Synergy through Water, Land and Forestry Systems

Towards evolutionary socio-ecological resilience in Red River Delta, Vietnam

Zhongjing Zhang

TU Delft, June, 2021

Synergy through water, land and forestry systems
Towards evolutionary socio-ecological resilience in Red River Delta, Vietnam

Zhongjing Zhang(5082358)
Transitional Territories Studio, 2020-2021

Delft University of Technology
Faculty of Architecture and the Built Environment
Department of Urbanism

First Mentor: Diego Andrés Sepulveda Carmona
Second Mentor: Daniele Cannatella

June 2021

Abstract

The formation of this triangular land and lasting cultivation upon it has transformed the Red River Delta into a highly anthropocentric rice-based delta. The delta area is affected by climate change variability as externalities, a fast and persistent urban expansion and environmental degradation presenting an increasing socio-ecological vulnerabilities, involving- biodiversity loss, water stress (mainly pollution and flooding), and social spatial fragmentation. These phenomena increase future uncertainty and local informality, the project calls for an acknowledge and awareness of the presented systems complexity of this typical monsoon Asian country under such risks.

The proposed project focuses mainly on the potential synergy between topos and habitat- flux, translations, and diversity. It is composed of a cycle of reviewing, reorganizing, and resonating, with recasting existing vernacular adaptation strategies. A combination of methods- sections, multi-scalar approach, evaluation frameworks, and dynamic pathways- is used to explore systemic thinking of water consumption, urban occupation, local culture and land cultivation in the area. The possibilities proposed by the project are constructed in order to facilitate an integrated resource co-management through adaptive governance, as to understand evolutionary systems of water, land, and forestry within. By exploring systemic interdependencies in and across systems and stakeholders, the exploratory cycle from local to regional scales by landscape transformation and socio-ecological evaluation reveals a revised relationship with the ground towards socio-ecological resilience.

Motivation

/ Culture dimension of climate change and adaptation
/ Heritage conservation
/ Traditional ecological knowledge

My interest lies in the cultural heritage of adaptation in rural landscapes. I want to focus my research on how to integrate agricultural heritage into spatial development strategies, and ultimately find a balance between tradition and modern. I'm specifically interested in how the intangible indigenous culture and knowledge- origin of humanity- can contribute and be integrated with processes of urbanization, especially in the areas where nature being highly manipulated by human. What we can learn from them of low cost but high efficiency, interacting more with nature and maintaining diversity. What new opportunities we can give them as developing a new ecology of culture and landscape, meanwhile building our common future with purity as well.

Static and dynamic views and conditions of Red River from upstream to downstream

Source: Screenshot from Google Map and *Forgetting Vietnam*. Trinh Minh-ha, 2015

Stepping outside of positivist epistemological structures; learning from the past, the locals, and distant cultures and displacing East-West, local global, and modern traditional binaries, the critical vernacularists have produced 'third spaces' for the creation and expression of local modernities.

- Nihal Pereram, Transforming Asian Cities

Acknowledge

to my dear mentors, Diego and Daniele, guide and inspire me through the whole journey patiently

to Taneha and Luisa, always support the studio with enthusiasm and explore a new way to think and express critically

to Marijne, Lucas, Janis, Kinga, Asmita, Hadrian, Jurrienne, Cas and Laura, with all your beautiful works, always enlighten me with surprise and new perspectives of seeing things

to Juliette, Reza, Dinh, Jiaxin, and director Trinh, for your passion to share the knowledge of Vietnam with me

to Ela and Kelvin, to meet talent you at the very beginning of studying in TUD and the continuous accompany

to Divya and Federico, for the full-time academic English writing support and free coffee sponsorship

to Siteng and Jiayao, my honor to have you as my roommates who see most of the mad moments I went into, allow and encourage me to share and discuss together adding new perspectives

to my mom, dad and grandparents, you're always my backbone, no matter the distance

Table of Content

Source: Screenshot from *Forgetting Vietnam*. Trinh Minh-ha, 2015

1 INTRODUCTION

Context - Red River delta

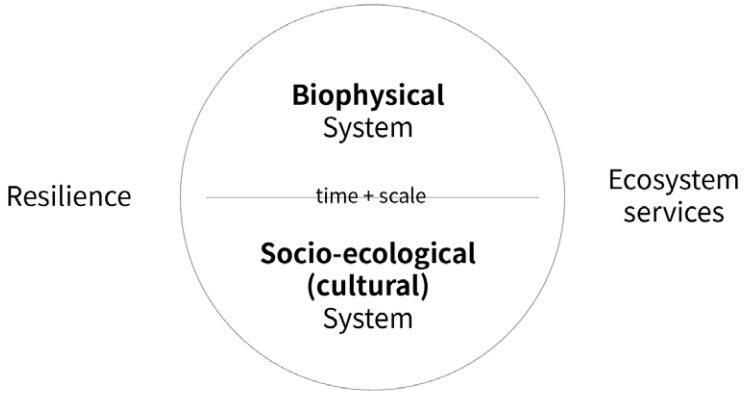
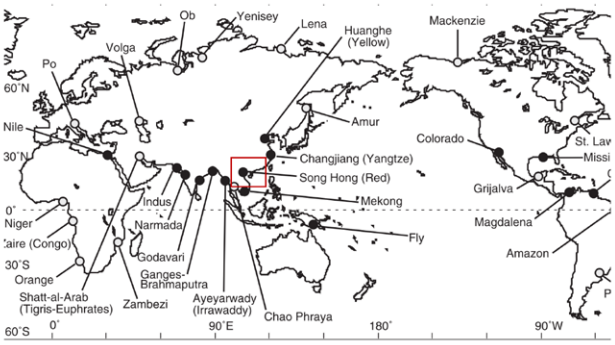


Fig 1.1 Integrating biophysical and socio-ecological aspects through space and time
Elaborated by the author

INTRODUCTION

The thesis project follows the idea of understanding the **risk and vulnerabilities** formed by complexities of biophysical and socio-cultural variations, thus further the evolving roles and actions of human in ecosystems and potential interaction for rehabilitation and robustness. Especially in developing country, most people highly depend on natural resources and transform natural landscape into highly human-occupied environment, deeply embedded in the root of culture. The growing **urbanization and exploitation of resources** are changing natural composition like habitats and riparian communities, while land intensification and conversion within limited space or on best soil are disturbing and diminishing the diversity of original continuity of both habitats and landscape. Local facts and externalities like socio-cultural fragmentation and climate change can lead to **de-synchronization and ecological degradation** in dynamic processes within scale and time.



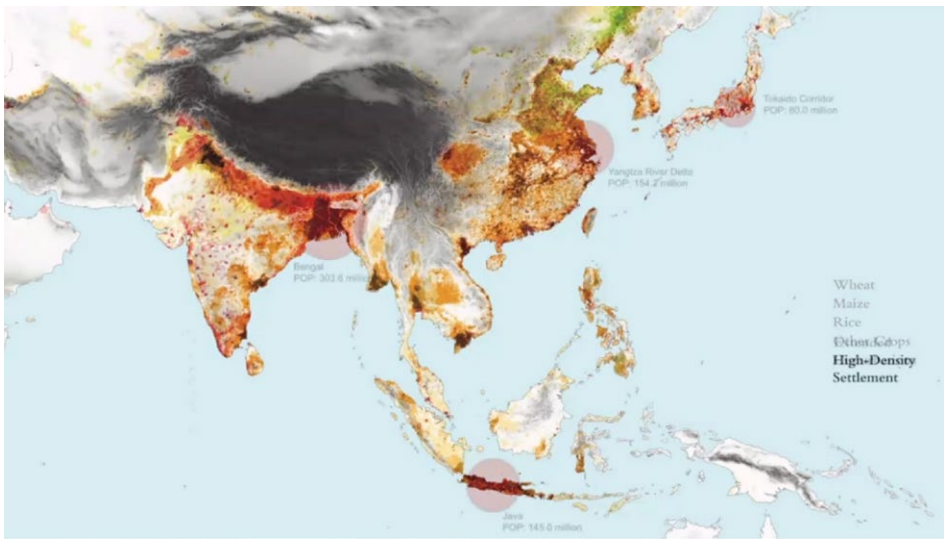


Fig 1.2 Location of the Red River Delta
Base map from Hori and Saito, 2003

Fig 1.3 Material from Cairns, Stephen. Agropolitan, Bioregion, Their settlement system: Urbanization after city. 10 Mar. 2011

Fig 1.4 Tracing the hurricane and tropical storm (2019-2012) rce: Pham, 2012; VNA3/BTL 78, 1960

CONTEXT - RED RIVER DELTA (RRD)

Vietnam

Tropical monsoon

Delta

A rice bowl

About

Red River Delta is located in Southeast Asia, of tropical monsoon climate. It is one of the major larger rivers' mouths in the world with a high sediment load. Due to the sedimentary geology and aquifer, the delta has developed historical crop cultivation and a high density of population and occupation. Meanwhile, there's also a high frequency of external climate risks that bring devastation. The trend is that the climate issues are moving in the south direction and become more frequent in the delta.

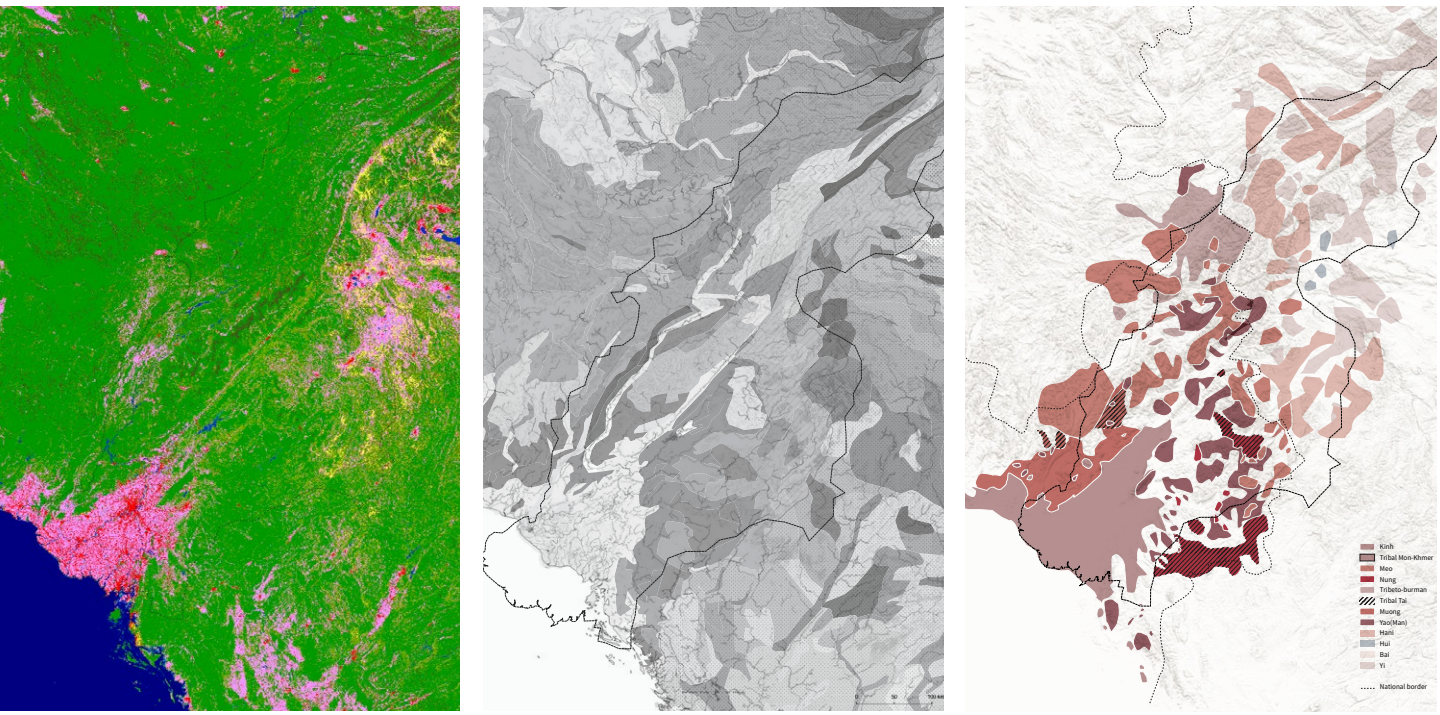


Fig 1.5 Land use, water erosion and ethnic distribution map of Red River Basin
Source: made by the author, combined data from OSM, Corponicus, ISRIC, and Wikipedia.

'The landscape in the Red River Delta is not only manipulated by humans but entirely transformed by humans.'
- Le Ba Thao, 1997: 323-31

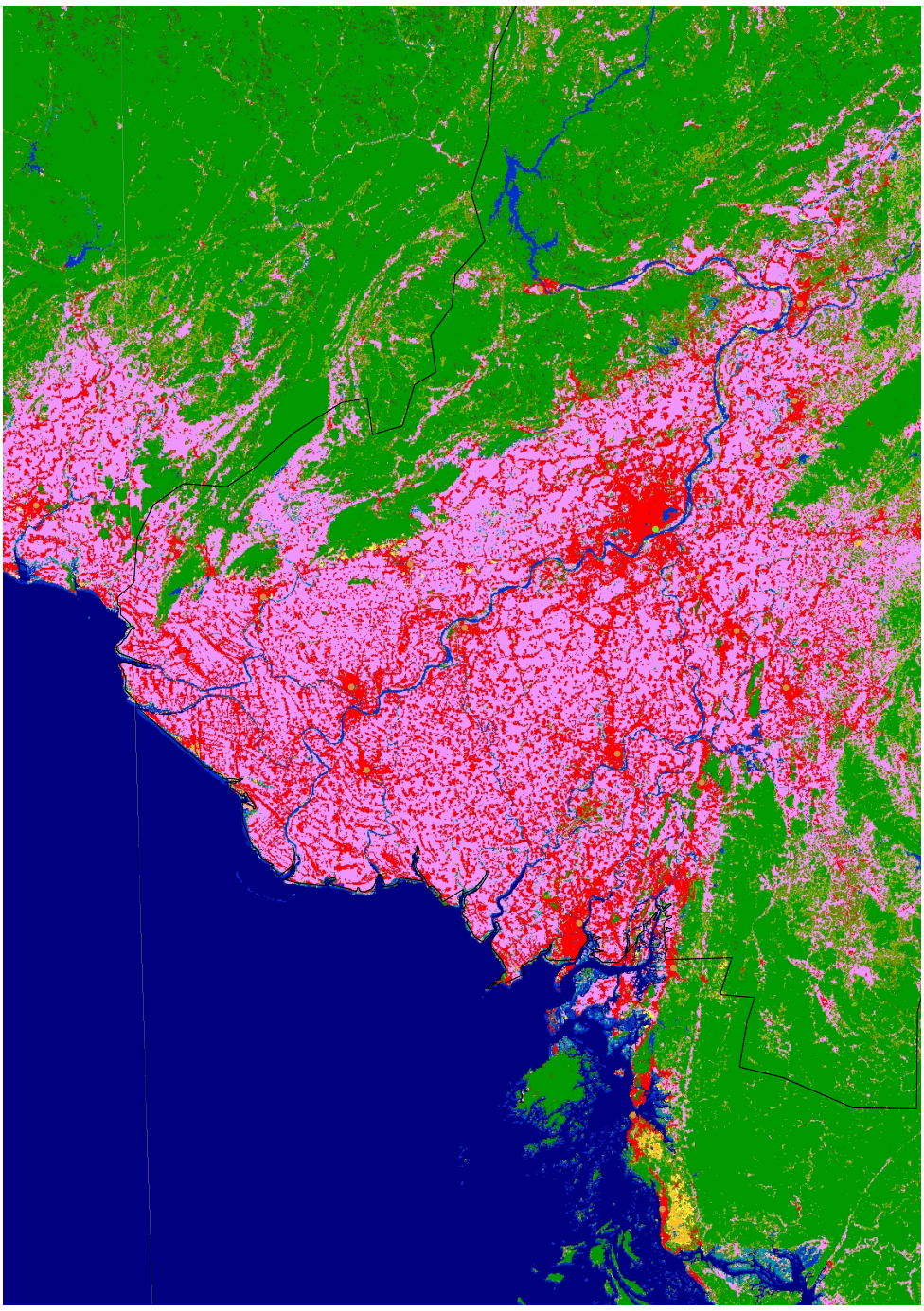
Territorial Water Basin

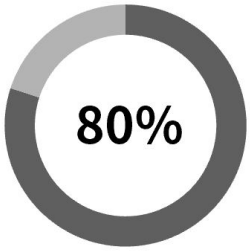
Red River origins from the mountainous area in China and runs east-south into Northern Vietnam and ends in the Gulf of Tokin. Along this transboundary river basin presents significant changes in the degree of urbanization and development, the extent of water erosion following the main waterways, and the distribution and size of diverse ethnic groups communities. This shows the impacts of geology on both environmental and socio-cultural development of the upper and lower reaches of the basin.

Fig 1.6 (right)
An overview of resource usage for production
Source: elaborated by the author, combined data from Corponicus 2019, Wikipedia and ADB, 2000.

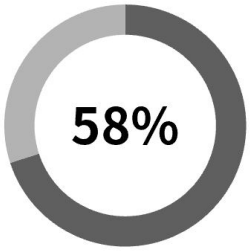
Delta Of Significance Of Monsoon Asia

The invisible rapid and intense urbanization and occupation has been embedded in the land use map, presenting mainly the use of built-up and cropland in this flat delta region. The unique characters inside are the traditional rice economy requires yields and resource consumption like water for irrigation, land for cultivation, and intensive labor.

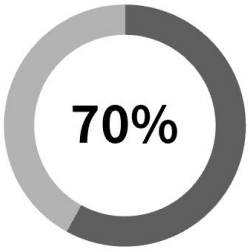




Annual water consumption for irrigation



Land use for agriculture



Workers in agriculture sector

'I got a bank loan to set up an aquaculture farm, but I didn't know anything about aquaculture. When all the animals died I couldn't make money. I got more bank loans to pay my debts hoping that the animals would return…but they never did. I had to sell everything at a cheap price and now life is a struggle.'

- from a local interview, Steven et al., 2015.

2 PROBLEMATIZATION

Problem fields

Problem statement

Research aim and outcomes

Main research questions

Working hypothesis

Fig 2.1
Red River Delta Flood 1971
Source: globalenergy-news, 2019

Fig 2.2
Waterflow abandoned in division area as pollution container
Source: Pham and Shannon, 2021

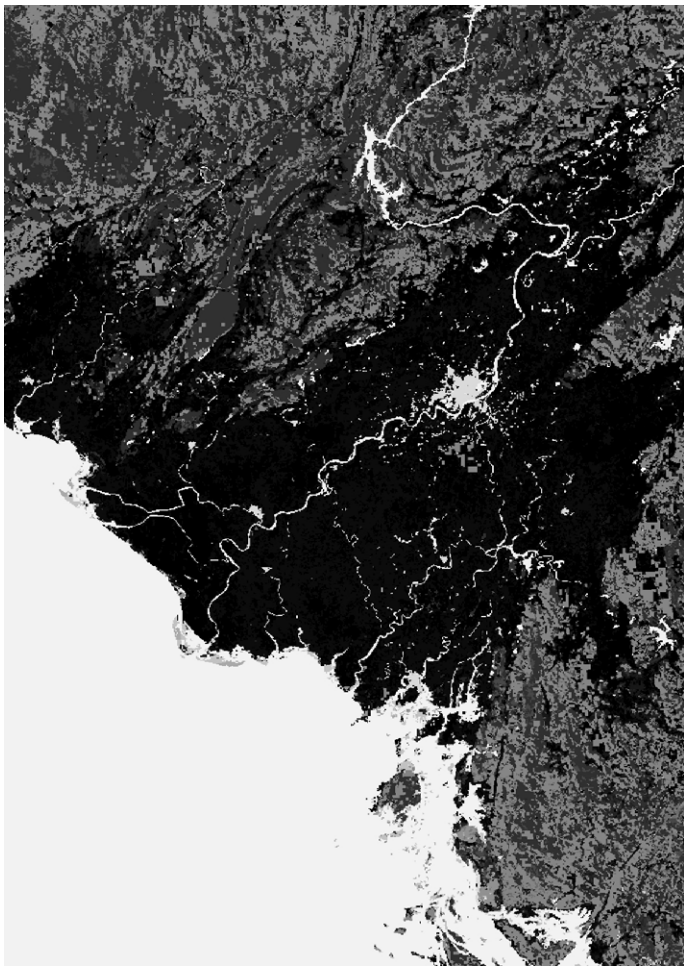
Fig 2.3
Eutrophication in a commune pond
Source: Google street view, 2019

PROBLEM FIELDS

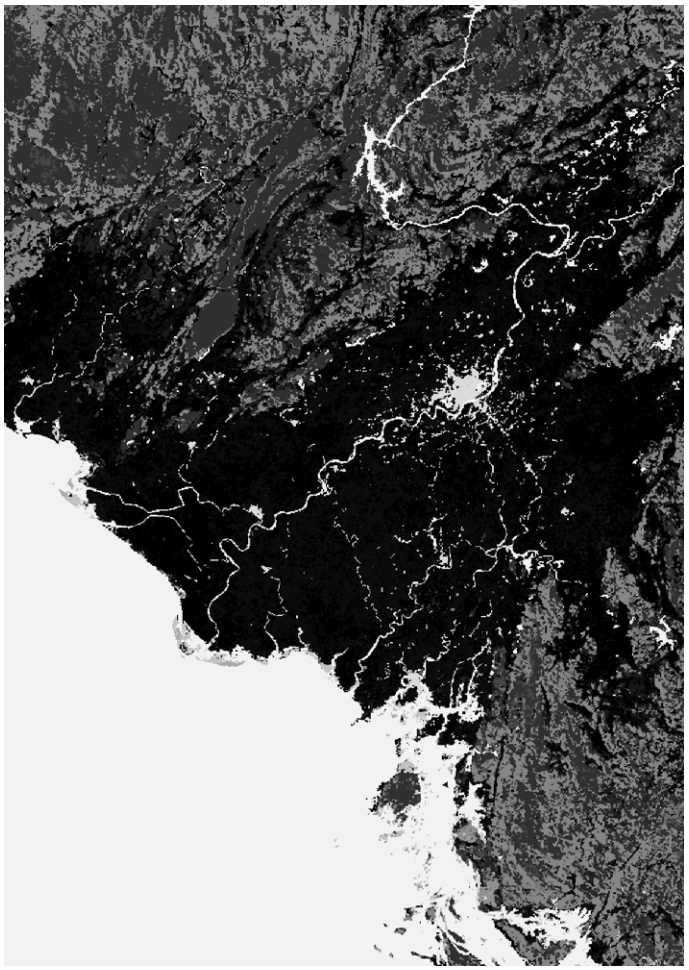
Water Issues

The rainy season floods partly depend on upstream emissions which are gradually becoming extreme year by year, increasing in the rainy season and reducing in the dry season. This results in huge changes in downstream water volume; if there is no emergency diversion area in advance, it will cause damage to downstream properties and lives. Access to security poses a serious threat.

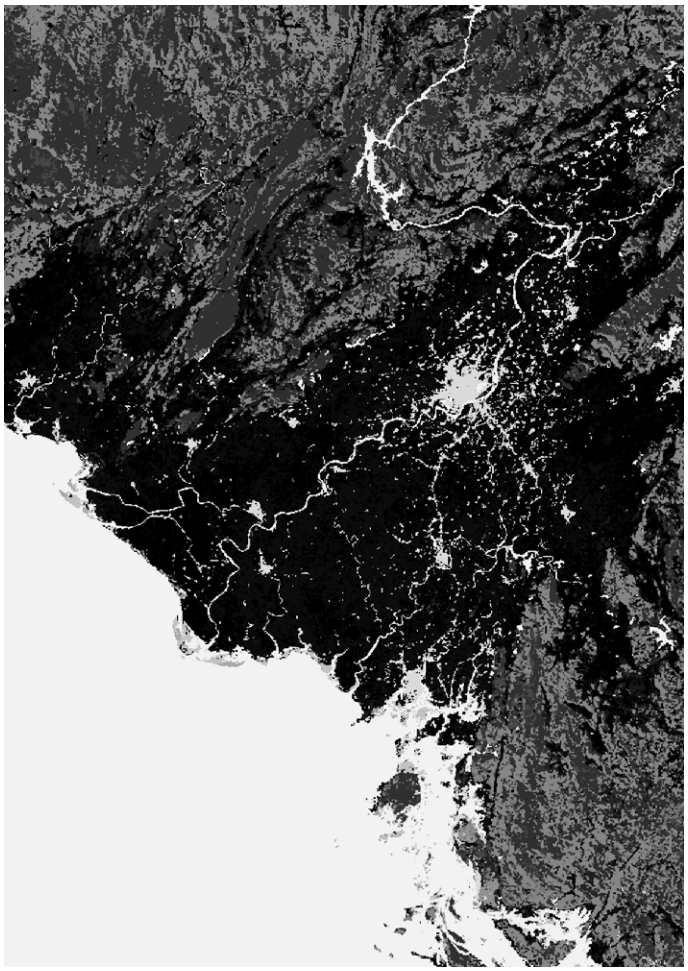
Artificial changes to the river course can easily cause some water bodies to become static and less hydrodynamics, not to mention a large number of informal exploitation of water sources. The lack of management of public infrastructure, including community ponds or sluices can deteriorate the quality and flow of water bodies. Directly discharged wastewater will exacerbate the degradation. From a biogeographical perspective, these places can be vulnerable to overflow from floods- an accumulation of static water bodies, influencing riverine biodiversity and the health of surrounding residents. To take irrigation water as an example, 80% of the annual use is mainly distributed by the government and companies by surface water regularly through canals and channels. Besides those informal private extractions from nearby rivers or shallow groundwater, these accessible water sources are also closely related to pollutants from such as domestic laundry waste and agricultural fertilizers.



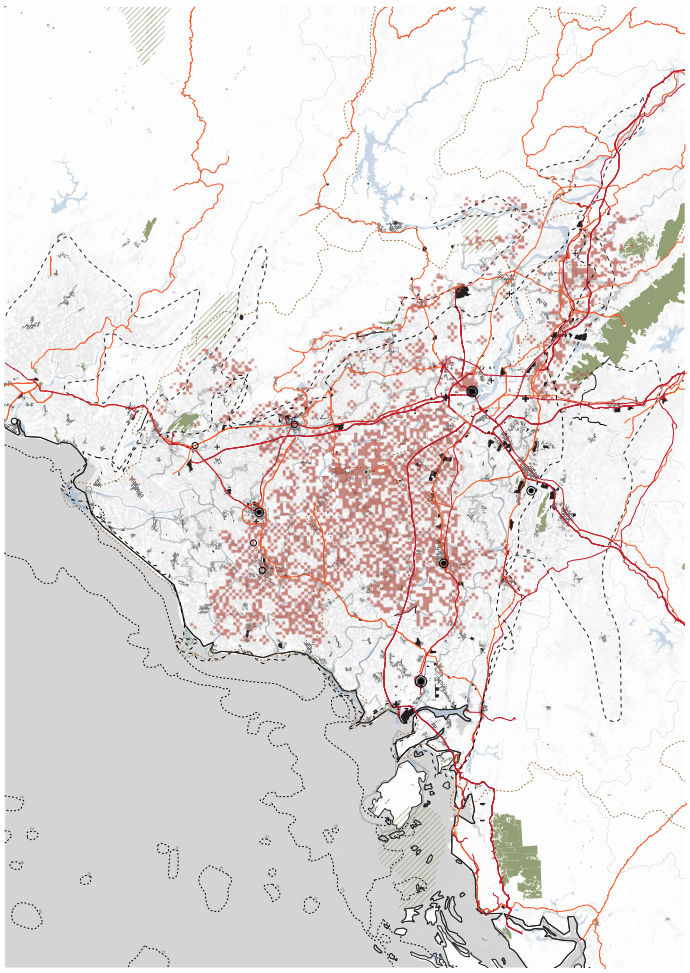
1995



2005



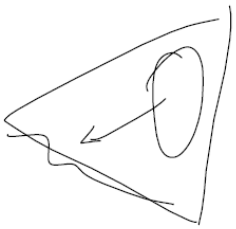
2015



2030

Fig 2.4 Changes of land cover of the Red River Delta through time. Source: esacii and van Dijk et al, 2013

→ N



A quick translation showing the trend of future expansion towards the coast.

Land use change by land class and scenario, 2007-2030					
	2007	2030-HCI		2030-HEG	
	km²	km²	change(%)	km²	change(%)
Paddy rice	53,462	41,434	-22	41,362	-23
Other agriculture	52,802	51,775	-2	46,941	-11
Production forest	74,858	100,498	34	105,429	41
Non-production forest	61,640	54,543	-12	45,246	-27
Shrub and grassland	62,986	50,401	-20	50,375	-20
Built-up areas	8645	15,742	82	25,039	190
Other land	18,517	18,517	0	18,517	0
Total	332.910	332,910	0	332,909	0

*HCI- High Climate Impact, HEG- High Economic Growth;
*BAU- Business as Usual, the result of which similar to HCI scenario;
*The other land also covers protected area, such as small tracts of paddy rice and other agriculture and shrub land.

Table 2.1
Scenario for 2030 and land use change projection
Source: Van Dijk et al, 2013

Urban Expansion

The Red River Delta occupies about one-third of Vietnam's population (about 23 million) (WB, 2019), and its growth rate is about 2.1%. According to the historical changes in land use cover, the delta shows a trend of dispersing road-based urbanization. Under 2030 scenario of High Climate Impact (HCI) (Van Dijk et al., 2013), a large amount of central farmland will be converted into urban use, by expanding infrastructure and original settlements. Industries will mainly develop along with the influence between upstream China, through peri-urban Hanoi, till the port at the coast. This trend implies an overall food security issue of the region and the income and livelihood of certain local household groups. More informality of economic production and uncertainties of management might emerge. In addition, the resource in-and-out relation between urban and rural will aggravate the unsustainable production methods in rural areas where lacks sufficient infrastructure asccessibility, making cities one-way extraction but unable to guarantee the quality of life for the rural;

At the same time, urban development also has an impact on the hydrological cycle. Surface changes will increase runoff and influence evapotranspiration. Limited agricultural land will increase cultivation and reclamation and reduce land permeability and accumulate negative nutrients.

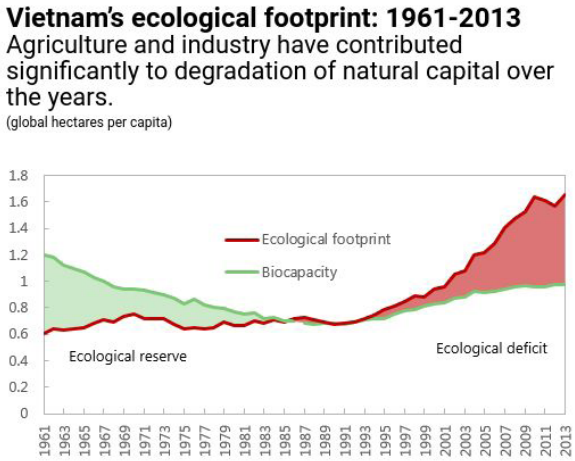


Fig 2.5
Vietnam's ecological footprint: 1961-2013
Source: Global Footprint Network

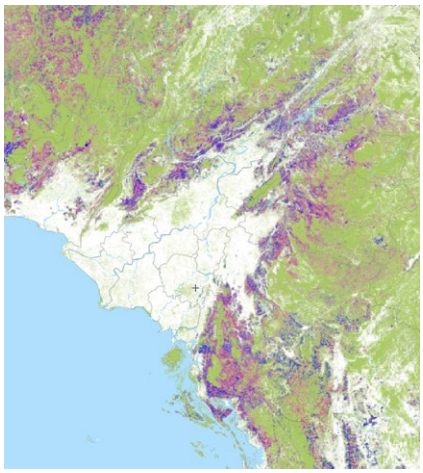


Fig 2.6
Forest condition
Pink as deforestation, blue as afforestation
Source: Global Forest Watch, 2016

Forestry Initiative

According to a report by the Asian Development Bank, Vietnam has experienced a sharp increase in its ecological footprint and shows a deficit in its biocapacity. Southeast Asian neighbors such as Malaysia are facing such problems as well. The reasons for the increase in ecological footprint including intensified paddy field cultivation releasing methane and absorbing chemical fertilizers, thermal power still as the main energy source, and other inefficient resource consumption.

The government's awareness of ecological restoration is reflected in the establishment of the Ministry of Natural Resources and Environment and its participation in the Paris Agreement 2015, and part of the goal aims to reduce greenhouse gas emissions to reduce global warming. Although the agroforestry system is currently receiving attention in the country because of its economic value, the resilience of forestry which can help both human society and nature to bounce back from external disturbances on resource or energy flows has been less aware. The values of a combination of agriculture and forestry can be about the process of soil and water restoration, the secondary forest products that can support the local, and the value to livestock and dairy products. The diminish of forests or wetlands by urban or crop use can increase the footprint, making the region less resilient. Besides, the current state of development of the country also needs a large amount of financial support, which is a big issue.

PROBLEM STATEMENT

Urban expansion and environmental degradation have exposed the Red River Delta to more serious ecological and social risks under the impact of climate change.

After the Green revolution and the national economic revolution in 1986, urbanization and industrialization have been speeded up. Land intensification and water stress caused by pollution and flooding are resulting in biodiversity loss and landscape fragmentation, while the population and human demands are growing. Urbanization and short-term economic goals highly accelerate the progress of anthropocentric activities over nature cycles, at the cost of ecosystem services.

Besides National Green Growth and Paris Agreement 2015, the Red River Delta is trying to restore the forest again. Reforestation is good for the long-term ecological benefits of the delta, but the delta and management institutes still lack awareness of the urbanization process within the biophysical processes and balance between protection and development. Organizations with better technological skills and local residents with a better understanding of natural habitus, they need a better stage to interact, communicate, experiment, and practice otherwise will further increase external input and environmental losses.

Therefore, it is necessary to integrate socio-cultural and physical management related to the biophysical system, with the potential of future expansion as a strategic reserved place and a more localized cycle to maintain and operate in order to ensure a future delta with water security, hybrid infrastructure, socio-cultural integration, and biodiversity conservation.

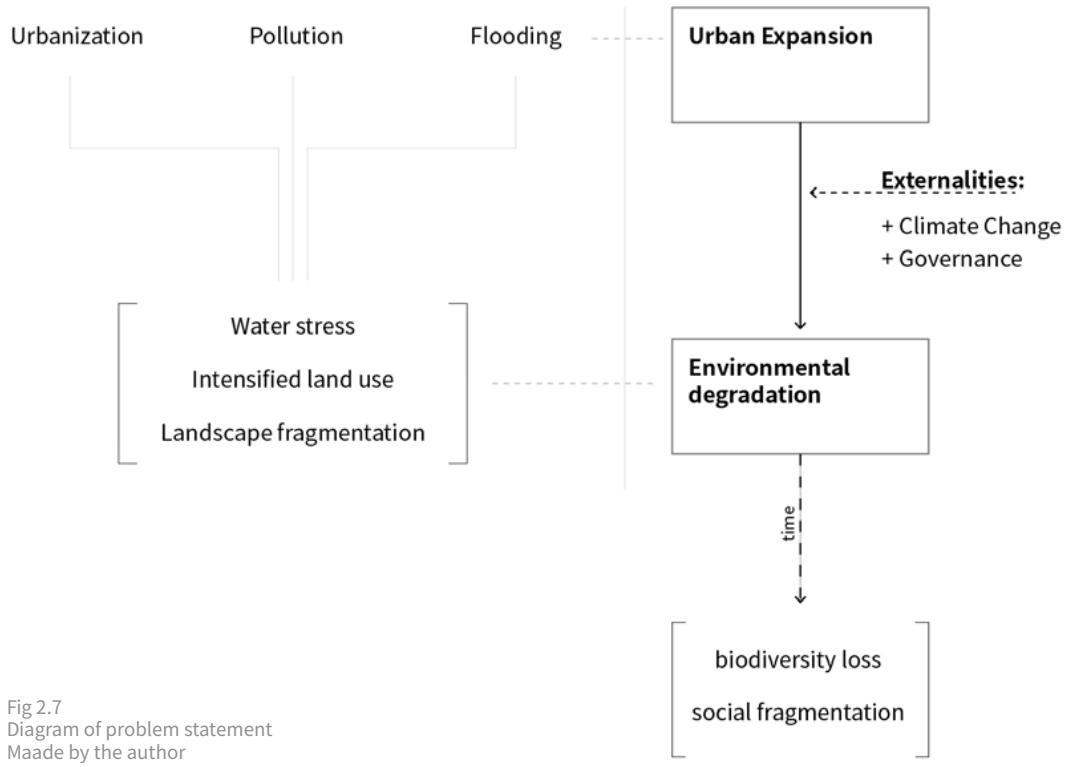


Fig 2.7
Diagram of problem statement
Maade by the author

RESEARCH AIM

Ecosystem-based Adaptation and Socio-Ecological Resilience

The research aims to recognize and assess the vulnerabilities and fragmentation of systems due to anthropocentric production and development. Further with the opportunitiy of forest restoration to transit towards a sustainable productive delta with awareness of both biophysical and human well-being through the lens of ecosystem services.

The goal is to develop an ecosystem-based adaptation to wise use eco-services and develop performative landscape with integrated systems, enhancing socio-ecological resilience with adaptive resource co-management besides climate change.

POTENTIAL OUTCOMES

A review of systemic rice-based delta performance

An ecosystem-based adaptation framework with sustainability assessment

Multi-scalar planning, design and strategies through processes

RESEARCH QUESTION

How and to what extent can performative landscape help to cope with socio-cultural and ecological vulnerabilities through adaptive resource co-management in the context of Red River Delta?

Sub-questions

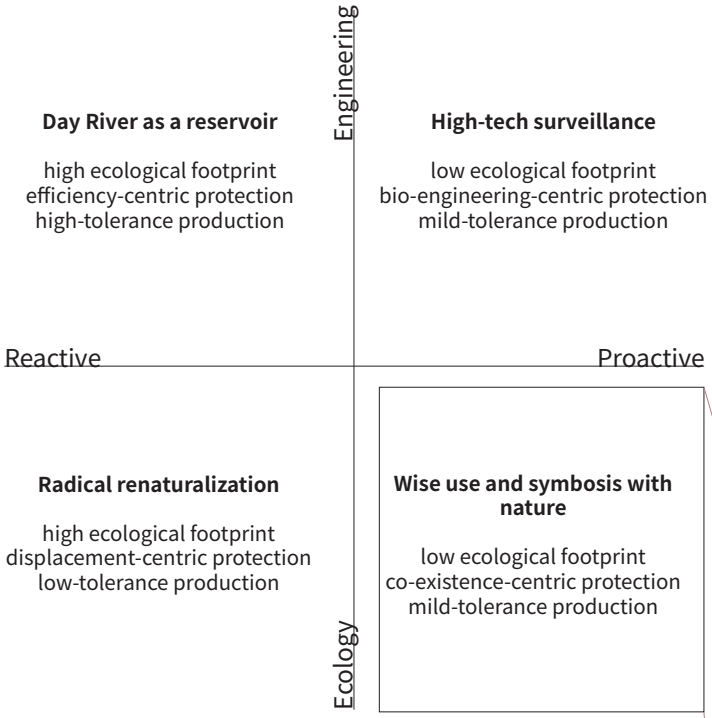
1
What are the current relations of local practices and external forces between land uses, water management and productive forestry in the existing cultural landscape within the lower Red River delta?

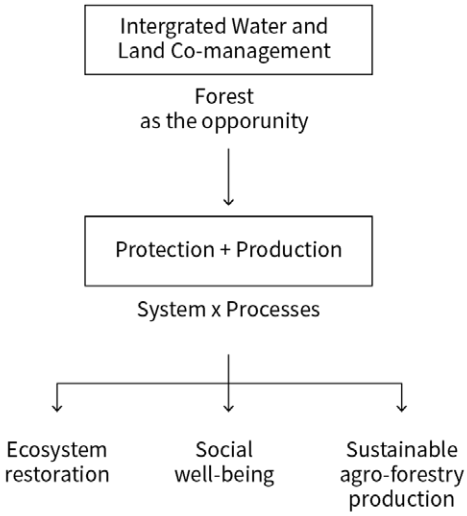
2
What indicators should be considered to assess socio-cultural and ecological vulnerabilities to build future capacity towards a sustainable and safe lowland delta?

3
How and to what extent can ecosystem-based adaptation through performative landscape contribute to implement adaptive

4
How can adaptive resource co-management at local scale reach socio-ecological resilience through evolutionary processes with adaptive governance?

Fig 2.8
Diagram of working hypothesis





WORKING HYPOTHESIS

[High-tech, Radical renaturalization] X [Reactive, Proactive]

Further developing regional scenario 2030 for HCI, hypothesis is proposed that the country is able to slow down the pace of population growth and able to keep the pace of economic growth based on national and foreign investment.

Responding to the awareness of climate change and the urbanization process, the matrix of drives of change for scenarios is developed with the level of risk-related strategies and engineering ecology, considering systems of water, land and forest, and infrastructure at the regional level.

Wise use of eco-services and resource co-management can link different actors across scales and levels within big potentials. Modification through cultrual landscape with reforestation as an opportunity can expand ecosystem services and approach towards socio-ecological resilience. Thus to ensure ecosystem restoration, social well-being and sustainable agro-forestry production in the delta processes.

3 METHODOLOGY

Theoretical framework

Conceptual framework

Scale and Method

Roadmap, time and design framework

Understanding sub-questions

INTRODUCTION

This chapter shows the structure and processing cycle of the project from reviewing, exploring to validating. Theory notions of evolutionary resilience, ecosystem services and adaptive governance are introduced to comprise the conceptual framework of the project towards socio-ecological resilience. Research and methodology states a more detailed plan for research steps, processes, potential methods,analytic scales and time sechdule.

THEORETICAL FRAMEWORK

This framework is trying to form an integrated system to support design by research. The key notion is socio-ecological resilience towards evolutionary resilience, with ecosystem services and adaptive governance being introduced as potential approaches in the process of capacity and action building. Landscape ecology and forest urbanism respond to the biophysical awareness mentioned by ecosystem services as well.

Meanwhile, secondary literature of context-based knowledge including articles, others' research papers, official documents, etc helps to understand the specific phenomenon of the context.

Resilience thinking

Evolutionary resilience(Davoudi et al, 2013) broadens the description of resilience from engineering and ecological views of restoring and improving to the ability of complex socio-ecological systems to change, adapt and transform in response to stresses and strains (Adger et al., 2005). Meanwhile, it requires recognizing owned capacity and reveal hazard, exposure, and vulnerability, in order to act upon, get prepared, and self-organize in the specific scales of space and time. This supports the idea of landscape as palimpsest rather than the tabula rasa.

Vulnerability is the susceptibility of a community to the impact of hazards, concerning biophysical, social-economical, cultural factors, or processes. Vulnerabilities are socially differentiated, which also results in the need for context-based adaption and policies (Young et al., 2006, 304-16). Criticality criticizes the breakdown of existing equilibrium by external pressure and relates to the capacity to maintain valuable ecosystem services through different levels. Operation and maintenance of ecosystem services across scales, and social institution and networks play important roles to enhance socio-ecological resilience (Adger and Brown, 2009).

Ecosystem services and social well-being

Ecosystem services(MEA, 2005) are defined as the benefits people obtain from ecosystems. Within the occupied delta context, technology has been connected with provisioning eco-services including quality of food and water condition. The regulation includes water and flood protection, soil protection, etc. Information relates to cultural and recreational services and mediation is looking back to matters like nutrient as the backbone. The concept recommends a framework of wise use to conserve, maintain and rehabiliate within the context of sustainable development with environment integrated inside. Connecting with sustainability assessment(López-Ridaur et al, 2002), they provide a reference framework to quantify the risks faced by vulnerable groups with the notion of different capacity and critical points, in order to understand where, how, who to adapt and practice through levels of ecosystem services and adapations in the area.(fig 3.).

Ecosystem-based adaptation (IUCN, 2008) provides approaches to adapt to uncertainty and reduce the vulnerabilities brought from climate change and biodiversity loss based on the ecosystem. It requires multi-disciplinary consciousness to encourage local participation and community-based adaption as well, in order to try to maintain local livelihood and food and water security.

Adaptive Governance

Adaptive governance (Adger et al., 2003) is necessary for long-term development and adaptation to climate change. It helps to build up social and ecological capitals through phasing and processes by integrating local and social institutions to communicate and express themselves and bind with formal decisions. Hybrid geography of environmental decision-making should engage diversity, scale, and flows of knowledge, power, and resources as outcomes (terminology proposed by Wilbanks, 1994; Zimmerer, 2000; Adger et al., 2003).

Economic efficiency, environmental effectiveness, equity, and political legitimacy have been highlighted as four main criteria for sustainable governance (Adger et al., 2003). The paper stated generalization to interpret the thickness of decision-making and implementation, as the amount of information and discussions accumulated inside. Though it is always hard to satisfy everyone, everyday life still matters, and dualities of costs and benefits should be considered in their spatial-temporary and across scales (Berkes, 2002).

Co-management (Armitage et al., 2009) relates to the entities of individual and cooperative, the

demand-supply relations of urban and rural, and the climate awareness of urban economy and global ecology. As Olsson et al. (2004) suggest, the 'self-organizing process of adaptive co-management development, facilitated by rules and incentives of higherlevels, has the potential to make···social–ecological systems more robust to change'.

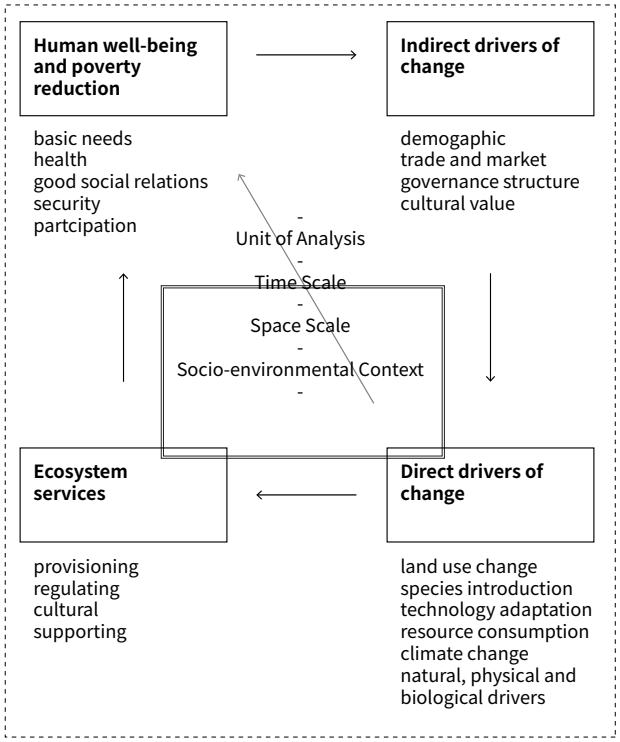


Fig 3.1
Ecosystem and human system framework
Adapted from Ecosystem Services(MEA, 2005) and MESMIS (López-Ridaura et al, 2012)
Made by the author

CONCEPTUAL FRAMEWORK

The aim is to approach evolutionary socio-ecological resilience in the future development of Red River Delta. The notions from theories help to recognize trade-offs and vulnerabilities within currect perfomance and mechanism of this anthropocentric delta under climate change, and evolve through an ecosystem-based adaption aligned with adaptive goverance. The ideal approach is the wise use of ecosystem services and resouce co-management towards a water security, biodiversity continuity, socio-cultural integration and local activation in Red River Delta. The social networks refers to both individual and cooperative, rural and urban, urban and global.

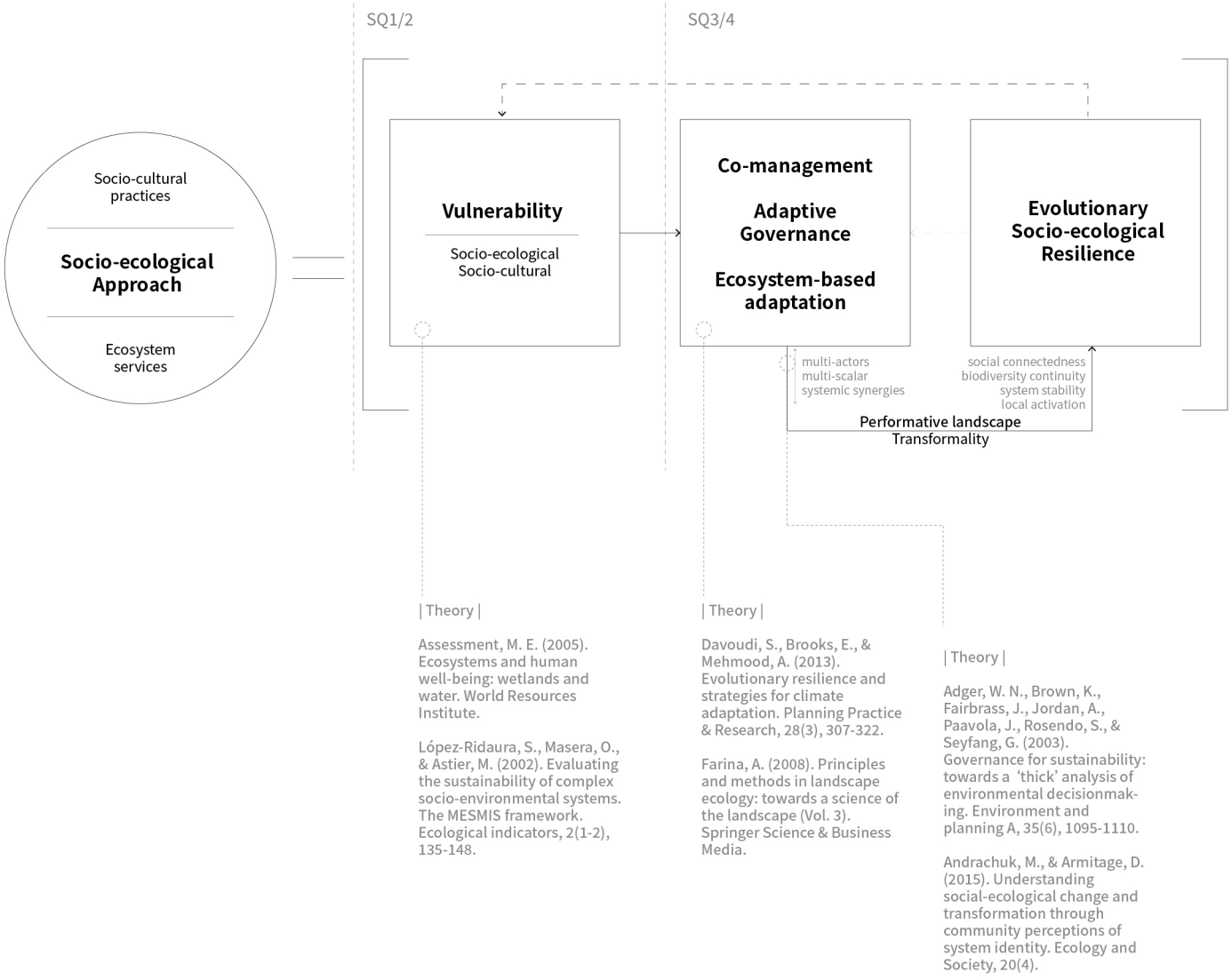
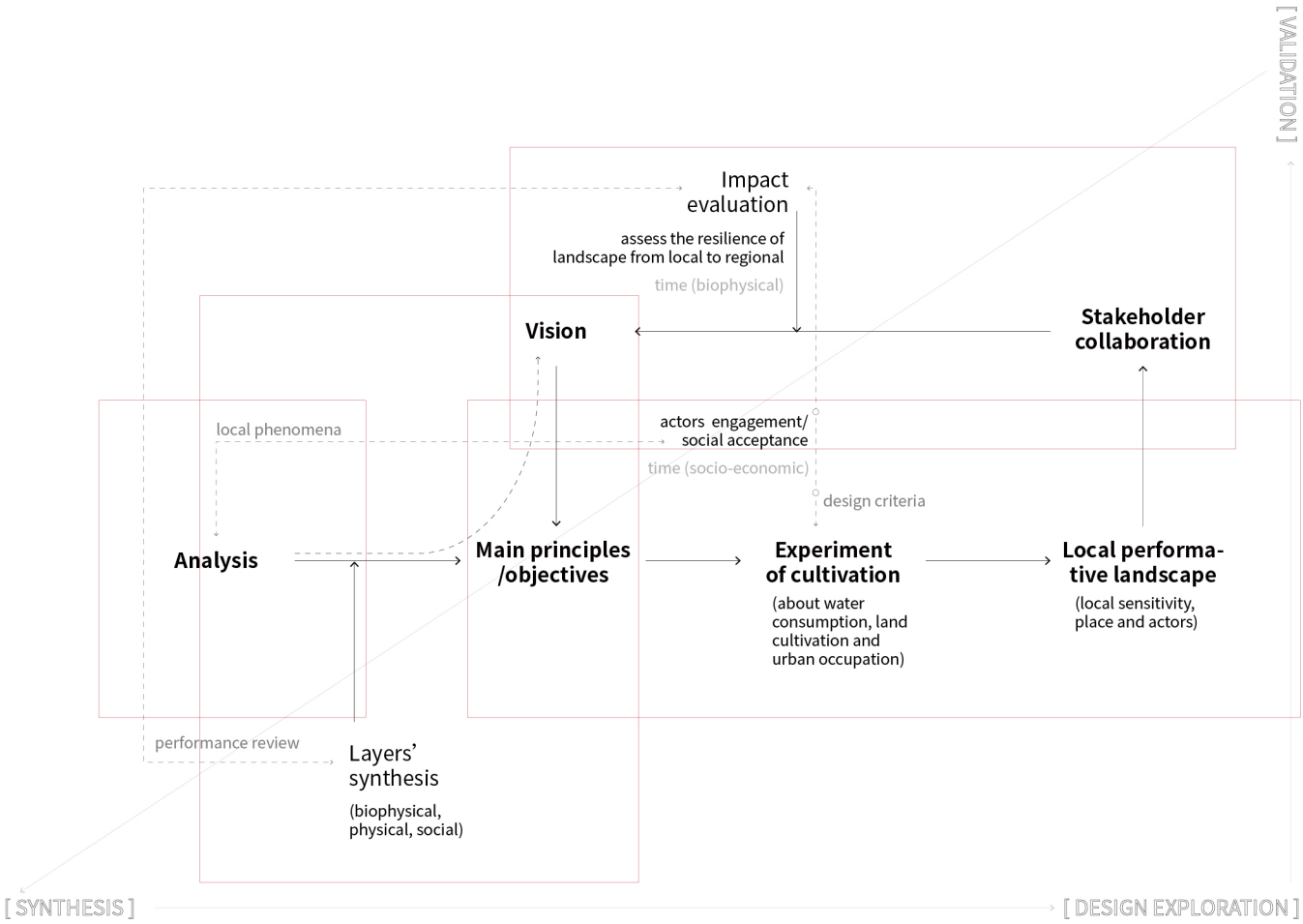
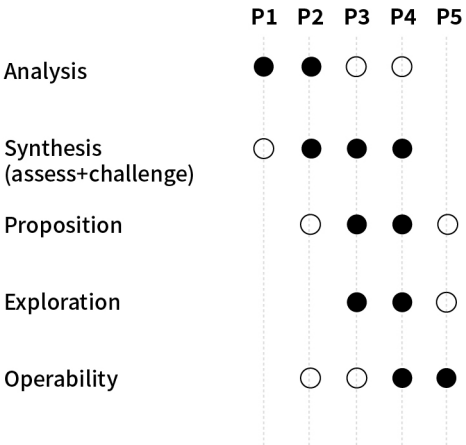


Fig 3.2
Conceptual framework and relevant support from theories
Elaborated by the author

ROADMAP AND TIME SCHEDULE



Sechdule



DESIGN FRAMEWORK

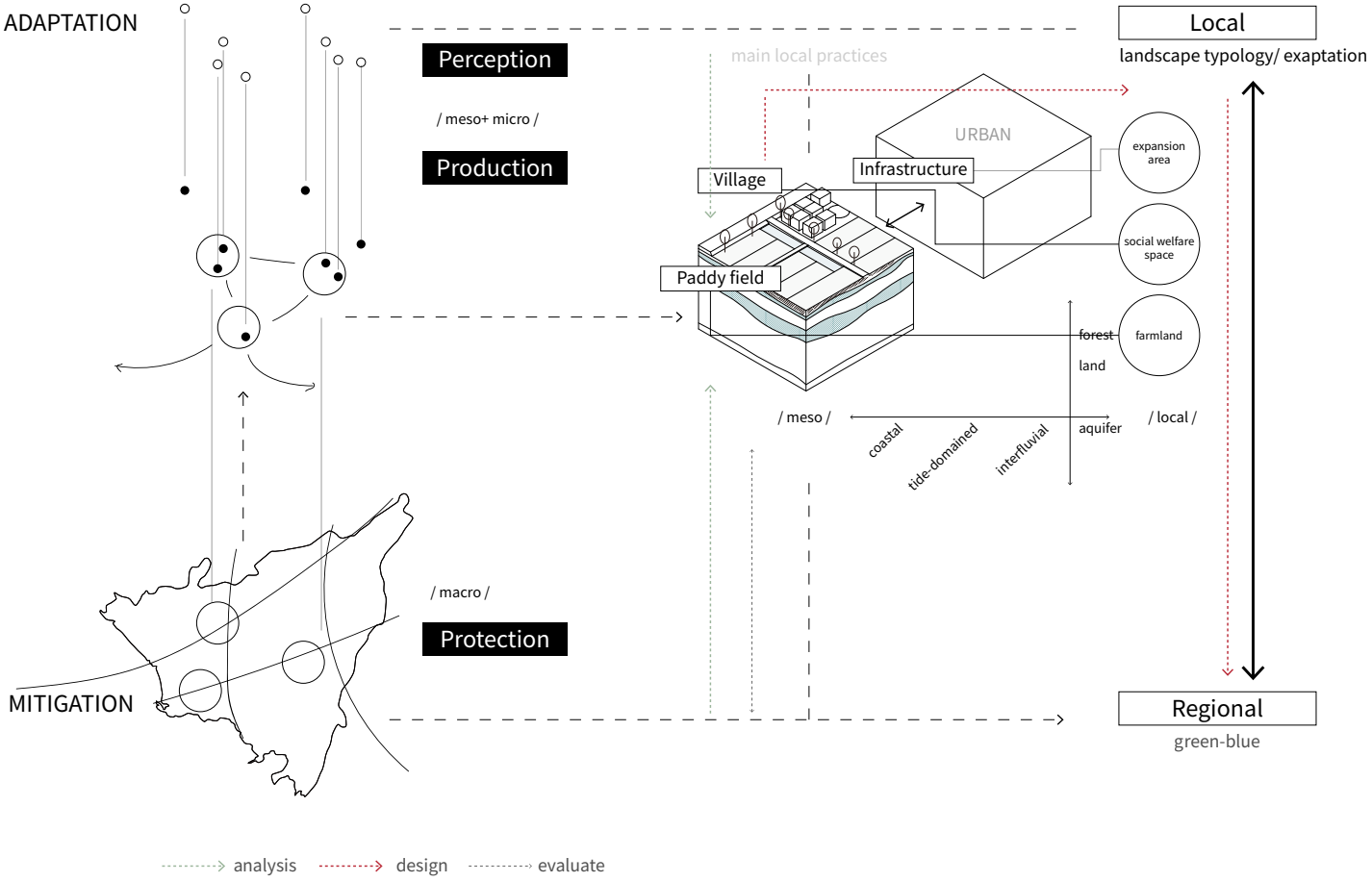


Fig 3.3 (left)
Roadmap of the thesis and time sechdule

Fig 3.4 (above)
Design framework through scales from local adaptation and regional mitigation, linking systems and processes

Made by the author

SCALE

network upgrade

detail implementation

Macro

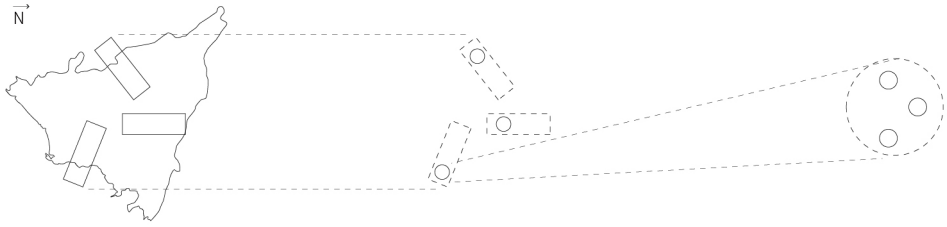
Delta.
Hybridity of infrastructure network

Intermediate

Urban-rural growing cluster regarding to three types of cultural landscape-tidal, high-tide and alluvial.
Potential of function integration across systems

Local

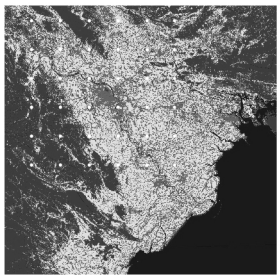
Rural commune within Intertidal case.



Biophysical

Network of green, blue and social infrastructure

Water structure
Green-blue buffer
Coastal mangrove
(Proposed urban structure)



(20km grid)

Socio-ecological
Socio-economic

Ecological restoration and socio-economic transformation of landscape
_along infrastructure, in paddy field or within human settlement

Changing water surface and wetland
Flooding or saline intrusion area
Forestation along water-infrastructure
Road depth
Dike modifcation
Special production program

(2km grid)

Socio-cultural

Resistance and transformation of local landscape

Landscape transformation with agroforestry and public activation

(1km grid)

Fig 3.5
Multiple scales for design and research
Made by the author

METHOD

Communication

Limited understanding from researcher' s perspective imagining future performance of Vietnam

* Local sociology implies people trust social media more than communal organizations in some cases as the latter are usually composed of villagers' family members, mixing interest and trust. Therefore, the media may be more useful than communal organizations, but also under supervision.

Virtual

Literature review
to understand main concepts related with evolutionary resilience, ecosystem services and adaptive governance in order to sound the whole project with research by design

Document review
to obtain certain knowledge for multi-disciplines, such as perspectives from hydrology and geography to understand the evolution of territory and human, and specific information of the context. Document includes related published research papers, official reports, articles and news, social media and policies, etc. The main focus is given to systems of water, soil, local settlement, rice-based production and culture.

Sustainability assessment
to evaluate and assess resources systems and governance for both the existing and possibilities through processes and across scales.

Proposition
to project, forecast and facilitate scenarios from technology to ecology adaptation, from reactive to proactive management with natural and social capitals building in an inductive way.

Multi-scalar mapping
to deconstruct and analyze, enable critical understanding of spatial-temporal components and interactons in-between by visualizing especially through sections.

Stakeholder analysis
to examine the interest and power of actors across scales and institutions involved in planning and strategies, implementation and management, analyze the gaps and establish potential collaborations through onion diagram. Perception change from individual to cooperative, from urban to global.

Online interview
to better get into the context in this special condition. Interview includes perspectives from reseachers who have context-related knowledge or working experience. Possible interview to local communes and people will be expected.

Case study
to learn from projects about resilience or governance management with similalr context to develop research method, design concepts and operability.

RESEARCH METHODS FOR SUB-QUESTIONS

Sub-question 1

What are the current relations of local practices and external forces between land uses, water management and productive forestry?

- What are main local practices of identity in terms of cultural landscape of production in the delta?
- What are direct and indirect drivers as external forces influencing RRD?
- How are elements of systems recognized above sculpturing current performance of systems in the lowland delta?

Intended outcome
Defining main drivers and ecoservices;
Defining main local production morphologies;
Revealing main problems and an unsustainable future of the delta.

How?

Methods:

Literature Review
Document review
Multi-scalar mapping
Stakeholder analysis

Quantative Research
Qualitative Research

Where?

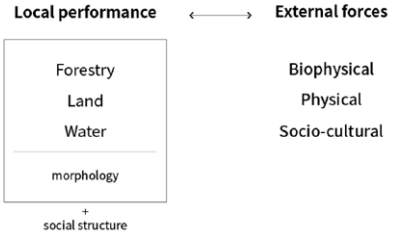
from territorial to local

Who?

Actor:

government
different levels of ministries related
local communities
local associations
companies (e.g. seed, hydraulic)
individual

What?



Local practices/ local

morphology of production landscape

(geology, ecological condition)
(management, political condition)

External forces/ regional to local

Biophysical
water quality
water quantity
flooding

Physical
land cultivation
transportation infrastructure
protection infrastructure

Social
population
physical movement
intensified cultivation
accessibility to services

Constrain:?

The main sources of analysis are indirect, from other reports or researchers. So there can be a lag of information updates due to a high rate of local informalities exist and change. This can further have an impact on the latter political resonates part regarding the policies for data collection.

Conclusion:

The current governance and road-based urbanization are not responding to the complex bio-geographical conditions and local capacities, at cost of eco-services. This phenomenon can add extra pressure to ecosystem biodiversity, local livelihood, and social well-being even with diverse adaptive intercropping production itself.

Sub-question 2

What indicators should be considered to assess socio-cultural and ecological vulnerabilities to build future capacity towards a sustainable and safe lowland delta?

- What and how to assess layers among three systems across scales?
- What are the current vulnerabilities within delta ?
- What can be new opportunities? the proposed scenario and main values for future delta?

Intended outcome
Deconstruction of matter and processes;
Gradients and vulnerabilities through synthesis of layers for different scales;
Setting the scenario for synergy- proactive and ecological proposal, clarifying structure and scales.

What?

Indicators

Biophysical
a1 pollution (underground, industry, agri, aqua)
a2 precipitation
a3 salination
a4 temperature

Physical
b1 landscape productivity
b2 urban expansion
b3 transportation infrastructure
b4 protection infrastructure

Social
c1 accessibility to information
c2 literacy
c3 population
c4 in/out physical movement
c5 flood risk exposure
c6 commercial and public services (tourism/ hotel/ university/ ...)
c7 accessibility to infrastructure services

Focus

Water stress (drought/ wet)
a1, a2, a3
b3, b4, c1, c5

Land intensification
b1, b2, c2, c4

Landscape fragmentation
b1, local practices

Vulnerability

Socio-ecological vulnerability
climate crisis
system instability
ecological degradation

Socio-cultural vulnerability
climate crisis
social inequity

How?

Methods:

Literature review
Document review
Sustainability assessment
Multi-scalar mapping
Online interview
Case study

Quantative

Deductive
Inductive

Scale

from regional to local

Constrains?

The assessment is mainly of regional and intermediate scales, and lack of synthesis with an objective coefficient- the hierarchy of drivers of change, The trigger and destination of the physical movement of people, and the characteristic of specific areas planned by an official are understood at an ambiguity level. As a result, the complementarity and connection between areas are based on a certain level of assumption.

Conclusions

The vulnerability will be defined in aspects of climate vulnerability, water system instability, and ecological degradation to understand systems, and to seek opportunities for the delta. Different locations show different hierarchies under the same problem. A similar assessment will also be done at an intermediate scale to explore the dependency and impacts across scales, such as the urban surface permeability linking to water system instability at a large scale. Thus to explore a working hypothesis in an ecological and proactive way with knowledge and technology input to support local livelihood and delta development. Current top-down governance with excessive interventions should be changed and integrate with participation from the bottom.

Sub-question 3

How and to what extent can ecosystem-based adaptation through performative landscape contribute to implement adaptive resource co-management in lowland delta?

- What does performative landscape mean as ecosystem-based towards the proposed scenario and values?
- How adaptive co-management can be implemented?

Intended outcome
Inductive regional resilience guide multi-scalar design explorations of systems and processes, relocate and reorganize through transect to plan;
Balance the time, cost and benefit, learn from local phenomena for different levels of acceptance of the risk by living in the delta.

How?

Methods:

Literature review
Online interview
Sustainability assessment
Multi-scalar mapping
Proposition
Stakeholder analysis
Case study

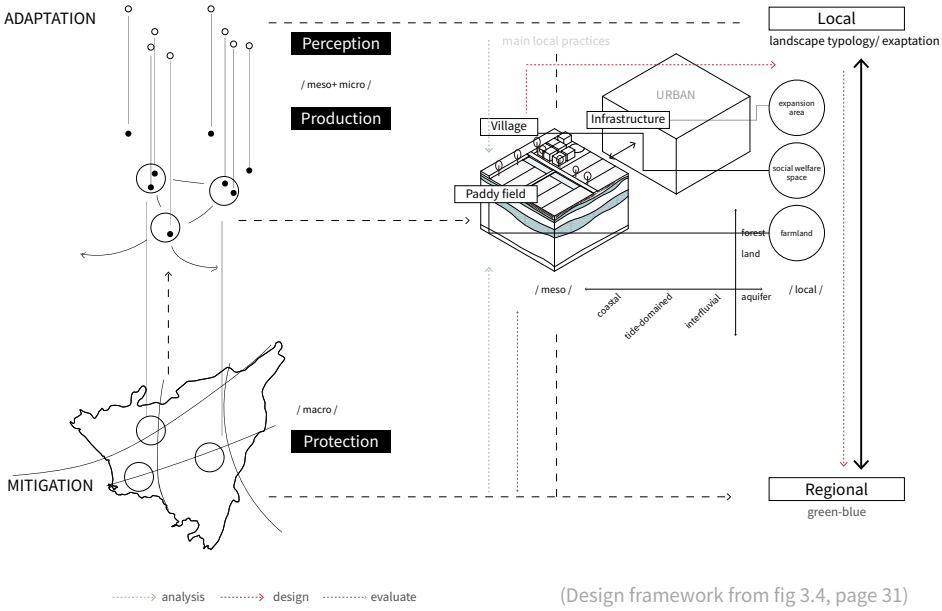
Qualitative

Exploratory
Deductive
Inductive

Scale

from intemediate to local to regional

What?



(Design framework from fig 3.4, page 31)

Conclusions

Through deductive case exploration from intermediate to local, the main principles and strategies belonged can help to facilitate, project, and forecast the robustness, adaptation, and transformation of the local hydrological cycle and agroforestry system as a potential transition of production landscape through socio-economic and cultural events, and reflect back on a supportive regional green-blue structure which can allow the delta towards system integration and socio-ecological resilience physically and for a longer time.

Sub-question 4

How can adaptive resource co-management at local scale reach socio-ecological resilience through evolutionary processes with adaptive governance?

(The expansion of design exploration, about challenges of the governance shift part need to be considered within and explored still.)

Intended outcome
Dynamic delta through time (biophysical) , evolutionary processes with implementation phasing of maintenance and construction, assessment and evaluation.
(Bridging between adaptation and mitigation, cost and benefit)
adaptive pathway
examplar processes an engaged actors

What?

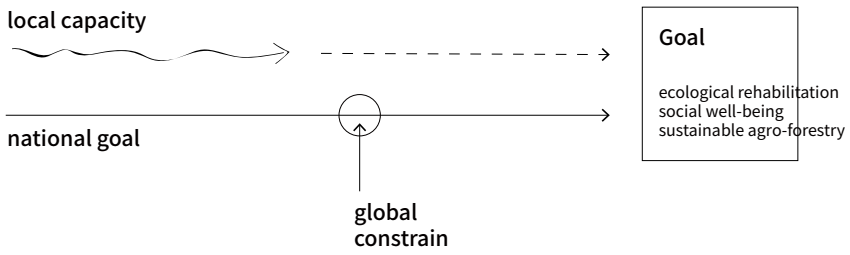


Fig 3.6
Diagram of current gap between local capacity and national gap
Made by the author

How?

Methods:

Literature review
Sustainability assessment
Stakeholder analysis
Adaptive pathways
Proposition

Exploratory
Deductive

Constrains

The local social structure and willingness of participation can help to locate the projects to expand the influence and change, a wise integration between planning goals and local demands and interventions can increase efficiency and social well-being. But at the same time, as the Myanmar case and Adger et al., 2003 has shown, the selected participant needs to have a certain level of knowledge or role of responsibility, and easy access to objects like water to facilitate the future bottom engagement.

Due to the limit of knowledge and information, the relation between shifting design intervention and policies, long-term and tipping points will be discussed at a more general level, which can be more accurate if with more information from local conditions.

Conclusions

To equip local capacity under regional goals to approach a socio-ecological resilient delta, Especially the market accessibility and investing in private, and the local actors can be strong enough as the main players in the game. Thus it's necessary to change at the local to resonate with the delta plan for contribution to systemic integration, while the government also makes wise use of local knowledge to predict and forecast and protect local livelihood in a cycle. Reviewing the power and interest relation between different actors can allow the collaboration or new groups' formation to facilitate the changing tipping point of resource management or local capacity built-up.

4 DECONSTRUCTION

Matter

Topos

Habitat

GeoPolitics

Projection and opporturnity

INTRODUCTION | Map of Reading

A chapter of more detailed analysis of existing conditions and processes of water and land of Red River Delta, under the studio methodology of Transitonal Territories 2020-2021, the framework of four lines of inquiries.

MATTER [WATER]
Water Fluctuation in Land
Pollution by linear use
Evolving engineering construction by urbanization
Water level change by urbanization and climate change

TOPOS [TRANSLATION]
Occupation, Expansion and Transformation of Land
Future urbanization trend
Land conversion and impact at coast
Pressure inside delta

HABITAT [DIVERSITY]
Cultivation of Land
Land productivity
Local diverse production model
Shifting patterns of diverse vegetation

GEOPOLITICS [OWNERSHIP]
Control of Land and Resources
Claiming the territory
Institution ecology
Transboundary water body

PROJECTION AND OPPORTUNITY

Down to the body

Fig 4.1 Screenshot from: Stories from Southeast Asia. 2016. “Pesticide and Food | Huế, Vietnam.” December 21, 2016. Youtube video, 6:30. https://www.youtube.com/watch?v=b3yvJzpl-r7I&t=9s&ab_channel=StoriesfromSoutheastAsia

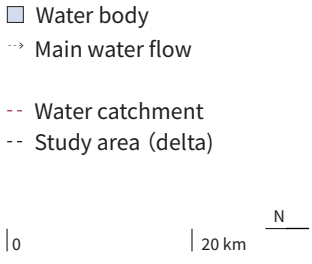
The intimate relation among human, land and water. The consequence somehow can already be imagined due to this series of movements. But it’ s a necessity for his livelihood. The projection is to see the evolutionary imagination down to this bodily relation with the environment, jumping from the large delta.

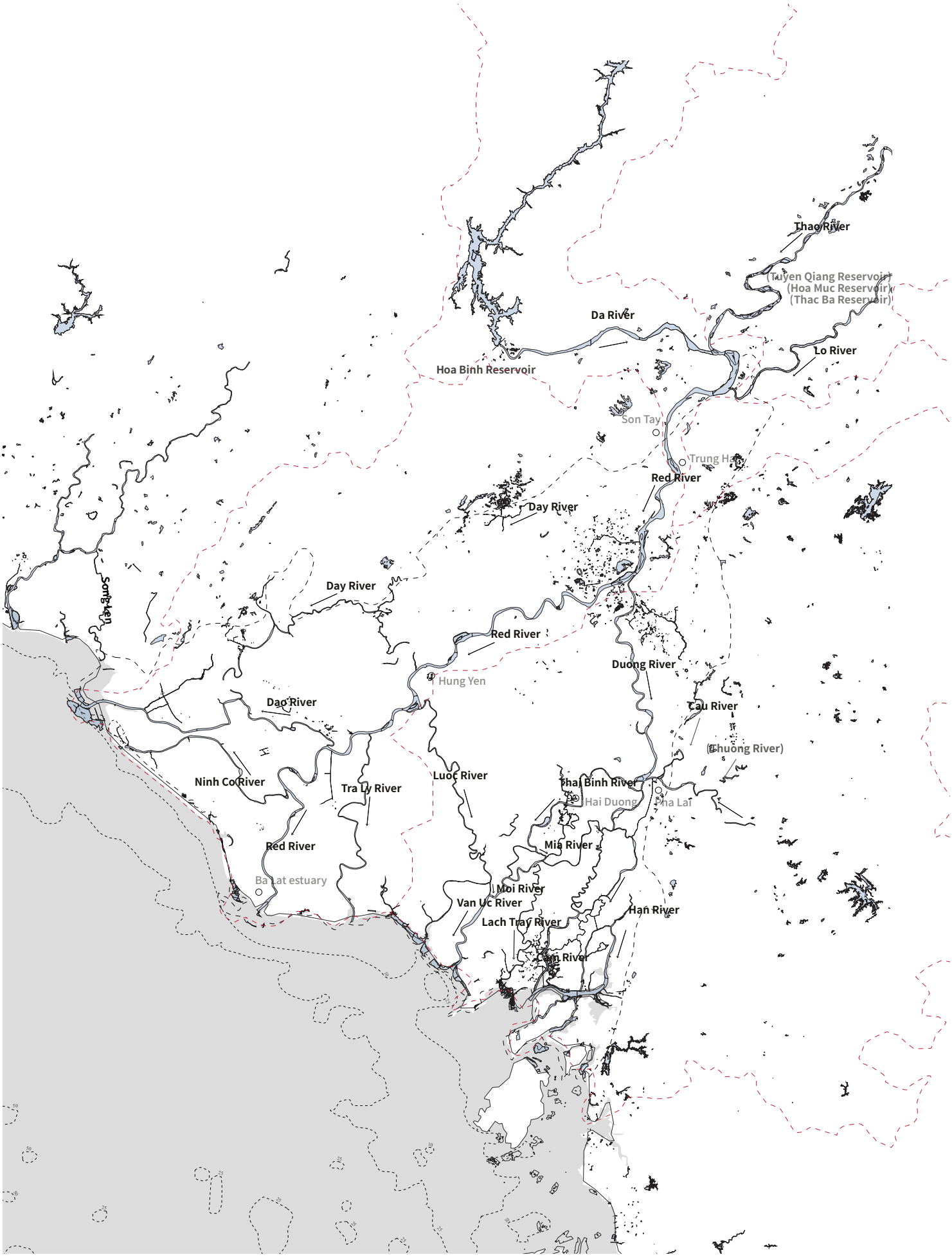
Main water flow

The map shows the main permanent water bodies in the Red River Delta.

Fig 4.2 Source: OpenStreetMap, 2018. Nguyen & Mukand, 2010
Elaborated by the author

The Red River runs from China down to Vietnam and joins with the other two rivers before entering the delta. The river carries soil with high nutrients, gravels and sands, etc. Due to the geographical condition, the Red River has an additional branch called Thai Binh River, whose ending divides into vessels-shape in the north of the delta.




Thao River
Tuyen Qiang Reservoir
(Hoa Muc Reservoir)
(Thac Ba Reservoir)
Da River
Lo River
Hoa Binh Reservoir
Son Tay
Trung Ha
Red River
Day River
Day River
Red River
Hung Yen
Duong River
Thai Binh River
Hai Duong
Kinh Thay River
Dao River
Ninh Co River
Tra Ly River
Luoc River
Red River
Ba Lat estuary
Mia River
Moi River
Van Uc River
Lach Tray River
Han River

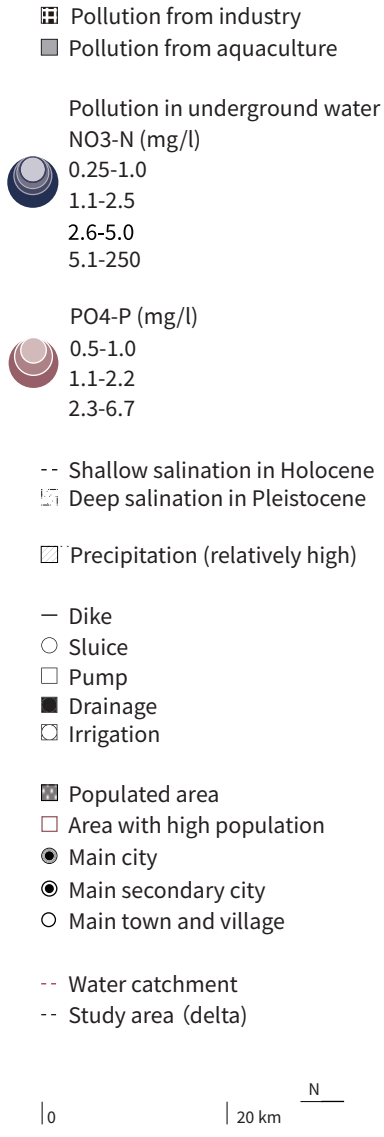
Water stress in drought season

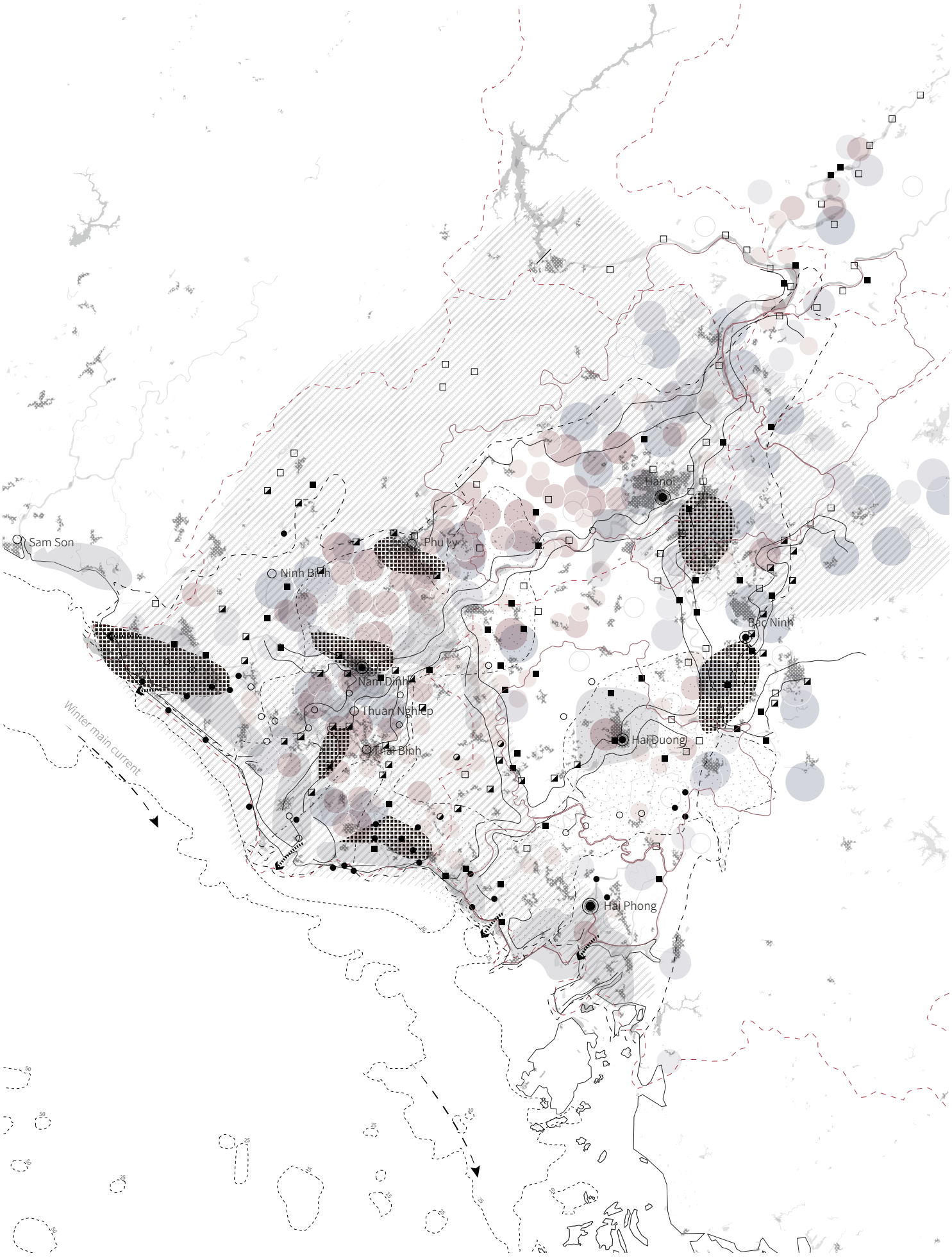
The map illustrates the main surface and groundwater pollution in drought season.

Fig 4.3 Source: ADB, 2000. Larsen et al., 2017. MONRE, 2019. Winkel et al., 2011
Elaborated by the author

The water usage and the pollution condition shows the high dependency from human. In the dry season, pollution from economic activities due to seasonal shortage concentrates more in or around industrial, domestic, and agricultural areas. Some segments of water like Nhue, Day, Cau River are polluted seriously. Heavy use of irrigation and groundwater facilities can aggravate further saline intrusion and affect water quality as well.

Matter



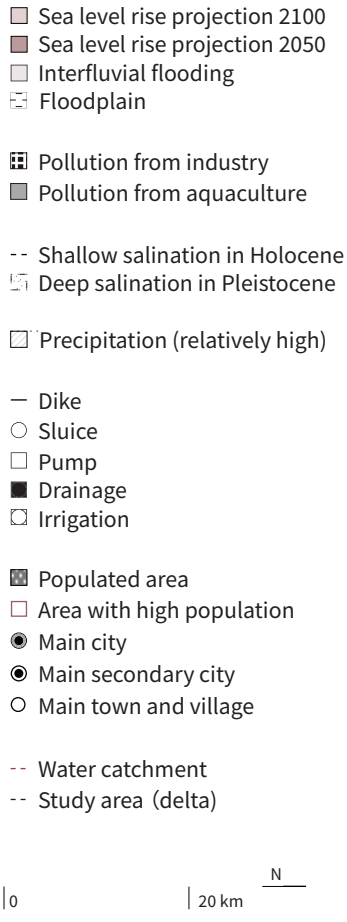

Hanoi
Sam Son
Phu Ly
Ninh Binh
Bac Ninh
Nam Dinh
Thuan Nghiep
Thai Binh
Hai Duong
Hai Phong
Winter main current

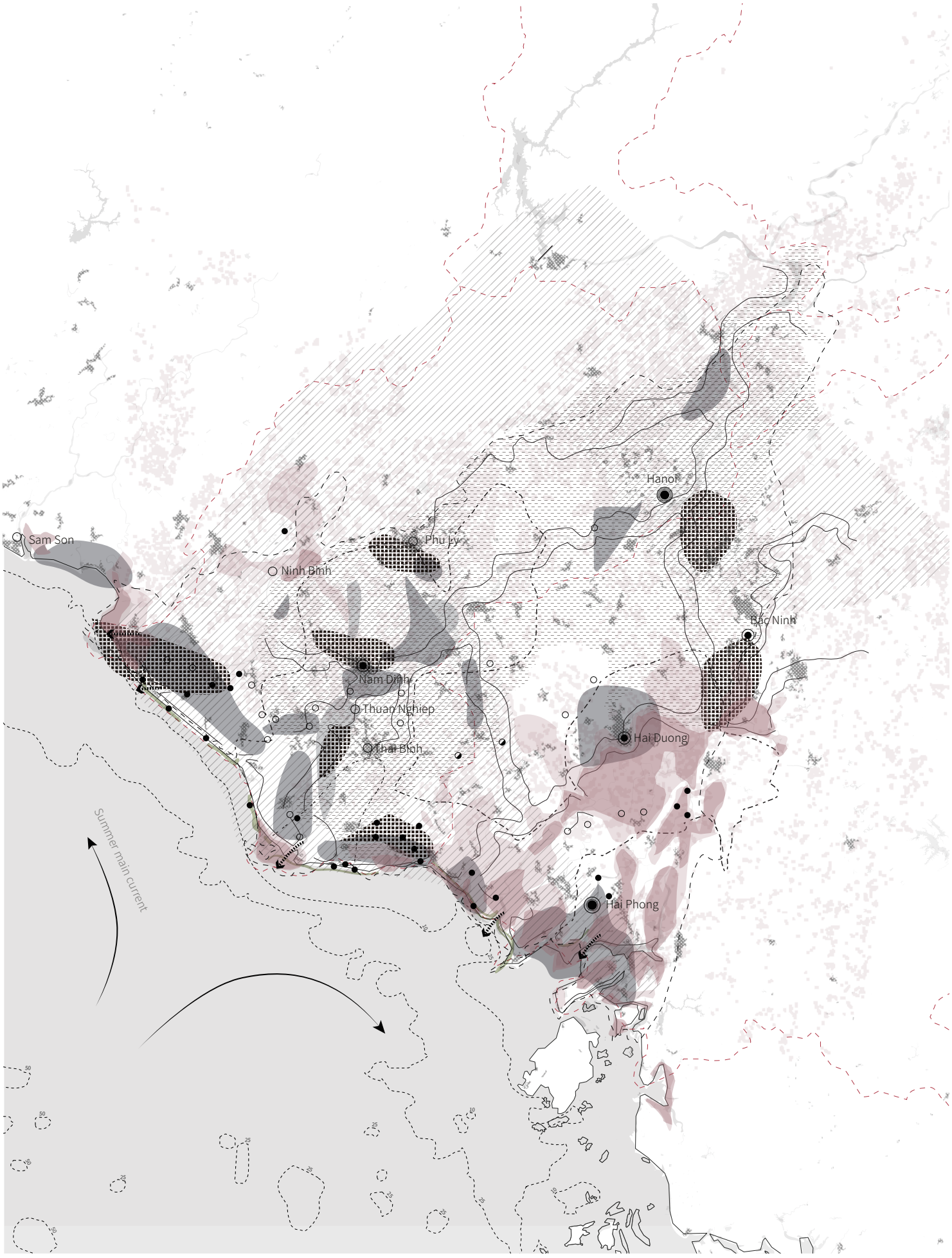
Water stress in wet season

The map illustrates the main surface pollution, saltwater intrusion and coastal flooding in wet season.

Fig 4.4 Source: ADB, 2000. Dang et al., 2010. Larsen et al., 2017
Elaborated by the author

In the wet season, more pollution is also concentrated along the coast and Thai Binh sub-basin, which tends to be industrial pollution, aquatic products, both interfluvial and coastal flooding. Besides floodplain being formed by natural reason, the high upstream discharge and high precipitation in monsoon season can easily concentrate in this flatness with the drainage capacity. Though flooding gives nutrients and refreshes the land, it can also bring diseases after a long time. Especially rice fields converted into aquatic products expose double pressure of pollution as the loss of organic function and the residual of pollutants.




Hanoi
Sam Son
Phu Ly
Ninh Binh
Bac Ninh
Nam Dinh
Thuan Nghiep
Thai Binh
Hai Duong
Hai Phong
Summer main current

Alteration

There have always been drainage problems in the middle and low parts and irrigation problems in the upland (Sophie, 2006). Canal construction was mainly started around the 11th century, and the initial flood control system began during the French colonial period in the 19th century.

History has shown Vietnamese intention to manipulate and control water. People tried to add hierarchical canals to irrigate besides natural floods, change surfaces, and evolve from hands and diesel to machines and electricity through time. Developed through the 60s Land Reform and the initiation of 'Cooperative', the 70s Green Revolution, water-related infrastructure focused on the regional canal system, by adding sluices and strengthening dike systems. Mixed sewage integrated pollution within the local water cycle; further, the focus went into local networks including tertiary, giving access to services for local and further giving rights for partly local to manage.

As the economy developed, the remaining problems include the illegal coverage of irrigation and drainage canals by private industries in the dry season, increasing urbanized surface and decreasing water surface, which exacerbated the water shortage in the middle and high areas, resulting in the needs to raise the water level manually or use a pump which is less cost-efficient.

With electricity and the canalization, the rising water level in the rainy season exposes problems including the direct connection of the mixed sewage network to the nearby waterways and even the Red River, while industry, domestic, tourism, etc. still occupy a large proportion of water use. The upstream urban wastewater is used as nourishment, while the coast will transform into aquaculture due to the water quality change. A large amount of external input eventually aggravated the accumulation of nutrients and pollutants along the estuary. The limited waste retreatment capacity and linear use of water resources are main risks.

Matter

1 Dike construction before colonial
2 Day River division sluice gate
3 Encroachment of canal
4 On-farm self-construction

Source: Tuan & Shannon, 2010

From river water to hydraulic water

The drawing shows a highly hydraulic modernism in the delta through time and socio-economic development.

Fig 4.5 (left) Images from Pham and Shannon, 2010
Fig 4.6 (right) Source: Devienne, 2006

Elaborated by the author

- Canalization improvement
- Urbanization
- Main water flow
- Main polluted water flow
- Pollution
- Saltwater intrusion

1960-1975
Strengthening primary and secondary networks and technique inputs

Midland

Dry season

local practices

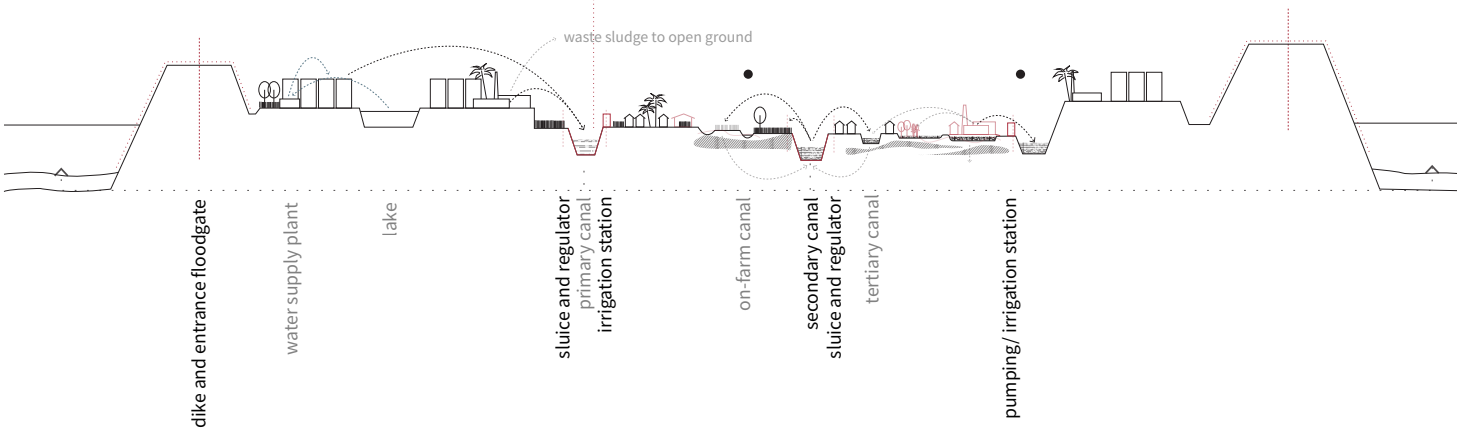
Tripod scoop

Rope basket

Small mobile diesel pump

Regulator tower

Deepened and straightened primary network

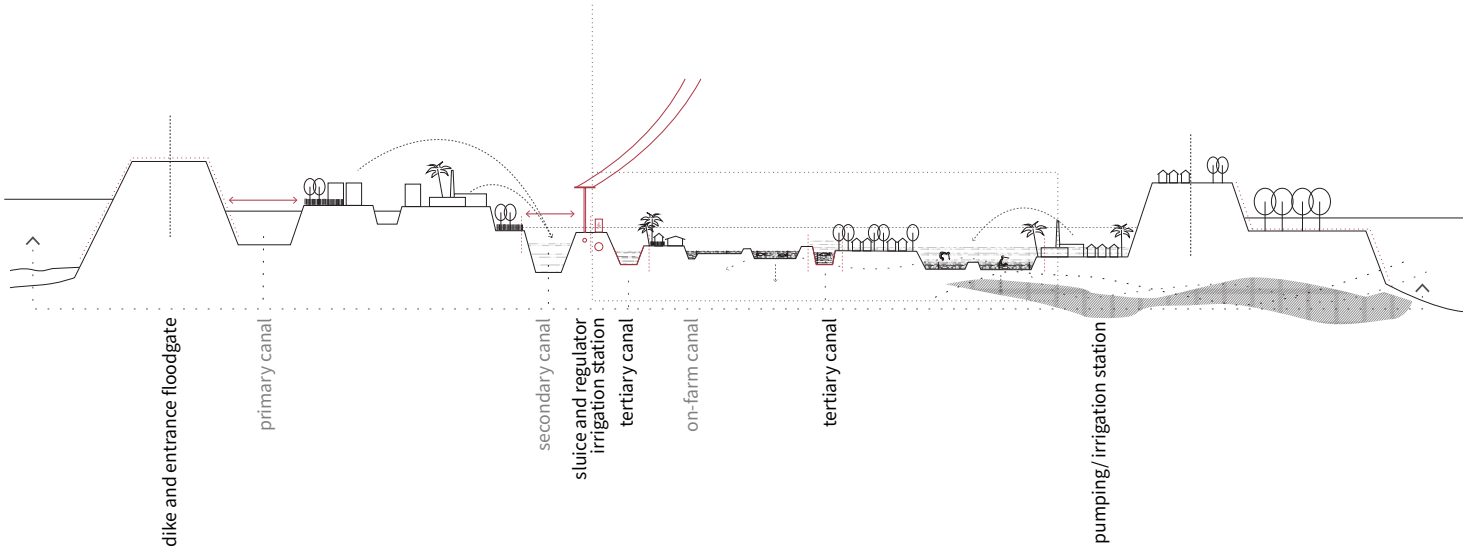


1975-1980
Improving tertiary network by concretizing irrigation and drainage canals and pumping station with electricity support

Lowland

Wet season

1980-90s
Introducing commune-based water supply and control with electricity



Limit

The limit is about the stability of water flow. Due to changing air water and socio-economic linear use between dry and wet seasons, the growing gap is leading to the scenarios of either too little or too much water as the weather shifts.

Delta of this flatness and uncertain climate change can cause loss of safety, property, and quality of life. The Day River was designed as the flood division in 1937, in case of high discharge by the conjunction of three main rivers in the basin entering the delta and important cities like Hanoi. According to the projection of floods, inland flood peak discharge in 2025, 2050, and 2100 will increase by 4.4%, 9.9%, and 20.9% (Dang & Babel, 2010). As shown in the figure, except that the estuary front is not affected, both Red-Day and Thai Binh sub-catchment are affected evenly; As for sea-level rise, Red-Day middle and upper areas are basically unaffected, while coastal and tide-domain areas are the most affected. Besides, infrastructures like the bridge to control salt intrusion in Hai Duong province controlling might create a gap around 0.26m below and above.

Matter

Regarding the water flow can both bring nutrients but also expand hazards as well. It asks us to reflect on the continuous change of water flow and the linear way of taking from nature. It also reflects on the overflow in wet seasons and our way to retentate and manipulate. Pollution which indirectly accelerates the diminish of ecosystem services is also asking for wise operation after or during the consumption, based on available existing technologies and knowledge sharing. Can the stability of water flow be redeemable under the mixed impacts of sea-level rise, pollution, irregular discharge and growing needs?

Changing water level

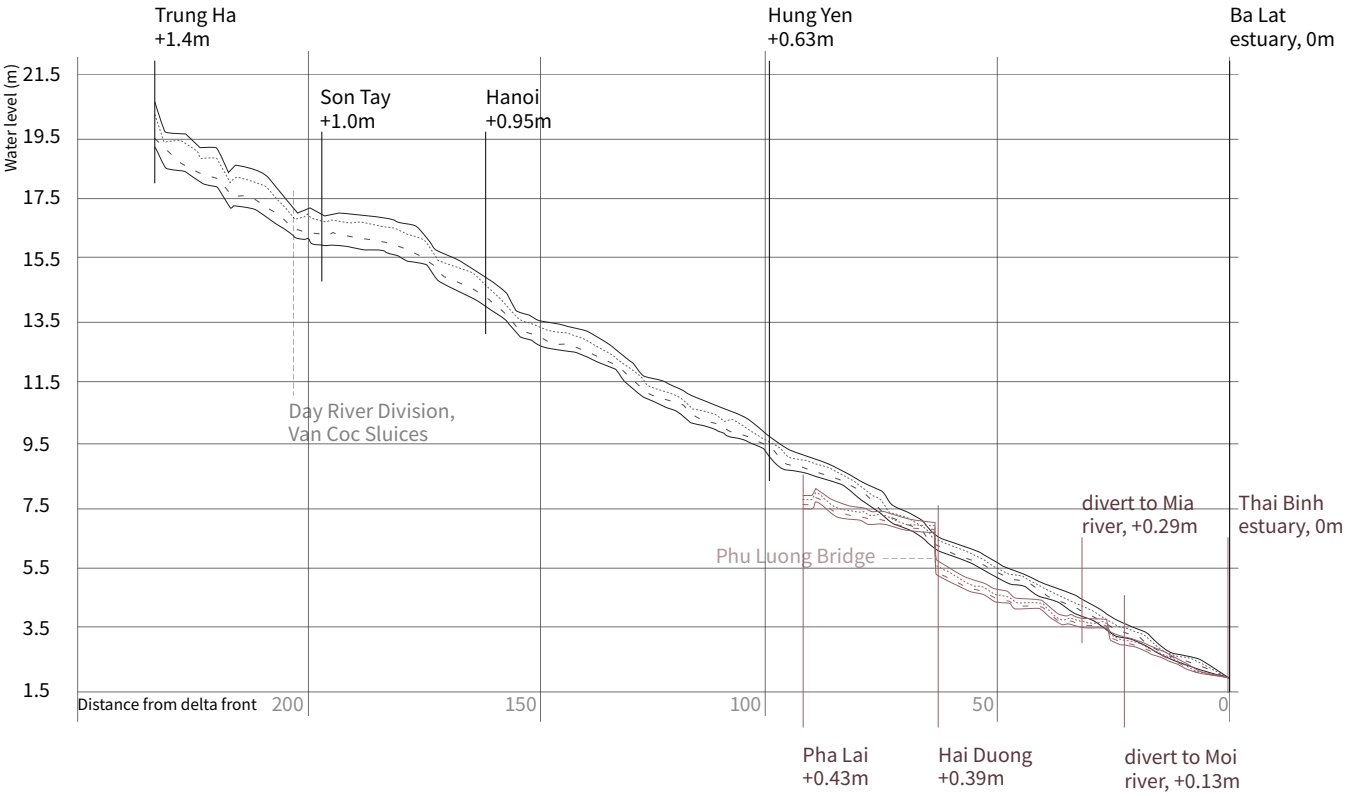
The diagram presents the projected water level fluctuation and its influence in different locations whithin the delta due to upstream discharge and sea level change.

Fig 4.7 (left) Source: Nguyen and Mukand, 2010
Elaborated by the author

Projected upstream discharge
Year 2005, 0%
Year 2025, 4.4%
Year 2050, 9.9%
Year 2100, 20.9%
+1.5m Growing water level 2100

Red-Day sub-catchment
Red-Thai Binh sub-catchment

Max water level along the Red River and Thai Binh River due to inland floods
(based on return-period and historical floodinag analysis)

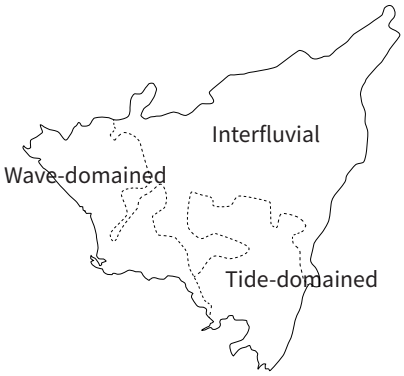


Composition

The formation and evolution of the delta expanded from the northwest highland to the northeastern lowland, being outlined by surrounding mountainous topography.

According to topography and geology, two sub-catchment areas of the Red River are mainly located on two sides. The terrain of the Red-Day sub-catchment is relatively higher. It is also the oldest area in the delta. It is where the natural floodplain and local cultural history mostly started from, while drainage by gravity is a problem; The eastern part of the later development mainly relies on siltation to terraform. The flatness allows natural water flow, but which can be easily affected by human and sea as well, being changed, or slowed down, or even abandoned; The coast is mainly deposited and closed by coastal bar and silt, forming the delta front. Affected by seasons, upstream discharge, and salt intrusion, the Red River Delta can be recognized by three main types of soil conditions (Gourou, 1936).

Topos



Geological setting of the delta

Fig 4.8 (above) diagram of hydro-geological conditions, source from Hori and Saito, 2007
Fig 4.9 (right) Source from Funabiki et al., 2012. Gourou, 1936, Hori and Saito, 2007

Elaborated by the author

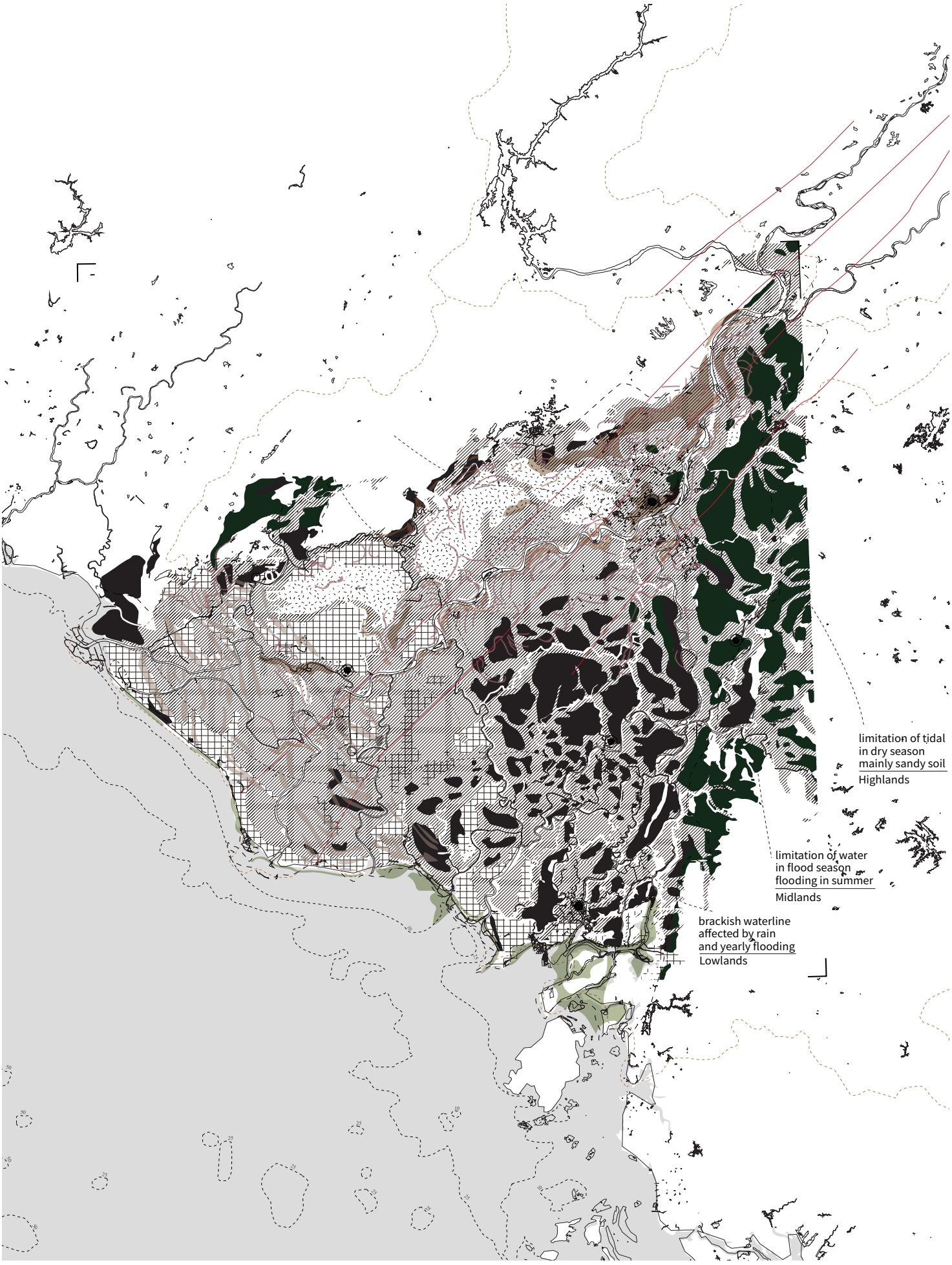
- Recent lowland
- Upper Holocene fluvial terrace
- Middle Holocene marine terrace
- Pleistocene fluvial/ marine terrace
- Tidal Flat (mangrove)
- Nature levees
- Beach Ridges
- Abandoned waterway
- Fault

- Main city
- Main secondary city
- Main town and village

- Water catchment
- Study area (delta)

N

0 20 km


limitation of tidal
in dry season
mainly sandy soil
Highlands
limitation of water
in flood season
flooding in summer
Midlands
brackish waterline
affected by rain
and yearly flooding
Lowlands

The High Climate Impact scenario has been analyzed under a global macro-economic simulation model (MAGNET) and a landscape-level spatial allocation model (CLUE). It assumes that the population at the regional level will increase as in the past, and the impact of climate change will have an obvious impact on the agriculture-based economy so far (van Dijk et al., 2013).

While the existing use of territories is mainly cropland and built-up, the growth of built-up land will be 82% higher. This transition includes half land conversion from previous agricultural land and further expansion with the development of infrastructure and industrialization.

Being boosted up by the 1975 Green Revolution and 1986 Economic Revolution, urbanization and industrialization intensified the development and occupation of agricultural land. The expansion mainly started in main inland cities and developed along the logistics line.

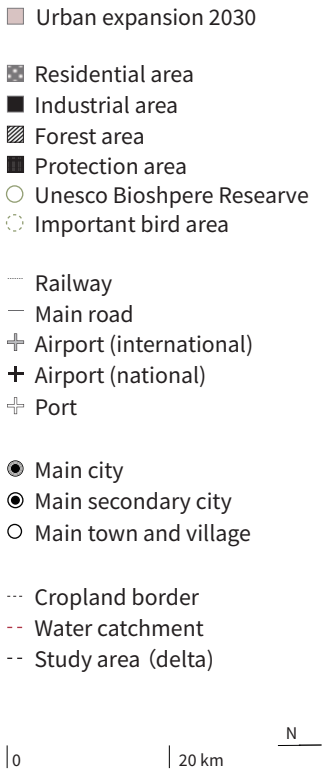
The scenario 2030 shows the trend of expansion after industrialization and urbanization moving towards the costal, but unclear of how to approach a well-considered expansion.

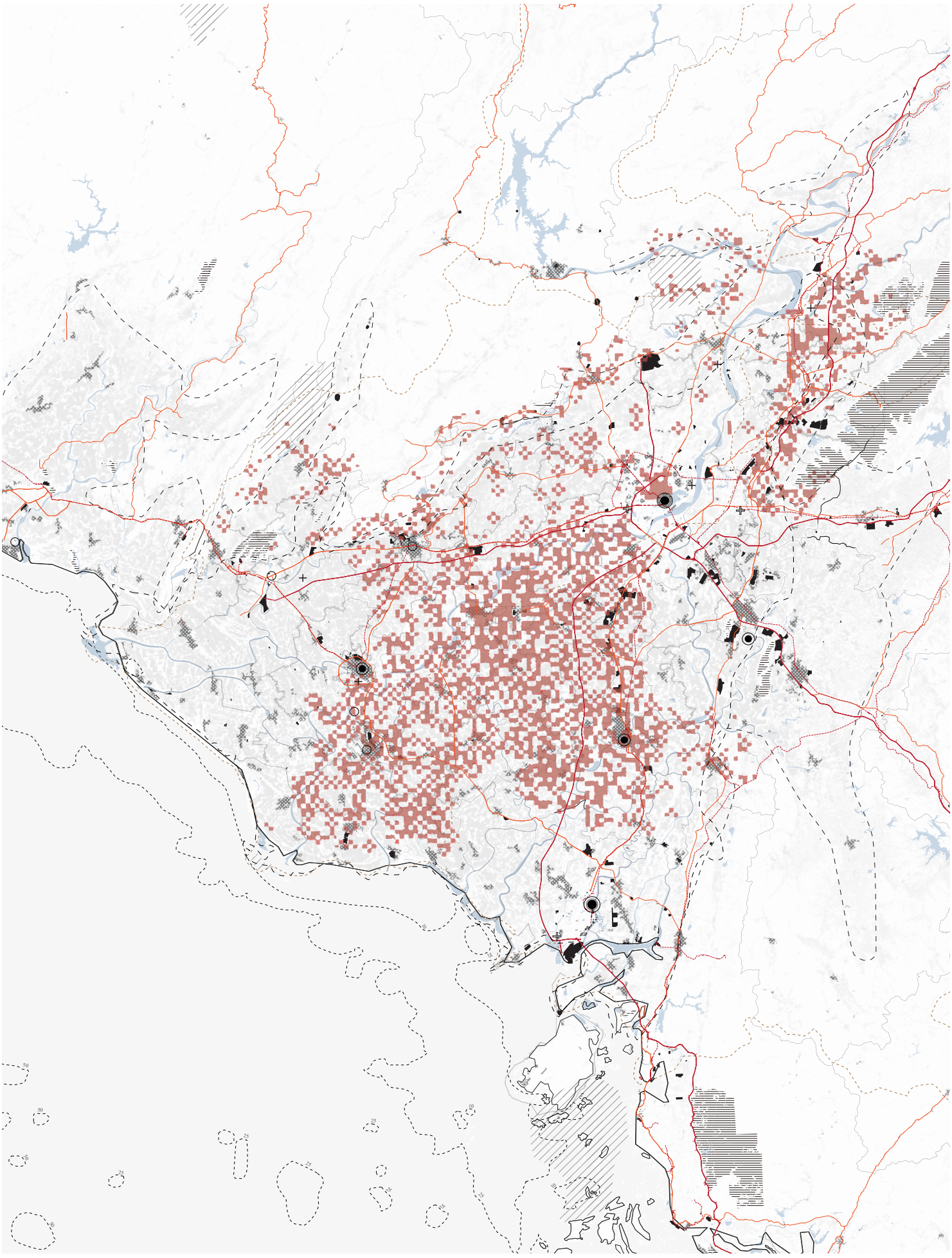
Topos

Proposed Urban Expansion Scenario 2030

This map presents the scenario of projected urban expansion for 2030 under High Climate Impact.

Fig 4.10 Source from van Dijk et al., 2013. OpenStreetMap, 2020
Elaborated by the author





Alteration

As the geological condition mentioned before, the delta is mainly formed by clay, silt, sand, and gravel. The gradient from inland to coastal is from sandy to brackish marine clay or sandy ridges. The human development on territories shows the suitability of location with considerable access to resources - Hanoi as the historical capital center located at the origin of the delta formation and Hai Phong as a new coastal city with well-connected transportation in the east. These two are the main cities in the delta, while the rest is a mixed-use of cultivated land and human settlements. Transportation and main canals are where linear development most likely to happen.

Comparing current land use with the projected expansion from inland to coastal in the north, middle, and south delta area, the conversion present different patterns in locations- Hai Phong expanding its surrounding even into the sea, high concentration in the belly of delta below Hanoi, and sporadic activities in south highland. These patterns are highly connected with the stability of the hydrological system and ecosystem, given the potential changes in the waterway, surface permeability, land cover and soil condition, etc. Yet the current quality and capacity of water-related infrastructure and sanitation are not sufficient for future growth.

Meanwhile, river mouths relatively show different paces of coastal expansion and sediment type based on the geological conditions and water flow during the journey. Comparing the progradation rate of two sides of the Red River, the Red River estuary deposits higher than the Thai Binh side with finer sediment. (Mathers et al., 1996).

Topos

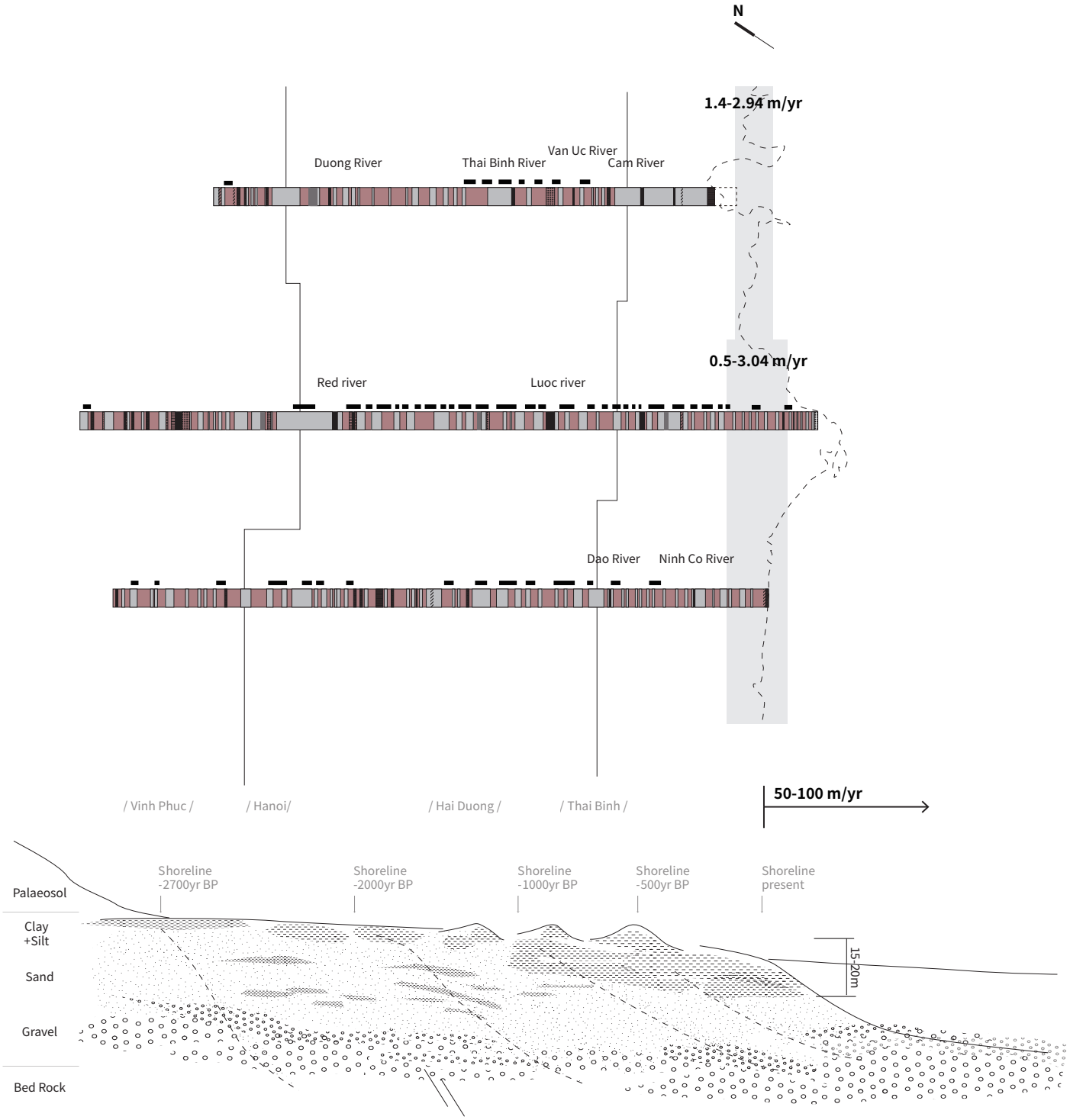
Formation, location and conversion

This diagram shows the transect of land use throughout the delta, combining with proposed land conversion on land.

Fig 4.11 Retrieved from Mathers et al., 1996; van Dijk et al., 2013; Land cover Copernicus, 2019
Elaborated by the author

m/yr Sedimentation rate (along coastal province)
Progradation rate (delta front line)
Large infrastructure connection

Built-up
Cropland
Forest
Shrubland
Herbaceous vegetation
Wetland
Water (permanent)
Industry
Urban expansion 2030


N
1.4-2.94 m/yr
Duong River
Thai Binh River
Van Uc River
Cam River
0.5-3.04 m/yr
Red river
Luoc river
Dao River
Ninh Co River
/ Vinh Phuc /
/ Hanoi/
/ Hai Duong /
/ Thai Binh /
50-100 m/yr
Shoreline -2700yr BP
Shoreline -2000yr BP
Shoreline -1000yr BP
Shoreline -500yr BP
Shoreline present
Palaeosol
Clay +Silt
Sand
Gravel
Bed Rock
15-20m

Limit

As the delta show a strong road-based urbanization, some cities may experience more frequent and longer periods of inundation, as infiltration capacity of the surface has been reduced by urbanization as well (Minderhoud et al, 2018). Both natural and anthropogenic processes can lead to compaction of land, soil, and aquifer. The current infrastructure with low efficiency under growing urbanization can increase vulnerabilities to subsidence and erosion, flooding and ecological degradation.

Heavy and over-extraction of groundwater can lead to the superimposition of aquifers, and then relatively low permeability layers or aquitard (Minderhoud et al, 2018). Though the Vietnam government has banned the use of groundwater to irrigate rice, groundwater extraction is now mainly used for mixed crops, aquaculture, and urban construction, as the growing trend of its socio-economic development. Especially along coastal, it also increases the possibility of saltwater intrusion into the dense inland surface water network in the delta, thereby increasing the pressure on groundwater reserves as well.

Topos

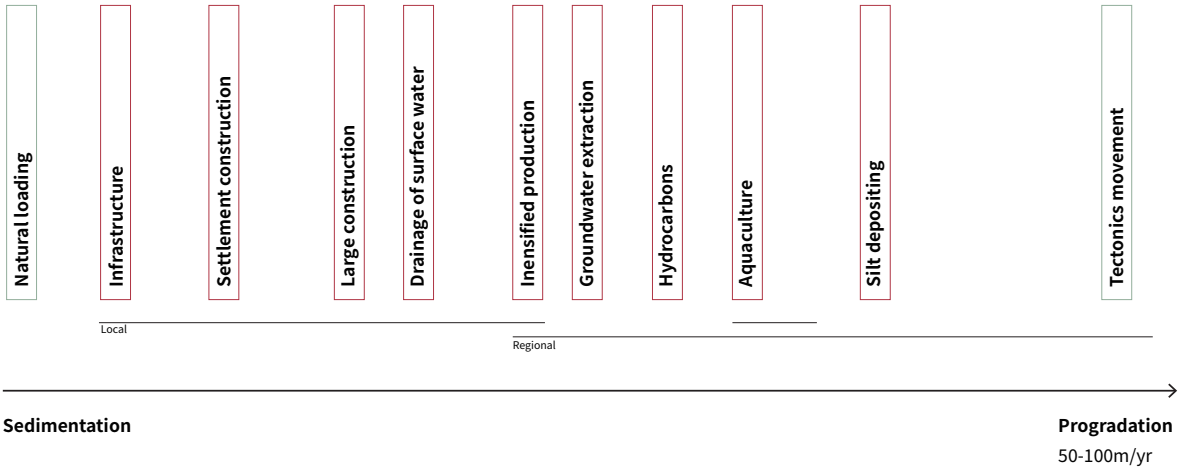
Limited space and intensified use generate seasonal discontinuities of the obvious landscape. This discontinuity can be a phenomenon or the invisible degradation of soil. A large number of pumping and drainage of agricultural land has led to a gradual decrease in the water table level, increased compaction and oxidation of clay and peat, and reduced soil organic matter. The fluctuation of wet and dry seasons can aggravate soil dryness, and the frequency of flooding in the rainy season might happen faster than the speed of soil itself repairs.

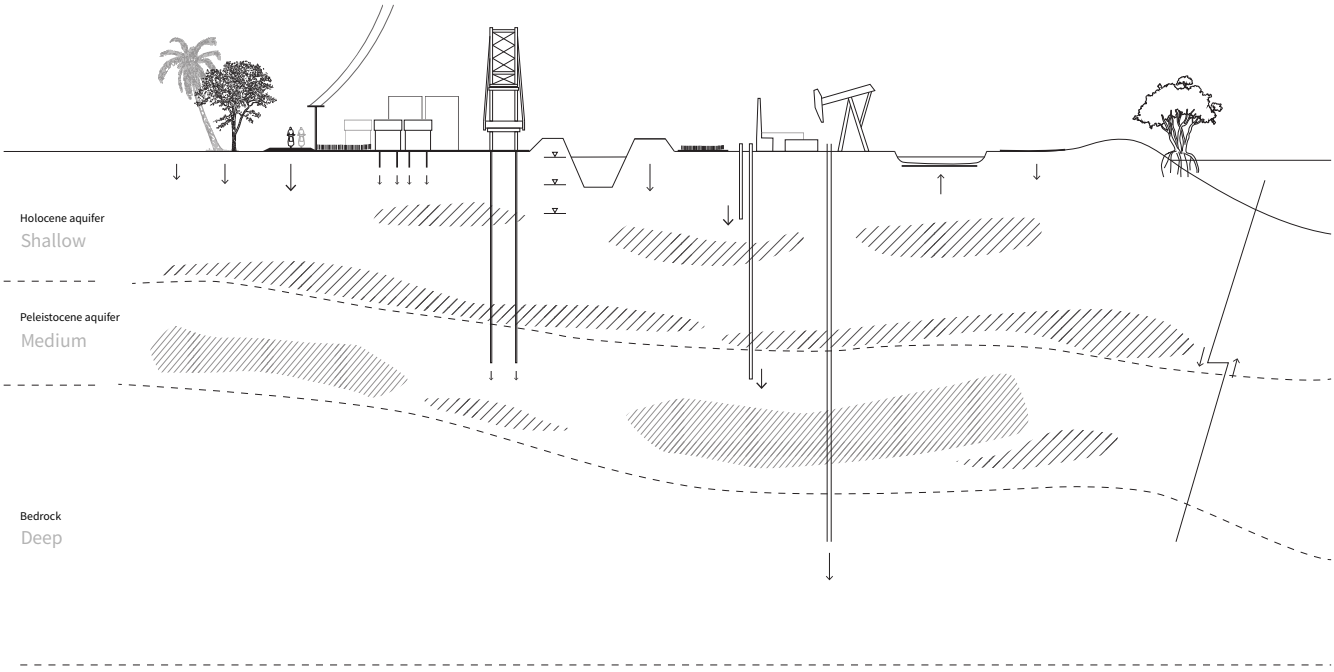
Compaction, subsidence and land condition

Natural processes and human activities having various influence on dynamic surface and underground.

Fig 4.12 Source: Minderhoud et al., 2018
Elaborated by the author

☐ Natural process
☐ Anthropogenic activities


Natural loading
Infrastructure
Settlement construction
Large construction
Drainage of surface water
Inensified production
Groundwater extraction
Hydrocarbons
Aquaculture
Silt depositing
Tectonics movement
Local
Regional
Sedimentation
Progradation
50-100m/yr


Holocene aquifer
Shallow
Peleistocene aquifer
Medium
Bedrock
Deep

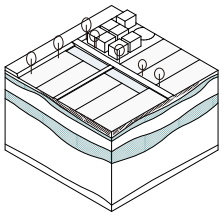
Composition

Based on the rice economy, Vietnam has developed towards diverse production, including the emphasis from buffalo and rice to poultry, aquaculture or further industries, etc. For example, while the southwest Red-Day region still mainly maintain traditional agriculture, transformation to industrial production happened along the line of Vinh Phuc- Hai Phong developed due to industrialization and logistics connection. Tide-domain area also transforms into a certain proportion of aquatic production. Meanwhile, demands for fresh and clean water grow with productivity and other economic activities.

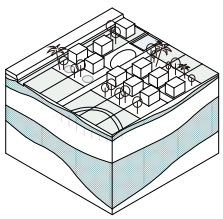
This shifting in production models is related with land suitability, environment condition, access to water and ways of management. Currently the general fact that rural as the raw material supplier exists. The future urbanization and growing demands will put more stress on rural life quality and access to resources, even implying certain exclusion of local people on-site as well.

Habitat

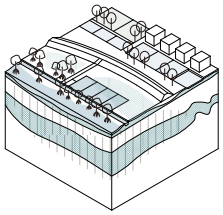
Midland, interfluvial
Cooperative-based mainly
groundwater: 0-10, 30-40
soil type: eutric gleysols and fluvisols, sealing condition
main production type: rice, vege
* trees been reduced due to land expansion and production need



Midland, tide-domained
Family-based mainly
groundwater: 0-10, 30-80
soil type: eutric gleysols and fluvisols, marine clay
main production type: horticulture, medicine, productive forestry, rice
* inland river can be influenced by wave, trees for infiltrate fresh and salt, especially in low velocity waterflow area



Lowland, coastal
Cooperative-based mainly
groundwater: 0-10, 30-50
soil type: marine clay, peat
main production type: shrimp, rice, fish
* mangrove as common property



Current performance of production land

Implying intensified cultivation and production types within the delta

Fig 4.13 Source: GOV data, 2015-2018; van Dijk et al, 2013
Elaborated by the author

- Cereal production
- Tuber production
- Industrial production
- Perenial production
- Pig (1.2 thous.ton)
- Fish (20 thous.ton)
- Shrimp (0.4 thous.ton)

- Urban expansion 2030(HCI)
- Area with high population
- Hotel and tourism spot
- University

- Training rate
- Telecom subscription rate

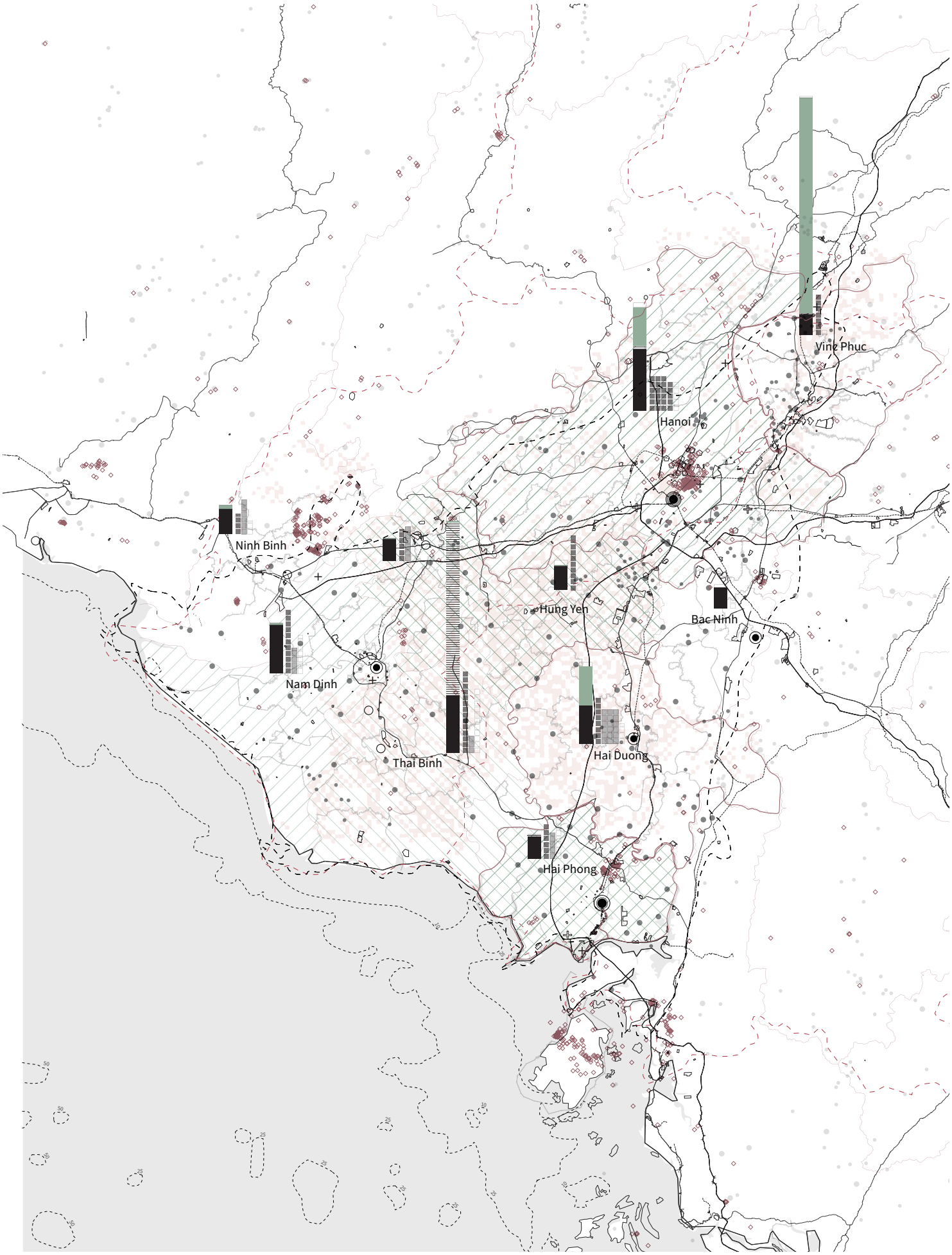
- Main city
- Main secondary city
- Town and village

- Railway
- Main road
- Airport (international)
- Airport (national)
- Port

- Water catchment
- Study area (delta)
- Province

N

0 20 km


Vinh Phuc
Hanoi
Ninh Binh
Hung Yen
Bac Ninh
Nam Dinh
Thai Binh
Hai Duong
Hai Phong

Alteration

The local cultural landscape evolves based on rice production, regarding different conditions of location, hydrological and geological conditions. On one hand, being influenced by Land Reform and Cooperative from the 60s, the social structure matters for the forms of production, operation, and maintenance on-site. As shown in the three main typologies in the diagram, there are intangible relations between plot size, crop diversity, and social structure. On the other hand, the products have been diversified under socio-economic development. Production enlarges local functions in the original model related to dynamic markets and interests，or even directly transforms into an off-farm business. The changes are presented in the labor, skills, market profit, and local organic nutrient cycle.

The drawing shows that in Hai Duong, this VAC model (Van Huong et al., 2018) is a combination of agriculture, forestry, and fisheries. It grows into, either more productive forestry and fishery or more fishery or livestock for largely serving market. Both expand outside the village, showing an inevitable transformation of paddy fields behind the growing profits and labor-saving promise. Rural development puts focus on the infrastructure of water supply and sanitation, involved projects of local to international organizations, while effectiveness and efficiency still being challenged by social acceptance and maintenance of this natural succession cycle by economic profits.

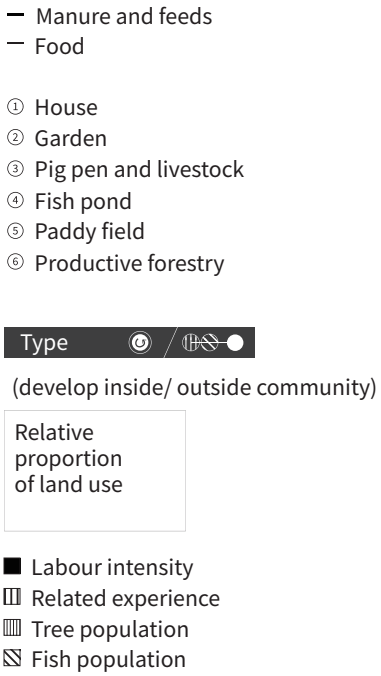
With climate change, technology, and external input gradually wearing out the original natural cycle, how can the changes in the form and content of production help to build ecological sustainability and social vitality?

Habitat

Evolving agriculture production model

As three main local production patterns in the delta have been recognized (and shown above), the image on the left is an further exploration of the second pattern showing evolutionary production model in tide-domained Hai Duong case of mixing agriculture, aquaculture, garden and forestry.

Fig 4.14 Source from Van Huong et al., 2018
Elaborated by the author



Developing infrastructure (transportation, canals, telecommunication, etc.);

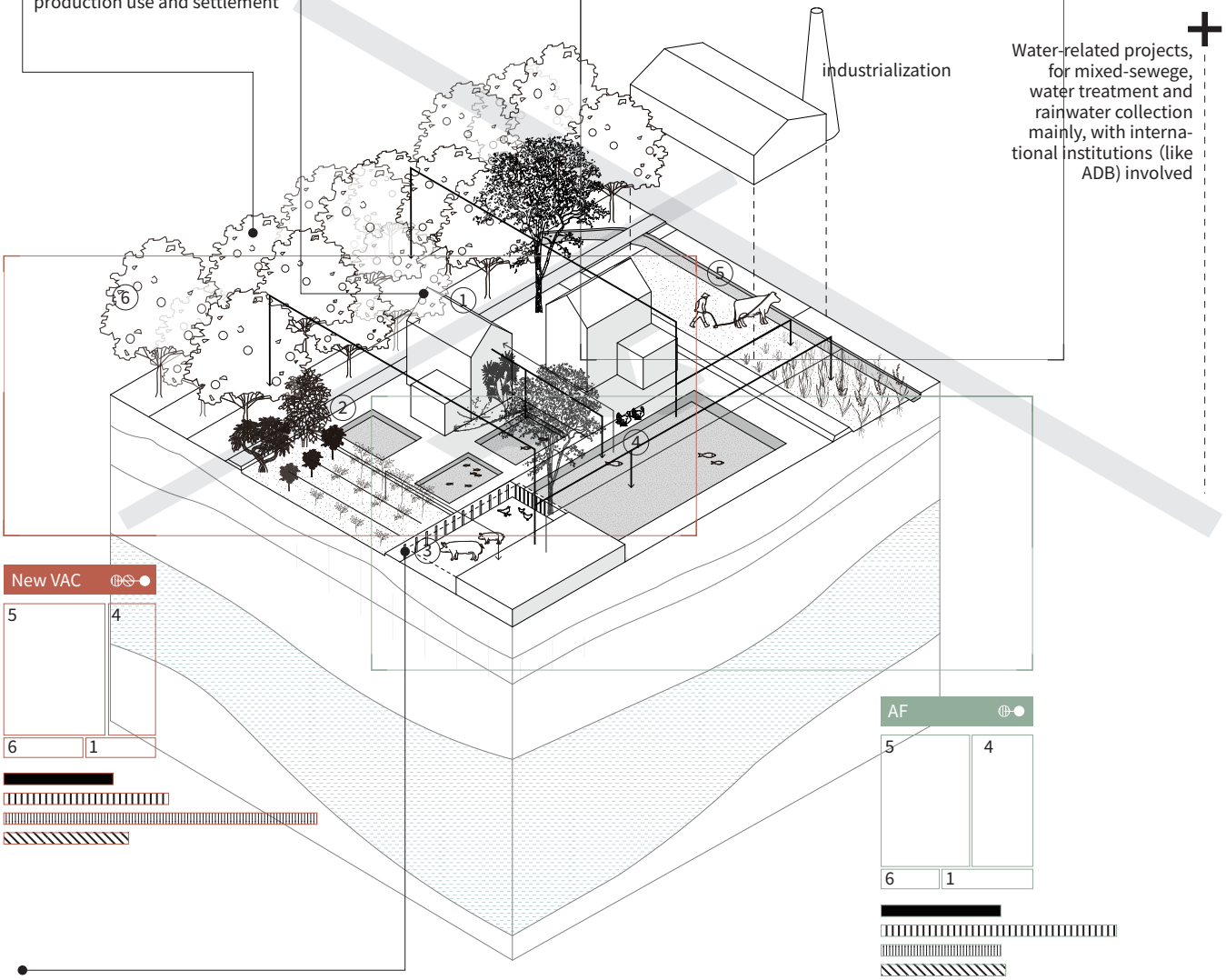
Urbanization development along the infrastructure line.

Local building with brick, rammed earth, etc.; Urbanization with concrete and brick, etc.

Forestry as windbreak, and further as saline and fresh water border in tide-domained areas;
Now dimishing to give space to production use and settlement

industrialization

Water-related projects, for mixed-sewege, water treatment and rainwater collection mainly, with international institutions (like ADB) involved



5 | 4 | 1 | 6
VAC

New VAC
5 | 4
6 | 1

AF
5 | 4
6 | 1

Fences and local low dikes made by local material such as maize stem and bamboo stick, etc

Limit

The human-nature relation of local view has been embedded in the performance of evolving production landscape. Under the impact of climate change and technology, production and transformation of the landscape have become more intensified, and the cycle has been shortened, while external inputs have also increased. These changes in the production landscape are mainly affected by social structure and policies, market structure, and the laws of ecology itself. Changes are then reflected in the increase in people' s income, changes in diet, and performance in terms of water use, etc. Fluctuation in crop diversity has increased due to land reform and household autonomy but reduced again due to seasonal risks and water quality, high yield demands with limited land, and species themselves, etc. As a large proportion of water has been used in the agriculture sector, the production itself requires the resonance of land and water based on the awareness of the growth cycle of organisms and pulsing natural dynamics including hazards.

Under Land Reform, local farmers and communities can cooperate with companies and lease and transfer land, etc., but limit by central and provincial planning for production and land use. The limited social capacity is presented also in one fit scenario for Vietnam developed with the implementation of technology, but inevitably social differences can' t be solved completely. The social differences also relate to the loss of diversity and waste of water by concentrating on specific production for economic profits.

In terms of the inevitable transformation of the traditional agriculture economy, how to build up the off-farm social capacity of the knowledge and labor while giving a change of breath to the soil? It' s also important to implement necessary techniques but not too hubristic to accelerate dramatic environmental change. How to integrate the continuity of biodiversity and perception towards the resonance through a new performative landscape?

Habitat

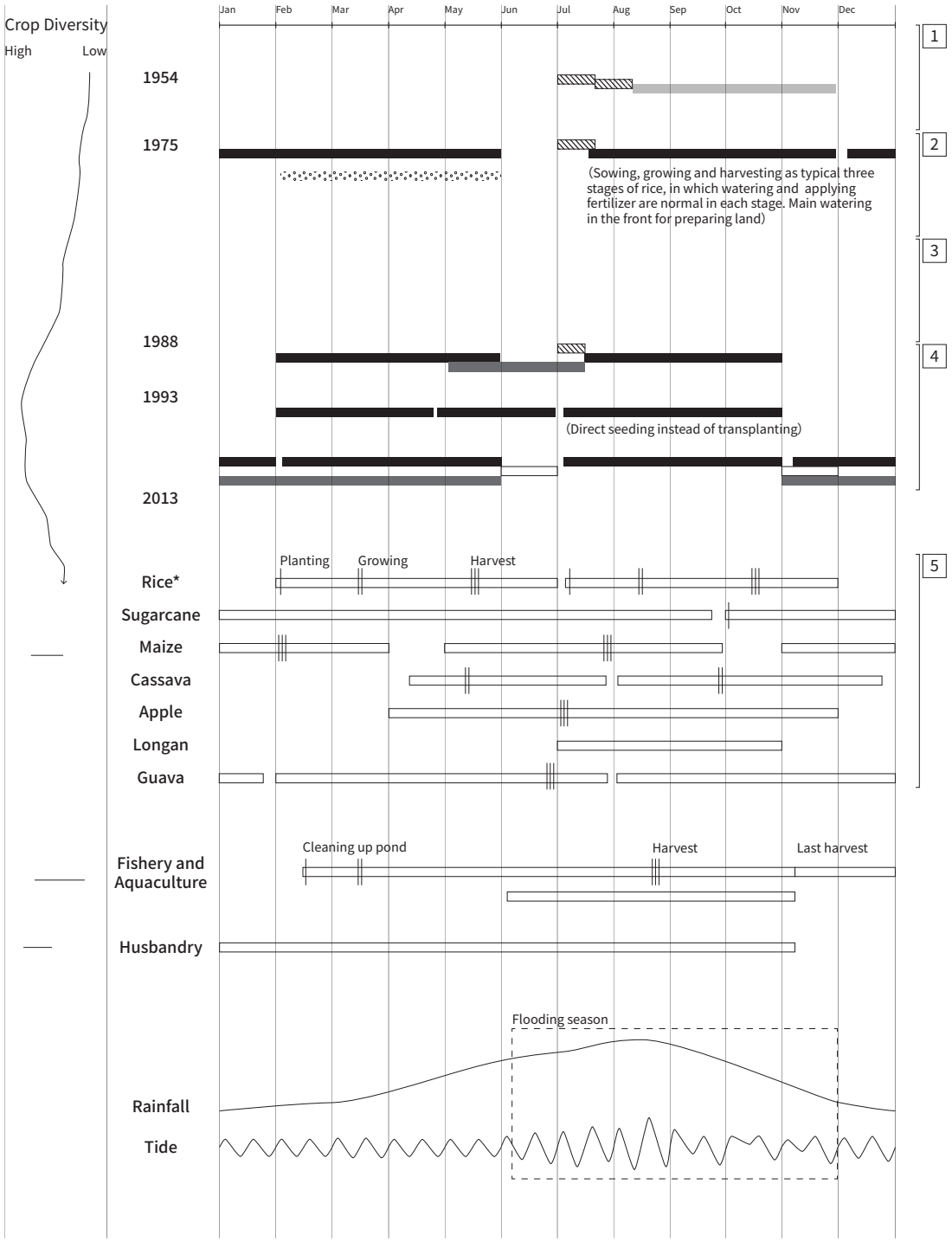
Continuity and perception about water and land

The diagram shows the changes in the production cycle under the influence of social structure and policies, market structure, and the laws of ecology itself.

Fig 4.15 Source from Devienne, 2006
Elaborated by the author

Rice
Rice (transplant)
Vegetable

Extension



1 The early start of 'Cooperative' - everything collected and shared by cooperative;
One-crop with rainfall and flooding for gravity irrigation;
Double nursery for better transplanting;

2 Reunion of South and North Vietnam;
Green Revolution, promoting high input for high yield;
Cooperative for hydraulics and materials supply;
Enhanced input of crop varieties, fertilizers, machines and hydraulic projects;

3 Socio-economic development faster than the construction of water infrastructure and production facilities;
Cooperative mainly for hydraulics;
Increasing import products implying decreasing productivity and labour shortage;

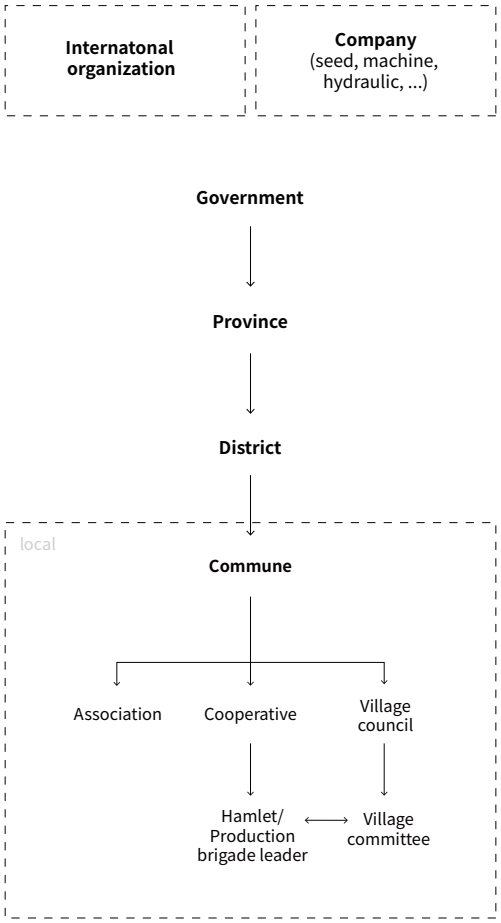
4 Evolution of ownership and long-term leases of land reform;
Areas close to transport and water infrastructure with higher advantages;
Family autonomy and active commune organization promoting crop diversity and trades;
Technology leading to varieties with shorter periods, most nursery land being occcupied for main production;

5 Credit contributing to rich and poor on two sides, especially such as investing in medicine crops in the garden;
Canopy interception relating with yield;

Composition

The land belongs to the entire people with the State as the representative owner 1 under a top-down domain governance. Although people have the right to use the land, the state and people have undergone various ways to manage from centralization to private operations. The participation from the bottom is basically passive and limited as in such a process that the governance of all levels is playing the practical role.

Besides the intangible overlapping of roles beyond this plan drawing, there' s also a lack of collaboration across provinces such as between the upstream and the coast. The whole regional manage wetland indirectly by managing other resources like land, soil, forestry, etc. (Nang, 2003).



(Geo)Politics

Territories and resource claims

The map overlays the administration border, sub-catchment border, and protection areas in terms of the flood, forest, and biodiversity. It is clear top-down governance with hierarchies as they only share limited information online.

Fig 4.16 (above) Diagram of the main governance structure of Vietnam, elaborated from Cuc et al., 1993. Orchard et al., 2015

Fig 4.17 (right) Elaborated from MONRE, 2019. OpenStreetMap, 2020.

- Forest
- Protection area
- Dike
- Water division area

- Main city
- Town
- Village and hamlet

- Provincial border
- District border
- Water catchment

0 20 km N


Son La
Hoa Binh
Thanh Hoa
Hanoi
Thai Ngu
Phu Ly
Sam Son
Ninh Binh
Bac Ninh
Nam Dinh
Hai Duong
Thai Binh
Bac Giang
Hai Phong
Quang Ninh

Alteration

It' s mainly about the relevant ministries and departments, people' s committees, private corporations, and research institutions regarding land use and resource management. Horizontally these departments have different functions and vertically give orders with hierarchies. Besides ministries have divided into construction, health, transportation, etc., rural development has been integrated under MARD, including flooding control and water supply.

The fact is that actual departments are relatively lacking cooperation which might cause conflicts and low efficiency. For example, conflicts can happen between urban construction and rural irrigation, the changing waterway coming from polluted upstream as original one being blocked. Lack of communication can also happen between institutions and locals. The result-based rural irrigation and drainage project being invested by World Bank and implemented by the local government might not fit the real needs of the farmer. Instead, these projects become less reliable as the quality or the size, raising the water level in the wet season which supposed to drainage wisely. Thus, the dislocation of information and intention happen easily during shifting cultivation, as the following from an interview to a local:

Besides, local sociology implies people trust social media more than communal organizations in some cases as the latter are usually composed of villagers' family members, mixing interest and trust. Therefore, the media may be more useful than communal organizations, but also under supervision- to mitigate the dislocation of information and arrangement under the changing environment.

Organizations and gaps related with forest, land and water

Institutions and their roles involved in land, water, and forest resources.

Fig 4.18 Source from Orchard et al., 2015. Ritzema and Kim, 2011. Waibel, 2010. Wikipedia, 2021
Elaborated by the author

Other ministries' functions:
1 standards for drinking water and sanitation
2 water use for industry and hydropower
3 general water quality standards
4 transport and waterway system
5 allocation of state budget
6 allocation of planning and investment

Abbreviation:
Asian Development Bank (ADB)
Communal People' s Committee (CPC)
District People' s Committee (DPC)
Irrigation and Drainage Management Committees (IDMC)
Ministry of Agriculture and Rural Development (MARD)
Ministry of Construction (MOC)
Ministry of Natural Resources and Environment (MONRE)
National Committee for Flood and Storm Control (NSFSC)
Provincial National Center for Rural Water Supply and Sanitation (CERWASS)
Provincial People' s Committee (PPC)
The Center for Promoting Development for Women and Children (DWC)
The Vietnam Institute for Water Resources Research (VIWRR)

MONRE
special and protection forestry land mangement, including wetlands

MONRE
general land use planning; overall natural resources management, including internationl coordination within basin

MARD
management of trees on special and protection forestry land; support CPC for mangrove management

MARD
irrigation, drainage and rural water supply; cultivation land management; dike manageent and flood control; fishery

MOC
urban development and urban water supply

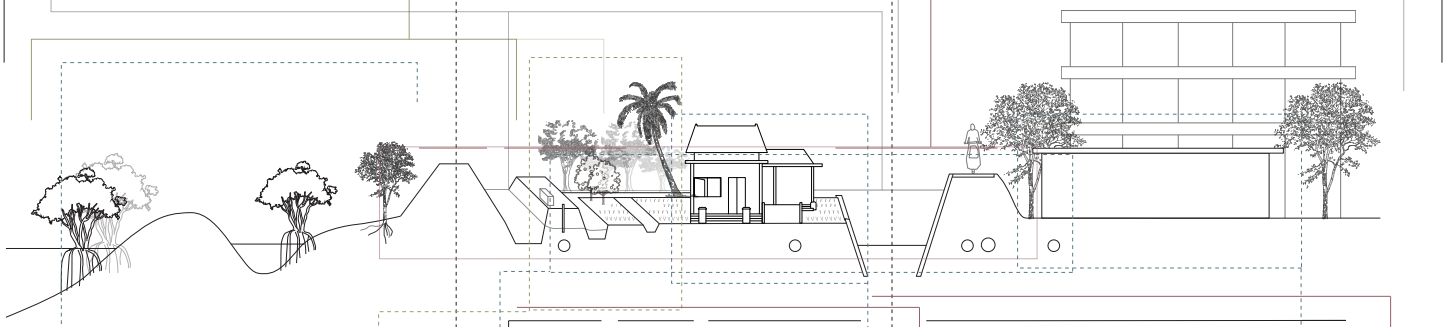
Other ministries
(Health, Industry and Trade, Science and Technology, Transport, Finance, Planning and investment)

State Forest Management Board
monitor and enforce legislation and policies of special and protection forest land management to protect biodiversity and risk defence

***** (no direct department for mangrove or wetland management)

Research
VIWRR
contribute to analyze problems, monitor, simulate and develop concepts

NCFSC
national committee office; responsible for main Day River flood division control



Individual, Households, Communities, Private Corporations
have right to use, transfer,lease, inherit, etc to invest market and support protection

***** (part of low-productive proetction forest land might also be included)

People' s committee
PPC
implement and enforce the Land Law; evaluate and approve organization plans of land conversion

DPC
evaluate and approve household and individual plans of land conversion

CPC
exercise state authority over land; temporary management of unallocated land

Civil organization
DWC
organize multi-actors participatory activities and help buidling capacity for locals

Rural supply and sanitation
Private water companies
State-owned enterprises
Agricultural Cooperative
Community management
District People's Committee
CERWASS

Urban water supply
Water service companies
Urban Environmental Companies
***** (private corporations' participation in urban water supply is limited to Build-Operate-Transfer (BOT) contracts for drinking water treatment plants.)

International organization
ADB
Worldbank
Germany
The Ramsar Convention
Japan...

Forest | Land | Water

Limit

Red River Basin is almost evenly distributed between Vietnam and China. In the projection 2061-2080, precipitation, which is the main water resources in the basin, will change abnormally due to human activities and climate change, as rainfall and temperature are important to land production capacity. The most significant influenced area is in the middle part of the basin, where includes two Chinese and four Vietnamese hydropower stations. Other projects within the basin are related to new highways, historical railway, solar power, and other financing and delivering projects. Due to the deforestation and erosion upstream and cultivation downstream mainly, delta becomes generally wet due to the growing discharge through the year becoming more evenly while the weather becoming more bipolar between dry and wet under climate change

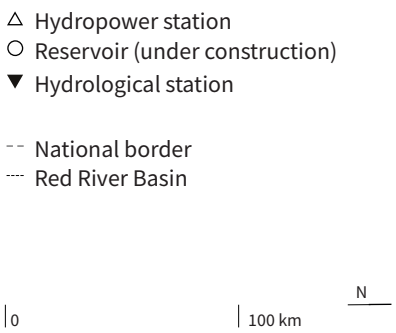
As a transboundary water body, the main issue is the nondisclosure of information and interests sharing between China and Vietnam. Though River Basin Organization has been established, it functioned less than it proposed to coordinate with others. Besides, as scales jumping from local in alteration to international here, it is interesting to look back- how to promote the figuration of local communes or associations with original diversity to move forward as one, down to the resources and labor?

(Geo)Politics

Transboundary water body

Under the projection of future precipitation and temperature change, the map shows the location and capacity of existing important infrastructure in transboundary river basin include hydrological stations, hydropower stations, and cross-regional transportation links.

Fig 4.19 Source from Pham et al., 2019. Le, 2018.
Elaborated by the author



1
Nan Shan (2007)
0.21 km³
0.7 billion kw·h

2
Ma Du Shan (2011)
0.55 km³/ 19.2 km2
1.3 billion kw·h

3
Son La (2012)
3.1 km³/ 440 km2
1.2 billion kw·h

4
Hoa Binh (1994)
1.6 km³ / 208 km2
0.8 billion kw·h

5
Thac Ba (1970)
2.49 km³/ 234 km2
0.5 billion kw·h

6
Tuyen Quang (2008)
2.3 km³
1.33 billion kw.h


Laos
Vietnam
China
Kunming
Lao Cai
Yen Bai
Hoa Binh
Vu Quang
Son Tay
Da River
Lo River
1
2
3
4
5
6

Laudato si'

manifesto

Arable land is changing, though Vietnamese already bear in mind from the past that nature is originally a resource to use. But now it' s being transformed or rewilded to allow water flow and pollution mitigation. Hydrological awareness is embedded in the care about groundwater recharge, wastewater retreatment, and rainfall capture. Localized economy is strengthened, and the new opportunities and techniques leave the land to rest and the soil to regenerate for some time. Locals are not in a hurry to farm as before. People know where they can go for a shifting experience and let the land and soil be ready for the next flooding. Infrastructure for expansion is seeded and weaved with agroforestry and mangroves, and new types of settlement as well，regarding the continuity and wise use of ecosystem services-for the capture of nutrients and sediment with local materials.

Departments collaborate with locals for environmental decision-making and learn from each other, while Vietnam and China are clear of the interests and responsibilities they shared in one basin. The prosperity from diverse production, the shifting habitus, and cultivation from migration might contribute to the essence of private companies like seed and hydraulic as the new local activated welfare places. Local people finally realize that they can express and protest for themselves and their land there.

Though the development might not be universal, the new forms of landscape and humanity change with the weather, trying to break this unseasonal expansion and exploitation cycle.

Projection

Fig 4.20 Projection drawing

By integrating the understanding of dynamic biophysical, physical and socio-cultural aspects of delta performance in a deconstruction way, risks and vulnerabilities of delta scale are recognized and assessed in three aspects of climate vulnerability, water system instability and ecological degradation to understand systems, and further to seek opportunities for the delta.

The list below gives possibilities to transform the current project-territory relation.

Opportunity/ Conclusion

Water

-

Groundwater recharge
Surface water retention
Wastewater from industry

Land

-

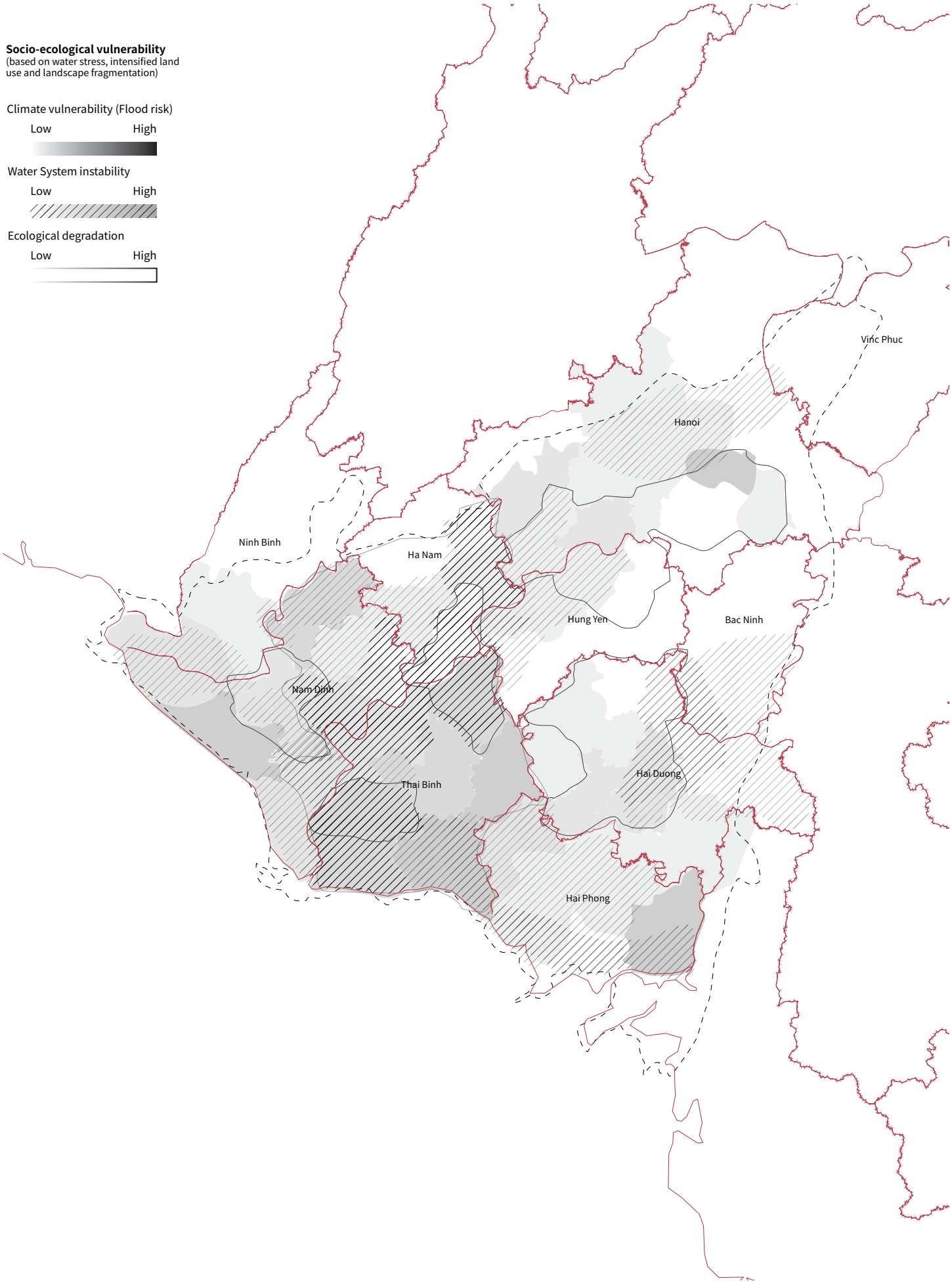
Strategic expansion
Knowledge sharing and accessibility
Land productivity

Forestry

-

Landscape continuity
Soil retreatment
Water defense

Fig 4.21 (right) Socio-ecological vulnerability based on the current delta performance
Made by the author


Socio-ecological vulnerability
(based on water stress, intensified land use and landscape fragmentation)
Climate vulnerability (Flood risk)
Low
High
Water System instability
Low
High
Ecological degradation
Low
High
Vinc Phuc
Hanoi
Ninh Binh
Ha Nam
Hung Yen
Bac Ninh
Nam Dinh
Thai Binh
Hai Duong
Hai Phong

5 LOCAL PHENOMENA

Local knowledge of materials

Social movement and physical capital

LOCAL KNOWLEDGE OF MATERIALS

for construction, for communal pond, for managing irrigation

In addition to concrete, other main common local materials also include rock, clay, and bamboo. According to the investigation, as shown in the picture, bamboo is not only used directly as a habitat by animals like birds but also artificially used for river reinforcement and infiltration. The drawing of dam construction in the past shows a flexible combination of those local materials (Vrolijk, 2002).

The public ponds in the settlements or front of the pagodas are often used as water retention ponds in communities. Common vegetation inside usually are lotus and water hyacinth, which are both aesthetically valuable and suitable for aquatic life. However, in these farmlands with incomplete facilities, a lot of solid waste is discarded and can be concentrated in drainage outlets along with irrigation and drainage, which poses the hazards of pollution and congestion of water outlets.

The current administrative group always collect statistics of future annual demand on irrigation water demand in advance and report it from the community to the water management department. But uncertainty can be brought by the changing production due to the changing seasons. At the same time, the current irrigation condition in rural communities usually has two groups of stakeholders involved, one is farmers, and the other involved managers and experts belong to another group. The shown gap between still needs to be improved with the use of local resources and maintenance of infrastructure, and an intermediate level to communicate with the bottom and let them participate. It is also pointed out that well-developing communities with their irrigation groups usually show more willingness to participate (Lin, 2008).

Source: Gooogle street view, 2020

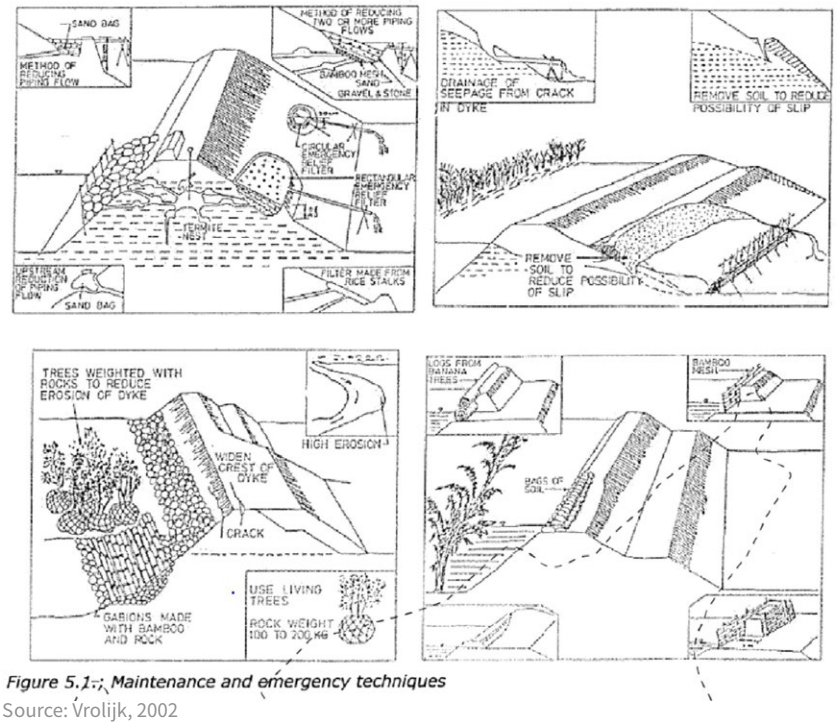


Figure 5.1: Maintenance and emergency techniques

Source: Vrolijk, 2002

Source: screenshot from "Vương quốc của các loài cò ở Hải Dương | VTC." YouTube, uploaded by NOW TIN MỚI , 2016

Source: Vrolijk, 2002

Source: Gooogle street view, 2020

Source: nhandan.vn

SOCIAL MOVEMENT AND PHYSICAL CAPITAL

Understanding existing unequal social access to services and growing demands

Combining with the general function of each region, social condition is identified with stability and resilience, and equity related to costs and benefits, through the provincial-level population density, disaster-related telecommunication rate per capita, and trained rate over 15 years old. It can be found that large cities and more industrialized areas have higher population density; coastal agriculture-based areas have a higher telecommunication and broadcast rate, and the inland high rate may be affected by both the climate broadcast and needs from local business; while the education rate is mainly concentrated in major cities. Combined with the map of future population growth facing potential flood threats on the left, coastal communities need to strengthen the education resources and the distribution of information along the inland rivers.

In addition to the movement of population, it can be found that although people from the delta will go to the northern mountain region due to expansion of economic development, most of the outflow population has gone to southern Vietnam, and most of the inflow population chose Hanoi, Hai Duong and Ha Nam as the destination. This may be related to a higher job opportunities and less disaster risk.

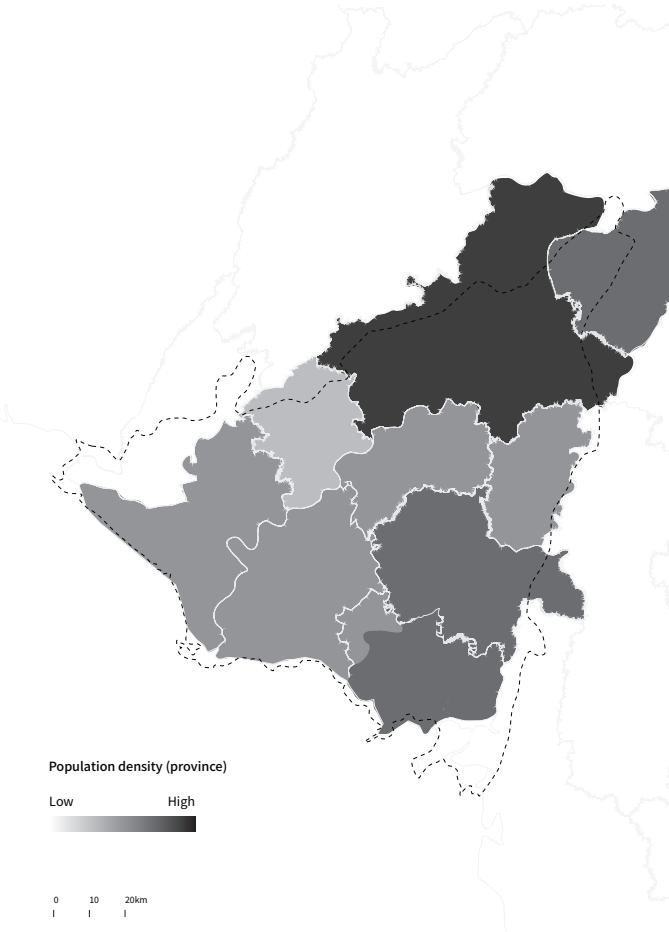
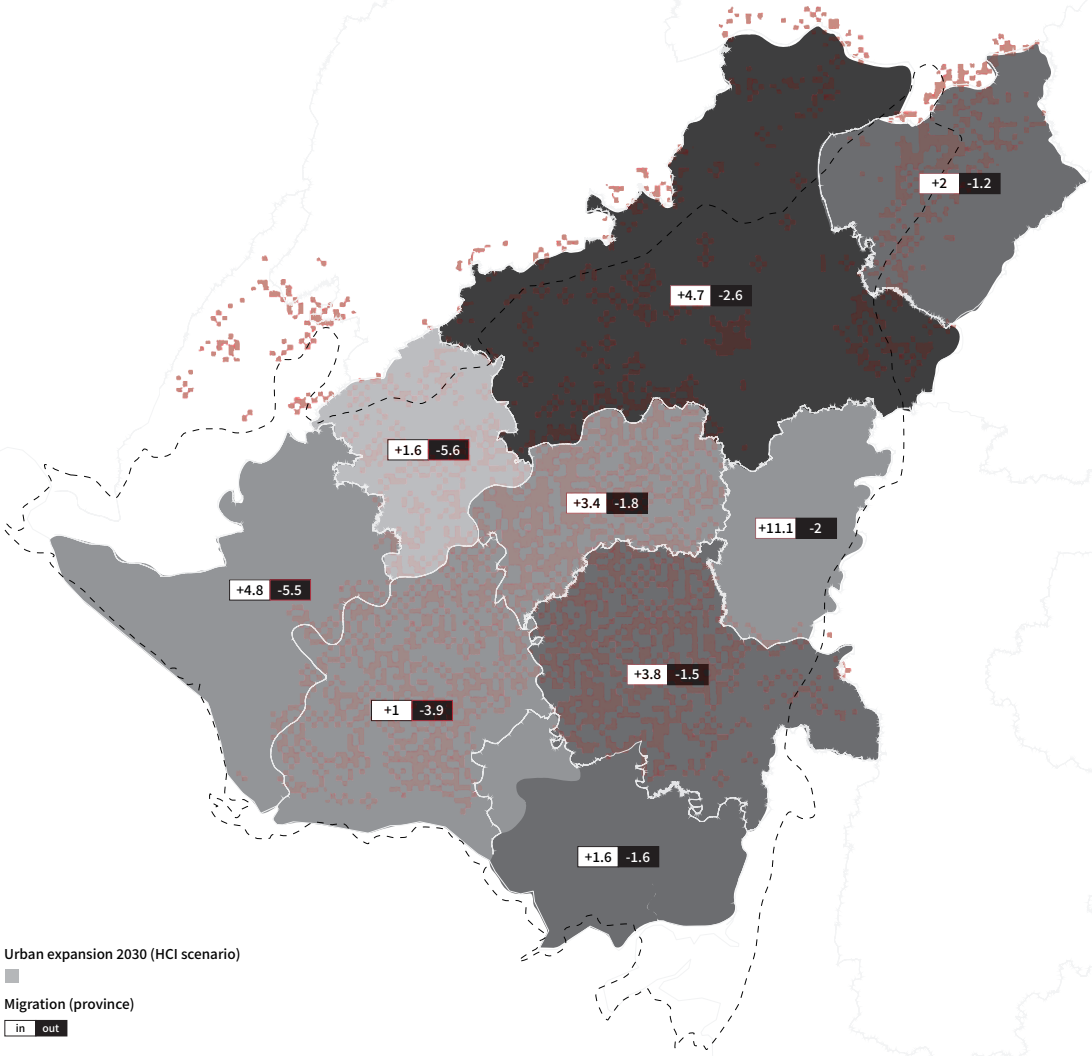
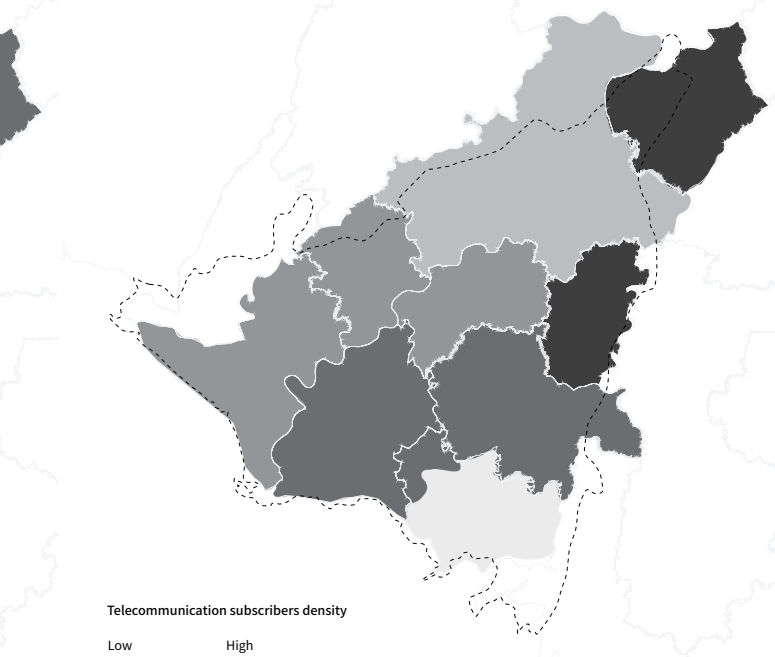
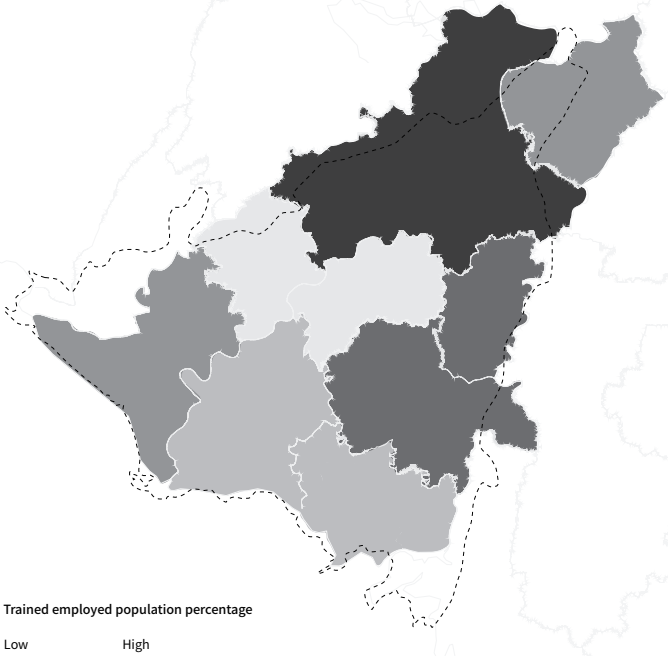


Fig 5.1 Future population growth facing potential flood risk and main trends of the movement of population map
Fig 5.2 Population density map
Fig 5.3 Disaster-related telecommunication rate per capita map
Fig 5.4 Trained rate over 15 years old map

Source from GOV, 2015-2018, made by the author


+2 -1.2
+4.7 -2.6
+1.6 -5.6
+3.4 -1.8
+11.1 -2
+4.8 -5.5
+3.8 -1.5
+1 -3.9
+1.6 -1.6
Urban expansion 2030 (HCI scenario)
Migration (province)
in out
Population density (province)
Low High
0 10 20km


Telecommunication subscribers density
Low High
0 10 20km


Trained employed population percentage
Low High
0 10 20km

6 PROPOSITION

Entering Proposition

Main principles

Temporal aspect

Reference study

Source: Screenshot from *Forgetting Vietnam*. Trinh Minh-ha, 2015

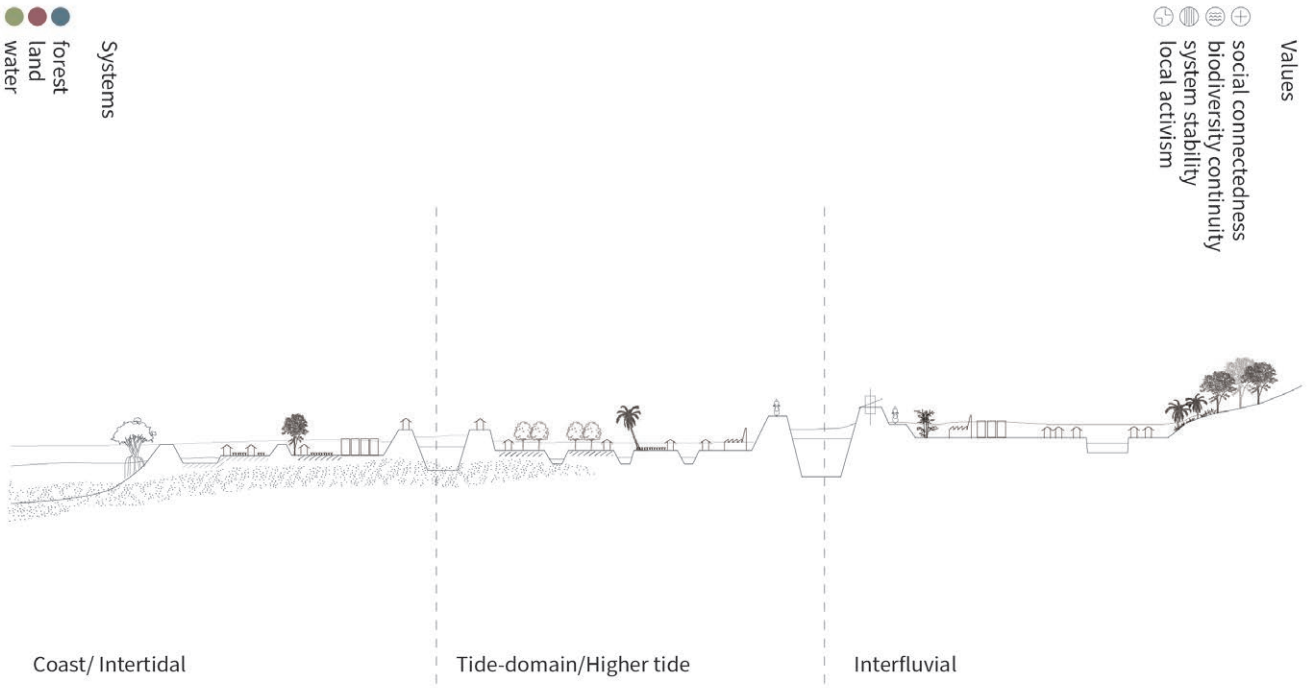
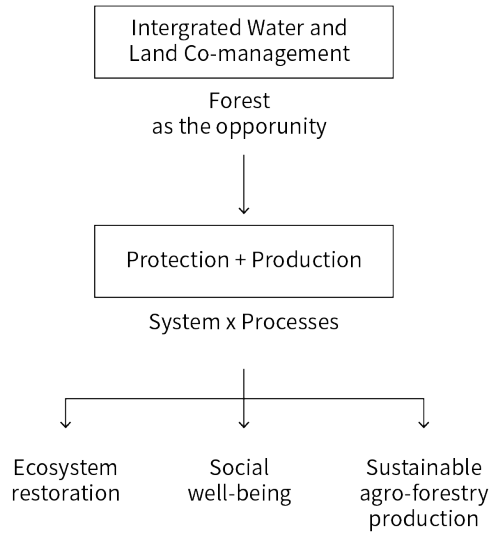


Fig 6.1
Linking spatial processes with focus systems and values, linking with the hydro-geological condition (fig 4.8, page 52)
Made by the author

ENTERING PROPOSITION

Exploring the selected scenario of synergy



(Working hypothesis from Fig 2.8, page 23)

The biophysical system is part of the remediation and development of the whole area, as vulnerability and risks are considered at a large scale. Later exploring design at the local is to see the potentials of the local economy as an intermedia process between risk and development.

Under the selected scenario of Wise Use Of Ecoservices And Resource Co-Management (MEA, 2005), the design proposition will focus on integrating water resources with land management by using forestry as the opportunity within three main types of cultural landscape (Sauer, 2007). The proposing social background is based on an accepted assumption of a slowly-growing population and economic growth at a certain loss.

Vision follows a proactive and ecosystem-based method, and be process-based as well. Design as a method is to explore interaction and intervention for three systems- water, land, forestry- towards expected values of social connectedness, biodiversity continuity, system stability and local activation. Vision and design in this project will start from a general idea for regional to the further opportunities and experiments exploration on meso and smaller scales, then back to regional by upscaling ideas and principles. The process will be mainly from deductive to inductive.

Performative Landscape as Vision

As transforming and cultivating land has been deeply embedded in Vietnamese culture, land cultivation has already been a consistent cultural identity of Vietnam. Performative Landscape is introduced as a vision towards evolutionary socio-ecological resilience, calling for a resonating synergy and co-existence between human and nature. In this project, it means restoring ecoservices and activating social facilities by multi-dimension ways of cultivation. Redundancy will be more about local scale, as to accept a certain variation to allow more capacities like room for water, and on the other hand, to control for example the use of areas

VISION	PRINCIPLE	MAIN STRATEGY	SPATIAL PROCESS
Performative Landscape (allow redundancy and contribute to enhanced hybridity of delta in protection and production)	clean water restore water access to knowledge	waste management wetland restoration sustainable production	along infrastructure paddy field communal space

TEMPORAL PROCESS	SOURCE	CRITERIA	VALUE
short-term dry season ainy season monsoon season long-term	Open source data Open report Documentary from artist and locals	water quality and quantity land use diversity sustainable livelihood	social connectedness biodiversity continuity system stability local activism

Fig 6.2
Proposition catalogue diagram
Made by the author

under expansion or contamination.

MAIN PRINCIPLES

Clean water, restore water, and access to knowledge are viewed as main goals and guiding principles. They are to explore the possibilities of the integration of those green, blue and social infrastructures which relate to three systems in order to approach a hybrid socio-ecological corridor. . The first two principles directly relate from the biophysical to local hydrology cycle across scales while the third is more about services and functions connected with the regional network from socio-related perspectives at smaller scales.

a. Clean water
This principle mainly focuses on ecosystem-based strategies, including phytoremediation, soil cleaning, and sustainable production. Sustainable technology for example the smart one to promote production and to monitor shallow aquifer quality might be considered as well but not the domain one.

b. Restore water
Water restoration considers the groundwater recharge and surface water retention, in order to manage runoff and riparian landscape as well. Spatial interventions include modifying the width and depth of permanent or temporary waterscape or wetlands and creating new water surfaces such as a seasonal lake.

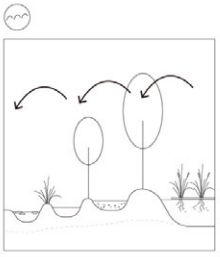
c. Access to knowledge
This principle is to discover the potentials of social infrastructures. Improving accessibility is also to approach social connectedness and equity, reopening the enclosure of rural as both being raw-material and labor extractive.

Principles can be further explored into different types of systemic interrelations, including socio-environmental ones, among those three systems and their elevated approaches, then give phase to decomposition possibilities to transform. Cost and benefit concerning the involved interventions and outcomes about the ecological footprint, production, and protection can be discussed.

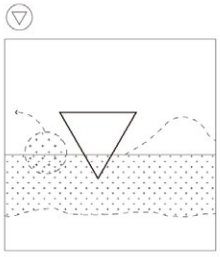
Main Strategies and Spatial processes

Main strategies further research land cultivation, urban occupation, and water consump-

Clean water



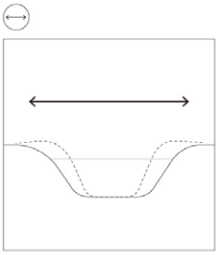
Phytoremediation



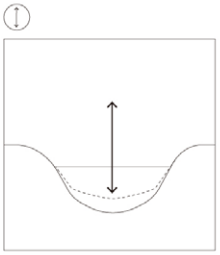
Soil cleaning

Sustainable production

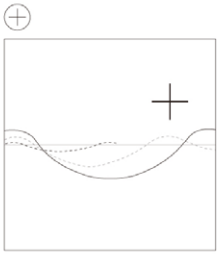
Restore water



Waterway width modification



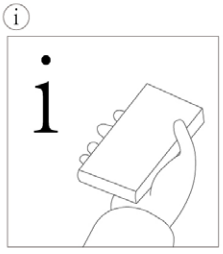
Waterway depth modification



New water surface

Access to knowledge

Social infrastructure activation



Public participation

Integration with tradition

Fig 6.3
Main design principles
Made by the author

With images from:
baoquangtri.vn, 2020
baobinhdinh.com.vn, 2017
Google street view, 2020
Satsuki Shibuya, 2015,
thaithuy.thaibinh.gov.vn, 2020
camgiang.haiduong.gov.vn, 2021

tion, responding with sustainable production, wetland restoration, and water management. The spatial processes are mainly being categorized by the project interests in rural and peri-rural:

a. along the infrastructure between urban and rural always with possible future infrastructure expansion and farmland erasure with ownership change;
b. paddy field as artificial wetland and soil degradation under poor management and exploitation;

c. communal space inside the community like lotus pond and sluice gate as common source pool.

The conjunction points of spatial process and water, land, and forestry systems allow a set of actions to build up multi-scalar visions. Thus, those spatial processes can be further explored in those potential morphologies of:

a. Land system- industry, pagoda, floodplain, VAC, rice-prawn/shrimp, ecotourism, railway, and transportation stations...

b. (Agro-)Forestry system- wetland, urban park, orchard, mangrove... related with hydrology cycle,

c. Water system- recharge, retention, infiltration, retreatment...

Temporal processes

Temporal processes connect with both activities of ecological restoration and local transformation. Local transformation is usually more frequent and shorter than biophysical activities. The temporal scale evaluates the needs for a certain long term to include local actors to stabilize and promote the performative local economy and social well-being. Long-term is composed of the dynamic movements of water, soil, biodiversity, and land-use changes; while short-term processes assess water fluctuation from drought, rainy to monsoon with local socio-economic events including festivals and production processes. The temporal scale assesses local ways of using territory in robustness and adaptation in the long term to generate better to stabilize water with land cultivation as a whole.

Criteria for design and assessment

The main body of assessing performance focus on water quality and quantity, land use diversity, and sustainable livelihood, in terms of climate vulnerability, system stability, and ecological degradation.

Reference of Sustainable Livelihood Assessment help to recognize the existing vulnerabilities and various owned or required capitals, thus prioritizing and organizing adaptation and mitigation needs. The five main capitals are:

a. Human capital- health, knowledge and skills, food, etc.

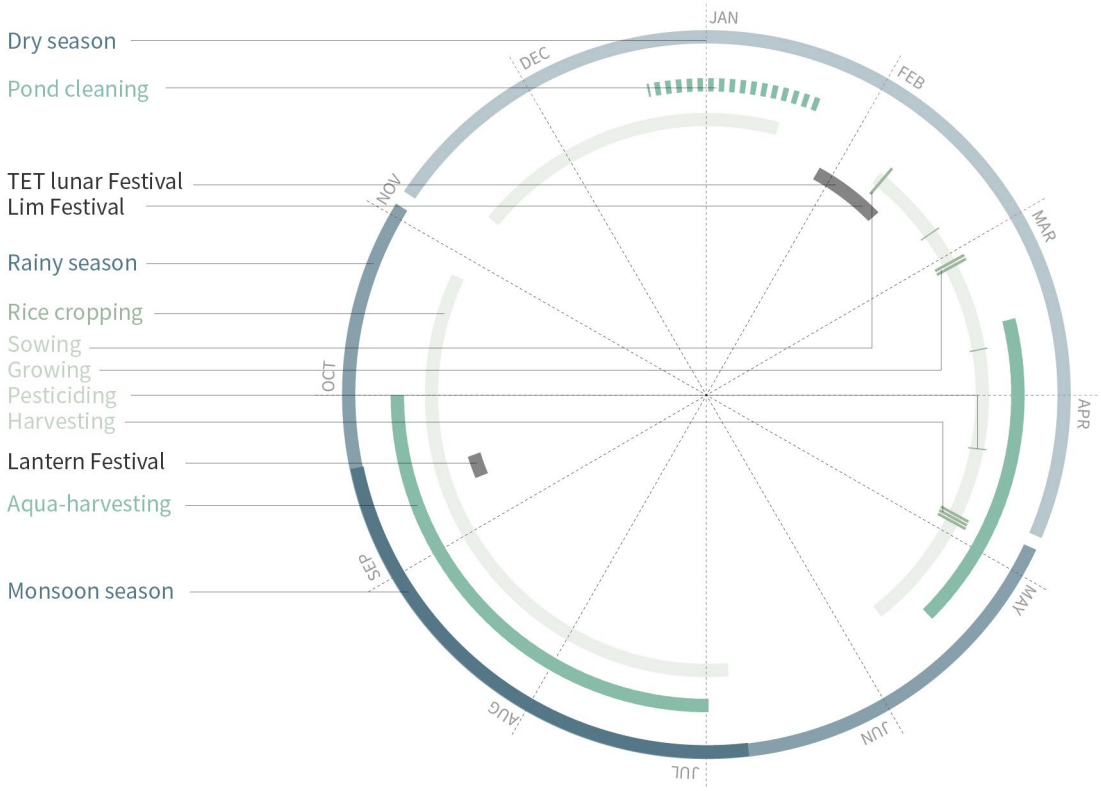
b. Natural capital- natural resources that support life, disasters, and climate variability like drought events, etc.

c. Social capital- population growth, social networks related with engagement and participation, etc.

d. Financial capital- return to labor, etc.

e. Physical capital- access to infrastructure and social facilities, etc.

The details of the indicators and assessment in this project are limited. However, the following research in local households in Northwest Vietnam can be used as a reference:
Huong, N. T. L., Yao, S., & Fahad, S. (2019). Assessing household livelihood vulnerability to climate change: The case of Northwest Vietnam. Human and Ecological Risk Assessment: An International Journal, 25(5), 1157-1175.



TEMPORAL ASPECT

Short-term awareness of socio-economics (and cultural) events and seasonal dynamics

This tells that the shifting of seasonal production models relates to external water events, and further the intensity of cultivation. It also supports the flexibility and opportunities through spatial and social distribution- green job opportunities, a combination of public space with propaganda, recreation, and vocation, further the community patrol and monitoring. It can be used in transects of intermediate scale to project and facilitate possible adaptation strategies, to restore human and social capitals. This time takes coastal area as an example, while inland might have subtle differences, such as an advancement of the flood period and the delay of the saline intrusion.

Fig 6.4 (top)
New year ceelebration and traditional food making
Source: visa2vietnam.blogspot.com

Fig 6.5 (middle)
Diagram of short-term socio-economic temporal scale
Elaborated by the author

TEMPORAL ASPECT

Long-term awareness of biophysical dynamics and land use diversity from regional

This shows the ecological performance that may result from doing nothing- proposed growing population and urban expansion of current pace. The performance is composed of water dynamics, land occupation, and ecological diversity. For example, water fluctuation can be accelerated by low surface permeability and external climate change; ecological diversity could be restored by wetland and mangrove conservation, and a growing orchard-based production model might as well. Forestation and soil cycle change such as activities of cutting and filling due to regional huge residential or infrastructure projects influence biodiversity together.

This diagram shows the system interdependencies embedded. It can help to understand the different leading factors under different biophysical and geographical conditions, to adjust the strategies that guide cleaning or restoring water or social development, as well as the joint participatory decision-making of different levels and the allocation of financial responsibilities.

The adaptive capacity of the region is represented in the diagram. On one hand, the decision-making itself requires regular periodic evaluation and assessment. On the other hand, strategies and interventions can be tested in-between, and vice versa, adjust the scope of application.

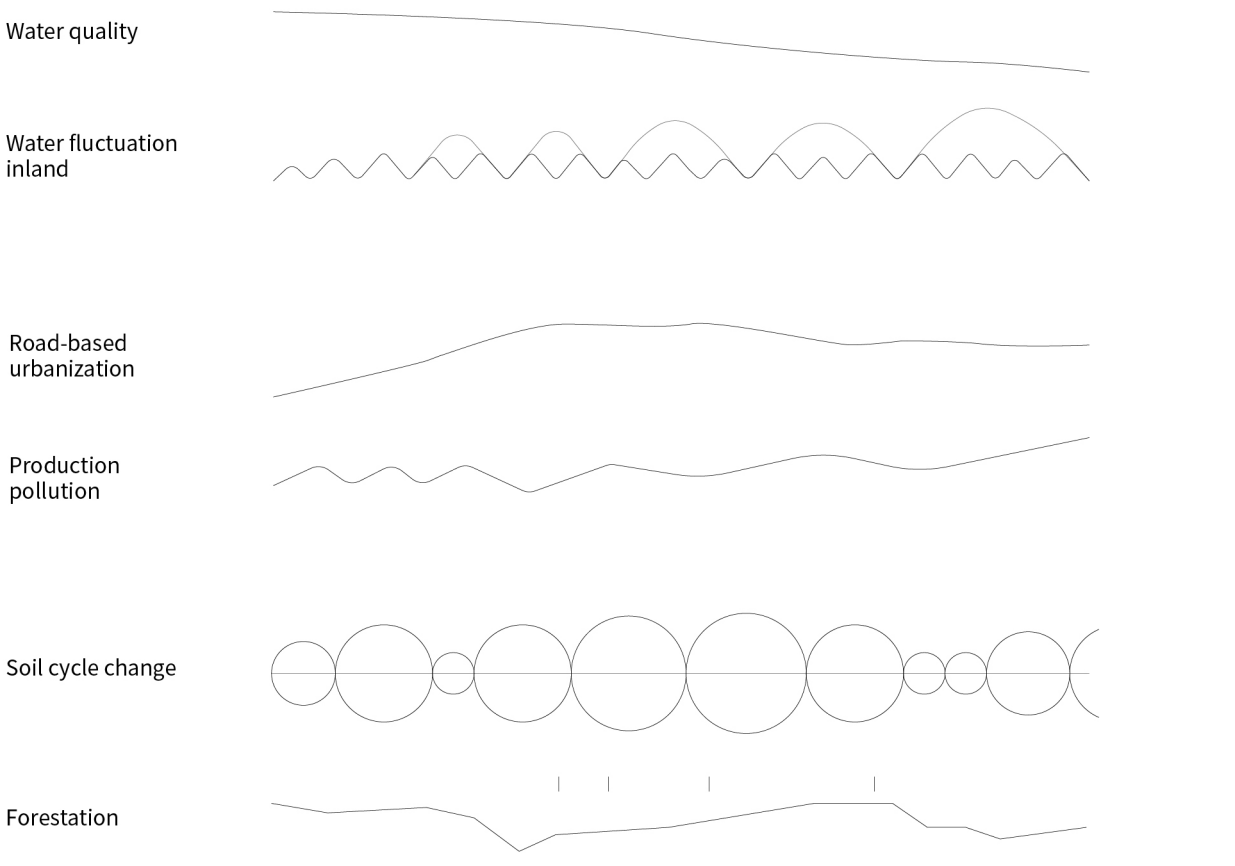
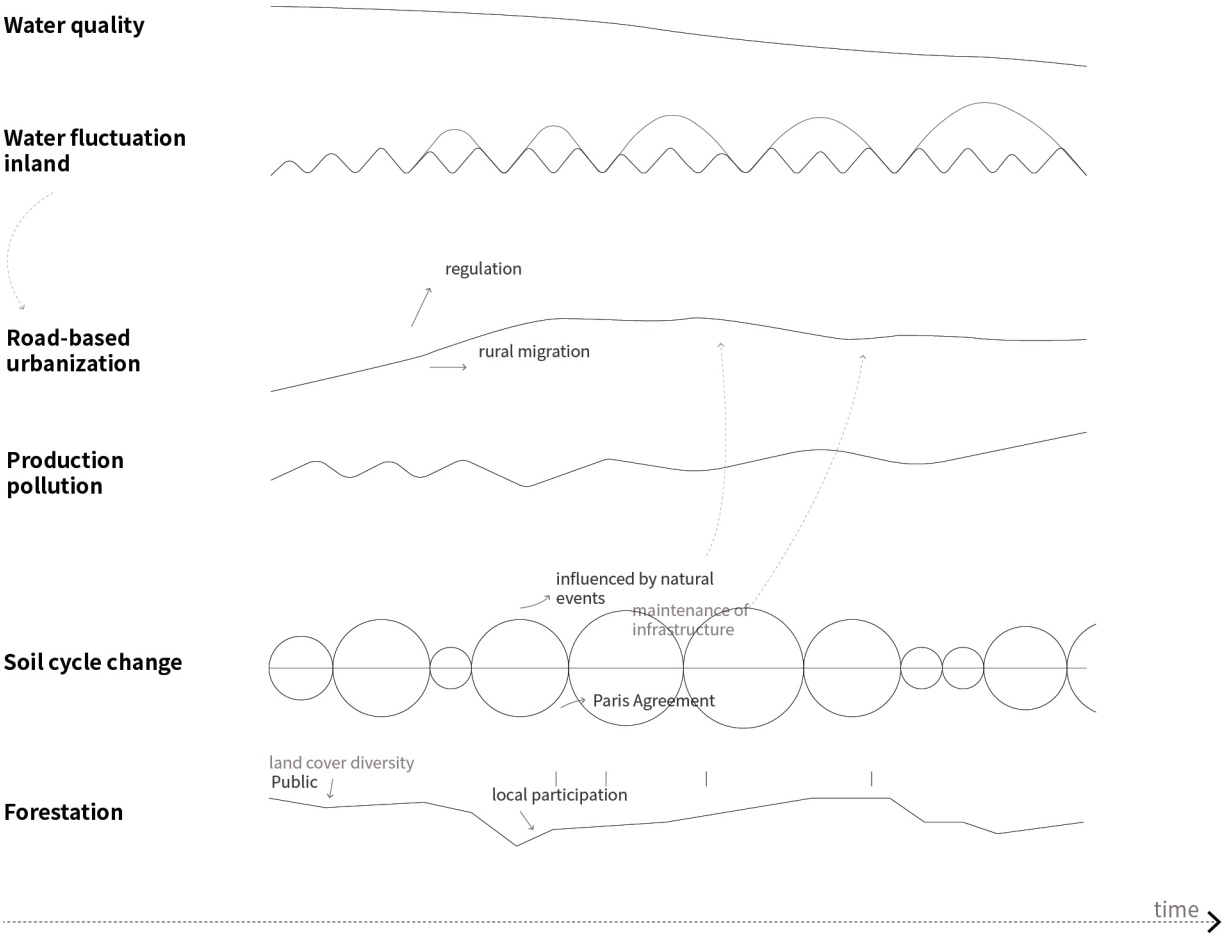


Fig 6.6
Diagram of long-term temporal scale (left) and a further reading of long-term temporal scale dynamics (right)
Elaborated by the author



REFERENCE STUDY

Weiliu Wetland Park

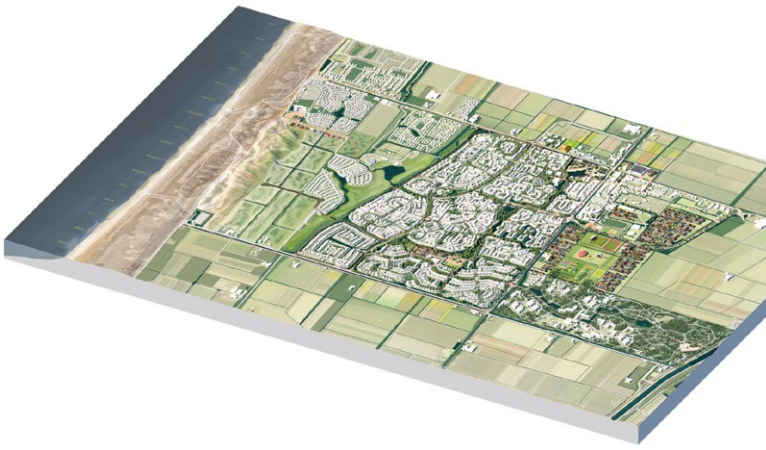
"Weiliu Wetland Park." Landezine, 2019, http://landezine.com/index.php/2019/01/weiliu-wetland-park-by-yifang-ecoscape/

Blue-green infrastructure. The project integrates adaptive flood management with wetlands restoration and construction in Xianyang city in Central China. The project also combines submerged wetlands, rainwater collection with urban parks, and at the same time protecting habitat and biodiversity, regulating and supporting recreational function as well. The design includes rewilding the riverine and giving robustness to the original dam landscape. Cost and benefit are well-considered with testing water quality and water recycling and reuse rate. The average construction cost of the park covers the number of biome communities, the purification capacity of wetlands, and the satisfaction and space preferences of users from different age groups.

PANORAMA LOKAAL - Julianadorp

https://www.fabrications.nl/portfolio-item/panoramalokaal-julianadorp/

This reference case explores non-radical intervention and methods in a dutch rural village. The project tries to activate community public spaces like courtyards. Water supply system is considered as an opportunity to increase social cohesion, and to follow the current sustainable trends of climate, energy, biodiversity, and circulation, etc. The design includes attempts to restore the connection between the village and the landscape, the sea and nature in a confined space, inclusive housing and sports space to ensure health, and replenishment of groundwater to ensure aquifer mobility and quantity to mitigate salinization and sedimentation-sensitive agriculture. The overall design is based on taking the growing spatial fragmentation in the village as an opportunity. Planning and development also consider socio-political aspects, like land consolidation being more preferred to facilitate functional transformation and mixed development.



'Small Project'

https://new.qq.com/rain/a/20200409A0PO0M00

Architect Liu recently used a bookshelf to turn his house into a dual-use of a normal shop and his design studio. In the traditional Guangzhou old community, the new-built bay board is used to enclose the yards inside. But the bottom of the boards is not sealed, allowing outdoor activities to create inner spaces. Through the rice paper, the light of the studio became the soft as the background supporting the exhibition. The shop pays attention to daily objects in traditional life and observes people's different perspectives upon them. Just a rice bowl, can be an architect for the food. We should learn from this attitude towards meticulous vernacular and objects in everyday life.

Local monitoring project in Myanmar

Thatoe Nwe Win, T., Bogaard, T., & van de Giesen, N. (2019). A low-cost water quality monitoring system for the Ayeyarwady River in Myanmar using a participatory approach. Water, 11(10), 1984.

The participatory approach in this case can be used as a reference for community co-management. This research was conducted in Myanmar for a low-cost water quality assessment by using a local mobile phone app as a sensor and test strips. Involved indicators are water discharge level, water turbidity, ph, electrical conductivity, nitrate, etc. The requirement of participators is mainly young volunteers from the official water department and local teachers, and especially living close to the river more preferred due to less commute and longer-term to participate. The app is still under development, but without a doubt with these weekly-collected data, the participatory from the local scale is increasing a higher spatial and temporal resolution of quality monitoring,

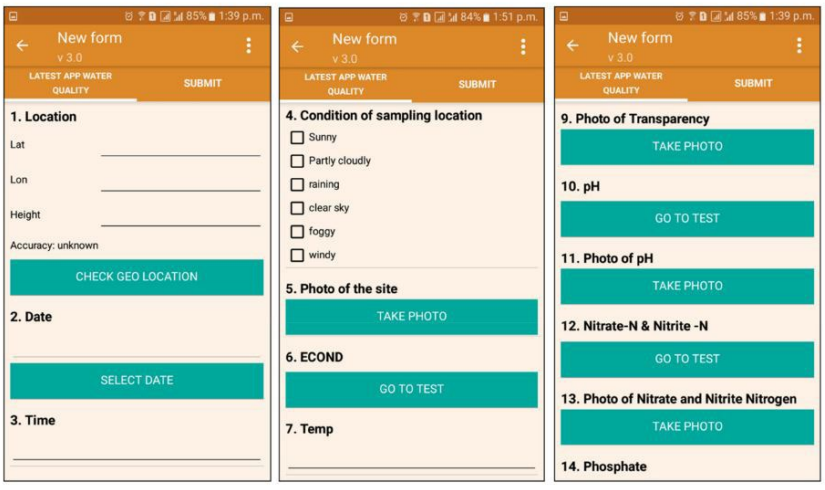


Figure 2. Flow application and survey form.

7 EXPLORATION

[Deductive - Intertidal Thai Thuy]

Exploratory catalogue

Current performance

Relation project-territory

Main strategy

Local intervention and phasing

[Inductive - Delta]

Seeing the future structure of the delta

Vision

Presence of Water in Vietnamese culture. Screenshot from *Forgetting Vietnam*. Trinh Minh-ha, 2015

EXPLORATORY CATALOGUE

Entering the exploration at intermediate scale

VULNERABILITY

Water system stability
Climate vulnerability
Ecological degradation

OPPORTUNITY

National economic corridor
Social diversity
Bioshpere conservation

CASE FOCUS

Freshwater supply and pollution at coast;
Sustainable saline-tolerance production;
Community participation in facility maintenance.

(These are related with problems at a COST of loss of yield, access to fresh water, rural sanitation and health...)

SPATIAL

LAND.
paddy field, aqua pond, mangrove field
URBAN.
market, settlement, industry, pagoda
WATER.
communal pond, canal, sluice gate

SOCIAL

Household-based
Collective
Rural migrant

TEMPORAL

Salinity, monsoon, flooding, drought

MAIN INTERVENTION

Sustainable production
Social infrastructure
Wetland restoration

MAIN ACTORS

Directly: farmer, rice company, cooperative;

Indirectly: commune, committ, monre, mard;

Regional: hunre, fao, irri, wb, vm?,agricultural extensive club

LAYERS

[WATER-related infrastructure]
road depth
water infrasructure- sluice, dike, canal,
wastewater concentration
normal, drought, rainy, flooding, saline water
sedimentation, erosion

[URBAN development]
lowland+geology
urbanization growth
population density
facility(market, school,)
political border/ ditric
poverty

[LAND cultural landscape]
intensified production
green landscape
market, processing,

Fig 7.1
Case study of Thai Thuy District, with 1km grid
Source from Google map

Thai Thuy District
CURRENT PERFORMANCE

Water quality and water quantity

The entire province locates in the tropical monsoon zone, and the annual rainfall is about 1,700-2,200 mm. Since the upstream flood has almost dispersed till the coast, the sea level rise and saltwater intrusion are relatively more severe than the flood in rising water level in this case. As a branch of the Red River into the sea, Diem Ho is mainly the most vital drainage river in the irrigation system of the northern province, flowing through the middle of Thai Thuy district, thus the quality of the surface is very susceptible to pollution from domestic, industry and production discharge. While geological sediments are formed in a mixture of upstream and tide, which allow a lot of water to store inside, but also pollutants and salt as well. The groundwater level is relatively shallow and easy to be exploited and used for irrigation. It is usually 1-1.5m underground in the dry season and less than one meter below the ground in the rainy season, but there are obvious uncertainties in acidity and turbidity (TBG, 2018).

Urban occupation

Coastal communities prefer more land consolidation to unify water supply and drainage. Domestic water is mainly supplied by deep groundwater extraction by state-owned or private companies, and the collection and use of rainwater. In the province, inside of large lakes or ponds, a small pond is the main form of water surface. Settlement is often formed along with these small ponds because people often fill up the ground by digging out soil in the pond, responding to the tidal impact as well. Settlements and ponds show the trend of road-based infrastructure and urbanism. Ponds are also one of the sources of freshwater supply (TBP, 2017).

Production Economy

Thai Thuy district with a population of around 250 thousand and an average annual income per capita of 1550 dollars, is the main agricultural economic sector in the district (TBP, 2017). But land subsidence and frequent cultivation will also increase indirect resource consumption and inefficient fertilizer input. The main productions in the region are the rice in lowland and usually those like vegetables, orchard, and medicinal materials which are relatively sensitive to floods in highland. Land consolidation has also prompted semi-industrial fish and shrimp farming along the coast. As for economic benefits, movement of labor and migrant workers-relatively having weaker bonds with the land and culture-are easier to cultivate natural land without management, outcomes including the reduction of mangrove, and the lack of maintaining canals and collecting garbage.

Development opportunities

The region locates in the planned Thai Binh Economic Zone, along with high-speed economic ties under construction connecting between China and central Vietnam along the coast, and the other connection with inland to Hanoi. Therefore, there is a promising future with an increase of service facilities and job opportunities along the road, but with the erasure of farmland and certain local livelihood as well; Local communities might have developed a

certain mechanism of natural protection and habitat preservation, and their knowledge of local plant and biome communities should be considered in cooperation with regional ecological restoration under risks and development.

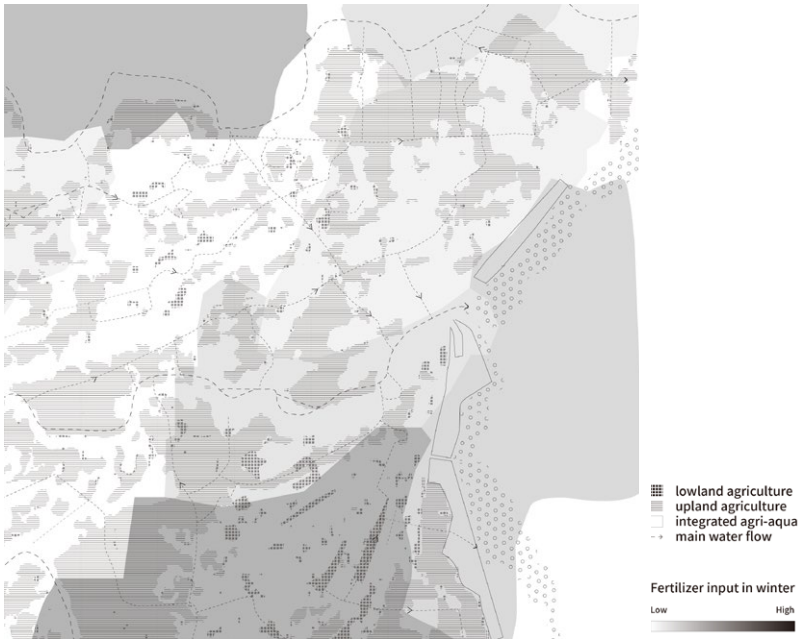
Social perception about trade-offs

The two main aspects from the farmers' perspective are profit and rights.

In terms of income and yield, farmers may be dissatisfied with the non-increasing net income. Besides the poverty situation, the fact that when the price of food rises, the corresponding fertilizer and seed labor will increase should also be aware of (Anh, 2019).
In irrigation management, farmers often build tertiary and fourth-level canals themselves, but the management irrigation fees that need to be paid to the government contradict their maintenance costs. The initiative of farmers in irrigation activities or the possibility of obtaining external professional technical support during community construction is also an aspect influencing local sustainable intention and motivation.

Fig 7.2 Mobile vending on the street
Source from Google street view

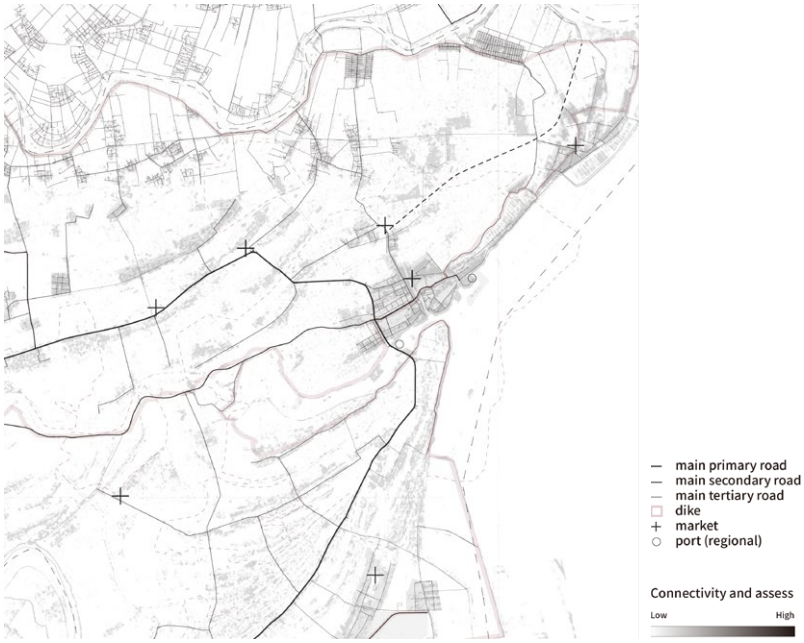
Fig 7.3
Gradients of three systems' conditions
Source from OpenStreetMap, 2020. Can et al., 2010
Elaborated by author



[LAND] PRODUCTION

Production landscape is mainly composed of farmland and coastal mangrove. The highlands that rely mainly on vegetable cultivation in the south are susceptible to the dual pressure of salt intrusion and fertilizer input for vegetables, especially in winter. There are certain limits in distinguishing production landscape only from satellite map in this project.

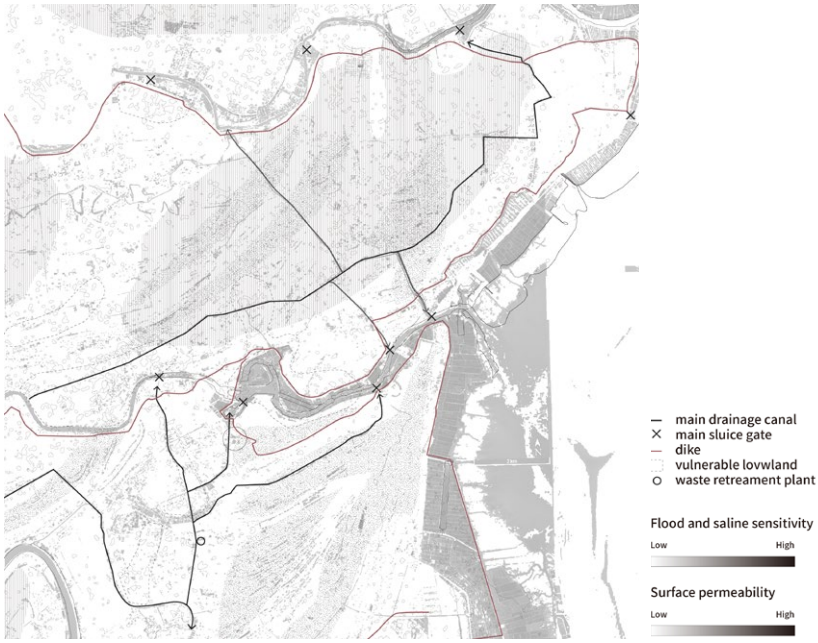
1 production landscape
2 fertilizer input in winter
3 main waterflow
4 mangrove
5 elevation



[URBAN] CONNECTION

The development of space such as towns and markets also indirectly interferes with the highlands by diachronic cut-and-fill movements. The main roads connect the market and port as the main material exchange places in food chain. This occupation should further explore the connectivity of assess to water and waste management. Values regarding to safety and well-being for commute landscape including motorcycles and water transportation under the regional ecological framework need to be enhanced as well .

1 road connectivity
2 market
3 urban area
4 dike



[WATER] FUNCTION

1 geology and soil type as infiltration capacity and permeability through surface
2 lowland as flood-prone in summer and salinity intrusion in winter
3 surface water body, mainly composing of nature waterway, canal, aquaculture, household and community pond and shrimp farm.
4 main drainage canal and sluice gate connecting main river
5 freshwater reservoir, in highland communal pond for irrigation, shrimp farm for adjusting salinity, along river for pumping and supply
6 livestock factory as one pollution source

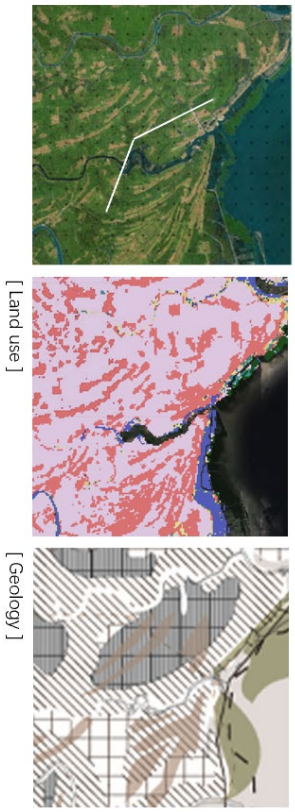
RELATION PROJECT-TERRITORY

Dynamics and inefficiency across existing three systems

The compound profiles extract the main spatial processes and related infrastructure between urban and rural in this coastal intertidal case. The drawing lists the current main problems about resource consumption under external environmental pressure related to three systems.

This method is to use design as a method to experiment- to relink and reorganize functions and networks with jumping lines, to connect gradients of interdependencies between actions across three systems, in order to optimize the use and efficiency of resources, as a reflection on the way of cultivation.

Relation Project-territory



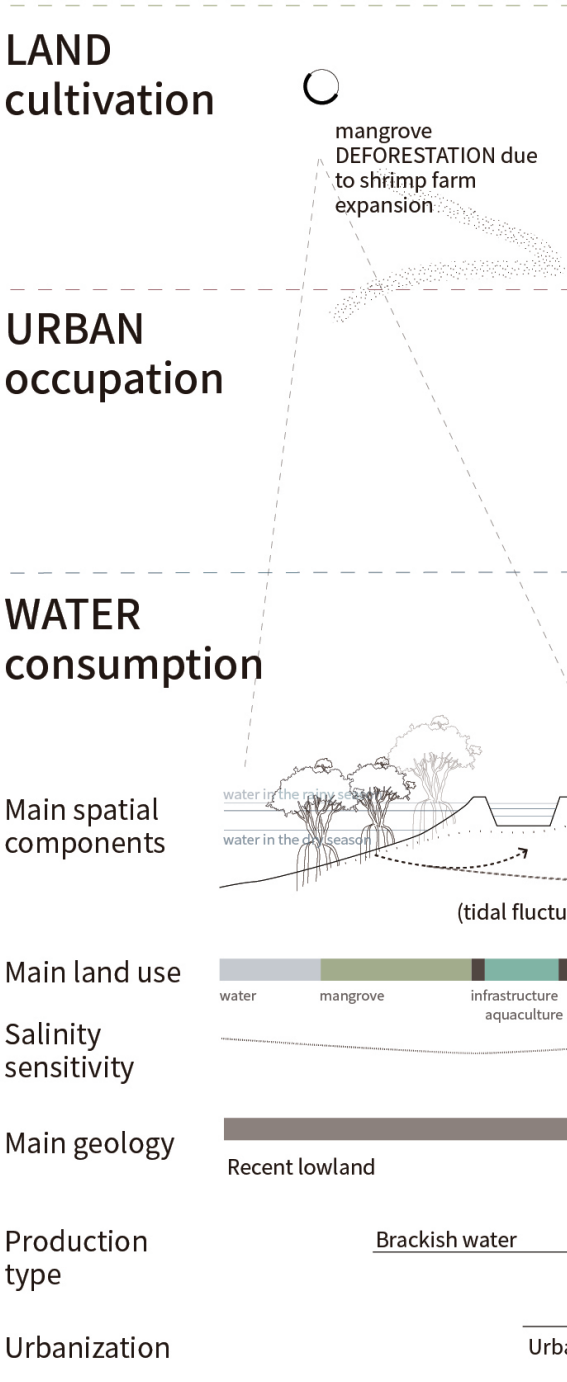
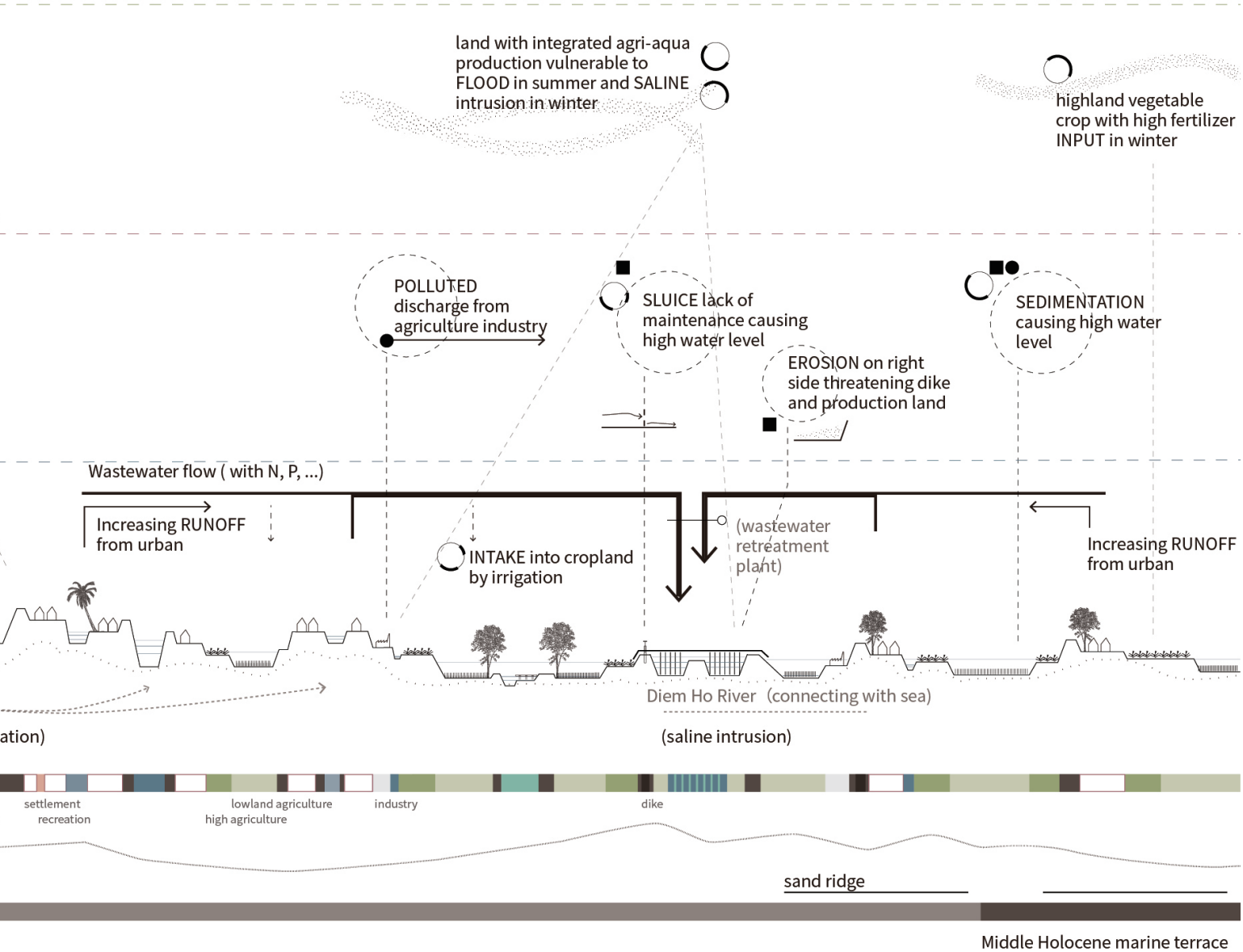


Fig 7.4
Transect composition for re-organizing three systems with land use and geologial conditions and other processess
Made by the author

The current performance of local conditions has been studied through the form of transects combines with understanding its geological conditions and land use. The linear use of water resources related to consumption problems links to the current low efficiency of infrastructure maintenance and pollution. The main conflicts includes: the shallow groundwater layer is sensitive to salinity, and can become deteriorated by pollution infiltration; the gentle sediment can also lower the efficiency and function of infrastructure and elevate water level under insufficient management; a pond is more preferable in the area compared to a large water body like a lake.



MAIN STRATEGY 1/3
Wetland restoration

From water consumption to restoration

WATER
restoration

Fig 7.5
Developing intermediate strategy of wetland restoration with potential local interventions and related principles
Made by the author

Processes concerned

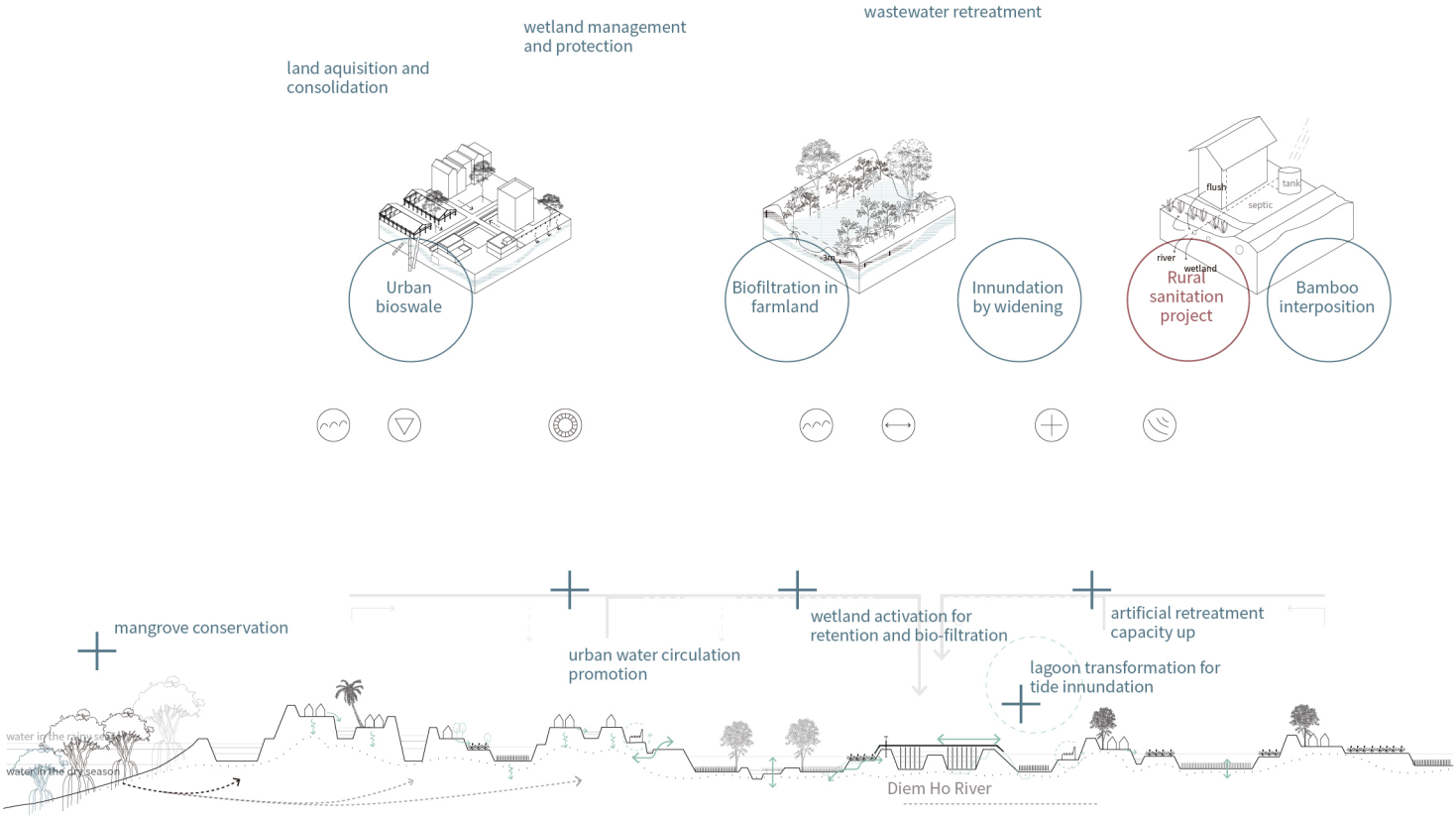
The issues involved from the overall compound profiles include linear use of water and wastewater discharge into rivers and canals, mangrove deforestation by shrimp farm expansion, flood and salinity sensitivity indirectly causing lower yield, etc.

Impacts on water quality/ quantity/ land use diversity

The idea is to transit from water consumption to water restoration. The method corresponds to the general guidelines of the area, including increasing permanent or temporary water surface by transforming part of farmland, modifying the width of original water surface, increasing groundwater replenishment, including improving surface permeability of urbanized areas, and so on. The purpose of the design is to restore water and supporting eco-services through wetland by reshaping riverine landscapes along with infrastructure. Land use diversity will be influenced by buffers created between built-up and farmland. On a local scale, strategies can further be translated into increasing ecological bioswales and ditches, paddy fields capturing nutrient deposits, rural sanitation, widening waterways for inundation, etc.

Response to large framework

It is under the large framework of retention, recharge, and buffer, to restore eco-services and hydrological cycle in the delta. The expected outcomes include modifying riparian edges and regulating sedimentation for facility maintenance. Encouraging permeable materials rather than concrete.



Impacts on socio-economic activities

It requires land by collaborating with locals or negotiating with the collective. It also encourages experiments of new types of local architect, though it takes time for a shift in the traditional habitus of using materials. Local traditional ecological knowledge for phytoremediation and vegetation should be integrated.

Engagement of actors

Stakeholders relate with:
1 Establishing direct wetland management and protection under MONRE;
2 Land acquisition and consolidation. compensation and vocation;
3 Water infrastructure operation and maintenance.
Public-private-participation is important.

Cost and benefit

1 Land conversion requires a large amount of investment for development and compensation to farmers;
2 Conversion means a loss of land and income; However, the improved water quality might make up for the loss originally caused by poor water quality irrigation;
3 Regulation saline intrusion by wetland can be possible;
4 Test the evolving production model of site suitability- the expansion of orchard and groundwater recharge model, rice-aqua model or rice production with improved varieties;
5 Ensure and guide the awareness and habits of maintaining water quality and quantity for future generations.

MAIN STRATEGY 2/3
Social infrastructure activation

From urban occupation to circulation

URBAN
circulation

Main Spatial
Components

Fig 7.6
Developing intermediate strategy of social infrastructure activation with potential local interventions and related principles
Made by the author

Processes concerned

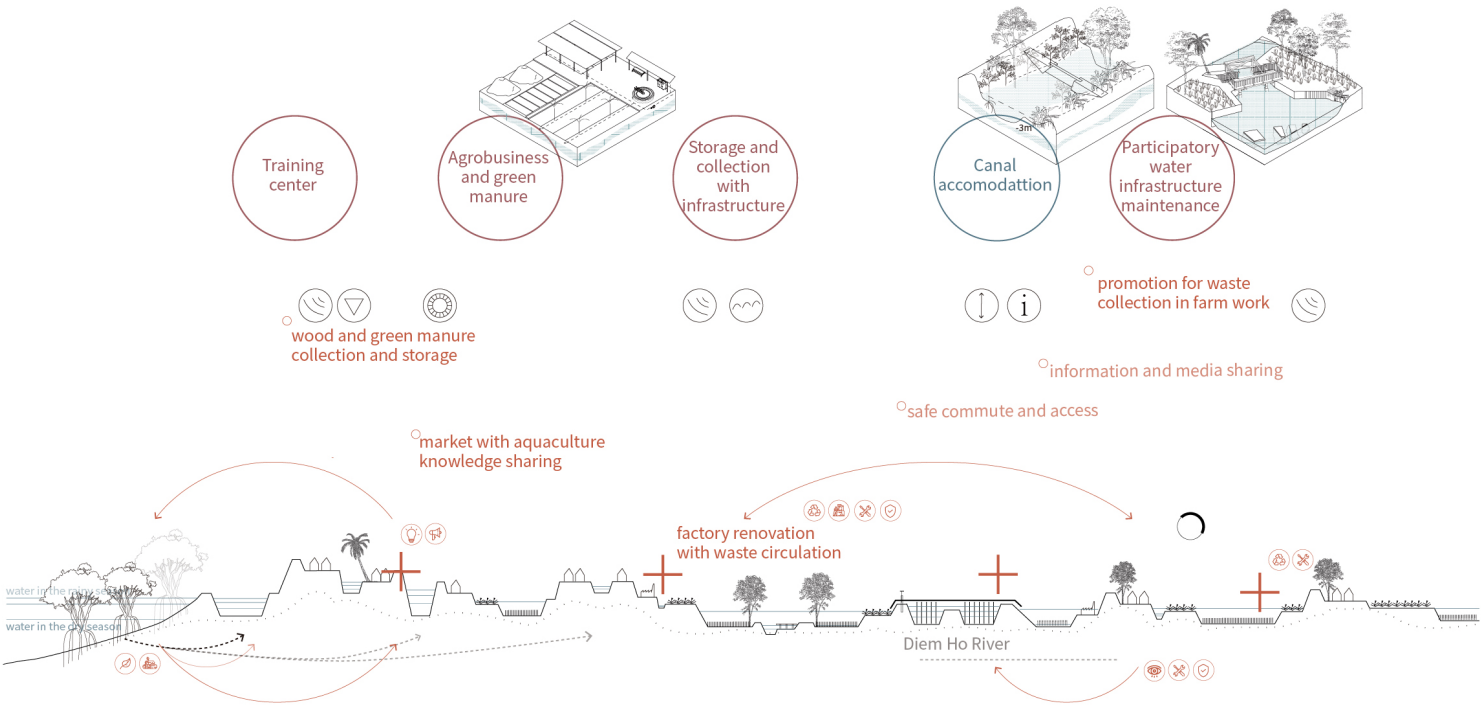
The mismatch between urban expansion and built-up maintenance along with road-based urbanization. The degradation and loss of eco-services such as the regulation for erosion prevention are disturbed by urbanization. Locals are influenced and discouraged from paying for themselves for the facilities while continuing farming in a polluted environment and livelihood with unequal assess to sources.

Impacts on water quality/ quantity/ land use diversity

The idea is from urban occupation to circulation- regenerating multi-functional infrastructure and landscape. Strategies can be further translated into the effort to reorganizing public space with programs and time- such as improving the retreatment capacity of private companies for surrounding communities and itself, mixing training use with mobile market and media propaganda, and regenerating built-up space for production chain support, etc. The main goal is to encourage social participation by redistributing common resources. By arising awareness benefits of natural succession cycle, to facilitate the following strategy of sustainable production as well.

Response to large framework

This strategy contributes to the connectivity through transportation and knowledge with local activation of common. Public departments should improve schemes like ‘Build-Operation- Transformation’ and VB4E with the private and regularly communicate with local teachers or researchers as local presentative of needs and thoughts. They should also consider providing related policies or



guidelines to facilitate local participation and waterway regulations. Emergent water supply will require a proactive collaboration with Red River upstream retention-related provinces, and with NGOs to provide goods and improve sanitation projects.

Impacts on socio-economic activities

As for locals, is to relocate and create existing road' s connection to water, activating new gradients and functions of landscape. at the same time, modifying secondary dikes or tertiary to adjust floodplain and natural nutrients; and support the sewage network implementation connecting with urban retreatment, and ensure a safe and livable living environment.

The overall focus are about between port and coastal development, connection and responsibility of public services along river to the maintenance and retreatment. The input of tech and knowledge is necessary.

Engagement of actors

Stakeholders relate with:
1 Land acquisition and consolidation;
2 Input of tech and knowledge of solid waste retreatment and circulation;
3 Water infrastructure operation and maintenance.
Besides MARD, MONRE, MOC, Department of Transportation might also be engaged with local waste collection projects.

Cost and benefit to mitigate the current conflicts between infrastructure maintenance and resource accessibility considering payment of eco-services.

MAIN STRATEGY 3/3
Sustainable production

Land cultivation

LAND
cultivation

Main Spatial
Components

Fig 7.7
Developing intermediate strategys of sustainable production with potential local interventions and related principles
Made by the author

Processes concerned

The low efficiency and over-exploitation of resources for production accelerate the agriculture pollution flowing into the river and accumulating at the coast. The private taking local resources and local passive shifting to aquaculture due to the changing environment are reducing mangrove forests, increasing more vulnerabilities to high tides and monsoon.

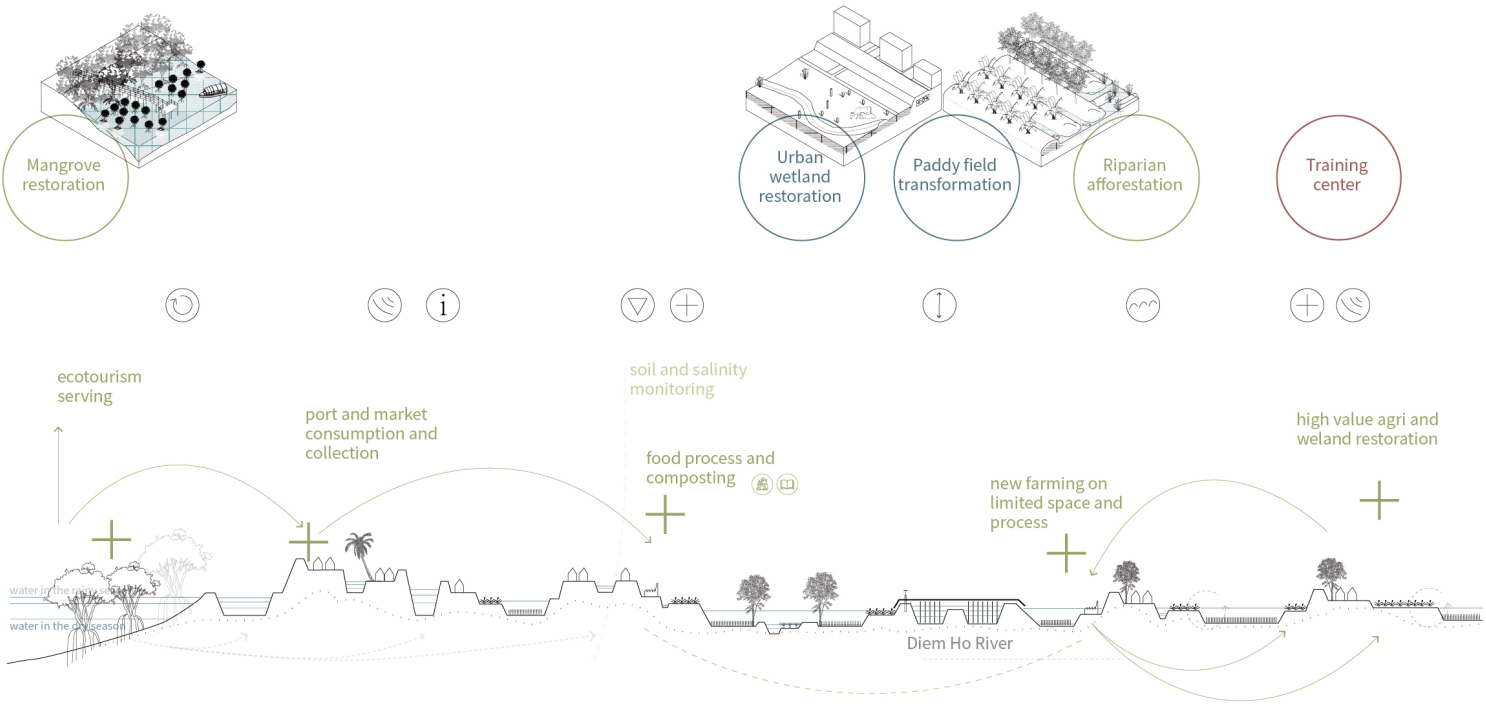
Impacts on water quality/ quantity/ land use diversity

The idea is wise cultivation with eco-services awareness. Mangrove conservation with eco-tourism and collective high-value crop production are considered and reframing certain wetlands proposed in the former two strategies with an additional function of production beyond purification and retention. Besides, promoting agrobusiness with industry and public facilities reflects on the current flow of the food chain- produce, transport, consume and collect. Innovative vertical farming can be triggered by limited space.

Response to large framework

It requires awareness of weaving green network with the agro-forestry system, including restoring the wetland. Policies to support production in limited space including urban farming and to engage local knowledge of vegetation selection are preferred. The public funding on knowledge, technology, and production integration, for example, research institutes with private companies of seed and machines can be accepted. NGOs can be engaged to improve local production models.

Impacts on socio-economic activities



It encourages a collection of information and facilitating sharing tools. Land acquisition and conversion, or renovation of existing for allocation of food chain processes and facilities are necessary.

Engagement of actors

Water and soil infrastructure/ supporting eco-services, operation and maintenance, including quality and quantity monitoring with research institutes and local representative; The effectiveness of production and remediation of land and nature are the main core for production. As for the coastal case, while salinity can be vulnerable to certain crops, the monitoring salinity can be combined with industrial production businesses, which can either be private or civic. Pollinators as non-human should also be engaged in terms of biodiversity.

Cost and benefit

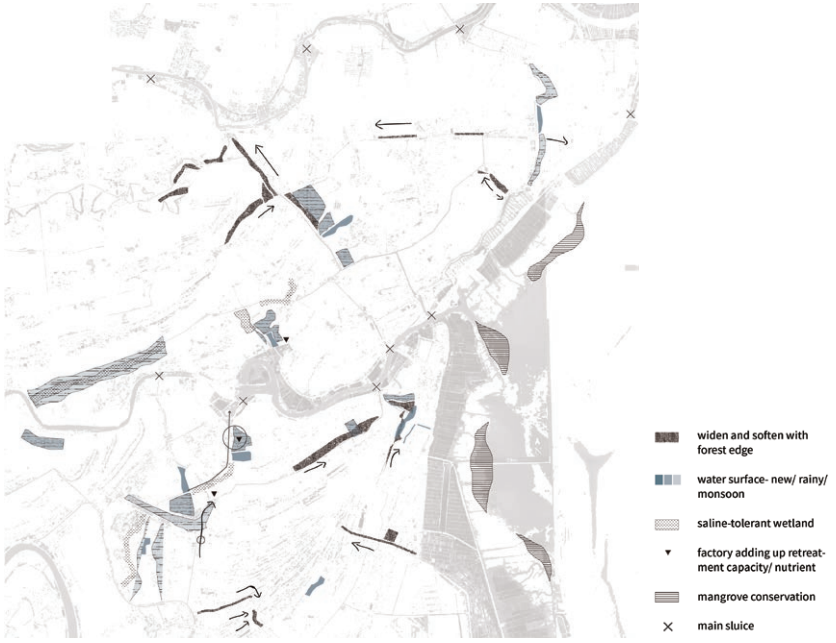
The shifting production can shift to a good yield, while can also shift to a conflict with tradition regarding social acceptance.

REORGANIZING SYSTEMS AND PROCESSES ON PLAN

Design composition and phasing implementation

Strategies on transect further being translated by allocating and reorganizinng elements and processes on plan into three steps- changes in water surface through time, upgrade in urban connection and characteristic-valued sustainable production.

Fig 7.8
Projecting strategies onto processes and systems on plan



[LAND] PRODUCTION

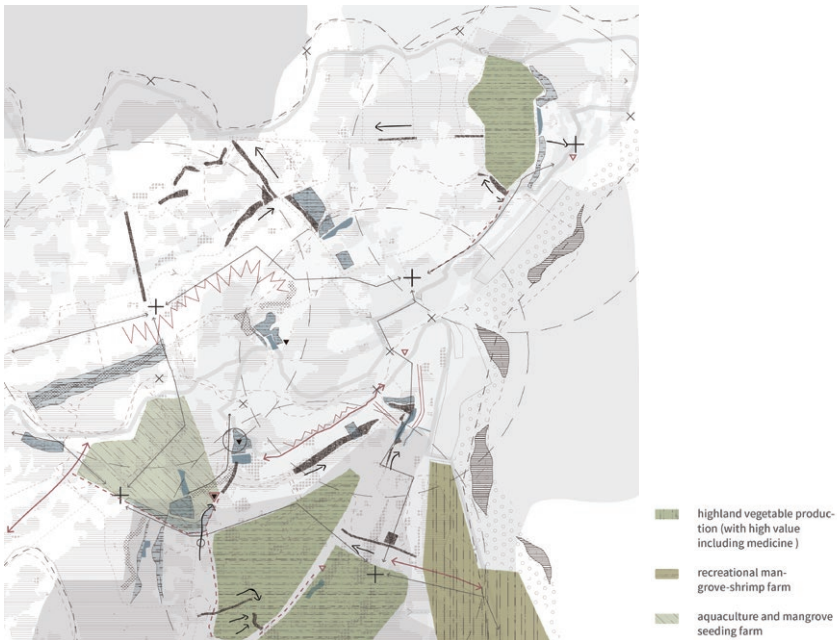
Production landscape is mainly composed of farmland and coastal mangrove. The highlands that rely mainly on vegetable cultivation in the south are susceptible to the dual pressure of salt intrusion and fertilizer input for vegetables, especially in winter. There are certain limits in distinguishing production landscape only from satellite map in this project.

1 production landscape
2 fertilizer input in winter
3 main waterflow
4 mangrove
5 elevation

[URBAN] CONNECTION

The development of space such as towns and markets also indirectly interferes with the highlands by diachronic cut-and-fill movements. The main roads connect the market and port as the main material exchange places in food chain. This occupation should further explore the connectivity of assess to water and waste management. Values regarding to safety and well-being for commute landscape including motorcycles and water transportation under the regional ecological framework need to be enhanced as well .

1 road connectivity
2 market
3 urban area
4 dike



[WATER] FUNCTION

1 geology and soil type as infiltration capacity and permeability through surface
2 lowland as flood-prone in summer and salinity intrusion in winter
3 surface water body, mainly composing of nature waterway, canal, aquaculture, household and community pond and shrimp farm.
4 main drainage canal and sluice gate connecting main river
5 freshwater reservoir, in highland communal pond for irrigation, shrimp farm for adjusting salinity, along river for pumping and supply
6 livestock factory as one pollution source

RELATION PROJECT-TERRITORY

Connecting local and regional through intermediate scale

The meso futher be explored under regional principles and potential local interventions. Followiing takes the one along the infrastructure as example.

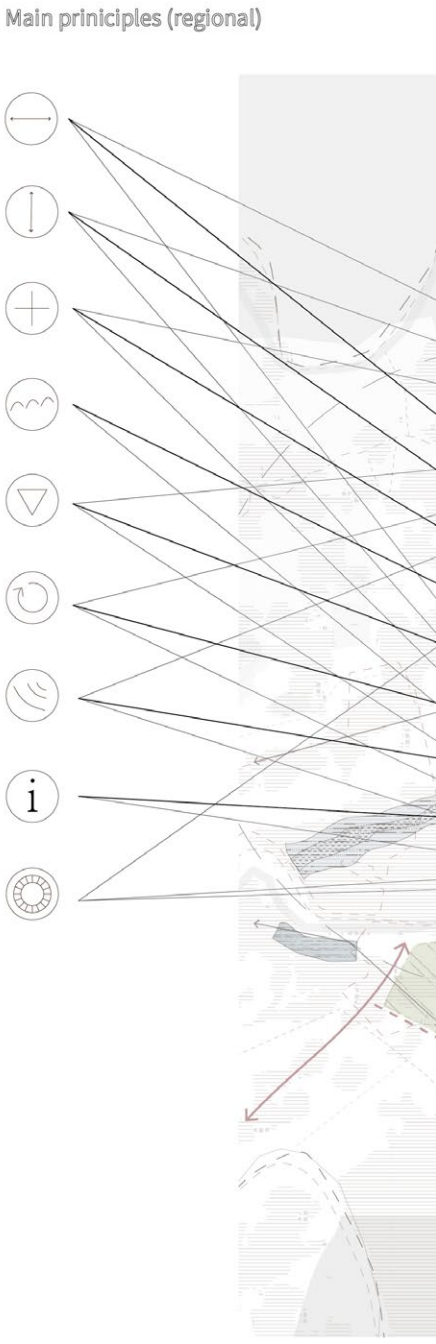
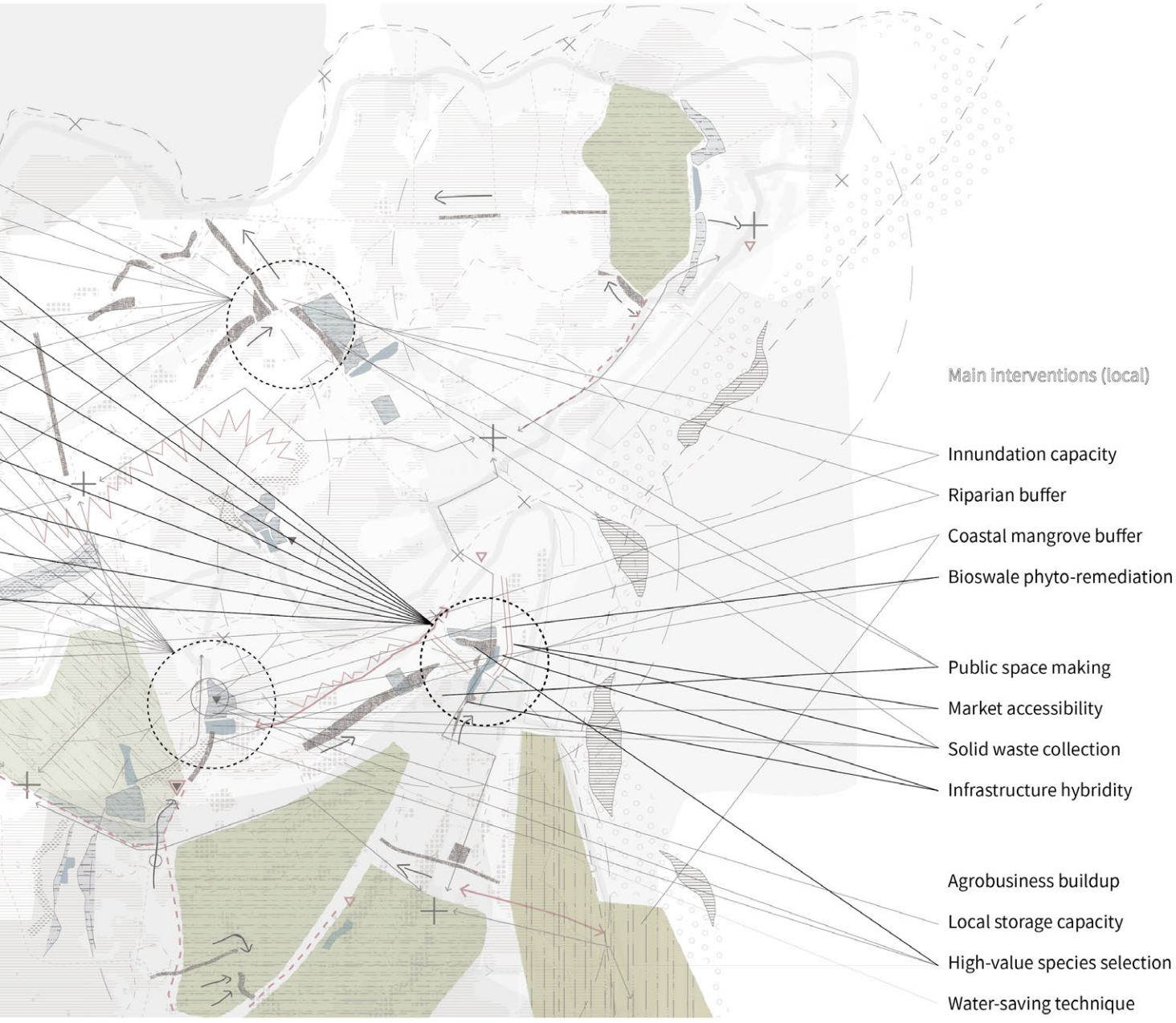


Fig 7.9
Local adaptation under regional principles and meso strategies


Main interventions (local)
Innundation capacity
Riparian buffer
Coastal mangrove buffer
Bioswale phyto-remediation
Public space making
Market accessibility
Solid waste collection
Infrastructure hybridity
Agrobusiness buildup
Local storage capacity
High-value species selection
Water-saving technique

LOCAL INTERVENTION 1/3

Testing flux, translation, diversity through time and socio-economic events by landscape transformation

Along with the linear development between settlement and farmland.

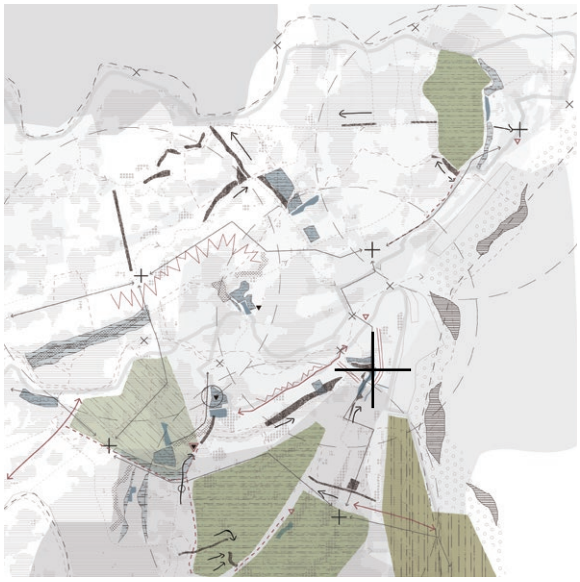
It' s about resource efficiency management at a public selection of community center and bus station. Including the use of floating sluices to increase the natural water storage in the lower area of the community besides the communal pond, different production efficiency and facility supply, and the activation of the ground floor of public space, etc.

In this area, shallow groundwater is susceptible to salt intrusion, and clay is the main soil type, so crop selection needs to be combined with local knowledge. This context setting also works for the following two local interventions.

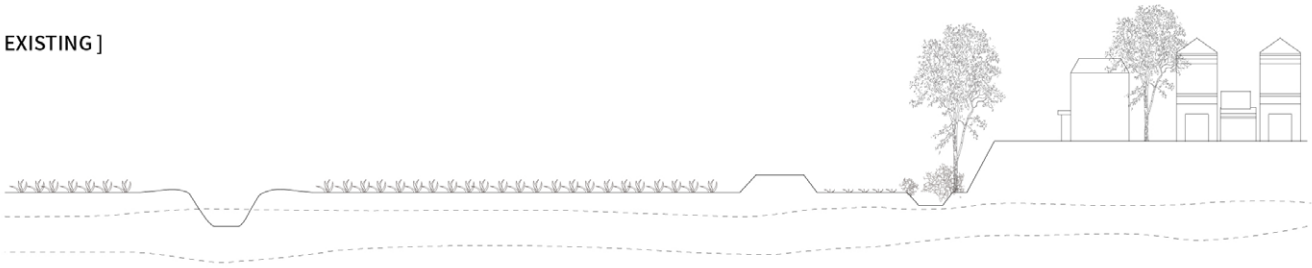
This local selection mainly talks about waste management and the maintenance of infrastructure.

Fig 7.10 (down)
Location of local intervention 1

Fig 7.11 (right)
Local intervention 1 on transforming landscape by cutting and filling

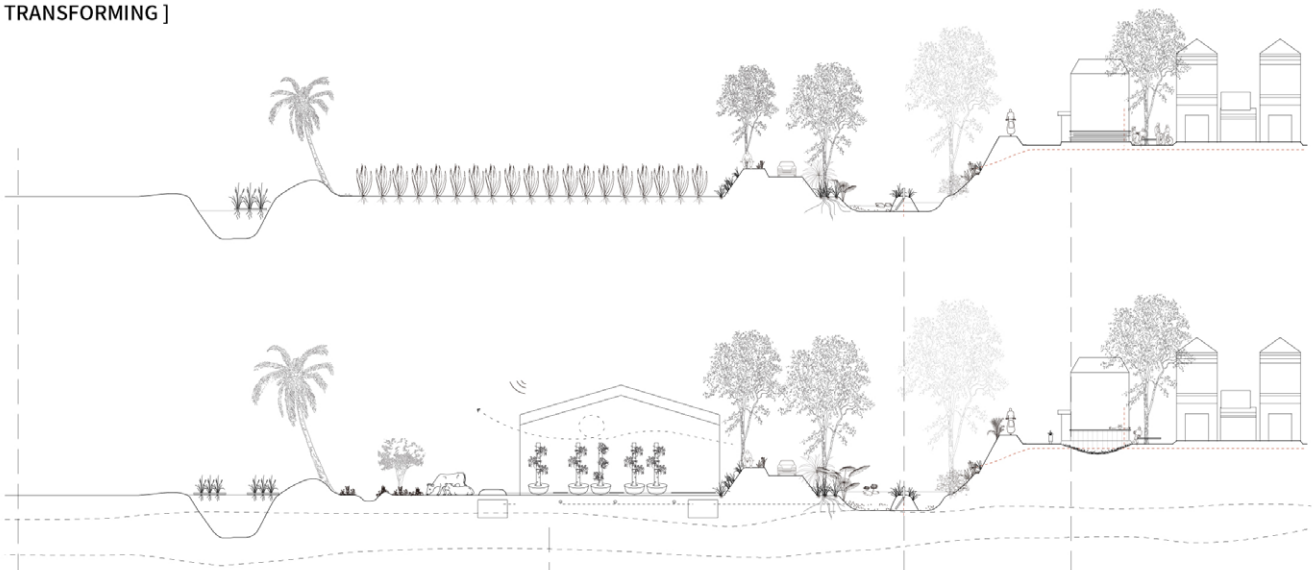


[EXISTING]



[CUT AND FILL]

[TRANSFORMING]



social center spreading
knowledge and storage
for temperory materials

improved surface water
quality for irrigation

flexible sluice accommodat-
ing canal overflow and
surface runoff

seasonal use change
- vertical farming, water
circulation and monsoon
sedimentation

rural sanitation including
rainwater purification

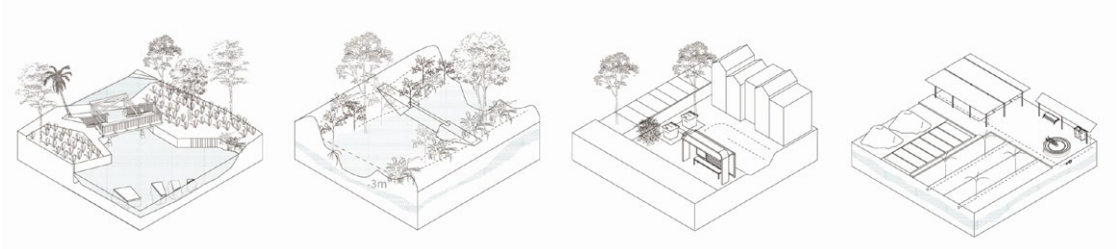
LOCAL INTERVENTION 1/3

Testing flux, translation, diversity through time and socio-economic events by landscape transformation

The collage is another form of visualization. Interventions include increasing the natural water storage in the lower area of the community besides the communal pond and cleaning water adaptation. In this area, shallow groundwater is susceptible to salt intrusion, and clay is the main soil type, so crop selection needs to be combined with local knowledge. Construction works activated public space and shifts materials and microbes and impact cultural heritage placemaking as well.

Fig 7.12 (down)
Location of visualization on section

Fig 7.13 (right)
Collage of part of local intervention 1



levee and earth dike maintenance

sluice maintenance

solid waste collection

circular carbon lab with water-saving techniques

Solid clay under concrete

Liquid clay

LOCAL INTERVENTION 2/3

Testing flux, translation, diversity through time and socio-economic events by landscape transformation

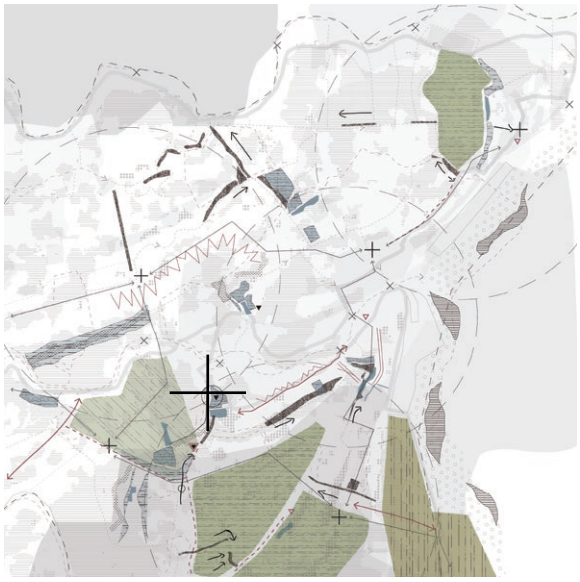
It' s about the transformation and reconstruction of a polluted poultry factory located at the outlet of the main drainage canal connecting the main river, and about buffer restoration of the surrounding wetlands as well.

Considering the ecological and water source restoration of different times, and how to reactivate the connection with spatial quality between the two communities.

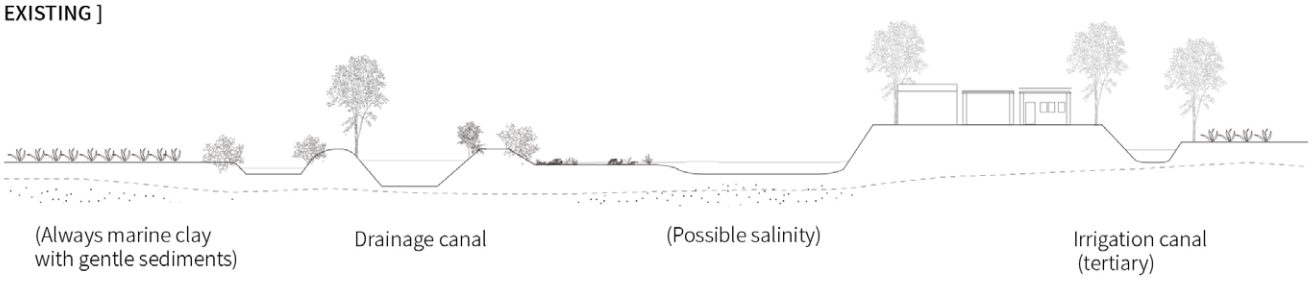
This local selection is mainly aimed at land use diversity and buffer capacity at the outlet.

Fig 7.14 (down)
Location of local intervention 2

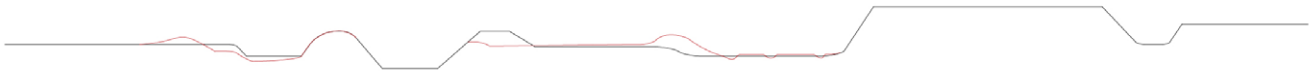
Fig 7.15 (right)
Local intervention 2 on transforming landscape by cutting and filling



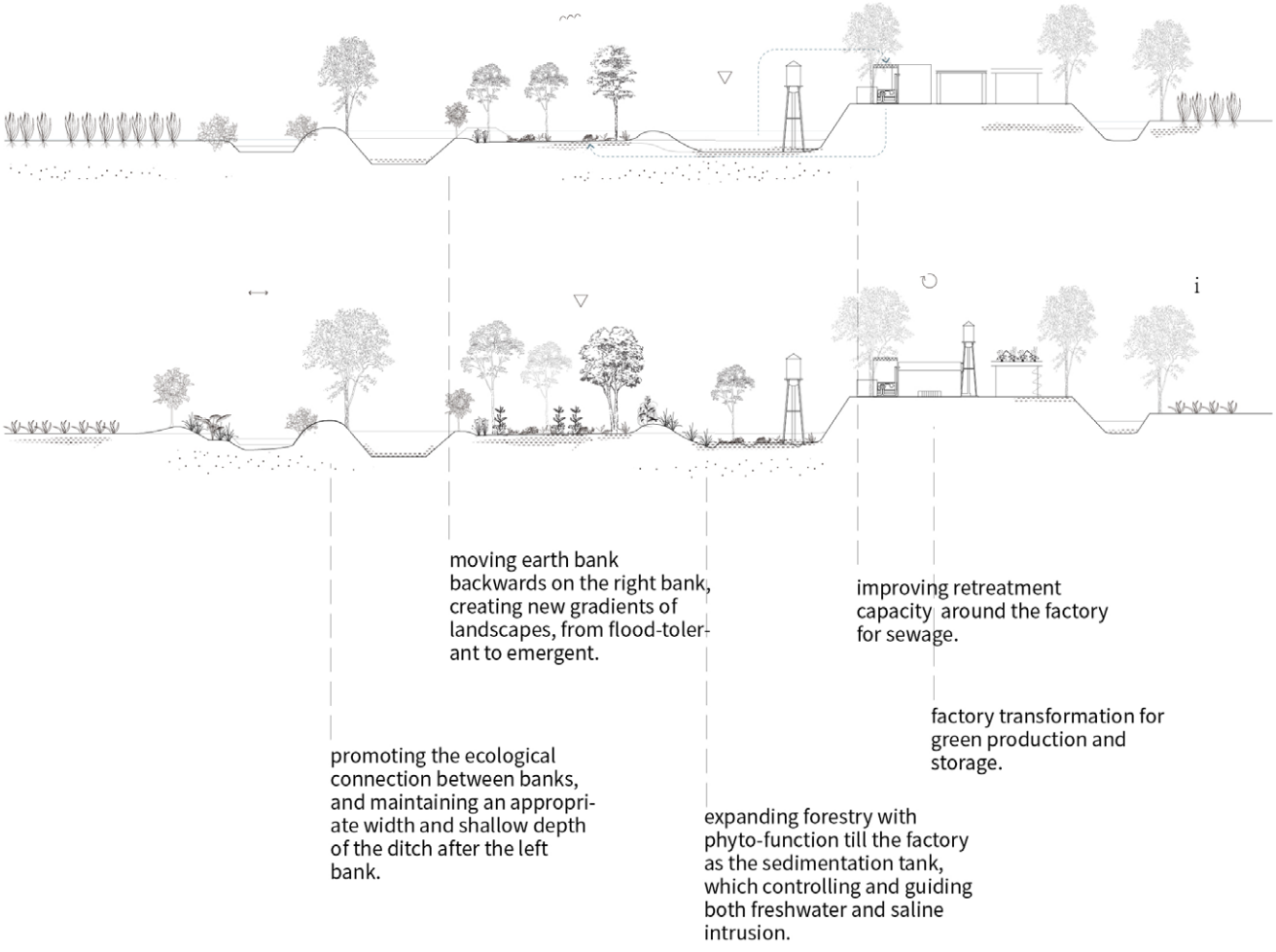
[EXISTING]



[CUT AND FILL]



[TRANSFORMING]



LOCAL INTERVENTION 3/3

Testing flux, translation, diversity through time and socio-economic events by landscape transformation

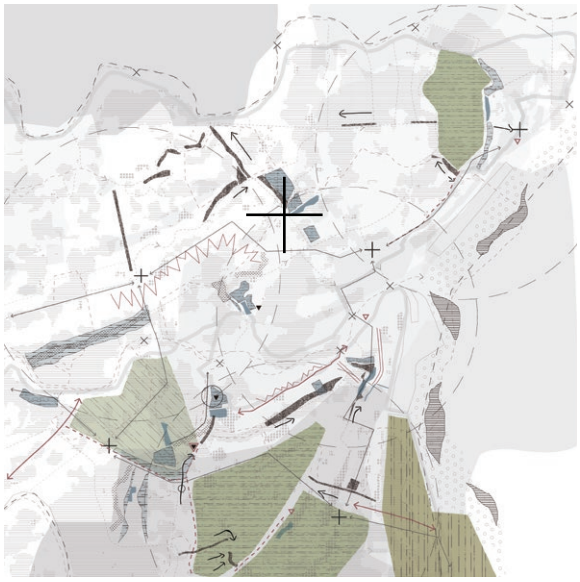
Road-based urbanization and its influence on surrounding land use and social lifestyle.

It should consider how the local participation in their own development and freshwater security.

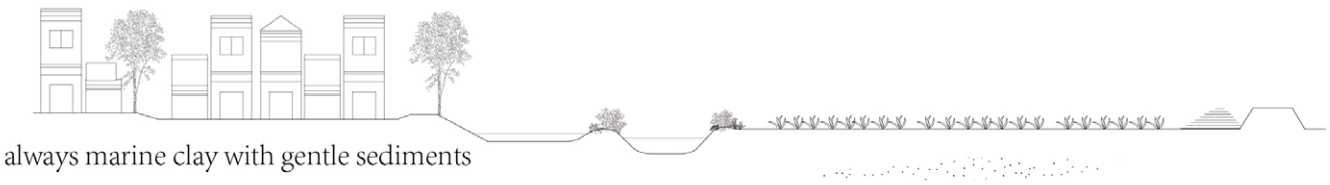
This local selection focuses on ensuring food production through special forestry and transportation relatedness with sources.

Fig 7.16 (down)
Location of local intervention 3

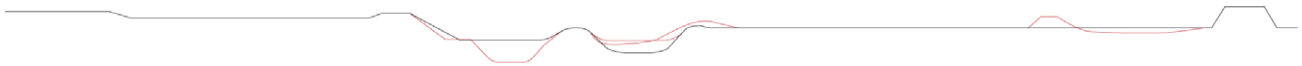
Fig 7.17 (right)
Local intervention 3 on transforming landscape by cutting and filling



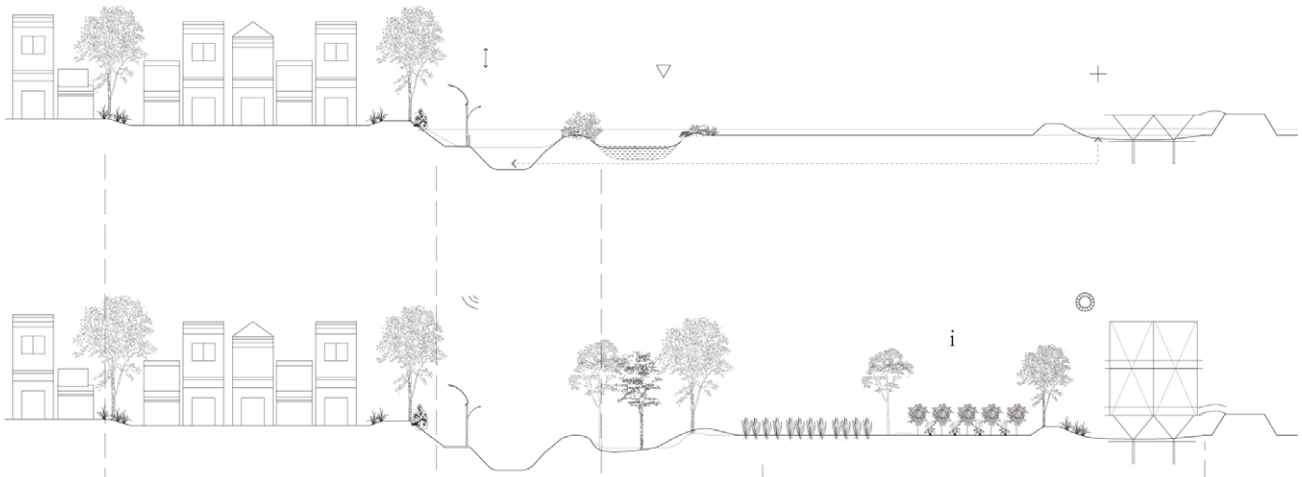
[EXISTING]



[CUT AND FILL]



[TRANSFORMING]



maintaining surface permeability of the built area

deepening the depth of part of the river on the side of the built area for riverside waterways;

land conversion and development promoting production from rice-domained to mixed forestry, orchard and rice.

filling the original pond with excavated river mud in the dry season, becoming nutrient plain by natural high tide events.

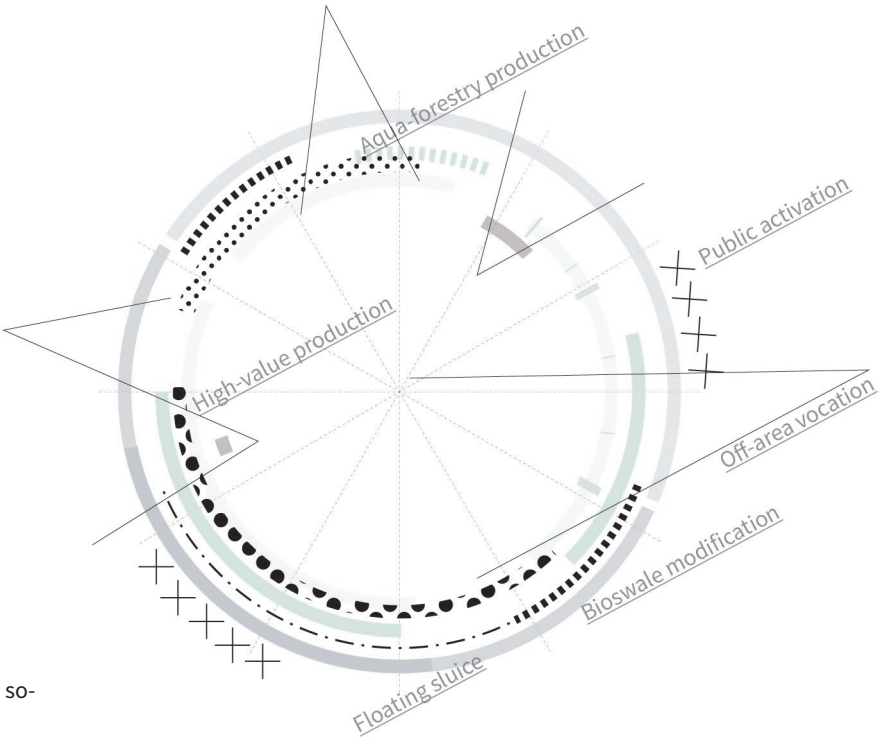
infrastructure like bridges between new houses and roads, and fields as new common places and identity.

road-based urbanism with elevated houses, leaving natural hydrological flow with the river through underground.

Fig 7.18
Satellite mapof the location of local intervention 1

Fig 7.19
Reorganizing resources

Fig 7.20
Phasing



PHASING
THE LOCAL TRANSFORMATION

Testing flux, translation, diversity through time and socio-economic events by landscape transformation

By following the shift of bioswale management, service network activation, land cover transformation and soil cycle change, the new shift turns out that a potential change can be the third-round production can be shift into a series of actions as vocation, agrobusiness with vertical or aqua-forestry for efficiency, and soil and infrastructure construction.
A new journey brings with new shift, commute, opportunity, and healthy environment.

Phase 1

Bioswale with local vegetation, from flood-tolerant to saline-tolerant.

Co-management

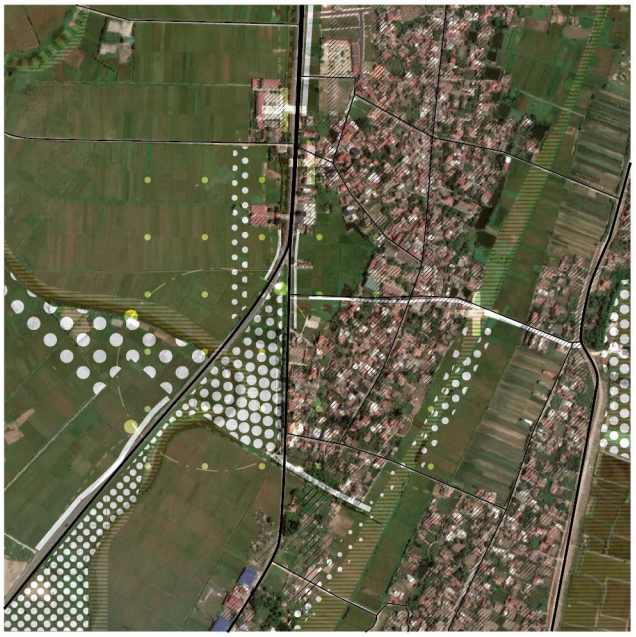
Public/ Department of transportation
Private/ Hydraulic company
Civic/ Cooperative

Phase 2

Public infrastructure activation and intalling floating sluice for seasonal water buffer.

Co-management

Civic/ People' s Committee
Research/

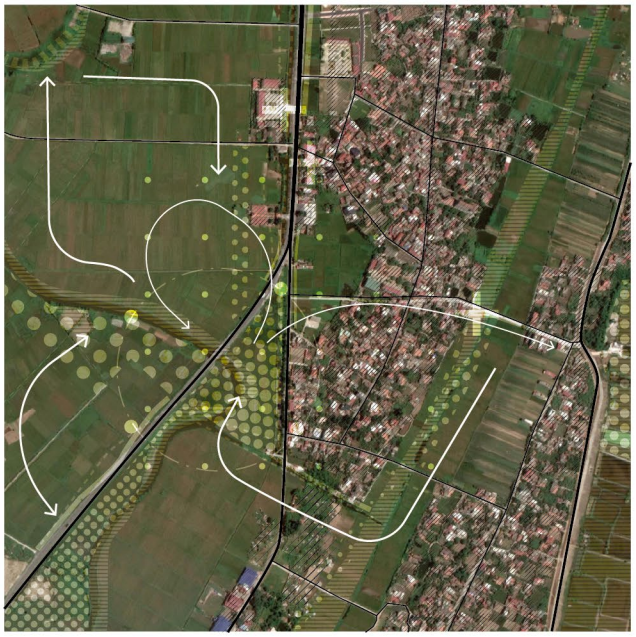


Phase 3

Forestation and green space connection.

Co-management

Public/ Department of Agriculture and Rural Development, Department of Transportation
Private/ Agricultural Extension Club
Civic/ Cooperative



Phase 4

Soil cycle change through cleaning, cutting and fillling.

Co-management

Civic/ People' s Committee
Research/

SEEING THE FUTURE STRUCTURE OF THE DELTA

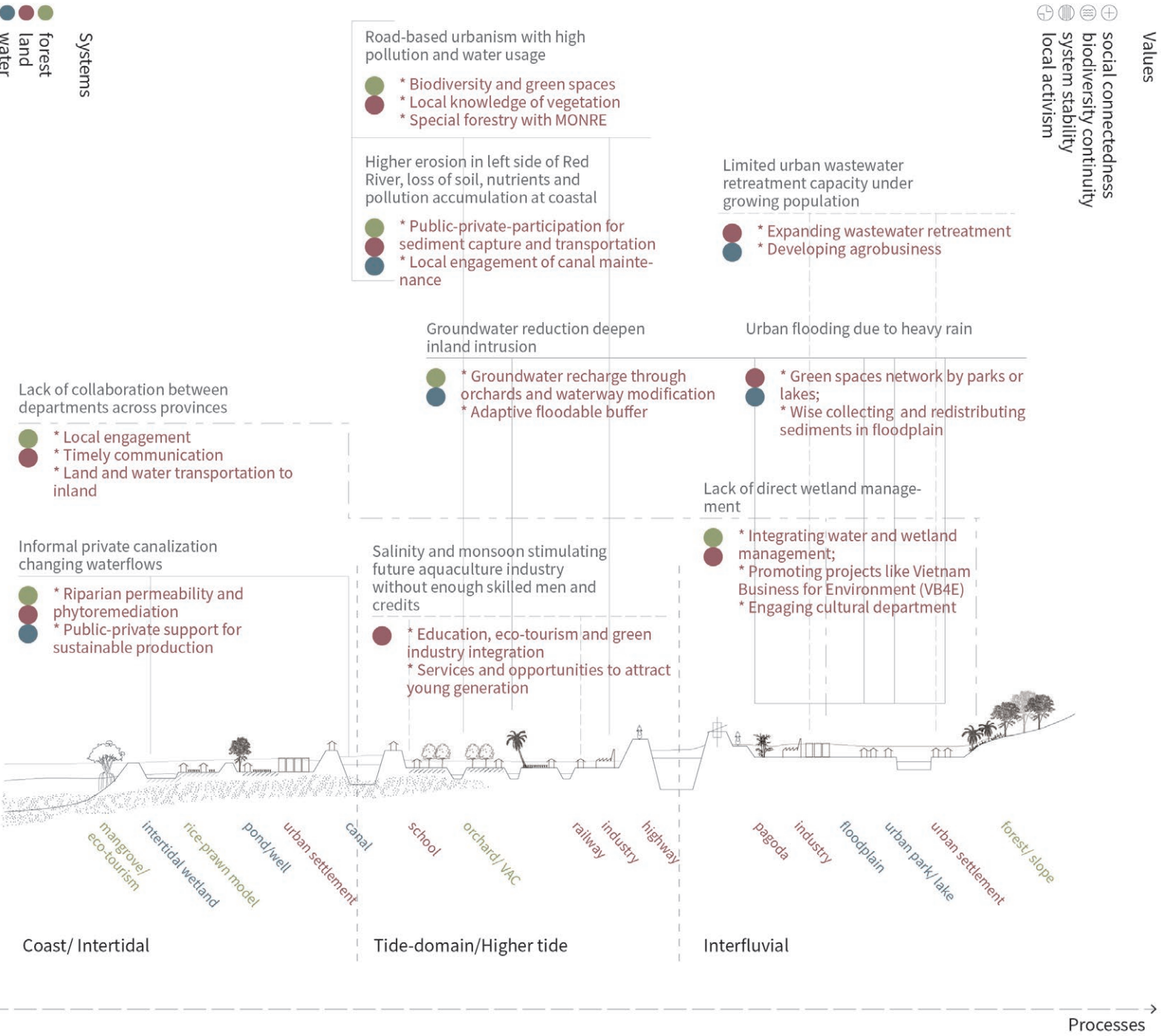
Inductive proposal of the delta vision towards evolutionary socio-ecological resilience

Former sections explore mitigation processes being tested and generated under three main principles in the intertidal case and more detailing on a smaller scale. Local transformation and adaptation consider situations like the extreme water pollution discharge by a factory into the river and urbanizing putting pressure on food security.

The regional proposition turns back to the main social and spatial processes within three types of production- and hydrogeological-related across the delta, with culture with nuanced habitus. Towards socio-ecological resilience, those prioritized issues and possible actions are listed, which can further be translated into redundant types of interventions. Interdependencies such as between upstream urban flooding and deeper salinity inland in higher tide areas and downstream intertidal irrigation management can be linked to some extent.

It can be further discovered that land cultivation is an essential issue. It' s important to change the current top-down excessive intervention and encourage cooperation of roles with a resolution for the target value. For example, surface permeability in the downstream is more a wetland restoration problem, while it more relates to urban social facilities in the upstream; therefore, a collaboration between upstream construction and coastal agriculture and development is necessary.

Fig 7.21
Adaptive systemic strategies within the delta


Systems
forest
land
water
Values
social connectedness
biodiversity continuity
system stability
local activism
Road-based urbanism with high pollution and water usage
* Biodiversity and green spaces
* Local knowledge of vegetation
* Special forestry with MONRE
Higher erosion in left side of Red River, loss of soil, nutrients and pollution accumulation at coastal
* Public-private-participation for sediment capture and transportation
* Local engagement of canal maintenance
Limited urban wastewater retreatment capacity under growing population
* Expanding wastewater retreatment
* Developing agrobusiness
Groundwater reduction deepen inland intrusion
* Groundwater recharge through orchards and waterway modification
* Adaptive floodable buffer
Urban flooding due to heavy rain
* Green spaces network by parks or lakes;
* Wise collecting and redistributing sediments in floodplain
Lack of collaboration between departments across provinces
* Local engagement
* Timely communication
* Land and water transportation to inland
Lack of direct wetland management
* Integrating water and wetland management;
* Promoting projects like Vietnam Business for Environment (VB4E)
* Engaging cultural department
Informal private canalization changing waterflows
* Riparian permeability and phytoremediation
* Public-private support for sustainable production
Salinity and monsoon stimulating future aquaculture industry without enough skilled men and credits
* Education, eco-tourism and green industry integration
* Services and opportunities to attract young generation
mangrove/ eco-tourism
intertidal wetland
rice-prawn model
pond/well
urban settlement
canal
school
orchard/ VAC
railway
industry
highway
pagoda
industry
floodplain
urban park/ lake
urban settlement
forest/ slope
Coast/ Intertidal
Tide-domain/Higher tide
Interfluvial
Processes

SEEING THE FUTURE STRUCTURE OF THE DELTA

Inductive proposal of the delta vision towards evolutionary socio-ecological resilience

This regional socio-ecological framework is proposed to mix and expand a sustainable lifestyle and biodiversity restoration to approach mitigation regarding current vulnerabilities. The aim needs help from the transformation of current social production models or vice versa, which can trigger potentialities for locals to transform.

The regional vision here shows conceptual ecological structure based on an assumption of the social network.

Urban layer:
social network assumed by potential population growth and movement, the role of main clusters and infrastructure connection; imagining services facilitating physical movement as the grapevine;

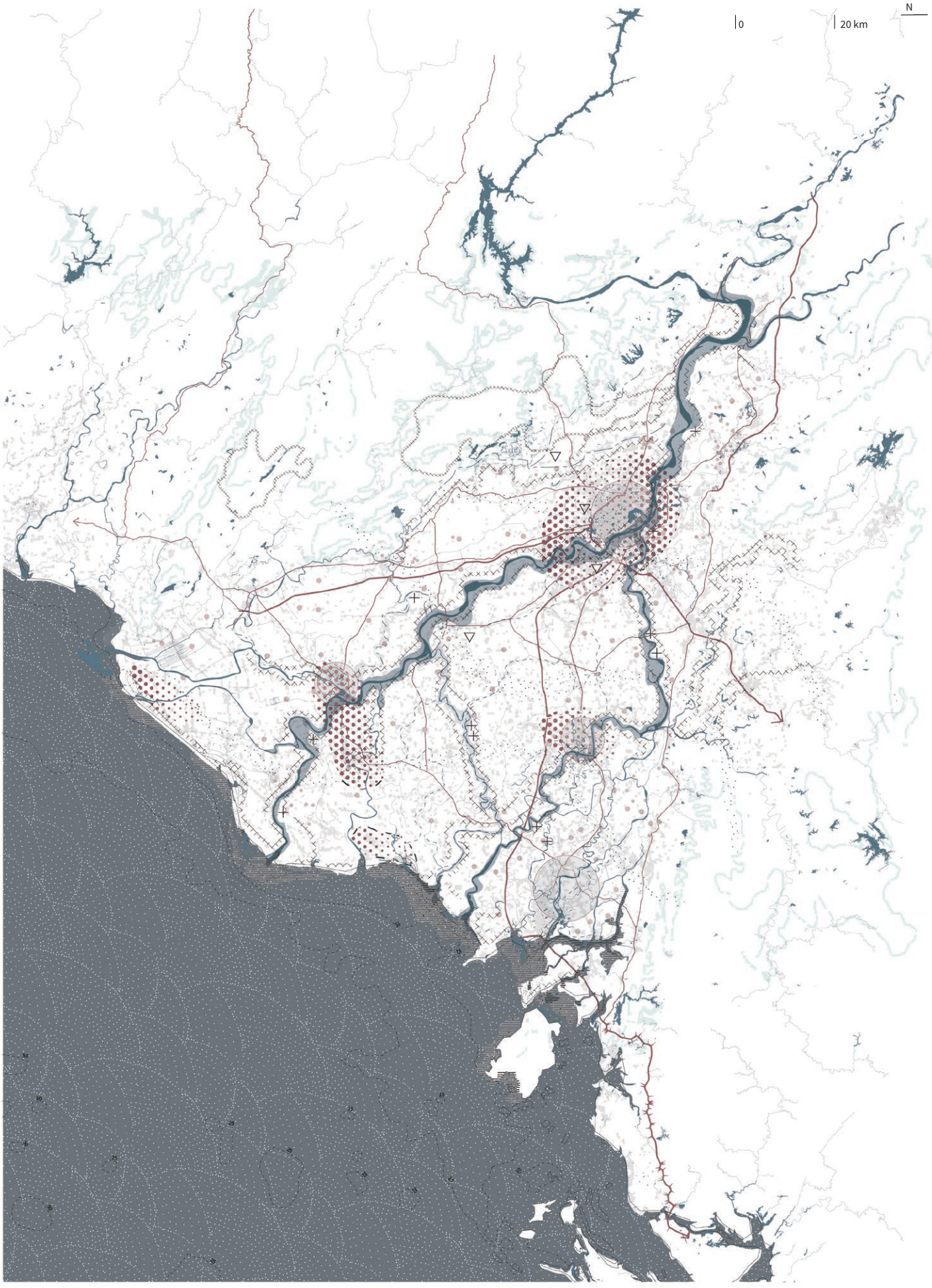
The triangular structure is composed of the capital Hanoi, Hai Phong- Ha Long Port cluster connecting with Nam Dinh agriculture traditional cluster, linking South Vietnam and China with economic opportunities.

Water layer:
The upstream needs more retention room to prevent the seasonal increase in water level and volume, and to prepare for irrigation water use; the treatment of urban sewage before it enters the Red River should also be improved;

In the central and wave-affected areas, regarding the household-domain production and land occupation, the model of orchard and ditch recharged should be studied and expanded. Especially in the dry season, saline intrusion is considered. The dash-line on the right side envisions such agroforestry with small water surfaces on a marine clay land, connecting urban green spaces and ecological diversity; strengthening urban cluster linkage.

At the coast, besides strengthening the spread of information and communication, groundwater replenishment and sediment research and management should be focused on, and high-value production and mangrove ecotourism to maintain a local livelihood and activate social reproduction as well.

Fig 7.22
Regional vision


N
0
20 km

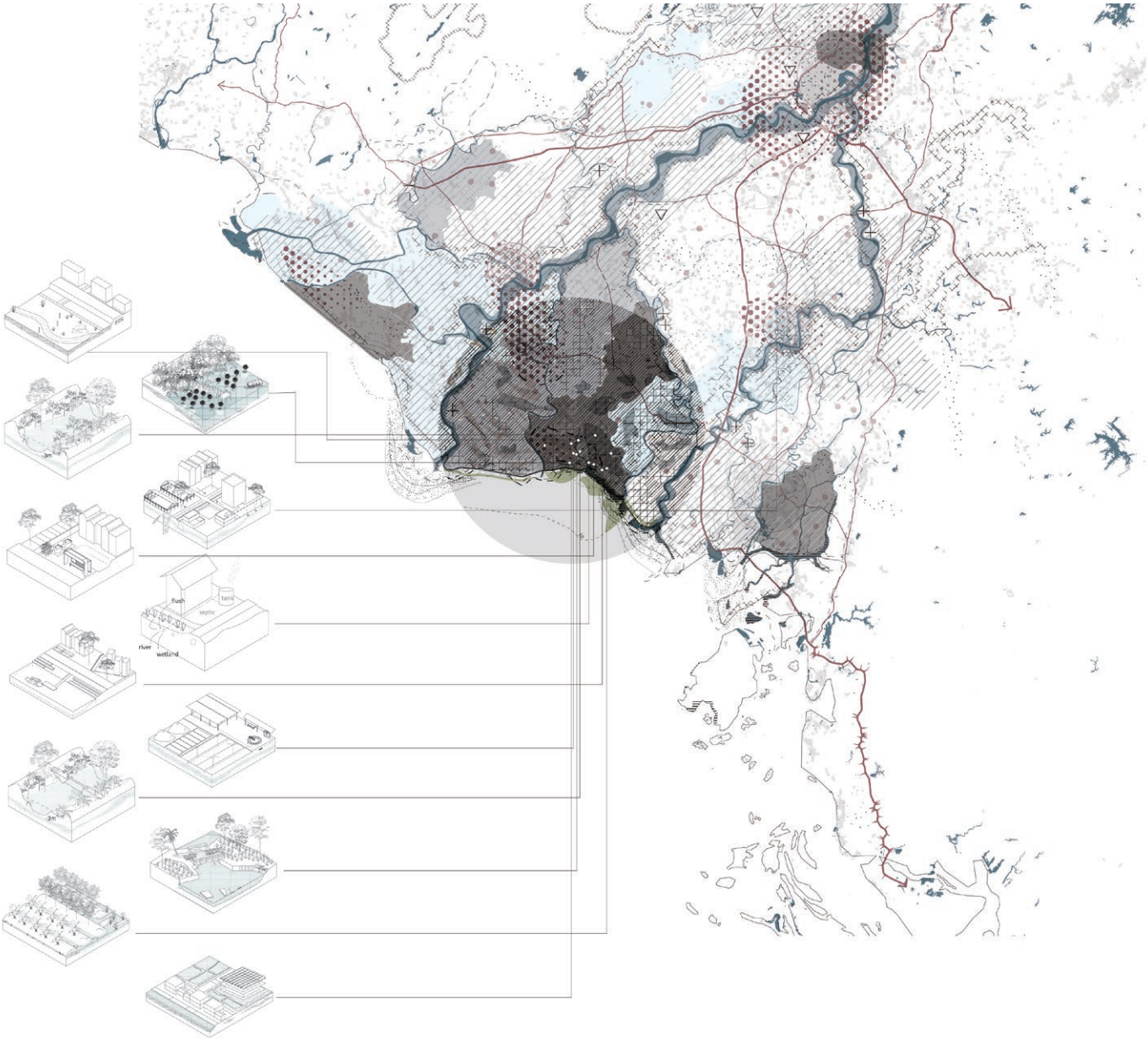
VISION

Linking local interventions to the delta region
Project with geology, production, and vulnerability

The diagram on the right trying to build a relation from local to regional through the exploration case. Being aware of the biophysical and geological condition, and identifying the socio-ecological vulnerabilities, actions developed under general principles of a higher level will further explore diversely in different locations. While one intervention has been discovered the implementability in the local case might be also used in other locations and develop extra characteristics, like cases can be different as in the vegetable area with clay or lowland riparian, or shifting around. In conclusion, these interventions are very context-based. A further detailed example is that the big water body like a lake or canal dredging is more preferred by upstream or ponds as a part of the local household downstream at sand ridge topos.

Fig 8.6 (right)
Systemic intergration transforming and having an impact on biophysical temporal scale

Fig 7.23
Linking local interventions to regional vision, taking Thai Thuy District as the case

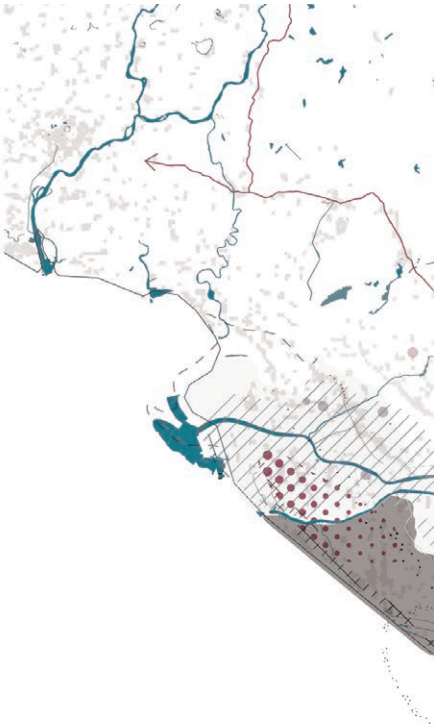

flush
tank
septic
river
wetland

VISION

Linking local interventions to the delta region
Project with geology, production, and vulnerability

The multi-scalar drawing links back principles, processes, interventions together. It' s through intermediate scale to link and integrate, mix and expand local adaptation to generate more mitigation processes at a large scale.

Regional principles can have different performances related to local bio-geological conditions and systemic processes inside, for example, sustainable production with cleaning water capacity will be more prioritized downstream while social infrastructure activation including industry renovation and highway maintenance upstream are highlighted. In continuous periods, the proposed interventions and more can be designed through different sequences and pathways and might serve as a seasonal base to allow locals to grow and approach values of social connectedness, biodiversity continuity, and water stability.



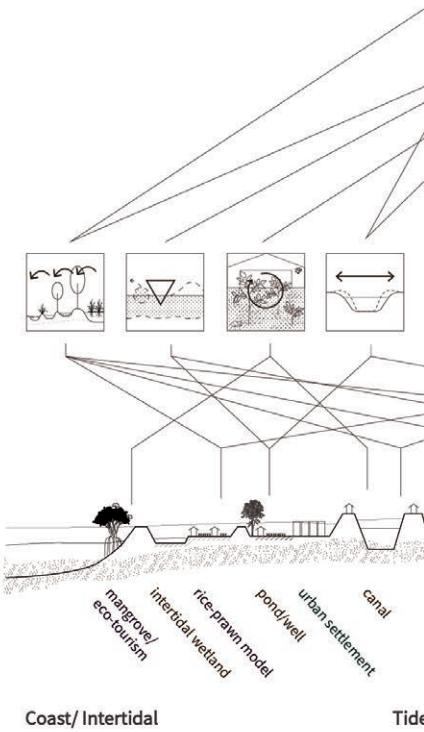
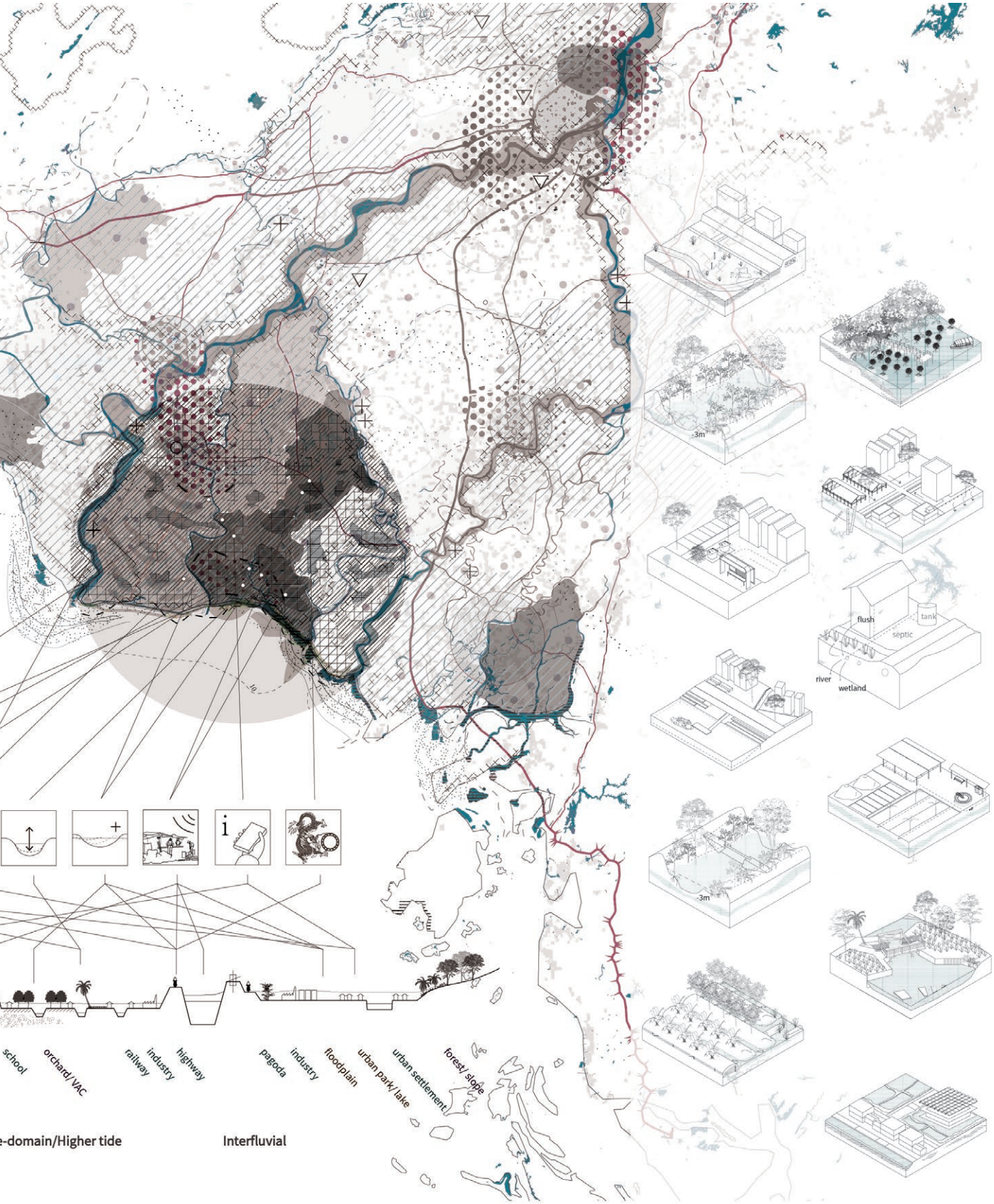


Fig 7.24
From local to regional to local


3m
flush
tank
septic
river
wetland
3m
school
orchard/ VAC
railway
industry
highway
pagoda
industry
floodplain
urban park/ lake
urban settlement
forest/ slope
e-domain/Higher tide
Interfluvial

8 OPERABILITY AND EVALUATION

Stakeholder engagement

Regional phasing and regulating

Resonating from local to regional

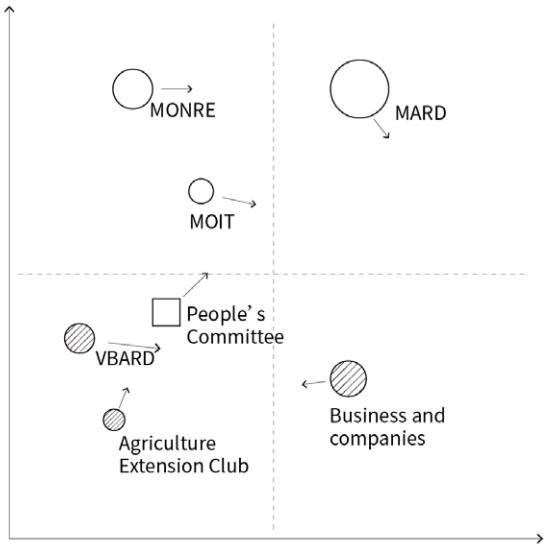
Evaluation

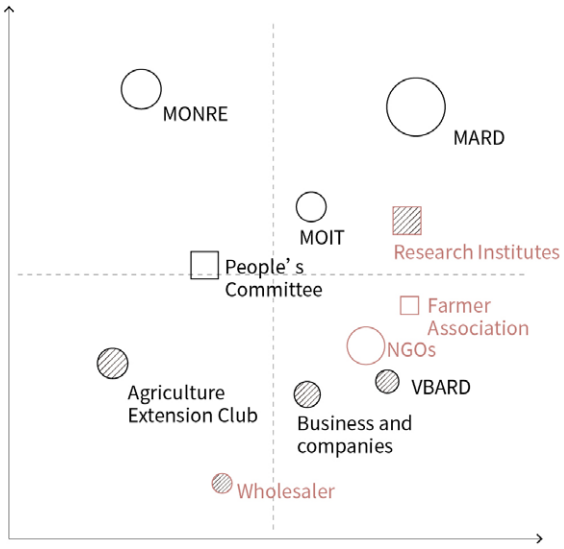
STAKEHOLDER ENGAGEMENT

Discussing at intermediate scale, using Strategy 3_ Sustainable production as an example

To produce food in a sustainable way regarding to local cultural habitus requires both technical and material support to enhance current intensification use and resource efficiency. Considering a series of actions of cultivating, processing, consuming, and retreating, two main points are highlighted. One is to improve the current supply and market chain, including inland nutrient supply and control, seeds and species selection, etc. The unequal accessibility of the market should be considered such as access to aquaculture and husbandry market for small-scale household-based production in high-tide region. The other is to integrate local participation and knowledge in decision-making and materials exchange, such as linking mangrove conservation to intertidal tourism-serving production.

To approach the aims, profit-driven actors should be eliminated certain interests regarding less ecological footprint or they should wise pair interests with local demands by regulation, while public-private participation should be encouraged in the market network to redistribute the power and interest to increase participation in not only consume but also maintain by improving data collection.

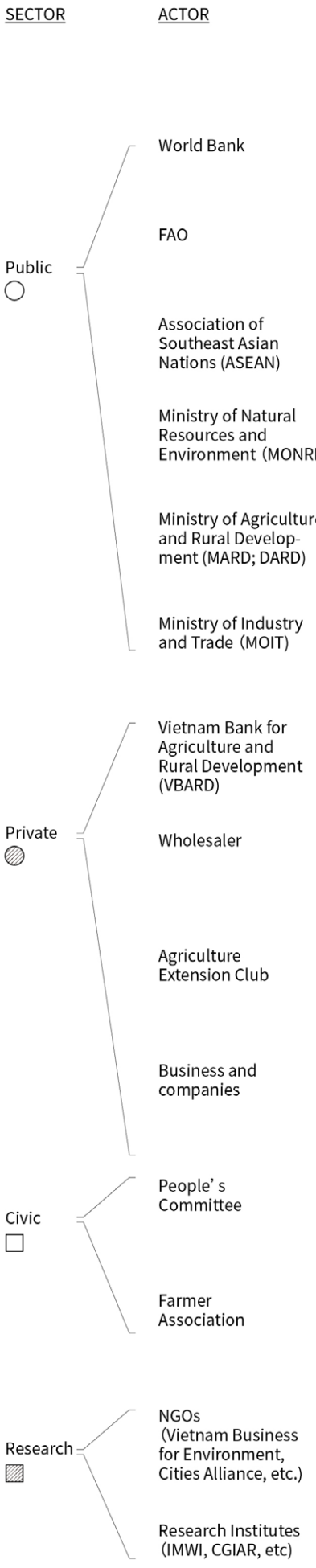




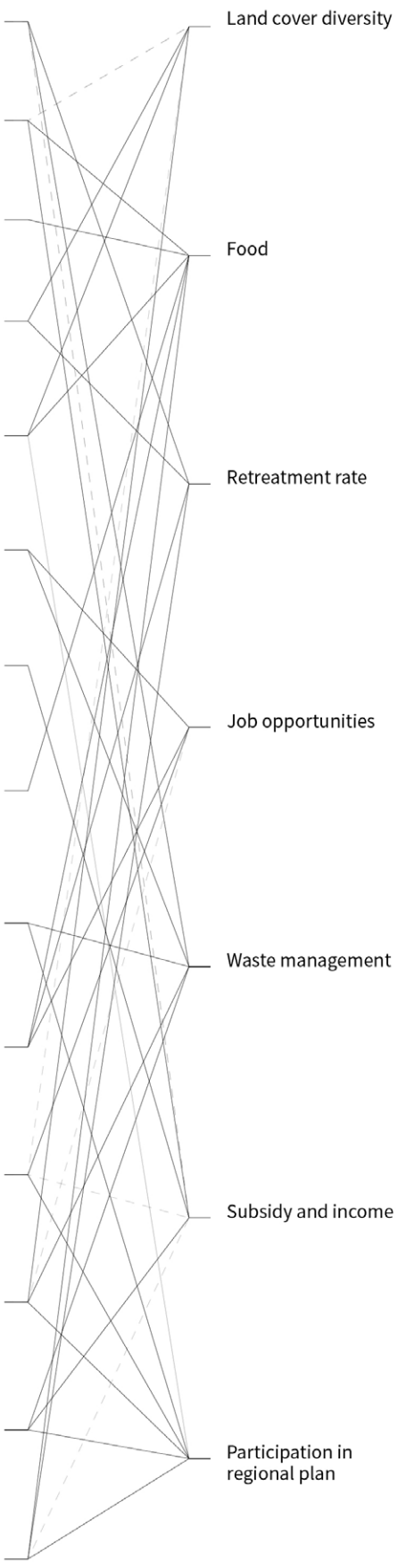
Stakeholders Interest and Engagement

Fig 8.1 (left)
Power and interest analysis for implementing sustainable production strategy

Fig 8.2 (right)
Understanding stakeholders related to criteria and project values



FUNCTION	SCALE	ACTION/ INTEREST
Funding, Researhing	International	Supporting green growth and projects of industrial production efficiency, and infrastructure construction, etc.
Funding	International	Supporting sustainable production by providing materials and knowledge including qualified seeds and tools, etc.
Investment, Collaboration	International	Coastal mangrove conservation; Supporting crop diversification promotion.
Regulatory, Monitoring	National	Setting climate adaptive policies; Assessing land use diversity and ecological footprint ; Regulating and monitorng buffer zones and biodiversity.
Regulatory, Monitoring	National Regional	Regulating crop diversification and footprint; Planning and guiding industrial production and sales; Green growth planning and forestry conservation.
Regulatory	National	Promoting new tech of processing, machines and guiding markets with by-products production, etc. ; Collaborating with research and education institutes for efficiency.
Investment	Regional	Providing diverse credits and enhancing interests to locals; Increasing private interests in PPP models such as Build- Operation-Transformation (BOT).
Investment Participatory	Local	Connecting supply chains and material exchange with efficiency, such as between local small-scale production and touristism, cooperative and mobile markets, port offices, etc.
Operation, Administrative	Regional Local	Coastal mangrove conservation and high-value crops promotion; Green manure market management; Improving riparian and public space with business.
Investment	Regional Local	Supply chains management, including seeds, logistics and storage, irrigation and drainage, industrial processing, etc; Providing off-farm job opportunities; Supporting riparian and public space activation.
Regulatory, Administrative, Participatory	Local	Monitoring soil quality; Green growth policies execuation and land conversion management; Supporting waste collection and vocational training.
Operation, Monitoring, Maintenance	Local	New production models design and execution; Organizing waste collection and vocational training.
Funding, Collaboration	Regional Local	Supporting local capacity building including sustainable business and biodiversity, data bank and information collection, etc; Ecosystem conservation.
Explorative, Funding		Funding and researching for innovation, including biodegradation wetland and high-value production; Culture and heritage conservation.



REGIONAL PHASING AND REGULATING

Proposing with long-term temporal aspect of planning framework for the lowland delta

The regular cycle follows a normal 10 years' cycle of setting vision, assessing, regulating and evaluating. By linking different scales, in my case, the conservation, infrastructure development, and forestation policies at regional, and Green Growth plan of intermediate scale will be the most relevant objective policies, which will reflect and allocte through projcts at local or other scales. The arrow shows the flexible direction of reflecting and upscaling.

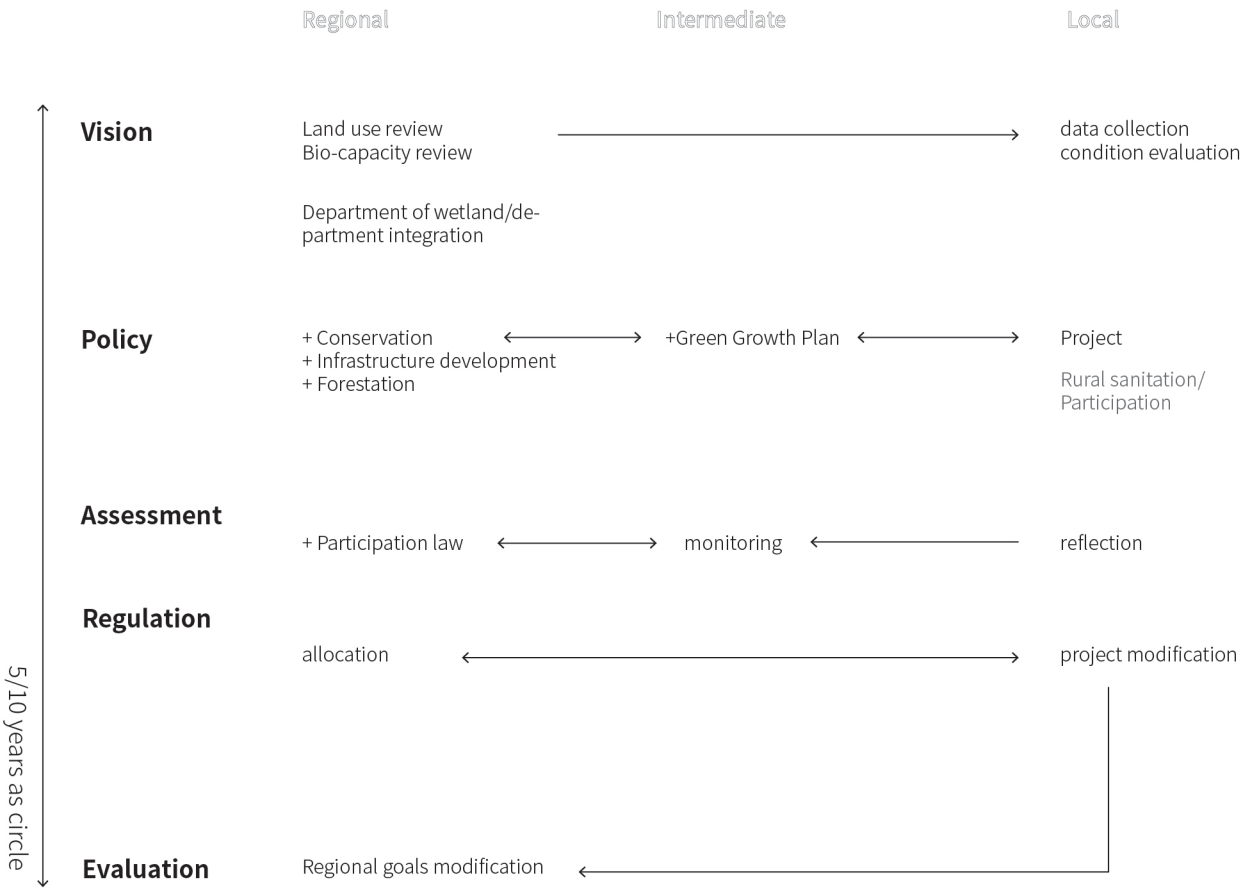


Fig 8.3
Phasing multi-scalar implementation

RESONATING
FROM LOCAL TO REGIONAL

Understanding operability through Adaptive Pathways
under biophyscial processes and management conflicts

Goal

Interpreting the four main values of the project - social connectedness, system stability, biodiversity continuity, and local engagement, the goal is to reflect on cost-effective and redundancy building in the Red River Delta context, from biodiversity and freshwater to local livelihood and safety including food and sanitation security.

Tipping points

Tipping points are set as the moment a certain level of external changes limiting current actions. Based on the former analysis of vulnerability and top-down governance, critical tipping points are assumed under considerations related to systemic specificities of water stress, urban occupation, and landscape capacity.

The proposed gradients of pressures are about:
1 Water stress: frequent drought and flooding; deeper inland saline intrusion;
2 Urban occupation: high land conversion rate for urban expansion; moderate infrastructure connectivity
3 Ecological degradation: lower soil fertility and biodiversity due to unsustainable agriculture intensity

Timeline

Referring to the frequency of national policies and existing scenarios, 5 and 10 years are taken as the main regular periods. While a period of 5 years is more suitable for frequent socio-economic actions, 10 years or over are more about ecological evolution and transformation.

The facts including that the current high use of 80% of surface water for irrigation, national promise about reducing 8%-15% greenhouse gas emission for Paris Agreement, and predicted 50cm sea level rise in 2050 are taken into consideration. These facts imply the trend of growth and consumption of ecological resources and social conditions for the region.

Actions

Actions consider the function of robustness, adaptation, and transformation.

Cost and Benefits, Acceptance and Engagement of these actions should be evaluated in order to choose the direction of a qualified pathway.

Actions have different practical operability and levels of acceptance. for instance, modifying width is more flexible than the depth even for the local farmers with local tools.

Actions have interdependencies among each other. For example, soil cleaning and waterway modification, and social infrastructure activation are an excellent combination of mutual influence. It can be considered in conjunction with the regular evacuation time in coastal flood-prone areas; or working with densification architect projects in the limited space of urban, etc.

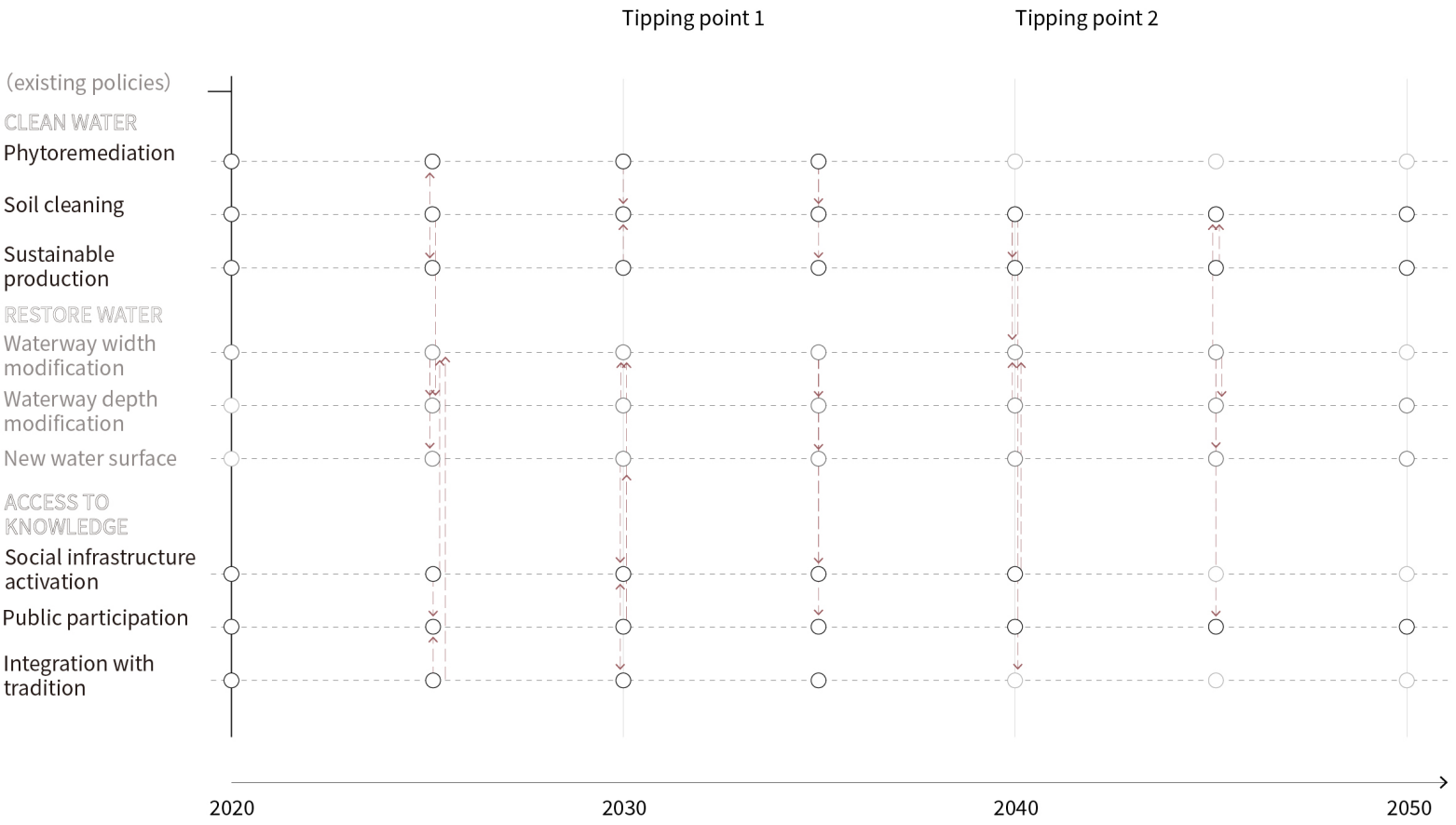


Fig 8.4
Adaptive pathways for local interventions dynamics shifting under general regional principles

RESONATING
FROM LOCAL TO REGIONAL

Understanding operability through Adaptive Pathways
under biophyscial processes and management conflicts

As adaptive pathways show different preferences of actions due to local social structure and local economy, etc. To activate local processes to change, local condition and capacity should be assessed, regarding resistance and acceptance, sharing information than informalities, to see how to combine vernacular strategies and adaptation to project and create transformation from backbones of different strategies through time.

Outcomes refer to main regional strategic principles. The operability of actions has different impacts between various production models from household-based to collective in urbanized lowland.

Different pathways are trying to lead to common values-diversity and stability of systems.

The main actions are marked here, based on a perspective of more designer as public, with a certain degree of ideality. Those dashed lines and arrows on the contrary represent the perspective of civic as the protagonist. Or their knowledge should be valued and engaged as a catalyst.

Abbre. for next pages:

T1 tipping point 1
T2 tipping point 2

A1 Phytoremediation
A2 Soil cleaning
A3 Sustainable production
B1 Waterway width modification
B2 Waterway depth modification
B3 Waterway depth modification
C1 Social infrastructure activation
C2 Public participation
C3 Integration with tradition

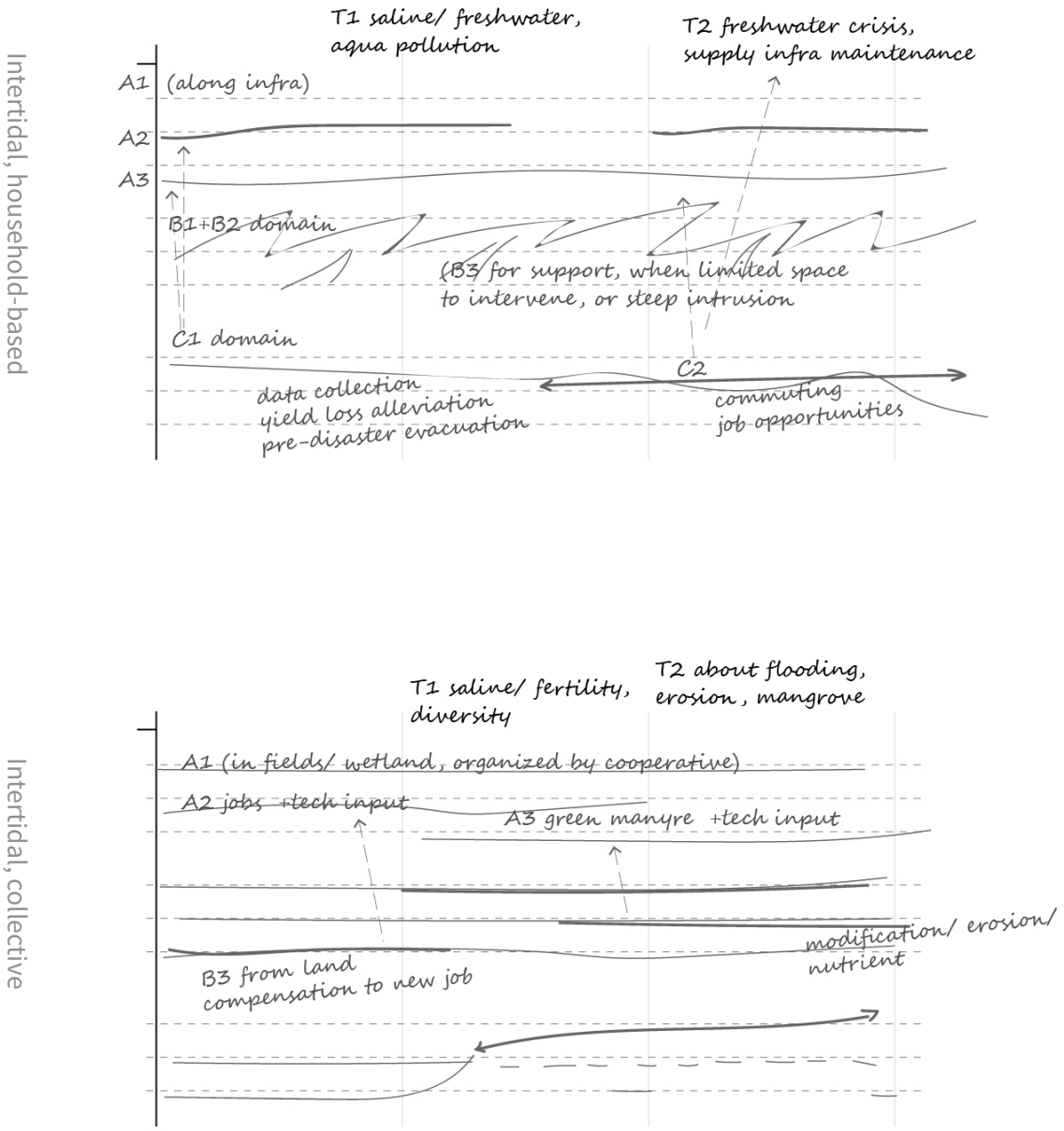


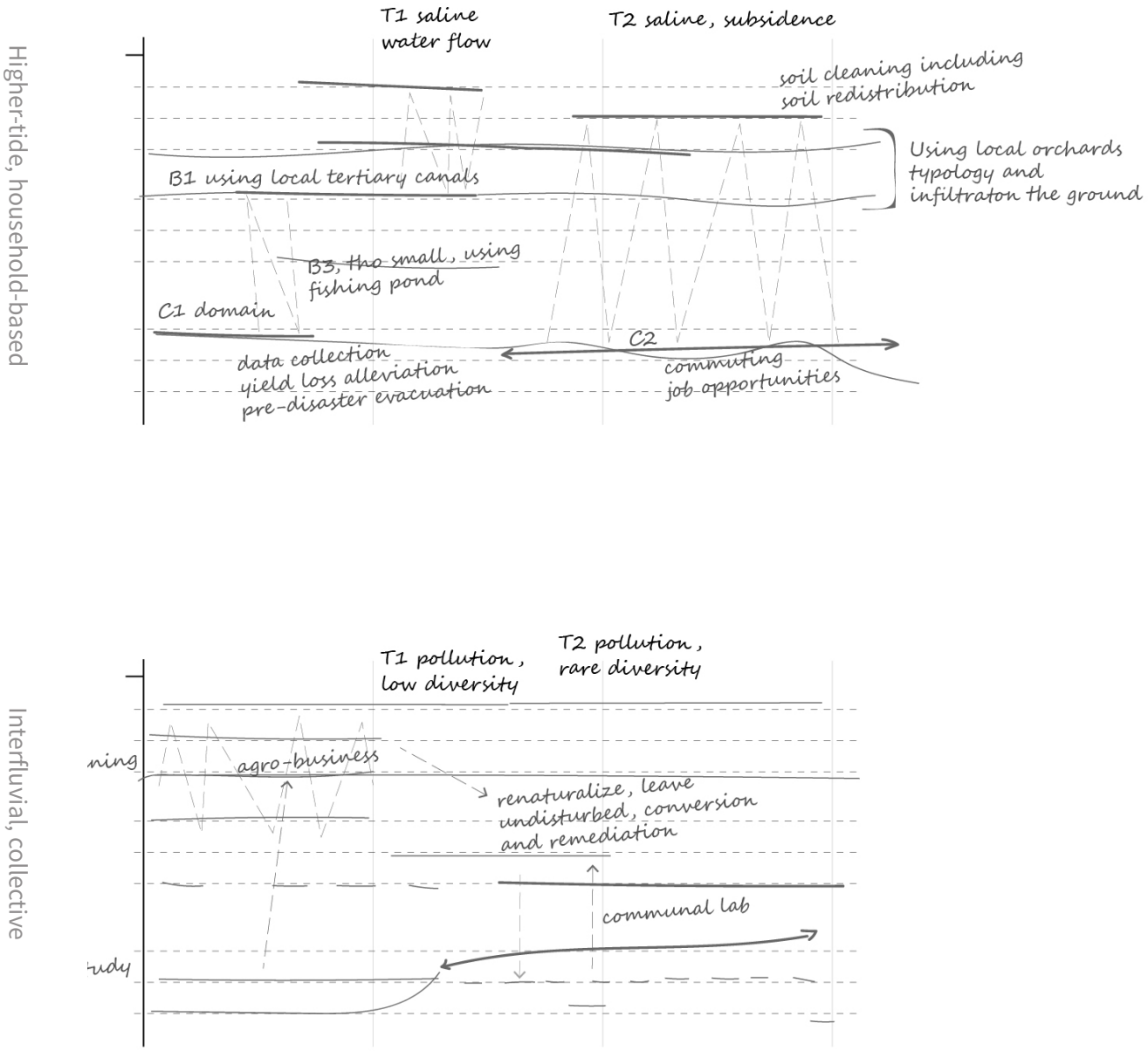
Fig 8.5
Proposing different cconditions of adaptive pathways based on its local context, capital and assets.

Both in intertidal communities, the main consideration for the tipping point is that saline intrusion affects freshwater resources, and the potential for livelihood-induced pollution. The threshold can be infrastructure maintenance, including inland water supply and coastal storm surge protection.

In the process of public facilities and place-making, household-based production can first activate public space to improve information collection and resource sharing and later should keep up with local or provincial policies that promote public participation; while cooperatives as collective can use their management advantages, from information collection and traditional cultural projects to indirectly build and improve the public network.

Based on the production and protection of water resources, small families have their advantages in vegetation diversity, which is worth learning and to be spread, to promote natural circulation of succession; encourage water companies and locals to cooperate in dredging; cooperatives can instead establish their own development companies, and the ownership is under the provincial level, to improve the unequal contradiction between existing management and demand.

For areas affected by regular higher tides, the

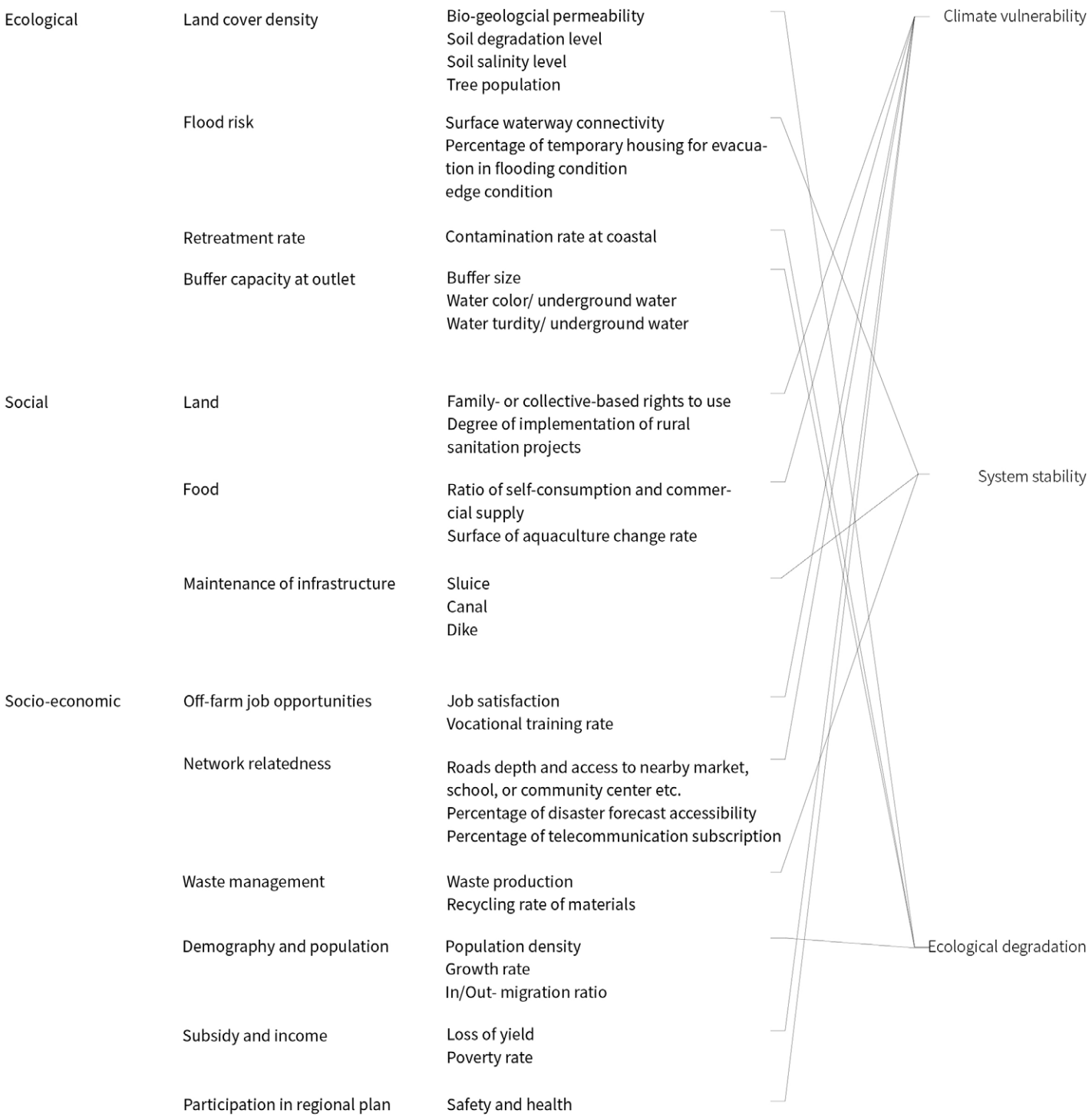


main tipping point is still salinity and freshwater, but attention should be paid to the safety and health of production pollution and rainwater collection devices, as well as subsidence caused by continuous urban development. Therefore, soil cleaning includes not only the transfer, restoration, and return of the topsoil by local companies due to construction, but also the transfer between provinces, the redistribution of soil due to erosion, and nutrition needs.

For the inland, it is more about pollution, including agriculture, industry, and domestic use, and the loss of biodiversity. Among them, Sustainable Production as the domain and lasting topic can further be explained as a sequence of actions. To take interfluvial collective as the case, the possibility can be composed of renaturalizing the pollution concentration by defining ecological conservation by provincial and national decisions, promoting agrobusiness and water-saving technology input by local place-making with cultural department and research institute, etc. Other actions amplifying redundancy of Sustainable Production can be the wood collection, etc.

EVALUATION

From local to regional.
Providing a certain resolution of context, showing indicators across scales that matter for dfferent actors and the environment.



Link back to biophysical temporal scale.

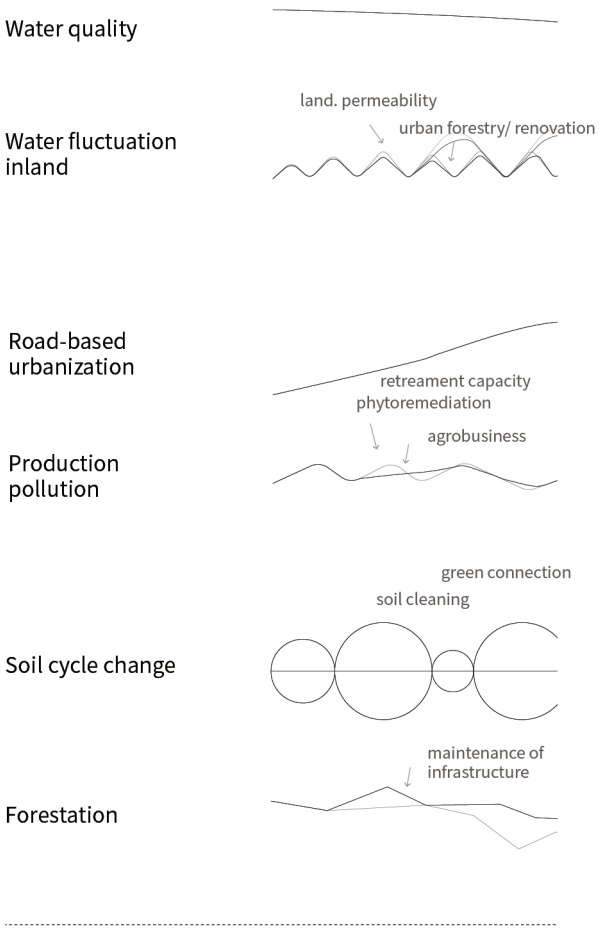


Fig 8.5 (left)
Evaluation framework for socio-ecological resilience

Fig 8.6 (right)
Systemic intergration transforming and having
an impact on biophysical temporal scale

Evaluation links back to the identified vulnerabilities and drivers of change that form the delta dynamics. It shows the potential physical and long-term impact on the performance of the delta, and always need to link to local context even just a nuanced difference in distance and domain craft industry, This evaluation framework values the aspects of economic efficiency, environmental effectiveness, equity, and policy legitimacy (Adger et al., 2003), and indicators regarding productivity, resilience, stability, reliability, adaptability, equity, and self-reliance from MESMIS (Lopez-Ridaura et al., 2002).

Back to the long-term biophysical temporal scale, actions and regulations may influence and alter the developing fluctuations. For example, the water fluctuation might be mitigated by the improvement of land permeability and urban forestry promotion; the pollution and waste production might be reduced by increased waste recycling and retreatment capacity and widespread compostable materials.

9 CONCLUSION

CONCLUSION

Overall evaluation of the project

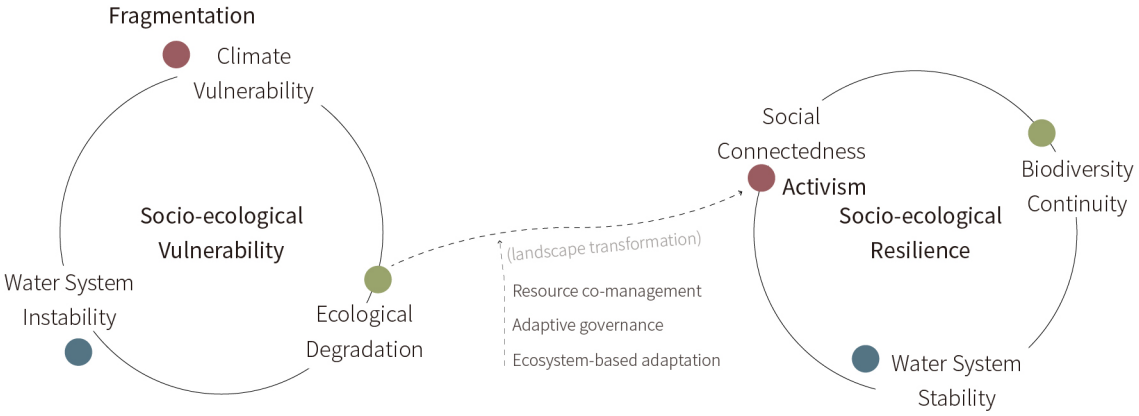


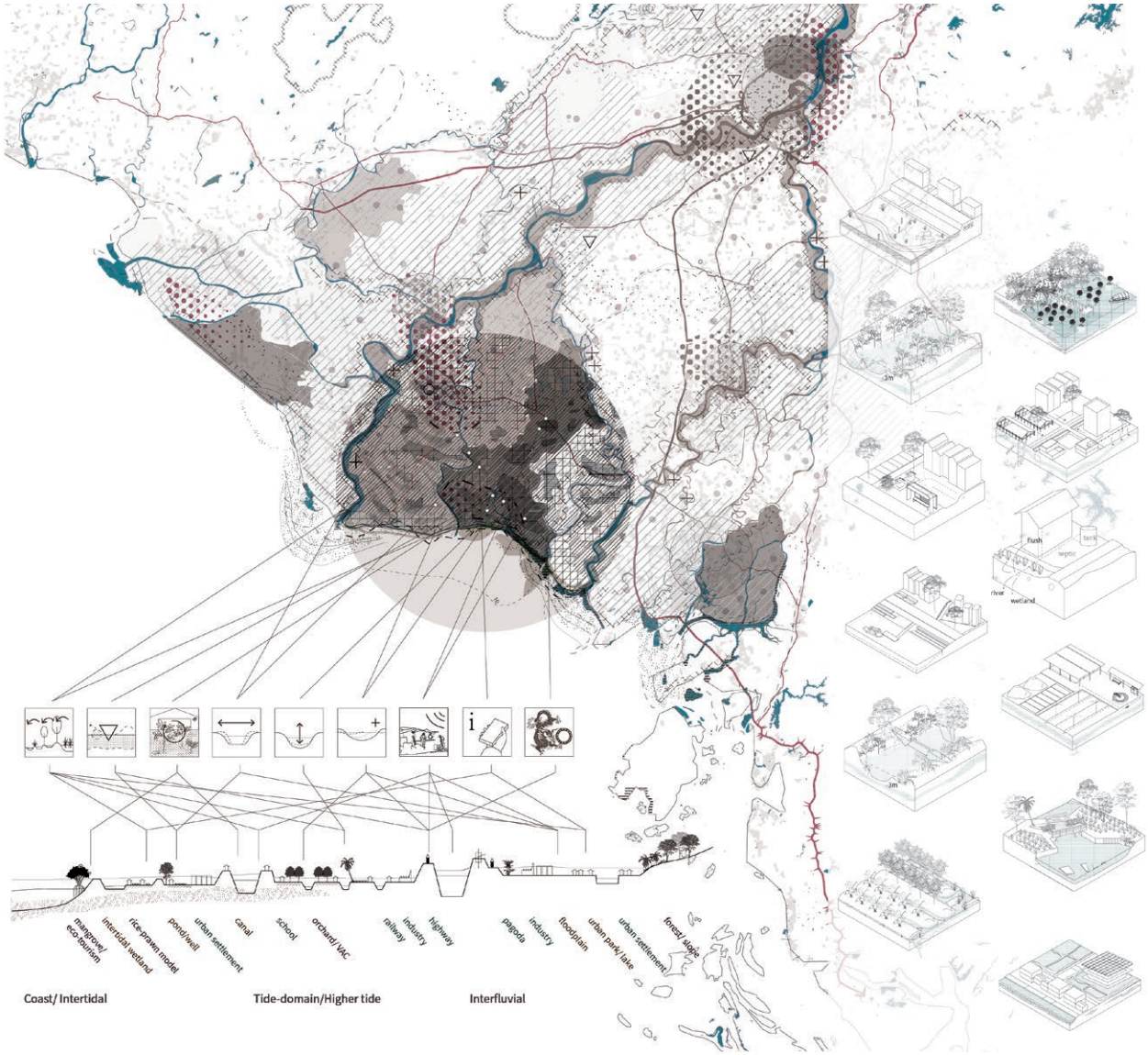
Fig 9.1 (above), from vulnerability to resilience

(Fig 7.24, page 129 (right), from local to regional to local)

Values of the project

The project highlights a systemic awareness from vulnerability to resilience within evolutionary processes by local adaptation and transformation. It follows a broad global issue about adaptation, livelihoods and ecosystems. Resource efficiency and social equity brought by urban expansion and environment degradation under external climate crisis are expected to be adapted and intervened as the working hypothesis proposes.

By understanding diachronic review of landscape performance and complex biophysical subsystems embedded, ecosystem-based adaptation including clean and restore water and increase access to knowledge, can help to build up systemic efficiency and resource co-management, further gain values of social connectedness, bio-diversity continuity and water system stability with a participatory management approach.

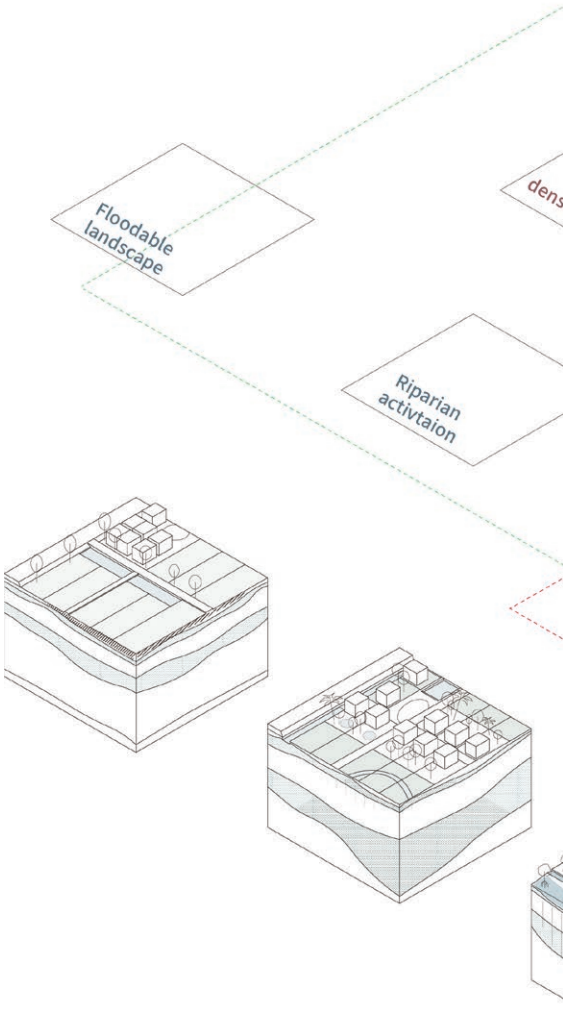


Multi-scalar systemic thinking and design approach

As it is learned that in RRD, the vulnerability is influenced by current performance of consumption, occupation, and cultivation of systems and keeps getting severe, multi-scalar approach with systemic thinking contributes to understand and project an evolutionary relationship between habitat and topos. By linking systems, principles, pathways- seeing and changing conditions through multi-dimensions, including production for intermediate, perception for local, protection for regional. Opportunistic approach to understanding how to integrate, mix and expand local adaptation to generate more mitigation processes, both physically and for a long term at a large scale. The method allows the study entering from specific cases under the systemic framework to synthesize and compare and project, from a deductive, exploratory to an inductive way.

Policy amendments will activate the conversion of interventions at small scales, while contrary, the joint effect of interventions may also promote the revision of policies in social or ecological terms. Time includes short-term economic activities and human resources distribution, as well as long-term soil deposition, groundwater reservoir, and saline rate, changes in traditional behavior should be considered.

Fig 9.2
A drawing of proposed local livelihood

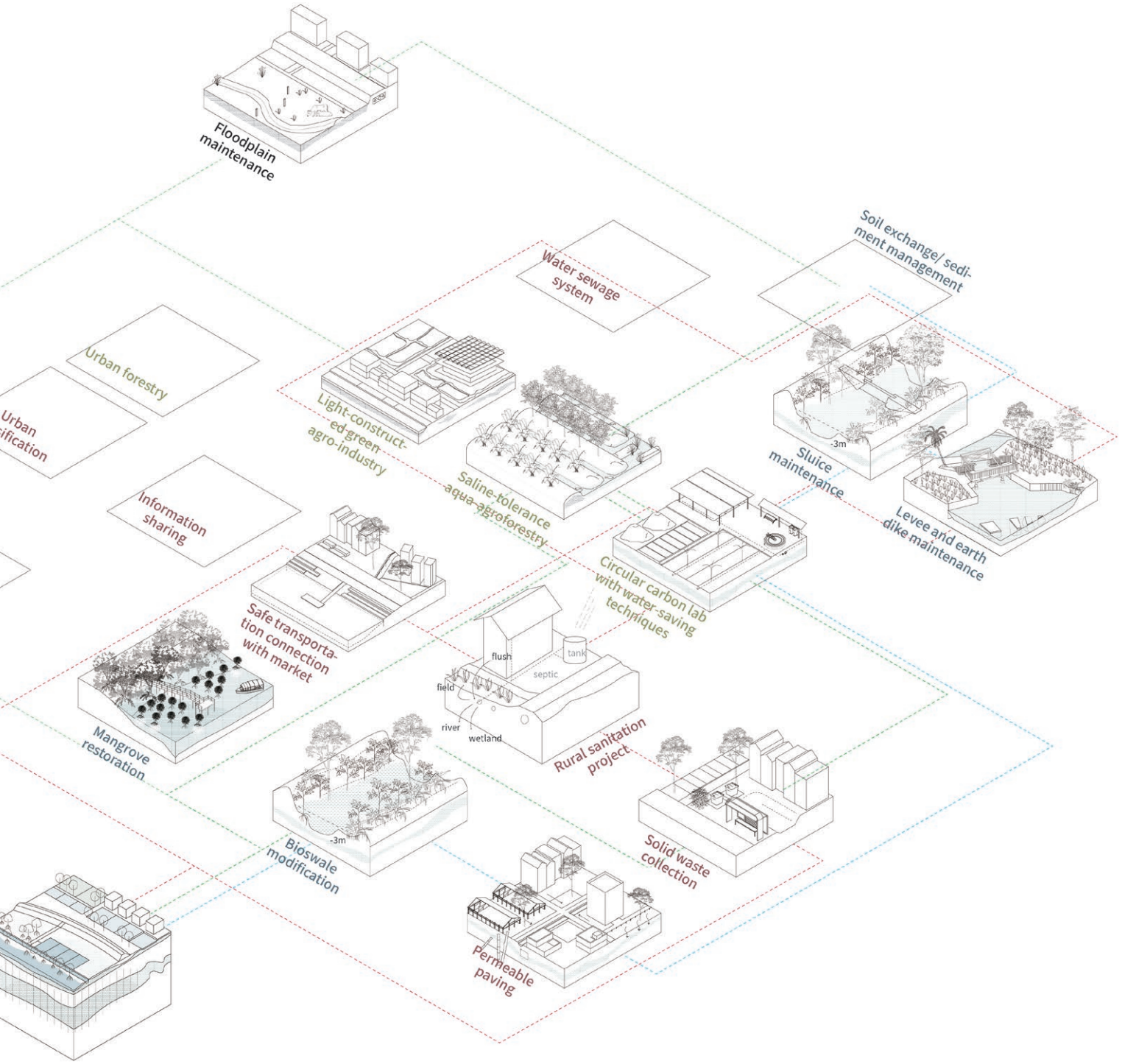


Local cultivation and perception, pathways

Forregional,Pathwaysandco-managementaretofacilitateactorsand users with systemic wise of scales allow the systems to be gradually changing, by considering criticalities as one of the strongest points. providing transformative systemic approach with a long period with efficiency; support from the public and private collaboration from a higherlevel.Regulatingandintegratingdepartmentsforconservation,

The exploration case has shown that a potential systemic transformation can be supported by policies, techniques, and public-private participation, while traditions might be influenced ini aspects of changing diet habits, media promotion, etc.

The selection of pathways depends partly on social structure and preference, the resistance. The same problem can belong to different departments in different locations. The shift between departments or actions can be changed by the sensitivity of resources that need to be guided by regional, or local capacity able to take over maintenance and reflecting large scale regularly to keep a wise efficiency.


Floodplain maintenance
Water sewage system
Soil exchange/ sediment management
Urban forestry
Urban ification
Light-construct-ed green agro-industry
Saline-tolerance aqua-agroforestry
3m
Sluice maintenance
Levee and earth dike maintenance
Information sharing
Circular carbon lab with water-saving techniques
Safe transporta-tion connection with market
flush
tank
septic
field
river
wetland
Rural sanitation project
Mangrove restoration
3m
Bioswale modification
Solid waste collection
Permeable paving

Limits and transferability

The project has a limitation due to data accessibility and communication. It also ends with a limited depth of analysis and projection, with cultural appropriation as a foreigner of the context.

But it still gives an open chance to learn from and discuss with similar delta context (frequent/ extreme flooding and drought), informality and urbanization, and mono agriculture, as an experiment. As The project is a process where design activation can happen at different levels, So transferability always relates to local conditions and models.


+ Medical
Craftman
Bamboo craft
Culture documentary
+ Water-tolerant plant
+ Emergent plant
+ Economic plant
Gravel
Sand
with biosolids and ash
Shallow Aquifer
2 – 10m
Marine clay
Sand
Silts

REFLECTION

Reflection

Relationship between research and design.

The project is to understand the dynamic processes of natural and urban systems within the territory from both biophysical long-term aspects and socio-cultural aspects. Research and design develop by understanding its diverse sub-systems inside with evolutionary movements by changing matter, topos, habitat, and geopolitics aspects, and reflecting on the values that an ecosystem-based adaptation can bring. Natural and urban dynamics with the perspective of re-cooperative eco-services and life by cultural issues to reinforce among nature systems-hydrology and agroforestry through time and space are the main focus. Research further goes into vernacular tradition and local identity, their attitude to water and floods, and ways of using local materials.

Under the proposed scenario- integrated water and land management by resource co-management, the design is about the possibilities of decoupling the present manipulation to reinforce the capacity of certain groups with a socio-ecological approach through the landscape. Design is used as a method of understanding and relocating local main mechanisms of management through transect, discovering and reorganizing spatial processes through the plan, and linking to biophysical and socio-economic events through time.

Relationship between your graduation (project) topic, the studio topic (if applicable), your master track (A, U, BT, LA, MBE), and your master program (MSc AUBS).

Transitional Territories Studio mainly focuses on water, land, and infrastructure which form those transitional territories from perspectives including social, ecological, and political. It responds to my initial interest that falls in the synergy between human and nature. So far, the multidisciplinary ways of study are a quite elaborated and influencing way of seeing of conducting an urbanism project, including the studio research method of four lines of inquiry, media as a way of communication, and the collaboration and view input from other researchers as well. In the end, my project and the studio are both more landscape urbanism more than architecture urbanism, a way more standing for letting nature grow and human occupying less.

My research project aims to focus on ecosystem services and human well-being, related to vulnerable groups in the delta region with a long history of rice production embedded. The project tries to find a symbiosis to live with nature through water and land dynamics, which relates to the focus of the studio as well. I also feel my interest in landscape design and personally being attracted by local traditional ecological knowledge, that's why the cultural dimension is added into consideration. Similarity connects to certain experiences in the first year, especially the projects about the circular economy, resilience, and scale for practices in Q3 and Q4, but also the Dutch layer method considered.

Elaboration on research method and approach chosen by the student in relation to the graduation studio methodical line of inquiry, reflecting

thereby upon the scientific relevance of the work.

The thesis project is to explore land management with the notion of living with nature by modifying adaptation, robustness, and transformation to dynamic urbanization and landscape. The question emerges that what if the socio-ecological coexistence could also bring certain opportunities to local socio-economic activities by integrating with socio-cultural elements? Then in the case with the significance of monsoon Asia, besides ecosystem restoration to stop the linear resource consumption and devastating anthropogenic activities, how can traditional cultural landscape evolve with new hybridity related to sustainable social livelihood and production economy to this agrarian territory?

The whole structure of the thesis can be divided into three parts of the review, reorganize, and resonate. The review part investigates the performance of the systems within the delta and local phenomenal practices through mainly the studio's four lines of inquiry methodological approach. By following the studio research methodology of four lines of inquiry, the project starts with understanding the current composition, the diachronic alteration and related limits of four themes- water fluctuation, urban occupation, land cultivation, and institutional management in my case; Reorganize part under the scenario of Wise-Use and Symbiosis with Nature, based on the clarification of main systems and values, discuss the notion of robustness and transformation towards evolutionary resilience and socio-ecological connectedness by revealing uncertainties, exploring possibilities and building redundancy through landscape and actions jumping among systems, scale and time. Actions talk about wetland restoration, sustainable production, and community participation by responding to the interdependency among three systems. Resonate part is about balancing trade-offs and implement, maintenance through time.

The criteria framework is developed through processes of analysis, design, and assessment within the project. Direct and indirect drivers of change which also applied to lines of inquiry are referred from ecosystem services (MEA, 2005) to understand socio-ecological and socio-cultural vulnerabilities from biophysical, social, and physical three aspects; Criteria which guides the design integrates drivers with social livelihood index (Huong et al., 2019) to reinforce the corridors and carriers at large scale and facilitate local-level intervention. It gives possibilities to experiment with the different ways of shaping the ground, including regulation and recreational eco-services; For assessment is about the performative characters of different actions across systems and scales, to evaluate the capacity of design manipulation responding to the vulnerabilities, risks and improving resource co-management. It should be a cyclic review and critic with regular monitoring and maintenance.

The thesis expects to absorb certain notions of professional knowledge from urban planning, water engineering, urban sociology and philosophy, and filmmaking as well, in terms of design as ways of seeing and storytelling, to land the project on a scale of efficiency and effectiveness. Due to the limits of field trips and the language gap, a detailed assessment is not possible in this case, but prediction by trends and evolutionary changes could be possible. Assumptions based on others' research of similar contexts in Vietnam can be used as a reference as predictable trends to take action.

Elaboration on the relationship between the graduation project and the wider social, professional and sci¬entific framework, touching upon the transferability of the project results.

'I don't know why the climate is changing... Floods are coming more often, and my fish and shrimps die more frequently due to those abnormalities of the weather.' from a Vietnamese farmer. As a reflection of the quote from a WHO report, the thesis expects a sustainable economy and quality of life guaranteed for vulnerable farmer groups under the influence of climate change. Cultivation in social assets should allow to reorganize and maintain sustainable livelihood and connectedness with enhanced access to clean water and knowledge and services of production, having possible contact with stakeholders from multiple fields.

Besides implementing the regional planning framework from the authority, it is also important that how can we learn from both the biomimetic and localized knowledge about water, land, and forestry. Meanwhile, by learning from social media and documentaries, the flood has already become a part of Vietnamese daily life. Prevention is no longer an expectation but instead, how can the form of living and working evolve by integrating smart use of technology and eco-services? And what cost and benefit and to what extent how to upscale? It is expected to see that new functional hybridity and ways of occupation for future generations as well. And designing mitigation with technical and narrative storytelling skills can allow this project to help people visioning climate imagination beyond plans and proposals.

In terms of social connectedness and local activation, system stability, and biodiversity continuity, the main goals of this project also respond to certain SDGs:
3 Good Health and Well-being; 4 Quality Education; 5 Gender Equality; 6 Clean Water and Sanitation; 8 Decent Work and Economic Growth; 9 Industry, Innovation, and Infrastructure; 10 Reducing Inequality; 11 Sustainable Cities and Communities; 12 Responsible Consumption and Production; 13 Climate Action; 15 Life On Land; 17 Partnerships for the Goals.

Transferability.

The project can connect with, learn from those territories with similar context and development conditions inside monsoon Asia- rapid urbanization, rice-based economy, and specific characteristics, such as cases of Java, Bangladesh, etc. While the thesis has a limitation of the depth of research and design, it is to give possibilities of land cultivation and regulation as a medium to generate or recover from different forms of occupation. As the context and theme of the project have embedded the background with social-cultural, biophysical, and political complexities. The proposal of ecological restoration and reducing inequalities might take another 20 years of Vietnam just to reach the current condition of the Netherlands. Thus the cost and benefit also relate to the impact of globalization trends and indeed financial supports, in terms of the transformation of this territory, to mitigate inefficiency or to better adapt in a local context, as there’ s still a long way to approach the proposition.

As the project is still a process where design activation can happen at different levels, so transferability always relates to local conditions and models. This requires a multi-dimensional reflection on different local conditions inside the delta and inductively wise-upscaling.

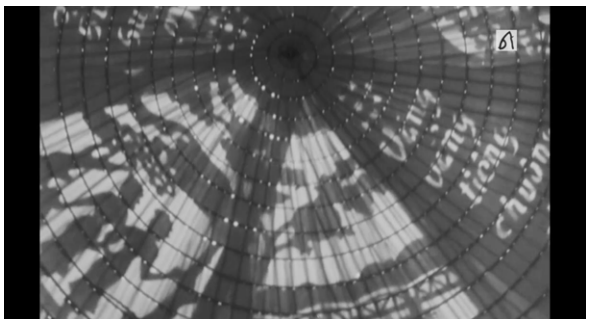
Discuss the ethical issues and dilemmas you may have encountered in (i) doing the research, (ii, if applicable) elaborating the design and (iii) potential applications of the results in practice.

Data and information in this project are mainly learned from second-hand information, including those open public project reports from NGOs. While my strategic model is to manage the robustness of a delta, the existing urban expansion and high level of informality are uncertainties to consolidate the project, the assessment gradients, and design depth as well.

The language gap is still a big communication obstacle in the project without a Vietnamese-speaking partner, especially for contacting and conducting interviews with the locals. This adds the limit to tell the story from a foreign perspective as well.

Ways of seeing should also recognize the cultural philosophy like how much locals do want to be engaged in the change. Regarding the long-lasting women’ s role and conventional virtues, the controversy of new materials against traditional habitus, the selection and suitability of public consultation, etc., how can these aspects be influenced in a way of future cultivation and new occupation in the delta?


I only want to ride the wind
and walk the waves,




slay the big whales of the
Eastern sea, clean up frontiers,


and
save the people from drowning


The wind softly
rocking the bamboo

Bibliography

Anh, H. Q., Tomioka, K., Tue, N. M., Chi, N. K., Minh, T. B., Viet, P. H., & Takahashi, S. (2019). A preliminary investigation of 942 organic micro-pollutants in the atmosphere in waste processing and urban areas, northern Vietnam: Levels, potential sources, and risk assessment. *Ecotoxicology and environmental safety, 167*, 354-364.

Adger, W. N., & Brown, K. (2009). *Vulnerability and resilience to environmental change: ecological and social perspectives* (pp. 109-122). London: Wiley-Blackwell.

Adger, W. N., Barnett, J., Brown, K., Marshall, N., & O'brien, K. (2013). Cultural dimensions of climate change impacts and adaptation. *Nature climate change, 3*(2), 112-117.

Adger, W. N., Brown, K., Fairbrass, J., Jordan, A., Paavola, J., Rosendo, S., & Seyfang, G. (2003). Governance for sustainability: towards a 'thick' analysis of environmental decisionmaking. *Environment and planning A, 35*(6), 1095-1110.

Adger, W. N., & Brown, K. (2009). *Vulnerability and resilience to environmental change: ecological and social perspectives* (pp. 109-122). London: Wiley-Blackwell.

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005). Social-ecological resilience to coastal disasters. *Science, 309*(5737), 1036-1039.

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., ... & Wollenberg, E. K. (2009). Adaptive co‐management for social–ecological complexity. *Frontiers in Ecology and the Environment, 7*(2), 95-102.

Asian Development Bank. Red River Basin Water Resources Management Project: Final Report on Management Study on Land Use and Water Management. 2000. http://bicn.com/wei/resources/Bennett-2000-ADBTA-2871-VIE-Land-Use-Water-Management-RRB.pdf

Assessment, M. E. (2005). *Ecosystems and human well-being: wetlands and water.* World Resources Institute.

Berkes, F. (2002). Cross-scale institutional linkages: perspectives from the bottom up. *The drama of the commons,* 293-321.

Cuc, Le Trong, A. Terry Rambo, Kathleen Gillogly, and Southeast Asian Universities Agroecosystem Network. "Too many people, too little land: the human ecology of a wet rice-growing village in the Red River delta of Vietnam." (1993).

Dang, Nguyen & Babel, Mukand. Flood hazard assessment the context of increasing floods and sea level rise in the Red River Delta, Vietnam. Hanoi: International Commission on Large Dams (ICOLD), 2010. https://www.researchgate.net/publication/255971583_FLOOD_HAZARD_ASSESSMENT_THE_CONTEXT_OF_INCREASING_FLOODS_AND_SEA_LEVEL_RISE_IN_THE_RED_RIVER_DELTA_VIETNAM

Devienne, Sophie. "Red River Delta: fifty years of change." Moussons. Recherche en sciences humaines sur l'Asie du Sud-Est 9-10 (2006): 255-280.

Davoudi, S., Brooks, E., & Mehmood, A. (2013). Evolutionary resilience and strategies for climate adaptation. *Planning Practice & Research, 28*(3), 307-322.

Fontenelle, Jean-Philippe. (1999). The response of farmers to political change: decentralization of irrigation in the Red River delta, Vietnam.

Huong, N. T. L., Yao, S., & Fahad, S. (2019). Assessing household livelihood vulnerability to climate change: The case of Northwest Vietnam. Human and Ecological Risk Assessment: *An International Journal, 25*(5), 1157-1175.

IUCN. (2008). https://www.iucn.org/theme/ecosystem-management/our-work/ecosystem-based-approaches-climate-change-adaptation

Lin, D. (2008). Performance evaluation of participatory irrigation management by the supply chain balanced scorecard approach. Copenhagen University, Denmark.

López-Ridaura, S., Masera, O., & Astier, M. (2002). Evaluating the sustainability of complex socio-environmental systems. The MESMIS framework. *Ecological indicators, 2*(1-2), 135-148.

Mathers, Steve, Jeff Davies, Andrew McDonald, J. Zalasiewicz, and S. Marsh. The Red River delta of Vietnam: A demonstration of the applicability of sedimentology to the investigation of unconsolidated sedimentary aquifers. BGS Technical Report WC/96/02, 1996.

Minderhoud, P. S. J., L. Coumou, L. E. Erban, H. Middelkoop, E. Stouthamer, and E. A. Addink. "The relation between land use and subsidence in the Vietnamese Mekong delta." *Science of The Total Environment 634* (2018): 715-726.

Nang, Doan. "Wetlands protection and management in Vietnam." Wetlands Management in Vietnam: Issues and Perspectives. WorldFish Center, Penang, Malaysia (2003): 21-24

National Assembly. "Law on Land." No. 13-2003-QH11, 2003

Nguyen, A. T., Trinh, Q. A., Pham, V. T., Le, B. B., Nguyen, D. T., Hoang, Q. N., ... & Hens, L. (2019). Farmers' intention to climate change adaptation in agriculture in the Red River Delta Biosphere Reserve (Vietnam): a combination of Structural Equation Modeling (SEM) and Protection Motivation Theory (PMT). *Sustainability,* 11(10), 2993.

Olsson, P., Folke, C., & Berkes, F. (2004). Adaptive comanagement for building resilience in social–ecological systems. *Environmental management, 34*(1), 75-90.

Orchard, Steven E., Lindsay C. Stringer, and Claire H. Quinn. "Environmental Entitlements: Institutional influence on mangrove social-ecological systems in Northern Vietnam." *Resources 4*, no. 4 (2015): 903-938.

Ritzema, Henk, and Bui Thi Kim. "Collaborative research to improve the water management in two polders in the Red River Delta in Vietnam." In Knowledge in action, pp. 57-84. Wageningen Academic Publishers, Wageningen, 2011.

Sauer, C. O. (2007). The morphology of landscape. *Foundation papers in landscape ecology, 2*(2), 36-70.

Steven E. Orchard, Lindsay C. Stringer, and Claire H. Quinn. "Environmental Entitlements: Institutional influence on mangrove social-ecological systems in Northern Vietnam." *Resources* 4, no. 4 (2015): 920.

Tanabe, S., Hori, K., Saito, Y., Haruyama, S., & Kitamura, A. (2003). Song Hong (Red River) delta evolution related to millennium-scale Holocene sea-level changes. *Quaternary Science Reviews, 22*(21-22), 2345-2361.

Thai Binh Portal. (2017, August 1). Brief introduction of Thai Binh province. https://english.thaibinh.gov.vn/Natural%20conditions/brief-introduction-of-thai-binh-province-68.html

Thao, L. B., & Phuong, N. Đ. (1997). Vietnam: The Country and Its Geographical Regions. The Gioi.

Tuan, Pham Anh, and K. Shannon. "Water management in Vietnam: indigenous knowledge and international practices: the case of the Red River Delta." In Conference of Network-Association of European Researchers on Urbanization in the South (N-AREUS XI). 2010.

Trinh, T. M. (Director). (2015). *Forgetting Vietnam* [Film]

van Dijk, Michiel, M. Hilderink, H. van Rooij, M. M. Rutten, Ralph Ashton, Kiki Kartikasari, and Vu Cong Lan. Land-use change, food security and climate change in Vietnam; A global-to-local modelling approach. LEI, part of Wageningen UR, 2013.

Van Huong, Nguyen, Tran Huu Cuong, Tran Thi Nang Thu, and Philippe Lebailly. "Efficiency of different integrated agriculture aquaculture systems in the Red River Delta of Vietnam." *Sustainability* 10, no. 2 (2018): 493.

Vrolijk, J.W. (2002). Risk Assessment of flood protection systems in the Red River Delta of Vietnam. TU Delft, the Netherlands

Vietnam academy of social sciences. (2011). Poverty reduction in Vietnam: Achievements and challenges. https://documents1.worldbank.org/curated/en/870971468318548031/pdf/642790WP0P107600Box0361535B0PUBLIC0.pdf

VietnamVisa. (2013, August 11). Vietnamese New Year 2015. https://visa2vietnam.blogspot.com/2013/11/tour-vietnam-vietnamese-new-year-2014.html

Waibel, Gabi. State management in transition: Understanding water resources management in Vietnam. No. 55. ZEF Working Paper Series, 2010.

Wilbanks, T. J. (1994). “Sustainable development” in geographic perspective. *Annals of the Association of American Geographers, 84*(4), 541-556.

Young, O. R., Berkhout, F., Gallopin, G. C., Janssen, M. A., Ostrom, E. and van der Leeuw, S. (2006). The globalization of socio-ecological systems: an agenda for scientifi c research. *Global Environmental Change*, 16, 304–16.

Zimmerer, K. S. (2000). The reworking of conservation geographies: nonequilibrium landscapes and nature-society hybrids.

Appendix

Theory paper

Socio-cultural dimension for adaptive governance
Towards a socio-ecological resilience in the context of Red River Delta, Vietnam

Zhongjing Zhang/ 5082358/ Z.Zhang-32@student.tudelft.nl
Transitional Territories/ Diego Andres Sepulveda Carmona/ Daniele Cannatella
Date of submission/ 25.11.2020

Abstract
Climate change, urban expansion, population growth and an increasing food demand are threatening traditional agricultural communities, especially in developing countries. The contradiction lies between dependency on external natural resources and a weak connection between social institutions in a degrading environment. The economic development goals, modernization and unsustainable infrastructure is transforming the Red River Delta into critical zones (Latour, 2014). This paper discusses why the cultural dimension should be included when approaching socio-ecological resilience and how adaptive governance can work as an agency for integrating local communities into environmental decision-making by enhancing information and communication. Thus to build stronger socio-cultural integration and self-reliance as a response to the pulsing dynamics of nature. The paper studies cases of capacity evaluation frameworks and several practices of adaptive governance in conflicts of invisible ownership and belonging, local economy, and global ecology. By reflecting on the context of the Red River Delta, the paper aims to reveal the socio-cultural impact on spatial performance and the importance of integration and communication between local communities and government, to mitigate and remediate the existing unwise use of resources for short-term economic goals.

Keywords
Adaptive governance, socio-ecological resilience, cultural dimension, Red River Delta, Vietnam

'The landscape in the Red River Delta is not manipulated only by human but entirely transformed by human.'

Le Ba Thao, 1997: 323-31

'Flowing automatically, water appears unevenly in the landscape, gathering with below the surface as ground water, or above the surface in separate cavities (holes, ponds, lakes), or continuous beds (streams, rivers). Such formations are of minor significance in an agricultural area enjoying ample precipitation, but they become immensely important in the water-deficient landscape.'

Wittfogel Karl August, 1978: 15

Introduction

After Doi Moi[1] enforcement, industrialization and foreign investment in national infrastructure have been stimulated enormously, resulting in land use intensification and diversified production, as well as a degrading and fragile delta environment. Future urban expansion and delta dynamics keep putting pressure on the Red River Delta.

This paper mainly focuses on the socio-cultural aspect and adaptive governance. The first chapter is to understand the concepts of resilience and vulnerability and the power of culture. The following two chapters are about interpretation of critical geography of the local environment and cultural performance, related with three pairs of entities reflecting on the context of the Red River Delta and similar delta regions. Then key indicators for evaluation and assessment are reviewed through case studies. Last two chapters deal with adaptive governance and further imagination towards a resilient framework, understanding how the concept of adaptive governance can contribute to resource context-based co-management and how it might expand the function and effectiveness of eco-services in long term. The common conclusion all leads to the trends of system thinking across institutions, scales, and disciplines within the specific context.

Resilience, vulnerability, and cultural dimension

Resilience has been discovered by several disiplines including engineering (Holling, 2001), ecological (Holling, 1973; Schulze, 1996), social (Adger, 2000) and evolutionary resilience (Davoudi el at., 2013). Evolutionary resilience updates the view of resisting and absorbing ability from engineering and ecological ones, and adds the complex socio-ecological systems to learn, reorganize, adapt and transform in response to capture the ability of people and ecosystems together to adapt to changing risk and opportunities.

Vulnerability is the susceptibility of a community to the impact of hazards, concerning biophysical, social-economical, cultural factors or processes. A good example is growing flooding risks related with engineering protection failure or reducing availability of clean water. Adger and Brown (2009) also mentions reasons like the rising connectedness of places, declining diversity of functions and the decreasing diversity in natural and culture landscapes. Vulnerabilities are socially differentiated, which also results in the need for context-based adaption and policies (Young et al., 2006, 304-16).

From society itself, this role of perception and decision-making of social institutions matters (Adger and Brown, 2009), since the growth of GDP does not represent the growth of human well-being. Context affects how a society can and might react with the environment properly through the formation of place, integration of market, performance of culture and capacity of adaption. Both individual and collective are not just a matter of economic relations. They are part of social capacity which helps to facilitate social resilience. Social trusts, norms and networks are also linked to political legitimacy (Beetham, 1991) and contribute to social capacity. While ecosystem services strengthen socio-ecological resilience, ecosystem resilience does not directly enable social resilience. In this way, the operation and maintenance of ecosystem services become the bridge of social and ecological resilience (Adger, 2000; Adger and Brown, 2009).

1 Đổi Mới (Vietnamese), means 'renovation' in English. The economic reforms initiated in Vietnam in 1986 with the goal of transforming from a command economy to a socialist-oriented market economy. These reforms introduced a greater role for market forces for the coordination of economic activity between enterprises and government agencies and allowed for private ownership of small enterprises and the creation of a stock exchange for both state and non-state enterprises.

Mediation is one role of culture in the process of evolutionary adaption and social resilience build-up. Culture has a thickness that results from the accumulation of anthropology, knowledge, time, and beliefs of a place. Generally, a place with higher culture Identity and place attachment can respond better to external or unexpected disturbance and can even create new economic opportunities and inclusive decisions (Adger and Brown, 2009; Adger, 2013). Society can learn from local traditional ecological knowledge, such as its intimate relationship with land and habitats. Reducing waste cycles by using local mud and nutrients is one of the many examples that stem from traditional ecological knowledge. Culture accumulates and inspires the future. However, improper management can lead to the extinction of culture, with irreversible consequence that cannot be compensated. A proper coordination between general and specific is then needed to cope with the uncertainty, with the notion that culture is partly immaterial and difficult to be quantitatively measured or controlled.

Under the impact of climate crisis, the priority of Red River Delta in a growing urbanization and industrialization context of Vietnam is to have a critical framework for resource management, adaptation for water safety, livelihood and health, diversity and social-cultural continuity in the long-term imagination under climate change.

Interpreting critical cultural geography: water, labor and arable land

In broad terms, cultural geography examines the cultural values, practices, discursive and material expressions and artefacts of people, the cultural diversity and plurality of society, and the spatial distribution of culture, the processing of places and identities, sense and perception, production and communication (Oxford University Press, 2017). Afterwards, people interpret its interaction with political or economic aspects. Cultural geography as place, is a result of condensation, showing the depth through times.

Landscape is the medium of geography transformations, following nature modification and human activities. What counts in landscape is less its ‘objectivity’ than the value attributed to its configuration. This value is and can only be cultural (Corboz, 1983). Landscape is a visualization of land cultivation. Cultural landscape adds up extra vernacular values. It is a type of cultural geography originally being described as natural landscape under the impact of human culture groups in 'The Morphology of Landscape' (Sauer, 2007). The essence of the concept keeps evolving given the duality of human and nature coexistence. The concept was included in the 'World Heritage Convention' in 1992, being defined as cultural landscapes; they are combined works of nature and humankind, expressing a long and intimate relationship between people and their environment (UNESCO, 1992). Three main types proposed in the Operational Guidelines of 2008: the decorated nature garden, evolved landscape with human performance and a more spiritual or even immaterial landscape. Traditional arable land documenting and representing human agriculture practices on the surface is a typical evolutionary cultural landscape, which keeps noting down the alteration and transformation from industry and urbanization activities, especially in a context of agriculture-based region.

Criticality is distinct from vulnerability (Adger, 2000). It criticizes the breakdown of existing equilibrium triggered by the overloading pressure from either social, cultural, or other agents. It relates to the social willingness to accept any public response to climate and economy, and the capacity to maintain valuable ecosystem services. When we view the landscape, we see different production patterns related to resource availability and infrastructure accessibility, changing from mangroves

and shrimps at the coastal to industry production inland, from city lake to the community pond. What is embedded inside relates to the entities of individual and cooperative, the demand-supply relations of urban and rural, and the climate awareness of urban economy and global ecology.

Individual and cooperative. The performance of Cooperative[2] changed from an administration to execute decisions by the government to a service organization for its members, concerning issues mainly about water and fertilizers (Yanagisawa et al., 1999). The relations between individual and cooperative showed general claims that individual preferred more local management such as cooperative than district designated by the central government through reviewing the evolution from centralization to decentralization of irrigation systems. The main reasons were flexibility and habitus to achieve production autonomy as much as their feelings of belonging with the land reform and Doi Moi, the intensification and urbanization in urban areas but also the extension from urban into rural increased. These facts are both competing for more water and land resources, or other industrial products for cash income and local livelihood. There were significant changes including the intensifying production calendar changing from 2 to 3 crops and annual nursery land also being cultivated, organizations like hydraulic companies intervening, and an introduction of water fee appearing. On the other hand, the comparation of organizing the maintenance of tertiary canals in the common area by a brigade chief and village 'Women's Association' in Hai Duong case suggested that collective work can be better performed than individual one (Fontenelle, 1999). However, information and communication between bottom and top is still disconnecting, while they are confusing what salination levels of the water are killing yields, and why more frequent floodings are happening than usual.

Urban-rural relations. In the nineteenth century, rural areas remained as a place for the execution from urban, which was regarded as a place for permanent enjoyment (Corboz, 1983). These cultural practices that people yearn for, believing that cities always provide better opportunities, leads to over-urbanization and insufficient resources, which further exacerbates social inequality. Population in the Red River Delta in 2013 was around 20.4 million, with a predicted growth rate of 1.07% per year. One research (General Statistics Office, 2009) shows that the current migration trend in Vietnam is inter-provincial and over-urbanization in most developed cities including Hanoi shows up with deficient public services, especially health. Doi Moi accelerated the land conversion and spread express transportation, connecting rural and urban. In Hanoi and its surroundings, the exchange and conversion of land into industry created new vulnerable social groups besides those at flooding risks. In 2000-2004, Hanoi has used 5496 hectares of land for 957 industrial projects, which seriously affected the living and employment status of 138,291 households, of which 41,000 are classified as rural farming households (Hồng Minh, 2005). A company in Huo Duong province only hired 48 workers instead of 11,000 as promised from the local commune (Xuân Quang, 2004). The loss of arable land is creating new vulnerable groups. These vulnerable farmers are not well accepted for a transitional position in current society and expected well-being, though they are willing to experiment with new technologies.

Farmer protests government cutting husbandry and nitrate release in the Netherlands since last year is one example for the urban economy

2 Initiated by Vietnam government (which is North Vietnamese government before 1975), organization of all farmers where land and other factors of agricultural production would be owned and used collectively. The ownership of all land remained with the State. Cooperative merged in 1953 and reached the high level in 1961- the share of cooperative's profits that workers can get depended on points they collected for working performance.

and global ecology. Especially in the COVID-19 pandemic, the global economy might not work, and techno-science seems to be the cheapest way to balance local costs and benefits. On one hand, a community might find a way to adapt itself to a new tolerable condition, such as shifting performance of local practices in cropping patterns related to the specific location and climate and optimal consideration of natural processes. Criticality emerges in overlapping fluxes and cycles of the many entities (Latour, 2014). On the other hand, an irreversible sacrifice of certain cultures, species, and knowledge in a certain area can happen without a 'Doomsday Seed Bank'. One report shows the crisis of floating rice cultivation in Mekong Delta, losing 99.9% of floating rice fields from 1990 to 2015, with the bilateral impact on redundancy labor and intensified pollution caught by the soil (Nguyen and Pittock, 2016)

In Marx's theory, the relationship between individual and collective, social relations and social labor are placed as basic, while art and education are placed in the superstructure, showing the absence of self and culture in social organization (Gielen, 2017). The missing cultural values among social institutions need governance to make good use of debt, investment, and financial for. It’ s not wise to keep consuming other limited resources to fix the problems leftover. That is why adaptive governance is introduced as an approach to give agency to local. To let locals scaling up and interacting with each other, co-managing resources within a political ecology integrating ecosystem services (Assessment, 2005) as public goods and new potential for the village. The impact of modernization on cultivation, techniques, and efficiency might also be interesting to explore.

Local culture and tradition ecological knowledge

The Kinh is the major ethnic group of Vietnam and is distributed along the Red River Delta. They account for around 85% of the Vietnamese population. Their general view of nature is that of a more transformed landscape than an untouched 'wilderness'' under the impact of Confucianism. They mainly live in the delta region but have also migrated across provinces, focusing heavily on wet rice cultivation as tradition (Lundberg, 2004).

Ethnic minorities in Northern Vietnam above the delta have an intimate connection through movements of people, influencing ethnologic culture and habitus. A diverse rural resource household of Tay, one of the ethnic minorities might manage a system composed of multiple interacting components, including paddy fields, home gardens, livestock, shifting cultivation fields, and secondary forests (Asian Development Bank, 2000)

The model of a typical Integrated Agriculture-Aquaculture household (IAA) is called VAC, which is a small scale production systems in the Red River Delta. It consists of garden (V), pond (A) and livestock pen (C) run an organic cycle of solar, waste and nutrient, etc. The term can also be understood as integrated off- and on-farm production, including using animal manure as organic fertilizer and fruits as income. Alcoholic beverage and rice milling can also be used for feeding other animals including fish (Van Huong et al., 2018).

Key indicators for building up an evaluation framework

In the case of the MESMIS evaluation framework (López-Ridaura et al., 2002), it mainly proposes seven measurement indicators, through quantitative and qualitative methods to assess what might be potential or critical constrains in existing conditions. These are productivity, reliability, resilience, stability, adaptability, equity, and self-reliance. Productivity is mainly based on the consideration of crop yields and the effectiveness of

profits. The profits here are relative to the effectiveness of land production capacity and valuable labor; extreme environmental degradation which causes resources reduction, or unfeasible social production may affect the resilience and stability of the specific system and human well-being; technology-related adaptability; the balance of costs and benefits for farmers; and farmers' participation in relevant agricultural or water management decision-making and dependence on external resources.

This method is based on the induction and summary of more than 20 actual cases, mainly based on the agricultural villages in Latin America, conducted by multiple international organizations and interdisciplinary experiments, and summarized the relative universality of farmers' natural resource management systems. Its purpose is to re-examine and improve the natural resource management that is underestimated by short-term socio-economic goals and contribute to future inclusive planning and decision-making. The analysis result is a generalization that can be combined with a specific context, guiding to strategies of modifying a system or proposing an alternative system to optimize.

In another assessment of rural livelihood vulnerability conducted in the case of Northwest Vietnam (Huong et al., 2019), it categorized the measurement by capitals including human, nature, social, physical, etc. Human capital mainly considers health, knowledge and skills, food productivity and livelihood income changes; Natural capital includes wood resources, land capacity suitability for cultivation, water security, natural disasters, and climate change; Social capital considers demographic changes and social networks (including information and forecasting dissemination through media); economic income and policy subsidies; infrastructure accessibility and housing security.

The above index evaluations are inspiring, but need to be further refined and clarified according to place-based characteristics. New policies or long-term goals should ALSO be considered. They should all include the perceptions from farmers and communities, and understanding whether agriculture is their only income. For the application of these research factors, the indicated expression, the selection and refinement of indicators, and the scale of analysis in the former show more general values for human, while the latter show more specificity but not much space for complex simulations.

Adaptive Governance as an approach

Adaptive governance is necessary for long-term development and adaptation to climate change. It helps to build up social and ecological capitals through phasing and processes by integrating local and social institutions to communicate and express themselves and bind with formal decisions. Hybrid geography of environmental decision-making should engage diversity, scale, and flows of knowledge, power, and resources as outcomes (terminology proposed by Wilbanks, 1994; Zimmerer, 2000; Adger et al., 2003).

Economic efficiency, environmental effectiveness, equity, and political legitimacy have been highlighted as four main criteria for sustainable governance (Adger et al., 2003). The paper stated generalization to interpret the thickness of decision-making and implementation, as the amount of information and discussions accumulated inside. Though it is always hard to satisfy everyone, everyday life still matters, and dualities of costs and benefits should be considered in their spatial-temporary and across scales (Berkes, 2002).