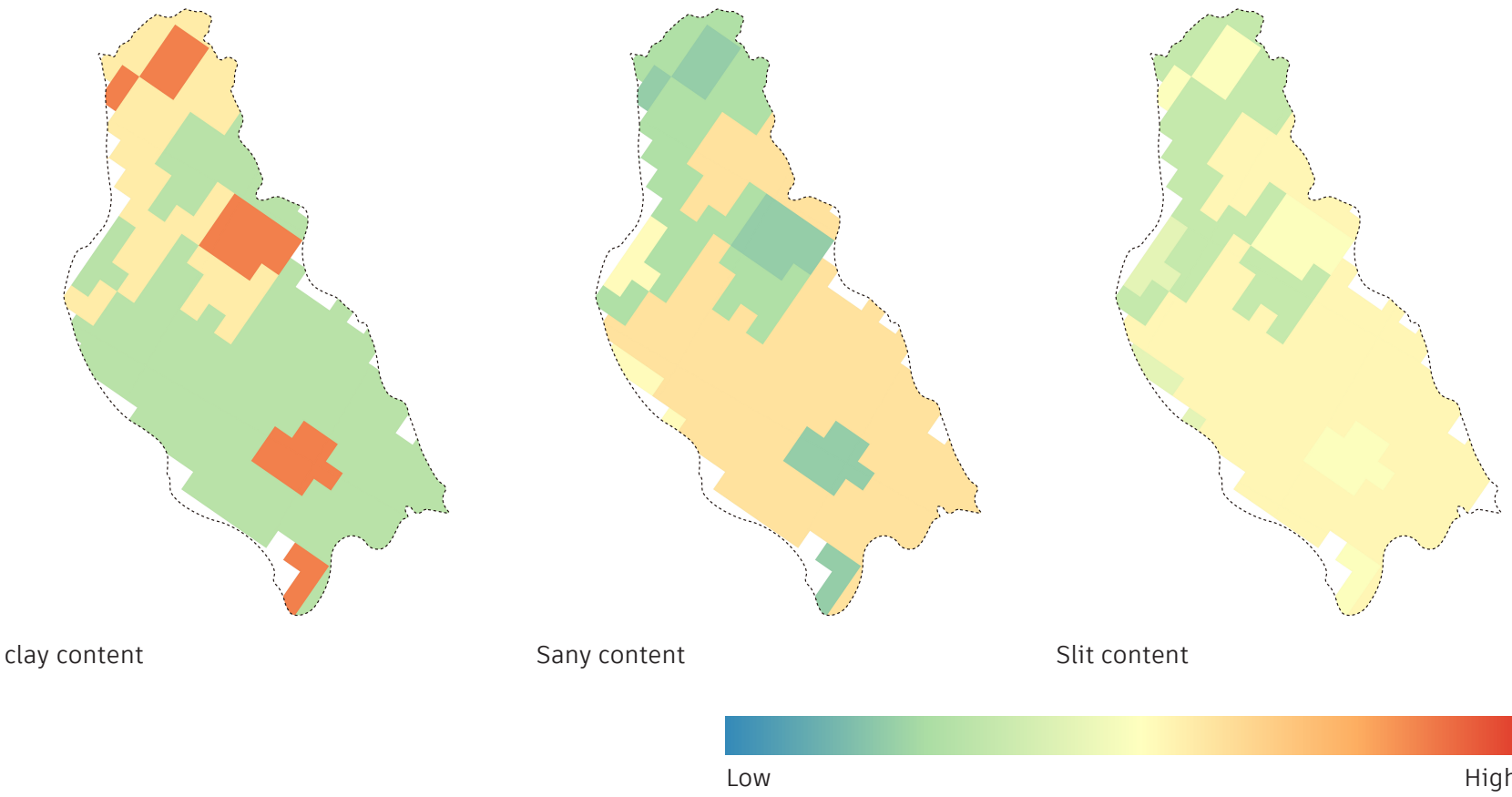


Present day











Landfrom

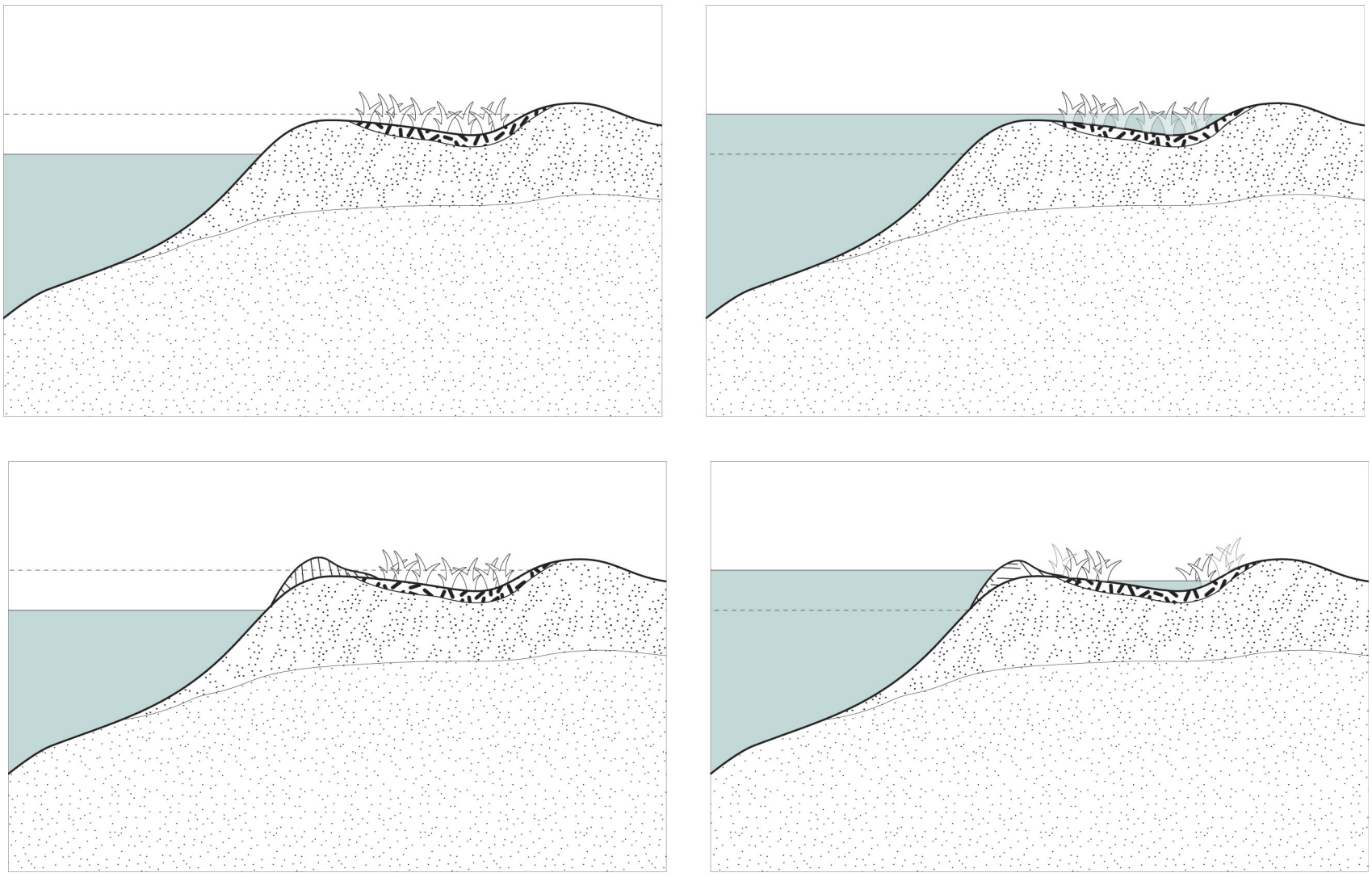
Sangyuanwei is located in the central part of the Pearl River Delta, situated in the alluvial plain formed by the confluence of the Xijiang and Beijiang rivers. It is a typical hilly terrace area for embankment agriculture. The region generally slopes from northwest to southeast, with a dense river network and rich water systems, providing favorable natural conditions for agricultural development and land reclamation activities. Geographically, the Sangyuanwei area is dominated by hills, ridges, and ancient terraces, with altitudes ranging from 10 to 25 meters, while some higher elevations, such as Xiqiao Mountain, reach over 150 meters. These hilly terraces are elevated above the surrounding areas, making them ideal for constructing embankments for land reclamation. The ancient terraces along the main streams of the Xijiang and Beijiang rivers, such as Feisuiling and Ganzhutang, present characteristics of high, flat terraces with gentle ridges, with elevations between 20 and 30 meters. The Xijiang river passes through the hilly terrace region, causing embankments on the east bank to often rely on these hilly terraces, thereby enhancing the stability of the reclamation and its flood control capabilities. Additionally, the outer areas of the terraces are often low-lying, with elevations around 0.5 meters, consisting of floodplains and alluvial plains. The terrain is flat, drainage is poor, but the soil is fertile, making it suitable for aquaculture and rice farming (Xi, 2016).

This typical river alluvial plain is densely crisscrossed by rivers and influenced by the monsoon climate, where rainfall is concentrated and abundant, allowing rainwater and floodwaters to accumulate quickly (Zhao, Yang, 2011). In its early days, Sangyuanwei was located in the brackish water confluence zone, where the indigenous people primarily relied on fishing and hunting, making crop cultivation and production difficult. The early inhabitants attempted to use brackish water resources for agricultural production, which led to the development of "tidal fields," a form of single-crop farming. However, this farming method had high maintenance costs, low yields, and was highly dependent on tidal movements, making it a less productive farming method (Zhao, Yang, 2011). While rain and rivers posed the risk of floods and waterlogging, they also provided valuable freshwater resources, which became an indispensable foundation for agricultural production. By the Song Dynasty, with the continued development of society, the central Pearl River Delta began to attract large numbers of migrants, leading to increasingly dense populations and rapid land development. In response to frequent flood risks, to ensure settlement safety, and to meet the agricultural demand for stable freshwater supplies, the construction of water management infrastructure became a significant part of the region's development wave.

"番禺，濒海皆腥咸蚝蛤区，潮水溉之，泻卤立可稻，是谓潮田"

——宋初的《番禺杂记》

Panyu, an area near the sea, is abundant with salty oysters and clams, irrigated by tidal waters, and with brine being quickly drained for rice cultivation. This is called tidal fields



Early hydrological process

Since prehistoric times, the Pearl River Delta region has existed within a shallow bay environment. Although the terrain is low-lying, it has long been inhabited by humans who relied on primitive tidal agriculture and fishing-hunting for subsistence. In the central delta region—particularly around Xiqiao Mountain—settlements were mostly distributed along rivers, forming the spatial foundation for the development of later village patterns.

From the 2nd century BCE to the 10th century CE (corresponding to the Qin and Han through Tang dynasties in China), the Pearl River Delta gradually developed into a typical deltaic landform. Due to continued alluvial deposition, the low-lying areas between Xiqiao Mountain and Foshan rose in elevation, expanding the alluvial plain and increasing the land area suitable for settlement development. Archaeological findings from this period show the emergence of plowing with oxen and paddy field landscapes, signaling a significant transformation in agricultural



10th - 14th

Between the 10th and 14th centuries, water management infrastructure in the Sangyuanwei region began to develop rapidly. The large-scale southward migration of northern populations provided abundant labor, while the rise of towns and markets further stimulated the prosperity of agriculture and hydraulic construction. During this period, previously scattered embankments were gradually connected to form continuous dike lines, and the height of the dikes was continually raised to withstand increasingly frequent flood challenges.



14th -16th

From the 14th to 16th centuries, as the population continued to grow and sandbank (known locally as shatan) sedimentation intensified, extensive land reclamation activities were launched. River siltation led to reduced water flow, prompting rapid expansion of privately built water channels ("private yong") to address freshwater shortages and drainage needs. Although some of these projects temporarily improved local water distribution efficiency, the lack of centralized management and systematic planning led to fragmented governance and dispersed resources. In some cases, reclamation was even undertaken preemptively to encourage siltation for farmland formation. Significant technological advances in land reclamation occurred during this period, such as using sunken ships weighted with stones and grass-mud piling methods, which improved reclamation efficiency and engineering sustainability.



16th -20th

From the 16th to the 20th centuries, shatan areas continued to expand, and major river channels inevitably became more silted and shallow. Early hydraulic works, which lacked comprehensive planning, began to reveal structural deficiencies, exacerbating flood risks. "Competing for sandbanks and farmland" became a norm of local rivalry. In pursuit of family interests and social standing, many private actors built small-scale and scattered dikes and channels, which ultimately weakened the regional flood defense system.

production. Simultaneously, the gradual opening of river channels, such as the Xijiang and Beijiang, established them as major water transport routes, thereby strengthening regional connectivity. As agricultural demand increased, the traditional tidal farming system could no longer meet the dual pressures of population growth and land development. Combined with the flood threats faced by settlements, the need for water management infrastructure became increasingly urgent. From the 6th century onward, the Sangyuanwei area transitioned from small-scale, privately-led reclamation activities to larger, more organized collective embankment projects, gradually forming major dike structures such as the East and West Embankments.

During the Republican period and after the founding of the People's Republic of China, with the establishment of a national governance framework and the reform of land ownership systems, the traditional clan-led water management model was gradually replaced by state administration. Following the institution of state ownership of land, governments at all levels increased investment in and coordinated management of water infrastructure. The construction of large-scale waterworks effectively mitigated flood disasters and provided institutional support and infrastructural foundations for regional agricultural development and urbanization.

In the early stages, reclamation in the Sangyuanwei area primarily used earthen embankments constructed by piling soil on relatively elevated shatan or caotan (grassy banks). This method was simple to execute, used readily available materials, and suited the geographic and technological conditions of the time. However, earthen dikes were weak against erosion and prone to flood damage. Before the Qing Dynasty, internal dikes in Sangyuanwei were typically repaired and elevated repeatedly by adding more soil.

By the Qing Dynasty, advances in hydraulic engineering and rising flood protection demands led to the introduction of stone-structured embankments in Sangyuanwei reclamation works. These stone dikes were more stable and durable, offering better resistance to flood erosion and improving overall protective performance. However, to support agricultural production, trees were often planted on the dike tops, and the root systems of these trees could compromise the integrity of the stone structures, leading to reduced dike stability. As a result, dike maintenance became a long-term and complex task requiring regular inspection and repair of damaged sections to ensure the safety and functionality of the embankments. In the era of the People's Republic of China, modern materials such as concrete and steel reinforcement were gradually introduced into dike repair and construction.

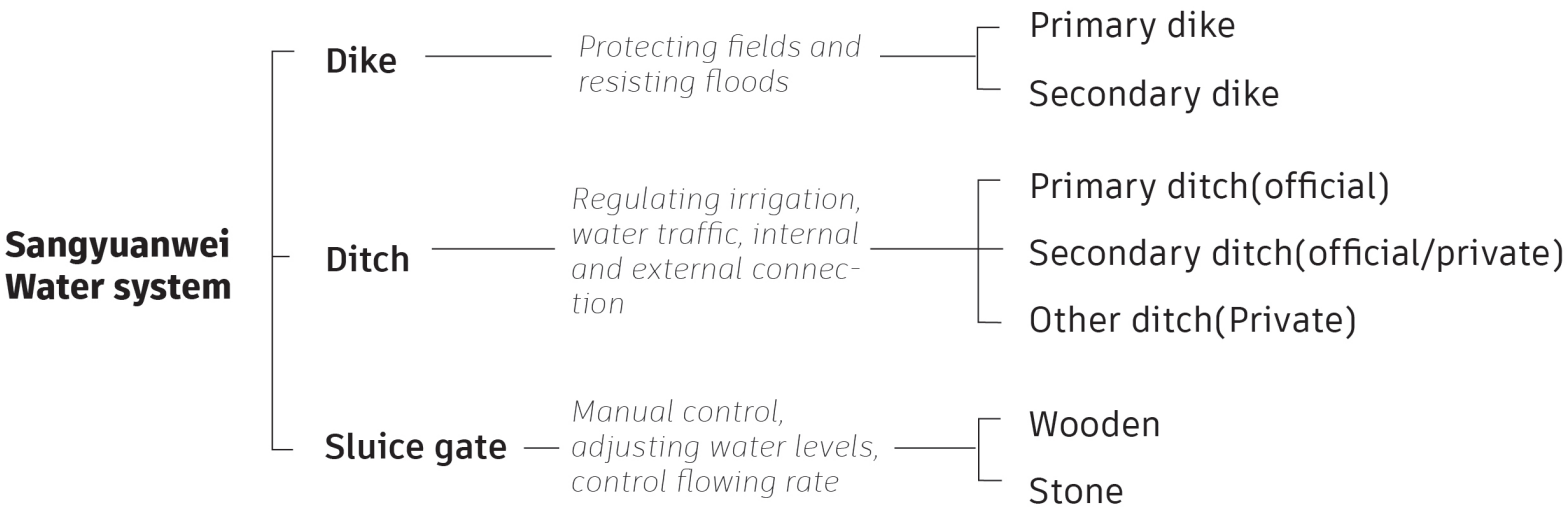
Water system in Sangyuanwei

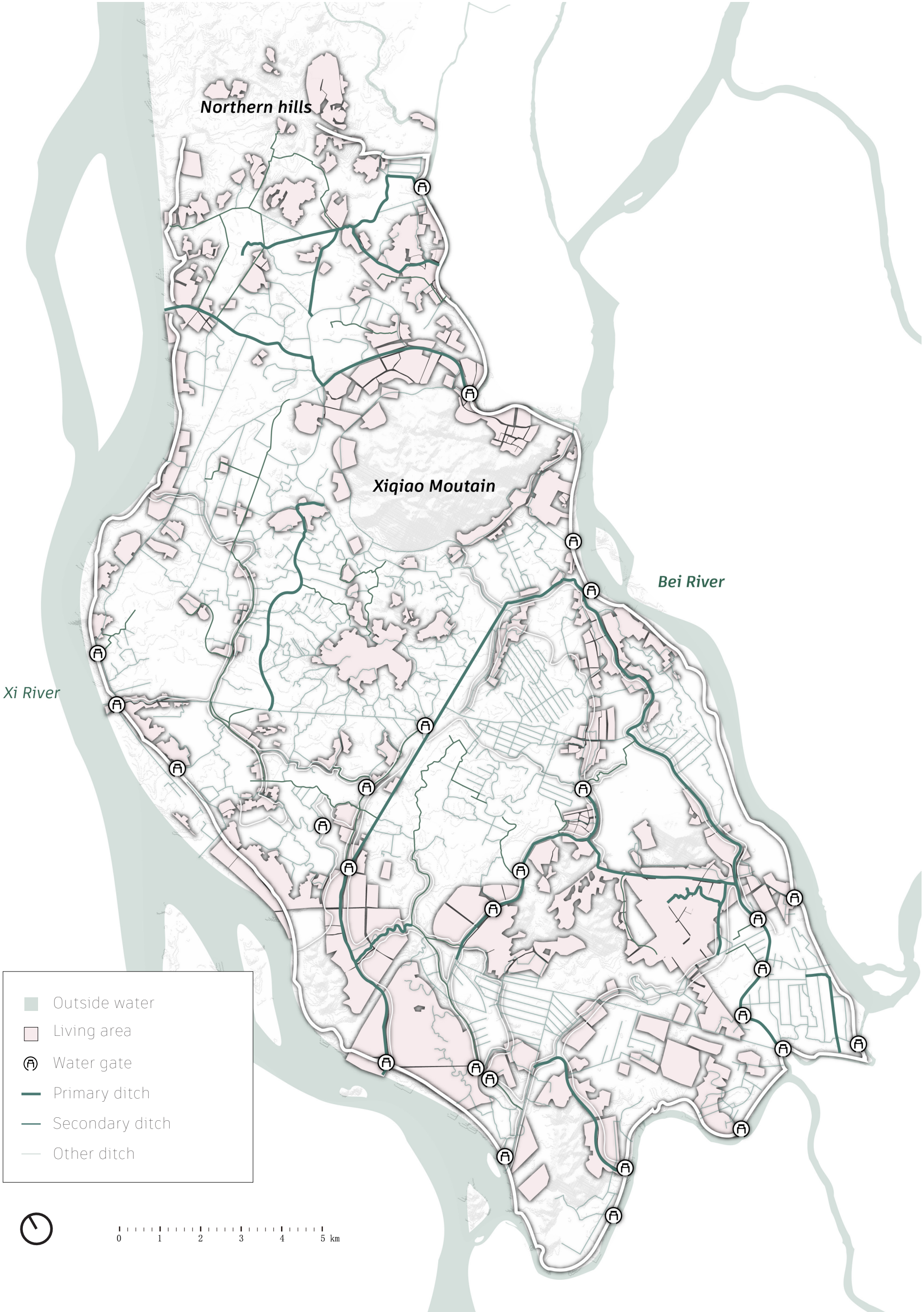
The water management system of Sangyuanwei is a multi-layered and integrated hydraulic network composed of embankments, ditches, and sluice gates, each fulfilling distinct yet interconnected roles in flood control, irrigation, and drainage (Wu, 2016; Zhang, 2021). Structurally, the system includes three main components: embankments, responsible for protecting farmland and resisting floods; ditches, which manage water retention and discharge, facilitate transportation, and link interior and exterior water bodies; and sluice gates, which allow for manual control of water levels and flow rates.

The embankment system itself is hierarchically organized. The outer embankment functions as the primary line of defense against riverine floods, enclosing large areas of agricultural land. Inside the outer embankment, sub-embankments provide further protection against internal waterways and are typically constructed by villages or clan groups to secure localized land interests. At a smaller scale, pond embankments enclose single fishponds or rice paddies, allowing for precise water management within the agricultural landscape (Zhang, 2021; Wang & Huang, 2023).

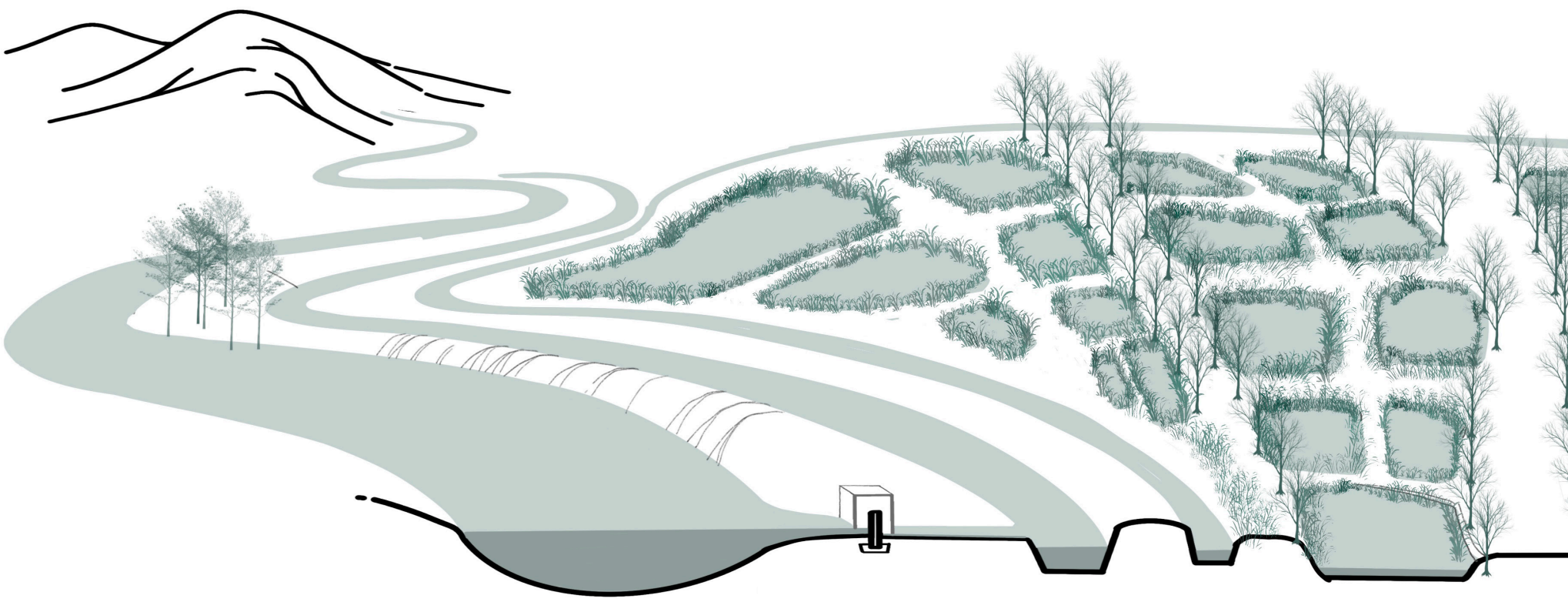
The ditch network is divided into official ditches, managed at the communal or regional level, and private ditches, constructed by households or lineage groups. This branching system enables flexible water allocation for irrigation and ensures connectivity between farmland, fishponds, and outer rivers. Sluice gates, including wooden sluices and stone sluices, serve as key control points within the network. These structures are essential for regulating water exchange between the interior agricultural areas and the external water system. By adjusting the gates based on seasonal rainfall and tidal conditions, communities could balance flood protection with freshwater supply needs (Wu, 2016).

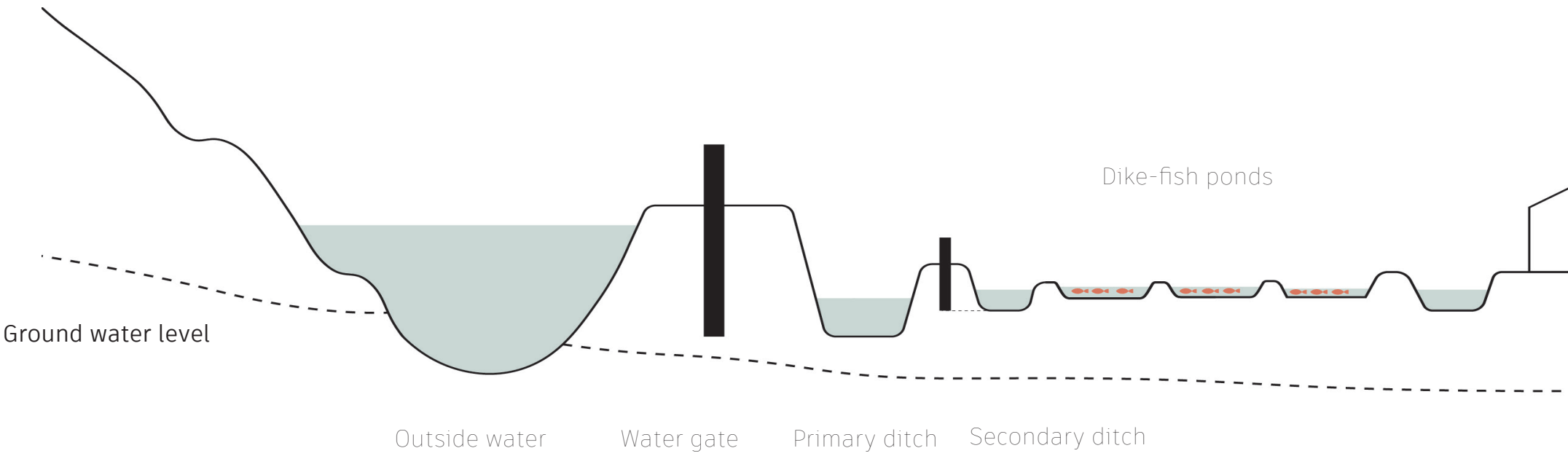
Within this complex water infrastructure, a highly interactive relationship between agriculture and hydraulic management emerged. The layout of farmlands and pond systems relied heavily on the coordinated operation of ditches and sluice gates. The joint function of embankments, ditches, and gates ensured timely irrigation and flood drainage, thereby securing seasonal agricultural productivity and reinforcing spatial resilience (Zhang, 2021; Wu, 2016).

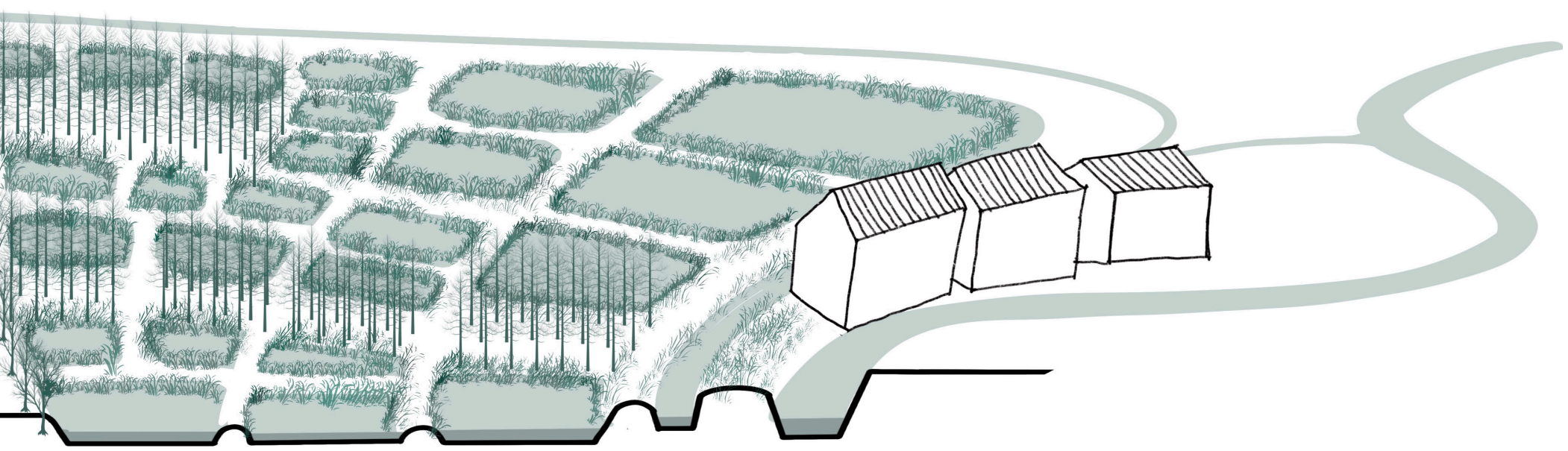


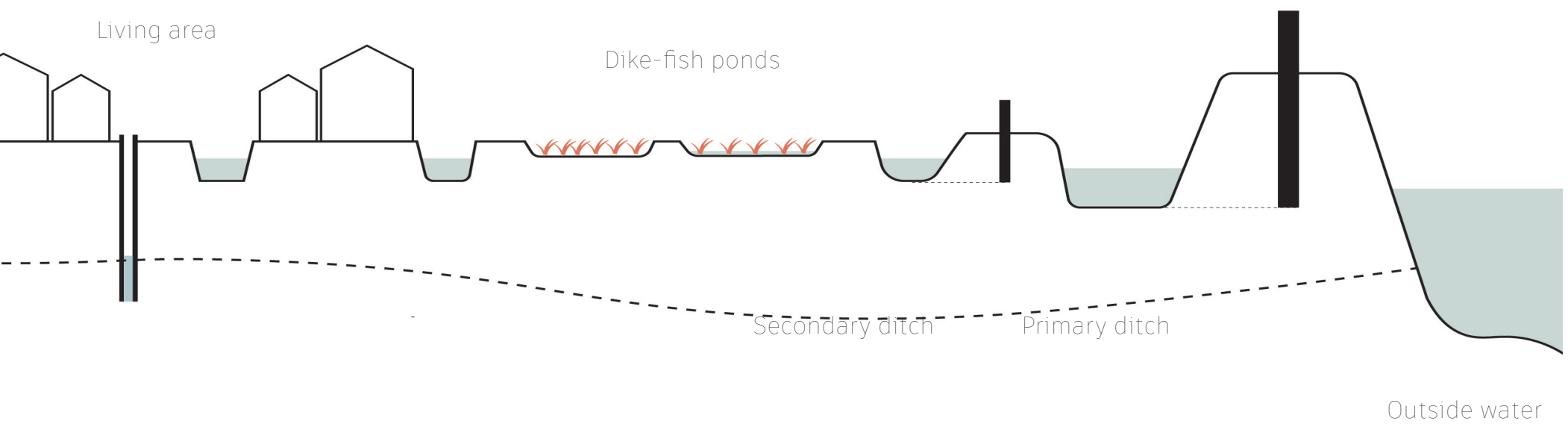

Northern hills
Xiqiao Moutain
Bei River
Xi River
Outside water
Living area
Water gate
Primary ditch
Secondary ditch
Other ditch
0
1
2
3
4
5 km

From sea to cultivation land: Land transformation and water system evolution






Living area


Living area
Dike-fish ponds
Secondary ditch
Primary ditch
Outside water

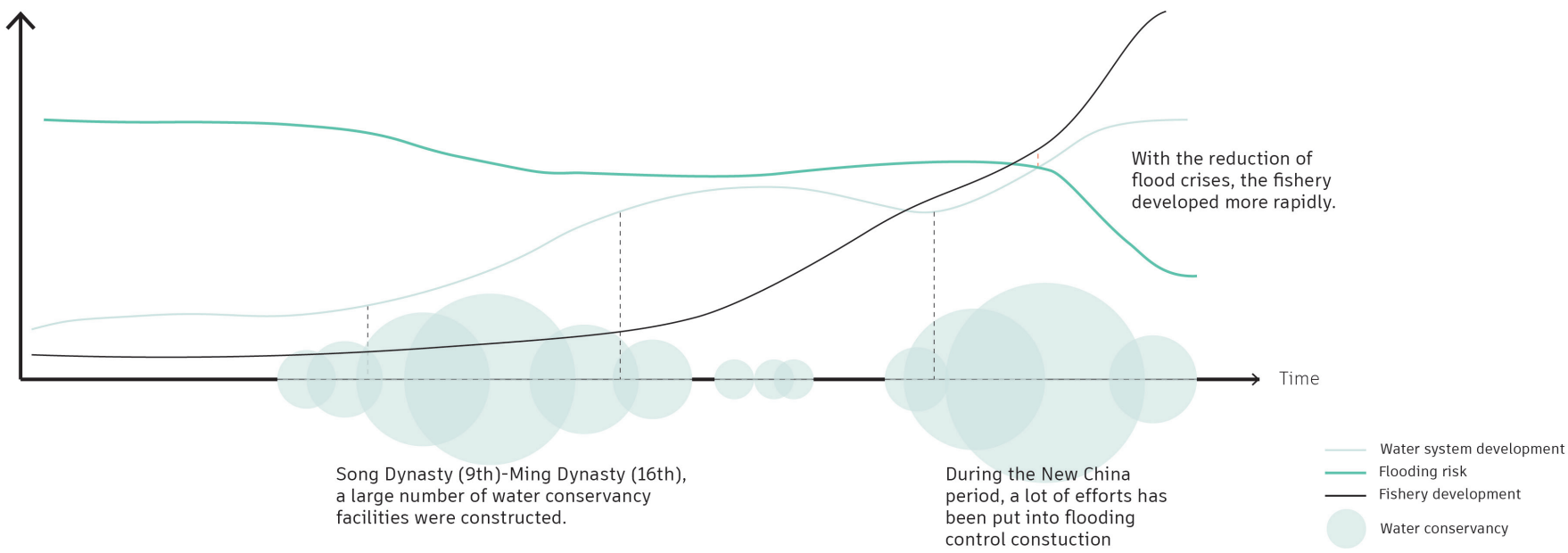
Contemporary construction of water system

In recent years, the continuous construction of water management systems has not only effectively mitigated flood disasters but also profoundly impacted the distribution of water resources in fishery production.

Firstly, large-scale urban development and the expansion of industrial zones have significantly altered both the number and spatial distribution of water channels in the region. Taking Sangyuanwei as an example, comparative analysis of historical maps and remote sensing images reveals a drastic reduction in the number of water channels still in reasonable use since the Qing Dynasty. Meanwhile, the hierarchical structure of these channels has also changed significantly. Some main channels, which originally played a dominant role in irrigation and drainage, have been compressed, cut off, or downgraded to secondary channels due to regional development, thereby weakening the connectivity and storage capacity of the water system.

Secondly, while upstream water infrastructure—particularly dams and reservoirs—has effectively controlled flood risks, it has also caused notable changes to downstream hydrological conditions. Monitoring data show that, due to the construction of numerous reservoirs and human sand mining activities, the long-term average water levels at several key sites in the lower reaches of important tributaries near Sangyuanwei, such as the Beijiang, Dongjiang, and parts of the Xijiang Delta, have significantly declined compared to the past (Tang & Duan, 2021). As a result, the original gravity-fed water diversion system, which relied on the water level difference between outer rivers and inner channels, has gradually failed.

According to field research, current fishery production heavily relies on real-time water exchange. In the face of water allocation challenges, fish ponds in the Sangyuanwei area now depend on artificial water diversion and drainage systems. Surveys indicate that the area has widely installed water pumping stations and pipeline systems to lift water from outer rivers to higher elevations, from which it is distributed into fish ponds through pipe networks. Wastewater from the ponds is discharged into lower-level channels and then directly released outside the region. This energy-intensive system, when operated long-term, has led to widespread water pollution, placing continuous pressure on water quality and ecological health.





Old ditch system



Current ditch system



Ganzhu Hydroelectric Power Station, Source from Pengpai News, 2022

Dike-ponds system as a hybrid production landscape

Agriculture evolution

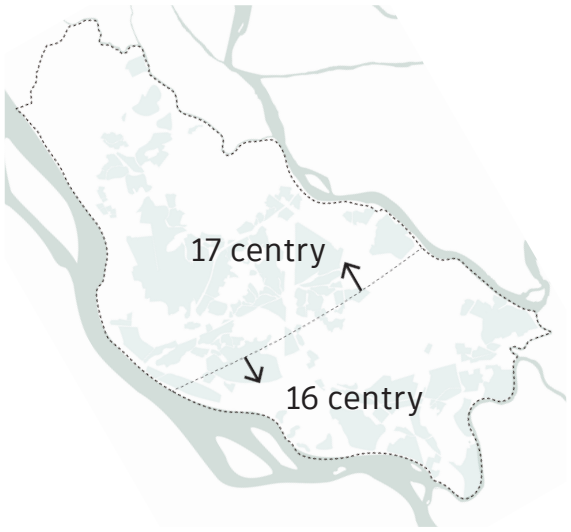
The Sangyuanwei area in the Pearl River Delta has had early water management infrastructure and agricultural activities dating back to the 3rd to 4th centuries BCE. Residents relied on the low-lying terrain for primitive cultivation and sustained their livelihoods through fishing and hunting. However, due to the flat topography and frequent flooding, agricultural production remained unstable for a long time, and the region lacked a developed water management system. It was not until the pre-Song dynasty period that local residents began privately constructing small-scale waterworks to improve the land, combat floods, and gradually develop small-scale agriculture.

In response to recurrent flooding, residents devised unique, site-specific strategies—such as digging ponds for fish farming in low-lying areas. This approach not only adapted to the flood-prone environment but also demonstrated a high degree of ecological wisdom: on the one hand, the ponds retained more water storage capacity, effectively mitigating flood peaks; on the other hand, the excavated sediment was used to backfill pond embankments or dikes, raising ground levels and reinforcing flood defenses. This created a three-dimensional flood management model of "digging low and filling high," making pond-based fish farming a major agricultural practice in the region at the time.

By the Northern Song period (1102–1110), the government began organizing large-scale dike construction projects. During the Hongwu reign of the Ming dynasty, surrounding dikes and embankments were further integrated, gradually forming a closed polder-based agricultural system in Sangyuanwei. Intensive farming techniques increased grain yields and facilitated trade with agricultural regions beyond the local area. As the agricultural environment improved and the commodity economy developed, residents began pursuing higher-value crops beyond basic grain production, prompting a gradual transformation of the cropping structure.

By the 11th century, sugarcane was widely cultivated in Sangyuanwei, and sugar products such as "rock sugar" became tribute items, reflecting the region's growing economic importance. In the 14th century, as land development accelerated, forestry also began to develop, supplying timber for dike construction and settlement expansion. During the 17th to 18th centuries, the rise of the commodity economy encouraged tea cultivation in hilly areas, leading to the formation of a regional tea industry. By the 19th century, as market demand for silk increased, sericulture (silkworm farming) began to flourish. The mulberry-dike fish pond system rapidly took shape and expanded, forming an ecological cycle in which mulberry trees were planted on the dikes and fish were raised in the ponds. Sericulture gradually replaced other crops to become the dominant agricultural activity.

Dike-fishponds constructed periods





11th Sugarcane



14th Fruit & Vagetable



16th Tea



17th Tea & Vagetable



18th Tea



18th Mulberry

Developed in dike-fish ponds

Developed in dike-fish ponds

Formulation and diversity of the dike-fish ponds layout

The layout of diked ponds in the Pearl River Delta originated from natural waterlogged areas and mudflats surrounding villages. Initially, basic pond structures were formed through seawall construction and land reclamation or by excavating fields to create ponds. At this early stage, the ponds were mainly used for fish farming, while agricultural and aquaculture zones remained relatively separate, and an integrated cultivation-aquaculture system had yet to emerge.

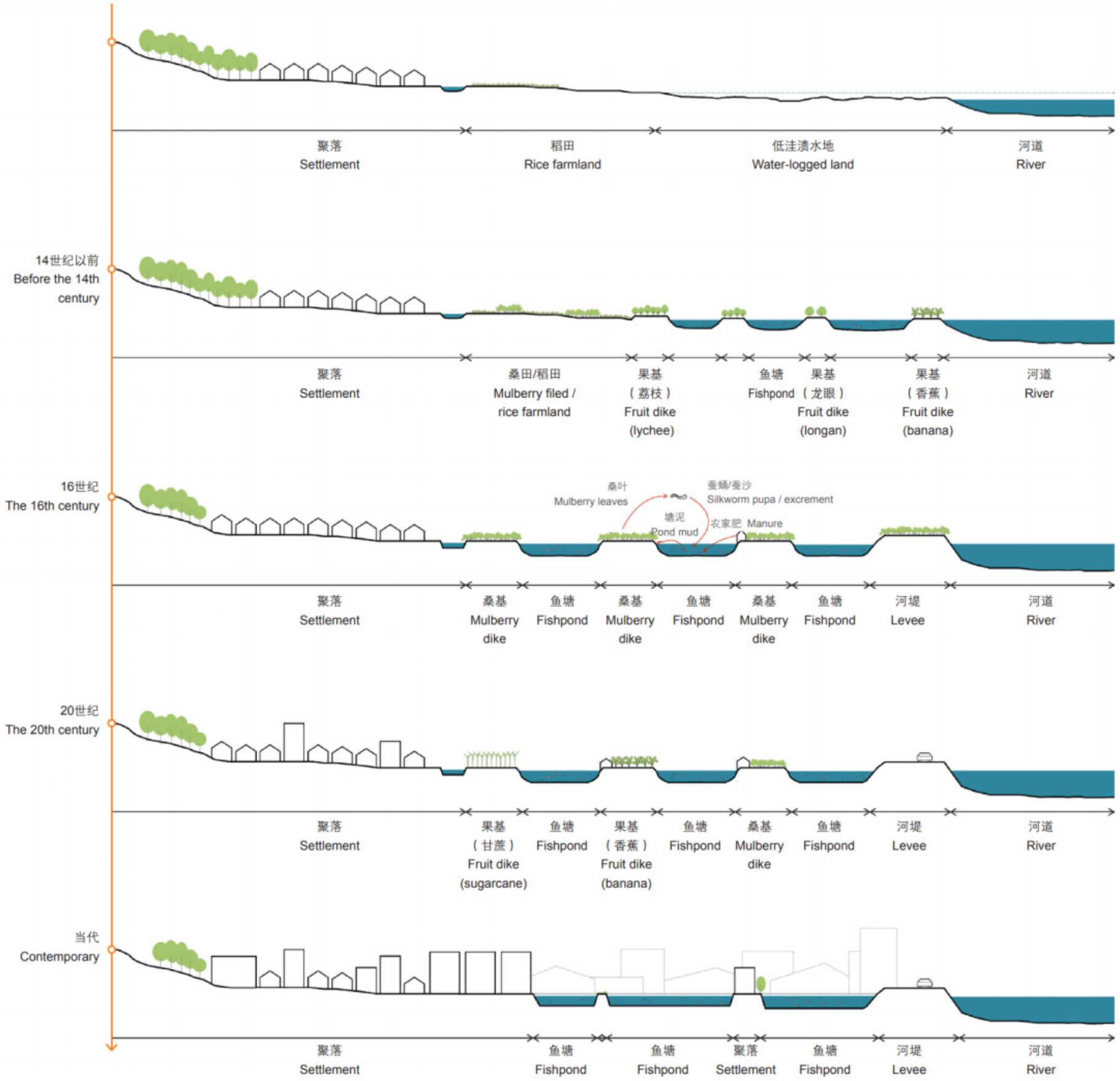
Since the early Ming dynasty, in an effort to improve land use efficiency and economic returns, residents began to elevate pond embankments using the excavated soil from pond construction and planted fruit trees on these raised areas, building what became known as the fruit-dike fish pond system. With the rise of sericulture in the Qing dynasty, mulberry trees gradually replaced fruit trees on the pond dikes, and silkworm rearing became widespread. This development led to the formation of the highly integrated and ecologically circular mulberry-dike fish pond system, achieving spatial integration and energy cycling between aquaculture and agriculture (Zhao & Yang, 2011).

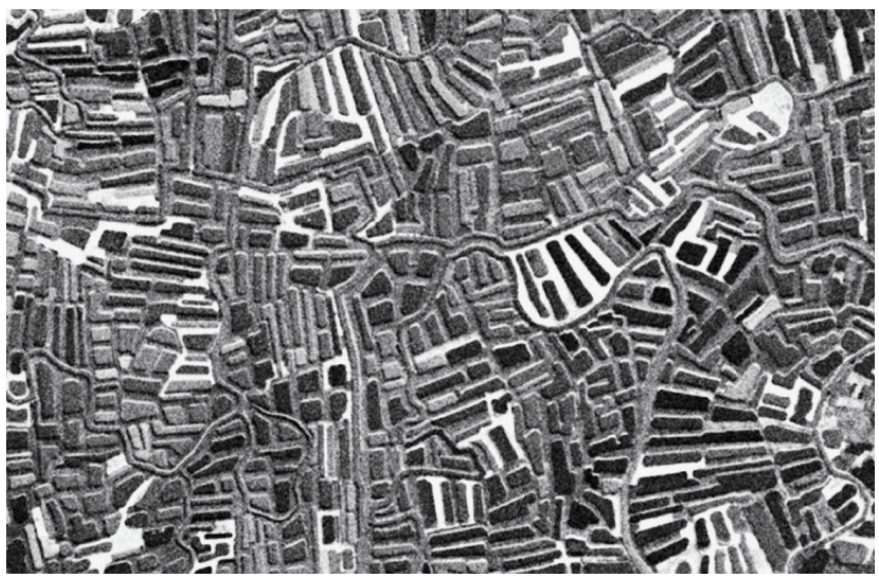
Once mature, the mulberry-dike fish pond system evolved into a highly developed agricultural-ecological system in the Pearl River Delta. However, with the decline of the mulberry and silkworm industry in the 20th century and the introduction of economic crops such as sugarcane, some abandoned mulberry-dike fish ponds were converted into sugarcane fields, giving rise to a new dike-pond economy in which sugarcane replaced mulberry trees on pond embankments. By the Republican period, the dike-pond model had diversified into multiple types, including fruit-dike fish ponds planted with litchi, citrus, bananas, vegetables, and longan; flower-dike fish ponds; and miscellaneous-dike fish ponds for legumes, fodder crops, and more (Chen, 1990).

Modern economic and social changes have had profound impacts on the dike-pond system. Starting in the 1970s, the economic value of fish farming rose significantly, reversing the traditional pattern of "emphasis on planting, light on aquaculture" to "emphasis on aquaculture, light on planting," or even leading to a complete separation of planting and aquaculture. Original crops such as fruit trees and mulberry were increasingly replaced by low-input vegetables and melons, or were abandoned altogether, resulting in decreased primary productivity. More critically, the spatial proportion of dikes and water shifted: the previously ecologically efficient layouts of "four dike, six water" or "five dike, five water" were increasingly replaced by "two dike, eight water" or even "one dike, nine water," with extensive compression of dike areas and, in some places, the near-complete loss of planting function (Tian, 2019).

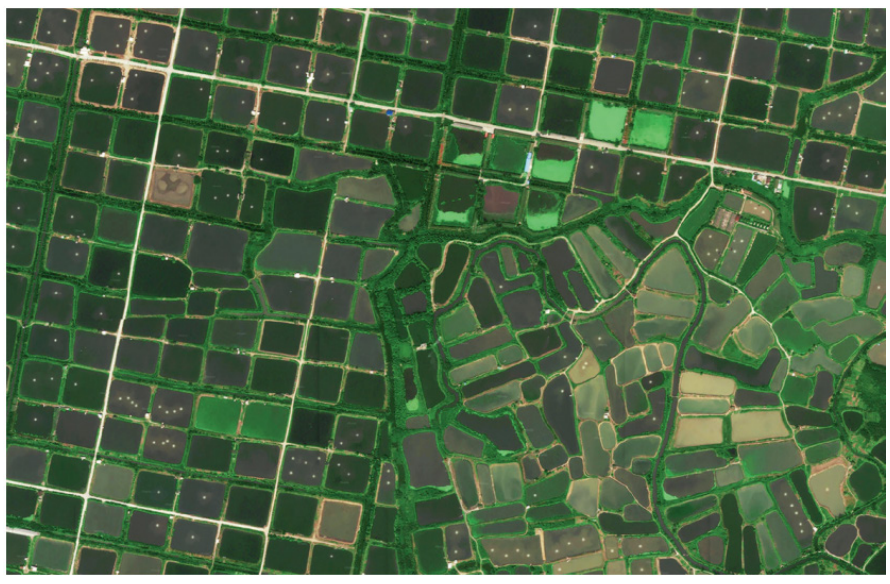
The first major dike-pond restructuring campaign in the 1960s–70s targeted low-efficiency areas and implemented standardized improvements, including "standardized fish ponds, grid-pattern rice fields, systematized canals, and standardized water levels" to improve irrigation and drainage. By the late 1990s, in pursuit of higher economic returns and intensified aquaculture, remnants of the organically patterned dike-pond landscapes were further transformed into standardized grids, with some areas even undergoing embankment and pond bottom hardening. These standardized fish ponds were mostly leased to external contractors for intensive production (Tian, 2019).

These transformations are clearly visible in current satellite imagery. Compared to historical images, the total area of dike-pond systems has been significantly reduced. In areas that underwent large-scale restructuring, the surrounding canals appear straight and narrow. In contrast, in organically preserved areas—especially ponds near villages—broad and winding canals remain. These areas are still managed and operated by local residents, retaining both ecological integrity and traditional knowledge.





1980



2014

Timeline of Dike-fishponds landscape,Tian, 2019

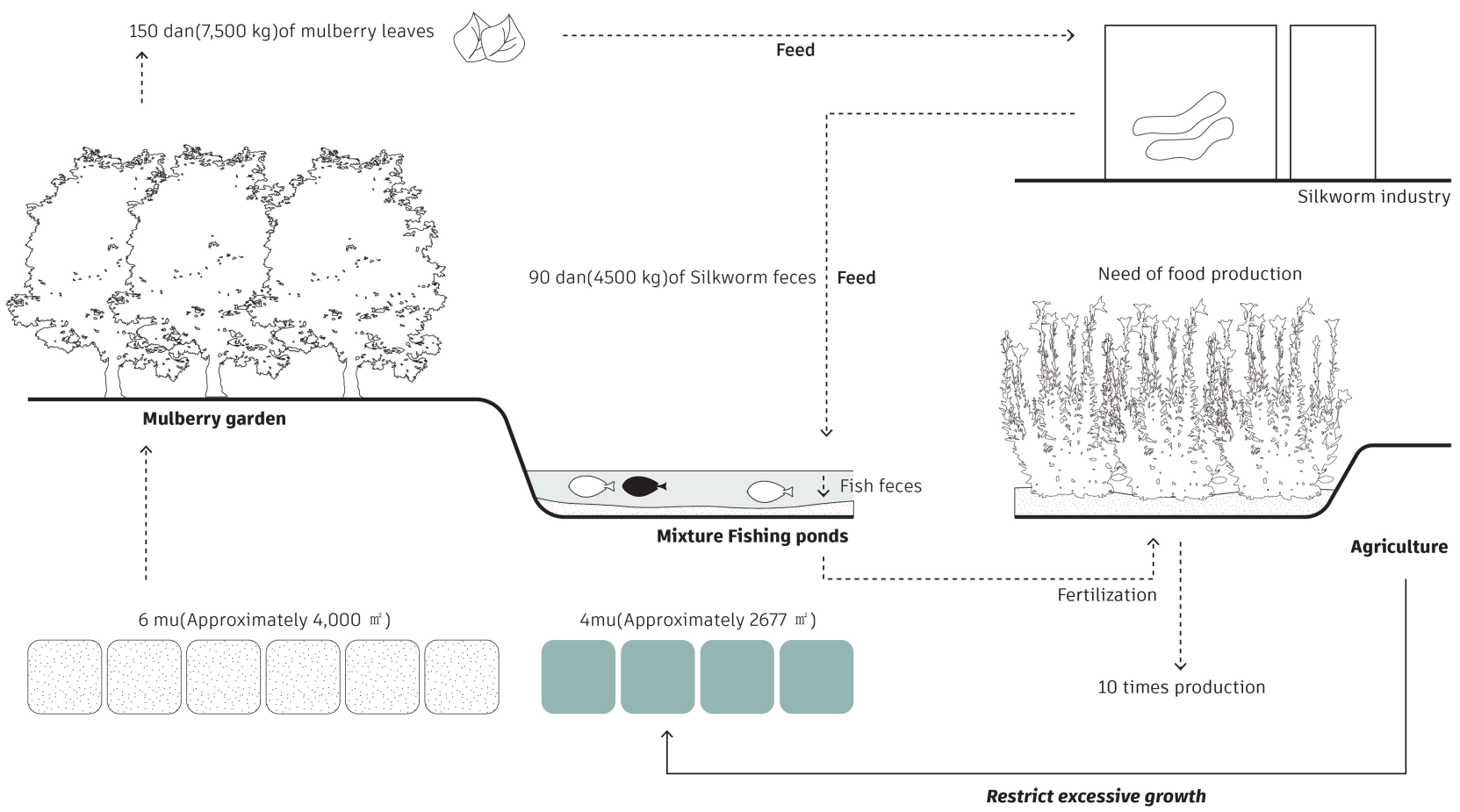
Echological value of the traditioanl dike-fish ponds

The traditional dike-fish pond system, as a unique agroecological model in southern China, embodies a harmonious relationship between agriculture, aquaculture, and the local environment. One of its key ecological advantages lies in the well-balanced proportion between the pond (fishery) and the dike (agriculture). Traditionally, the width and height of the dikes were carefully designed to optimize land use while preventing flooding and providing structural support. This proportional logic ensured that fish ponds had sufficient water volume and flow, while the dikes were wide enough to support diverse crop cultivation.

“将洼地挖深泥复四周为基，中凹下为塘，基六塘四，基种桑，塘畜鱼，桑叶饲养，蚕屎饲鱼，两利俱全，十倍禾稼”
——《高明县志》

According to the traditional knowledge of experienced farmers in the dike-pond regions, approximately 8 dan (a traditional unit of weight) of silkworm droppings can feed 1 dan of pond fish. In the past, each mu of mulberry field could yield about 25 dan of mulberry leaves. Therefore, 6 mu of dike land could produce around 150 dan of mulberry leaves, which could be used to raise silkworms, resulting in about 90 dan of silkworm droppings and 3 to 4 dan of silkworm pupae. This amount of feed would be sufficient to support 4 mu of fish ponds, meeting the feed requirement for producing 400 to 500 jin (Chinese pounds) of large fish per mu.

On the dikes, farmers grew a wide variety of crops, including mulberries, bananas, sugarcane, vegetables, and medicinal herbs. This plant diversity not only enhanced biodiversity but also created microhabitats for insects, birds, and beneficial microorganisms. The diverse vegetation on the dikes functioned as ecological buffers, filtering pollutants and stabilizing the soil, thus maintaining water quality in the adjacent ponds. Furthermore, the organic waste from the crops and dike vegetation was often recycled as feed or fertilizer in the system, forming a closed-loop ecological cycle.



Circularity in mulberry garden dike

The mulberry-dike fish pond system is a typical model of ecological circular agriculture that developed in southern China, especially in the Pearl River Delta and the Taihu Lake Basin. At its core, the system achieves a multi-level cycle of "planting mulberries – raising silkworms – feeding fish – returning pond mud to the dikes." Specifically, mulberry trees are planted on the dikes; their leaves are used to raise silkworms. The silkworm droppings and pupae serve as high-quality feed for fish in the ponds. The nutrient-rich pond mud is regularly dredged and applied back to the dike fields as organic fertilizer, thus completing a closed-loop nutrient cycle (Chen et al., 1990).

This production structure is characterized by the interdependent and mutually reinforcing relationship of "dikes supporting ponds, and ponds supporting dikes." Each component is linked to the others, which greatly improves resource efficiency, reduces the need for external inputs such as chemical fertilizers and commercial feed, and ensures the system's sustainability and ecological stability (Wang et al., 2018).

In addition, the mulberry-dike fish pond cycle is often integrated with livestock raising—for example, pig farming. Pig manure is used both as fertilizer for mulberry trees and as feed for fish. Aquatic green fodder is also planted around the ponds to feed livestock and poultry, further enriching the layers of material flow and energy conversion. This multi-link and multi-layered circular model not only enhances the resilience and sustainability of the agroecosystem but also significantly diversifies the sources of income for rural households. Recent quantitative studies show that only when mulberry, silkworm, and fish production are organically integrated and operate synergistically can the system achieve its maximum ecological, economic, and cultural service value (Wang et al., 2018).

The integrated production of the mulberry-dike fish pond system not only significantly boosts the efficiency of agricultural resource recycling but also promotes cooperation and mutual assistance within rural families and communities by activating labor across various production links (Chen et al., 1990). Thanks to the diversity and continuity of this production structure, rural labor could flexibly participate in different tasks based on seasons, family expertise, and needs—greatly enhancing the productivity of the household-based production unit typical of traditional Chinese society.

From a watersystem sociological perspective, this circular agricultural model, with water as its central organizing element, not only shaped unique ecological landscapes and production methods but also profoundly influenced and reshaped rural social structures, cooperation mechanisms, and community identities. The shared use of water spaces, the collective management of dike-pond resources, and inter-household collaboration in production activities have strengthened internal social ties and collective action within communities. The dike-pond system thus functions as a socio-ecological platform for interaction and cooperation between people and nature, advancing the socialization and communitization of water system governance. Therefore, the circular integration of the mulberry-dike fish pond system is not only an innovation in ecology and economy but also a vivid embodiment of rural social structure and interaction mechanisms in the sociological sense of waterscape governance.



耕织图

Live with water

Water as a power : The socio-political logic of water management

Since the Song Dynasty, numerous hydraulic projects have been constructed in the Pearl River Delta, particularly in regions like the Sangyuanwei area (Zhao & Yang, 2011). By the Qing and Republican periods, land reclamation, embankment construction, and the pond-dike system had become the three pillars of the region's water infrastructure (Wu, 2004; Dai & Zhong, 2022). The proliferation of small-scale waterworks after the Song era laid the foundation for the emergence of large-scale, composite systems like Sangyuanwei. These hydraulic works not only served flood control and drainage functions but also supported the ecological agricultural system of mulberry-dike fish ponds (Zhao & Yang, 2011; Wu, 2020).

With the population boom and increasing land pressure during the Ming and Qing dynasties, local clans and landlords actively participated in land reclamation, embankment building, and pond-dike construction to secure land and maintain lineage control (Wu, 2020). During this period, a water governance network emerged centered on clans, with ancestral halls, clan schools, and family-run temples ("private Taigong") functioning as key institutions for infrastructure coordination, maintenance, and labor mobilization.

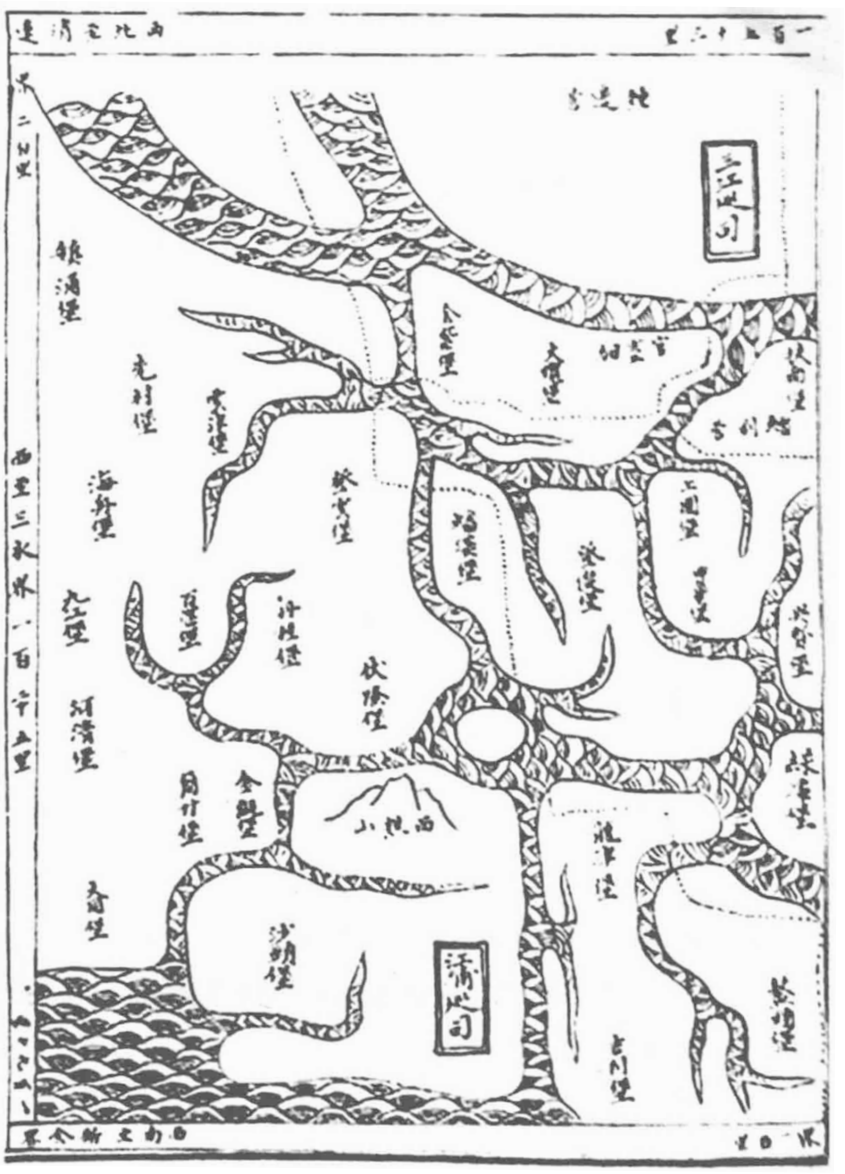
In the Republican era, new forms of local self-governance such as irrigation cooperatives and water associations emerged, introducing mechanisms for public participation. Nonetheless, clan elites continued to dominate resource allocation and water governance (Wu, 2020; Xu, 2020). After the founding of the People's Republic of China, the clan system gradually disintegrated, and management of the hydraulic systems transitioned to government agencies and public institutions (Foshan Sangyuanwei Irrigation Heritage Plan, draft).

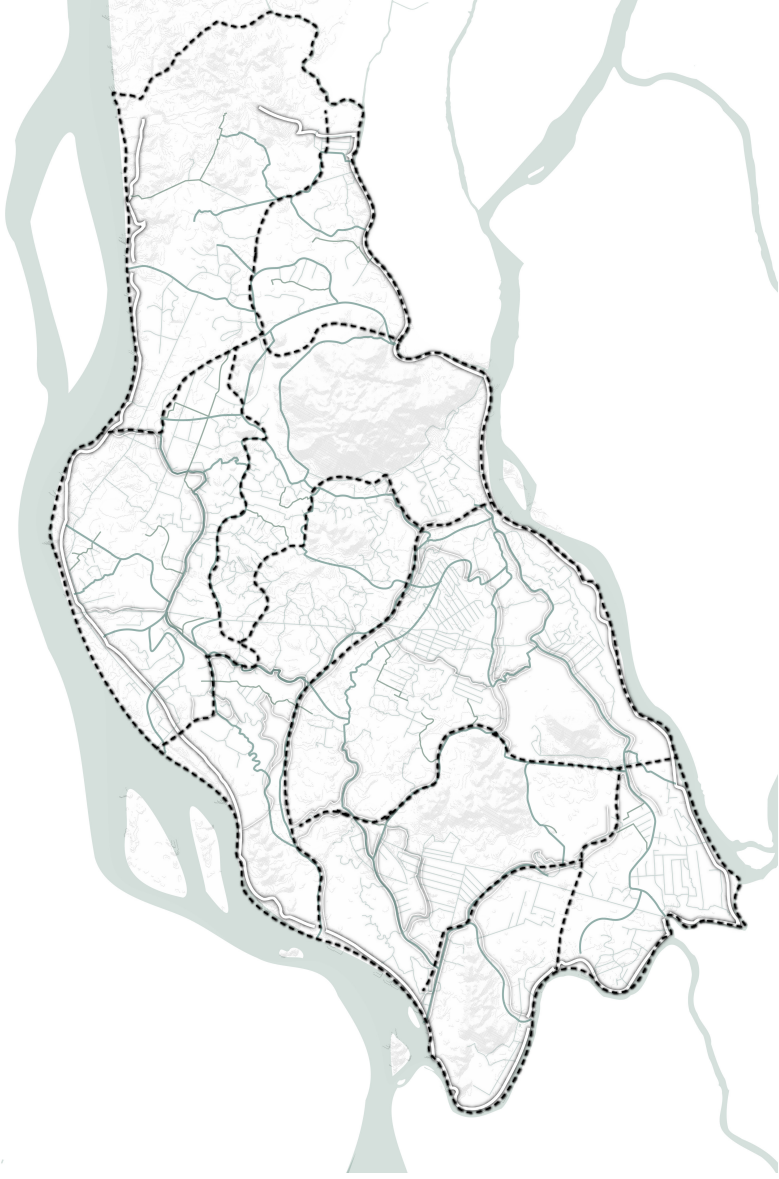
Around Sangyuanwei and the pond-dike system, a complex social structure evolved, centered on clans and local elites, with landlords, smallholders, tenant farmers, and laborers participating in collective land and water governance. Large landholdings declined, and small family-run fields under clan schools emerged, promoting labor mobilization and integration of agricultural resources (Wu, 2020). Waterworks were typically built and maintained through mutual aid, work exchange, or hired labor, reducing costs and reinforcing community cohesion.

Clan-based social capital, moral norms, and economic incentives ensured the continued operation of these systems (Wu, 2020; Dai & Zhong, 2022; She & Long, 2022). As pond-based economies became highly market-oriented, income and risk intensified, and clan- and family-owned lands served both productive and redistributive social functions. Disputes over irrigation and resource allocation were often mediated through a mix of government arbitration, clan negotiation, and community self-regulation (Xu, 2020; Dai & Zhong, 2022).

Notably, in the Xiqiao area, the bao (fort) was not only an administrative unit but also the basic spatial unit for embankment management. Since the Ming dynasty, the region adopted a grassroots governance structure of "bao-governs-tu, tu-governs-village", closely tied to the construction of water systems (Liu; Chen). The boundaries of a bao shifted with the construction of embankments and land expansion and only became fixed when land use stabilized. Each bao could encompass multiple natural villages and lineages, which coordinated and negotiated over land, irrigation, and tax obligations (Xu, 2015). This system reflects the Pearl River Delta's collective capacity to adapt to its hydrological environment and demonstrates the deep interrelation between spatial governance and water infrastructure.

Thus, the construction and governance of water systems in the Pearl River Delta not only signify environmental adaptation but are deeply embedded within local social structures. Ongoing hydraulic construction sustained ecological cycles and agricultural productivity, while clan systems, market mechanisms, and social cooperation laid the foundation for effective and resilient water operations (Dai & Zhong, 2022). In traditional society, water infrastructure functioned not only as material support but also as a key nexus of social organization, power hierarchy, and identity formation (She & Long, 2022).





Layout of settlement near the water system

In the mulberry-dike pond areas of Sangyuanwei and Foshan in the Pearl River Delta, a complex spatial system has developed, closely coupling settlements with the dike-pond system and underpinned by hydraulic infrastructure. Settlement locations within the area rely on elevated terrain, embankments, and water gates. Villages are typically distributed along embankments, rivers, or highlands, which not only provides flood protection but also facilitates transportation, irrigation, and material circulation (Xi, 2016; Wang & Huang, 2023). The space of dike-ponds and settlements is highly integrated. Villages are commonly surrounded by dike-ponds on the periphery, with communal ponds and docks often located inside the village. Embankments and village paths are interconnected, forming a "water–field–dwelling" composite spatial structure. Streets within the settlements often extend along the embankments, integrating with the dike-pond landscape, tightly connecting public life with agricultural production (Xv, 2015).



The morphology of the dike-pond system determines the spatial distribution of settlements. Depending on the layout of rivers, embankments, and dike-ponds, the spatial patterns of settlements in Sangyuanwei vary, including "Centripetal," "Dispersed," and "Grid" forms (Xi, 2016; Wang & Huang, 2023). The spatial expansion of the dike-pond system has propelled the development of settlements. Since the Song and Yuan dynasties, the advancement of embankment and water management technologies has promoted land reclamation, transforming low-lying areas into arable land. This led to the continual expansion of the dike-pond system and encouraged village migration from elevated terrain to reclaimed field areas (Wang & Huang, 2023; Xi, 2016).



Grid



Dispersed



Centripetal

Since the 20th century, with the progress of urbanization and industrialization, the expansion of urban land has caused a disconnection between residential spaces and the dike-pond system. A large number of dike-ponds have been converted into urban construction land, severing the original coupling between settlements and the dike-pond system and disrupting the traditional "village–dike-pond–water network" model (Liu et al., 2008; Wang & Huang, 2023). This has also weakened public space and ecological functions. The socio-ecological-productive functions of the dike-pond system have declined, the interaction between residential spaces and dike-ponds has diminished, and the continuity of village public spaces, productive ponds, and everyday ecological spaces has been compromised, leading to the erosion of the vernacular fabric (Xi, 2016;Wang & Chen, 2022).

According to existing satellite imagery, some areas within Sangyuanwei still preserve a large number of small traditional settlements. These are typically located at nodes such as highlands, rivers, and embankments, with compact spatial forms and built environments deeply integrated with the texture of the dike-ponds, continuing the historical human settlement patterns of the Lingnan water towns. On the other hand, with the advancement of urbanization, some areas of Sangyuanwei have already developed large-scale modern residential communities, which are generally distributed along main roads or key nodes. These new communities differ significantly from traditional settlements in terms of spatial scale and architectural form. Additionally, smaller villages or residential clusters are scattered around the dike-pond peripheries and water network intersections, forming a point-like "dike-pond–settlement" mosaic pattern.



Satellite 1984



Satellite 1997



Satellite 2022



large-scale modern residential communities



scattered settlements

Water system as a daily life infrastructure

Sangyuanwei is not only one of the most representative hydraulic engineering and ecological agricultural areas in the Pearl River Delta, but also a "water infrastructure system" deeply embedded in local society, culture, and daily life. Here, water is not only essential for survival—it also shapes settlement patterns, everyday lifestyles, belief systems, and festival customs, forming the spiritual core of Lingnan water-town culture (Xi, 2016; Fu & Tang, 2020).

The formation and distribution of settlements in the Sangyuanwei region are closely dependent on the water network and embankments. Villages are often situated along rivers, highlands, and embankment openings to avoid flooding and facilitate transportation and material exchange (Xi, 2016). The densely interwoven water networks and interlaced dike-pond landscapes not only provide irrigation and flood prevention for agricultural production, but also serve as essential spaces for daily life. Villagers rely on these water bodies for drawing water, washing, cooking, and recreation.

Moreover, the water system of Sangyuanwei profoundly influences local belief systems and festivals. Due to the frequent threat of flooding, residents have developed a tradition of worshipping water deities such as river gods, water gods, the Dragon Mother, and the Flood Sage. Temples dedicated to these deities are commonly located near water gates, embankments, and sluices, forming central spaces for daily worship and ritual celebrations. In this way, water spaces are naturally integrated into the ritual landscape of local communities (Fu & Tang, 2020; Zheng et al., 2024).

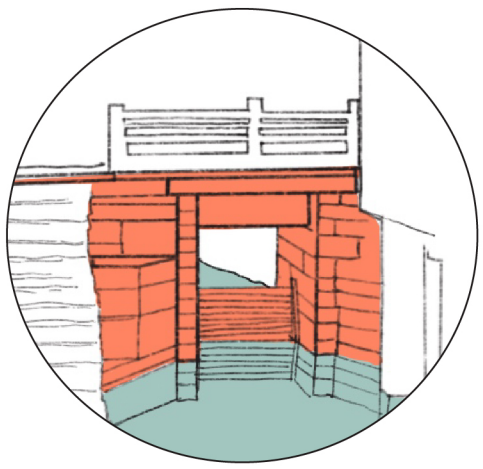
In addition to its ecological and spiritual significance, the water infrastructure system also supports dense waterborne transportation networks. In the Sangyuanwei area, water routes have historically functioned as the primary connections between villages and between villages and market towns. Boats and sampans are widely used for traveling to markets, visiting relatives, and transporting goods. Water gates, sluices, and docks serve not only as key nodes of transportation, but also as venues for community gathering, trade, and temple fairs. In this context, water transport not only enables the circulation of goods and agricultural production, but also promotes regional economic and cultural exchange and reinforces social cohesion (Xi, 2016; Fu & Tang, 2020).



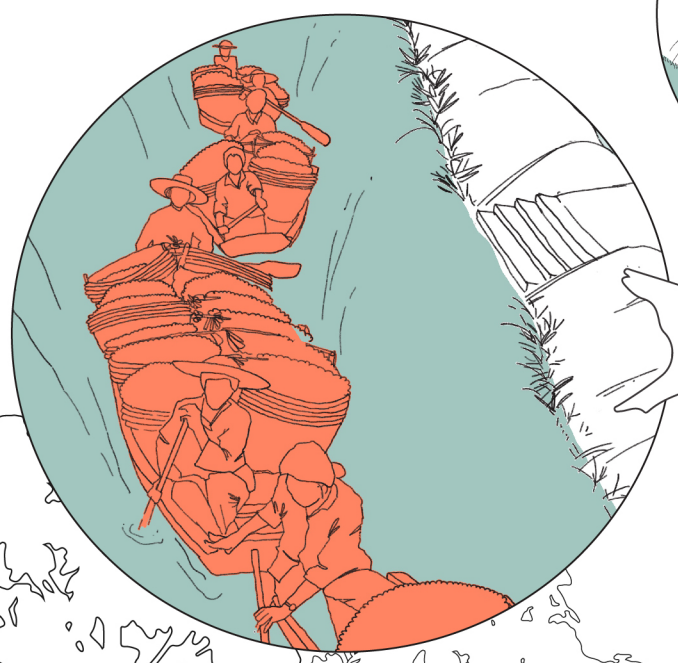




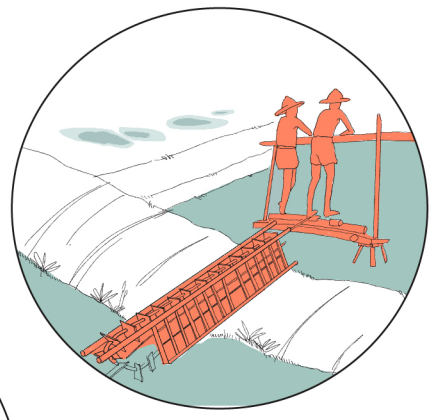
1. Sluice gate
between river and ditch



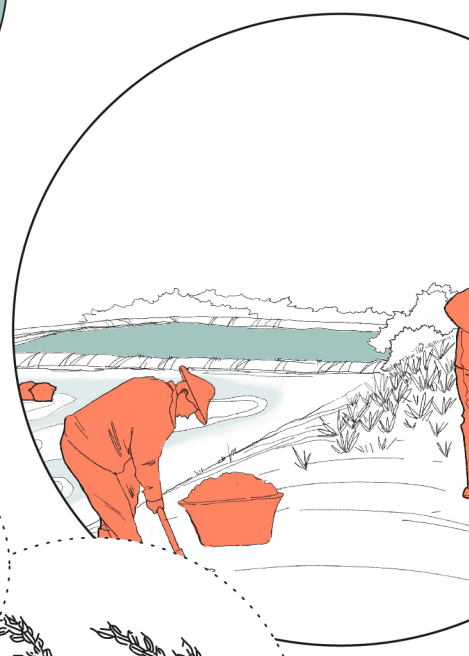
2/ Silkworm cocoon transpotation

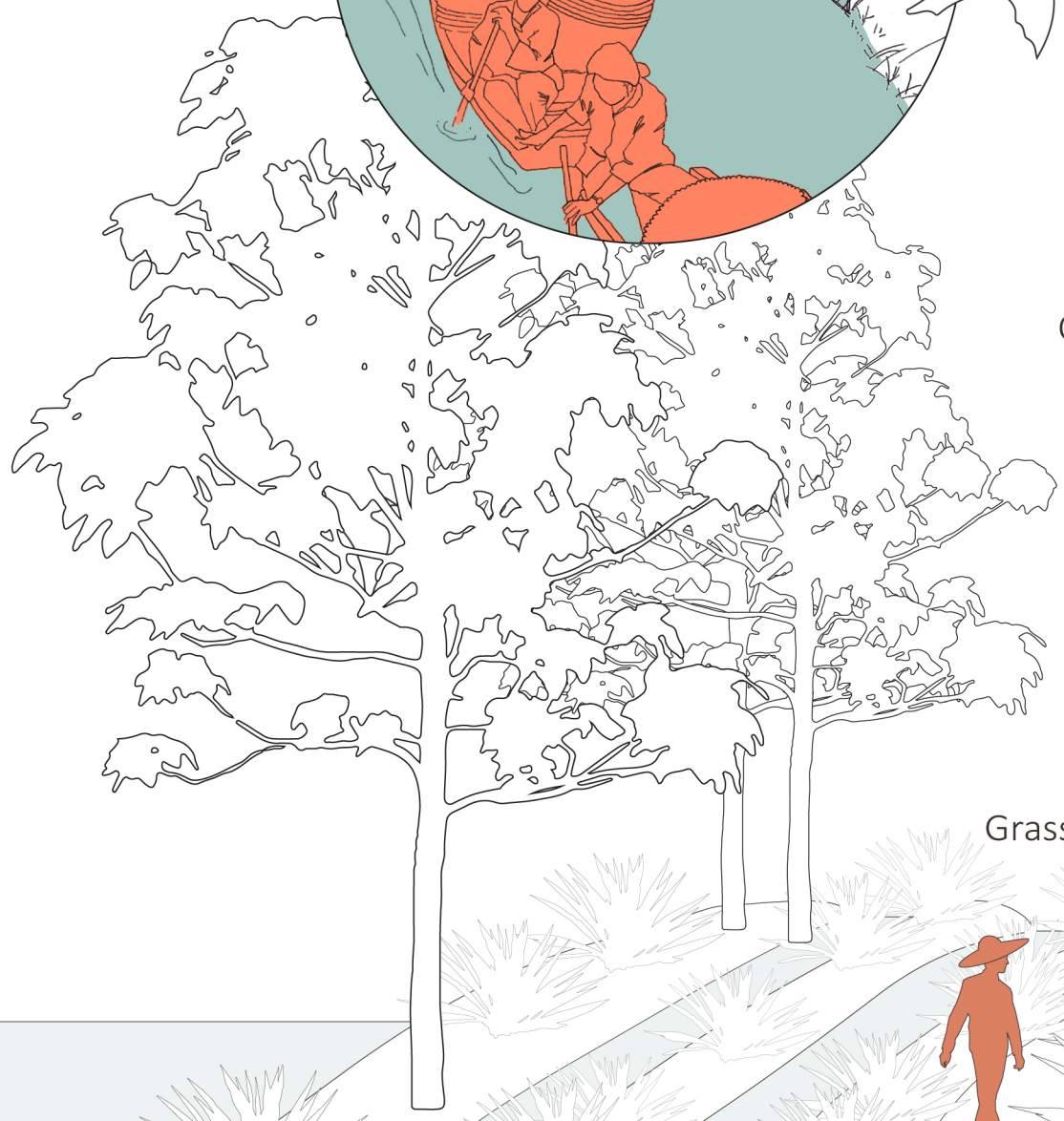


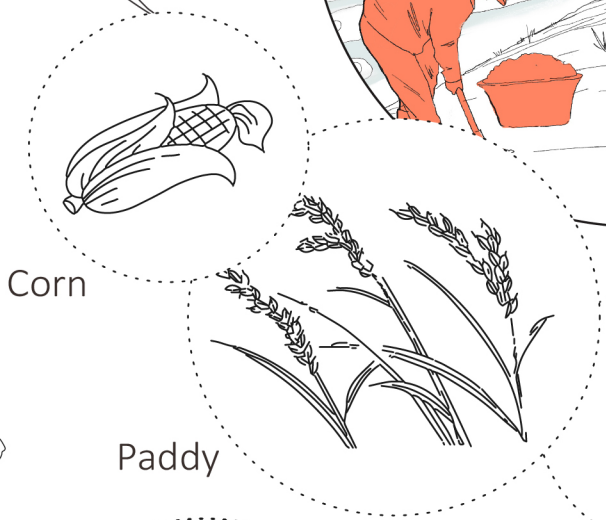
3. Water transpotation between
ponds and ditch



4. Agricultur

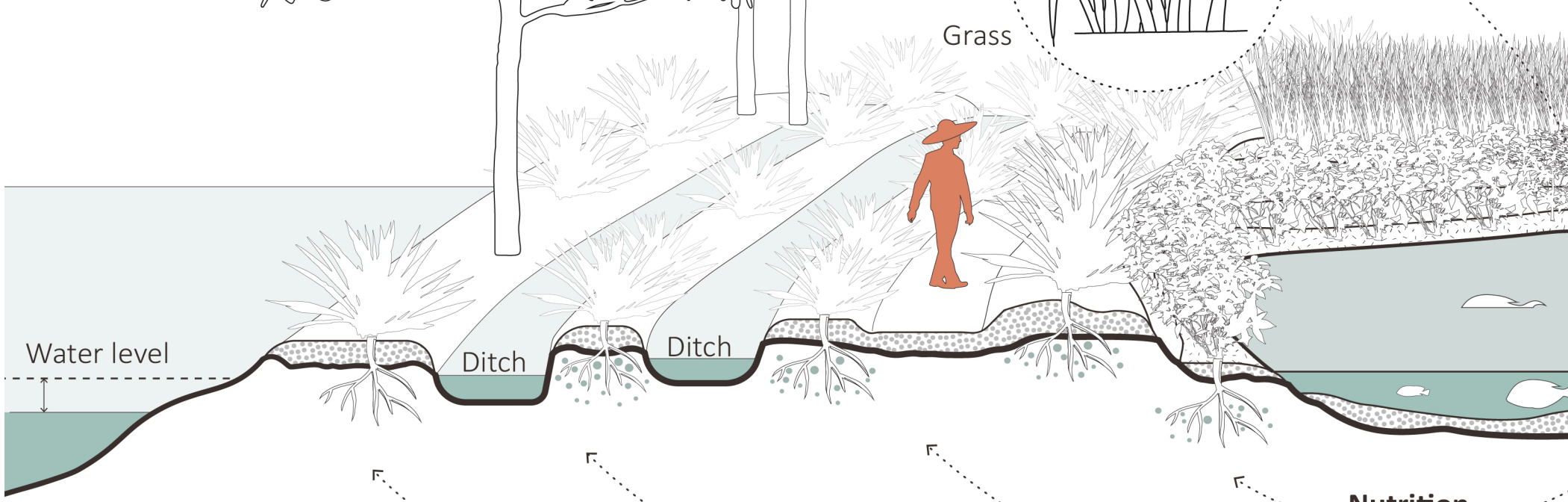








Food



Nutrition

Reinforcement materials
Nutrition

re

5. Fishery

Mulberry leaves

6. Mulberry leaves harvest

Fish

Feces of Fish

Food

Silkworm

Feces of Silkworm

Food

Mulberry garden

Local family

Local silkworm industry

Feces



Transfer to an intensive fishing industry

4.1 A centralized fish industry:
- 4.1.1 From localize to centralized: less land but more productivity
- 4.1.2 Modern production model: rely on electricity and chemical treatmen
- 4.1.3 Invisible stakeholder: non-local contractors and government

4.2 Profit or not? Risk from the intensive industry
- 4.2.1 Spreading pollution
- 4.2.2 An ongoing vicious cycle

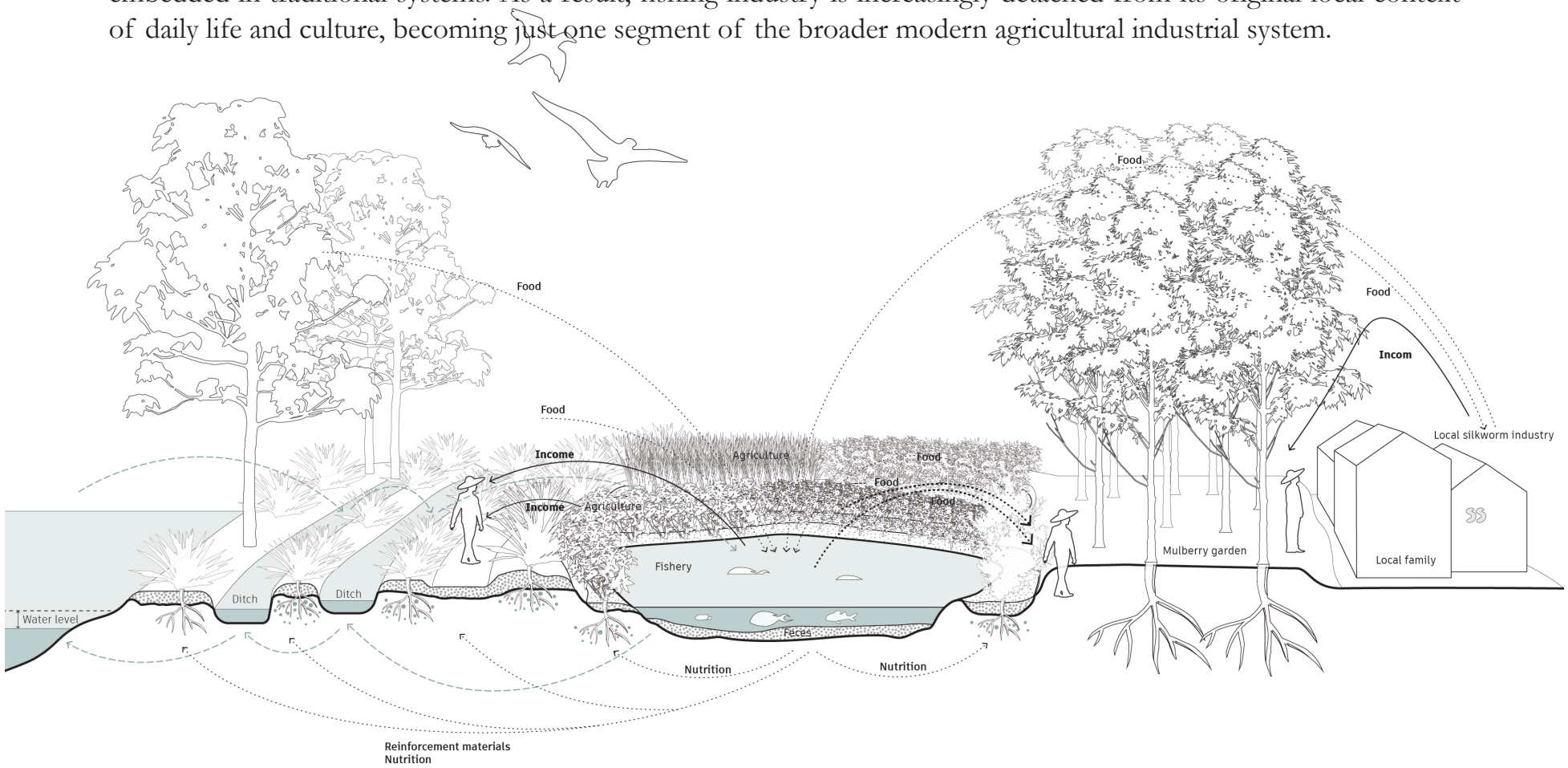
A centralized fish industry

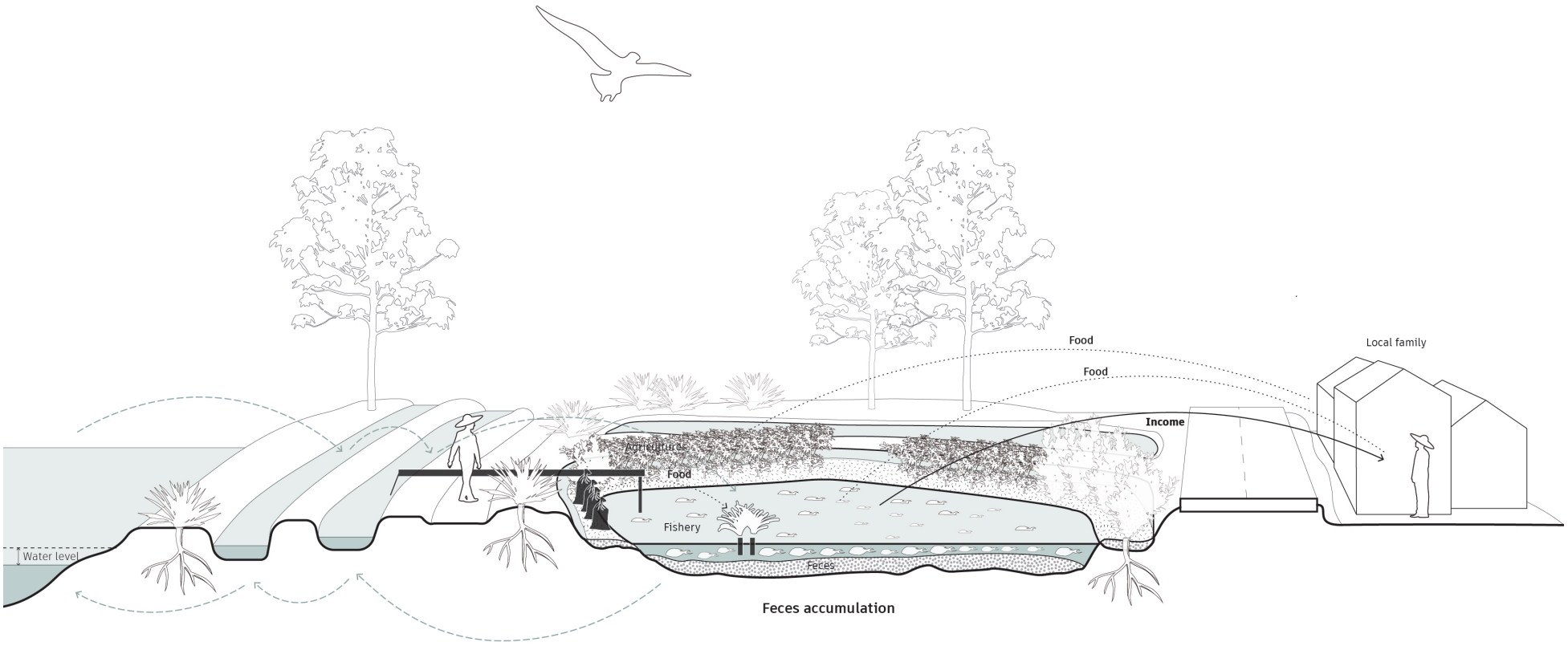
From localize to centralized: less land but more productivity

In recent years, with accelerating urbanization and increasing pressure on land resources, the dike-pond area in the Foshan mulberry-dike fish pond region has experienced a significant decline. According to Meng et al. (2025), the aquaculture area in Foshan was approximately 353,000 hectares in 2023, showing a decrease compared to previous years. Pond land has gradually been encroached by urban expansion and other functional land uses such as manufactory. Meanwhile, the spatial structure of the mulberry-dike fish pond system has also undergone major transformation. The traditional multifunctional ecological system—known as the "mulberry-dike fish pond" model—is increasingly shifting toward an integrated fish pond system characterized by monocultural high-density aquaculture fishing industry between fish ponds and spaces such as rice paddies and residential areas (Liu et al., 2008; Tian, 2019).

Despite the reduction in pond area, the yield has risen significantly due to advances in intensive fishing industry techniques and standardized management. In 2023, the total freshwater fishing industry output in Foshan reached approximately 800,000 tons, with pond-based aquaculture yielding up to 22.6 tons per hectare—well above the national average (Meng et al., 2025). The dramatic increase in stocking density and production per unit area has made Foshan one of the core regions for national fishery output (Su et al., 2023).

At the same time, this form of fishery has undergone a transformation from a localized, subsistence-based production system to a highly industrialized industry oriented toward national markets. The traditional mulberry-dike fish pond system primarily served local households, maintained livelihood functions, and reflected strong place-based characteristics. Its production were closely aligned with seasonal cycles, emphasizing ecological recycling. However, under the dual forces of economic globalization and market-driven development, local governments and enterprises have increasingly promoted large-scale and specialized aquaculture operations to meet the growing demand for high-quality aquatic products in regional and international markets. Such transformation not only alters modes of production and spatial organization but also weakens the ecological rationale and cultural associations embedded in traditional systems. As a result, fishing industry is increasingly detached from its original local context of daily life and culture, becoming just one segment of the broader modern agricultural industrial system.





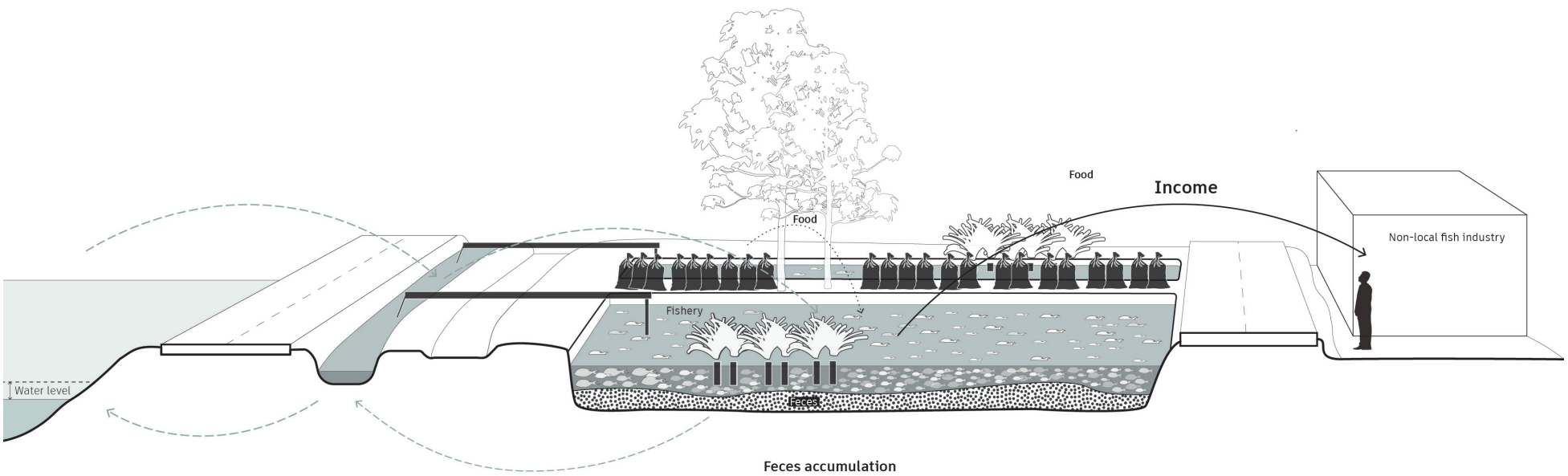
Feces accumulation

Pumping station
Pumps
Foods and chemical medicine

Polluted water recycle

Less agriculture
More fish output
More fish ponds
little pollution

No mulberry garden



Feces accumulation

Pumping station
Pumps
Foods and chemical medicine

Polluted water recycle
Less water system

No agriculture
More and more fish output
More fish ponds area
Excessive pollution

No mulberry garden

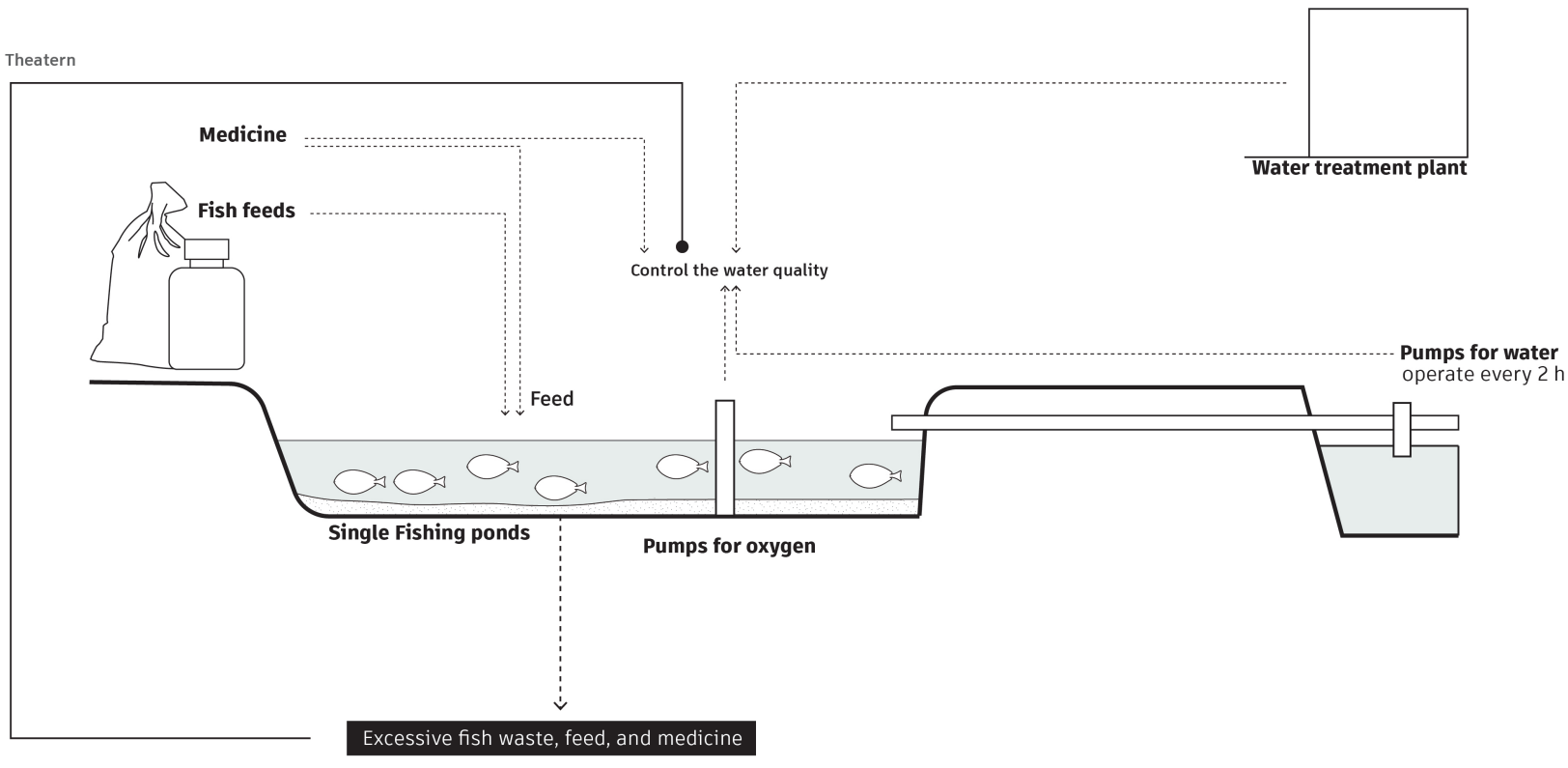
Modern production model: rely on electricity and chemical treatment

High-density and intensive aquaculture in Foshan's fishing industry heavily depends on continuous mechanical aeration and water circulation. Field investigations show that the vast majority of fish ponds require year-round water exchange and oxygenation via electric pumps, resulting in extremely high electricity consumption. Due to excessive construction of the mulberry-dike fish pond system in earlier periods, the existing water channel infrastructure is now insufficient to meet the circulation needs of intensive aquaculture operations (Tian, 2019). While production efficiency has increased, each kilogram of fish now consumes approximately 3 to 13.4 cubic meters of water, placing significant pressure on water resources (Liu X., 2024).

In addition, to sustain high yields, large quantities of feed, pharmaceuticals, and disinfectants are applied throughout the farming process. This leads to the accumulation of organic matter and nutrients—particularly nitrogen and phosphorus—in both ponds and surrounding water bodies. Effluent from these ponds often contains pollutant concentrations of suspended solids, ammonia nitrogen, total nitrogen, total phosphorus, and chemical oxygen demand (COD) far exceeding surface water quality standards, resulting in eutrophication, frequent algal blooms, and ongoing water degradation (Liu X., 2024; Zhang et al., 2024).

Long-term intensive farming also causes substantial accumulation of organic matter, nitrogen, phosphorus, and heavy metals in pond sediments. These sediments have pollution levels far above those of natural soils. When disturbed, they can re-release pollutants into the water column, exacerbating water quality deterioration and posing persistent and potentially irreversible ecological risks (Liu X., 2024).

As a result, Foshan and the broader Pearl River Delta have become one of China's most concentrated regions for freshwater aquaculture discharge. Pollution intensity per unit of output is high, non-point source pollution is severe, and the ecological risks to local rivers and streams are increasing (Su et al., 2023). At the same time, vast areas of land are exclusively occupied by monoculture aquaculture, leading to diminishing ecological and social returns. The traditional multifunctional ecological system is gradually disappearing.

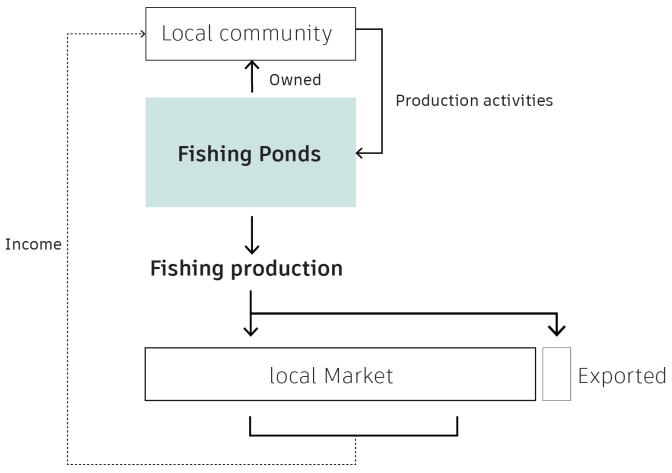


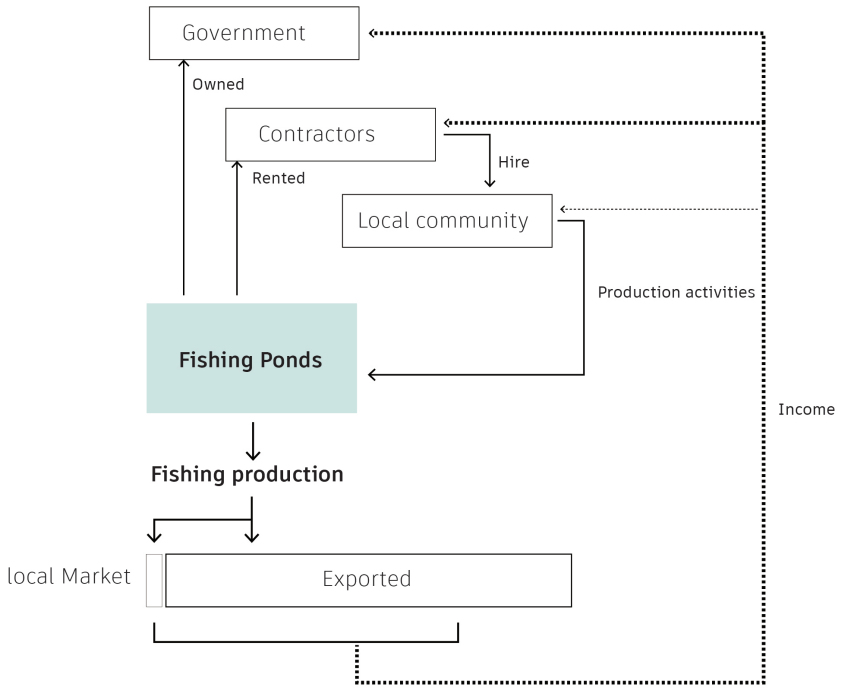
Invisible stakeholder: non-local contractors and government

As the dike–pond system transitions toward a model of high-density, intensive aquaculture, the traditional household-based, place-specific, and livelihood-oriented mode of fish farming has gradually been replaced by a contract-based system. An increasing number of fishponds are no longer directly managed by local residents but are instead leased to non-local aquaculture contractors through government-led or village-level coordination mechanisms. These non-local contractors, equipped with greater capital, technical expertise, and market access, are primarily profit-driven. They prioritize production efficiency and yield, often neglecting the ecological cycles and cultural values embedded in the traditional dike–pond system.

The government has played a pivotal role in facilitating this transition. On one hand, it promotes the scaling-up and standardization of the fishing industry through industrial policy, land consolidation, and investment promotion. On the other hand, in processes such as land transfer and operational rights distribution, the government tends to allocate resources to more competitive external contractors in pursuit of local economic growth (Gao, 2023). This institutional arrangement has progressively excluded local residents from the core of fishery production, disrupting the interdependent relationships between water, pond dikes, and everyday life.

This non-local, capital-led operational model has led to the emergence of an "invisible" power structure: contractors dominate the production process, while the government controls policy direction and resource allocation. Meanwhile, residents—who actually live in these regions—are increasingly marginalized, losing their capacity to engage in or influence fishery practices. As a result, the separation between production and daily life intensifies, and local communities' participation in water governance and ecological stewardship is significantly weakened.





Profit or not?
Risk from the intensive industry

Spreading pollution

Behind the pursuit of high yield and efficiency in the intensive fishing industry lies a range of environmental and public health risks. First, the pollution resulting from high-density fish farming is gradually extending beyond the boundaries of individual ponds, spreading into the broader mulberry-dike fish pond landscape. To sustain rapid fish growth, large quantities of feed, pharmaceuticals, and disinfectants are used, leading to the accumulation of nitrogen, phosphorus, organic matter, and other pollutants in the water. These substances not only cause eutrophication but also seep into or are discharged into the surrounding soils, further weakening the ecological resilience of the region.

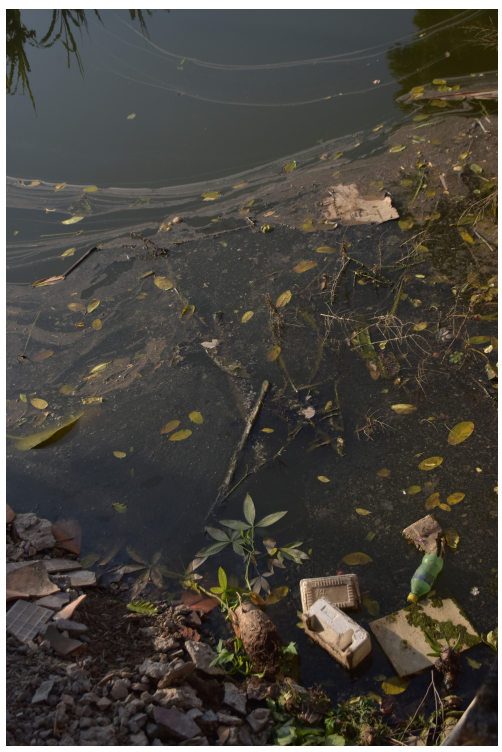
More critically, the impacts of water and soil pollution have begun to feed back into the fish products themselves. According to field interviews, many local informants noted that some operations within the fishing industry sell their fish directly to urban restaurants without undergoing any formal market inspection or quality control. These unregulated products may contain excessive levels of drug residues, heavy metals, or pathogens, posing significant food safety risks to consumers and undermining the long-term reputation and branding of the fishing industry.



Eel Harvest in Dike-fish ponds
Image from 珠江商报 , 2018



Water pollution in Dike-fish ponds
Image from 中新网 , 2018



Water pollution in Dike-fish ponds, Foshan,2024

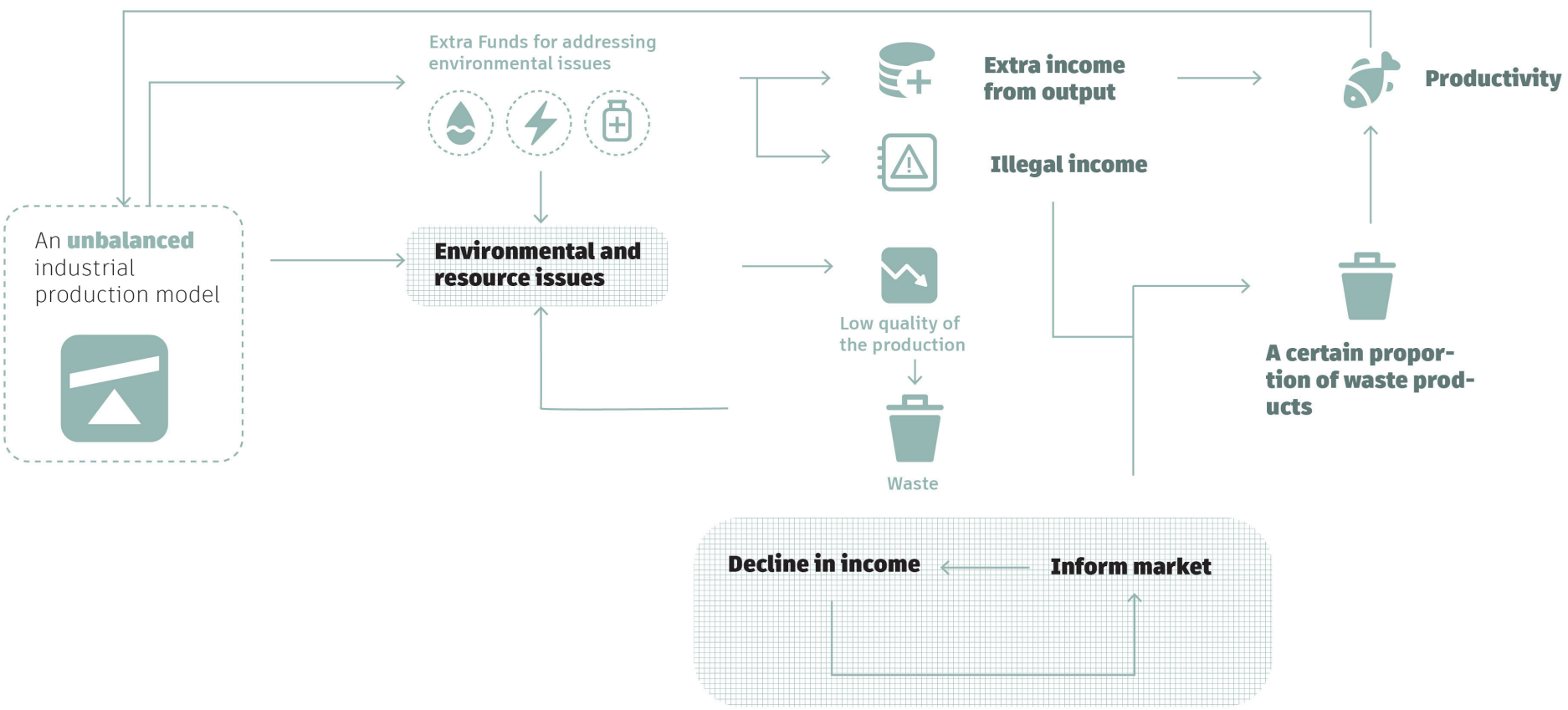




An ongoing vicious cycle

The intensive fishing industry is inherently resource-intensive, particularly in its reliance on electricity and chemical inputs. To sustain fish survival and growth in dense environments, oxygenation pumps, water circulation systems, and disinfection equipment must operate year-round, resulting in immense energy consumption. Some farmers even install their own power generators to meet demand. At the same time, to prevent disease outbreaks in such intensive conditions, constant use of antibiotics and chemical agents is required. This high-cost production model drives operators to pursue ever-higher yields to offset expenses, which in turn increases dependence on energy and chemical inputs—thus forming an ongoing vicious cycle.

In the short term, this model may lead to increased output and profits, but the environmental costs and ecological risks are accumulating rapidly. Once pollution levels exceed ecological thresholds, the consequences may include skyrocketing environmental remediation costs, mass fish mortality events, and food safety crises—ultimately threatening the long-term sustainability of the entire fishing industry.





Design Proposal:
Reimagining a Symbiotic Landscape between People and Water

5.0 Conclusion from the relevant research

5.1 Design Logic and Multi-Scale Framework
- 5.1.1 Problem-Driven Approach: From Research to Design
- 5.1.2 Site analysis
- 5.1.3 Multi-Scale Strategy: Regional – Meso – Micro Integration

5.2 Regional Planning Strategies
- 5.2.1 Reorganizing the Water System and Governance
- 5.2.2 Blue-Green Infrastructure Framework
- 5.2.3 Diversified Industrial Transition

5.3 Pond Typologies, Intervention Strategies and Meso-scale implementation
- 5.3.1 Locally Managed Ponds: Formal Dike-fish ponds: Large-Scale Ecological Infrastructure
- 5.3.2 Meso-scale Implementation: Ecological Production Area (Contractor-Driven)
- 5.3.3 Organic Dike-fishponds: Cooperative Eco-Production
- 5.3.4 Meso-scale Implementation: Ecological and Tourism Integration Area (Locally Managed)

5.4 Design Feasibility: Urgency, Community Support, and Established Foundations

Conclusion
from relevant research

From traditional sustainability to monocultural landscape

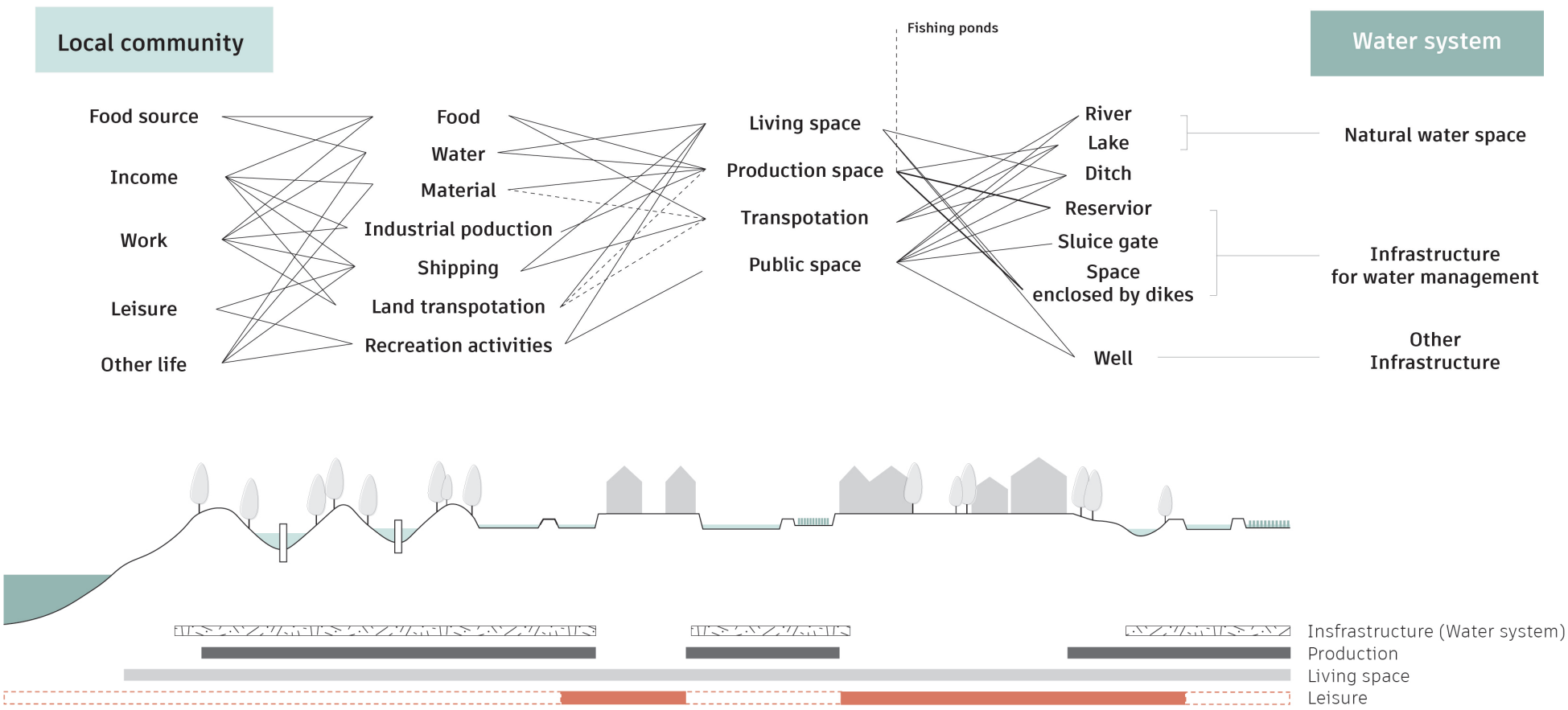
The Pearl River Delta region, especially the Mulberry Garden Dike(Sangyuanwei)development of humans and water. In the context of a naturally low-lying terrain constantly threatened by tidal and flood risks, the early settlers transformed wetlands and shallow seas through land reclamation activities, gradually forming land that could be cultivated and inhabited. This adaptive land reclamation practice not only created stable production spaces but also nurtured a social life order centered around water.

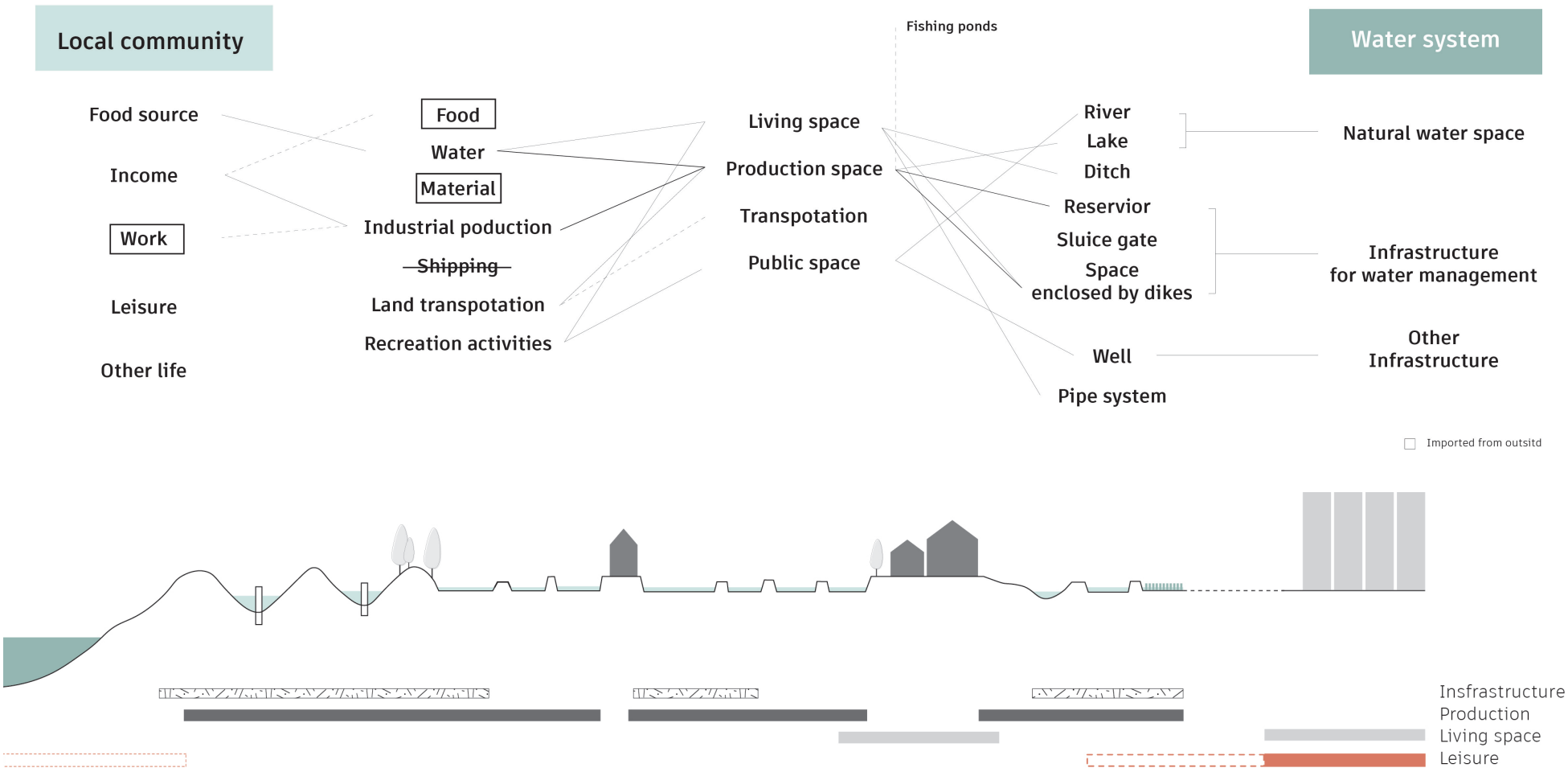
Closely tied to the land reclamation is the evolving water management system. In the early stages, local residents constructed water channels, embankments, gates, and other facilities based on water flow characteristics and topography to control tidal water and ensure agricultural and residential safety. These systems not only served practical functions such as flood control and irrigation but also embedded local governance models and social customs, becoming important carriers of community cooperation, ritual activities, and cultural identity. Residents were not only beneficiaries of water resources but also direct participants in their governance and maintenance, forming a grassroots water culture of "shared water governance."

The agricultural system that developed on this foundation, especially the "Mulberry-Dike Fish Pond"model, is a model of ecological wisdom and spatial multifunctional use. This system involves planting mulberry trees and other crops on the pond embankments while raising multiple species of fish in the pond. The fish are fed by the waste from the silkworms raised on the mulberry trees, creating a multi-functional and highly complementary circular economy. Pond mud is used as fertilizer, mulberry leaves nourish the silkworms, and silkworm droppings are returned to the pond. This system promotes a healthy flow of material and energy balance between humans and nature. This composite landscape not only improves land use efficiency, enhances ecological resilience, but also imparts unique cultural and visual characteristics to the region, representing a model of ecological, social, and productive integration.

Urban expansion and production pressures have forced the originally sustainable mulberry-dike pond production to gradually shift towards a pure fish pond model. This transformation is mainly driven by multiple factors in the process of modernization. First, with the rapid advancement of urbanization, the demand for land has increased dramatically, especially for industrial and commercial development, leading to large-scale land acquisition and the conversion of areas originally used for agricultural production into other uses. In particular, in the Pearl River Delta, land has been extensively redirected towards urban construction and infrastructure development, causing the gradual shrinkage and fragmentation of the mulberry-dike pond area. The once-continuous agricultural production space has been broken apart. To adapt to these changes, agricultural production has undergone a transformation, and the traditional mulberry-dike pond model has been gradually replaced by centralized and large-scale fish pond models.

This transformation has altered the original ecological balance of production from a spatial perspective. The traditional mulberry-dike agricultural system relied on a diversified land use approach, with fish ponds, farmland, and mulberry orchards interwoven to form a highly ecologically resilient composite space. However, as this traditional system shifted towards a single, high-density fish pond model, the multi-functional land was replaced by a singular farming space.


Local community
Food source
Income
Work
Leisure
Other life
Food
Water
Material
Industrial poduction
Shipping
Land transpotation
Recreation activities
Living space
Production space
Transpotation
Public space
Fishing ponds
River
Lake
Ditch
Reservior
Sluice gate
Space enclosed by dikes
Well
Water system
Natural water space
Infrastructure for water management
Other Infrastructure
Insfrastructure (Water system)
Production
Living space
Leisure


Local community
Food source
Income
Work
Leisure
Other life
Food
Water
Material
Industrial poduction
Shipping
Land transpotation
Recreation activities
Living space
Production space
Transpotation
Public space
Fishing ponds
River
Lake
Ditch
Reservior
Sluice gate
Space enclosed by dikes
Well
Pipe system
Water system
Natural water space
Infrastructure for water management
Other Infrastructure
Imported from outsitd
Insfrastructure
Production
Living space
Leisure

To address the ecological degradation and loss of multifunctionality caused by the shift to intensive fish pond farming, design interventions should focus on restoring spatial diversity and ecological connectivity within the landscape. This can be achieved by reintroducing mixed land uses—such as integrating mulberry planting, diversified crops, and smaller-scale fish ponds—while creating buffer zones that enhance water quality and biodiversity. Design strategies should also prioritize the revitalization of community participation by creating shared public spaces that reconnect residents with the water system and traditional practices. Furthermore, adaptive water management infrastructure that respects both historical water governance and modern environmental needs can support sustainable production while preserving cultural identity. Overall, the design approach should seek to balance production, ecology, and social dimensions, promoting a resilient and multifunctional landscape that reflects the unique water town heritage of the Pearl River Delta.

Restore diverse land uses to enhance ecological resilience and multifunctionality.

Design public spaces that foster community engagement and revive traditional water culture.

Implement low-energy, sustainable water management to protect resources and ecosystems.

Integrate traditional knowledge with modern governance for balanced social and ecological development.

From water based sustainability to fragmented efficiency

The intensive fishing industry model in the Sangyuanwei area has shown strong economic adaptability and market orientation in the context of urban expansion and land resource scarcity. Although the traditional mulberry-dike fish pond system has gradually transformed into an industrialized fishery focused on high-density farming, its annual output and economic returns remain substantial, continuing to support the local agricultural economy. However, this production model carries significant ecological and social costs: excessive reliance on energy and chemicals leads to water pollution and soil degradation, breaking the traditional water-pond-people relationship, marginalizing local residents in the fishing industry, and weakening ecological cycles and water culture. Furthermore, water pollution is now impacting the safety of fish products, creating structural environmental and social crises.

In this context, although the problems are increasingly evident, pushing for the "de-industrialization" of fisheries in the name of environmental protection is not realistic. The current fishing system remains profitable in the short term, and any radical intervention without a clear understanding of its economic logic and institutional mechanisms may destabilize society. Therefore, the key to design intervention is to identify opportunities for transformation within the fishing system, gradually introducing ecological alternatives while retaining some economic function to achieve a systemic transformation.

Specifically, the Sangyuanwei area, with its unique water town landscape and cultural foundation, offers potential for the development of ecological industries or other sustainable alternative industries. For example, combining local landscape conditions and residents' experiences, new industries like ecological farming, recreational fisheries, eco-tourism, and educational agriculture could serve as economic compensation mechanisms for industrial fisheries. This would help reduce ecological risks, enhance the multifunctionality of land use, and offer local residents opportunities to re-engage with the industry and water resource management.

Through design, guiding the collaborative evolution of ecology and economy can regenerate the traditional water town landscape in a contemporary form, opening new possibilities for the region's long-term development.

Introduce low-energy and sustainable water management systems to reduce the dependency on energy and water resources in high-density aquaculture and enhance ecological resilience.

In high-output areas, pilot ecological farming demonstration zones, using small-scale, controllable units to drive green transformation and explore replicable alternative pathways.

Rebuild the interaction space between dike-fish ponds and residents by creating public spcaces or communal facilities to activate residents' spatial participation and water culture memory.

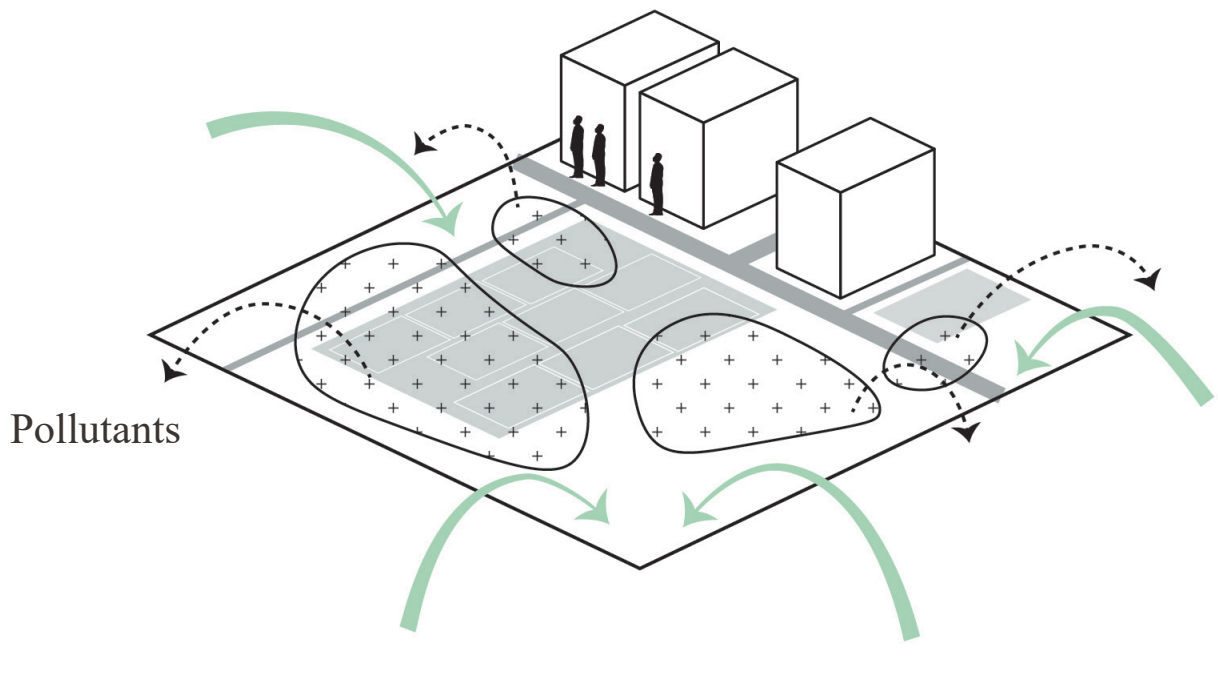
Through policy and spatial coordination, reshape the relationship between production, ecology, and daily life, enabling local knowledge, traditional practices, and modern management systems to coexist and complement each other.

Design goals

1. Enhancing Ecological Resilience

Restore degraded dike-pond ecosystems, addressing water quality deterioration, sediment pollution, and biodiversity loss.

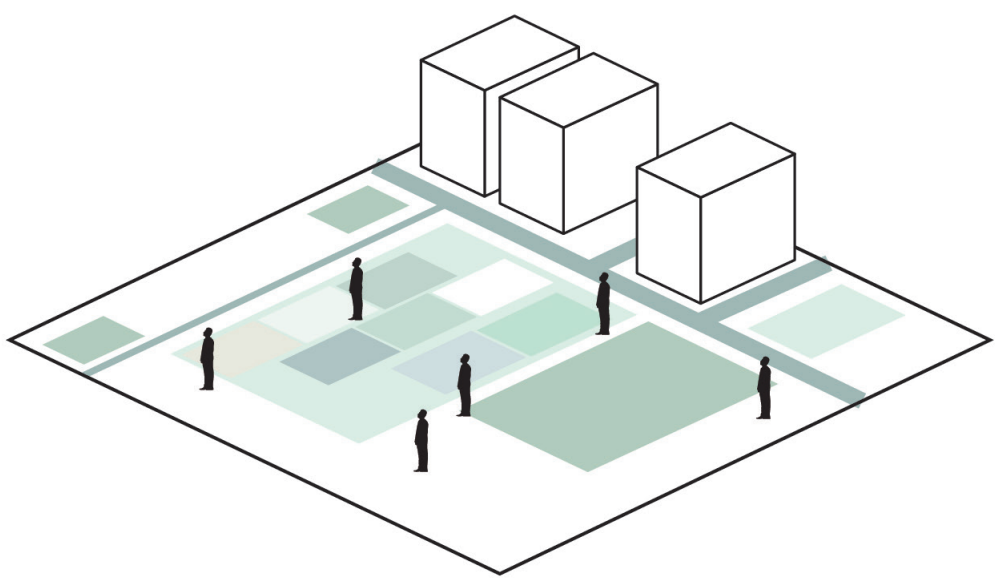
Transition the dike-pond system from monoculture to diversified production models to enhance ecological resilience and water self-purification capacity.



2. Rebuilding Public Green Spaces for Community Use

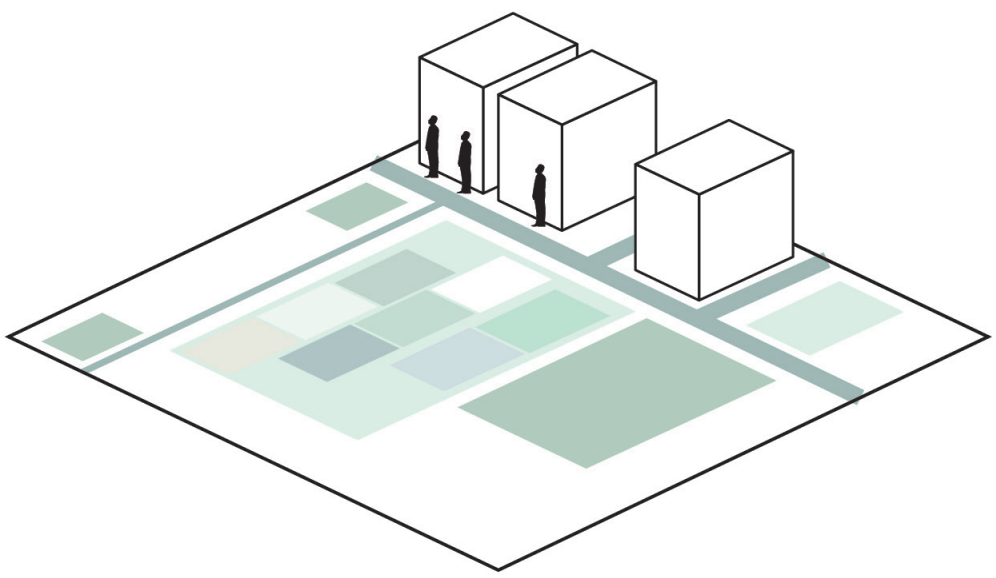
Establish a community-centered water resource management system, empowering residents with greater participation and decision-making rights.

Design public spaces and interactive installations to foster collaboration and communication in water management, education, and cultural activities.



3. Diversifying Industries and Supporting Livelihoods

Integrate aquaculture, agriculture, tourism, and ecological restoration into the design to create multifunctional production landscapes and promote economic diversification.Optimize the production-ecology ratio of dike-ponds to balance productivity and ecological functions.



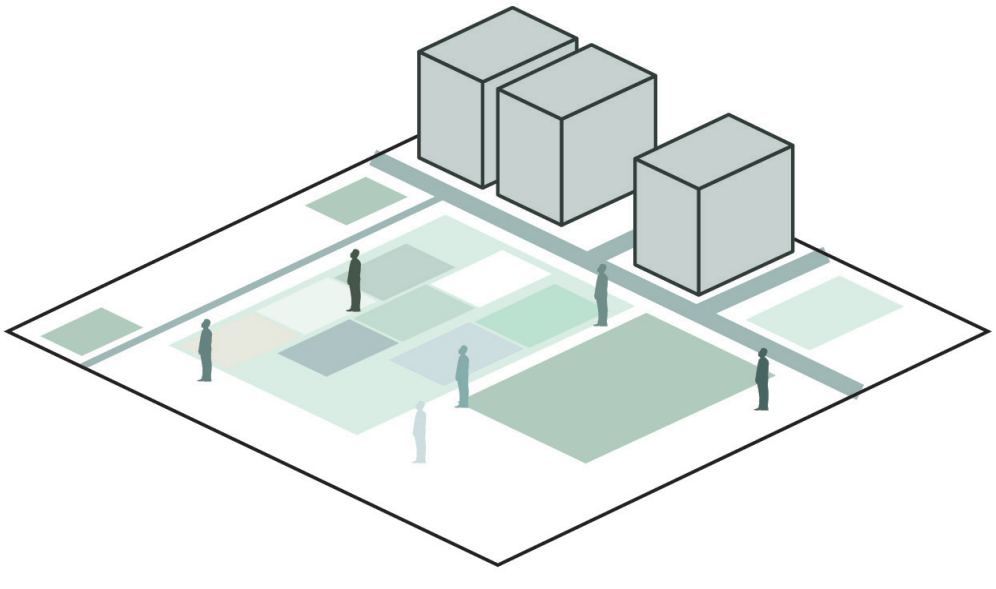
Monoculture ⟶ Polyculture

→

4. Reviving Water Culture and Human–Water Relationships

Preserve and reconstruct the cultural value of the dike-pond system, revitalizing traditional social activities such as water rituals, labor practices, and collective cooperation.

Integrate dike-pond culture into contemporary life through cultural exhibition spaces, pathways, and community education nodes.



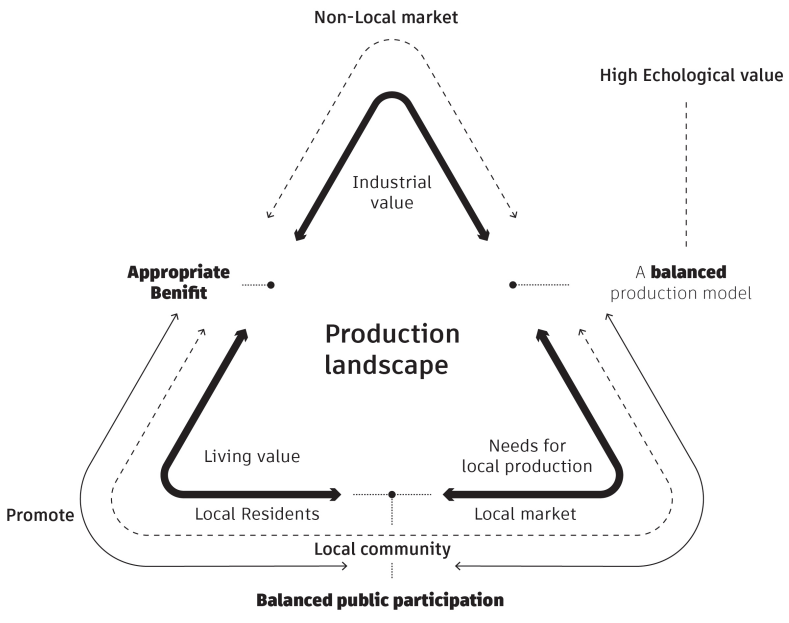
Design Logic and Multi-Scale Framework

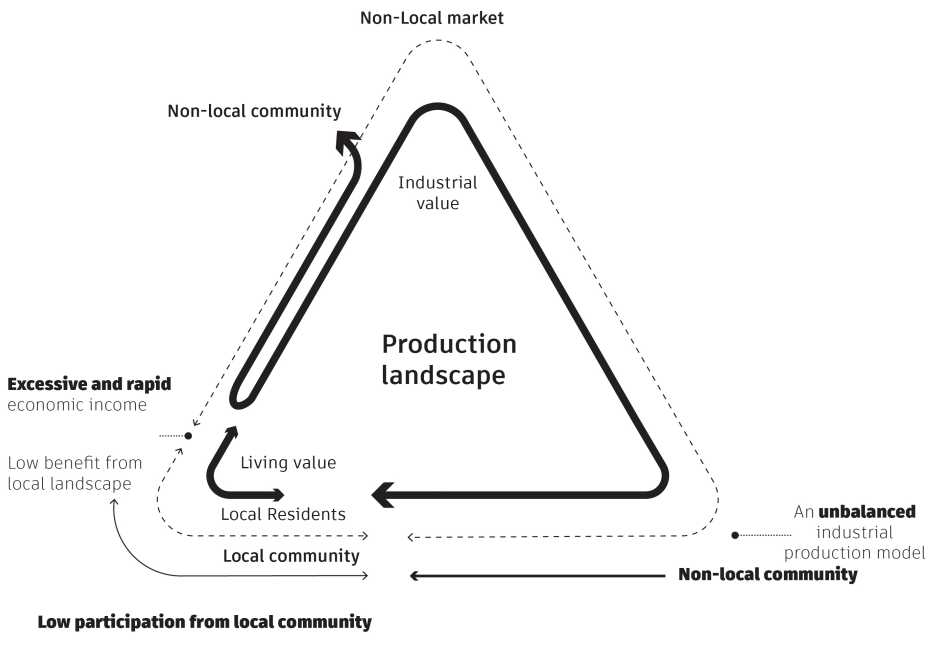
Problem-Driven Approach: From Research to Design

This design adopts a problem-driven approach, transforming comprehensive research on the farming areas of the Pearl River Delta into targeted spatial strategies. The research identifies three critical challenges. First, intensive fishing production has caused severe environmental pollution, including eutrophication, ecological imbalance, and accumulation of sediment in ponds, all of which threaten water quality and biodiversity. Second, the water management system is fragmented and lacks transparency; overlapping authorities and unclear responsibilities hinder effective water resource allocation and governance, limiting community participation. Third, current water governance is overly technocratic and top-down, neglecting the social and cultural dimensions of water as a shared public resource, and failing to engage local residents and stakeholders in meaningful management and stewardship.

In response, the design proposes multi-layered strategies. To alleviate environmental pressures, the project focuses on refined water system restructuring and the establishment of blue-green infrastructure to enhance water purification and ecological resilience. To address governance disorder, it introduces a clear redefinition of water management units combined with transparent and participatory management mechanisms that foster collaboration between local communities and authorities. To overcome the lack of social engagement, the design reclaims water's cultural and public value by creating interconnected public spaces and cooperative production models that activate water culture and empower community self-governance. Overall, the design not only aims at ecological restoration but also seeks to reimagine the socio-ecological relationship between people and water, building a sustainable and resilient system.

The livelihoods of local residents are severely affected by environmental pollution. The deterioration of water quality and degradation of ecosystems directly lead to declines in fisheries and agricultural productivity, undermining the foundation of traditional economic activities and threatening residents' income and quality of life. At the same time, due to the lack of social water governance, residents have limited voice and participation in water resource management and environmental protection, preventing them from effectively safeguarding and improving their livelihoods. This dual pressure from environmental degradation and social governance gaps exacerbates community vulnerability. Therefore, a more transparent and inclusive water management system is needed to promote resident participation and restore the potential for healthy and sustainable development of the site.





Traditional fishery

Intensive fishing industry

The environmental condition in traditional fishery is **better**. Traditional ponds rely on natural water systems and ecological cycles, maintaining relatively **clean water quality** and high biodiversity. The ponds integrate with farmland and wetlands to form diverse ecosystems with strong ecological resilience.	Environmental Aspact	**Water pollution**, leading to nutrient overload, oxygen depletion, and ecosystem damage. This threatens biodiversity and harms local livelihoods dependent on healthy water systems.
Traditional water management emphasized **social participation** but had relatively simple infrastructure. Historically, water management depended on community maintenance and coordination with high social involvement and flexibility. Although facilities were basic and flood control capacity limited, communities relied heavily on **local knowledge and collective action.**	Water Management	Modern water management features advanced infrastructure but low social participation. Current hydraulic facilities improve regulation and flood control through centralized management, but **social engagement has decreased**, with less transparency and reduced community control over water resources.
Traditional fishery livelihoods coexist harmoniously with **ecological economy**. Traditional ponds support diversified production including aquaculture and agriculture. Residents depend on ecosystems for **food, income, and cultural identity**, resulting in stable and sustainable lifestyles.	Social Aspect	Intensive fishing industry yields **high economic benefits** but harms livelihoods. While it promotes economic growth, the monoculture and high-intensity production damage the environment, leading to limited income diversity, reduced life quality, and weakening of traditional culture and community ties.

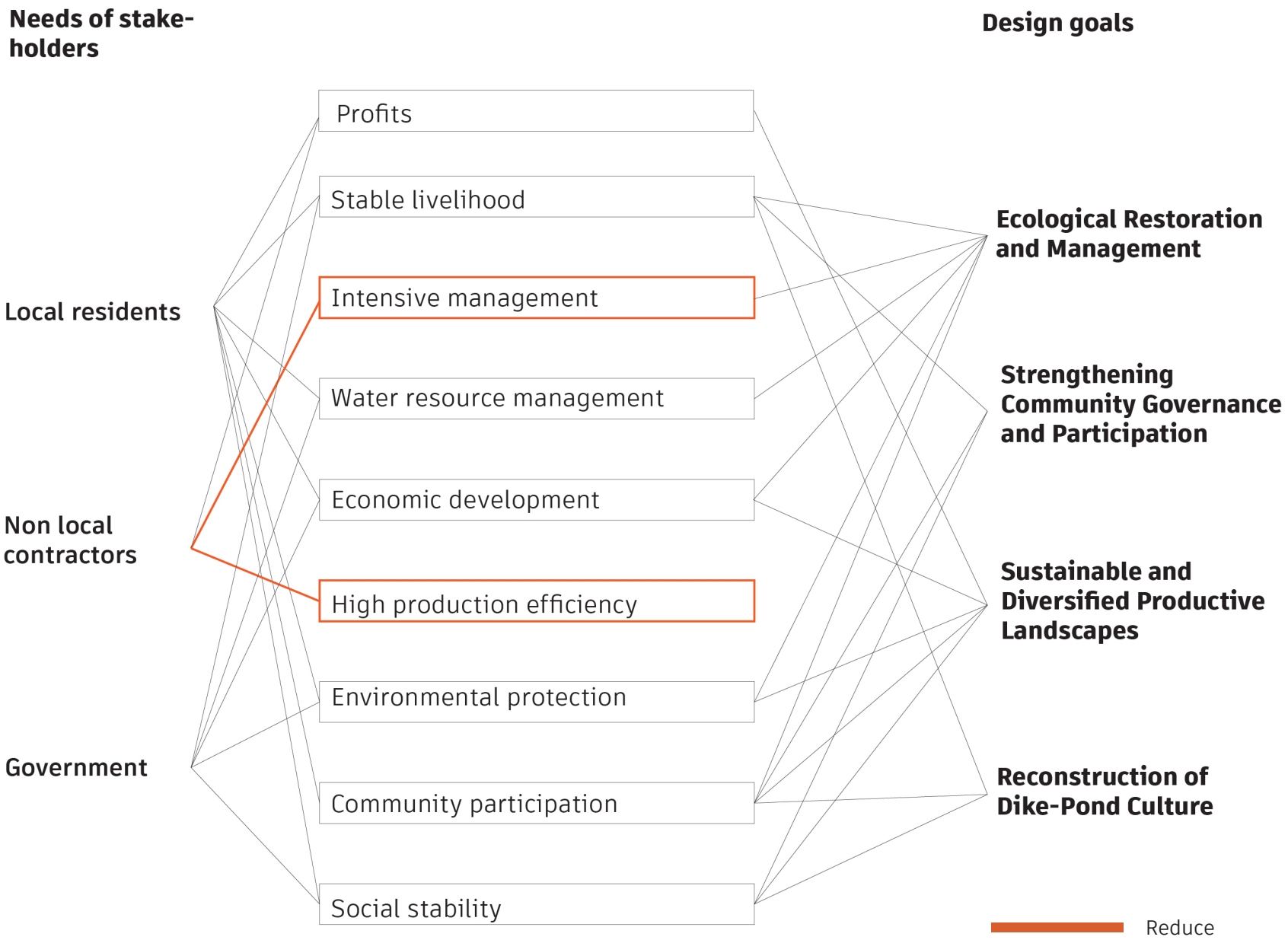
Key Problems

Environmental Pollution

Disorderly Water Management

Lack of Social Engagement

→ **Bad livelihood**



Site analysis

Current Water System Structure and Governance Issues

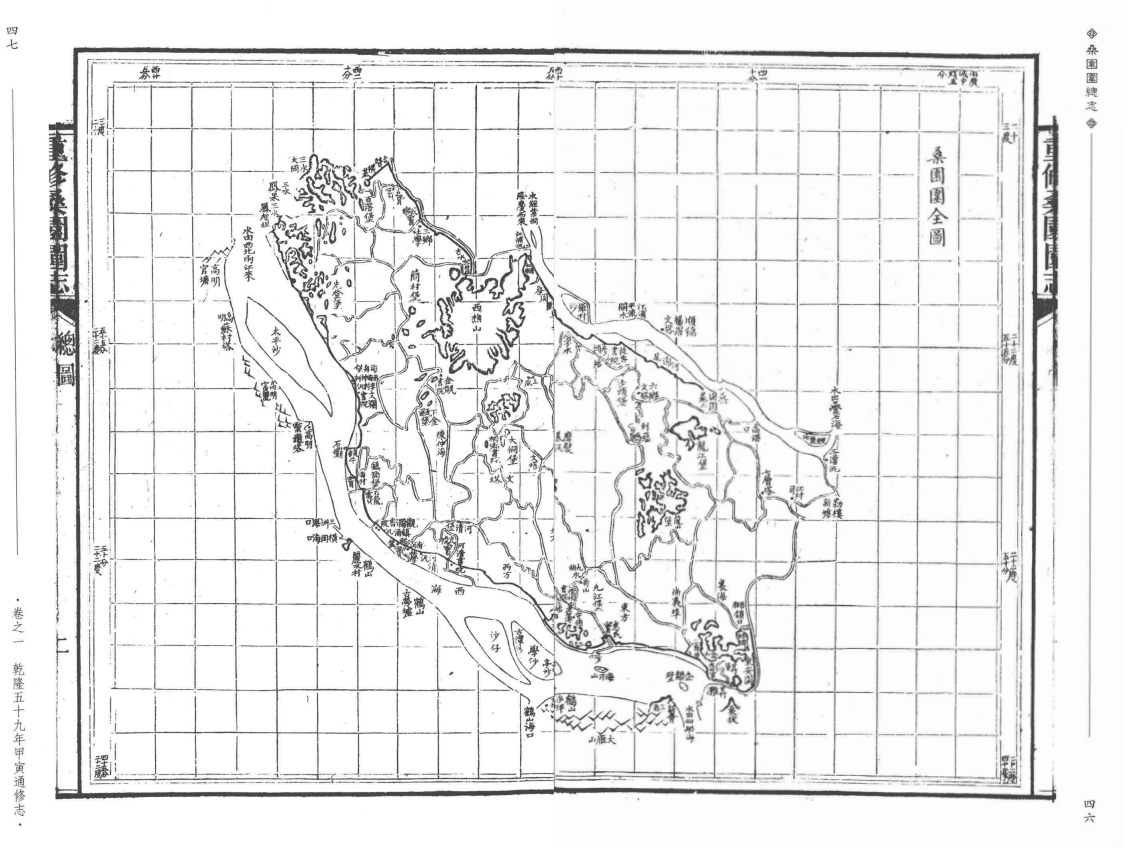
An analysis of the existing water system reveals that historical water management units were not simply defined by natural hydrological boundaries, but rather shaped through a complex process of social and ecological evolution. The traditional dike-pond systems, canal networks, and village territories were interwoven, forming a resilient human-water relationship that supported aquaculture, irrigation, flood protection, and daily life.

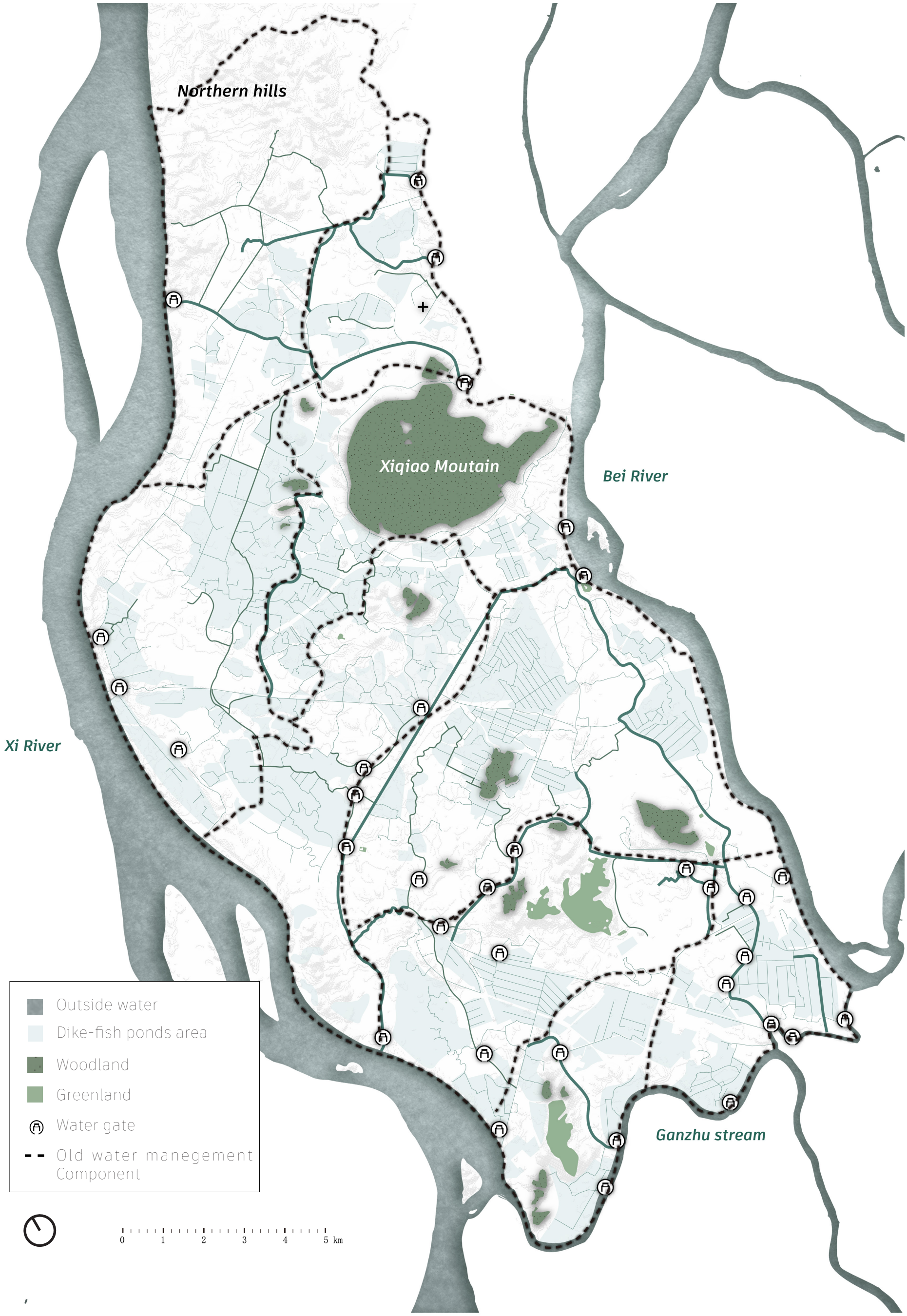
Today, however, this intricate management pattern has been disrupted. The current water system is characterized by fragmentation, homogenization of function, and a lack of coordination among stakeholders. Intensive aquaculture practices have led to the use of mechanical pumping and forced water circulation, which not only results in excessive energy consumption but also fails to provide effective control over water quality and distribution.

Furthermore, the management system has become opaque and top-down. Local communities have little to no involvement in decision-making, leading to unclear responsibilities, delayed responses to pollution, and a loss of connection between people and water landscapes.

These isues highlight the urgent need to re-divide water management component, introduce a layered governance structure, and re-establish the ecological and social integrity of the water-based production system.

Traditional water management component-Bao(堡)




Northern hills
Xiqiao Moutain
Bei River
Xi River
Ganzhu stream
Outside water
Dike-fish ponds area
Woodland
Greenland
Water gate
Old water manegement Component
0 1 2 3 4 5 km

Site analysis

Current dike-fish ponds topology and blue-green system

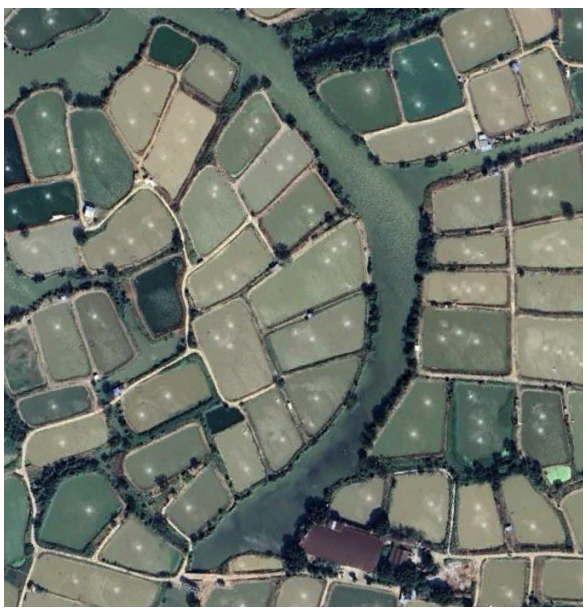
With the growth of the intensive fishing industry, many fishponds in the region have been consolidated under external contractors, forming large-scale industrial clusters. These ponds often adopt high-density production methods and closed management systems, disconnecting them from the traditional village-based water networks. As a result, pollution levels rise, transparency in management declines, and local communities are excluded from participation in production and water governance.

Spatially, contractor-managed ponds tend to be concentrated in downstream or low-lying flood-prone areas, which facilitate centralized drainage and water control. However, these areas also become hotspots for pollution discharge. Lacking traditional water connectivity, ecological buffers, and sedimentation wetlands, surface runoff often flows directly into major rivers, degrading overall water quality.

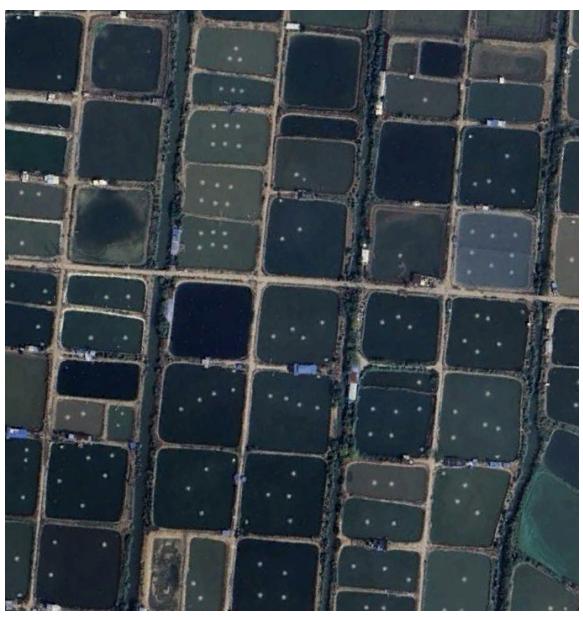
In addition, as these areas are managed primarily by non-local actors, local residents are rarely involved in decisions regarding water management or land use. This disconnect between ecological governance and local needs further exacerbates the fragmentation of the "fishpond–village" system.

Nevertheless, the spatial continuity of these pond clusters offers significant potential for integration into a broader blue-green infrastructure. Although green spaces exist across the region, they are fragmented and lack systemic connection. As ecological nodes linking blue (rivers, water bodies) and green (farmlands, vegetation), fishponds can be reimagined as corridors of ecological and social value.

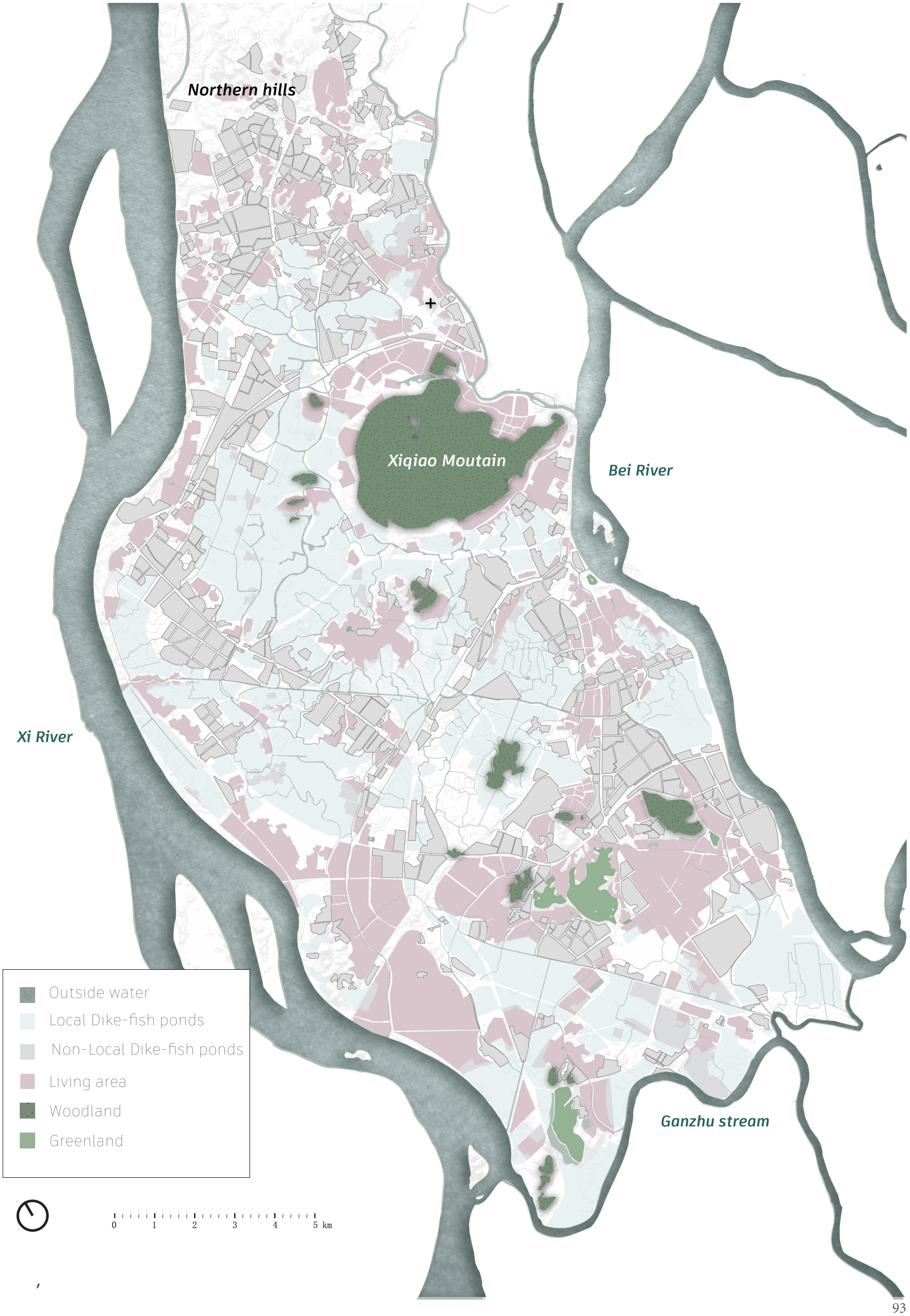
By applying ecological restoration, water quality control, and landscape redesign, these ponds could be reintegrated into the regional ecosystem—improving environmental conditions, supporting ecological resilience, and providing space for community engagement and public use. This sets the groundwork for multifunctional land use and participatory governance



Local Dike-fish ponds



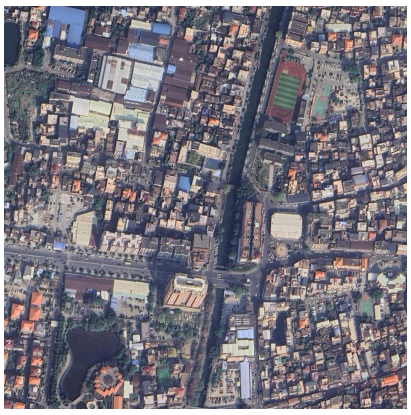
Non-Local Dike-fish ponds


Northern hills
Xiqiao Moutain
Bei River
Xi River
Ganzhu stream
Outside water
Local Dike-fish ponds
Non-Local Dike-fish ponds
Living area
Woodland
Greenland
0 1 2 3 4 5 km

Site analysis

Current land-use

The rapid expansion of urban development and manufacturing industries has significantly transformed the landscape, occupying vast areas that were once dedicated to traditional fisheries and agriculture. This extensive land conversion has fragmented natural habitats and agricultural zones, disrupting the ecological connectivity that previously supported diverse species and ecosystem functions. As natural and productive landscapes become increasingly isolated, local residents experience a weakening of their cultural and economic ties to the environment. The reduced access to natural spaces and water systems limits opportunities for traditional livelihood practices, such as small-scale aquaculture and agriculture, thereby impacting community resilience. Furthermore, the altered land use patterns challenge the integrity of existing water management networks, complicating the sustainable management of water resources essential for both ecological health and local production. Overall, the manufacturing-driven urban expansion has not only reshaped the physical environment but also contributed to a growing disconnect between people and the natural systems that historically sustained them.



Living area



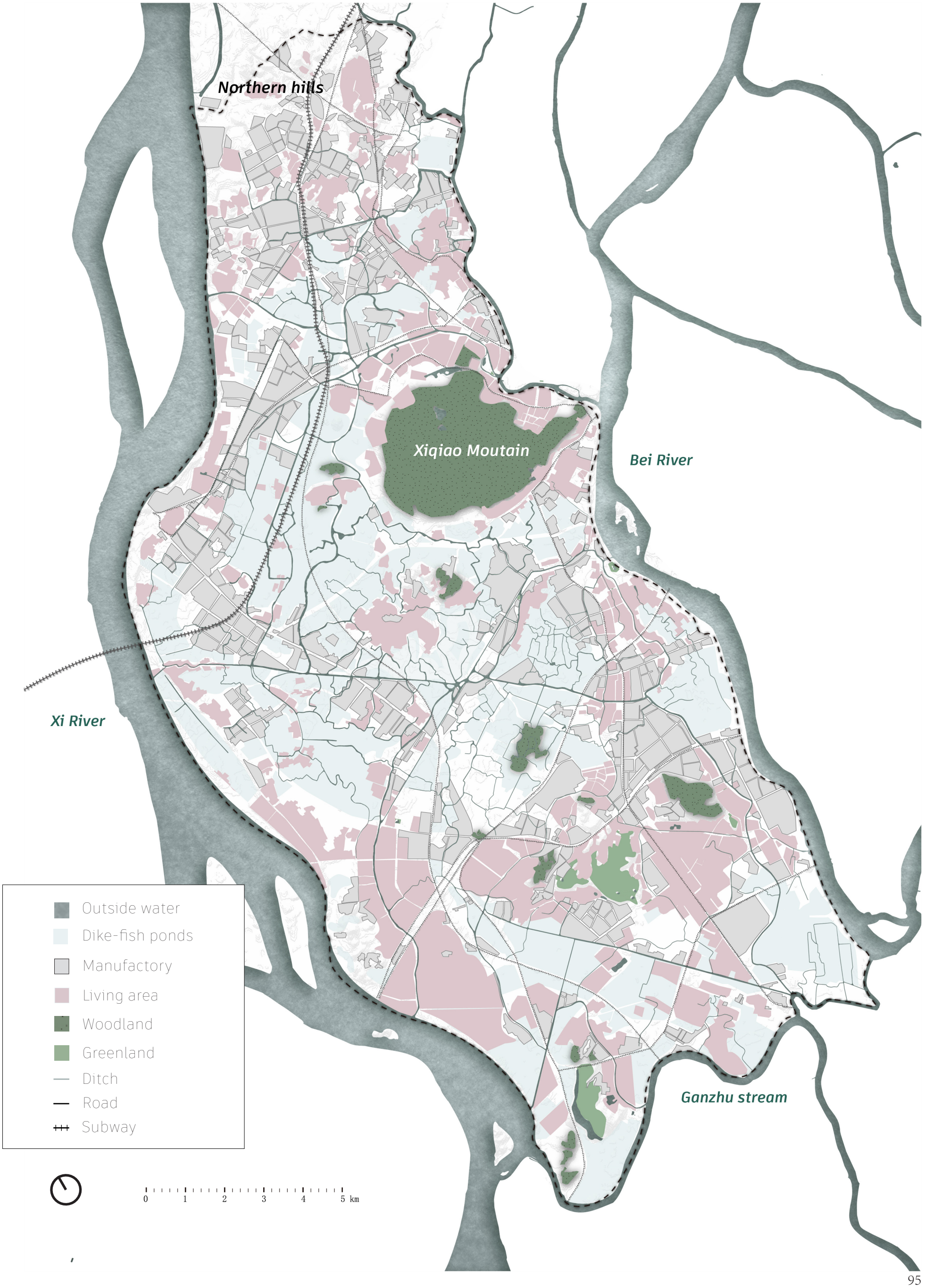
Manufactory



Dike-fish ponds



Birdveiw of Living area, manufoctory and dike-fish ponds


Northern hills
Xiqiao Moutain
Bei River
Xi River
Ganzhu stream
Outside water
Dike-fish ponds
Manufactory
Living area
Woodland
Greenland
Ditch
Road
Subway
0 1 2 3 4 5 km

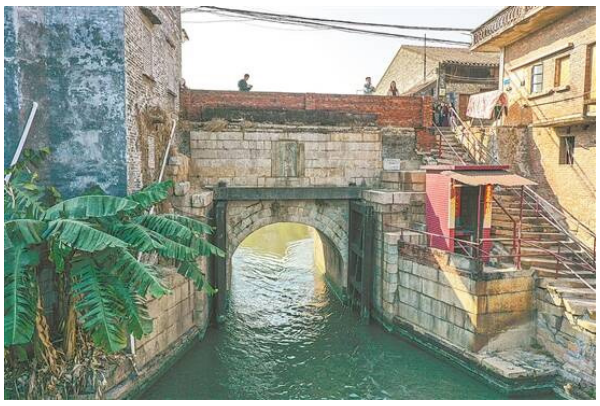
Site analysis

Cultural relics

This analysis map illustrates the spatial distribution of cultural relics within the study area, including traditional water systems, dikes, bridges, temples, and ancient villages. Most of these elements are closely linked to historical practices of water management and land adaptation. They reflect not only the ingenious hydraulic wisdom of past communities—developed in response to the challenges of a water-rich environment—but also the emergence of locally rooted governance structures and cultural expressions centered around water.

These relics, as integral parts of the traditional water system, carry significant historical and cultural value, embodying the evolving relationship between people and water over time. In the contemporary context, they hold immense potential for future development. On one hand, they serve as valuable resources for eco-cultural tourism, offering rich narratives and unique landscape identity that can support local economic diversification. On the other hand, they can function as platforms for re-engaging communities with water systems, encouraging collective memory, cultural continuity, and participatory water governance.

Therefore, these cultural relics are not merely static monuments of the past, but dynamic catalysts for reconnecting society with water culture and ecological stewardship in a meaningful and locally grounded way.



Water gate



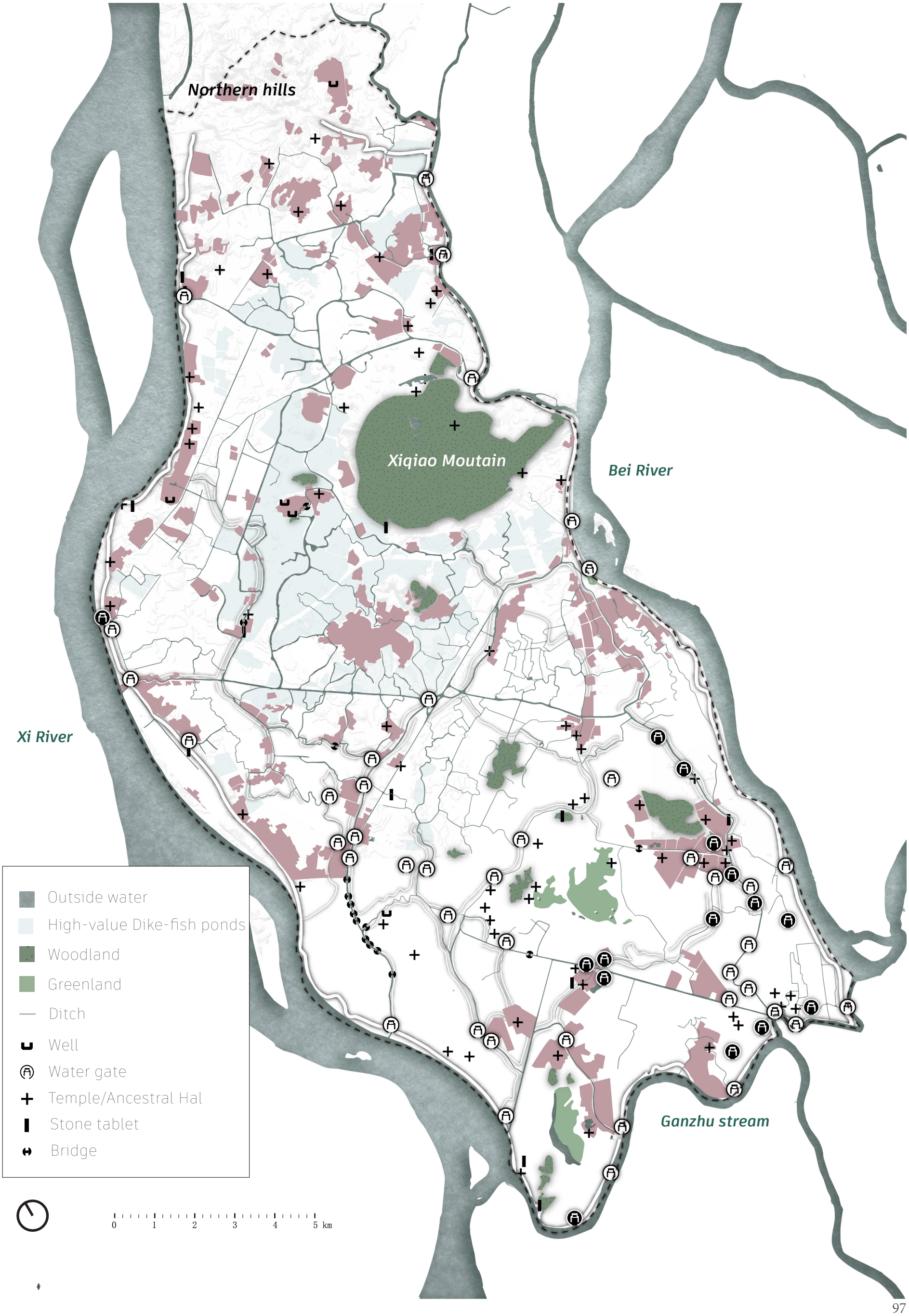
Bridge



Stone tablet



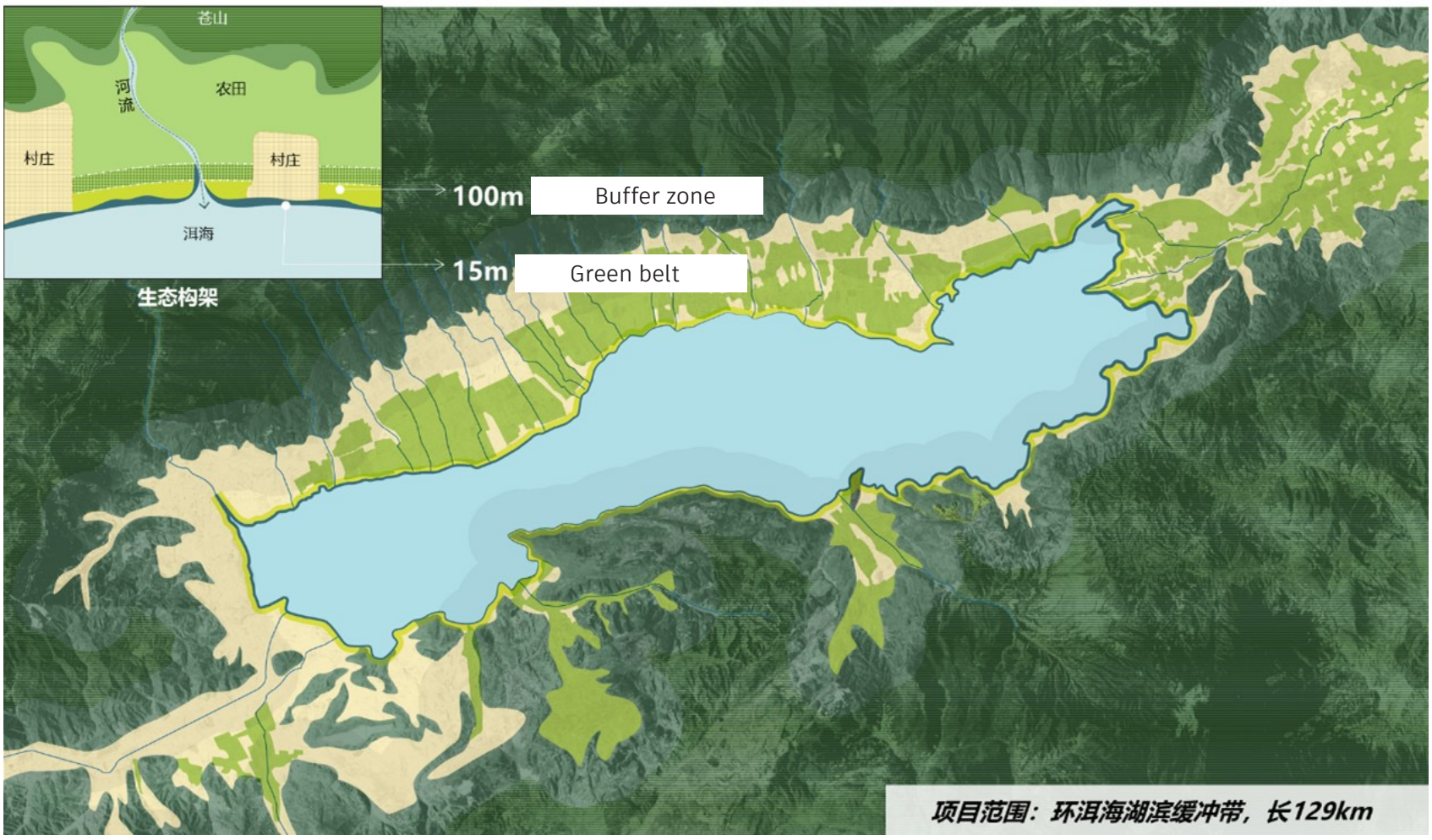
Ancestral Hal


Northern hills
Xiqiao Moutain
Bei River
Xi River
Ganzhu stream
Outside water
High-value Dike-fish ponds
Woodland
Greenland
Ditch
Well
Water gate
Temple/Ancestral Hal
Stone tablet
Bridge
0 1 2 3 4 5 km

Multi-Scale Strategy: Regional – Meso – Micro Integration

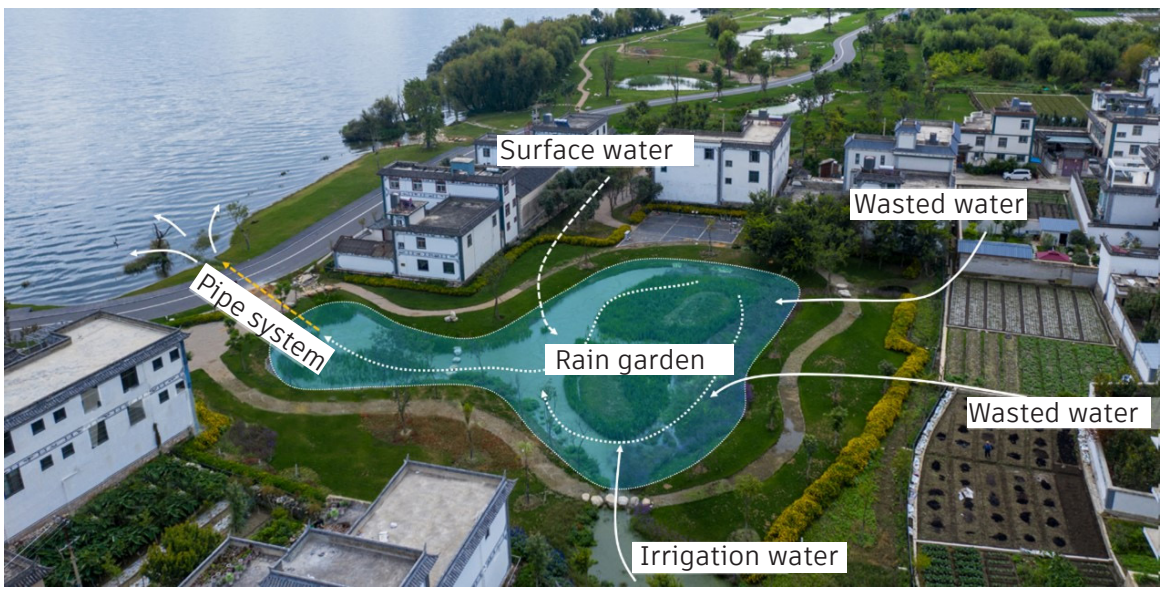
These analysis maps reveal the complex and diverse layers within the region, highlighting the necessity of adopting a multi-scale design strategy. Firstly, the existing water management system is characterized by complexity and opacity, spanning multiple management units and making localized interventions insufficient. Therefore, at the regional scale, it is essential to redefine water management units by integrating centralized control with community participation to build more effective water quality monitoring and resource allocation systems, fundamentally revitalizing the participatory water management tradition of the dike-pond culture. Secondly, fishponds managed by contractors are widely distributed and large in scale. The meso scale design focuses on spatial optimization of village clusters and fishpond groups, developing differentiated strategies for different management actors, adjusting the proportions of dike-pond systems, enhancing the blue-green infrastructure network, and promoting the integration of ecological restoration and industrial upgrading to support diversified land use and community involvement. Additionally, rapid urban construction and industrial development occupy significant land, altering residents' livelihoods and their connection to the natural environment. This requires regional planning to coordinate industrial expansion with ecological protection, using blue-green infrastructure to buffer industrial impacts. Meanwhile, meso scale design optimizes urban-rural spatial relations and explores ecological-industrial compensation mechanisms to support sustainable community livelihoods. Finally, the distribution of cultural heritage relics such as water systems, dikes, bridges, temples, and ancient villages underscores the importance of micro scale interventions. Micro scale design not only enhances residents' quality of life and participation but also activates cultural heritage and ecological governance through public space development and rural tourism. The meso scale complements this by integrating cultural preservation with ecological restoration, creating a cohesive system. In summary, these analysis maps encompass multiple dimensions from water system management, industrial layout, urban expansion to cultural preservation, spanning macro to micro levels, fully demonstrating the necessity and rationality of multi-scale design. Through this multi-level design approach, ecological restoration, industrial transition, community participation, and cultural protection can be organically integrated to promote sustainable regional development.

Dali City's Erhai Lake Buffer Zone Ecological
Restoration and Wetland Development



Zoom in:
Natural purification wetland





Zoom in:
Rain garden

http://www.landscape.cn/landscape/12260.html

Multi-scale Design Framework

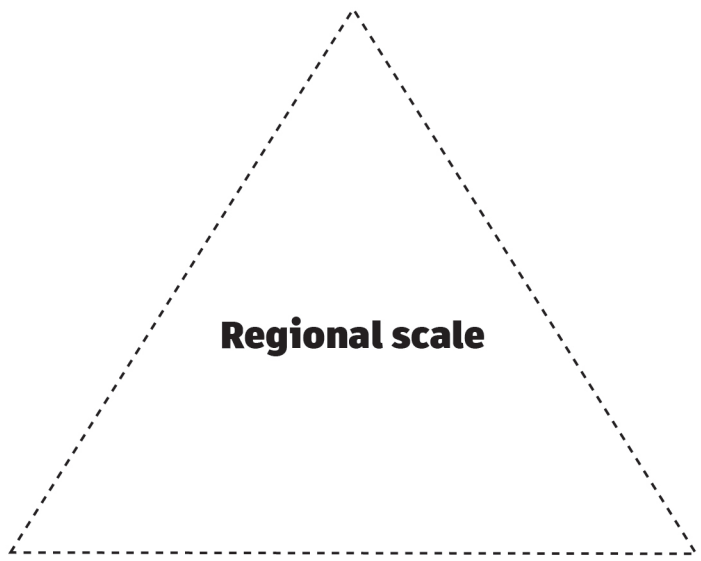
Design concept

↓

Design Principle

1. Ecological Restoration and Sustainability
2. Strengthening Community Governance and Participation (especially for local people)
3. Sustainable and Diversified Productive Landscapes
4. Reconstruction of Dike-Pond Culture

Reconstruction of the regional **water system**



Integration of **blue-green infrastructure** and ecological restoration

Introduction of diversified **industries** to offset fishing industry adjustment losses

2 type of dike-fish ponds

Non-local management **fishponds**:
sustainable production landscape

+

Local management **fishponds**:
community cooperation space with water ma-negement

Open-Mulberry garden dike musemu

Public water manegement spot

Public sluice gates station
Water quality wetland
family ponds garden

Zoom in

Micro scale

the design not only focuses on the reconstruction of ecological systems but also emphasizes the **restructuring of water manegement power dynamics.**

Through spatial planning, it aims to foster a water management system that is "visible, participatory, and negotiable," thereby rebuilding the **social connection between water and local people** and restoring water's role as a public resource and medium of everyday life.

Meso scale
Typical area practice

Coexistence of Local Living and Tourism

Coexistence of Industrial Development and Intensive fishing industry

Regional scale

1. Water management: the redefinition of water management units facilitates a shift from solely large-scale centralized management to a hybrid model combining centralized control with community participation at smaller scales. Adjustments to water levels and systems not only optimize resource allocation but also establish more effective water quality monitoring and management frameworks, fundamentally addressing issues of pollution and excessive electricity consumption. This spatial reorganization helps revive the traditional dike-pond culture by restoring a more nuanced water management approach rooted in local participation.

2. Blue and Green infrastructure:The implementation of blue-green infrastructure forms a continuous ecological network that enhances pollution control and ecosystem resilience, fostering ecological restoration and sustainability.

3.Industrial development:Industrial planning compensates for economic losses during the transformation of the fishpond landscape and creates increased opportunities for local residents to engage in income-generating activities, contributing to sustainable and diversified productive landscapes.

Meso scale

The design focuses on the rational spatial distribution and practical transformation within the study area, aiming to optimize the composition of dike-pond landscapes to promote coordinated development among different systems. This scale centers on village clusters and fishpond groups, integrating traditional aquaculture with modern production demands.:

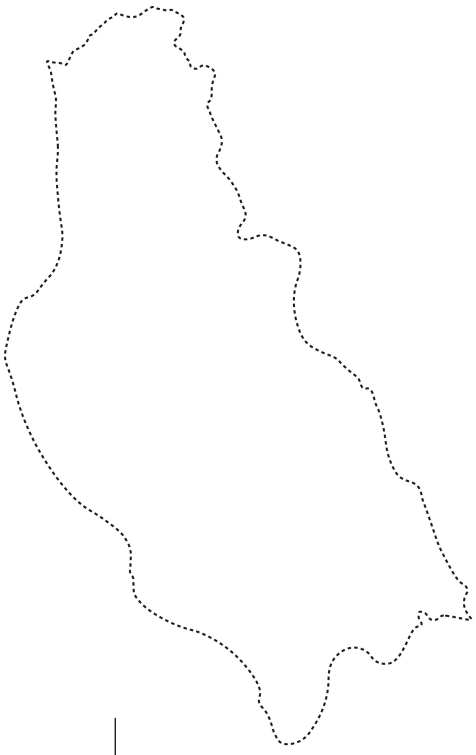
1. Organic Dike-fishponds:
These fishponds are transformed through small-scale cooperative farming models inspired by traditional dike-pond wisdom. Multiple neighboring ponds are grouped and co-managed by local residents, with one pond repurposed as a composting wetland to treat polluted sediment. This strategy encourages ecological restoration while creating new income channels and reinforcing community networks.

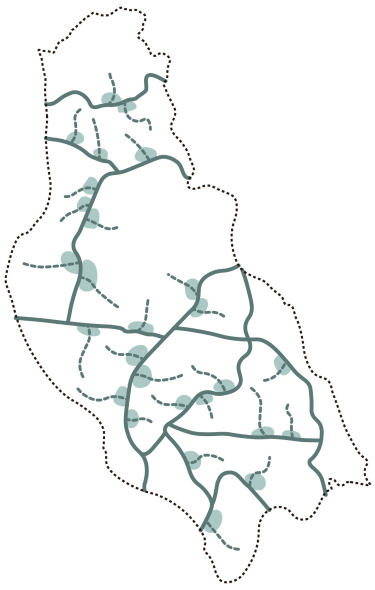
2.Formal Dike-fishponds:
For contractor-managed fishponds, a larger-scale spatial reorganization is proposed. These ponds are upgraded into productive zones that integrate self-purifying systems such as sedimentation and purification basins, and adopt a hybrid aquaculture model combining “re-watering fish” techniques with traditional methods. This approach supports ecological resilience while providing an opportunity for surrounding communities to reengage with the landscape and its management.

Micro scale:

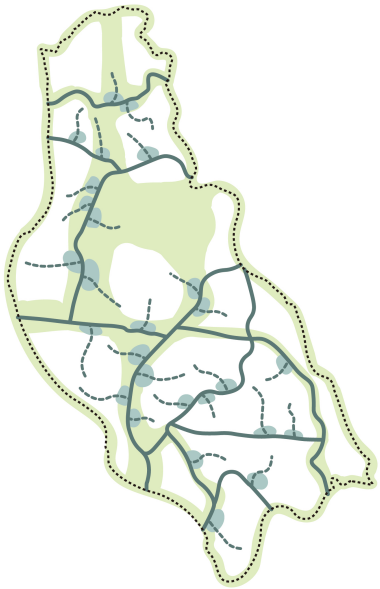
Emphasis is placed on improving local residents’ livelihoods by increasing income opportunities, enhancing participation in water governance, and improving the quality of living spaces. For example, the mulberry garden open museum area leverages rural tourism to boost income and showcase local culture; village meeting spaces foster greater resident involvement in water management; and wetlands designed for both water purification and recreational use provide public green spaces while enhancing transparency and community engagement in water governance. These localized efforts support ecological restoration, sustain cultural heritage, and reinforce social cohesion.

Through the integrated approach across these three scales, the design supports the reconstruction of the dike-pond culture by reintroducing participatory water management; fosters sustainable and diversified productive landscapes through mixed land uses and balanced ecological-industrial transitions; enhances community governance and participation by empowering local stakeholders; and advances ecological restoration and sustainability by rebuilding resilient water and green systems. This multi-dimensional strategy aims for a harmonious balance of ecological health, economic vitality, and social well-being.

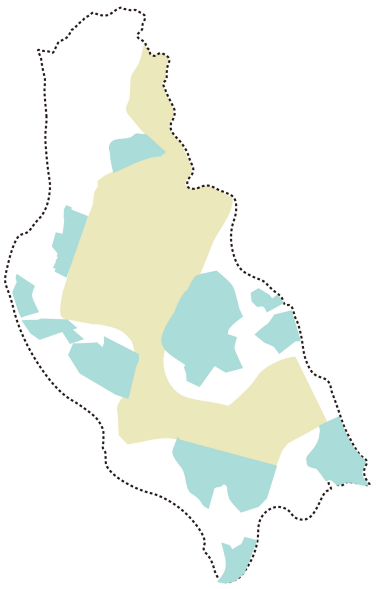




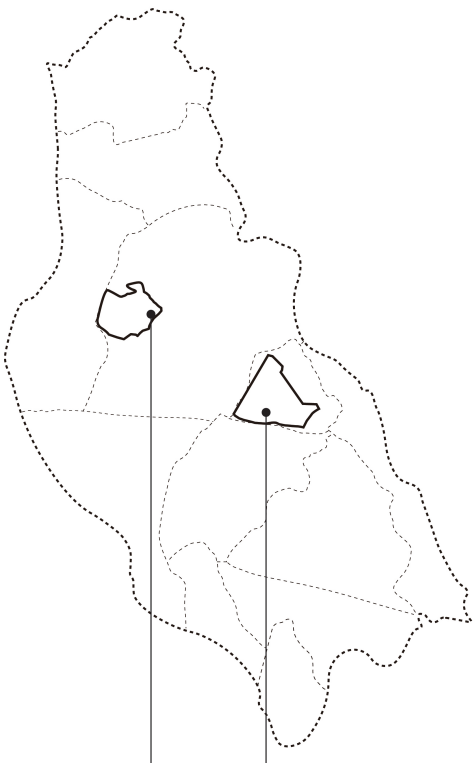
Water system management
&
Purification system



Blue-Green system



Industrial Development Planning

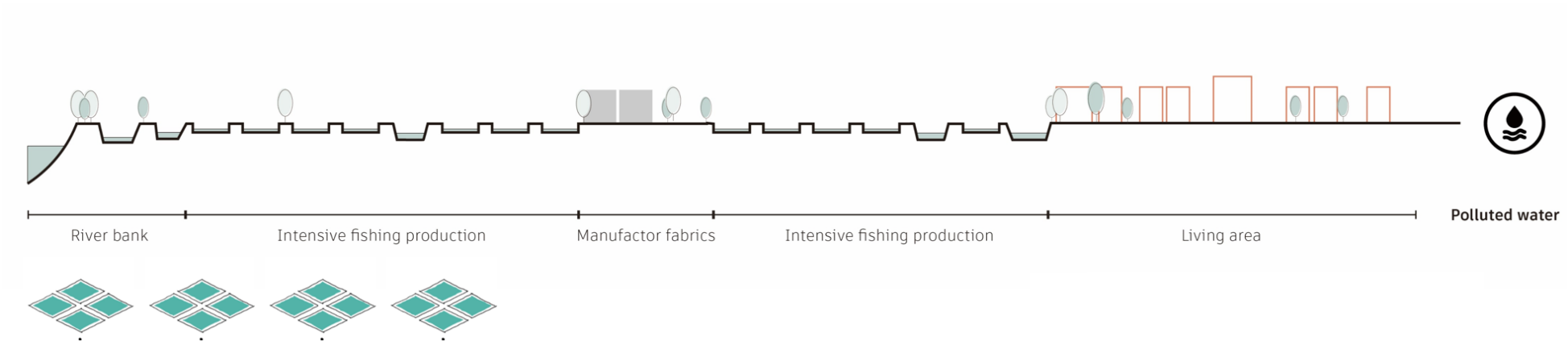


Organic dike-fishponds

formal dike-fishponds

Zoom-in 1

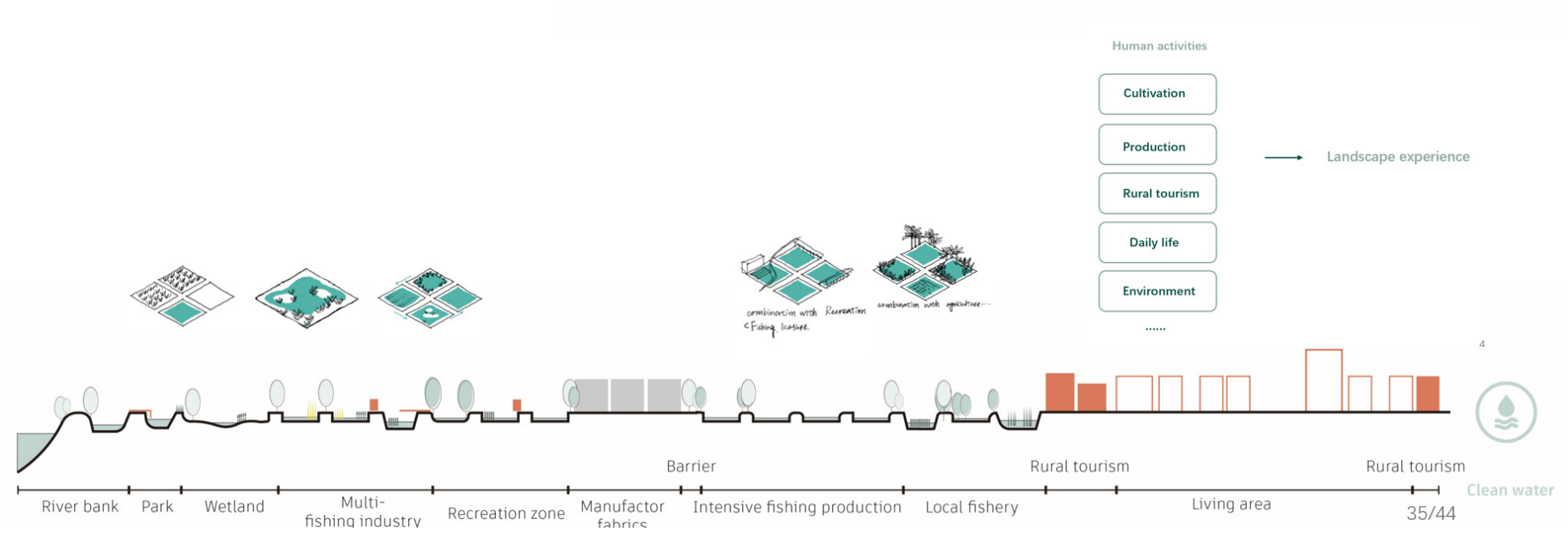
Zoom-in 2



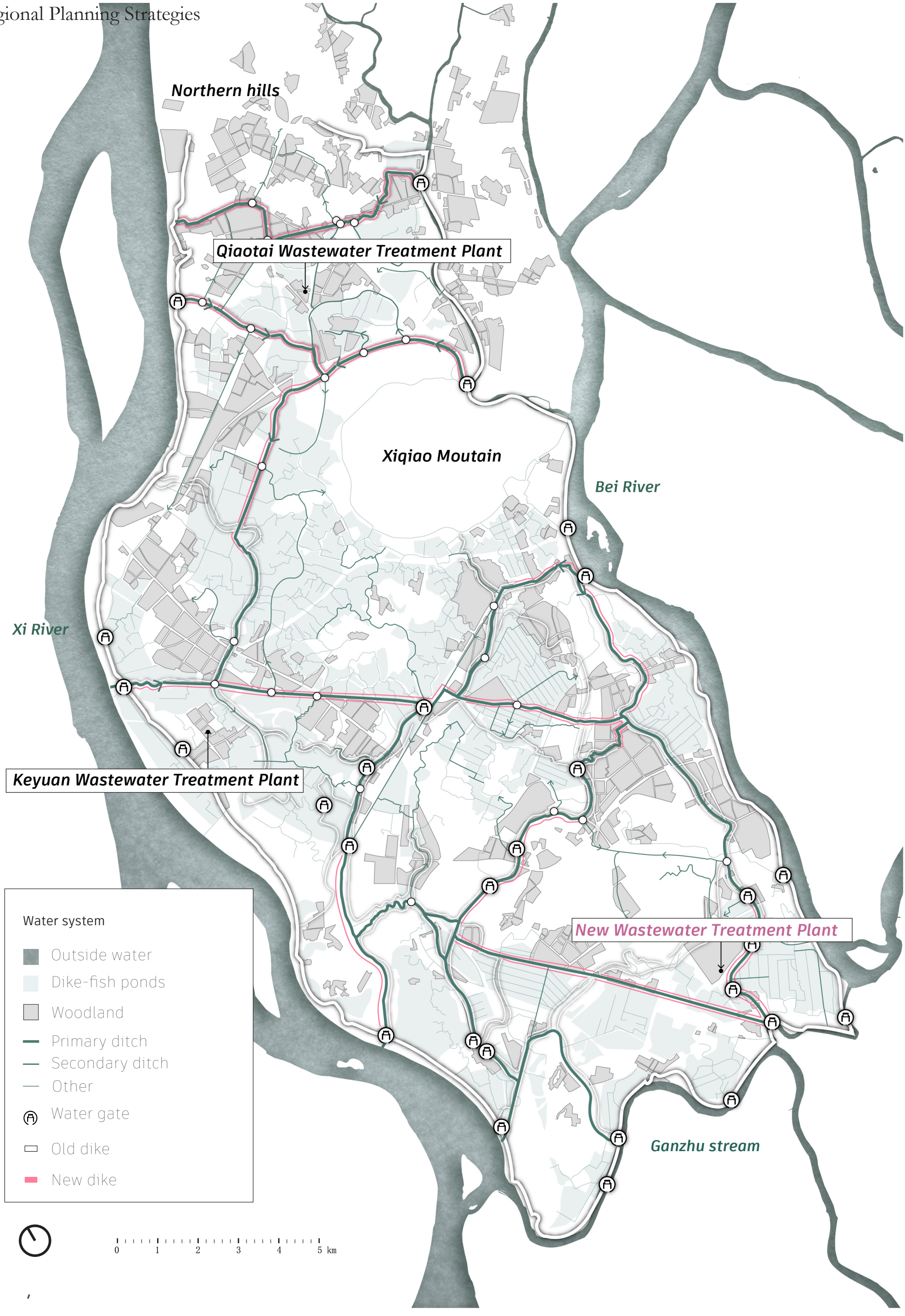
A Conceptual vision

Once, the dike-fish ponds lay heavy and dense, their waters murky, their edges silent, save for the drone of machines. Nature felt distant, and people stood apart. But now, the water stirs with new life. Dikes bloom with diverse crops and wild plants, and clear streams flow gently through reconnected channels. More and more hands tend the land, more eyes watch the water. With care, the ponds grow cleaner; with diversity, the landscape breathes again.

No longer just vessels of production, these waters have become places where people and nature meet—where clarity returns not only to the water, but to the bond between land, life, and those who dwell upon it.....






Northern hills
Qiaotai Wastewater Treatment Plant
Xiqiao Moutain
Bei River
Xi River
Keyuan Wastewater Treatment Plant
New Wastewater Treatment Plant
Ganzhu stream
Water system
Outside water
Dike-fish ponds
Woodland
Primary ditch
Secondary ditch
Other
Water gate
Old dike
New dike
0
1
2
3
4
5 km

Regional Planning Strategies

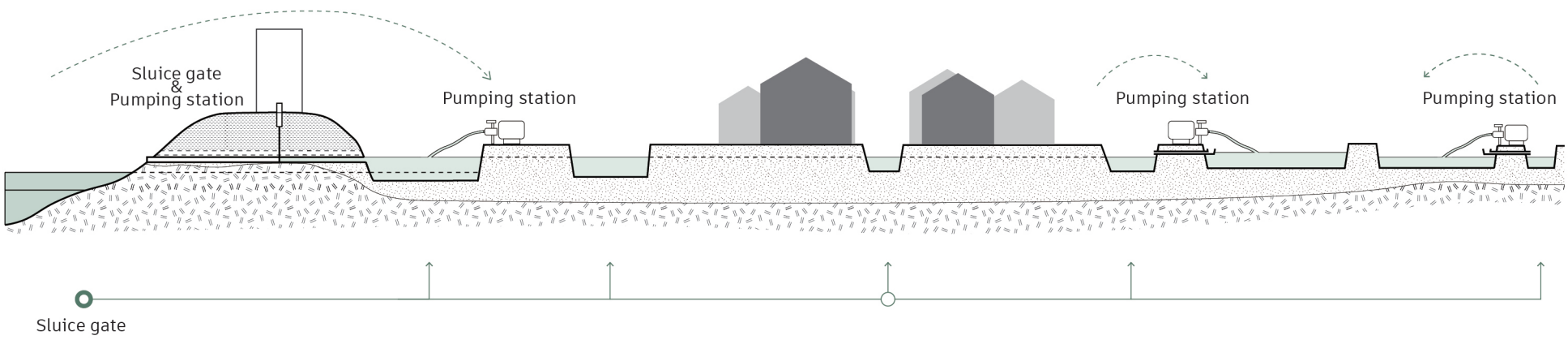
Reorganizing the Water System and Governance

Currently, water is often pumped directly into ditches or fish ponds, which consumes a large amount of electricity and lacks flexibility for community participation, as the system is managed at a centralized, large scale by local authorities. To address these issues, the design proposes a reorganization of the ditch system by introducing a hierarchical water network that supports small-scale, decentralized water governance.

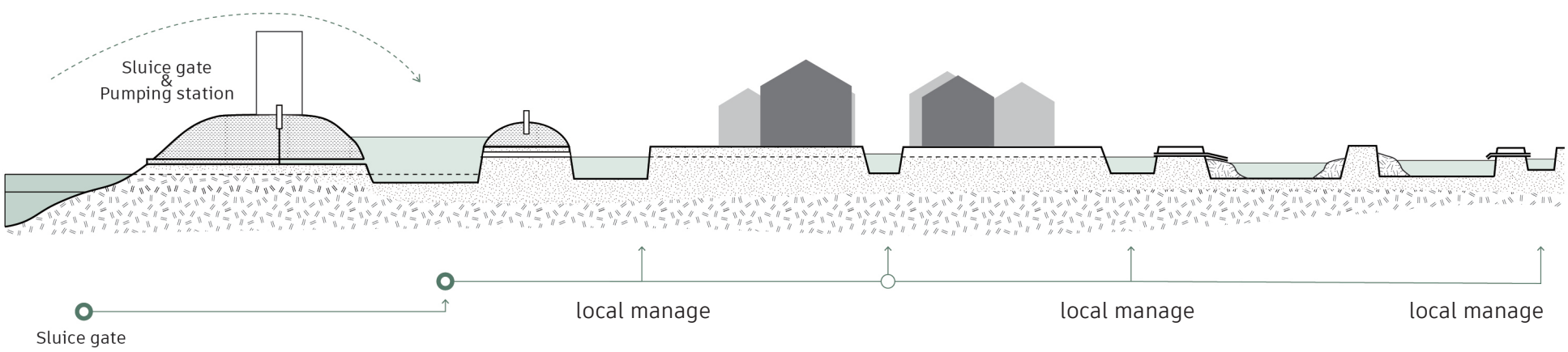
The strategy involves identifying and upgrading existing ditches with good ecological and hydrological performance as primary and secondary ditches. By enhancing or constructing new dikes around the primary ditch, the water level can be effectively managed. Water can be pumped into the primary ditch, then flow naturally into the secondary ditches, and subsequently into tertiary ditches or dike-fish ponds. This system enables water to be temporarily stored in ditches and ponds, improving water distribution and ecological resilience.

A new water treatment plant will also be introduced into the South area to address the water pollution from manufactory and living wasted water.

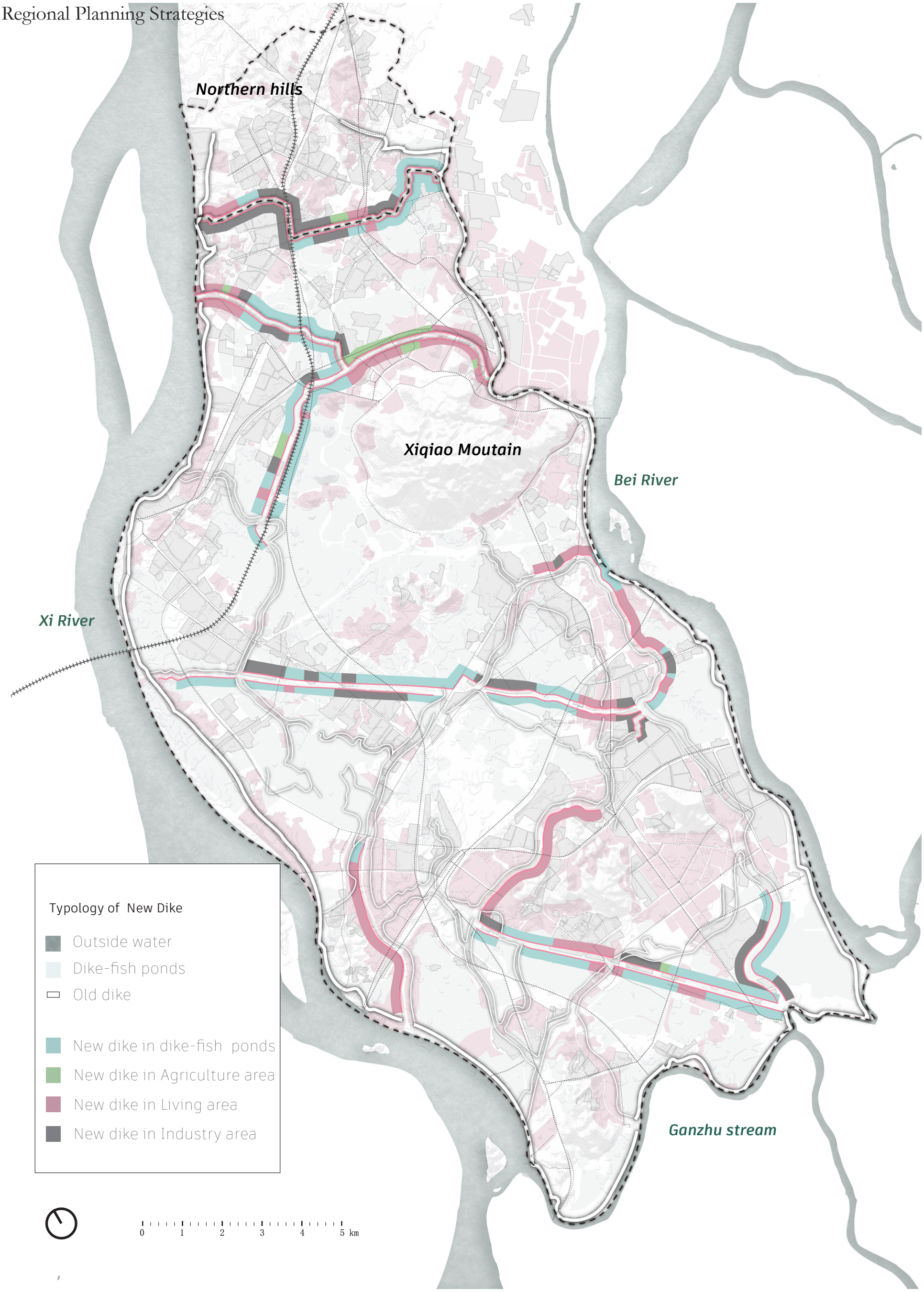
Such a system allows phased, small-scale design interventions to be integrated into different components of water infrastructure over time, offering both flexibility and long-term adaptability. Most importantly, it significantly reduces the reliance on high energy input, while reactivating the potential for community involvement in water management.



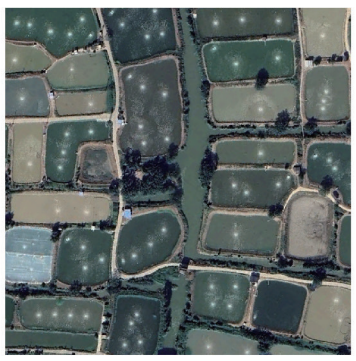
Current water system

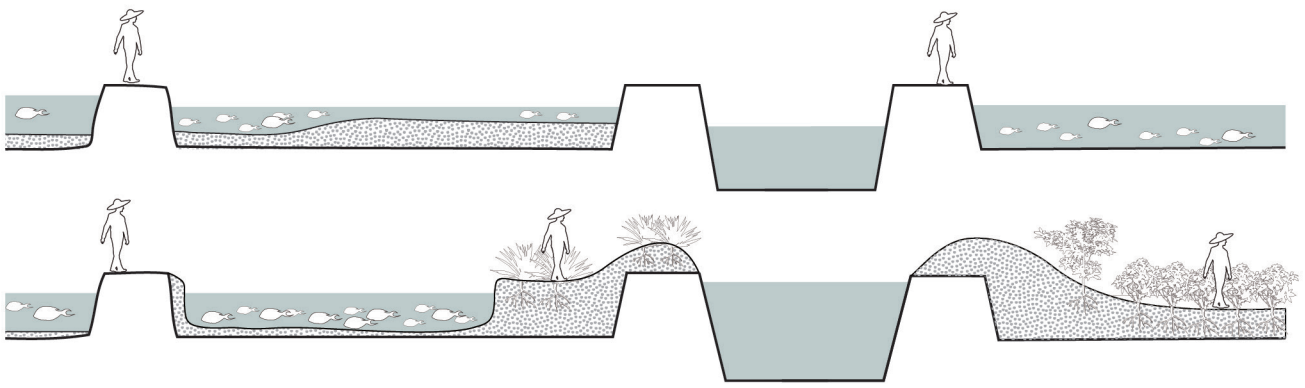


New water system


Northern hills
Xiqiao Moutain
Bei River
Xi River
Ganzhu stream
Typology of New Dike
Outside water
Dike-fish ponds
Old dike
New dike in dike-fish ponds
New dike in Agriculture area
New dike in Living area
New dike in Industry area
0 1 2 3 4 5 km

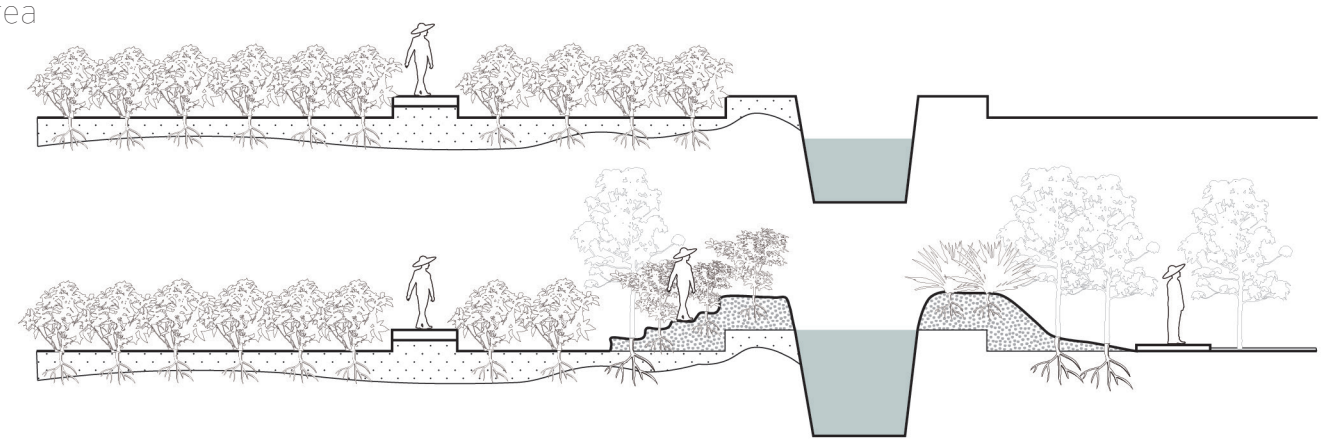
New dike in dike-fish ponds





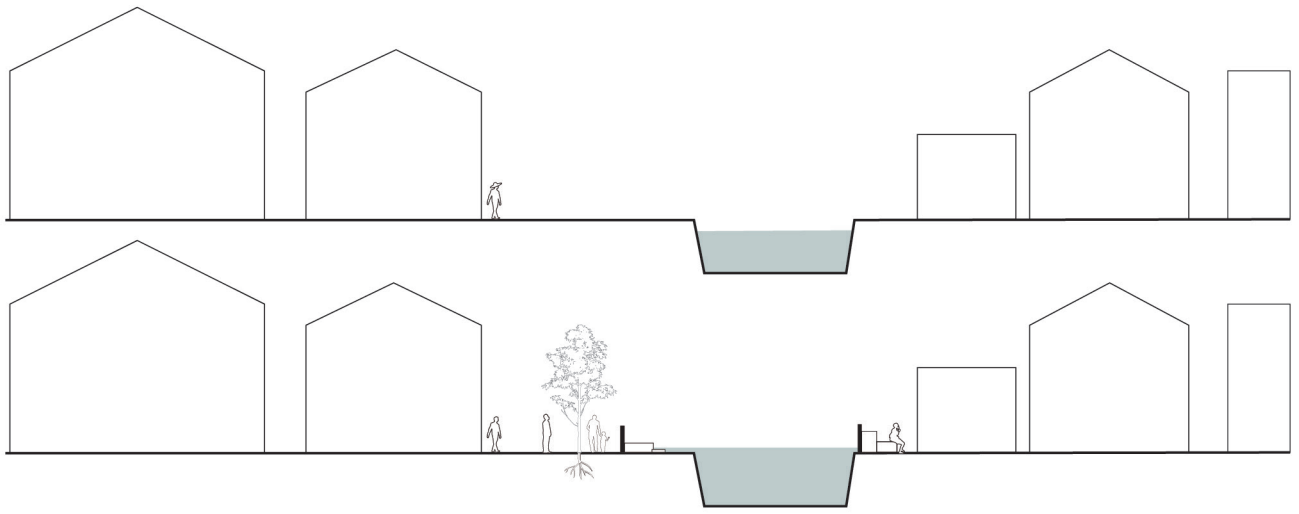
New dike in Agriculture area





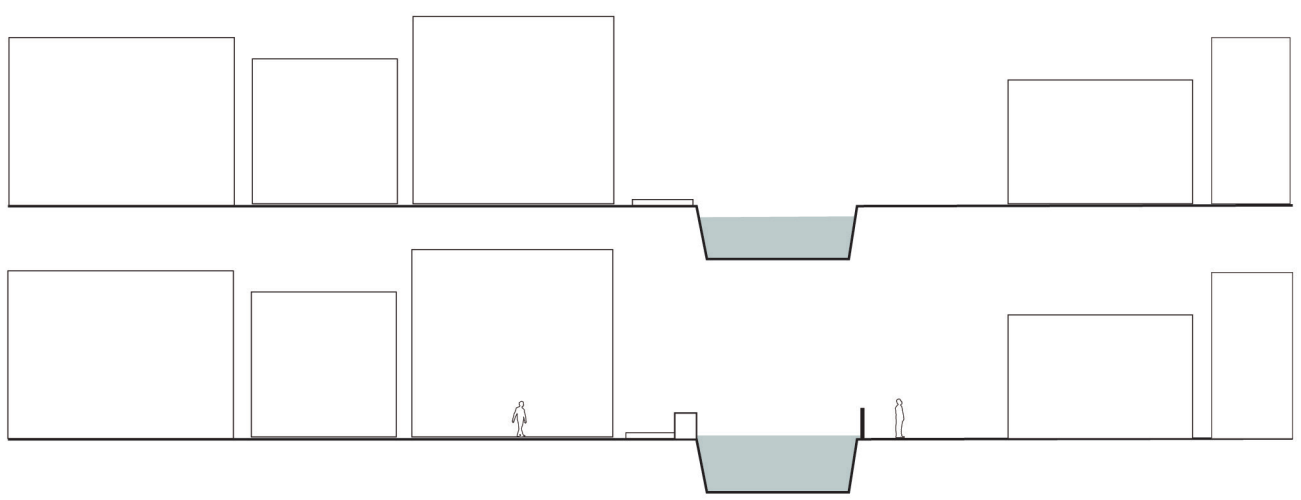
New dike in Living area

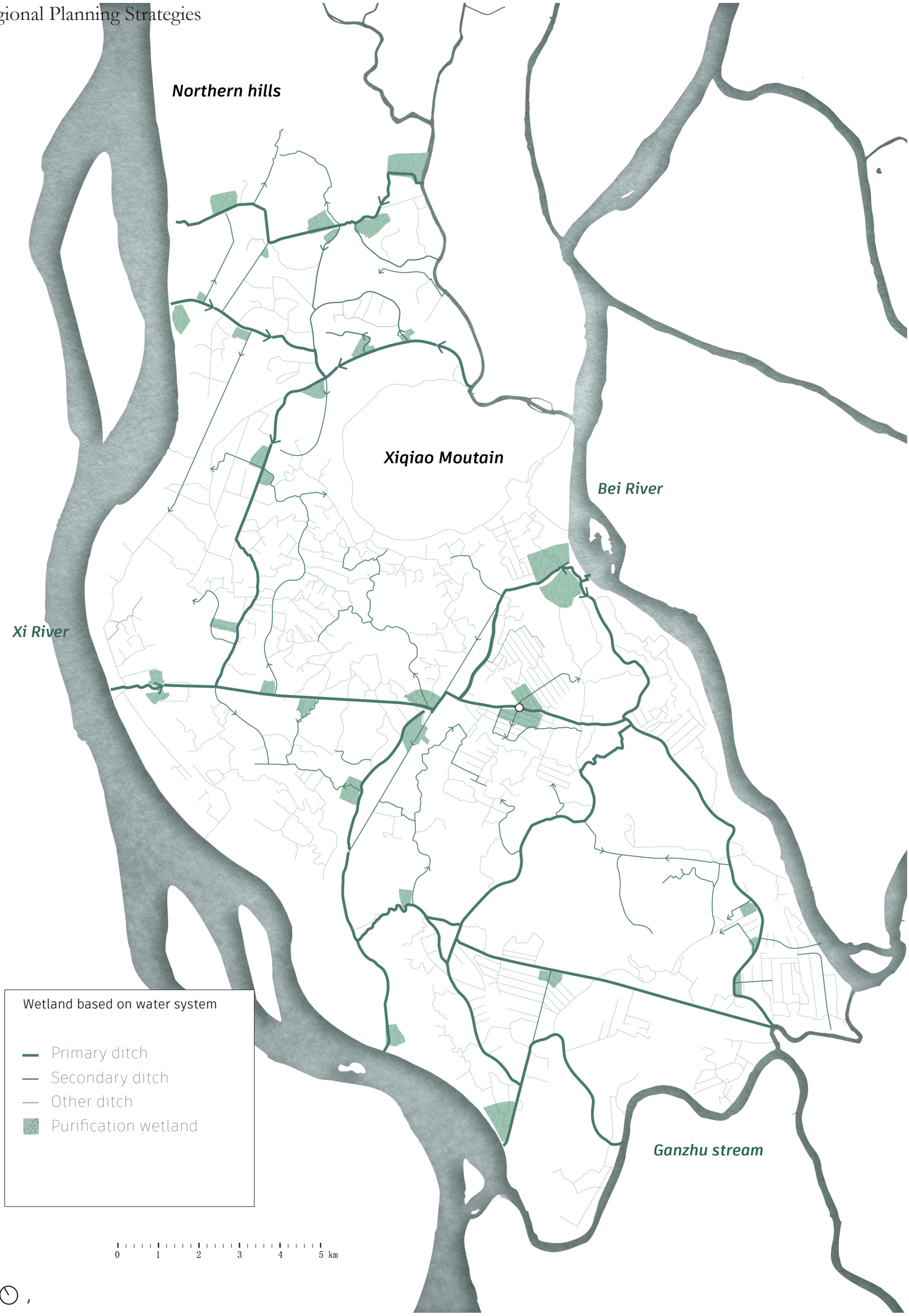




New dike in Industry area





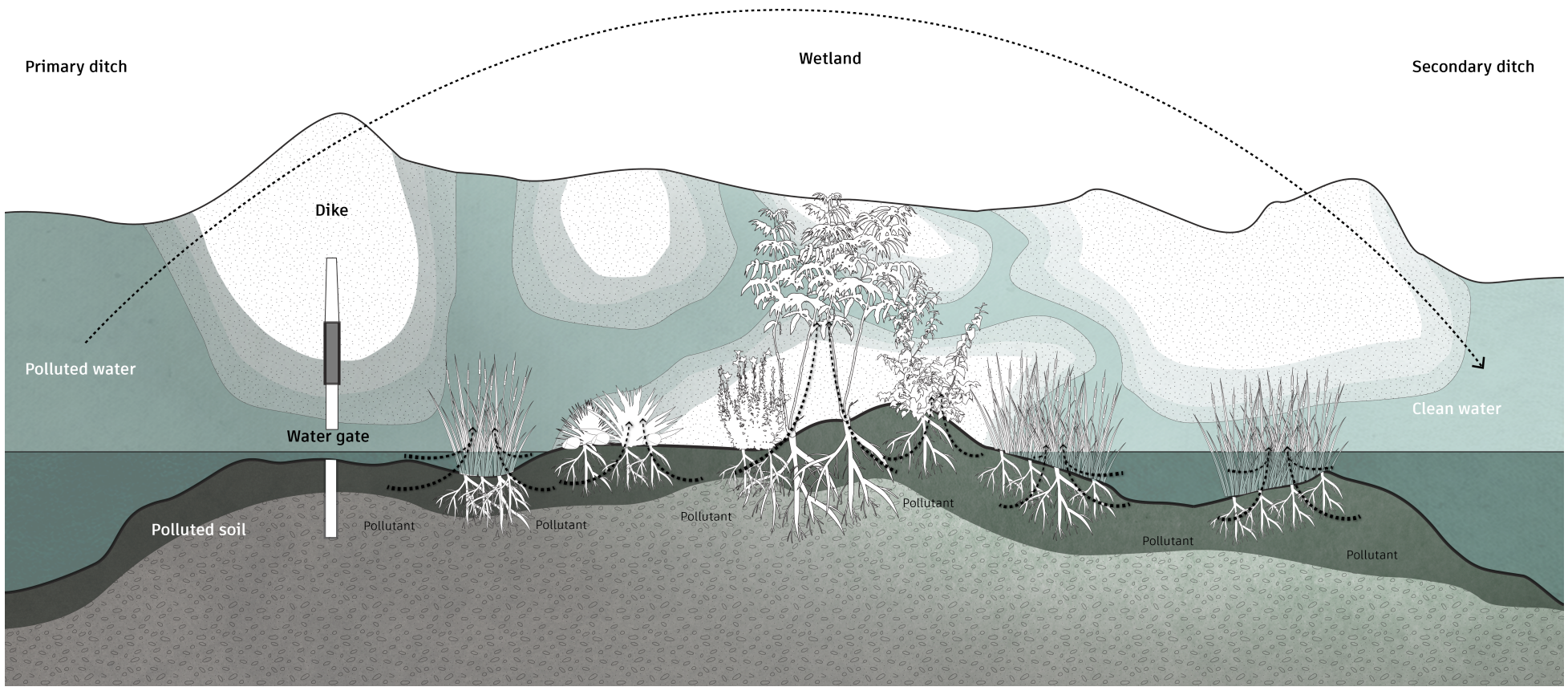

Northern hills
Xiqiao Moutain
Bei River
Xi River
Ganzhu stream
Wetland based on water system
Primary ditch
Secondary ditch
Other ditch
Purification wetland
0 1 2 3 4 5 km

New dike construction(illustrated in the diagram on the previous page)

The new water system is built upon an updated dike network, which optimizes and retains portions of the existing dikes while introducing new dikes to define and support the revised hydrological structure. Based on the surrounding land use characteristics, the system is divided into four main types. Each type corresponds to a specific spatial context and is guided by tailored construction strategies to respond effectively to local ecological, agricultural, and social needs.

Purification wetland

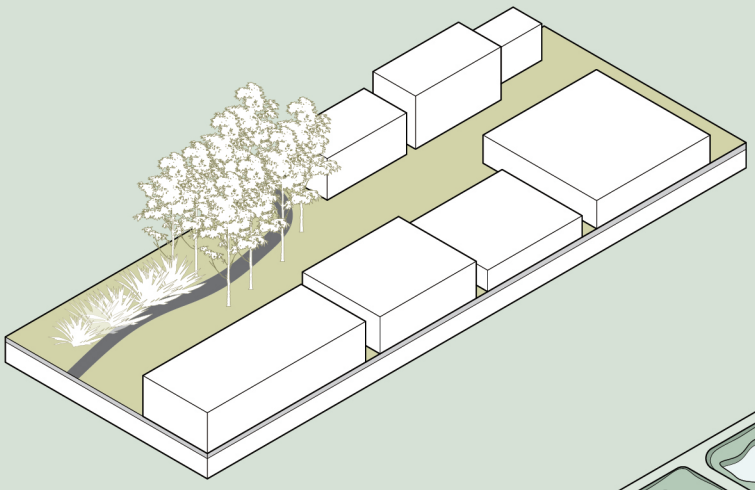
Purification wetlands are strategically located between the primary ditch and the secondary ditch within the water management system. Their main function is to filter and improve water quality before it flows into smaller management units, such as ponds or agricultural fields. These wetlands utilize natural purification processes—such as sedimentation, plant uptake, and microbial activity—to reduce nutrients, pollutants, and suspended solids, thereby enhancing the overall ecological performance of the system. In addition to their ecological role, these wetlands are carefully integrated into the landscape as visible and accessible features. They offer visual indicators of water quality improvement and contribute to the scenic value of the site. Furthermore, by incorporating paths, signage, or viewing platforms, purification wetlands can become educational spaces where local residents and visitors can learn about sustainable water management practices, ecological functions, and the importance of preserving water resources.



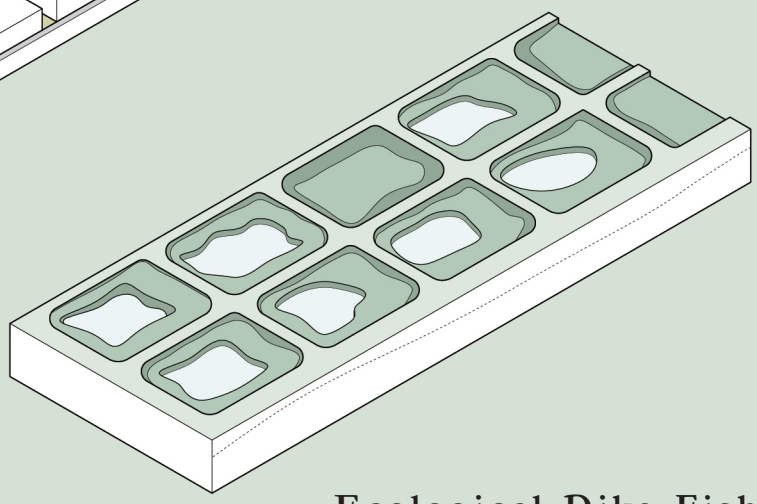
Blue-Green Infrastructure Framework

The blue-green infrastructure system integrates water bodies and green spaces to deliver multifaceted ecological, social, and spatial benefits. It not only purifies water and regulates water flow, reducing dependence on energy-intensive pumping, but also reconnects fragmented forests, fishponds, and dikes to form a resilient ecological network that enhances flood adaptability and biodiversity. Simultaneously, it provides accessible spaces for recreation, cultivation, and water interaction, fostering a stronger community identity and public participation in water governance. As a platform for both ecological restoration and cultural revitalization, the blue-green system supports sustainable regional development and improves overall quality of life.

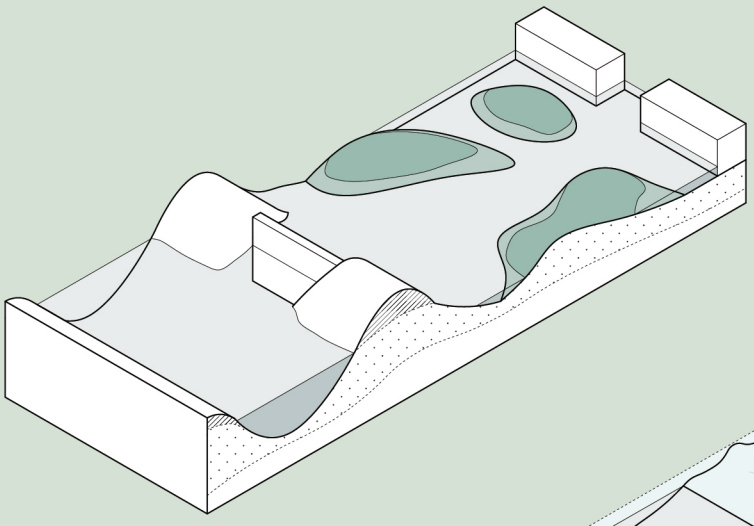
Type	Benifit	Strategy
Purification Wetlands	Low-cost filtration, reduced pumping energy, stronger community stewardship	Install bio-retention cells and surface-flow wetlands at the inlet of each small management unit; add simple testing stations so residents can monitor water quality.
Ecological Dike-Fish Ponds (Dike:Pond ≈ 4:6 / 5:5)	Link fragmented woodlands, diversify agriculture and income, form ecological corridors	Rebalance the dike-to-pond ratio; plant diverse crops and wet-tolerant species on dikes to create a layered agro-ecological system
Buffer Dike Green Corridor	Provide a linear buffer, increase resilience and habitat quality, also serve as a riverside trail	Retrofit river-parallel dikes by widening the berm, planting deep-rooted flood-tolerant vegetation, and adding floodable depressions.
Urban–Rural Green Belts	Offer recreation space, act as visual & pollution buffer, improve public health and liveability	Establish parks, greenways, and rain gardens around settlements and factories, using pollutant-tolerant plants for phytoremediation.



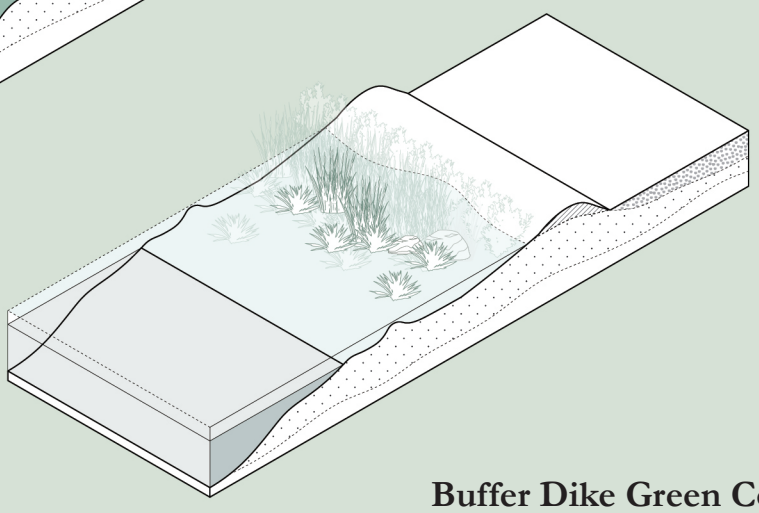
Urban–Rural Green Belts



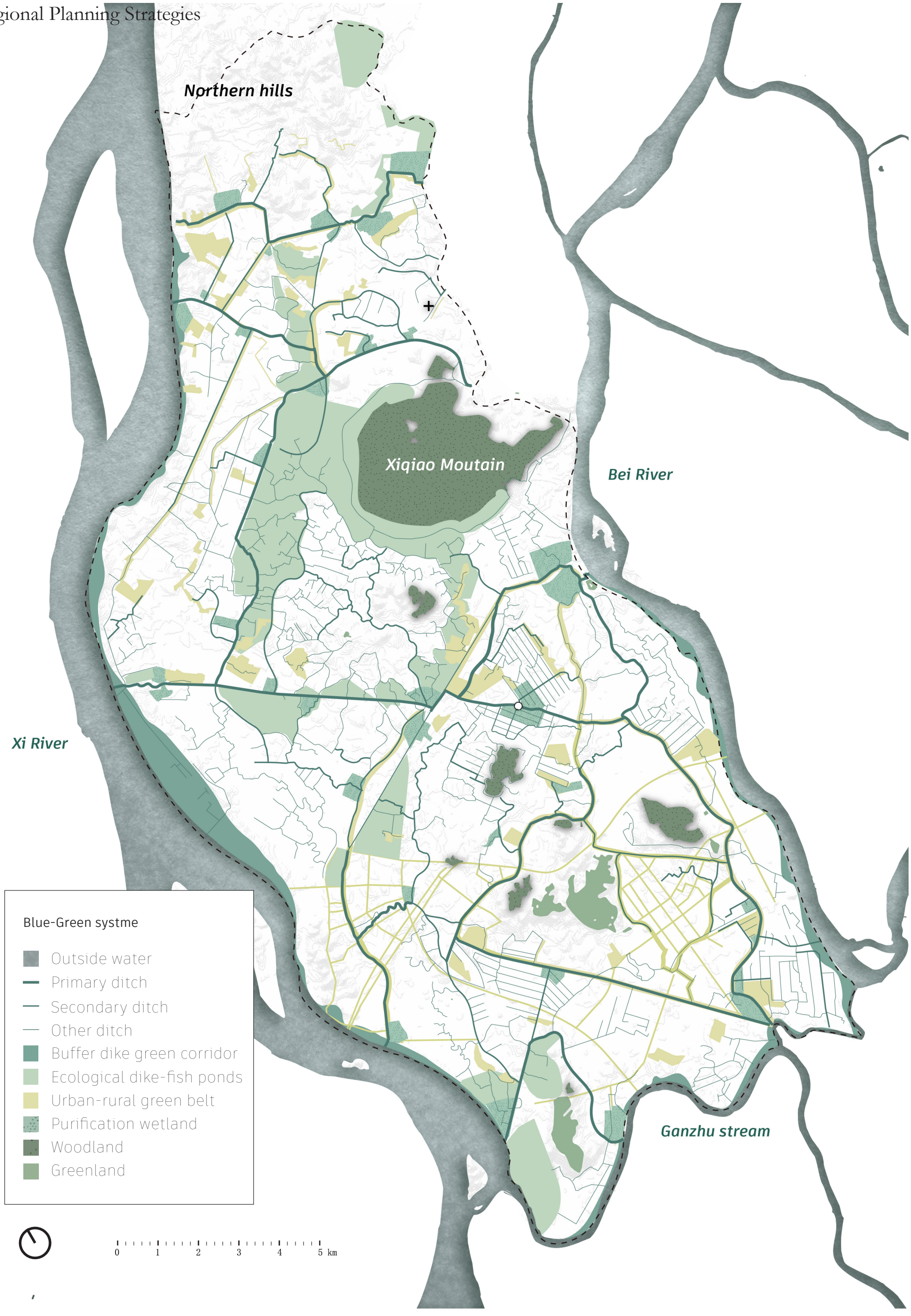
Ecological Dike-Fish Ponds
(Dike:Pond ≈ 4:6 / 5:5)

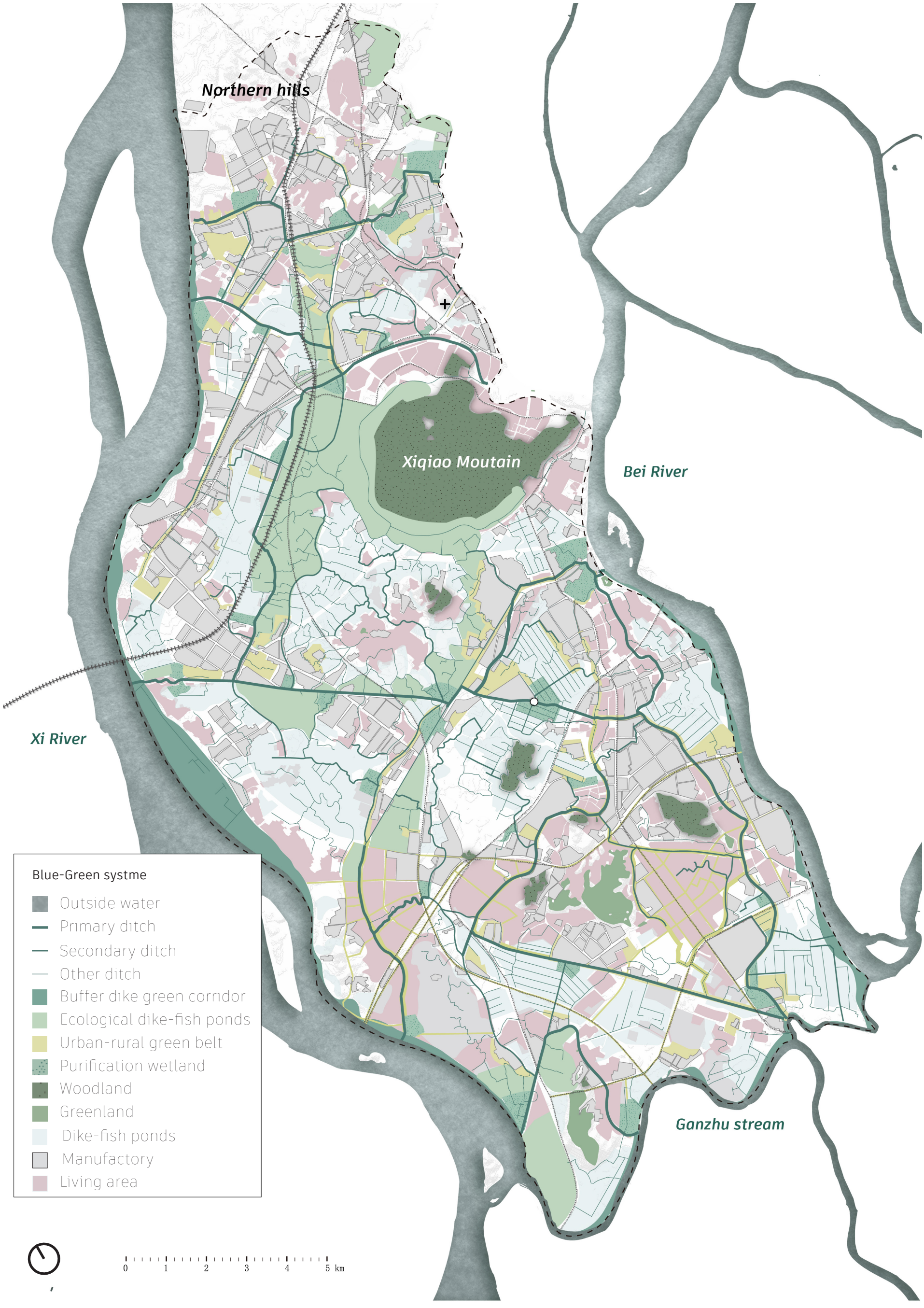


Purification Wetlands



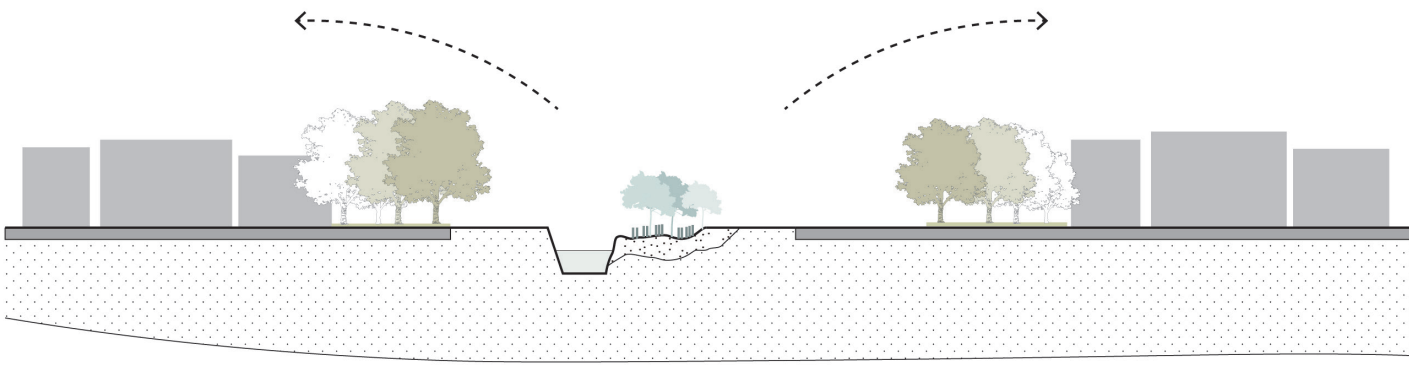
Buffer Dike Green Corridor


Northern hills
Xiqiao Moutain
Bei River
Xi River
Ganzhu stream
Blue-Green systme
Outside water
Primary ditch
Secondary ditch
Other ditch
Buffer dike green corridor
Ecological dike-fish ponds
Urban-rural green belt
Purification wetland
Woodland
Greenland
0
1
2
3
4
5 km


Northern hills
Xiqiao Moutain
Bei River
Xi River
Ganzhu stream
Blue-Green systme
Outside water
Primary ditch
Secondary ditch
Other ditch
Buffer dike green corridor
Ecological dike-fish ponds
Urban-rural green belt
Purification wetland
Woodland
Greenland
Dike-fish ponds
Manufactory
Living area
0
1
2
3
4
5 km

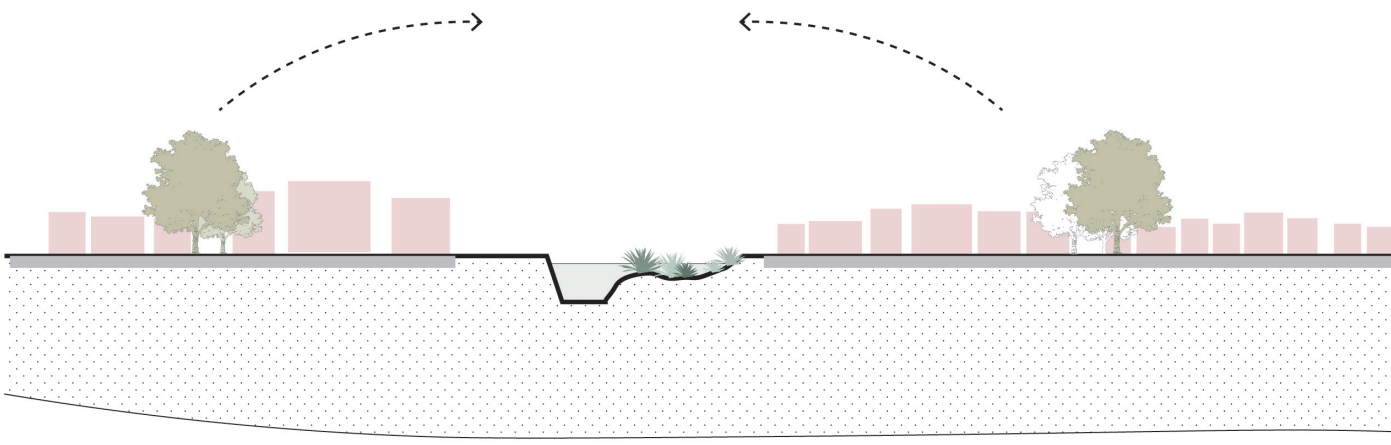
In manufacturing zones, blue-green infrastructure serves as a crucial ecological buffer that helps mitigate the environmental impacts of industrial activities. It reduces air and water pollution, absorbs noise, and improves local microclimates. Strategically placed vegetated buffers, wetlands, and retention ponds filter runoff and help prevent contaminated water from reaching nearby ecosystems or residential areas.

From a visual and spatial perspective, green corridors help soften the rigid, often monotonous edges of factory buildings and infrastructure. By introducing layers of vegetation and natural elements, they reduce the visual dominance of industrial structures, helping to integrate these areas more harmoniously with the surrounding landscape. Moreover, these green spaces can also provide pathways for pedestrians and wildlife, contributing to ecological connectivity and creating opportunities for recreation and restoration in otherwise heavily industrialized environments.



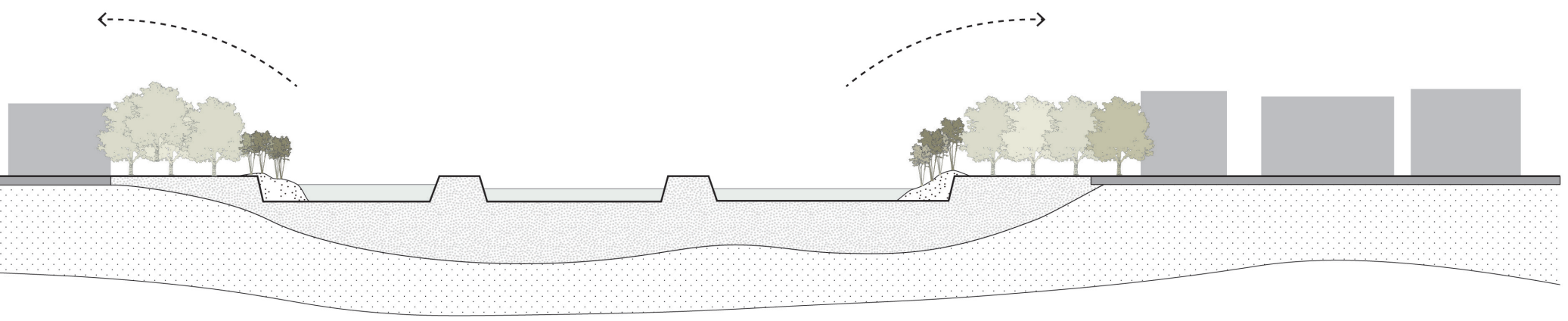
In residential areas, medium-scale blue-green infrastructure systems play a vital role in promoting interaction between residents, nature, and the productive landscape. These systems may include community gardens, vegetated swales, rain gardens, and small wetlands that not only manage stormwater but also provide accessible green and blue spaces for daily life and seasonal activities.

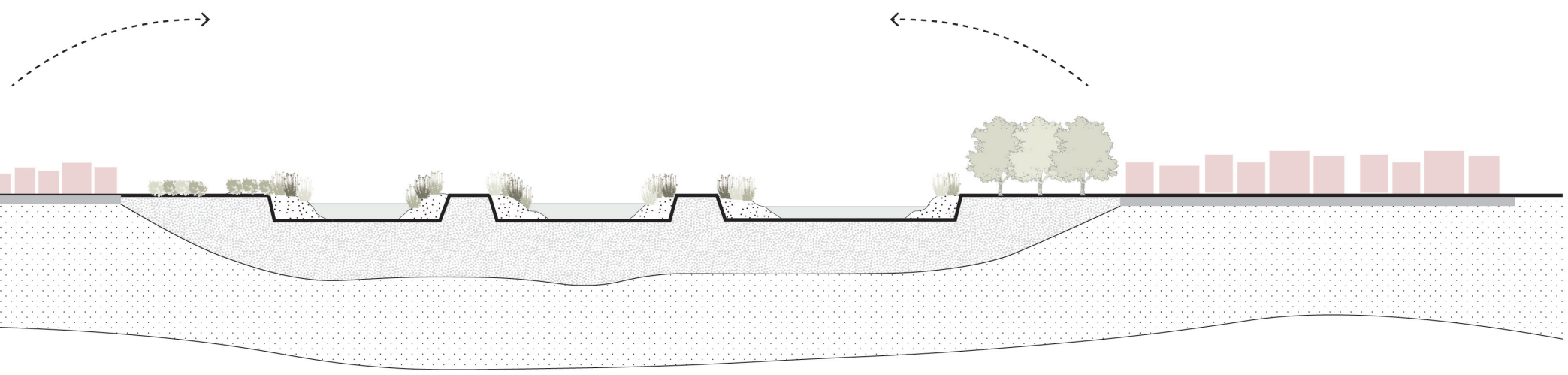
Such infrastructure encourages residents to engage with the landscape through gardening, water-related activities, or simply enjoying shaded and biodiverse environments. By integrating vegetation and water features into the neighborhood fabric, these systems significantly improve the local microclimate—moderating temperatures, increasing humidity, and enhancing air quality. As a result, they contribute to higher levels of thermal comfort, biodiversity, and a stronger sense of place, elevating both the ecological quality and livability of the residential environment.

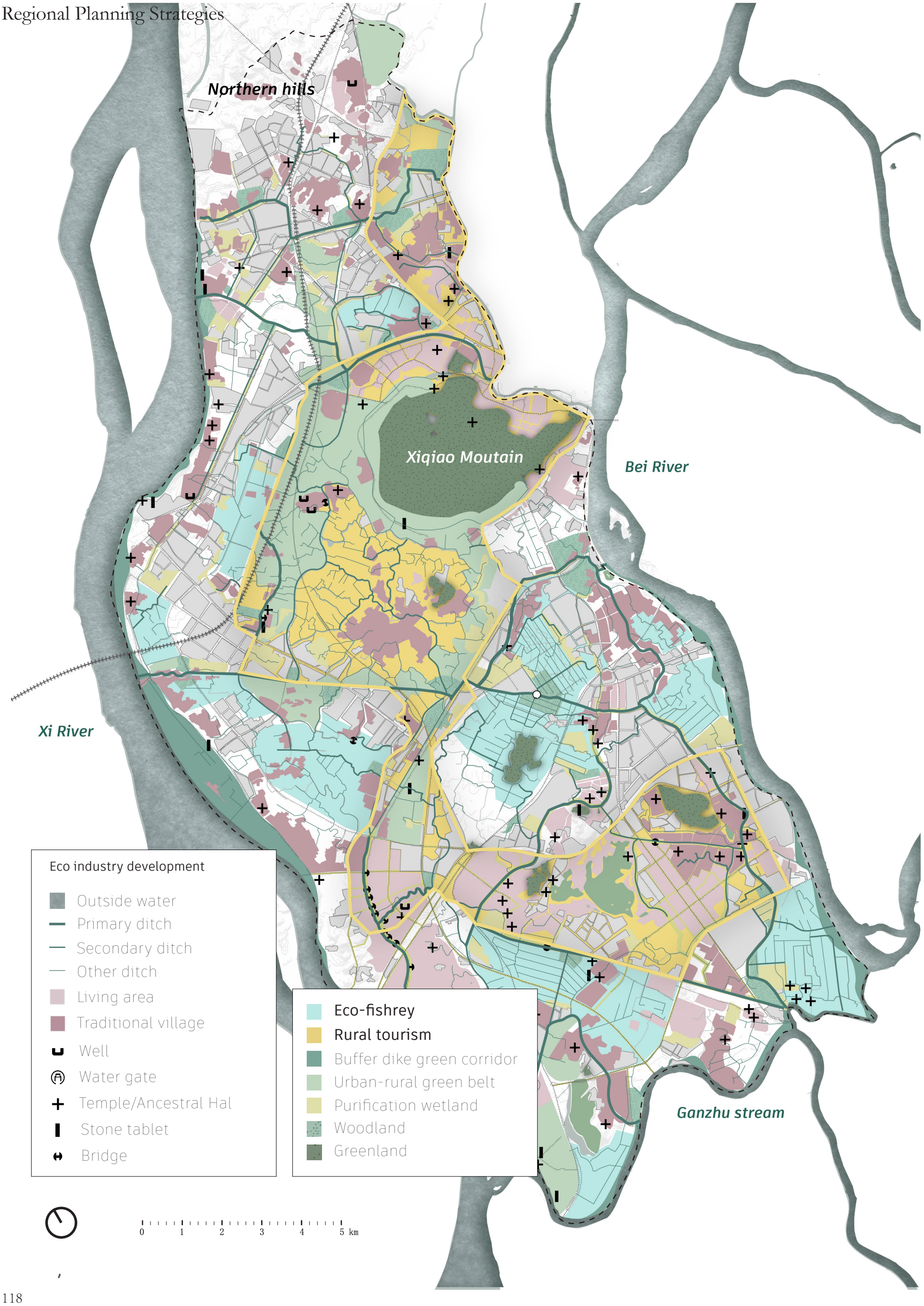


Manufactory

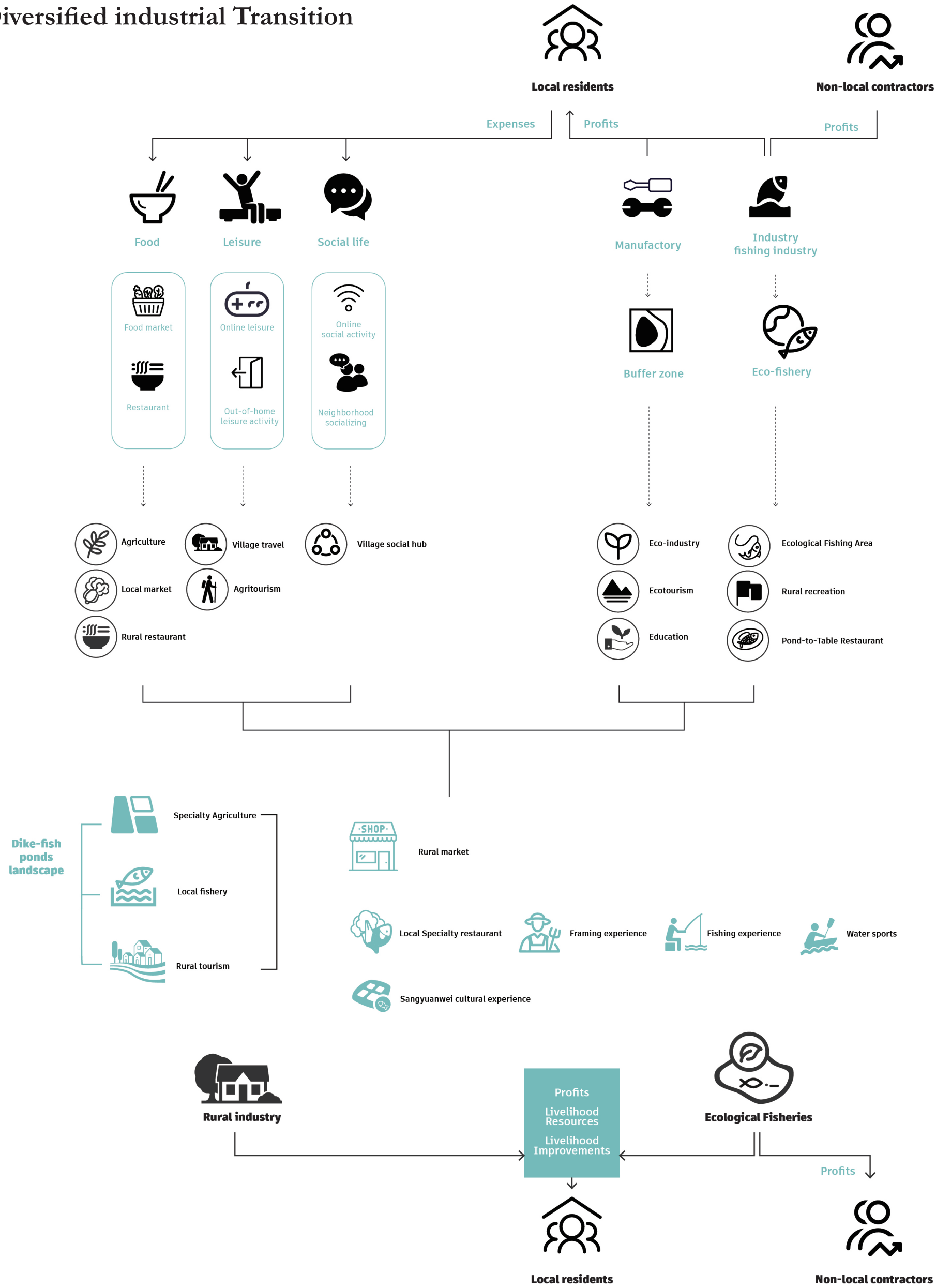
Living area






Northern hills
Xiqiao Moutain
Bei River
Xi River
Ganzhu stream
Eco industry development
Outside water
Primary ditch
Secondary ditch
Other ditch
Living area
Traditional village
Well
Water gate
Temple/Ancestral Hal
Stone tablet
Bridge
Eco-fishrey
Rural tourism
Buffer dike green corridor
Urban-rural green belt
Purification wetland
Woodland
Greenland
0 1 2 3 4 5 km

Diversified industrial Transition



Dike-ponds typologies Intervention strategies and Meso-scale implementation

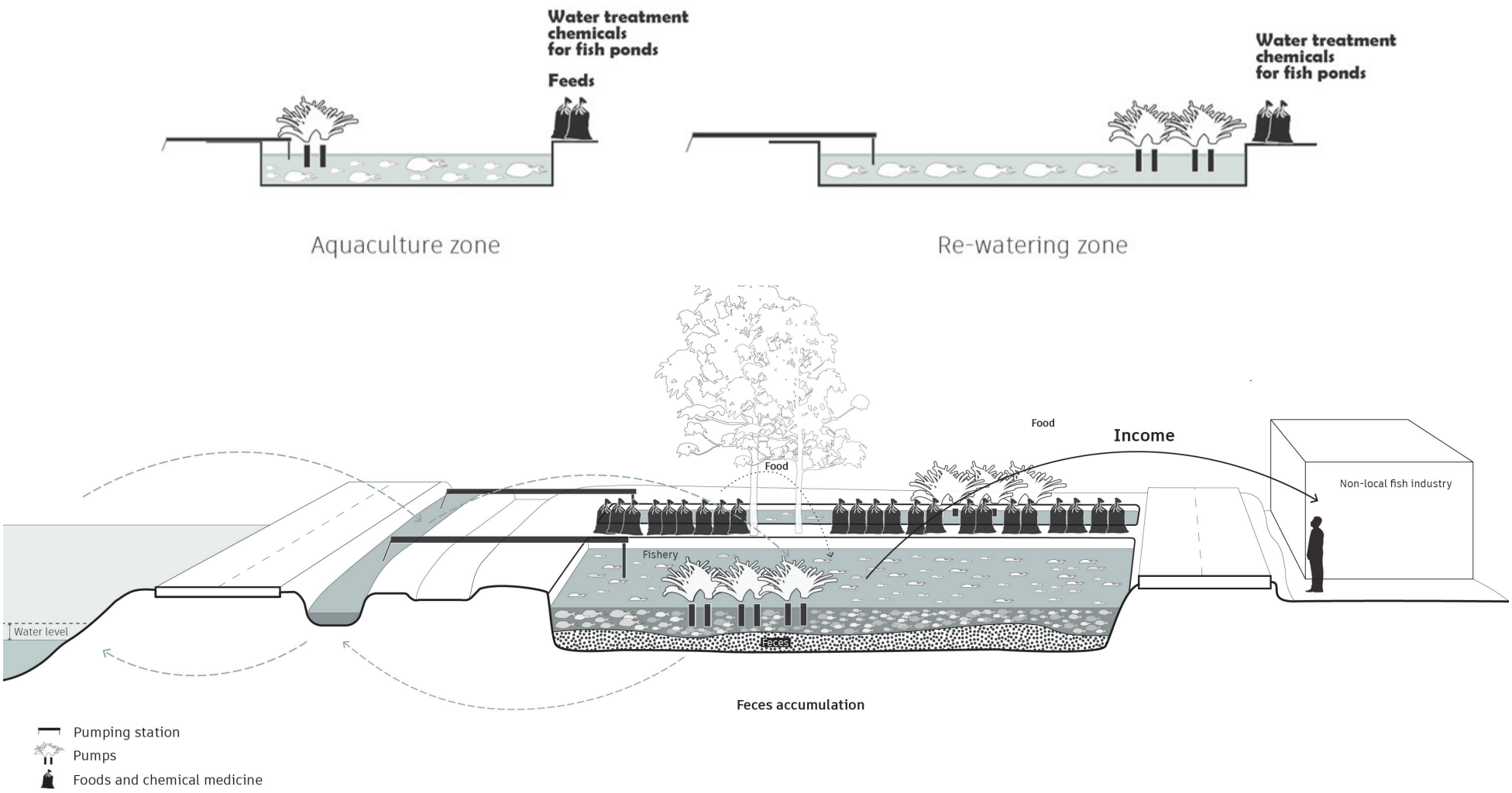
Formal Dike-fishponds: Large-Scale Ecological Infrastructure

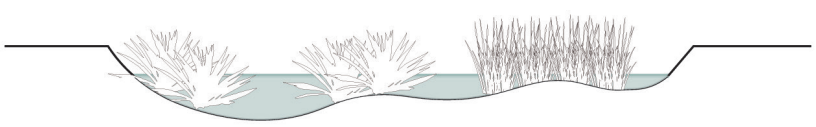
Drawing on both traditional fishery wisdom and modern ecological farming theory, this strategy envisions a future of zero-discharge and zero-pollution fishing industry.

This design introduces a layered water purification strategy. Water first passes through a buffer zone, then slows in the sedimentation area, moves into a vegetated purification layer, and finally reaches a clean-water core zone. This purified water is supplied to both suspended-water ponds and traditional aquaculture zones. Wastewater from the traditional ponds is treated again through the purification system before being reused, forming a closed, regenerative loop.Moreover, nutrient-rich sediment is no longer discarded, but repurposed in purification zones, supporting plant growth and system resilience. By reconnecting ditches, ponds, and eco-zones into a self-sustaining network, this strategy reduces energy consumption while restoring a deep harmony between people, water, and production.

Re watering fish

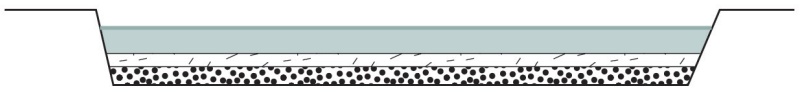
It involves purchasing adult fish at a low price and raising them without feeding, only ensuring sufficient dissolved oxygen in the water. The purpose of this practice is to expel waste from the fish's body and intestines, remove the earthy smell from the fish meat, and improve its edible value





Low down the water speed while remove some solid matter

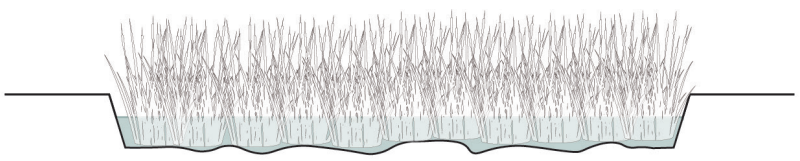
Buffer zone



Sendimentation

Base layer

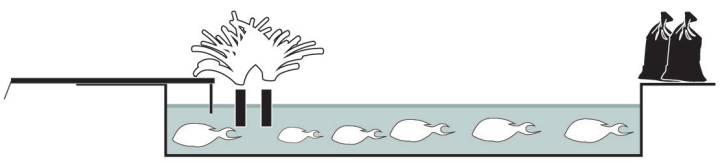
Sedimentation area



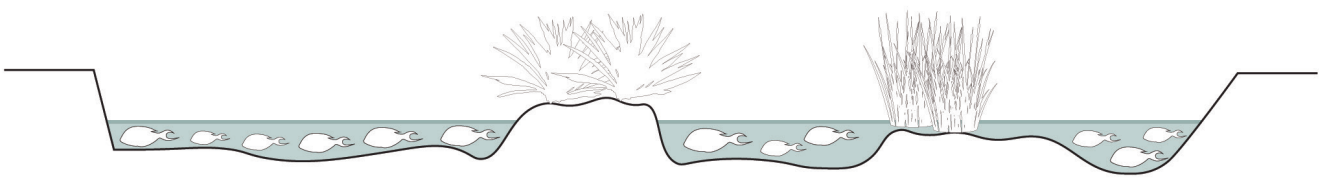
Purification layer

Clean water

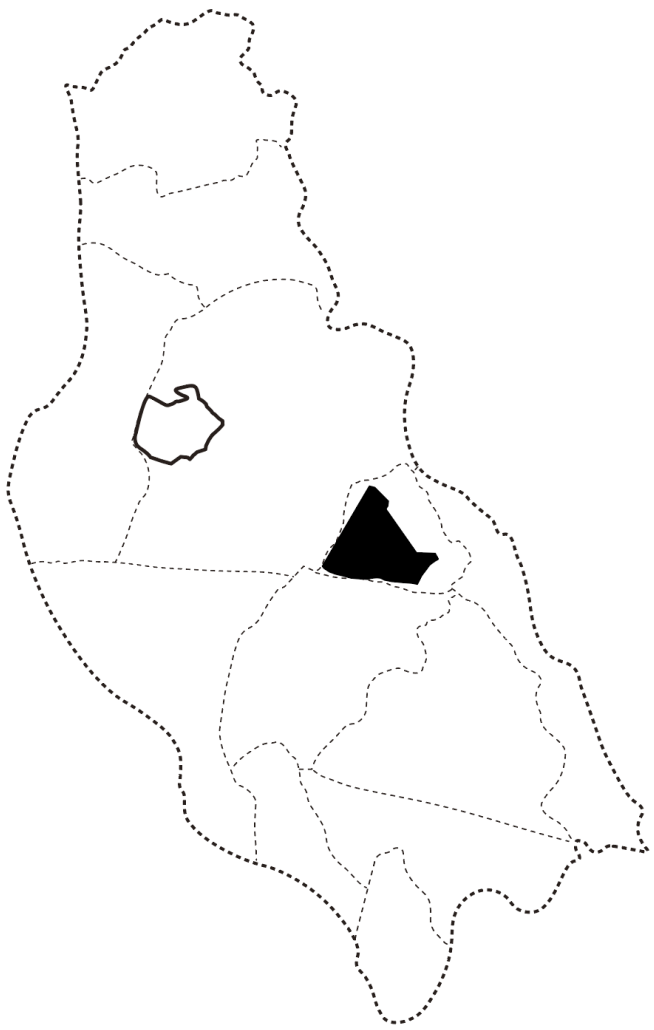
Purification layer



Aquaculture zone



Re-watering zone



Meso-scale Implementation: Ecological Production Area (Contractor-Driven)

This area exemplifies the characteristics of an intensive aquaculture landscape, where the majority of dike-fishponds are leased to and operated by non-local contractors. The production model adopted here is highly input-intensive, heavily dependent on artificial feed, antibiotics, hormones, and chemical additives to sustain rapid growth cycles and maximize short-term yields. While this model has increased productivity in the short run, it has come at a significant ecological cost. The continuous accumulation of uneaten feed and fish waste has led to heavy sedimentation, while excessive nutrient loading has triggered eutrophication, algal blooms, and a sharp decline in water quality and overall ecosystem health.

Compounding these issues, the area is also surrounded by scattered small-scale industrial operations, such as workshops and processing plants, which pose additional environmental threats. Without adequate treatment infrastructure, these facilities may discharge untreated or partially treated wastewater directly into surrounding water bodies, intensifying aquaculture-related pollution and further disrupting ecological processes.

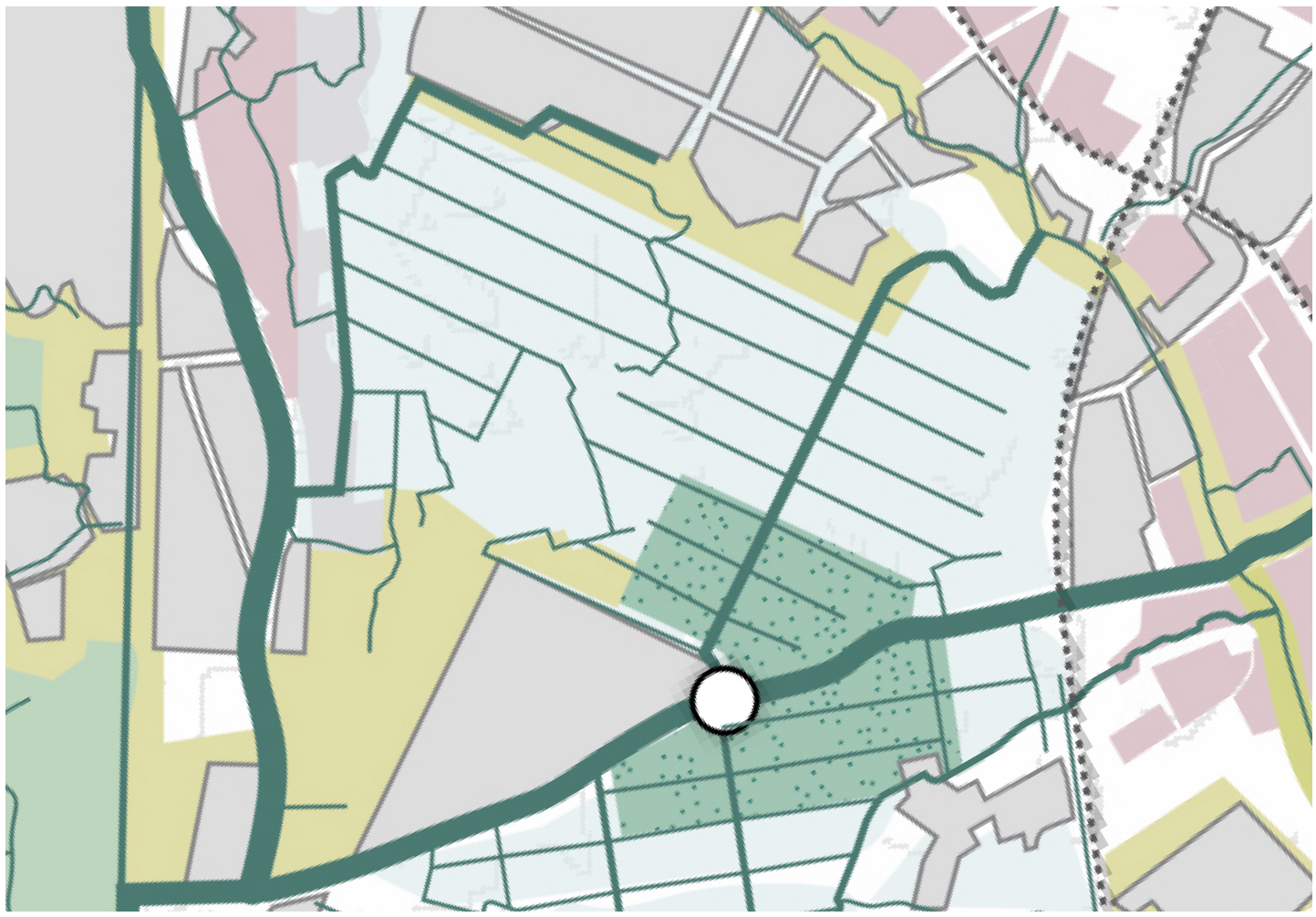
From a spatial and social perspective, the transformation of this landscape into an externally controlled production zone has resulted in the progressive displacement of local residents from their traditional roles in land and water management. Local farming practices—once embedded in seasonal rhythms and community-based stewardship—have been largely replaced by commodified, market-driven operations. As a result, local communities are increasingly marginalized, with reduced access to land, limited economic benefits, and minimal decision-making power in the face of ongoing environmental degradation.

The area is now at a critical turning point, calling for comprehensive restorative strategies that go beyond technical solutions.

1. Mitigating pollution through nature-based purification systems
Integrating ecological wetlands, vegetated ditches, and bio-filtration ponds to effectively reduce pollutants from aquaculture and industrial wastewater, restoring the self-purification function of the water system.

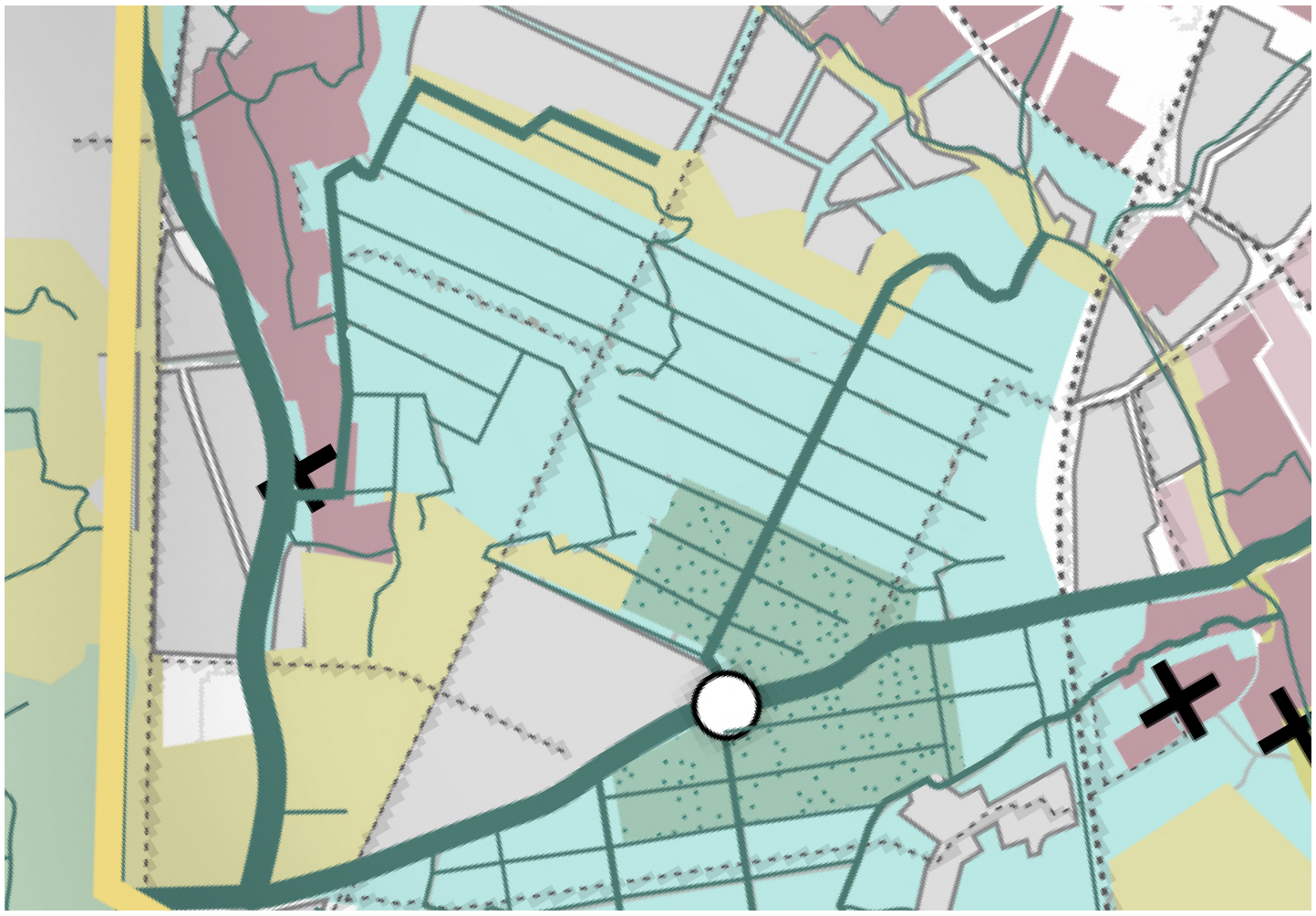
2. Reconfiguring fish pond and dike systems to restore ecological functionality
Adjusting pond layouts and optimizing the dike network to improve water circulation, support biodiversity, and reinforce system resilience based on both historical and current spatial structures.

3. Increasing transparency of water quality and raising public awareness
Introducing monitoring stations and visual displays to make water quality data accessible to the public, encouraging local residents to participate in supervision and protection efforts.



Dike-fish ponds
Living area
Primary ditch
Secondary ditch
Other ditch
Road
Subway

Urban-rural green belt
Purification wetland



Eco-fishrey




0
20
40
60
80
100m



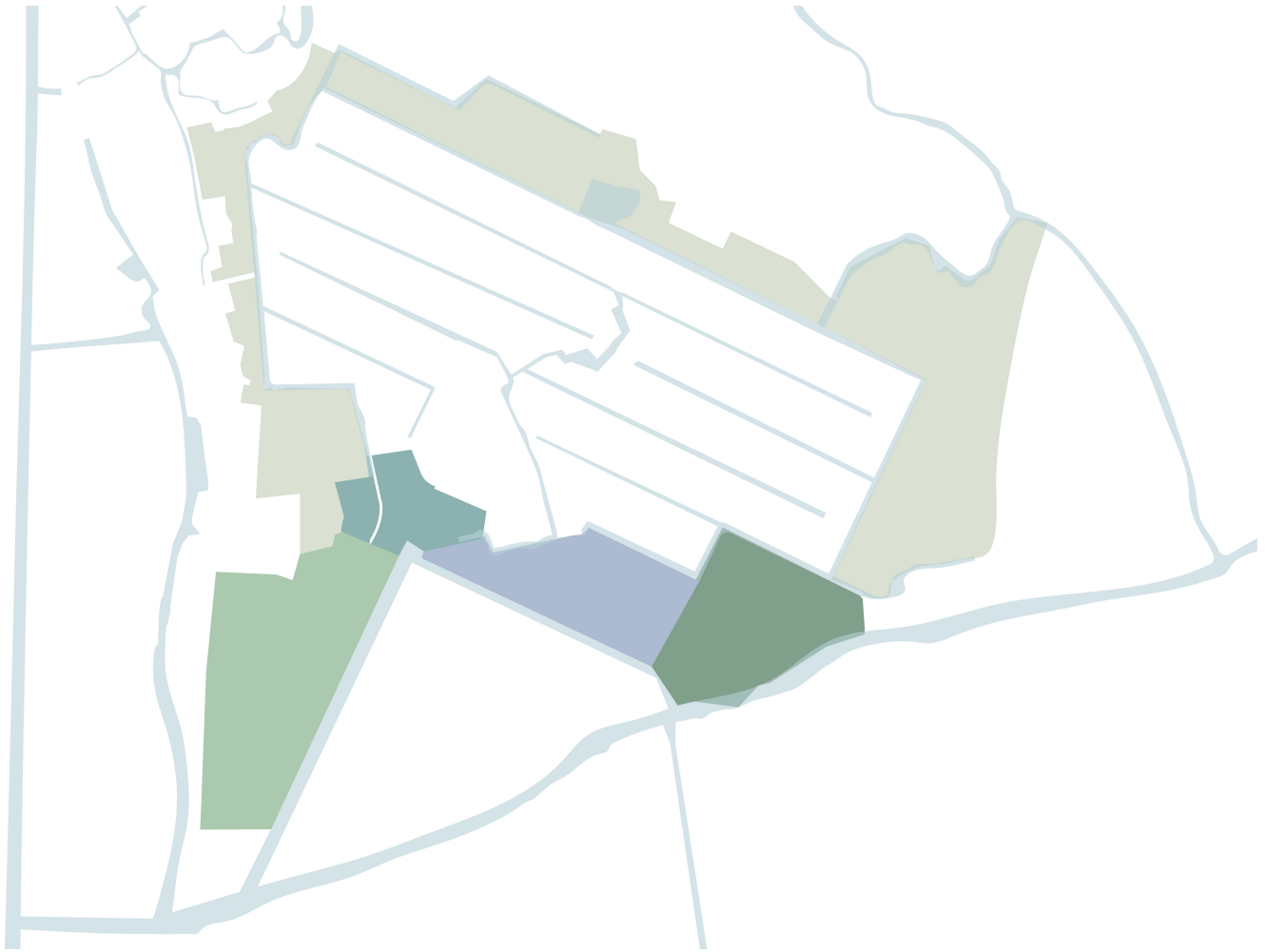
Current system

Ditch

Dike-fish ponds

Manufactory

living building



Transformation
of Dike-fish ponds

Buffer zone

sedimentation ponds

Connection area

Purification wetland

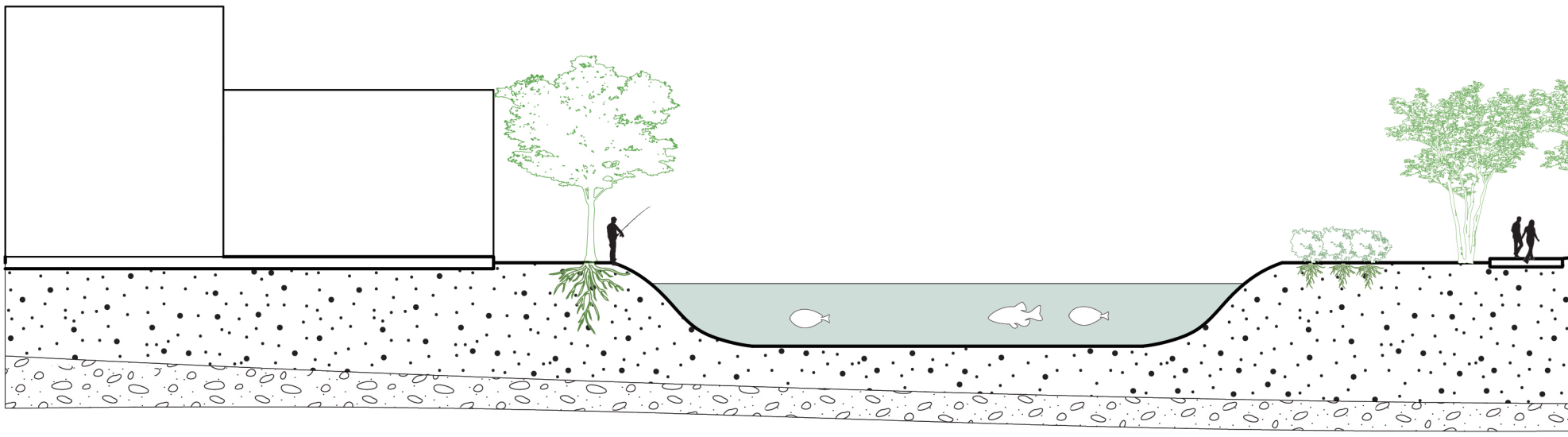
Re-watering fish ponds

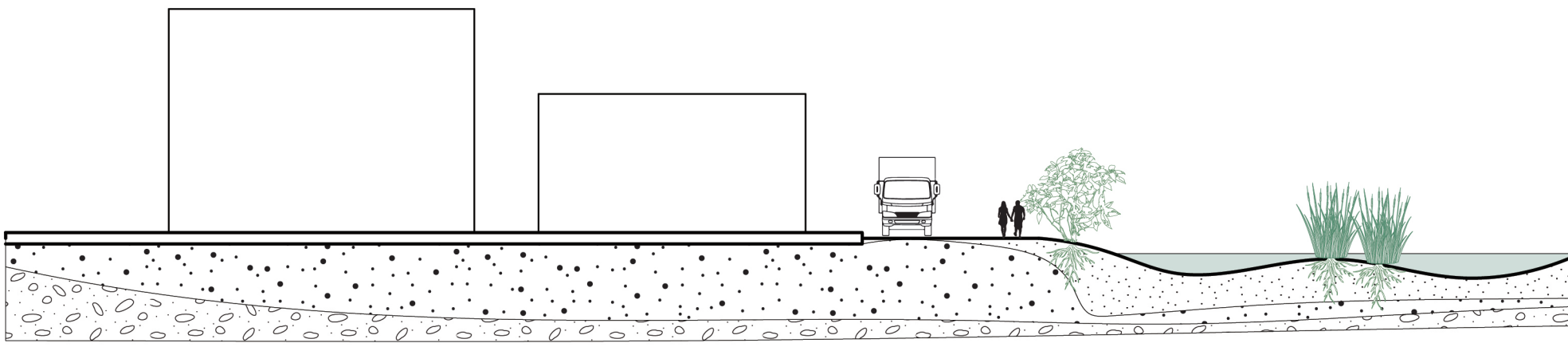


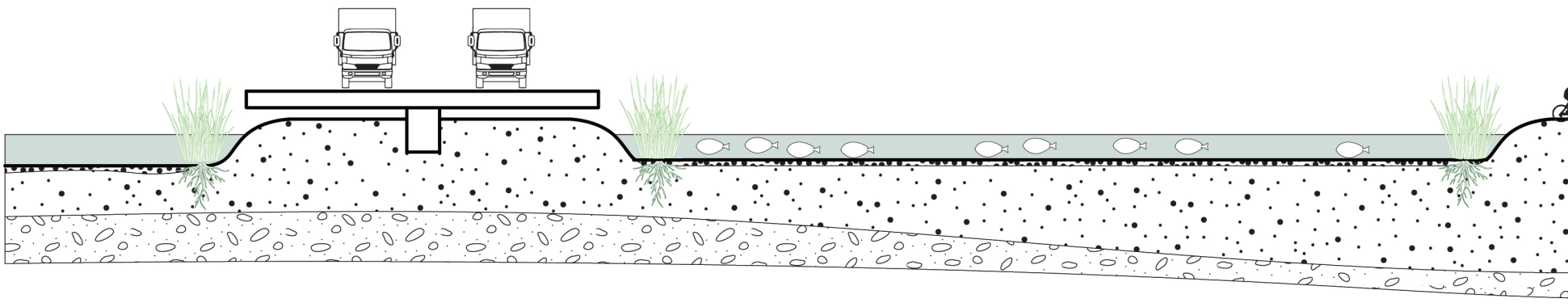
The design of this area responds to the environmental challenges caused by intensive aquaculture by restructuring the original pond system into a multifunctional landscape that integrates ecological purification with continued fish production. Portions of the existing ponds are redefined into buffer zones, sedimentation areas, purification wetlands, ecological connection zones, and rewatering fish ponds. Buffer zones at the periphery reduce external pollutants from agriculture and nearby industry; sedimentation areas capture suspended solids in early drainage; purification wetlands, planted with emergent and floating vegetation, absorb nitrogen and phosphorus from aquaculture runoff; ecological connection zones enhance circulation within the system; and the treated water is ultimately directed into selected fish ponds for reuse. In addition, the design introduces a separated water supply and drainage system, ensuring that clean water is used for aquaculture while wastewater is independently collected and treated—breaking the cycle of contamination. This integrated strategy maintains productive potential while significantly improving ecological functions, offering a path toward sustainable regeneration in heavily polluted production landscapes.

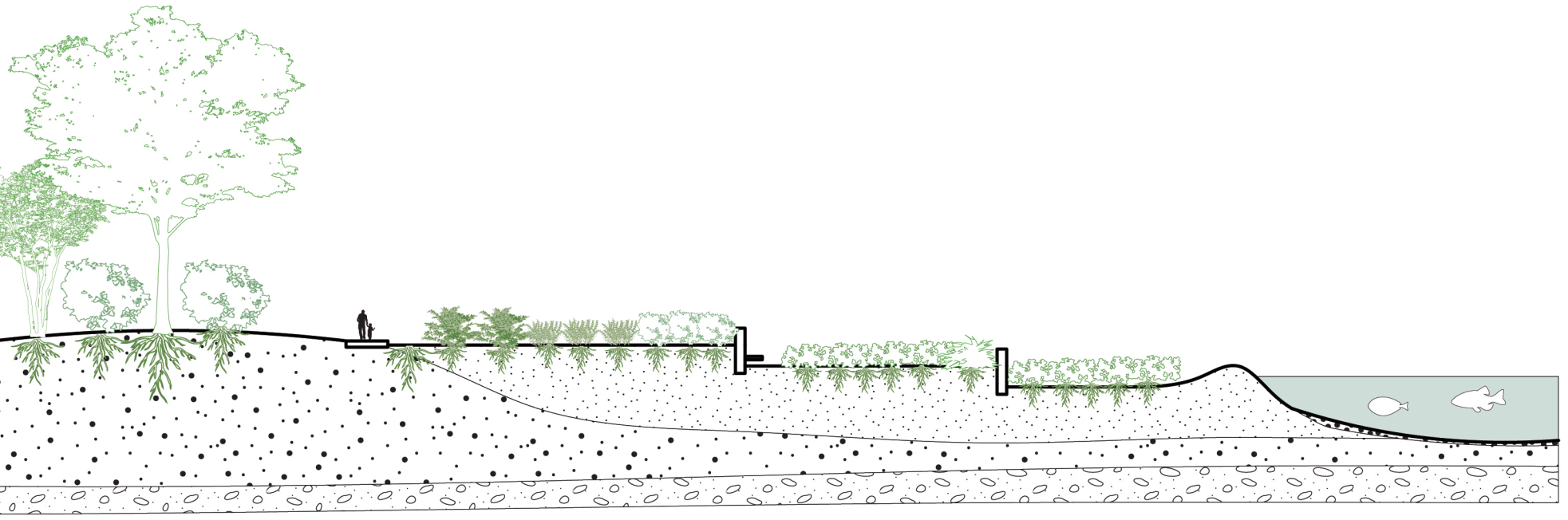

Rural restaurant
Section D-D
Section F-F
Water quality park
Section E-E
Wetland park


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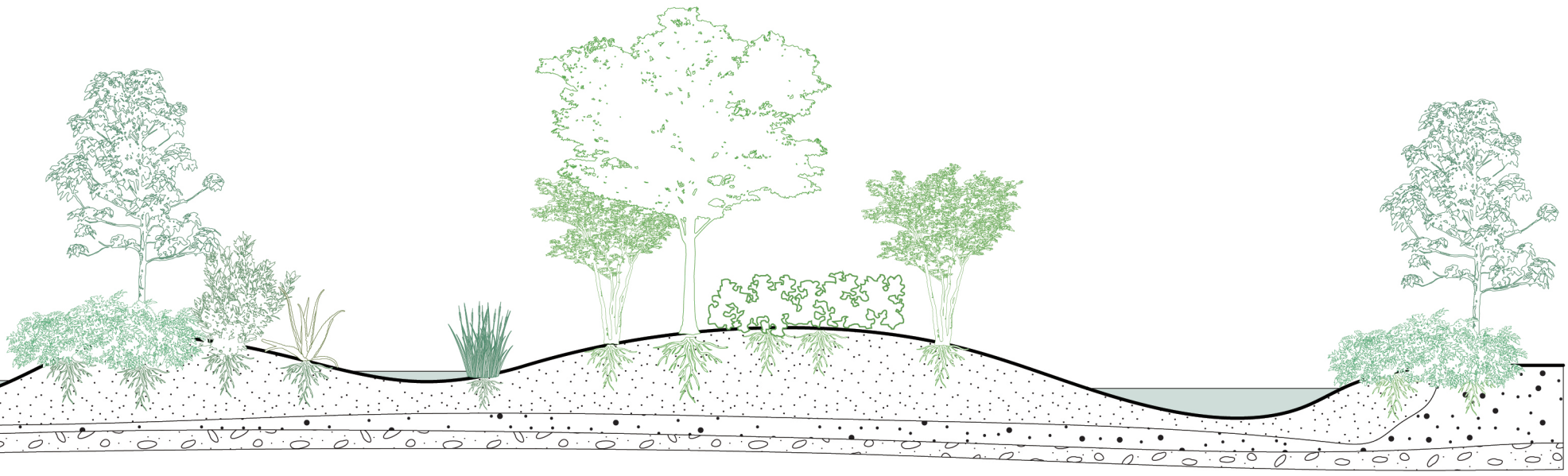




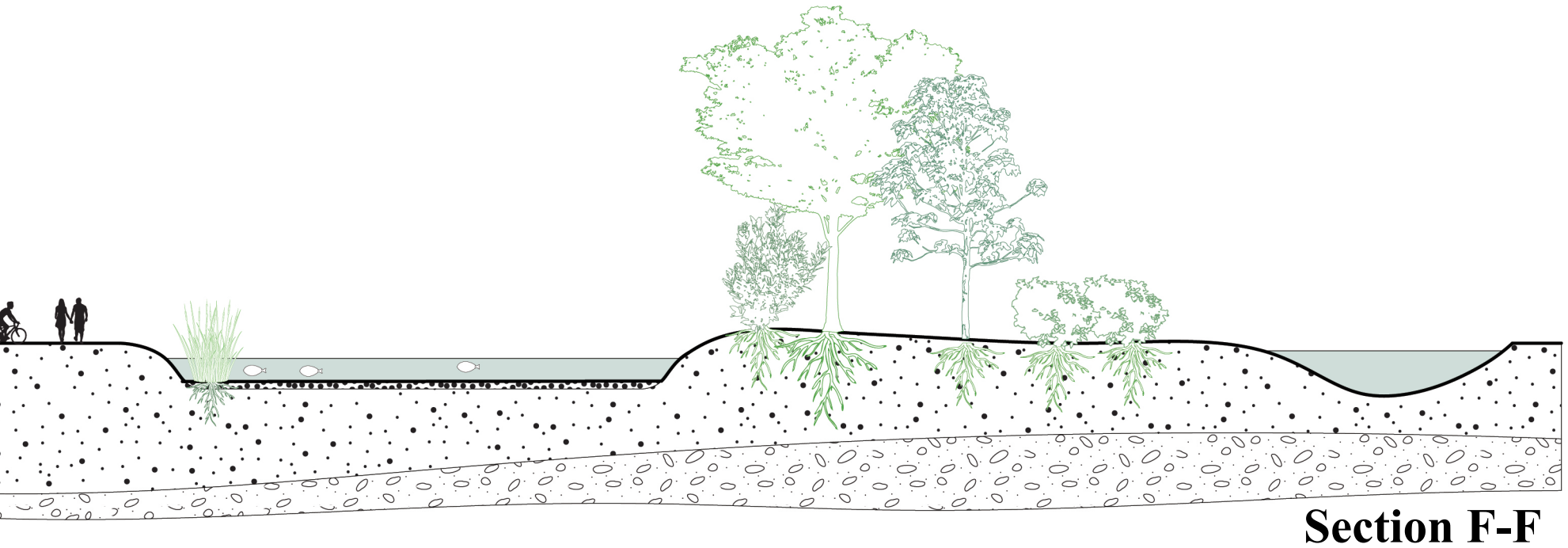




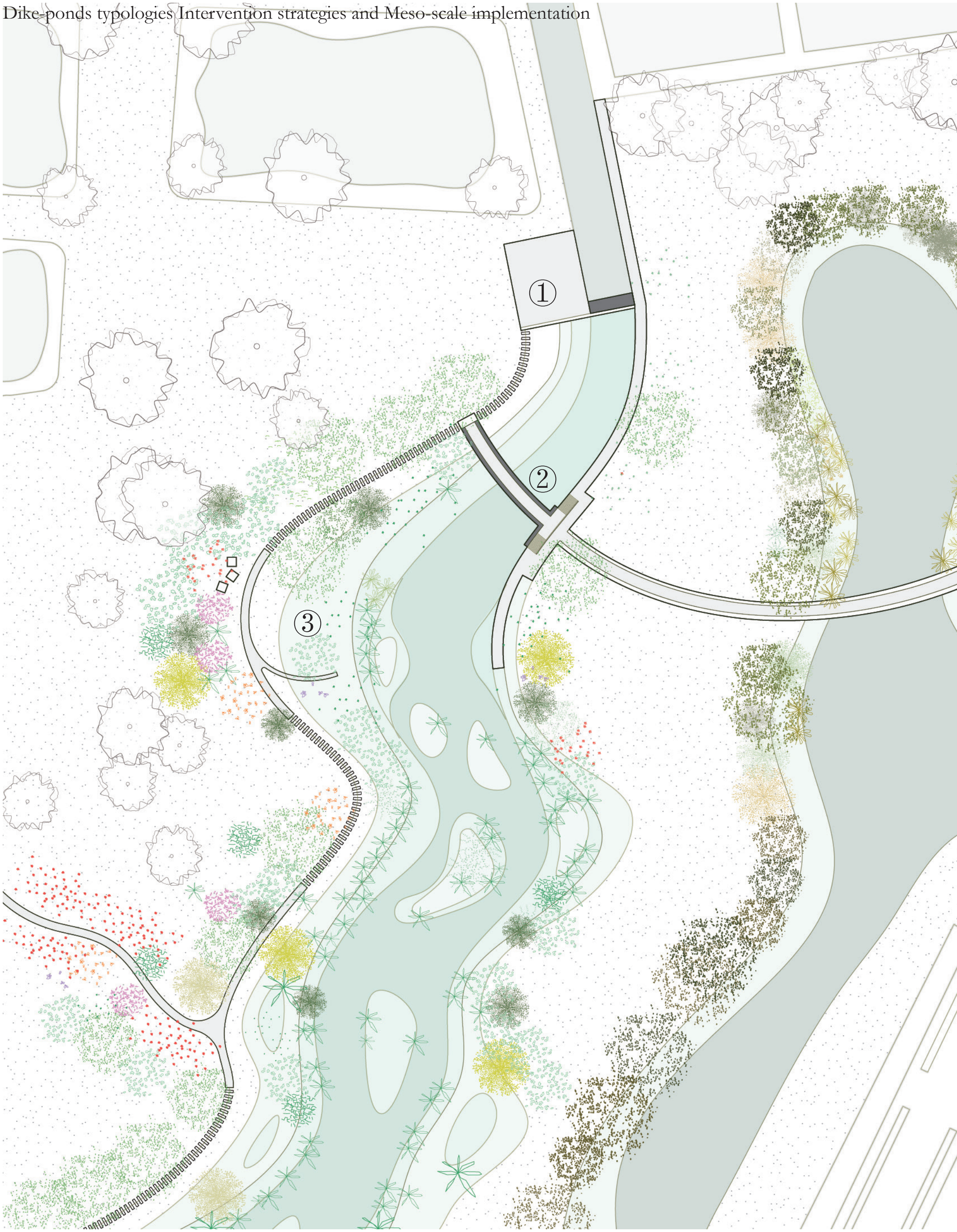
Section D-D



Section E-E



Section F-F


①
②
③



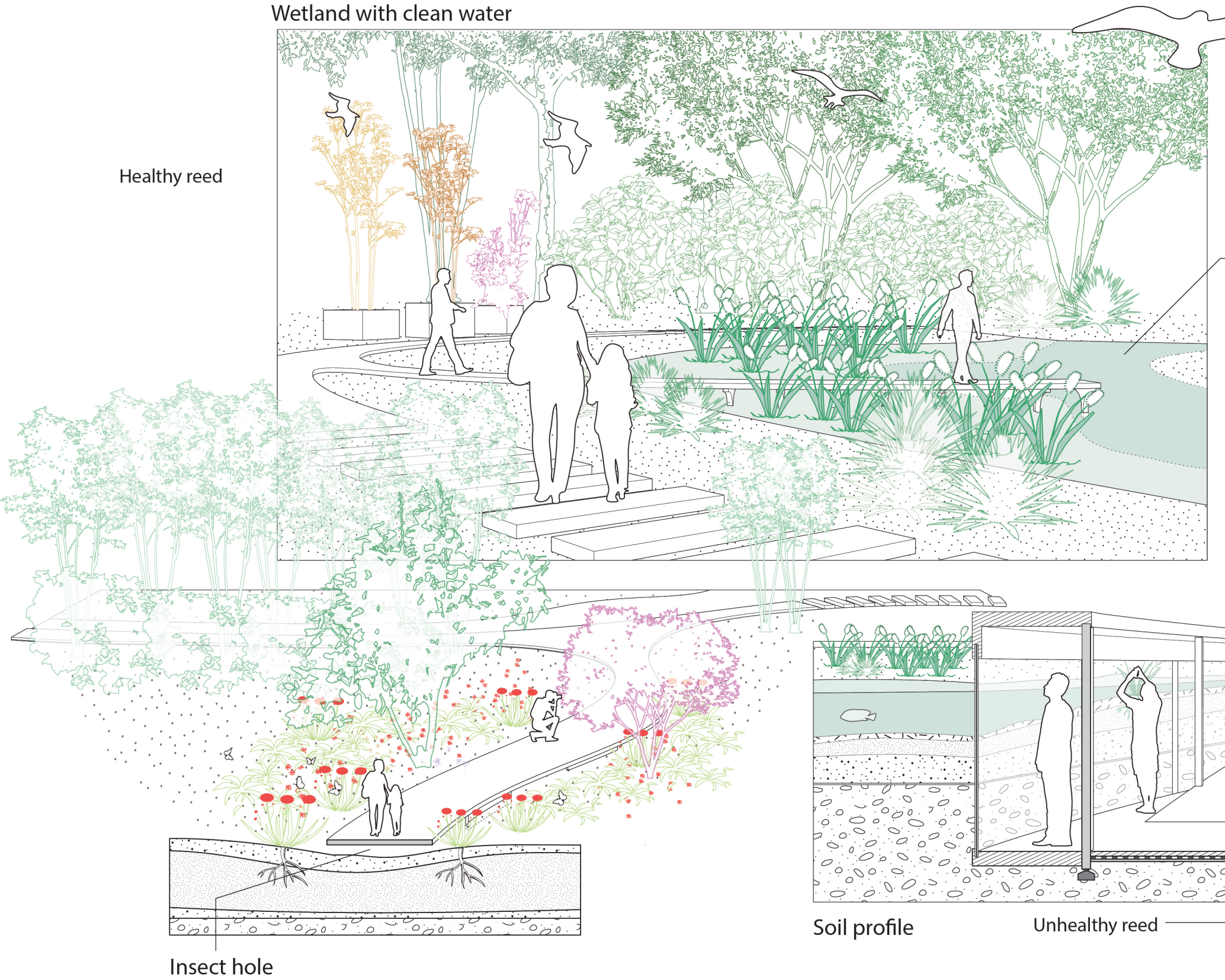
Water quality park

Although all zones are part of the same purification wetland system, their spatial openness or enclosure is intentionally designed based on the quality of water they serve. Areas with better water quality are designed to be more open—featuring broad water surfaces and minimal planting—to visually emphasize clarity and ecological health. In contrast, zones with poor water quality are deliberately designed to feel more enclosed, with dense vegetation such as reeds and emergent plants, enhancing their filtration function and signaling the need for ecological remediation. These spatial differences are not natural variations but purposeful design strategies to both support ecological performance and communicate environmental conditions to the public. By shaping the landscape in this way, the design turns water quality into a readable spatial experience and raises awareness of ongoing purification processes.

① Pumpping Station

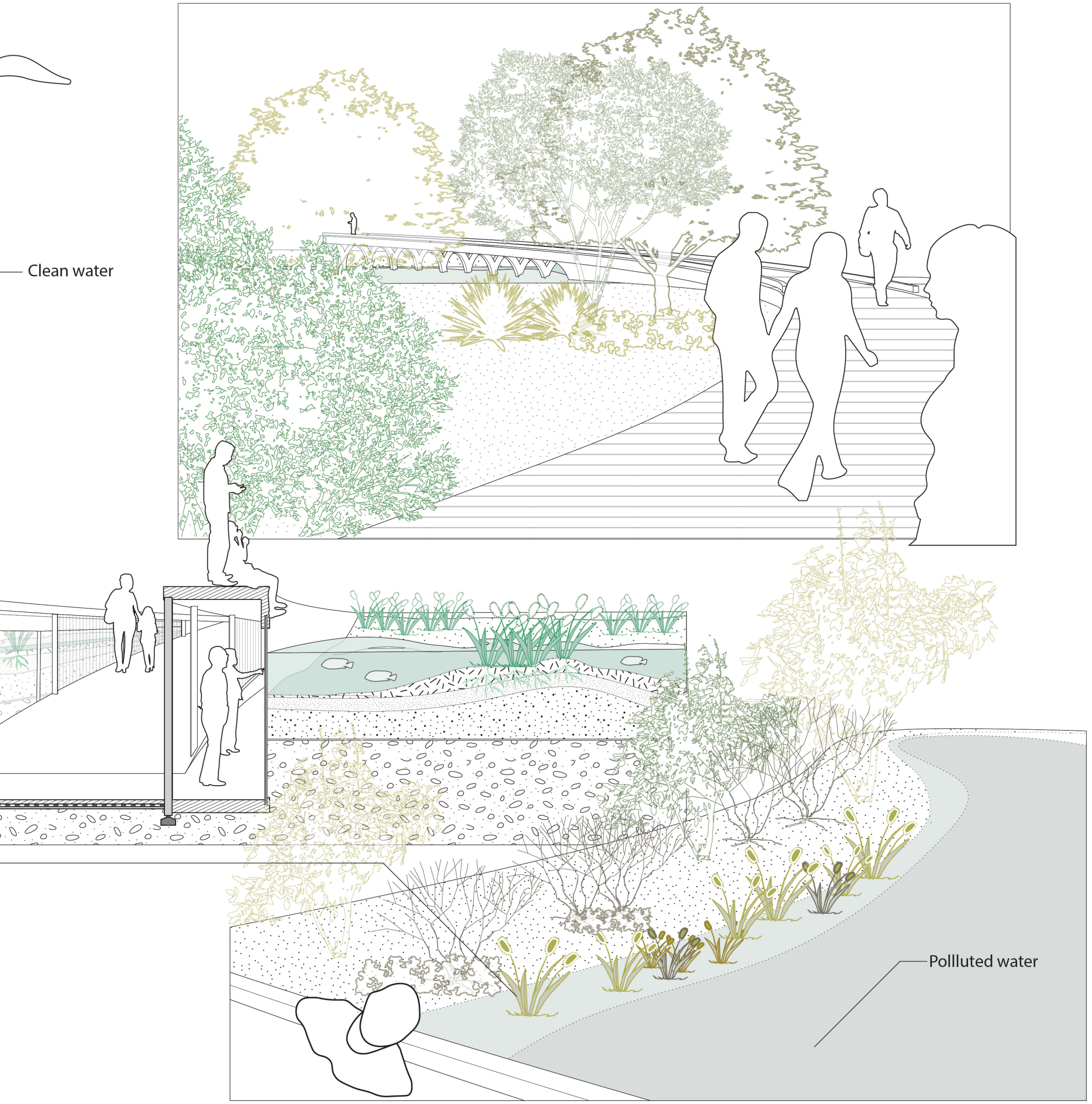
② Soil profile route

② Wetland park



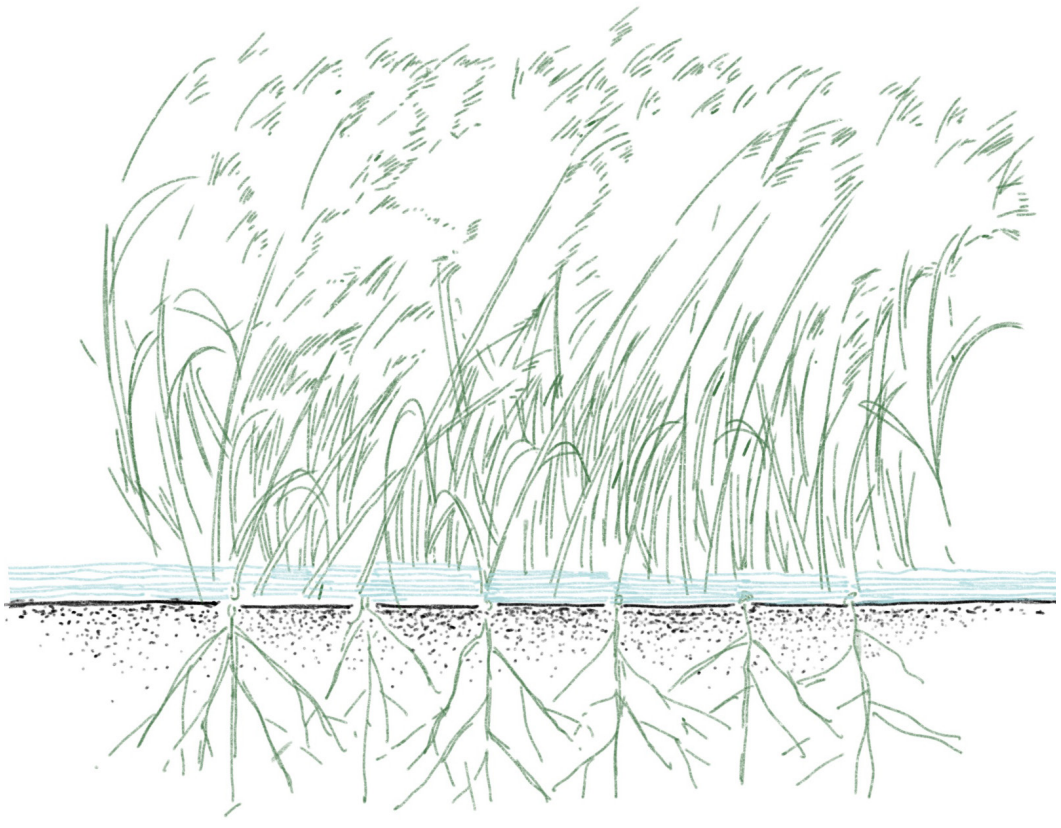
Healthy green vegetation densely surrounds clean water bodies, creating open and interactive spaces that invite public engagement and provide visual clarity of the water's high quality. These open areas promote social interaction, education, and a closer connection between people and the natural environment. In contrast, zones with polluted or degraded water are characterized by sparser plant coverage and more enclosed spatial arrangements, which reflect the ongoing ecological challenges and the need for restoration.

A specially designed sunken walkway runs through the wetland, exposing the soil layers beneath and revealing the natural purification processes occurring below the surface. This feature serves as an educational element, allowing visitors to visually and physically experience how the wetland filters contaminants and improves water quality, thereby enhancing public understanding and appreciation of ecological functions.



Wetland with polluted water

Open spaces towards the clean water



Reeds in clean water

In clean water , reeds grow sparsely but healthily, with upright stems and well-developed root systems. The good water quality enables reeds to facilitate oxygen exchange in the water, helping maintain ecological balance. Their main ecological functions include providing habitat and filtering minor suspended particles, thereby supporting the stability and health of the wetland system.

Closed spaces towards the polluted water

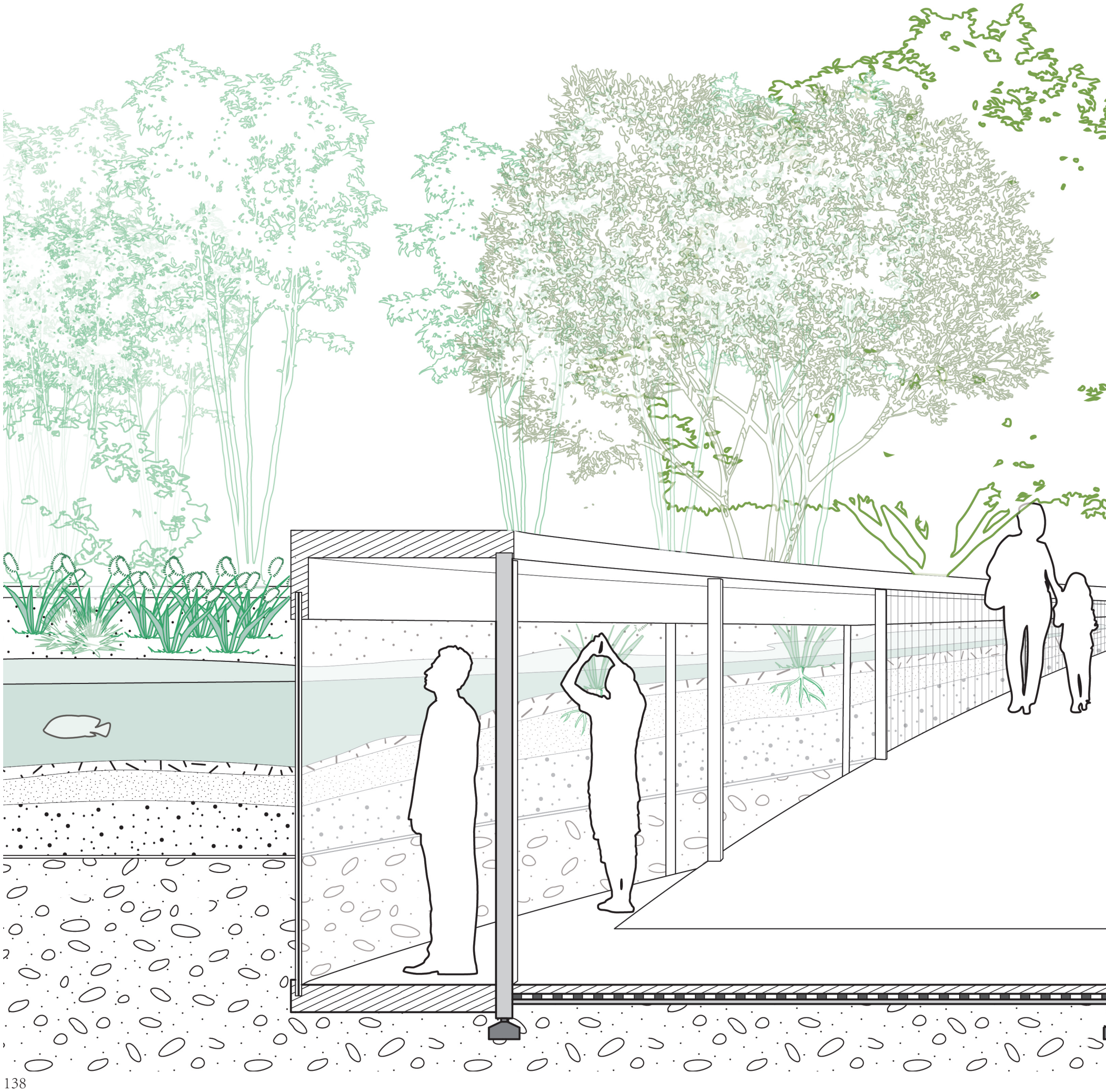


Reeds in clean water

In polluted or eutrophic water bodies, reeds tend to grow more densely and sometimes excessively. They absorb excess nutrients such as nitrogen and phosphorus, playing an important role in purifying contaminated water. However, prolonged exposure to polluted water may cause excessive accumulation of organic matter, disrupting the wetland's ecological balance and potentially leading to degradation of reed communities and a decline in biodiversity.

Soil profile route

The Soil Profile Route is a sunken walkway designed to immerse visitors into the heart of the wetland ecosystem by physically descending into the water body. Along this pathway, transparent glass panels are installed at various points, allowing visitors to observe the different soil layers beneath the surface as well as the evolution of wetland vegetation and microbial life over time.



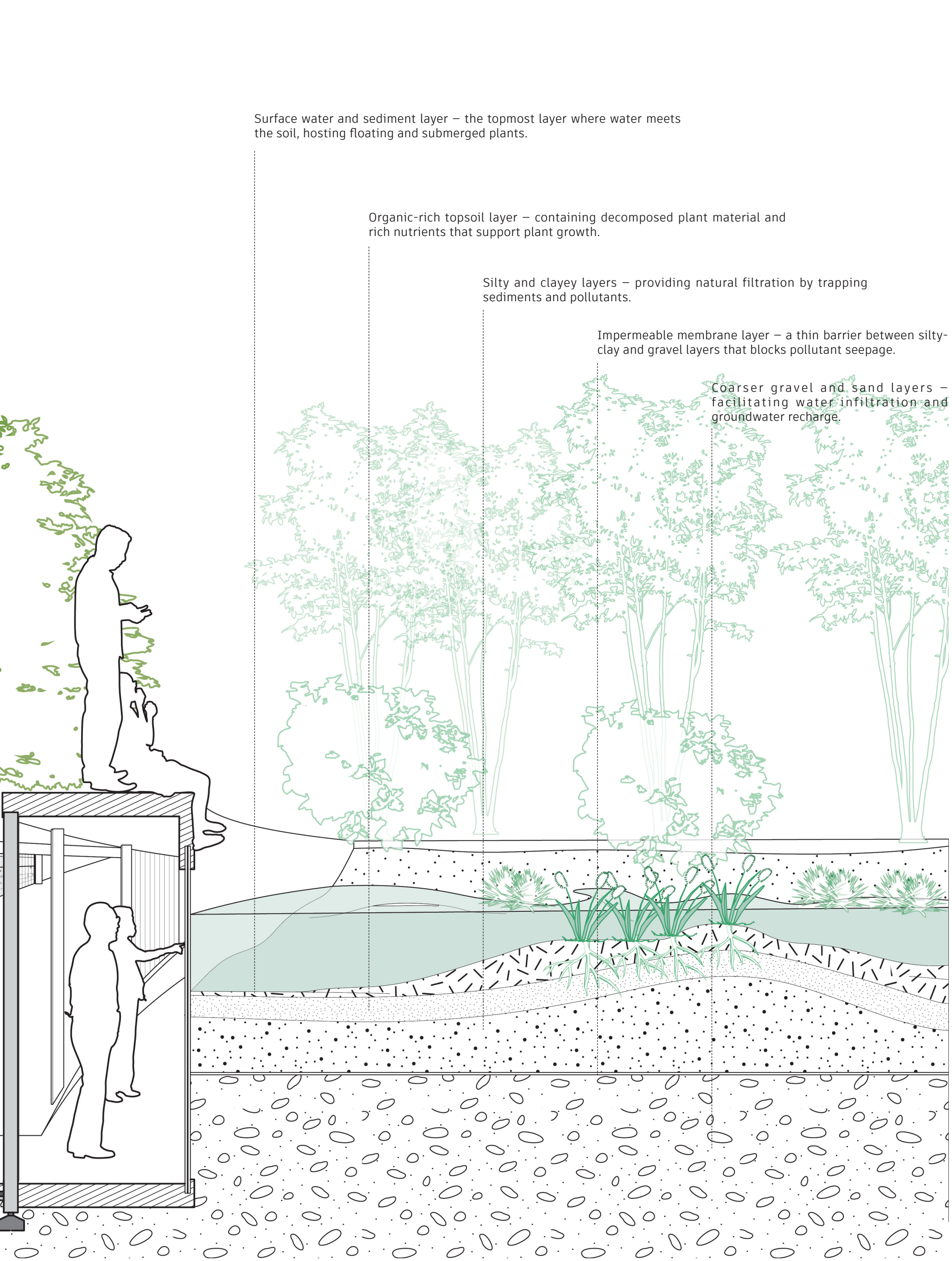
Surface water and sediment layer – the topmost layer where water meets the soil, hosting floating and submerged plants.

Organic-rich topsoil layer – containing decomposed plant material and rich nutrients that support plant growth.

Silty and clayey layers – providing natural filtration by trapping sediments and pollutants.

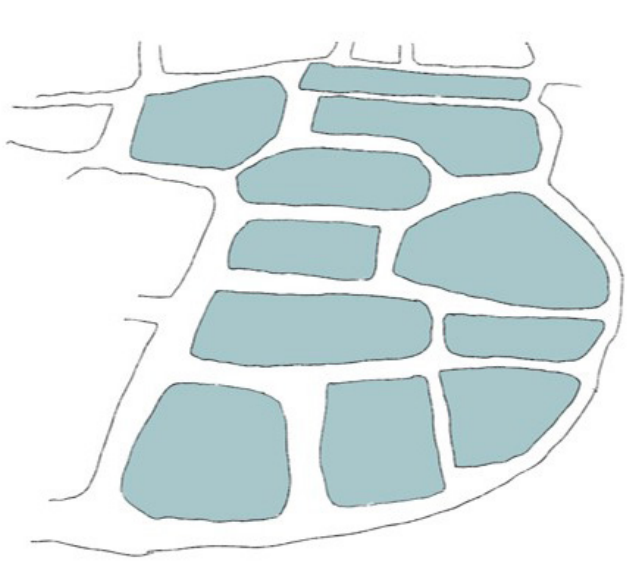
Impermeable membrane layer – a thin barrier between silty-clay and gravel layers that blocks pollutant seepage.

Coarser gravel and sand layers – facilitating water infiltration and groundwater recharge.



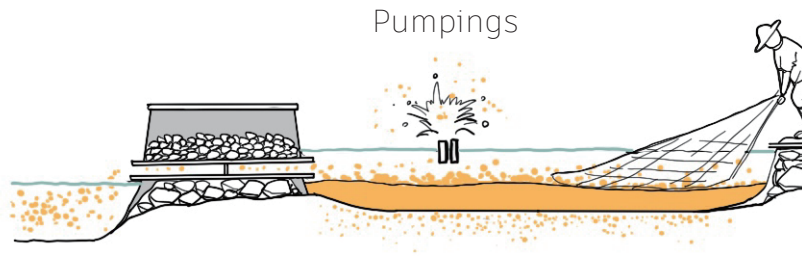
Organic Dike-fishponds: Cooperative Eco-Production

Each group of 6 to 10 small dike-fishponds is organized into a localized management unit. Within each unit, one pond is selected and transformed into a shared public zone dedicated to essential ecological functions such as sediment collection, composting, and water purification. This cooperative approach not only improves overall environmental quality and resource efficiency, but also encourages community participation in the eco-production process, fostering a resilient and self-sustaining dike-pond landscape.



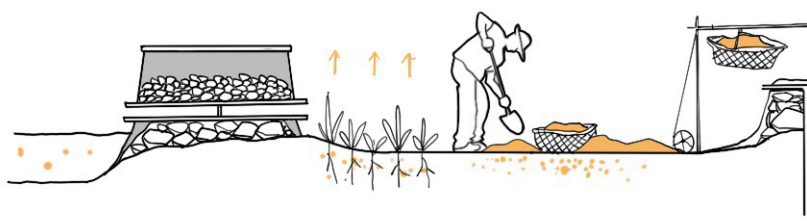


Fish



Excessive feces from the intensive fishing industry ha
water pollution among the whole region

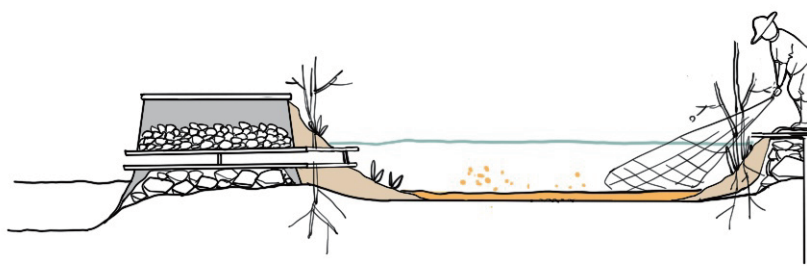
Digging



Collecting the toxic sedimentation and using plantat
from the intensive fishing industry

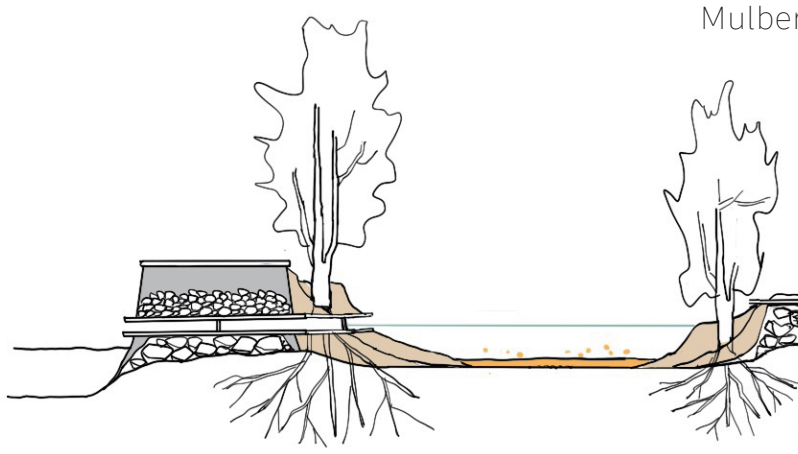
Composting is a process which help to transfer toxic s
stage

Fishe



Using organic soil to rebulid landscape. A more health

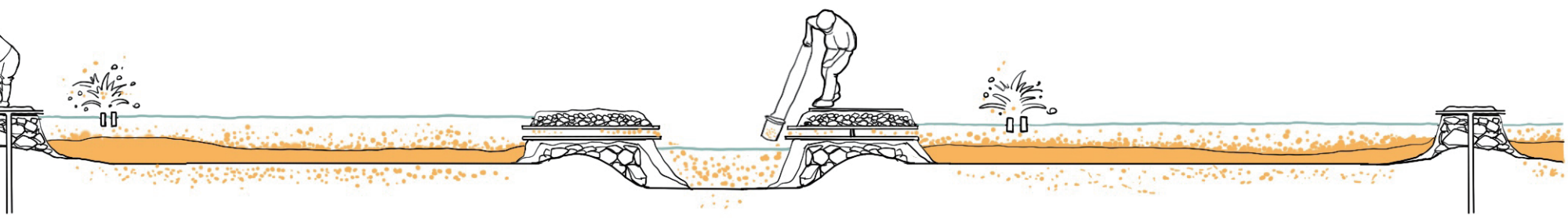
Mulber



A sustainable and self-cleaning water system will b
(Natural purification wetland) agriculture and silkwor

ery

Water intake

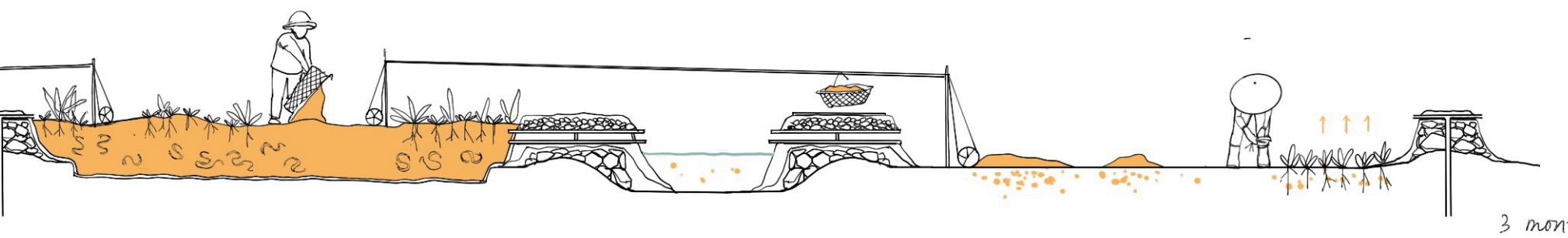


Now

as accumulated in the dike-fish ponds, casuing soil pollution and

Composting

Planting



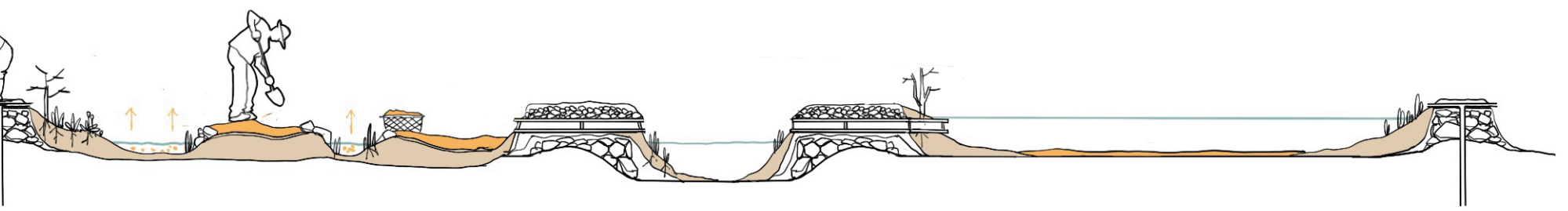
3 months

tion to absorb pollution is the first step to control the pollution

sendimentation into organic soil, and the soil can be used in next

ry

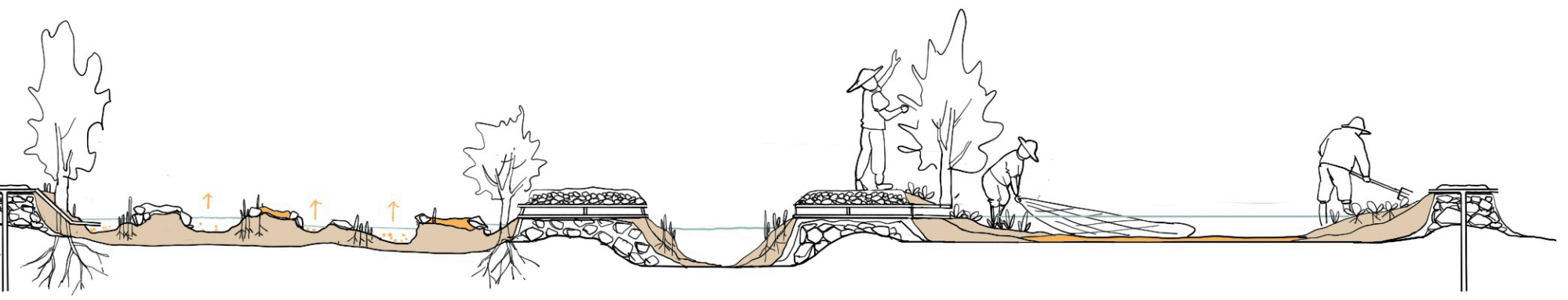
Composting



nier production could be introduced into the region

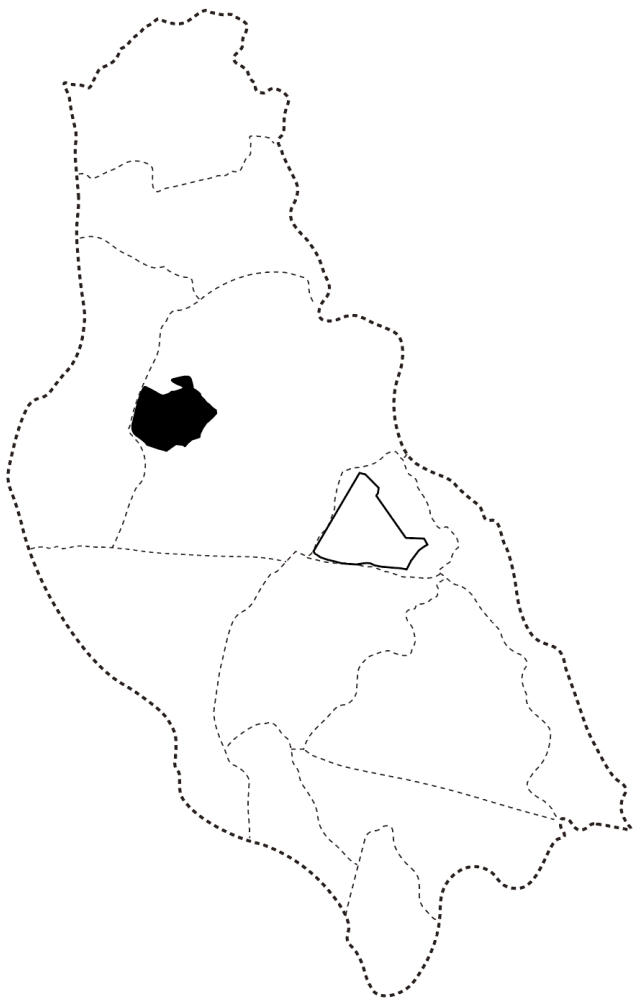
1 year

rry tree



e use for the fishing indutry, which combine the green buffer
m industry

10 year



Meso-scale Implementation: Ecological and Tourism Integration Area (Locally Managed)

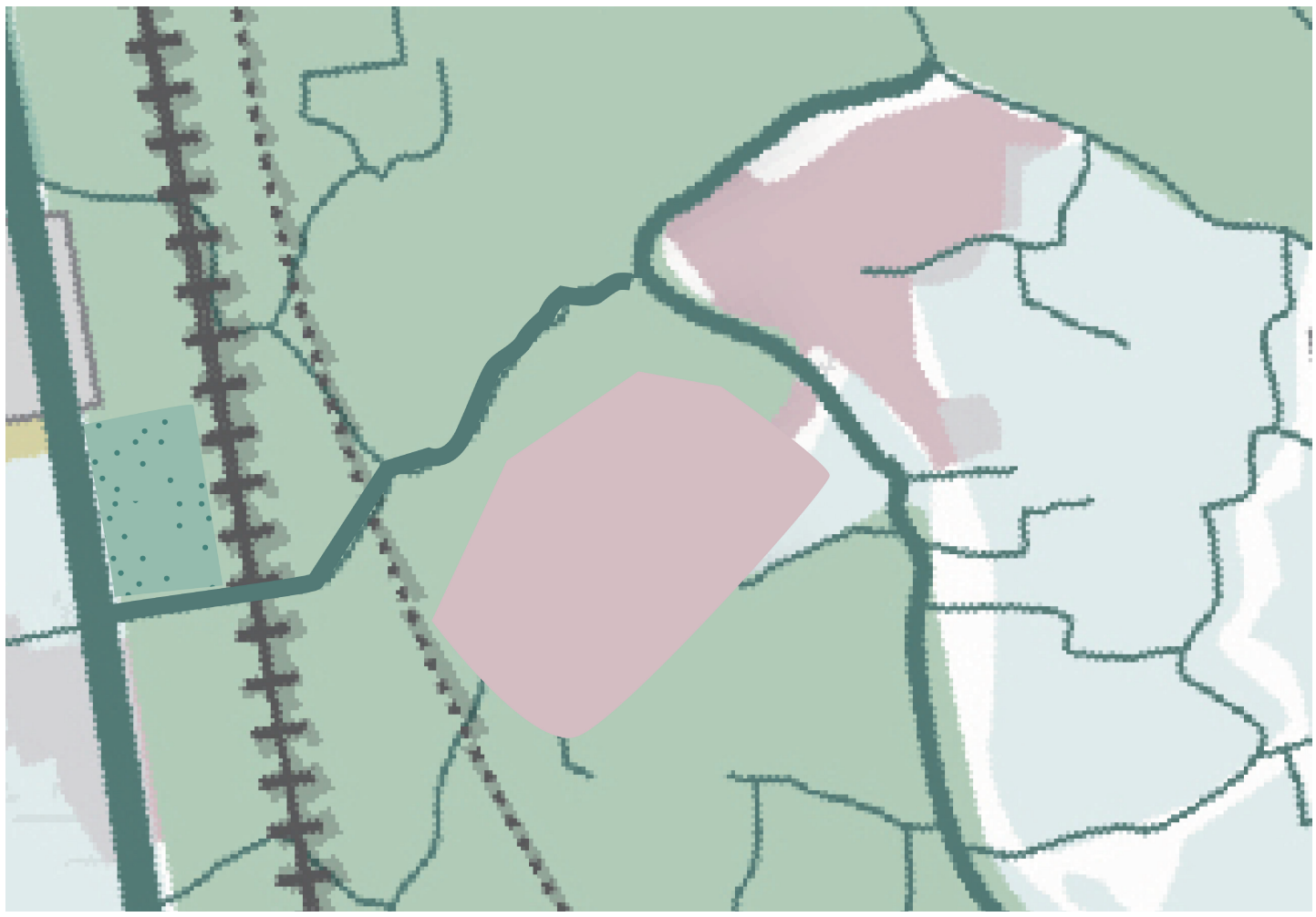
Ruxi Village is located to the west of Xiqiao Mountain. It is an area where traditional village patterns and water management facilities are relatively well preserved. The natural ecology here remains in good condition, surrounded by lush greenery and clear waters, showcasing a relatively original natural landscape. The fish ponds in the village are primarily managed by local residents, with aquaculture methods inherited through generations, forming a water landscape highly integrated with the surrounding ecological environment.

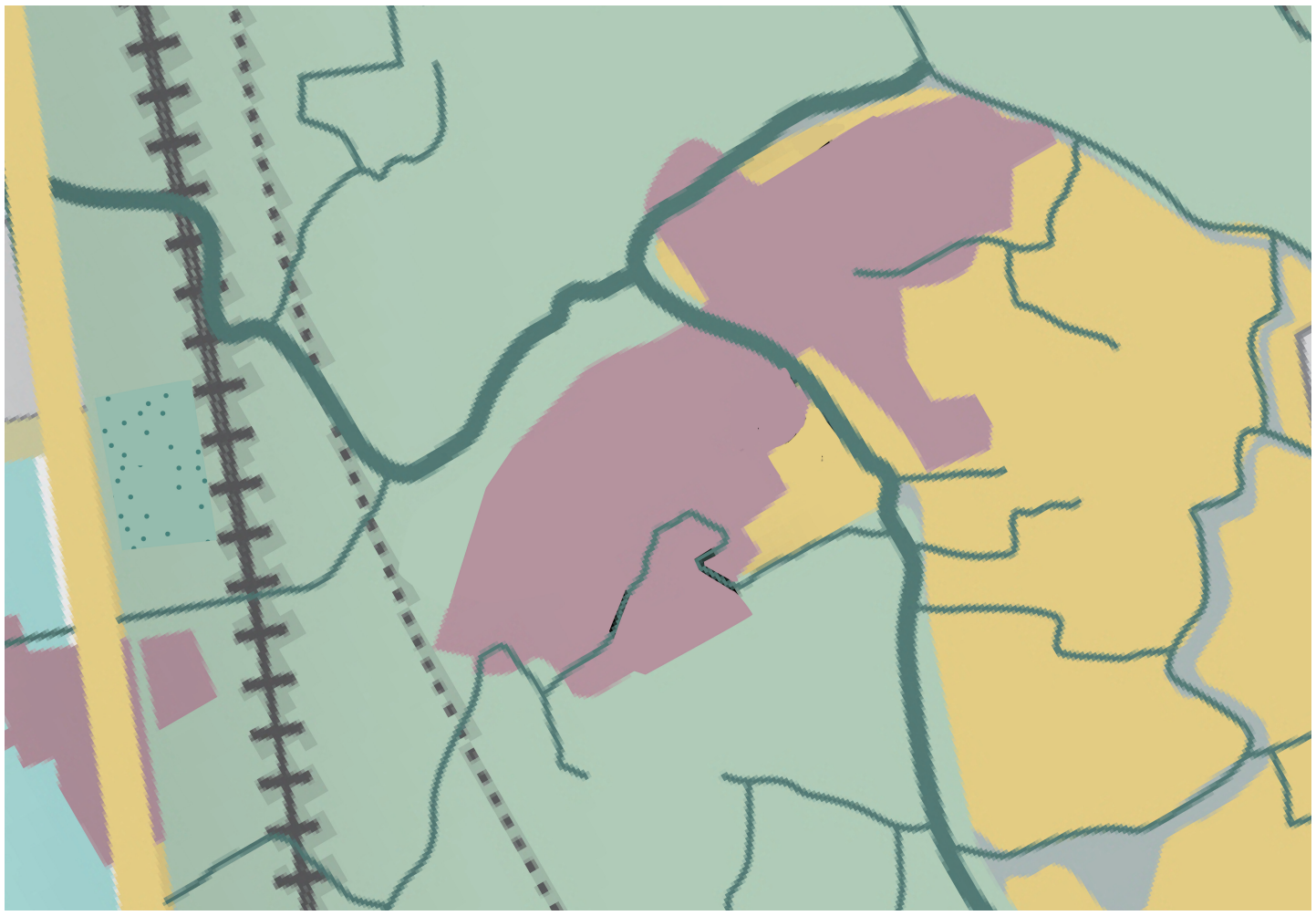
The fish ponds in Ruxi Village are densely distributed with good water connectivity, serving important ecological functions. They not only play a crucial role in water regulation and habitat provision but also supply fishery resources to the community. Because the fish ponds are mainly managed by local villagers, there is significant flexibility and potential for transformation and improved management, offering substantial opportunities for ecological restoration and landscape enhancement.

Currently, Ruxi Village faces both opportunities and challenges brought by urban-rural integration. Traditional production methods increasingly encounter conflicts with modern living demands. However, relying on the natural resources and cultural heritage of Xiqiao Mountain, the village has great potential for ecological tourism development. The design and planning focus on the dual goals of ecological development and rural tourism, aiming to promote coordinated growth through scientific spatial arrangement and ecological restoration measures.

Ecologically, the plan emphasizes enhancing water system connectivity and fish pond ecological functions, protecting and improving biodiversity, creating green ecological corridors, and boosting water purification and ecosystem services. From a rural tourism perspective, the unique local water culture and traditional village landscapes will be integrated to develop distinctive tourism products and leisure spaces, fostering the integration of agriculture, fisheries, and tourism, and promoting local community participation and benefit-sharing.

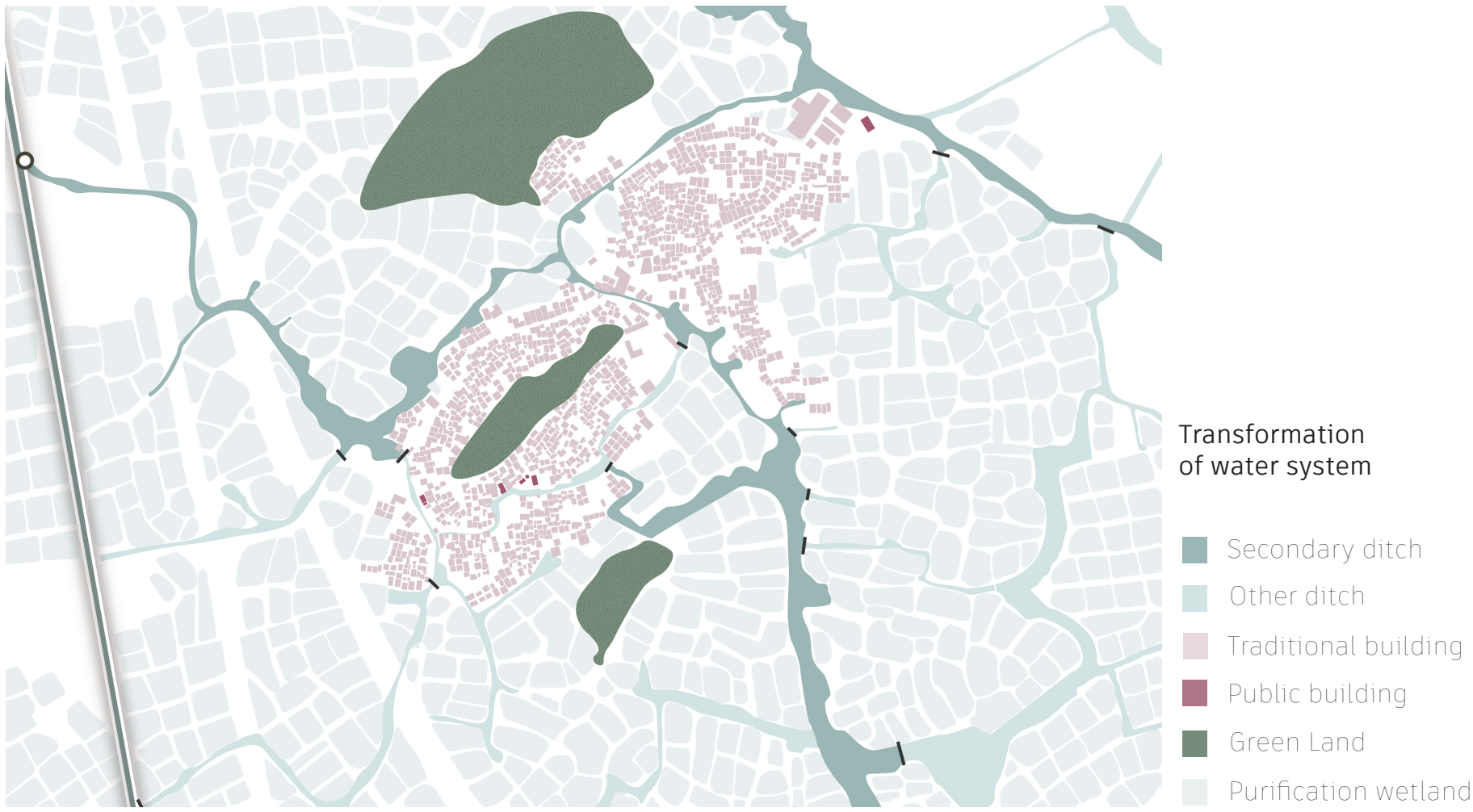
Overall, as a traditional village with relatively complete water management facilities and ecological environment, Ruxi Village has the potential to become a model area for ecological countryside development. Through reasonable planning and design, it will serve as a demonstration zone where ecological conservation and rural revitalization coexist, achieving an organic combination of green development and cultural inheritance.


Dike-fish ponds
Living area
Primary ditch
Secondary ditch
Other ditch
Road
Subway
Ecological dike-fish ponds
Purification wetland

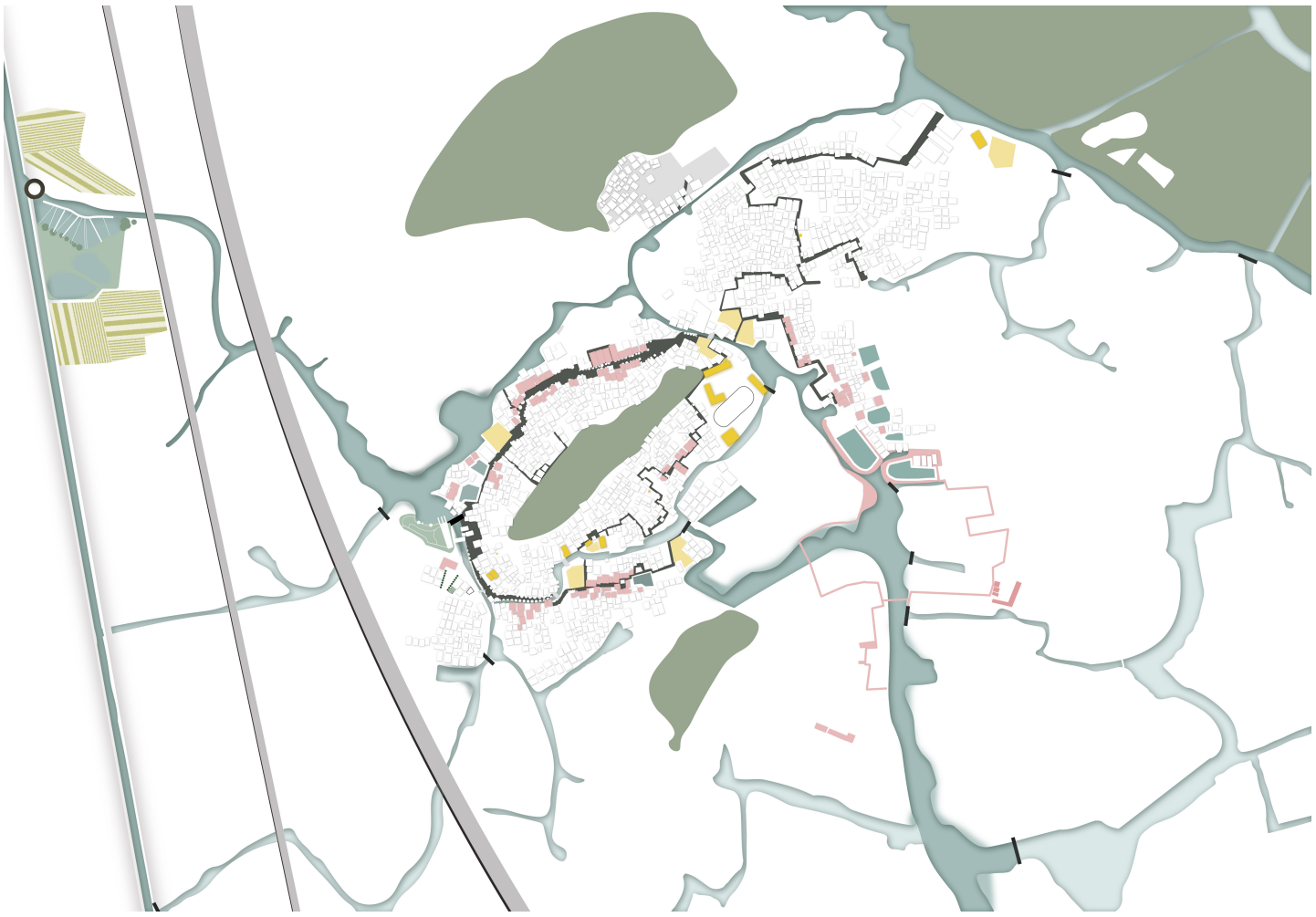

Rural tourism
Eco-fishrey


0
10
20
30
40
50km




Transformation
of water system
Secondary ditch
Other ditch
Traditional building
Public building
Green Land
Purification wetland


Transformation
of Dike-fish ponds
Eco-production dike-fish ponds
Tourism-local dike-fish ponds
Eco dike-fish ponds



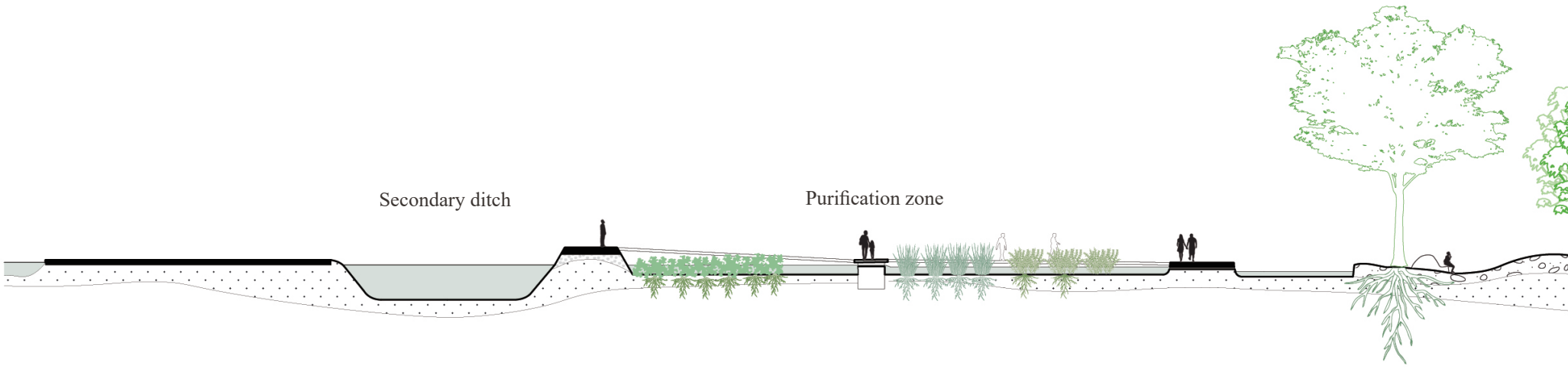
The design focuses on adjusting the water system, optimizing the spatial structure and production methods of the fish ponds to enhance ecological functions and promote diversified industry development. Specifically, the plan involves reorganizing the shape and layout of the fish ponds to better suit modern ecological aquaculture and landscape needs, while integrating traditional management practices to improve both production efficiency and ecological value.

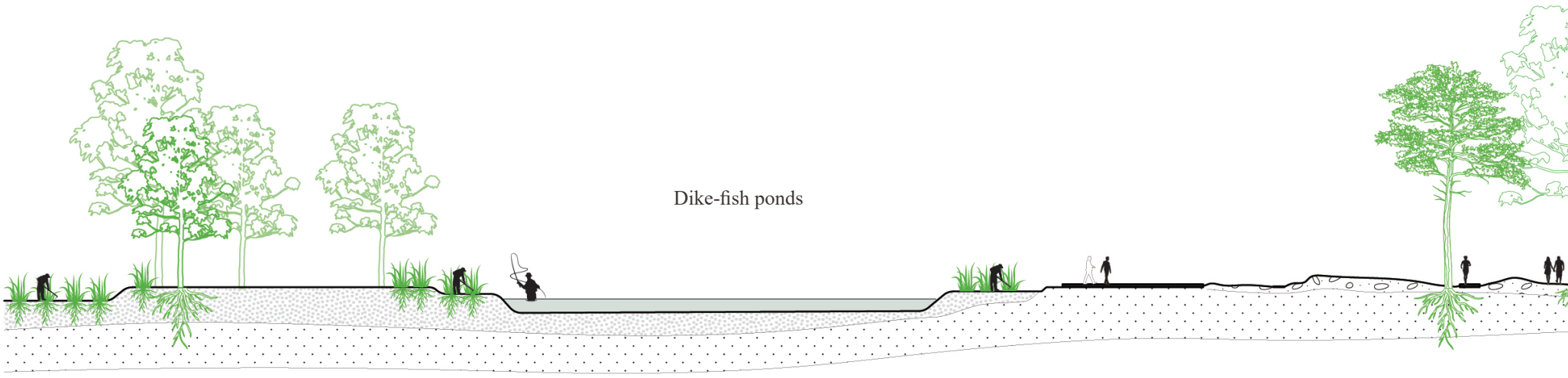
Additionally, the design emphasizes the development of rural tourism by incorporating the rich local water culture and traditional village characteristics to create diverse tourism products and experiential spaces that attract visitors and stimulate active participation from villagers. Through establishing community engagement mechanisms, local residents are encouraged to take part in water management, ecological conservation, and tourism services, achieving a win-win situation for economic and social benefits.

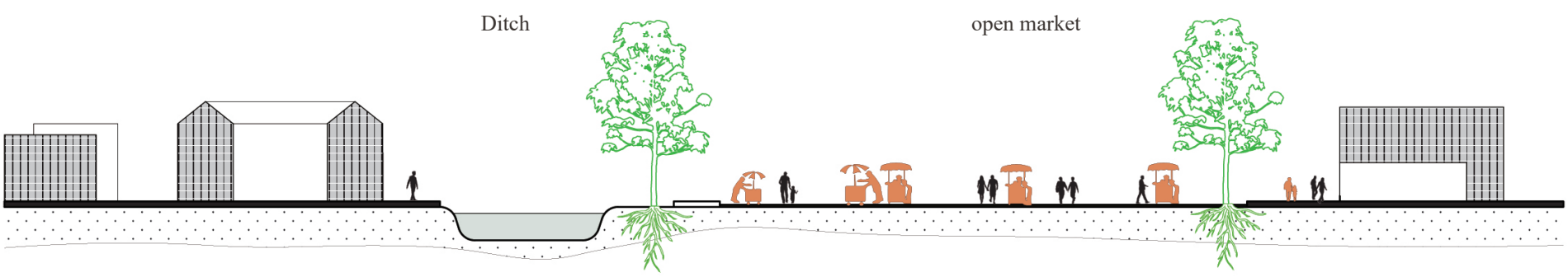
All design and management measures strictly follow the regional planning guidelines to ensure coordinated goals of ecological protection and rural revitalization, positioning Ruxi Village as a model area for the synergistic development of ecological sustainability and rural tourism.

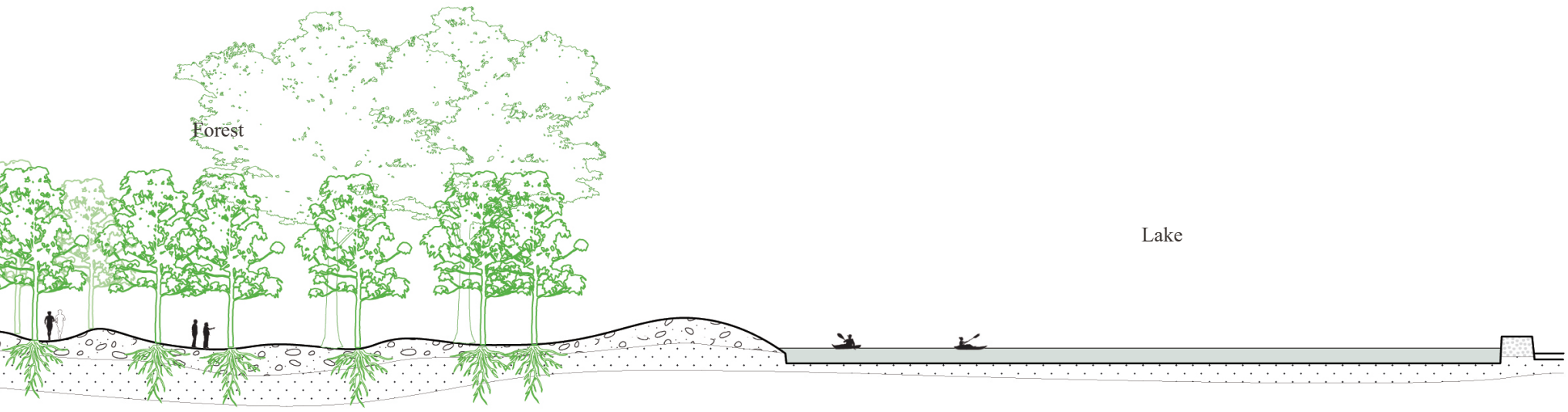

Purification wetland park
Section A-A
Agriculture park
Commertial belt
Rural stage
Rural restaurant
Section B-B
Water gate Park
Rural stage
0
10
20
30
40
50km


Water education
Water Park
Agriculture experience
Local dike-fishponds
ural square
ion C-C
Zoom in-1
Mulberry garden dike open musemu
Eco dike-fishponds

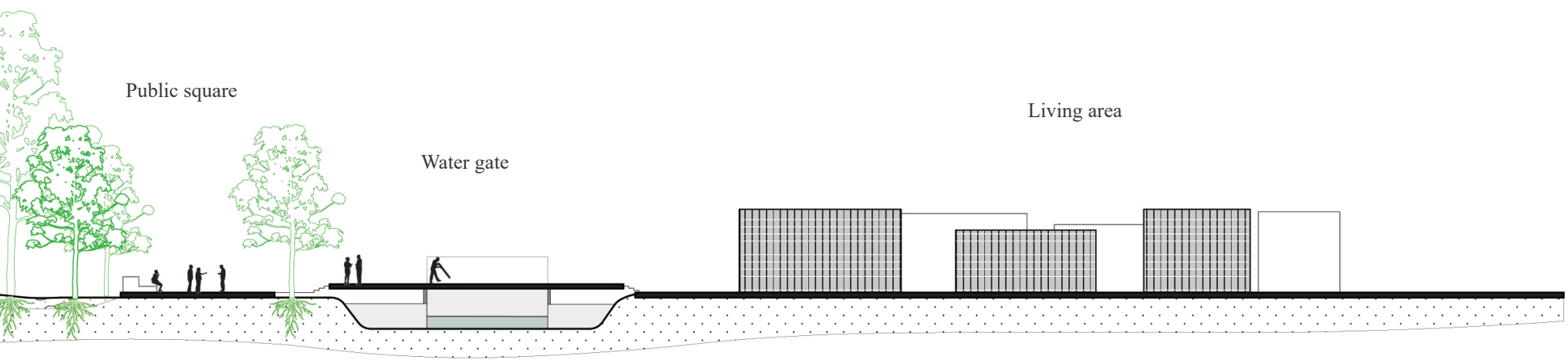

Secondary ditch
Purification zone


Dike-fish ponds

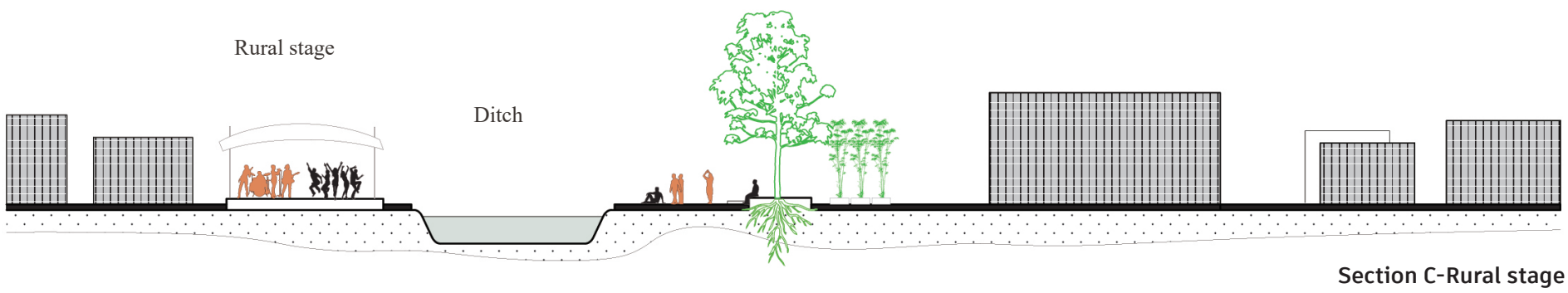

Ditch
open market



Section A-Purification wetland park



Section B-Water park



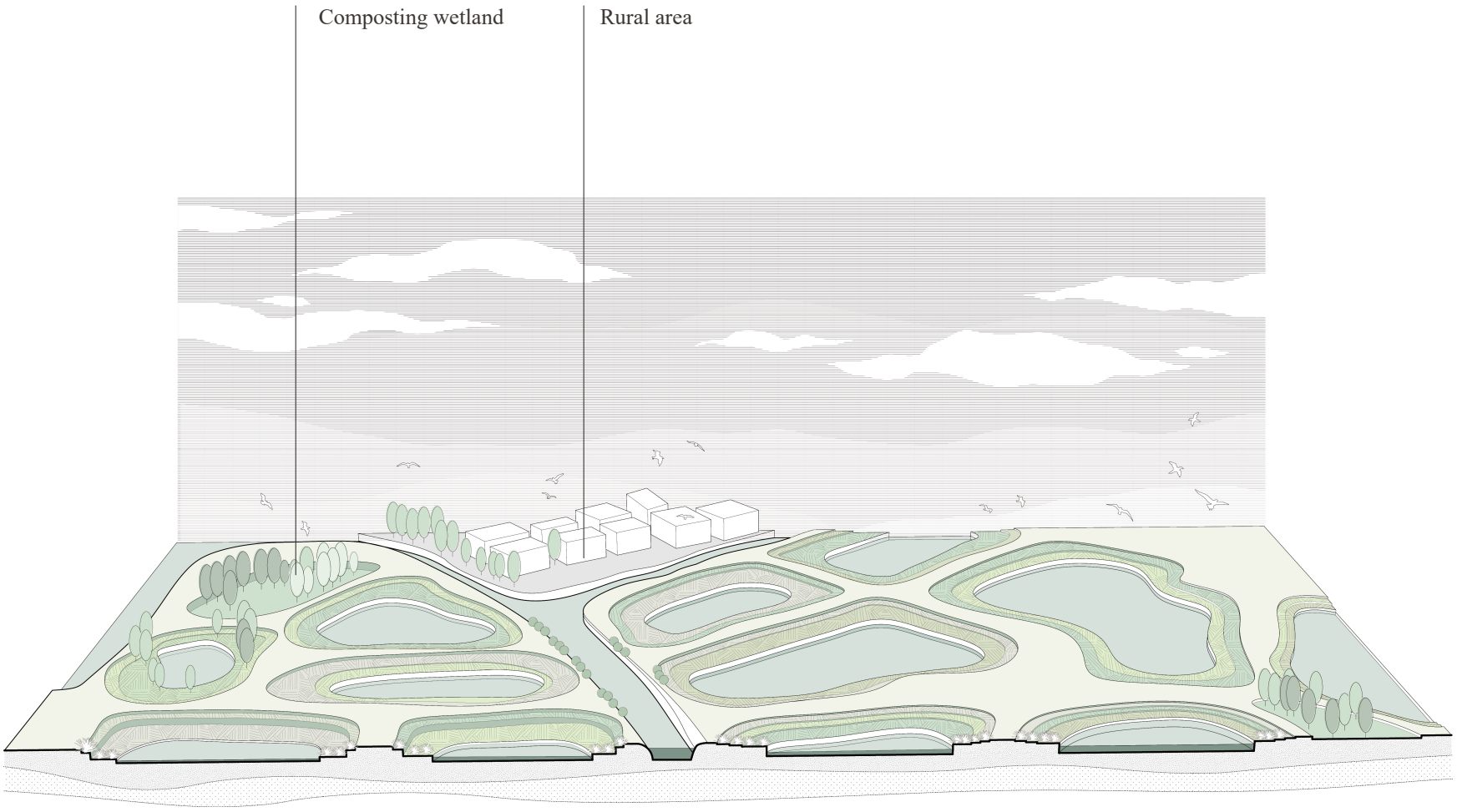
Section C-Rural stage

Eco dike-fishponds

Eco dike-fish ponds are integrated agro-ecological systems that blend traditional wisdom with contemporary ecological principles. Based on the traditional model of "fish in the pond, crops on the dike," this system adopts a balanced dike-to-pond ratio of 4:6 to 5:5, optimizing the spatial structure to support both fishing industry and agricultural productivity.

The dikes are used to grow a diverse mix of crops—such as rice, legumes, vegetables, or mulberries—creating a multi-functional landscape that improves land efficiency and reduces ecological pressure from monoculture. The fish pond itself provides a healthy habitat for aquatic life, while the planting zones absorb excess nutrients from aquaculture and offer habitats for birds, insects, and other wildlife, forming a self-sustaining micro-wetland ecosystem.

Unlike large-scale, resource-intensive aquaculture systems, this model operates on a small-scale, low-input basis, relying on local knowledge and traditional ecological management. Nutrients in pond sediments are gradually absorbed through plant uptake and decomposed through natural and manual processes, keeping the pond clean and ecologically balanced. By embracing the principle of "ecology as production," this system unifies ecological restoration, productive farming, and rural landscape resilience—offering a sustainable and culturally grounded path for eco-agriculture development.



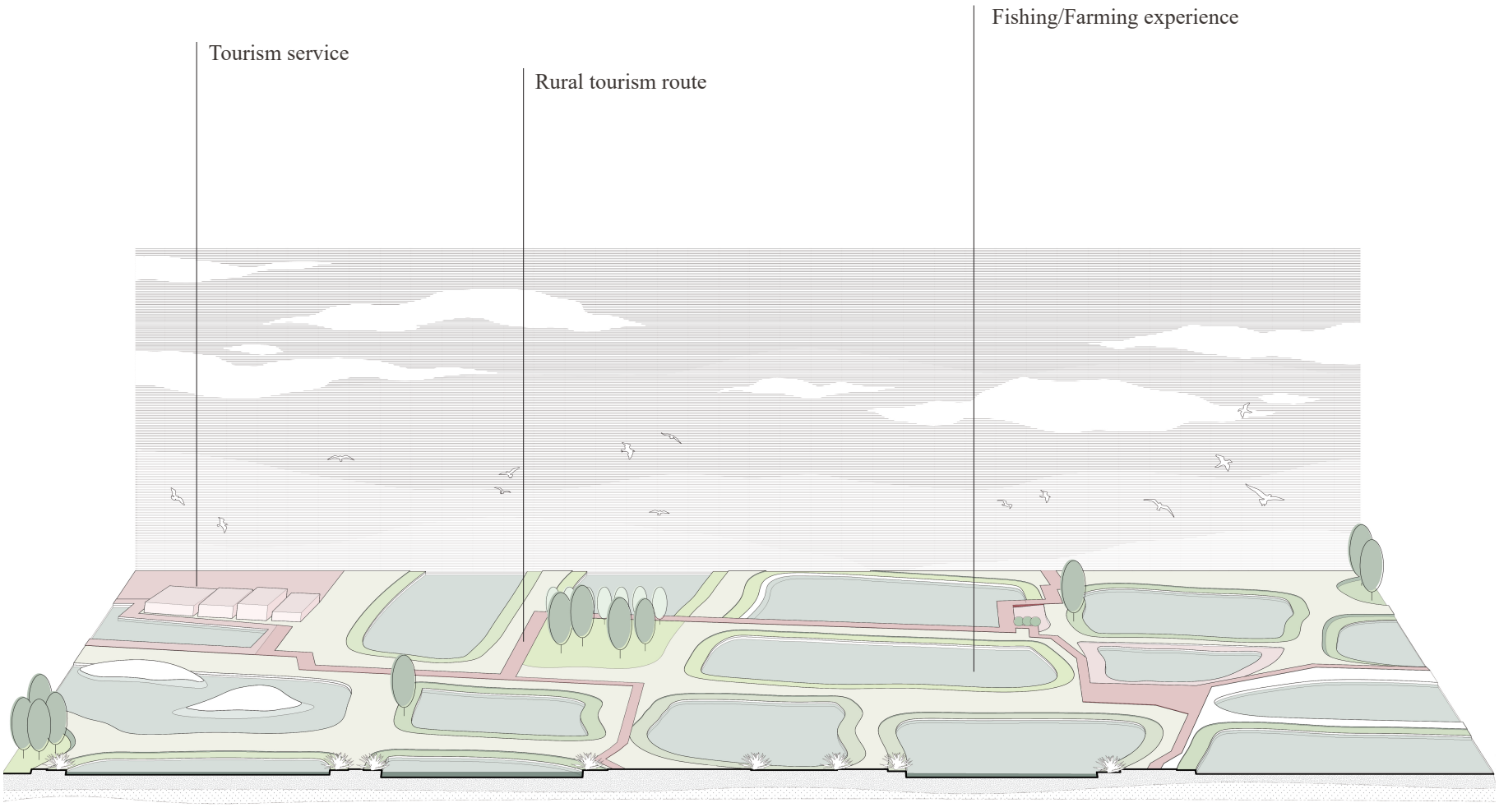
Local dike-fishponds

Local dike-fish ponds are multifunctional landscape systems that integrate ecological aquaculture, agricultural production, and rural tourism within a traditional diek-ponds layout. With a typical dike-to-pond ratio of 4:6 or 3:7, these systems preserve core farming functions while expanding the potential for tourism and recreational activities.

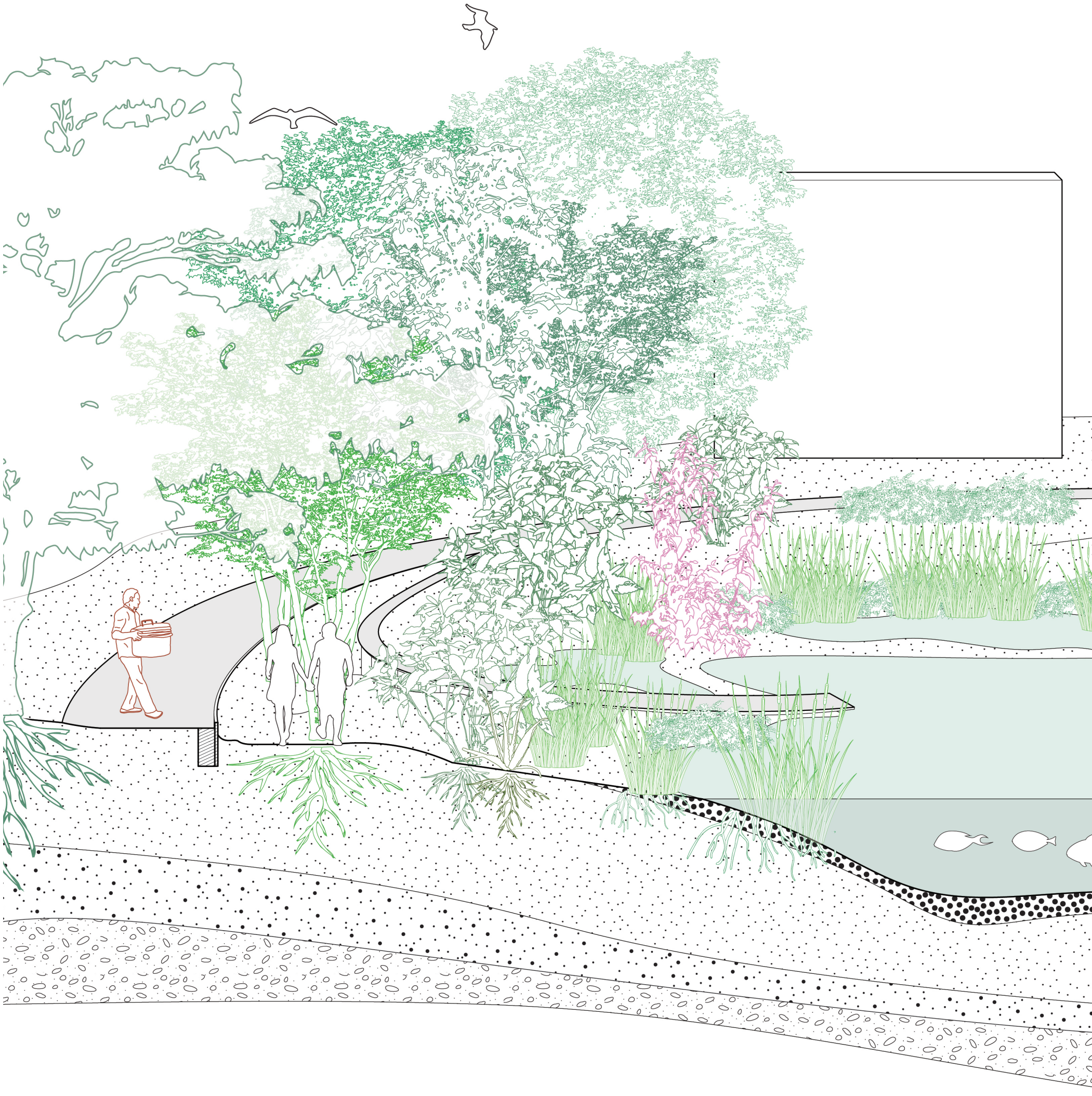
Beyond aquaculture and farming, these ponds serve as key spaces for eco-tourism and rural experience. The dike areas can accommodate walking paths, fishing platforms, rest areas, and farming experience zones, allowing visitors to engage directly with water landscapes and agricultural life.

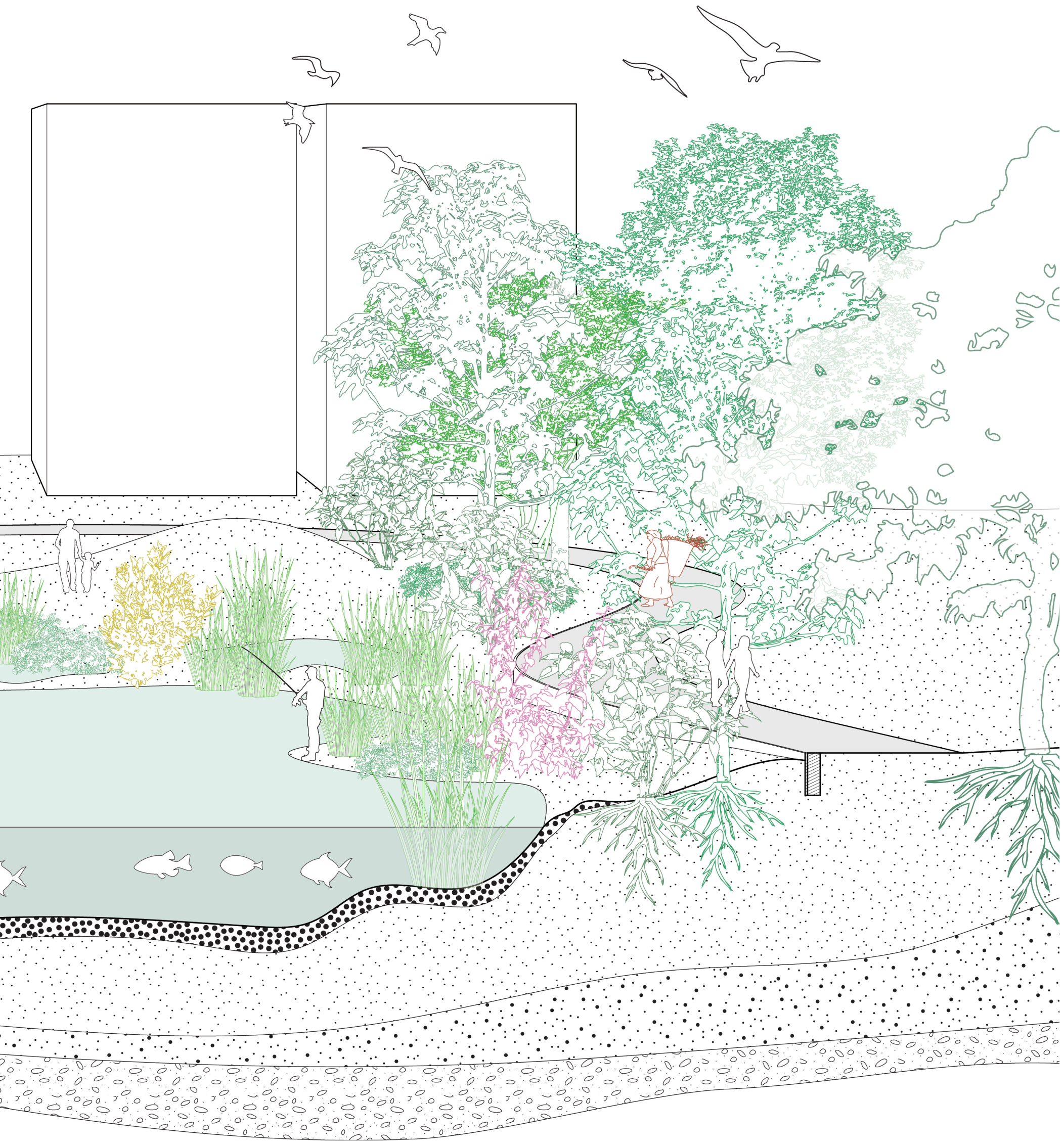
The design aims to balance ecological integrity with economic benefits. Techniques such as vegetated filtration, nutrient cycling, and land–water habitat interweaving help maintain water quality and support biodiversity. Meanwhile, polyculture of fish, shrimp, and crab, combined with seasonal crops and tourism activities, enhances economic returns and spatial vitality.

Tourism dike-fish ponds represent a new model of productive landscape—fusing ecology, agriculture, and cultural experience into one multifunctional rural space—supporting sustainable development and revitalization in rural areas.

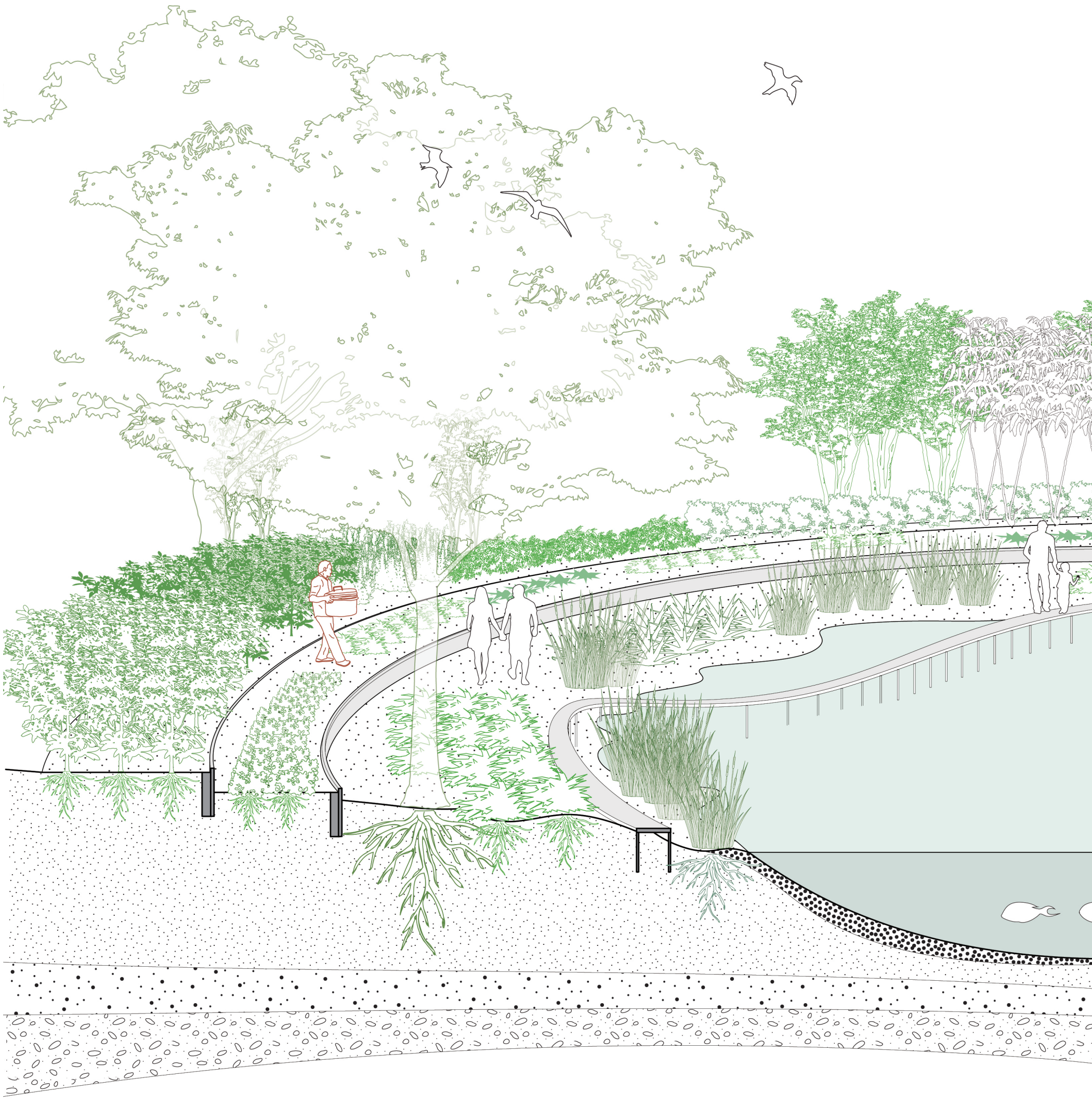


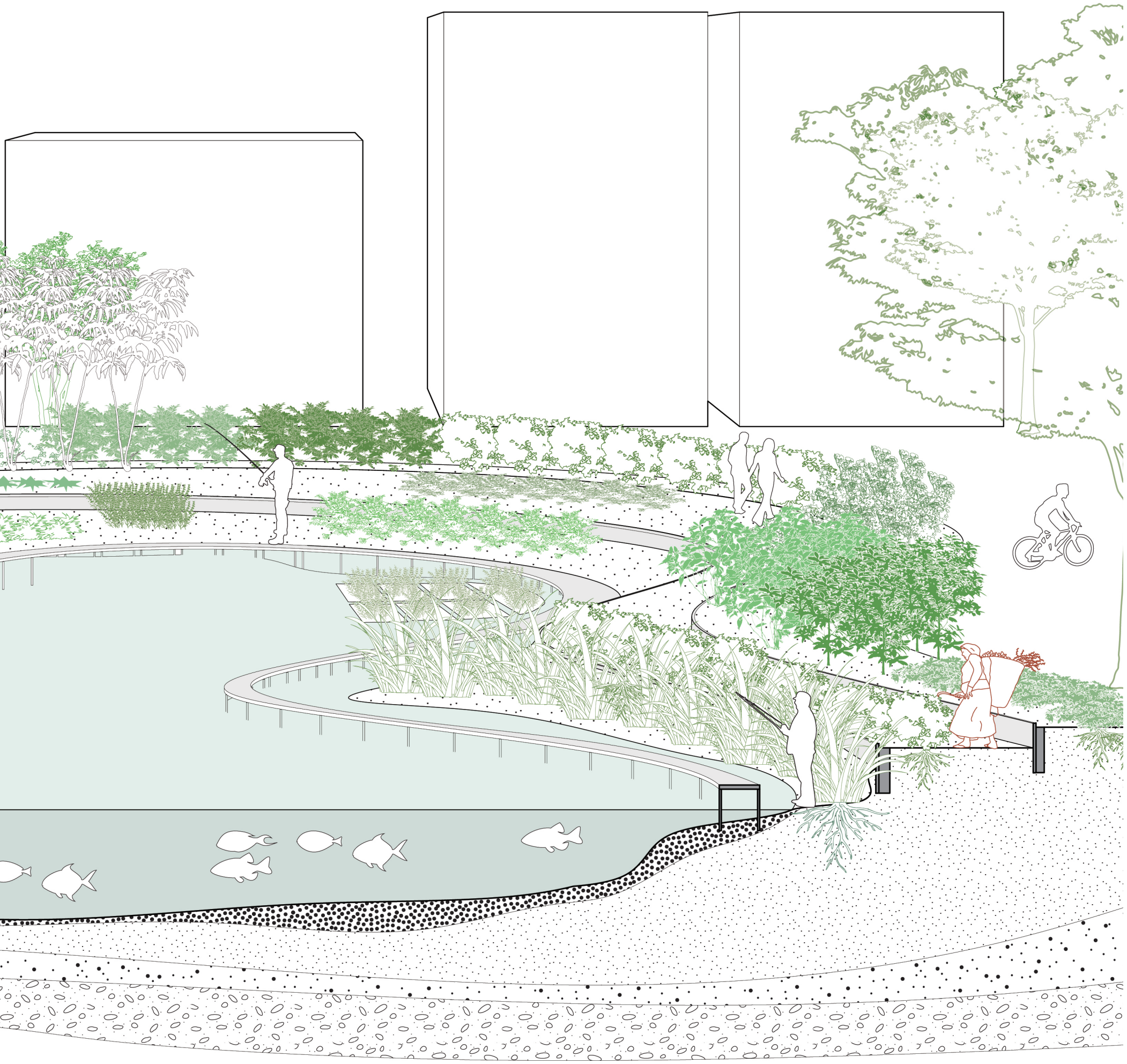
Eco dike-fishponds

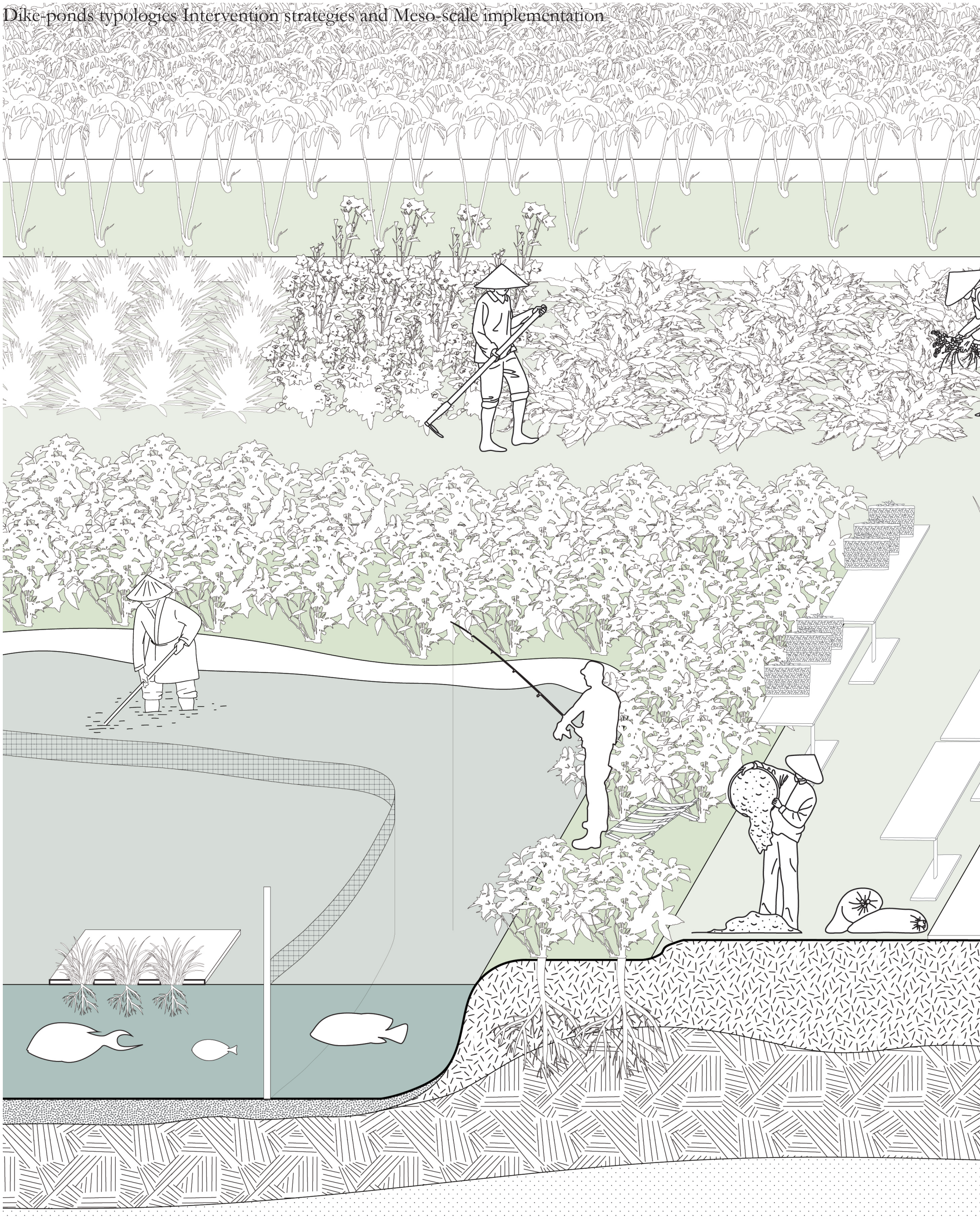


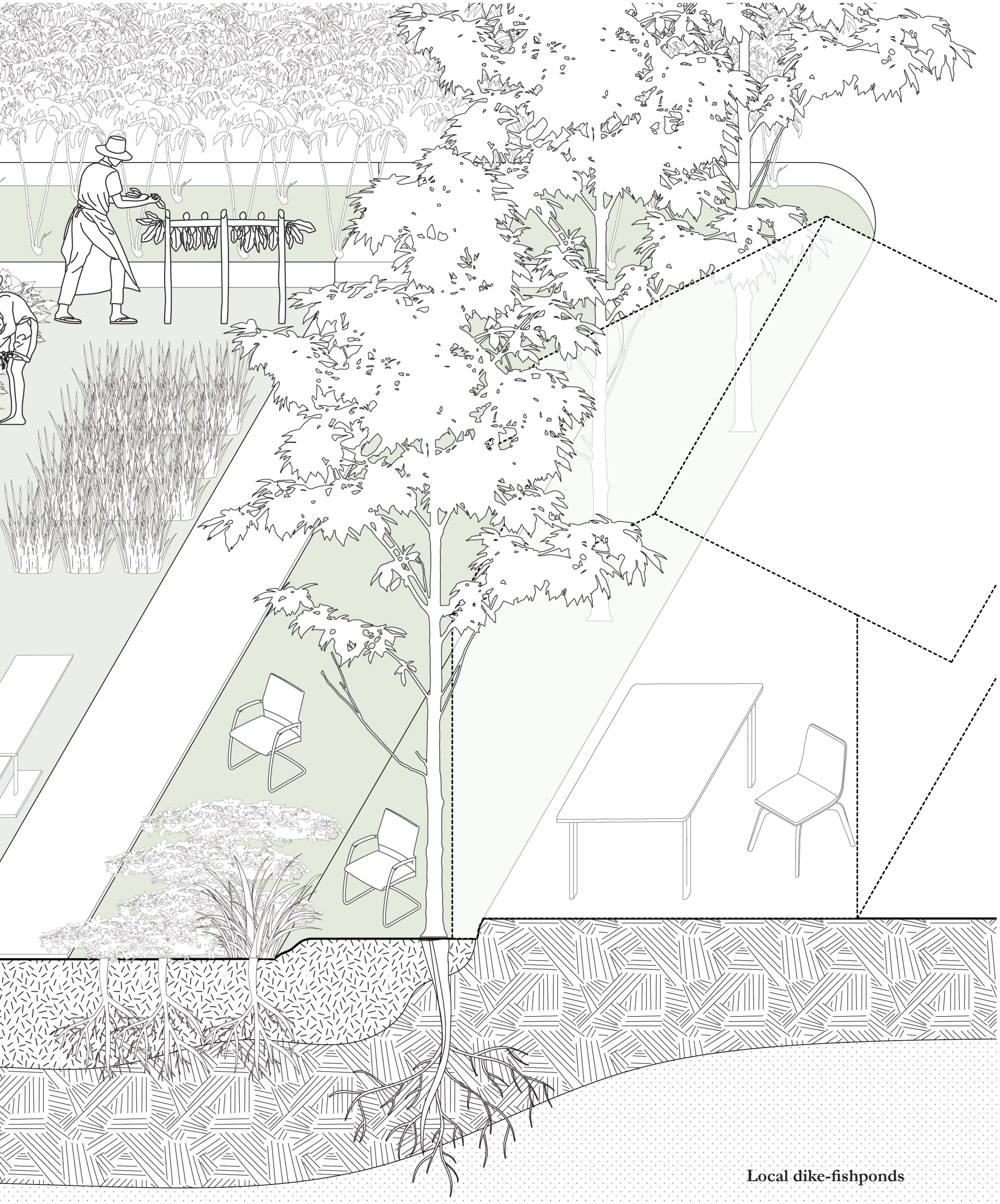


Local dike-fishponds

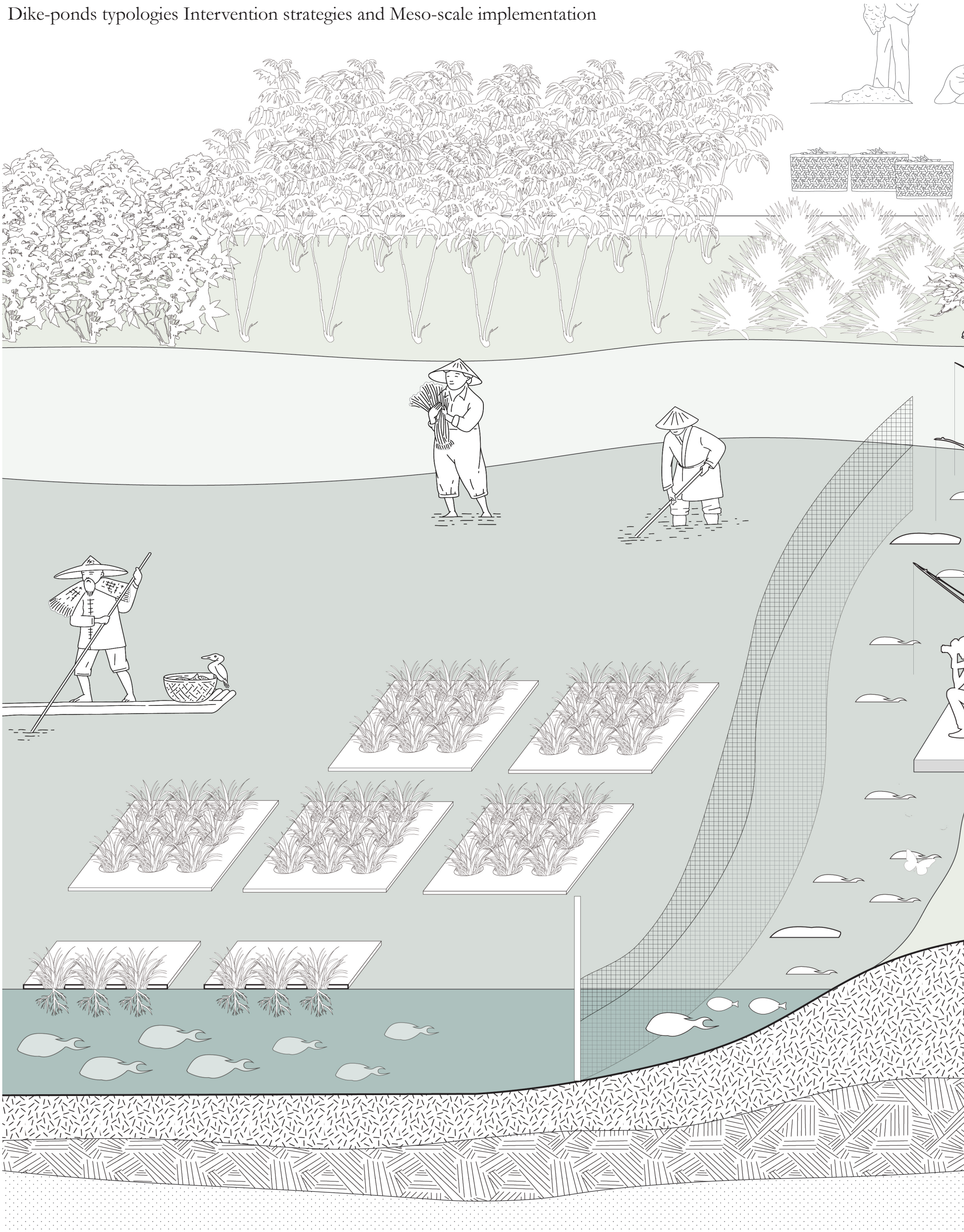


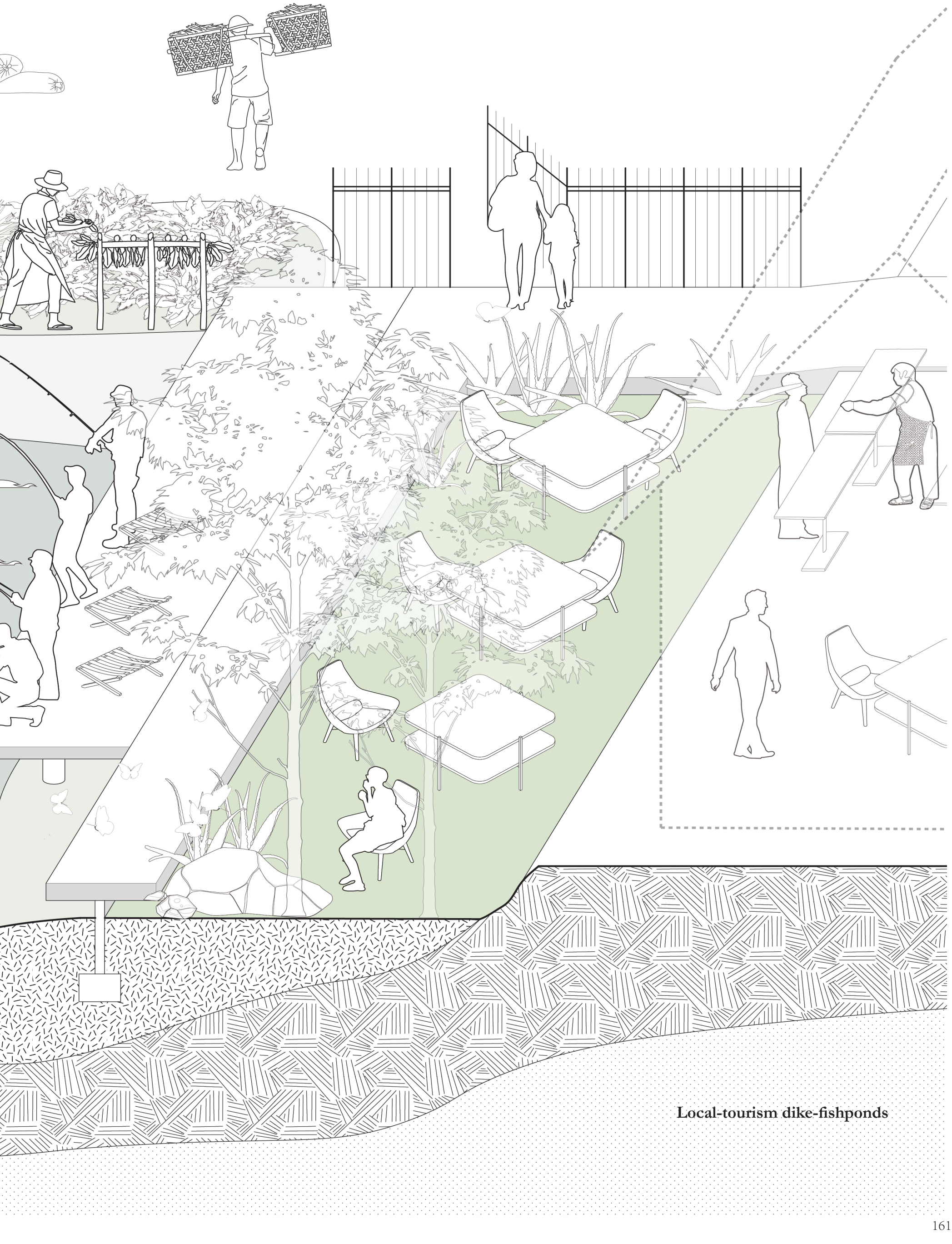






Local dike-fishponds





Local-tourism dike-fishponds

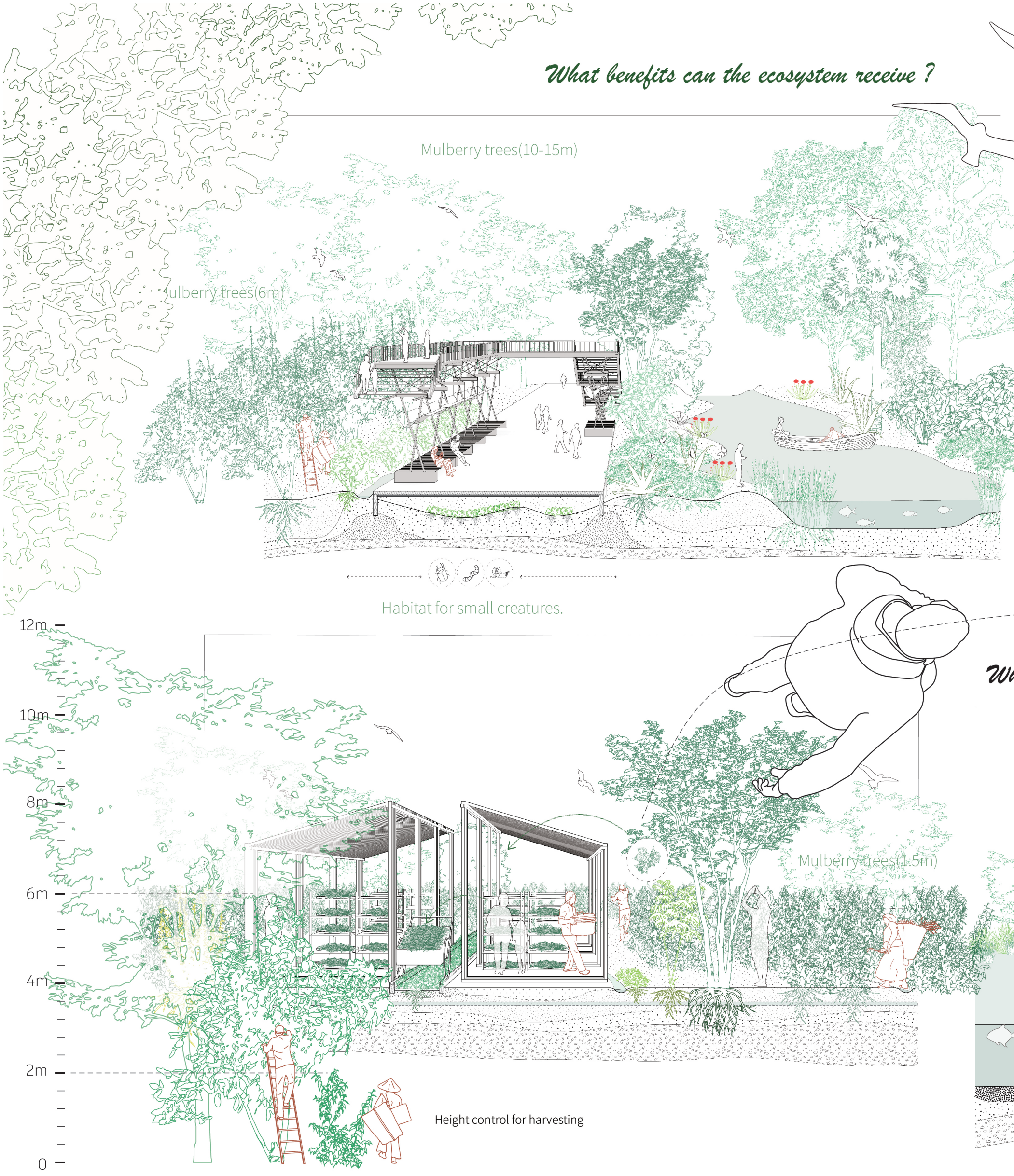

Rural restaurants
Agriculture experience
Section 1
Section 2
Section 3
Section 4
Shipping station

Mulberry garden dike open musemu

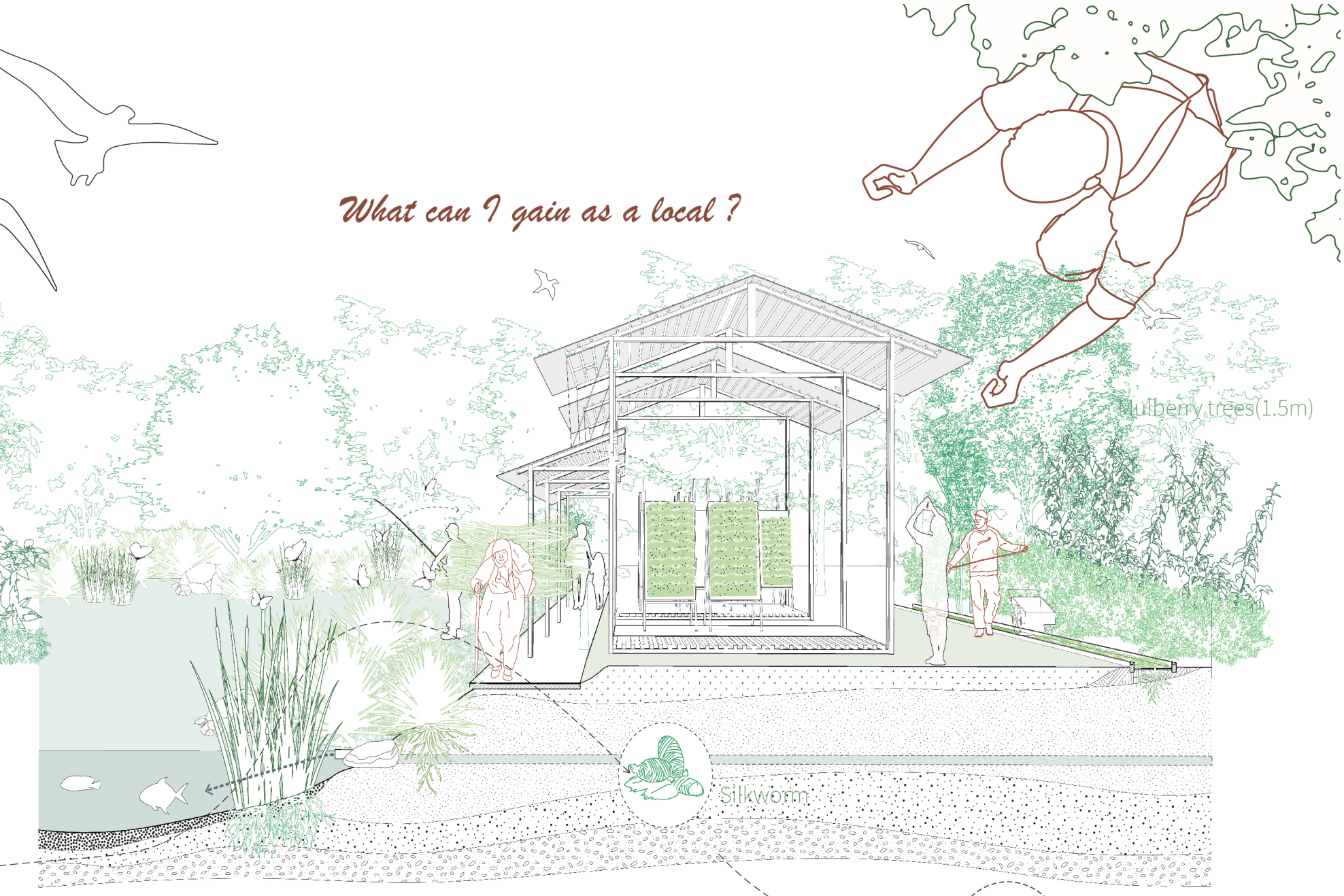
The Mulberry Garden Dike Open Museum reconstructs a section of the traditional mulberry-dike fish pond landscape, incorporating carefully designed walking paths to offer visitors a detailed and immersive experience. Visitors can closely observe the water systems, dike structures, and aquaculture ecology, gaining insight into the historical heritage and contemporary value of this unique agricultural water culture.

For local residents, the museum not only provides diverse employment opportunities—ranging from tour guiding, crop cultivation, to fish farming and related services—but also introduces a boat commuting function. This traditional mode of water transportation enhances daily mobility and enriches community life, preserving the authentic local character. Moreover, the museum serves as an important space for leisure and social gathering, strengthening community cohesion and cultural identity. For visitors from outside the region, it presents an authentic experience of the mulberry-dike fish pond culture, allowing them to understand aquaculture techniques, ecosystems, and participate in traditional cultural activities while enjoying the harmonious natural landscape.

The agricultural landscape surrounding the museum is thoughtfully utilized to include specialty restaurants that serve fresh vegetables and fish sourced directly from the mulberry-dike ponds. This farm-to-table approach enriches visitors' dining experience and promotes a close integration of agricultural production with tourism consumption, stimulating local economic development. At the same time, this model supports sustainable ecological farming practices, maintaining ecological balance and enhancing the overall environmental quality and ecological function of the area.

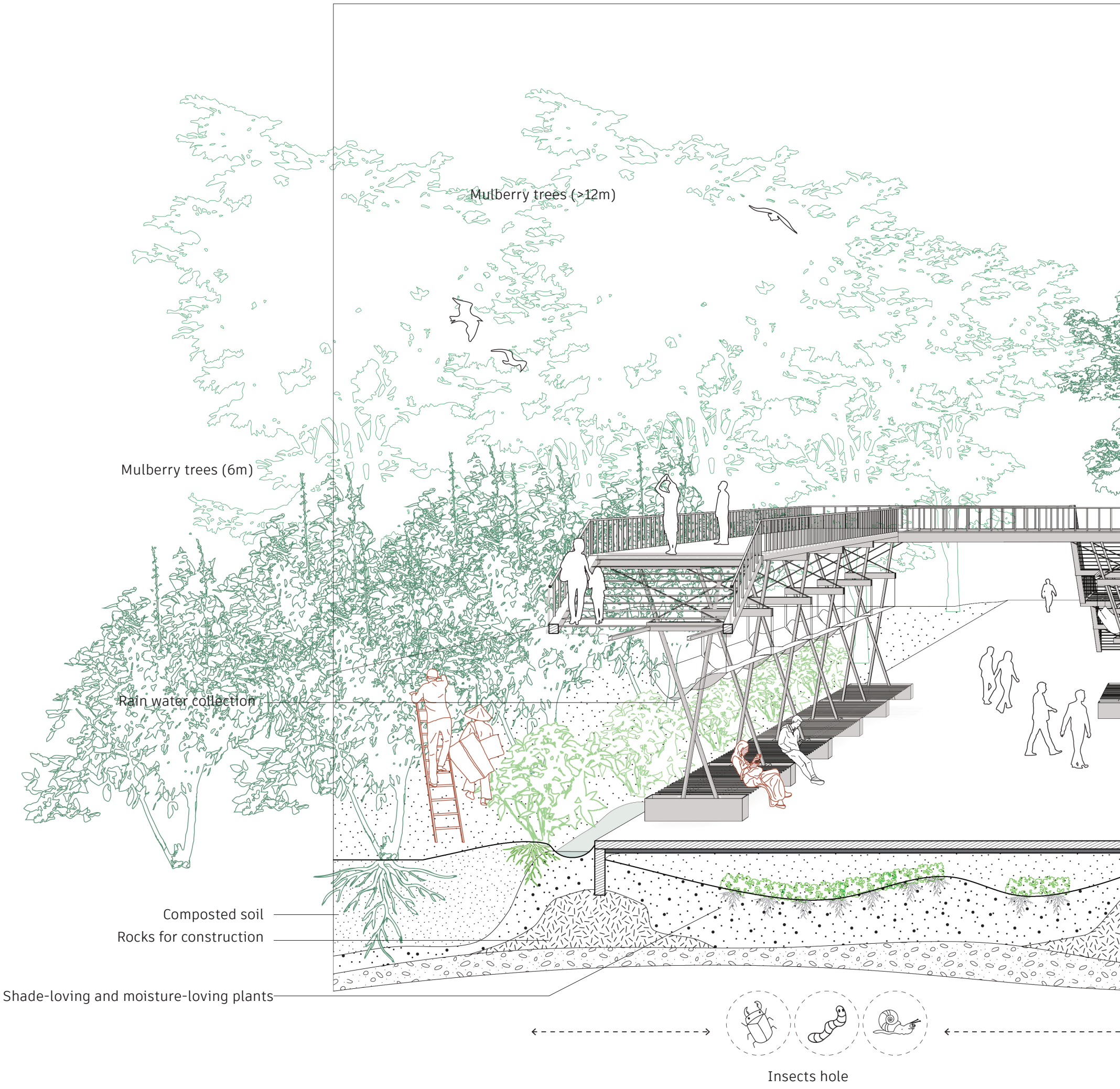

What benefits can the ecosystem receive ?
Mulberry trees(10-15m)
Mulberry trees(6m)
Habitat for small creatures.
12m
10m
8m
6m
4m
2m
0
Mulberry trees(1.5m)
Height control for harvesting

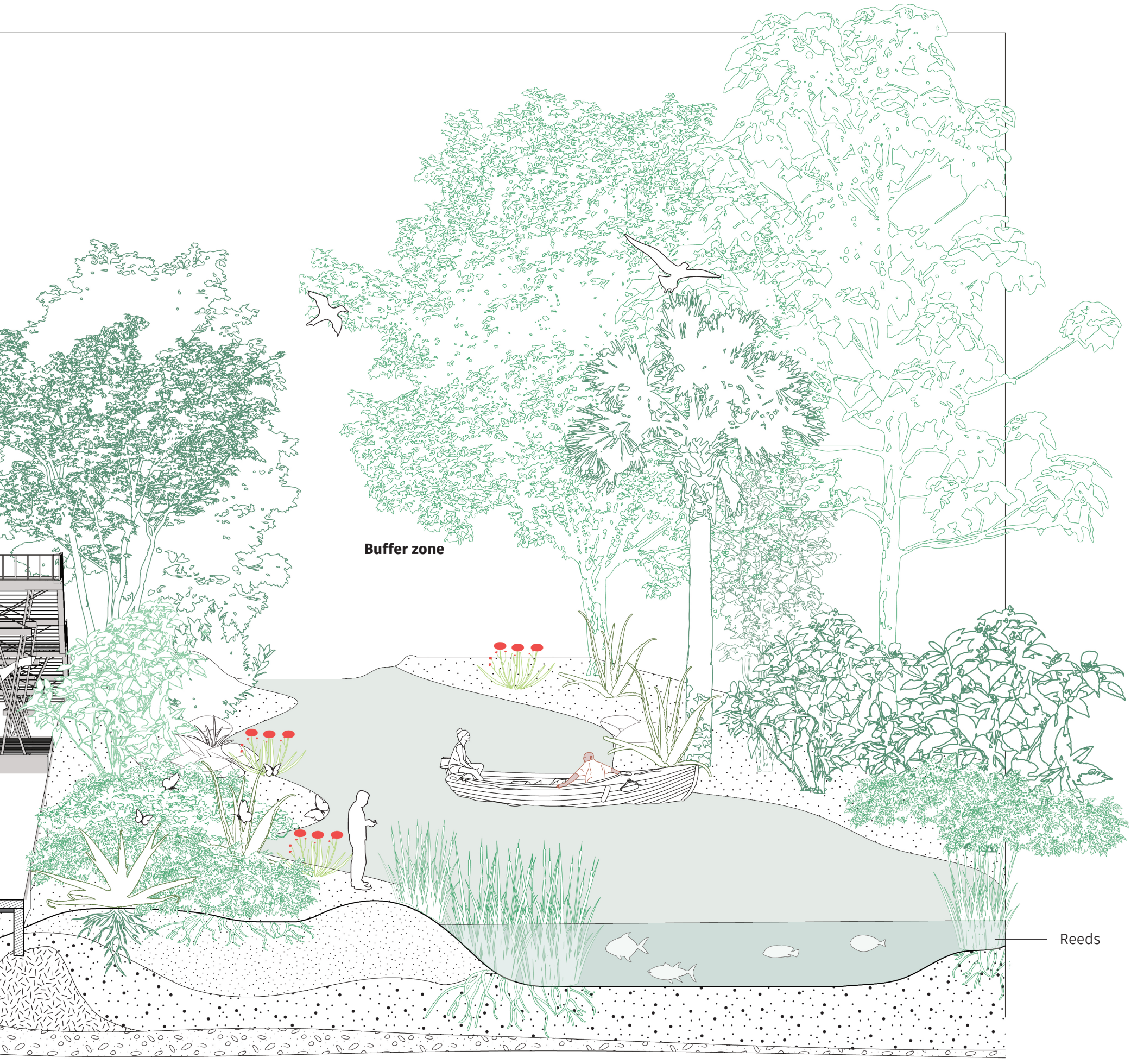
What can I gain as a local ?



hat can I see as an outsider ?



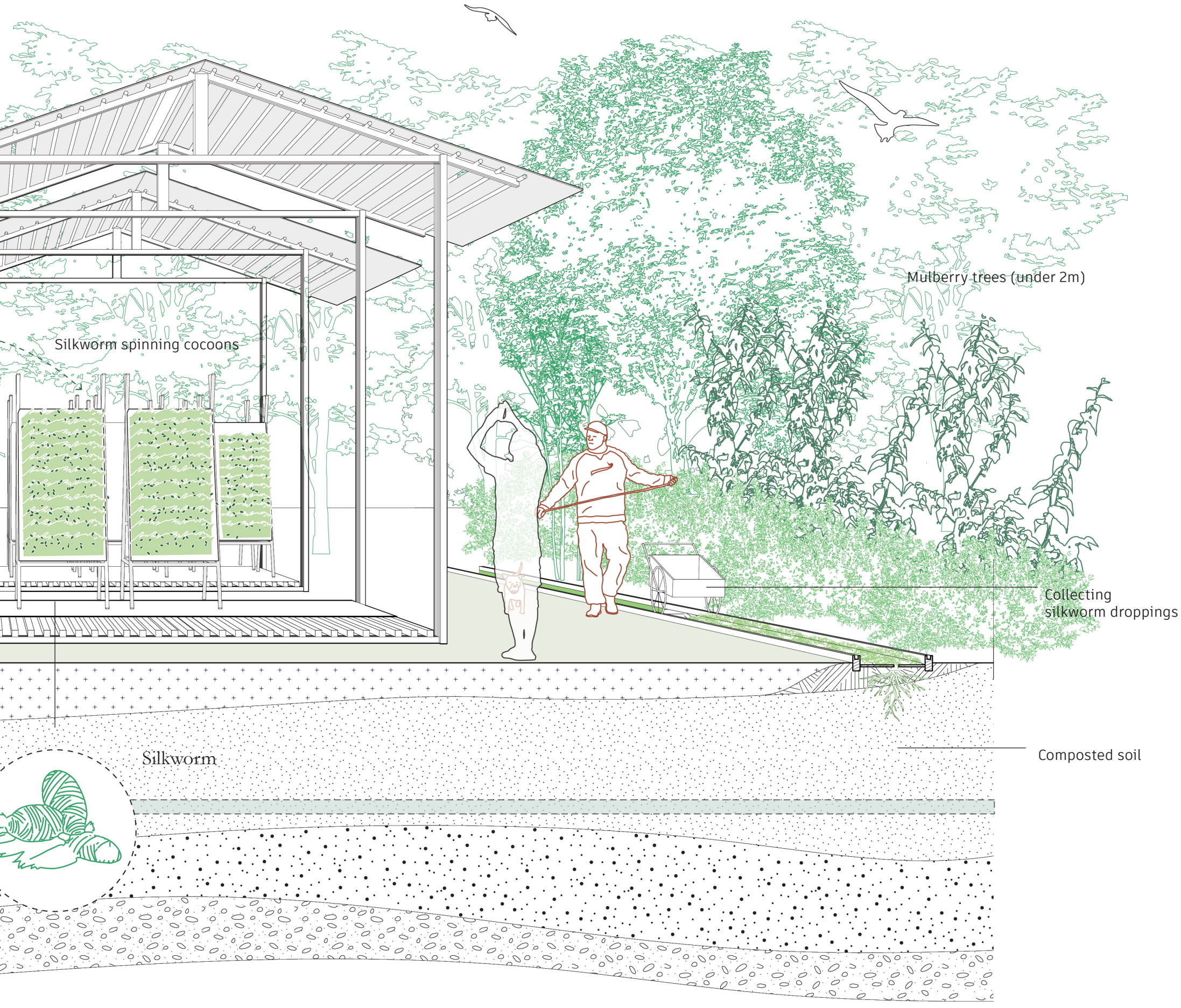

Mulberry trees (>12m)
Mulberry trees (6m)
Rain water collection
Composted soil
Rocks for construction
Shade-loving and moisture-loving plants
Insects hole

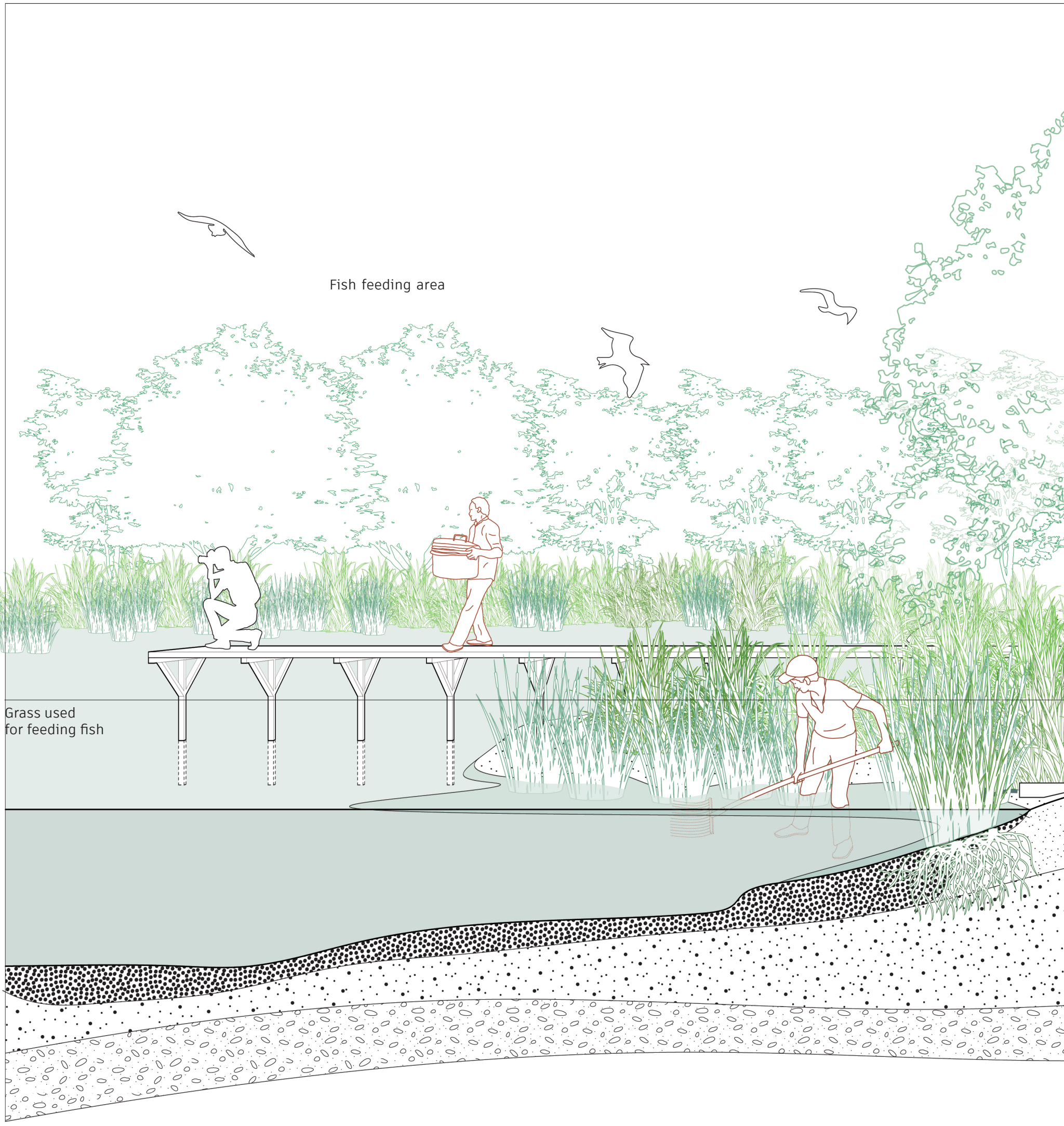

Buffer zone
Reeds

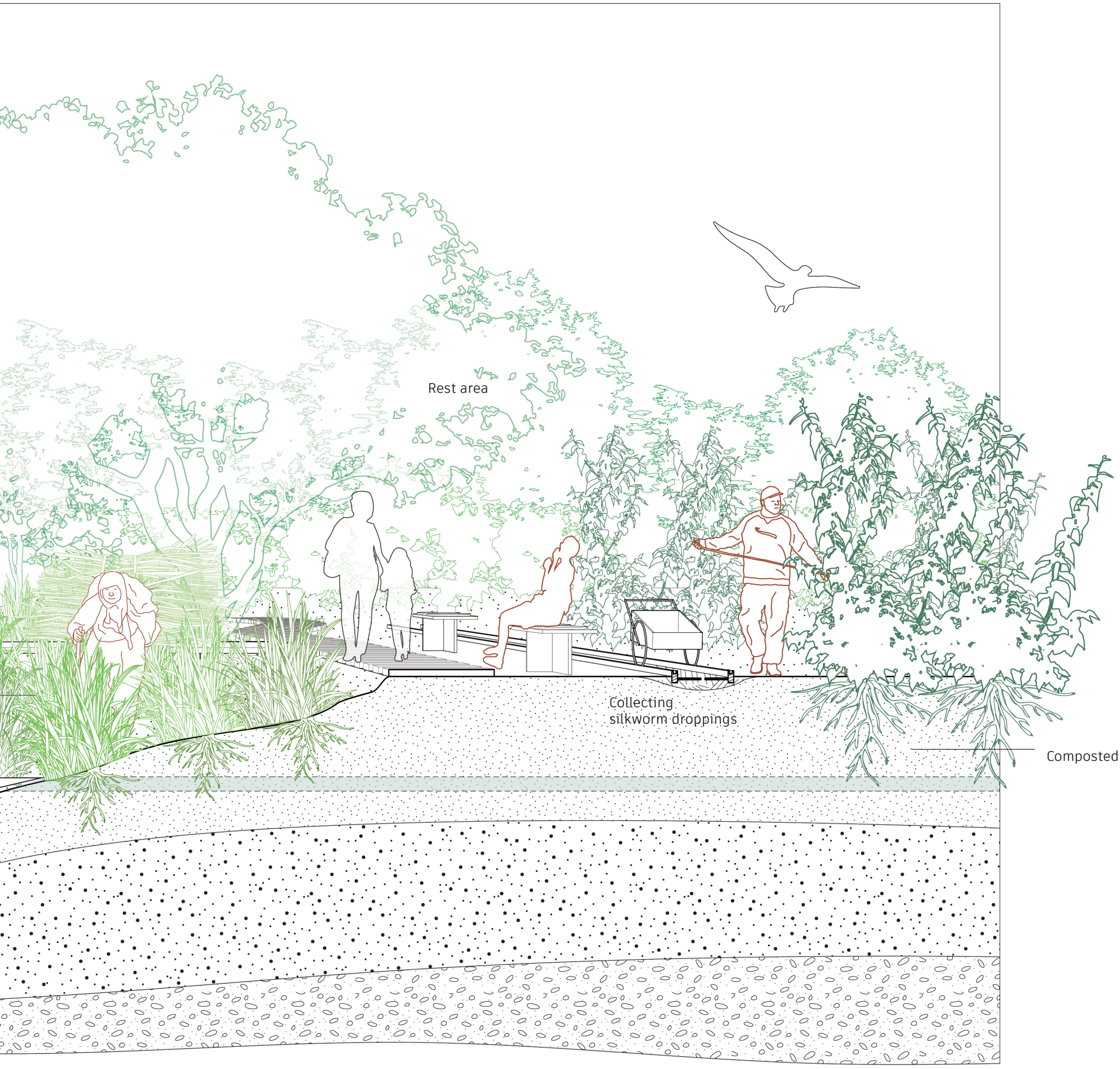

Leaf collection
Ground cover plants


Mulberry leaves
Mulberry trees (under 2m)
Composted soil
Pipe system
Small ditches
to prevent waterlogging
in planting soil


Grass used for silkworm cocoon spinning


Silkworm spinning cocoons
Mulberry trees (under 2m)
Collecting
silkworm droppings
Composted soil
Silkworm


Fish feeding area
Grass used
for feeding fish


Rest area
Collecting
silkworm droppings
Composted soil

Design Feasibility:
Urgency, Community Support, and Established Foundations

This design aims to address an urgent pollution issue in the region. On the surface, the pollution might not appear severe; however, the contamination of water bodies has led to fish consumed by local communities containing harmful substances, posing significant public health risks. More importantly, the economic costs of pollution are often indirect: polluters do not pay directly for the damage caused. Instead, these costs are borne through extensive use of chemicals, high electricity consumption, and increased land rents driven by wastewater treatment requirements. These hidden expenses eventually transfer to the local economy and ecosystem, resulting in severe resource wastage and ecological degradation, causing substantial long-term losses. Therefore, timely and effective remediation measures are imperative.

At the policy level, the government maintains a proactive stance toward ecological protection and green development, emphasizing the importance of sustainable development and environmental governance. If our design can successfully integrate ecological restoration with income generation, it will not only enhance the social benefits of the project but also significantly increase the potential for collaboration with governmental agencies and access to public funding. This support is crucial for the project's long-term implementation and scalability.

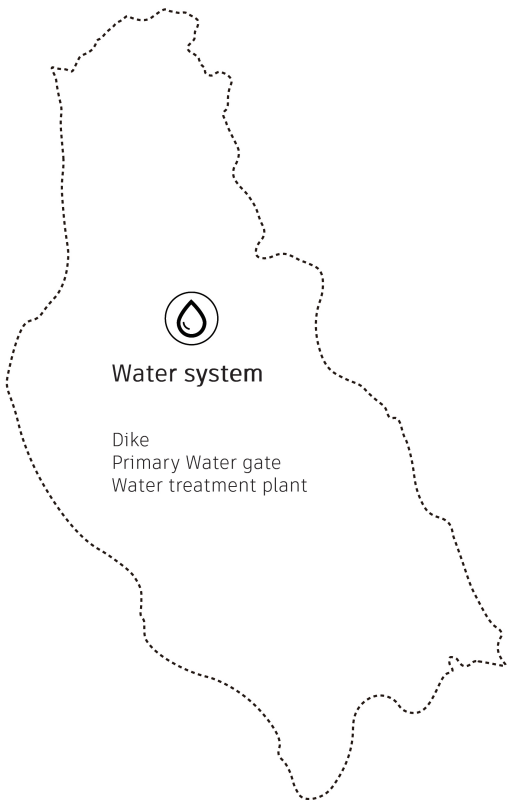
The design employs a phased and tiered implementation strategy, especially focusing on meso- and small-scale interventions, avoiding large-scale construction from the outset. By advancing gradually with continuous optimization and adaptation, the project ensures that each phase meets both ecological and social needs effectively. Moreover, the project actively mobilizes and relies on local community participation, which fosters a strong sense of ownership and responsibility, reduces dependency on external resources, and controls the scale and risk of construction efforts. Most importantly, this approach generates significant employment opportunities, providing stable income sources for local residents and promoting sustainable socio-economic development.

Additionally, the design respects and leverages existing traditional water management systems and land-use practices in the area. This not only preserves local cultural heritage but also utilizes existing ecological infrastructure, creating a win-win situation for cultural continuity and ecological function restoration. The organic integration of traditional dikes and fish ponds offers a solid material foundation for ecological rehabilitation while enriching the community's cultural life.

In summary, with a clear understanding of urgent problems, proactive policy support, phased implementation combined with strong local engagement, and reliance on traditional foundations, this design presents a highly feasible and valuable model for sustainable development and replication.

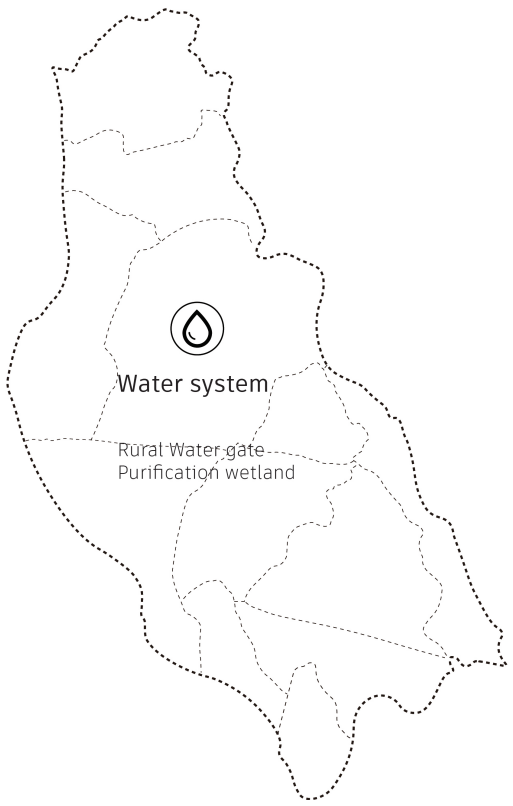
Centralized management

Regional implement and management

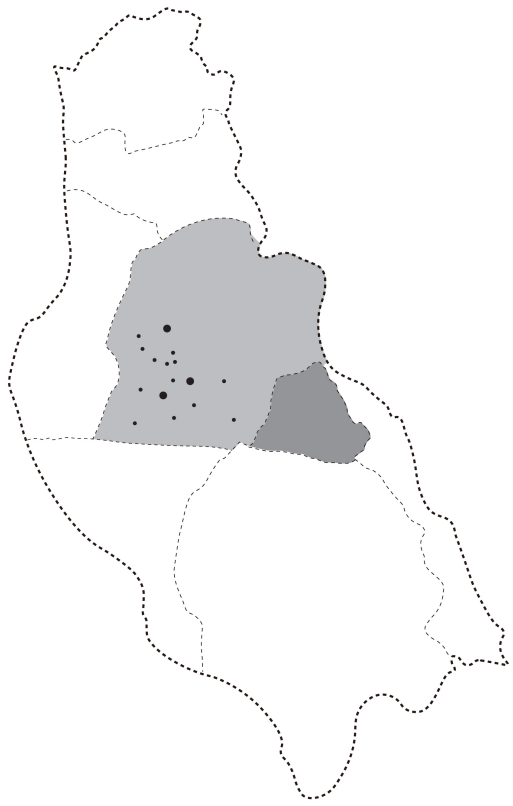


Transformation in water management component

in different time periods



Implement with the coorperation with local residents





Reflection

6.1 Significance and Innovation

6.2 Research Limitations and Challenges

6.3 Future improvement

6.4 Delaration of AI use

Significance and Innovation

Significance

Focusing on the traditional mulberry-dike fish pond system and its flooding control- irrigation infrastructure, this project emphasize the multiple values of this traditional production landscape in a contemporary environmental and social context. Its significance can be understood in the following dimensions:

First, the project emphasizes the ecological, cultural, and social values embedded in traditional water systems. In the context of highly intensified agriculture and rapid urban modernization in China, production landscapes are often reduced to a single productive function, leading to the degradation of ecological services and the loss of cultural connections. By reconstructing the spatial logic of traditional water systems and monocultural dike-fish ponds, this project aims to reawaken public ecological awareness and cultural identity, restoring interactive relationships between people and nature.

Second, the project provides a practical and sustainable response to the pollution problems found in the current dike-fish production landscapes. By integrating local knowledge and ecological design strategies, it offers effective solutions for water quality and soil restoration, creating a replicable model for other regions facing similar challenges.

Third, the project seeks to improve the livelihoods of local residents through a comprehensive approach. It addresses the Improvement of living spaces and public environments, improves food safety, restores ecological and leisure spaces, creates opportunities for local production-based employment, and re-empowers communities in the management of water system and landscape resources. This people-centered strategy strengthens the project's social resilience and long-term viability.

Finally, through a multi-scale landscape design approach, the project establishes a sustainable spatial system that links regional planning with localized interventions. This coordination across spatial layers offers a more adaptive and effective mode of operation, addressing the complex interplay between hydrological dynamics, ecological restoration, and human habitation.

In conclusion, this project goes beyond heritage preservation. It serves as a forward-looking spatial experiment that demonstrates how landscape architecture can integrate ecological regeneration, cultural continuity, and community participation to shape a more sustainable future.

Innovation

Resonance with the Concept of "Everyday Heritage"

Although this project did not explicitly adopt the concept of "everyday heritage" as its theoretical starting point, its design process aligns closely with this idea. "Everyday heritage" emphasizes that the value of heritage lies not only in its historical forms or non-human elements but also in its ongoing everyday use and continual reinvention of functions and meanings. This project does not strip away production activities for the sake of ecological restoration or cultural display. Instead, it regards "production" itself as an integral part of heritage value. Through the selection, renewal, and system reconstruction of the mulberry-dike fish pond system, the project strives to achieve a renewed internal synergy among ecological, productive, and cultural values in contemporary expression. This focus on how heritage is "used in the present" injects dynamic sustainability into traditional agricultural landscapes.

From "Shallow Participation" to "Deep Empowerment"

In contemporary landscape design, public participation is often limited to formal information gathering, scheme consultation, or the provision of educational panels and recreational spaces—passively serving the "public use" demand. This project attempts to move beyond this paradigm of "shallow participation" by deeply responding to the real roles of community residents in production, daily life, and environmental governance.

By redesigning traditional water management systems and fishery spaces, the project renrew the local residents' agency and participation rights in water management, production planting, and spatial usage. \This deeper level of intervention is not merely "designing for the community" but "co-constructing with the community," highlighting new possibilities for landscape design in social negotiation and local autonomy.

Addressing Water System Restoration from a Social Perspective

Traditional water system restoration designs tend to focus on ecological processes or natural recovery, such as improving water quality, rebuilding wetlands, or restoring habitats for flora and fauna. However, this nature-centered technical approach often overlooks the complex relationships formed by long-term interactions between water bodies and human societies and underestimates the direct impact of social behaviors on water environments.

This project starts from the interaction between society and water, emphasizing the positive role of productive activities, daily behaviors, and spatial management methods in promoting water system restoration. For example, whether residents can continuously use and maintain a particular water ditch or consider ecological spaces as part of their production and daily life directly affects the water system's ability to function ecologically.

Therefore, the project not only restores "healthy water bodies" in an ecological sense but also rebuilds the relationship between people and water and revitalizes the role of water system in social spaces. This focus on the "sociality of water" reflects a design-level response to the theory of the "sociology of water"—namely, that the sustainability of water system cannot be maintained solely through ecological engineering but must be achieved through the joint efforts of social structures and cultural practices.

Research Limitations and Challenges

Limitation

This project faces significant problems in data acquisition and information integration. The internal water system of the Sangyuanwei area is complex and has undergone multiple modifications and updates throughout history, which makes consolidating data particularly difficult. Although many studies have summarized aspects of the region, these works focus on different themes and vary in the detail of information provided, resulting in challenges for re-reading, comprehending, and integrating the literature comprehensively.

Consequently, existing spatial water management data are extremely fragmented and difficult to unify. Precise data on land use, waterbody distribution, and water quality lack a centralized public access channel; some of this information remains inaccessible due to private ownership, inevitably causing errors in spatial analysis. Furthermore, most existing water management records are available only at large scales, with a significant lack of detailed small-scale spatial data, leaving substantial gaps in understanding and reconstructing local water networks. While historical maps offer valuable references, the considerable differences between ancient cartographic techniques and modern mapping methods often result in large positional inaccuracies, further complicating data use and introducing uncertainty.

Regarding fish pond management and the environmental impact of production wastewater, there is an absence of systematic direct monitoring data; existing information mainly comes from government-issued remediation announcements, news reports, and limited interviews, which means that the classification of fish pond types and assessments of ecological impacts based on these sources still have considerable room for improvement. In addition, the research area is covered by a wide range of academic and local literature with diverse and sometimes conflicting viewpoints, making it difficult for the researcher to fully and systematically grasp all available information. Many early local historical studies contributed little to spatial mapping, so maps inferred from these sources may contain omissions or inaccuracies. Conducting research from abroad has limited the possibility of sustained fieldwork, restricting the researcher's ability to deeply understand and experience the local residents' culture, social activities, and psychological perspectives, relying instead on indirect channels such as literature, audiovisual materials, and interviews. Finally, the vast majority of core materials are in Chinese, including classical Chinese texts, which pose significant challenges for a non-native speaker in accurately translating and synthesizing into English, thus hindering international dissemination and academic communication.

Challenges

The project's design framework is highly complex, encompassing ecological restoration, social participation, production management, and economic sustainability, and therefore constitutes a multidimensional, interdisciplinary framework. This complexity requires the researcher to set clear objectives, balance diverse demands, and exercise effective planning and decision-making, so that effort does not become scattered and the core issues remain in focus. Design interventions occur at multiple spatial scales, from regional ecosystem restoration to the fine-grained management of individual production units; each scale therefore needs explicit goals, strategies, and implementation pathways, and the links between scales must be well articulated to prevent gaps, overlap, or vague solutions that fail to address concrete spatial problems.

During the research process, extensive early-stage literature review and data collection consumed considerable time, leaving the overall framework insufficiently refined and necessitating substantial revisions later—an especially acute issue given the limited timeframe of a master's thesis. Although the project prioritizes community social life and participation—emphasizing local residents' agency in water-management and day-to-day production—the researcher is not a native of the area and lacks direct experiential knowledge and cultural immersion. Consequently, it is difficult to attain a full understanding of residents' social behaviors and motivations, which inevitably constrains how precisely the design can meet authentic community needs.

Time and resource constraints pose an additional major challenge. As a master's-level study, it is not feasible to conduct prolonged fieldwork or engage in multiple rounds of community feedback, limiting both the depth and breadth of the investigation. In sum, the central difficulty lies in striking a balance between the project's many objectives and the limited resources available—focusing research priorities and advancing the project in a systematic, evidence-based manner. Meeting this challenge is not only essential to the project's success, but also a crucial test of the researcher's overall capabilities.

Future Improvement

Firstly, there is considerable room for improvement in the acquisition and accuracy of spatial data. The current analysis of land use, water quality, and local water system structures largely relies on open-source data and satellite imagery, which limits the precision of spatial interpretations. Future efforts could focus on establishing collaborations with local government agencies, water management departments, and research institutions to obtain more detailed and authoritative datasets. Additionally, integrating advanced spatial technologies such as drone surveys and LiDAR, combined with on-site investigations and water quality monitoring, would significantly enhance the accuracy and relevance of spatial analysis and design interventions. Creating a unified geographic information database would also facilitate better integration and comparison of data across different temporal and spatial scales.

Secondly, deepening the understanding of the site's social and cultural context is essential. This involves systematically reviewing local gazetteers, historical records, policy documents, and supplementing these through visits to local museums and heritage sites to gather first-hand information. Where possible, conducting phased field studies with long-term observations of local production, daily life, and seasonal cycles would provide valuable insights into community rhythms and needs. Furthermore, increasing direct community engagement through participatory mapping, focus group discussions, and other inclusive methods can strengthen the responsiveness of design proposals to local voices and lived experiences.

Thirdly, there is significant potential to expand research on the classification and ecological assessment of fish pond systems. Current categorizations are primarily based on literature reviews and field observations but lack systematic empirical support. Future studies could develop a more refined classification framework by considering ownership structures, management practices, and pollution discharge patterns, supported by GIS-based modeling and visualization. Incorporating in-situ monitoring data such as effluent water quality and biodiversity indicators would improve the credibility of ecological assessments and provide more precise foundations for design interventions.

Finally, the project's implementation process could benefit from increased phasing and flexibility. Given the constraints of time, resources, and policy environments, dividing the project into short-term pilot phases, medium-term expansions, and long-term integration stages would facilitate gradual progress. Introducing regular evaluation and feedback mechanisms would enhance the project's adaptability to uncertainties such as climate variability and institutional changes. Concurrently, fostering community capacity building through training and knowledge exchange would support the sustainability and social impact of the interventions.

In summary, continuous improvements in spatial data acquisition, contextual knowledge deepening, systematic classification and modeling, and phased implementation will collectively enhance the academic rigor and practical relevance of this project, contributing to more targeted and resilient landscape strategies.

Declaration of AI use

Artificial Intelligence (AI) tools were utilized during the preparation of this thesis in a limited and supplementary capacity. Specifically, AI-assisted services were employed to enhance the clarity, coherence, and academic tone of selected written passages through language refinement. In addition, AI was used to support the translation of specific content from Chinese to English, particularly in cases where linguistic precision and consistency were required. These tools functioned solely as linguistic and editorial aids. All substantive content, including the formulation of research questions, methodological design, data analysis, critical argumentation, and conclusions, represents the original and independent work of the paper.





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