Between mountains and mangroves

Designing a gradient city

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Graduation Lab: Landscape-based Urbanism

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Second Mentor: Sophia Armpara

New Capital of Indonesia



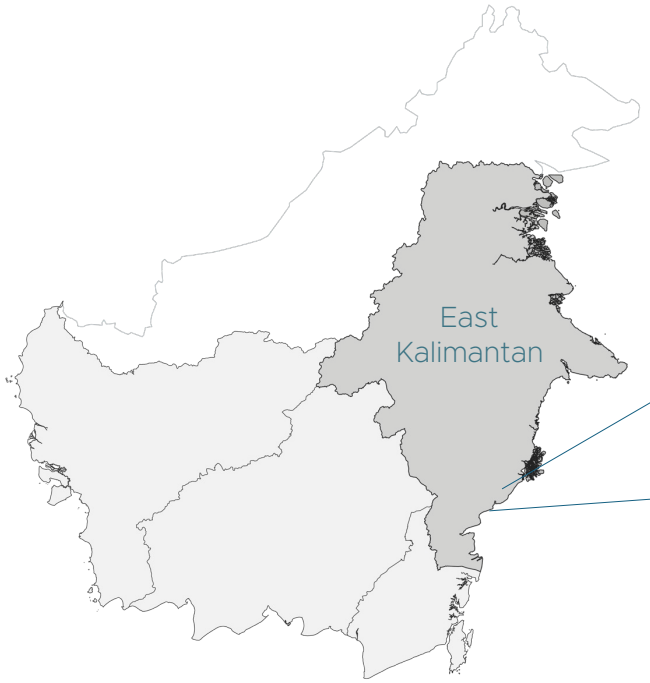


Nusantara under construction(Robin Zwartsenberg, 2025).

Presentation outline

1. Project Introduction
    I. Location
    II. Problem Field
    III. Research Definition
2. Analysis and Understanding
    I. Historical Development
    II. The Landscape Before
    III. The Landscape Now
    IV. Challenges and Potentials
3. Design Principles and Strategy
    I. Collecting Design Principles
    II. The Principles of Designing with Gradients
    III. Regional Design Phases
    IV. Regional Vision
4. Design Explorations
    I. Gradient from City to Mangroves
    II. Gradient I – Integrating local communities
        I. Detail I – Integrated Mangrove Aquaculture
        II. Detail II – Agroforestry Transition
    III. Gradient II – Developing urban gradients
        I. Street typologies
        II. Conceptual exploration
    IV. Return to the large-scale gradient
5. Conclusion and Discussion

On the island of Borneo



Samarinda

Planned
Urban Area

Planned
Metropolitan Area

Balikpapan
City

Balikpapan
Bay

The World's Sustainable City

biodiversity of Nusantara towards global environmental conservation efforts

ment, 2024)

Current Planning



(Amalia, 2023)

"Settlement Transformation
smart, collaborative, compact, bas



(Ibu Kota Nusantara, 2021)

WARDS THE INDONESIA 2045 VISION

GLOBAL CITY FOR ALL

CALLY INTEGRATED, GLOBALLY CONNECTED

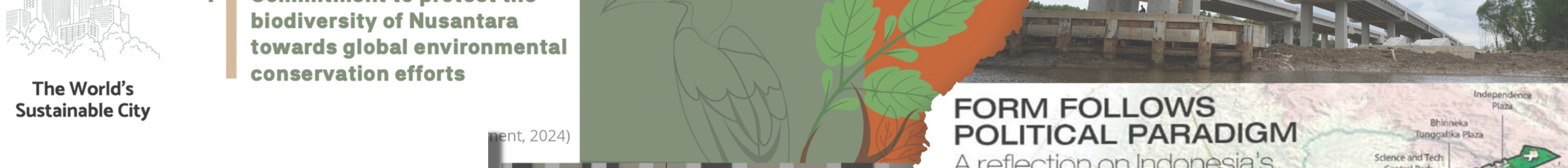
NIVERSALLY INSPIRED

1 DESIGNED ACCORDING TO NATURE

Over 75% of the IKN's Governmental Zone will remain green

Every single resident inside the city can easily reach a green recreational site within 10 minutes

All residential, institutional and commer buildings are constructed using str environmentally friendly constr methods



FORM FOLLOWS POLITICAL PARADIGM

A reflection on Indonesia's new capital city

by Dr Johannes Widodo



(Widodo, 2022)

Nusantara's growth threatens ancestral water sources

Sibukdin, the leader of the Balik community, accompanied DW to visit the Sepaku River flowing near to their village before the construction began.

(Ekawati & Kusumaputri, 2024)

Lost homes, lost traditions, lost habitats: the cost of Indonesia's brand new city

Residents of Balikpapan Bay in eastern Borneo dismiss claims that Nusantara will be a sustainable city that coexists with nature

(Ratcliffe, 2024)

Wildlife-rich mangroves suffer as Indonesia ramps up construction of new capital

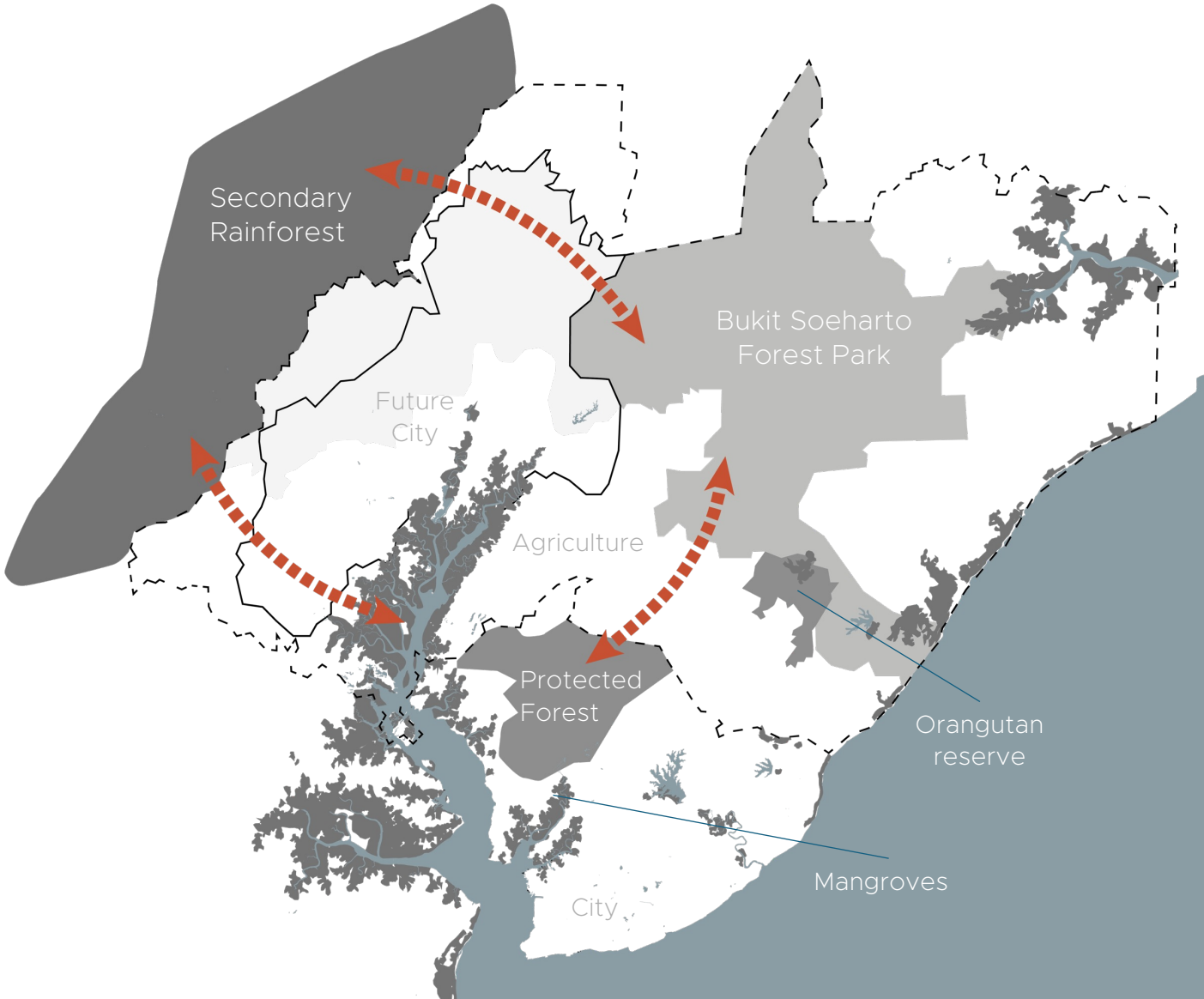
HANS NICHOLAS JONG
3 SEP 2024 ASIA



(Jong, 2024)

Landscape Fragmentation

- Division of patches through agricultural activity
- Disruption of functional landscape connectivity
- Erasure of the lowland rainforest



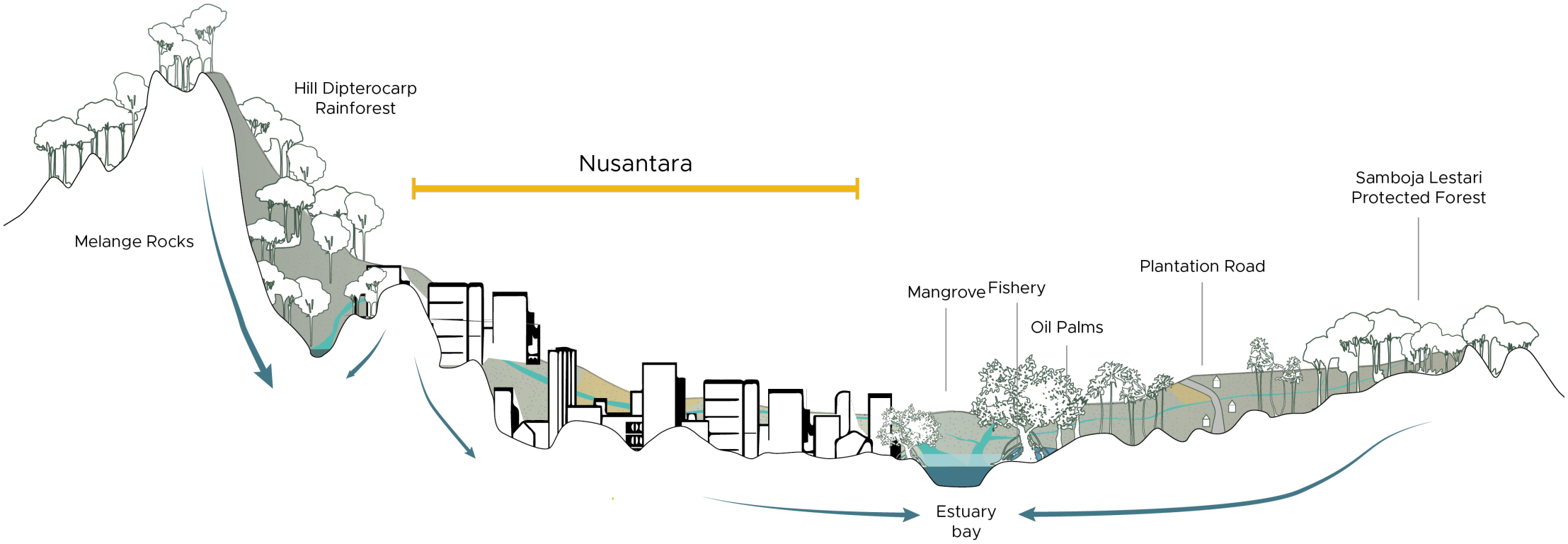


Oil palm plantations result in notable soil erosion and degradation



Monocultural eucalyptus plantations are regularly logged creating large deforested patches in the landscape

Disruption of Gradients



Nusantara is positioned across the large-scale gradient transition from hilly rainforest to mangroves



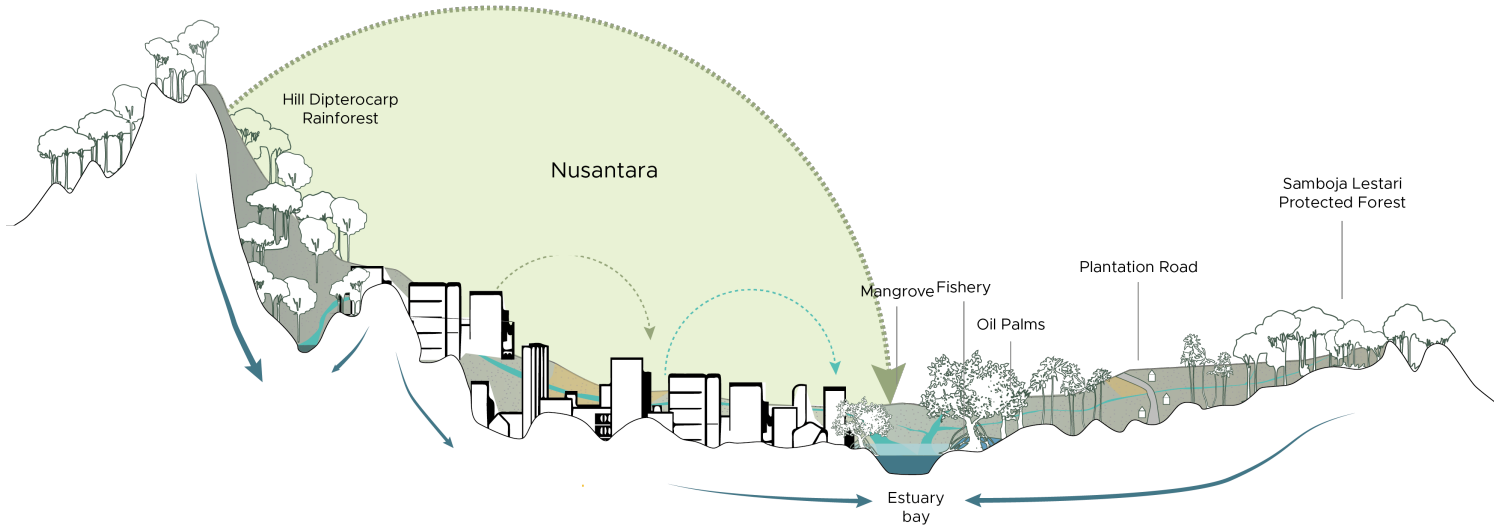
Biodiversity in gradient landscape zones (Robin Zwartsenberg, 2025).



Fishing village in a gradient coastal zone, 2025.

Research Question

How to design an integrative landscape framework that regenerates natural gradients and supports the socio-ecological urban development of the new capital Nusantara?



Theoretical Framework

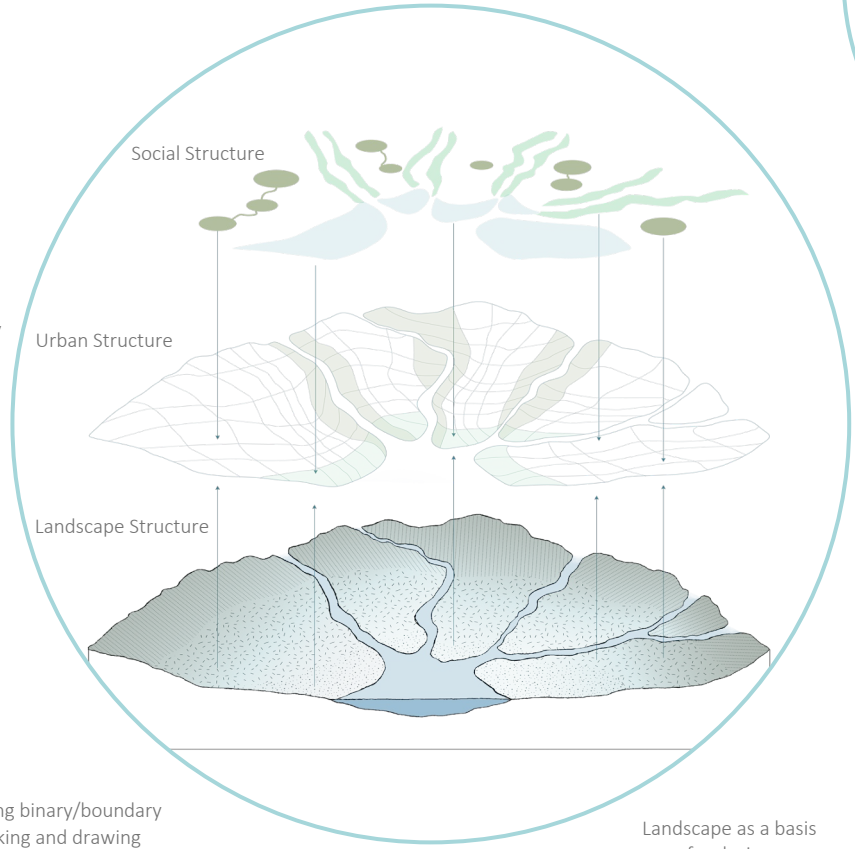
Landscape-based Urbanism

(Steffen Nijhuis)

Designing connective gradient structures

Functional and Physical Connectivity

Recognizing and representing the complexity of the landscape



Creating Multifunctional Connections

Landscape Structure and Gradients

(McGarigal & Cushman, 2005; Van Leeuwen, 1965)

Landscape Connectivity

(Hernandez-Santin, et al., 2020; Crooks & Sanjayan, 2006)

Avoiding binary/boundary thinking and drawing

Landscape as a basis for design

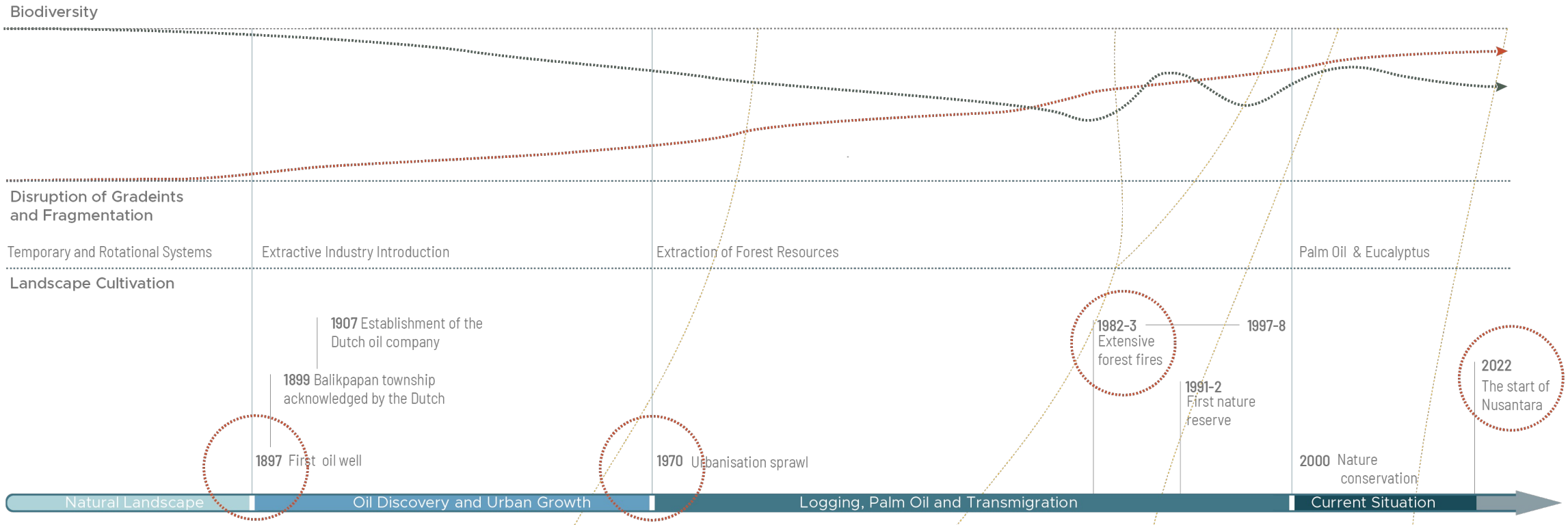
Thinking with systems and processes

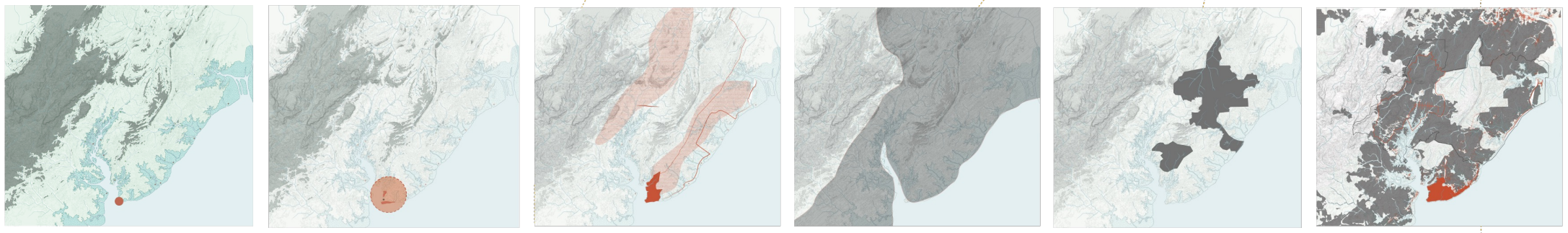
Designing with people, nature, and history

Landscape Analysis and Understanding

SRQ1: What are the ecological and cultural landscape characteristics and gradients of the region and what opportunities and challenges can be identified regarding its current state and its transformation into an urban landscape?

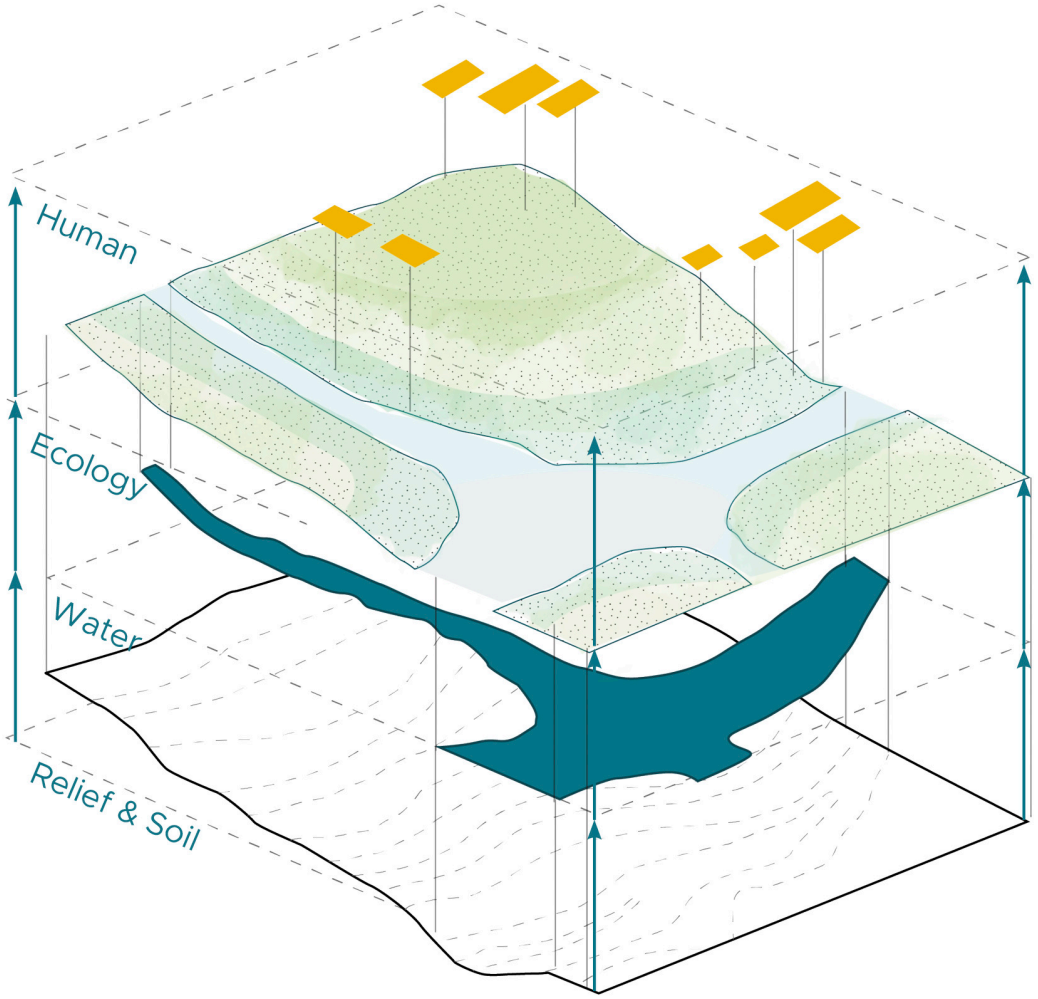
Historical Development



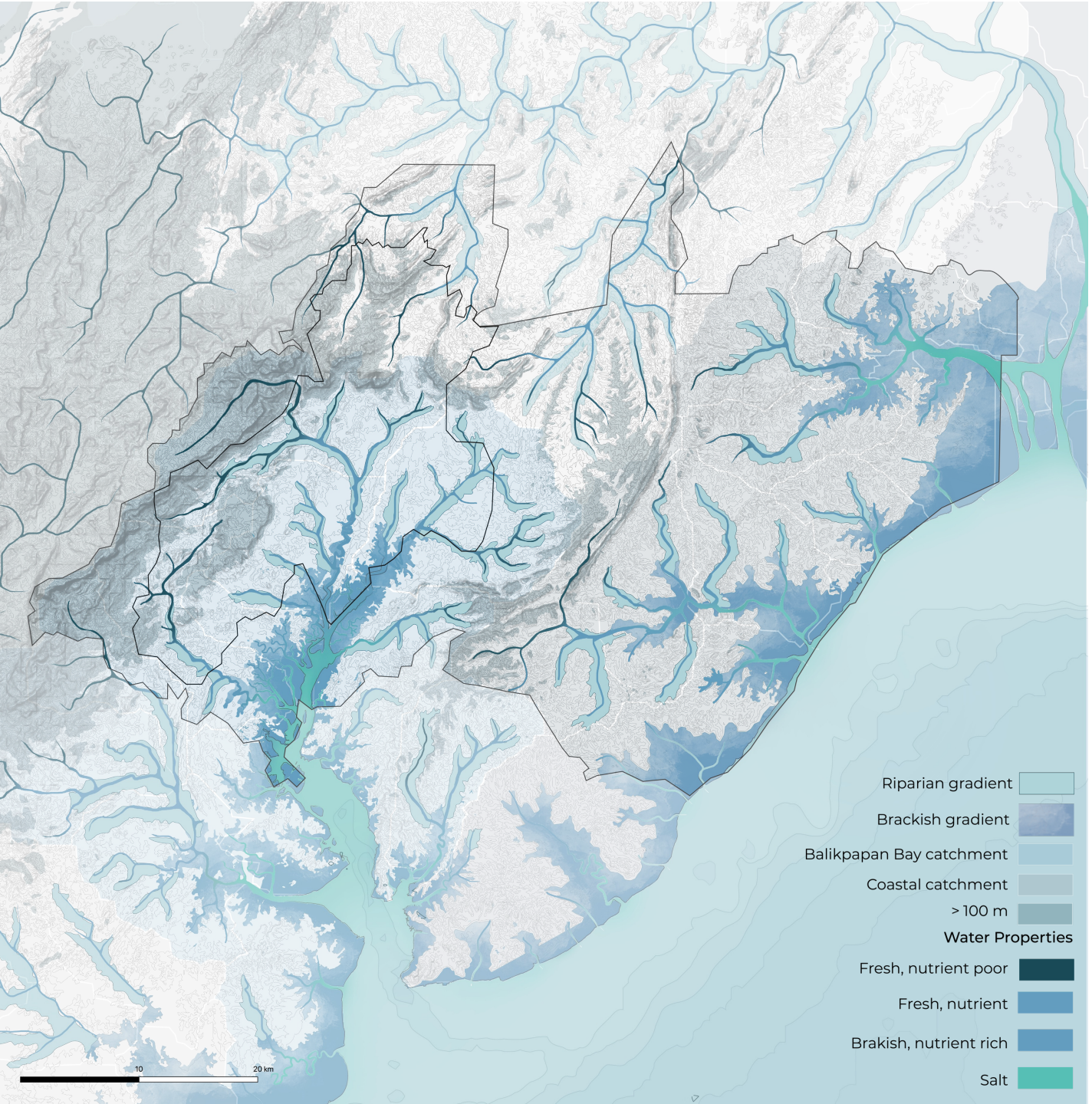


Landscape Before

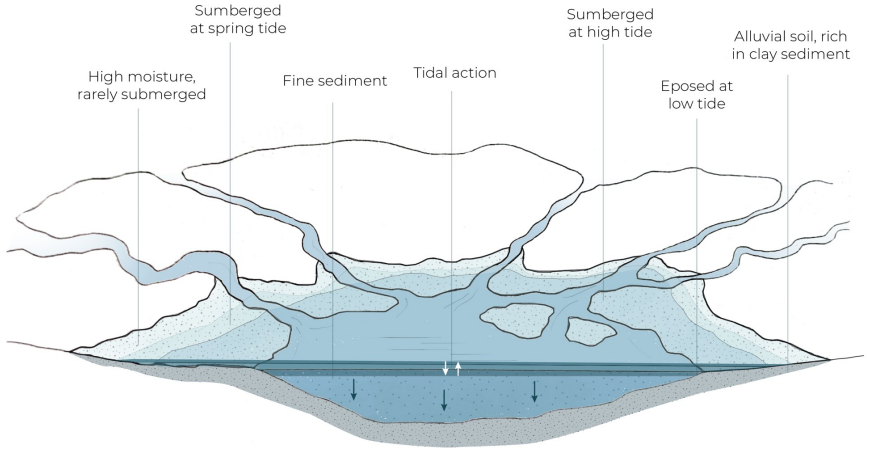
- The layers of the landscape create unique conditions and gradients
- Local communities develop cultivation and cultural practices according to the landscape conditions



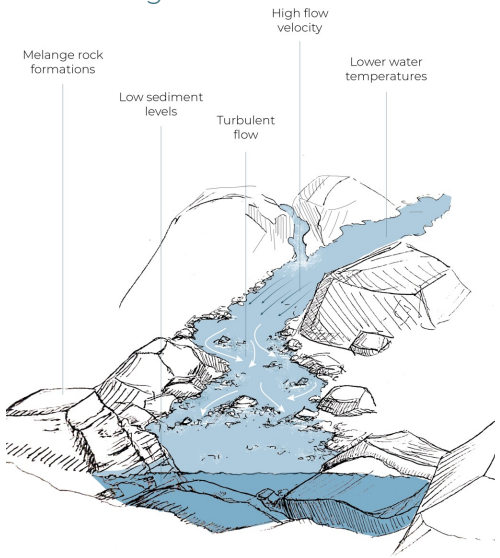
Water Gradients- Before



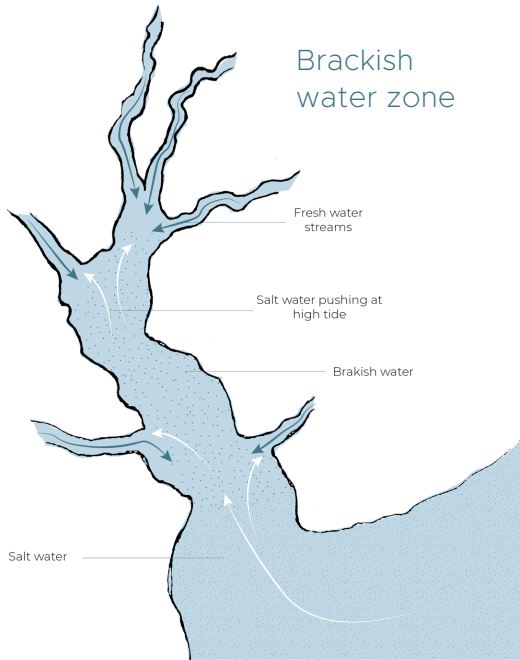
Tidal zone



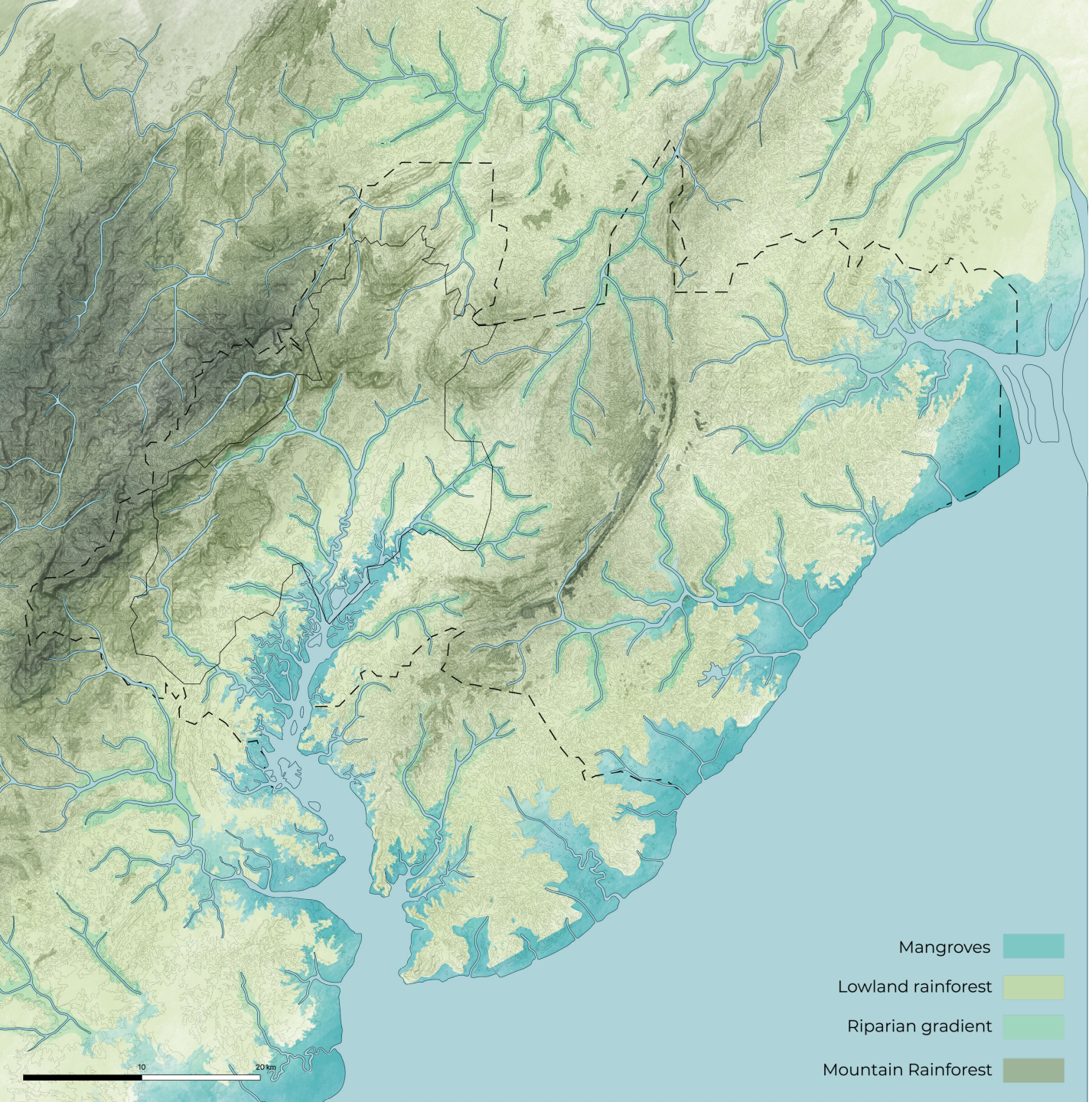
River and stream edges

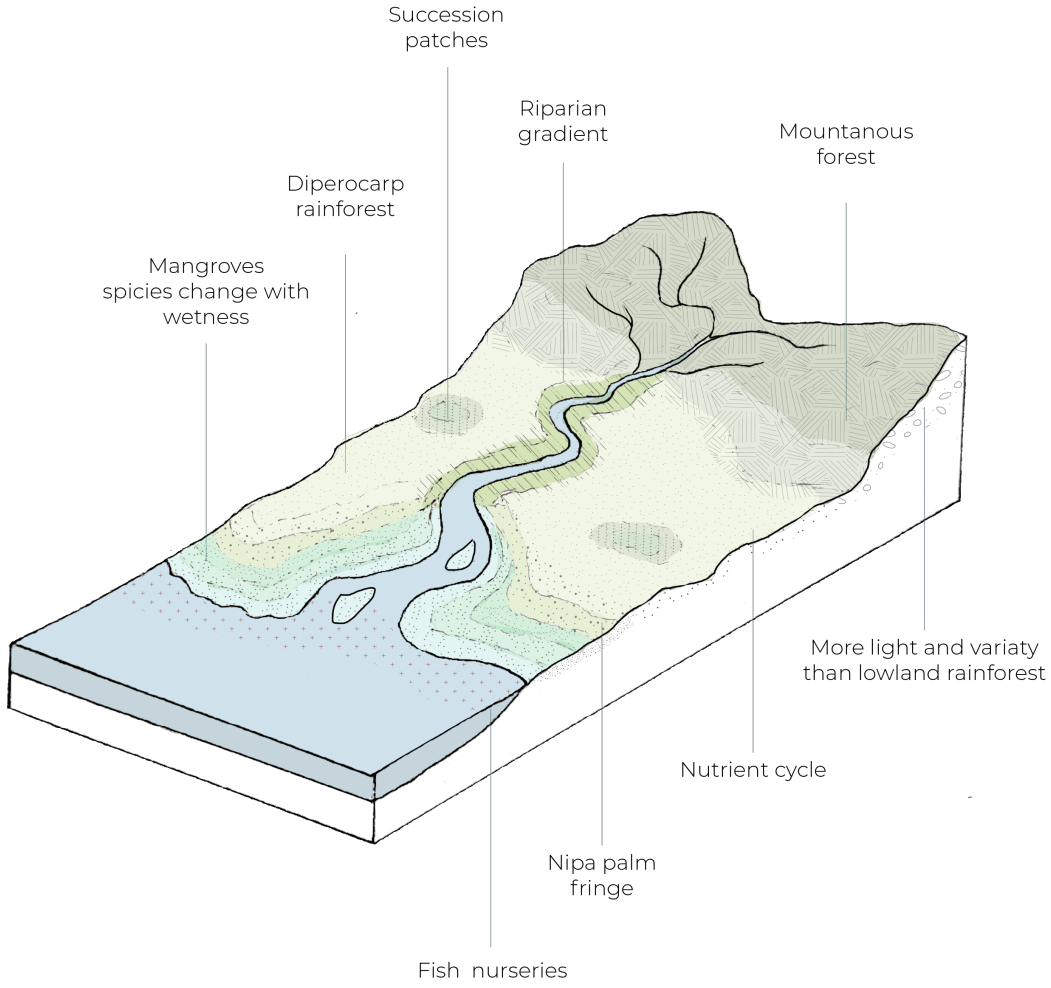


Brackish water zone

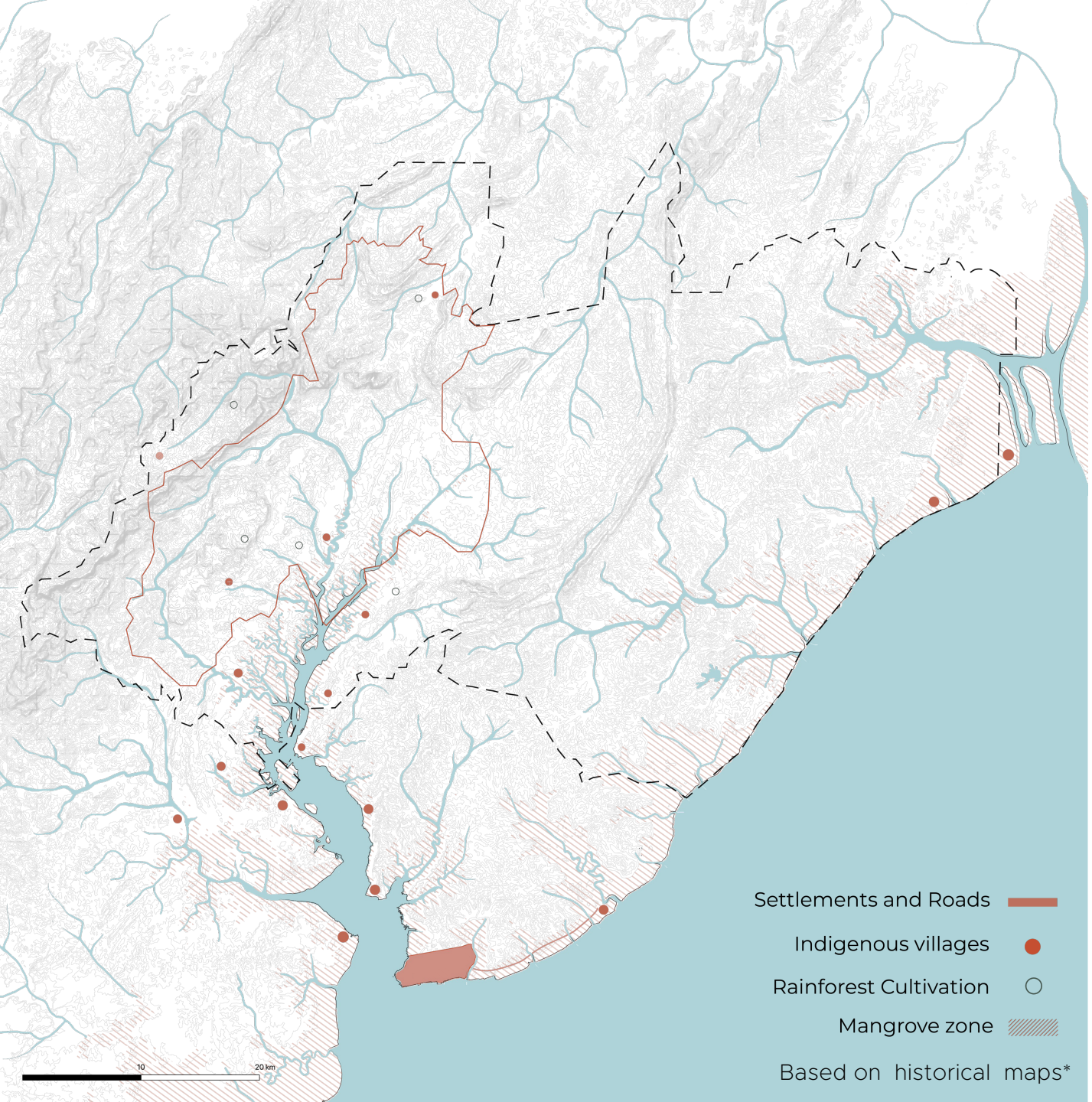


Ecological Zones - Before





Local Communities - Before



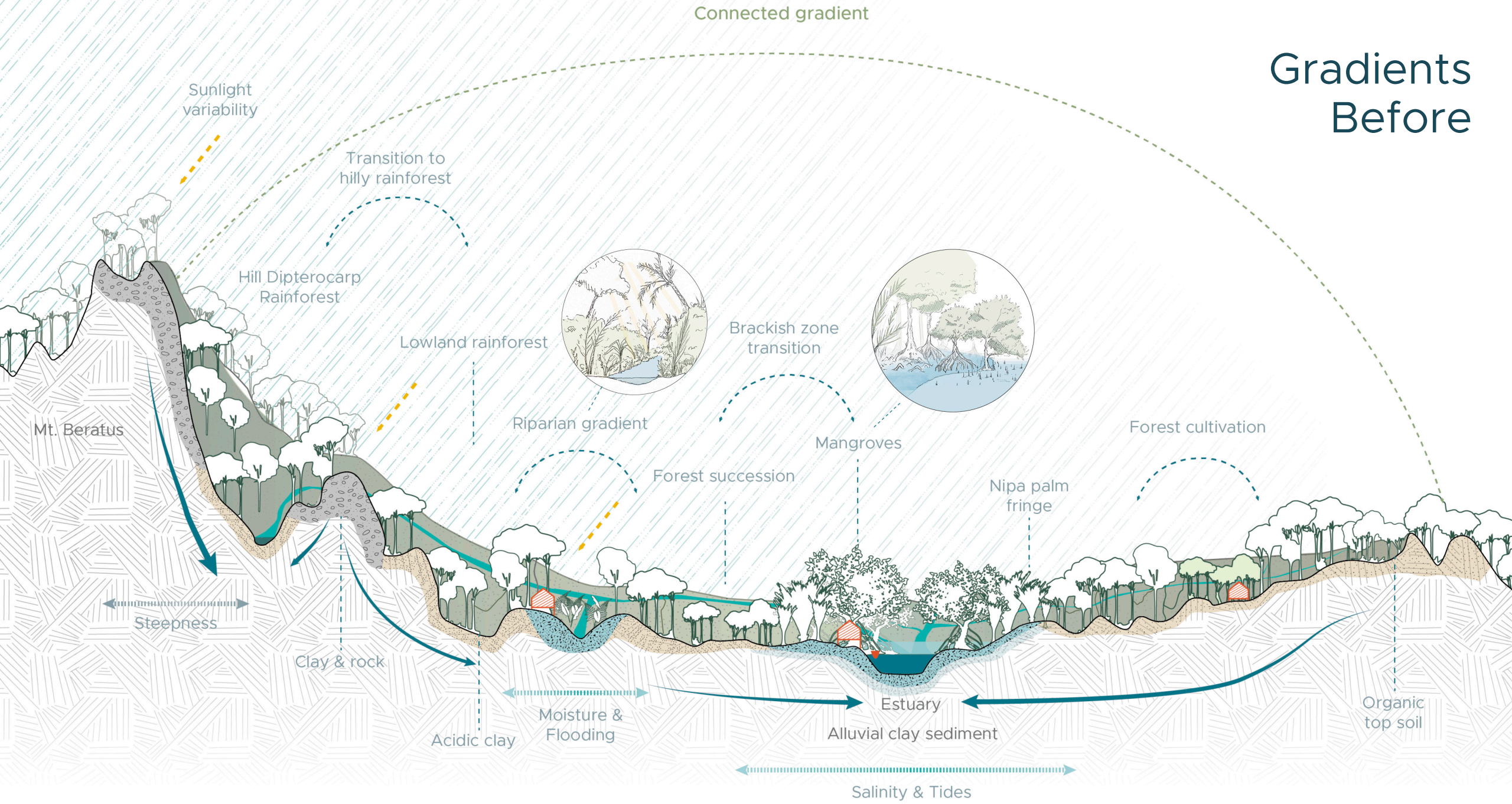


House on the riverside, Arnoud H. Klokke 1950s



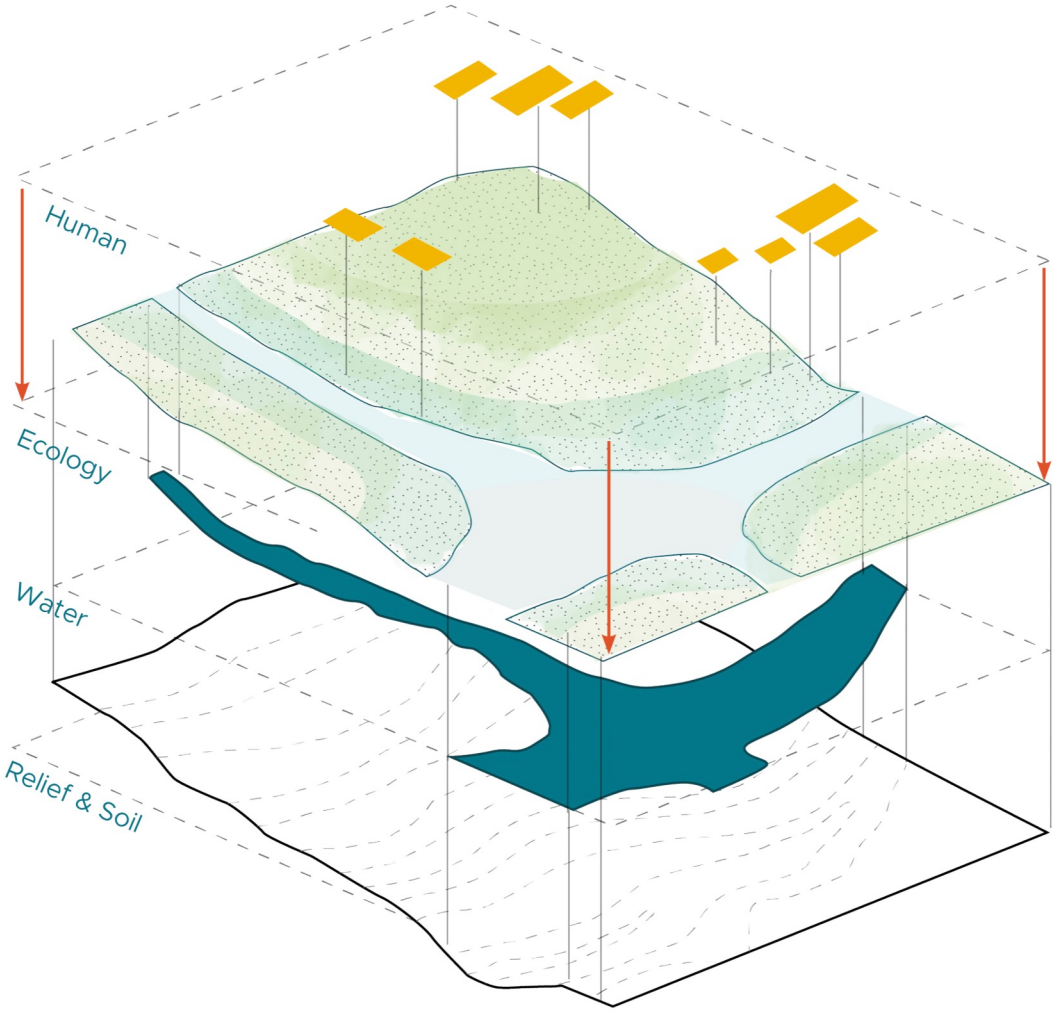
House on the riverside, Arnoud H. Klokke 1950s

Gradients Before



Landscape Now

- Human activity has a significant influence on all layers of the landscape
- A decline of several landscape systems can be observed



Water System - Now

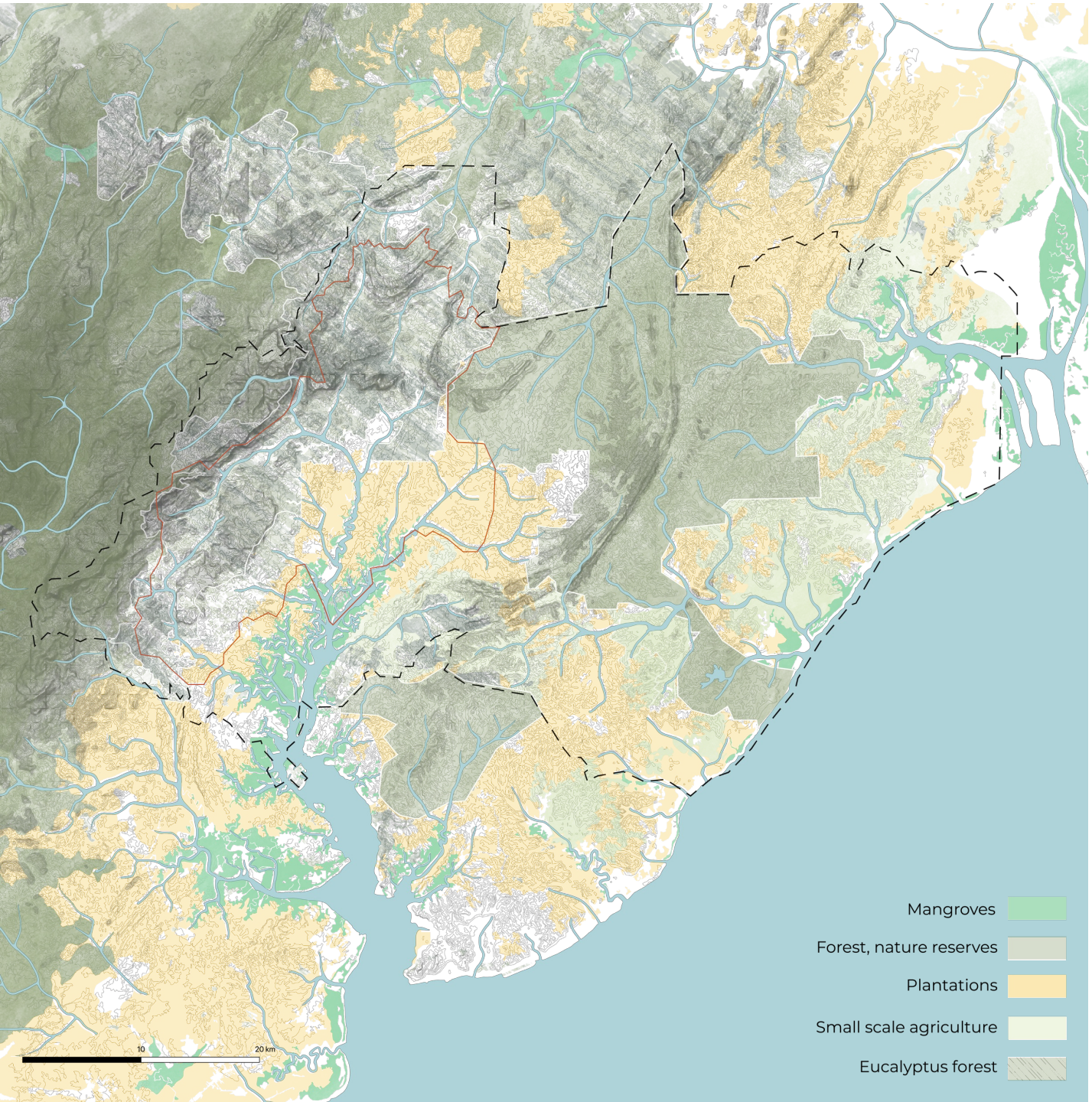

Sepaku River Dam and Aquaculture (Sitompul, 2024)

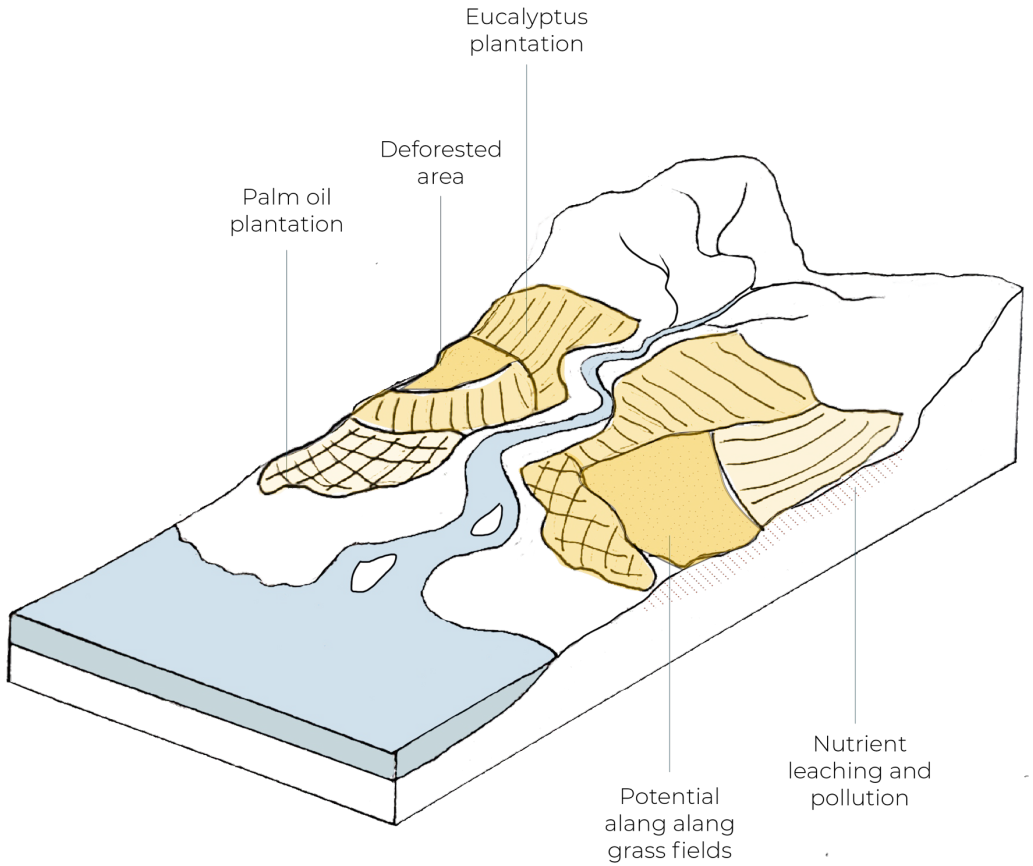

Pollution and mangrove removal in Balikpapan 2025

Aquaculture
Brakish, nutrient rich
Funtioning wet zone
Altered wet zone
Water pollution
Dam
Settled Coastline
Shipping routes
Roads and Settlements

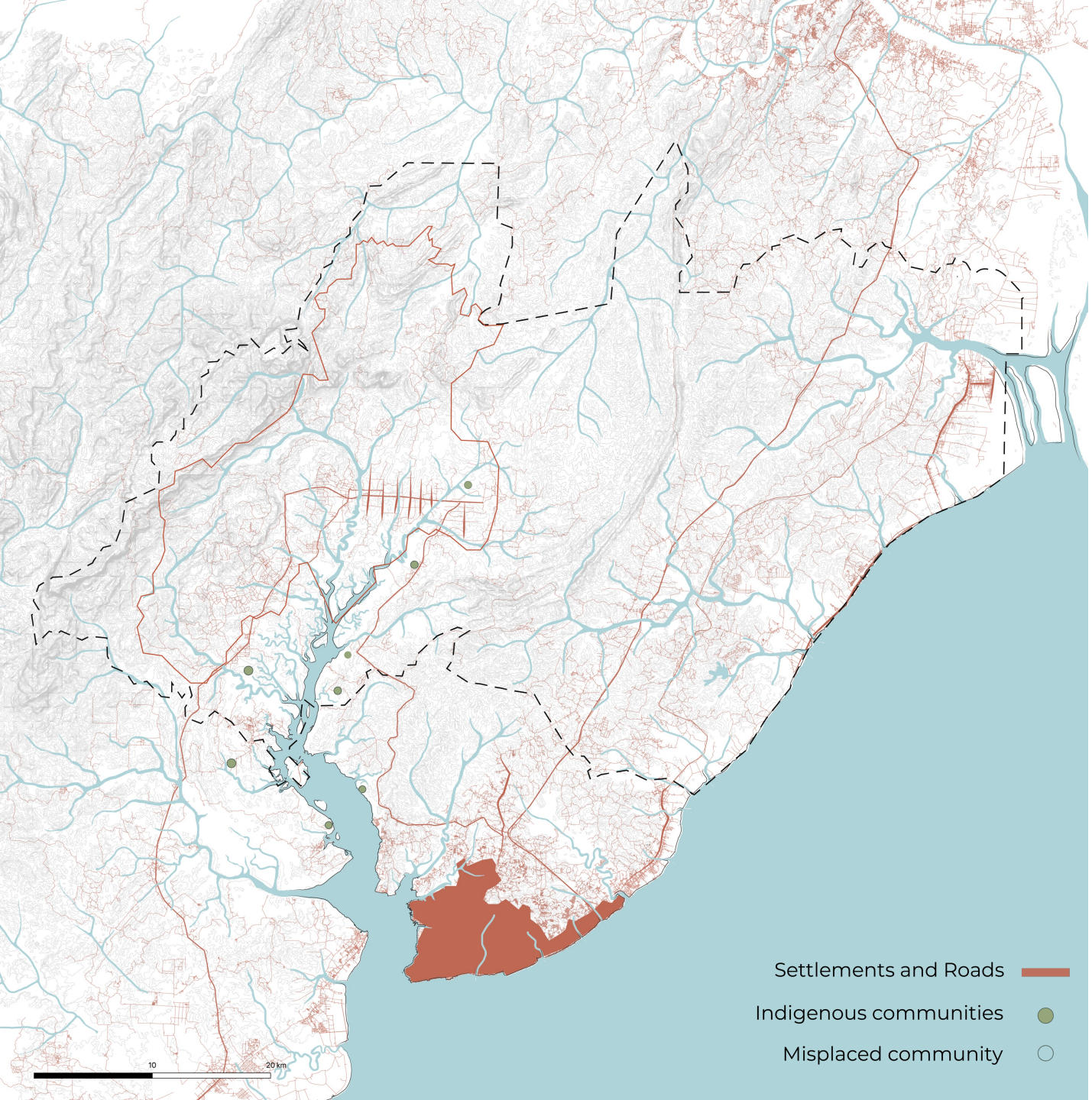
10 20 km

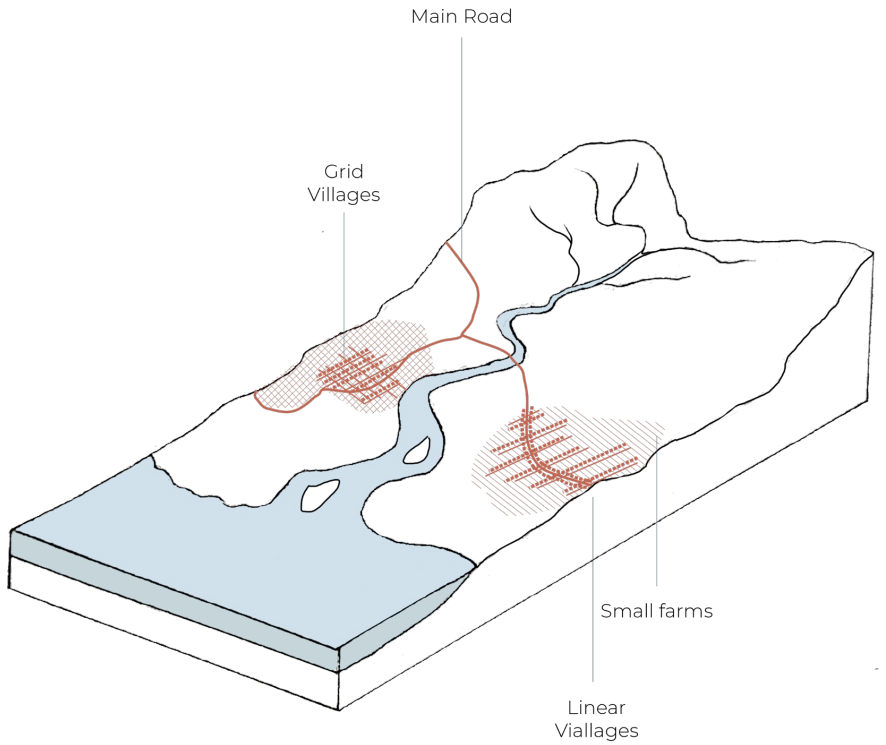
Ecology and Agriculture - Now





Living Typologies- Now







A small linear village near the mangroves of Balikpapan 2025.

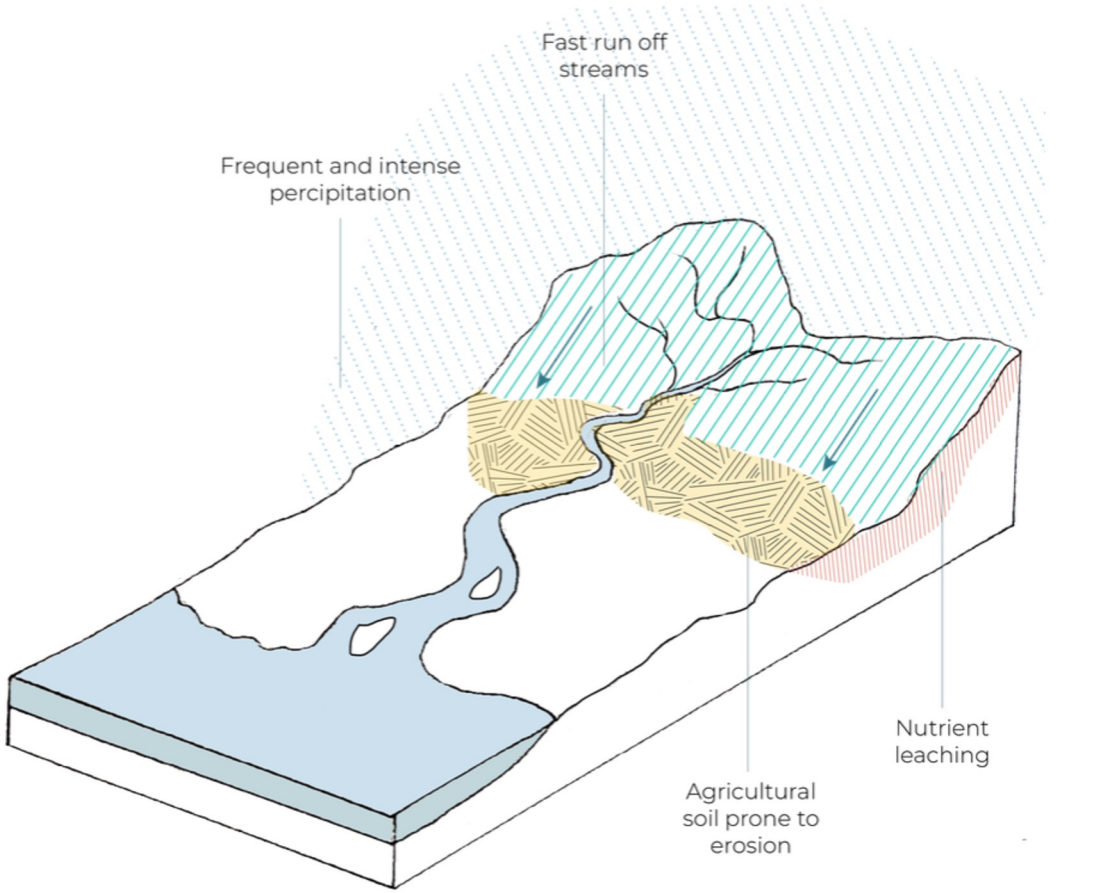
Climate Change



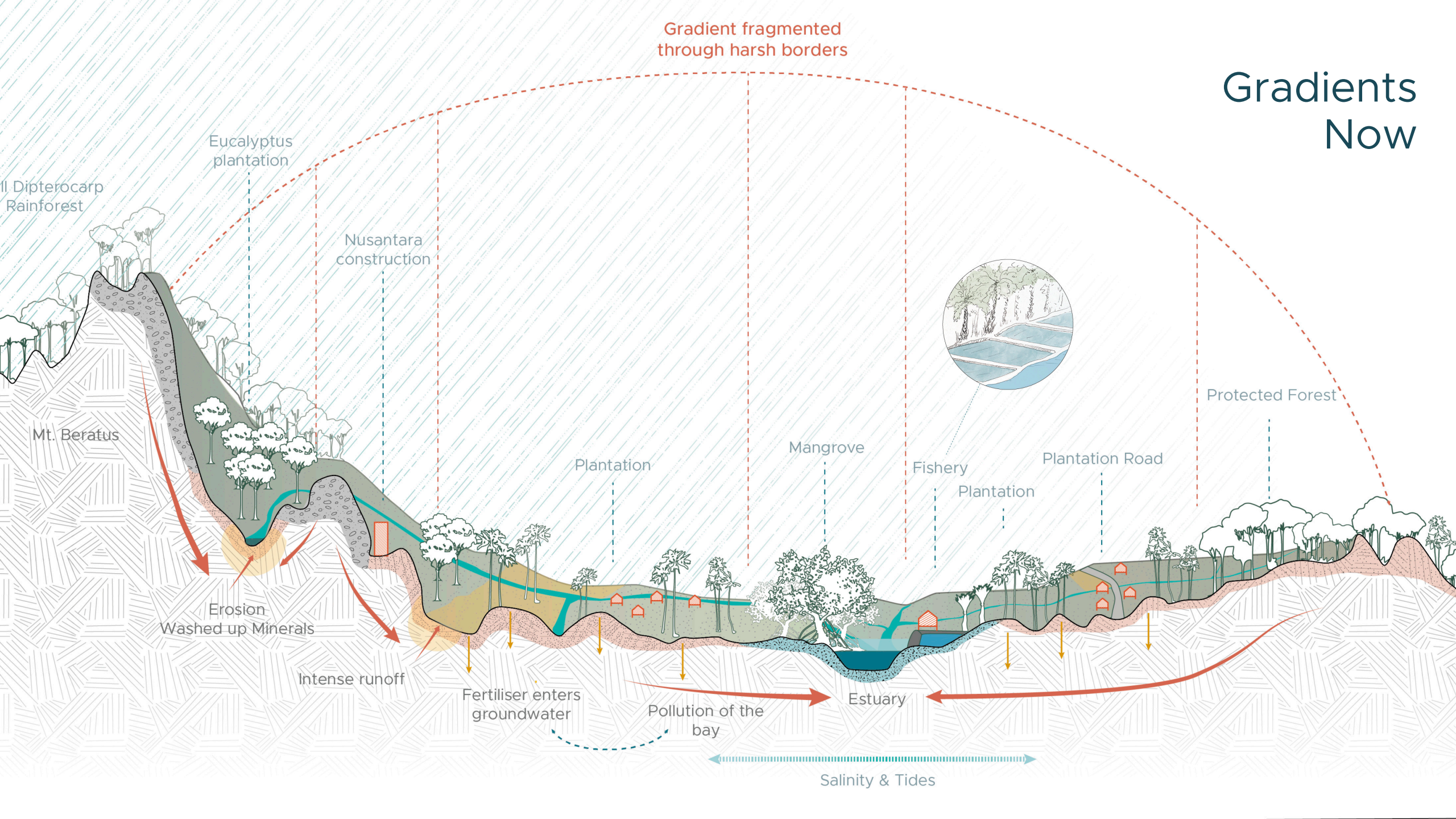
Forest fires in East Kalimantan (Junaidi Hanafiah)



Flooding in Sepaku Village 2024 (Tempo.co)



Gradients Now



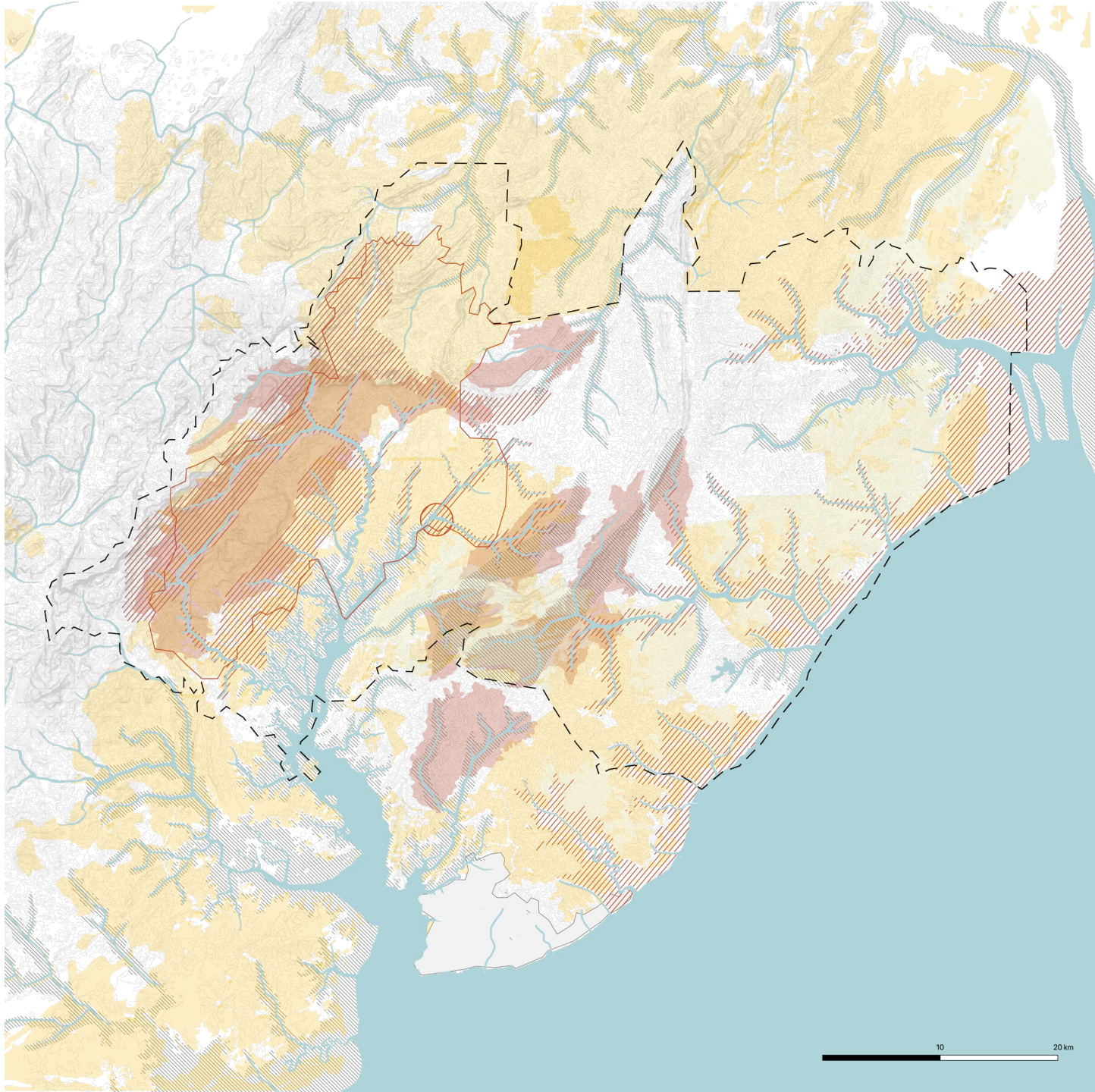
Challenges and Potentials

Challenges

- Fragmentation and loss of gradients
- Degradation of soil and water system
- Climate Change

Potentials

- Ecologically and culturally rich gradient transition zones



Challenges

- Agriculture- soil degradation
- Soil erosion
- Lost Gradients
- Interrupted water flow

Potentials

- Remaining Gradients

Design Principles and Strategy

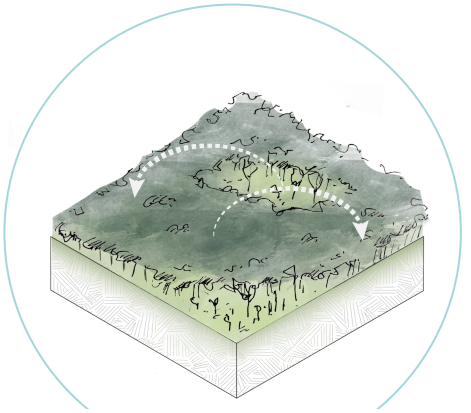
SRQ 2: What spatial design strategies and principles can be derived from the concept of landscape gradients to enhance landscape ecological connectivity and socio-culturally inclusive urban development?

Indigenous practices



Dayak mountain farm (Sumarni Laman)

- Dayak forest gardens
  - Rotation strategy
  - Working with the forest
- Tambak fishery
  - Small scale
  - Using natural water gradients



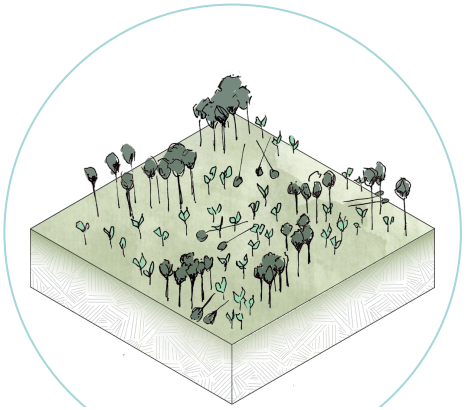
Temporary/Rotational Forest Cultivation

Reforestation



Samboja Lestari Orangutan Conservation Center

- Pioneer trees first
- Compost for soil restoration
- Secondary rainforest trees
  - Pioneer species -> timber for locals
- Locals can benefit from the project



Initiating natural succession

Mangrove Restoration

mangrove seeds

important to have spicie variety

hard to grow many of the spicies

planting in small intervals 50 - 40 cm

planting depends on the site salinity + elevation

Risophora spicies leave less damage to structures while roots and are most easy to grow



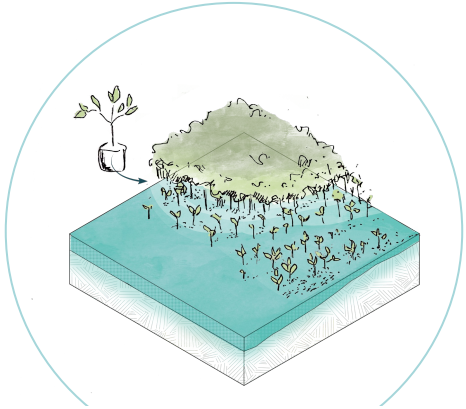




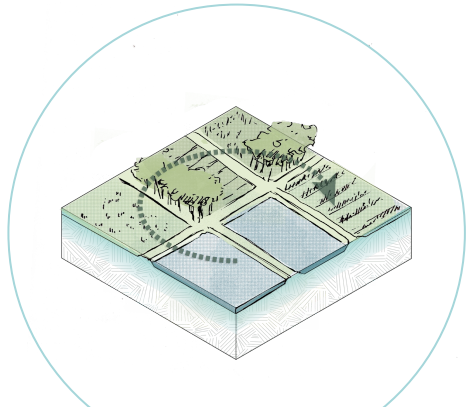
degradable planting sacks improve chances of survival



Restored mangrove after 10 years



Replanting Mangroves

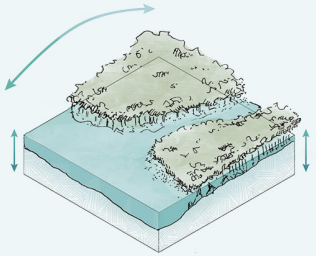


Integrated Mangrove Aquaculture

GRADIENT TYPOLOGIES

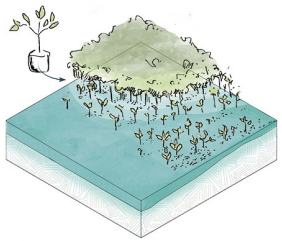
NATURAL

CULTURAL

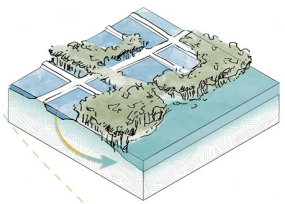


BRACKISH GRADIENTS

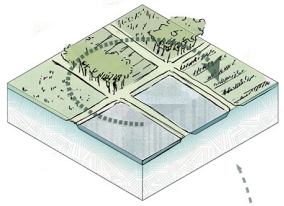
Regenerate mangroves



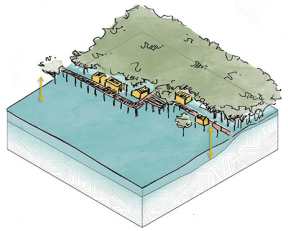
Adapt aquaculture

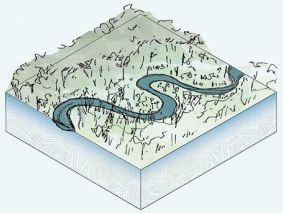


Implement seasonal agriculture practices



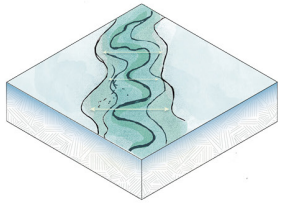
Adapt cultural village typologies



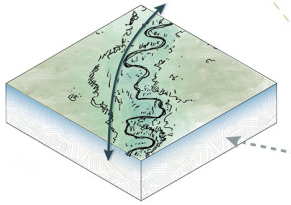


RIPARIAN GRADIENTS

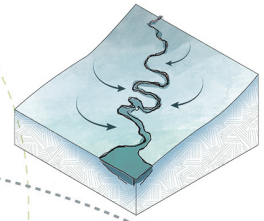
Protect and restore floodplains



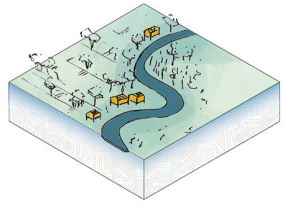
Regenerate riparian corridors

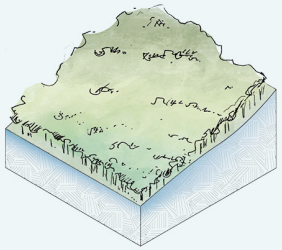


Manage water supply



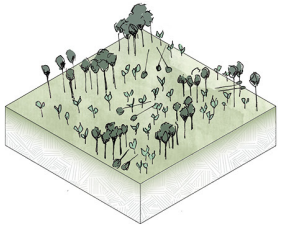
Adapt floodplain villages



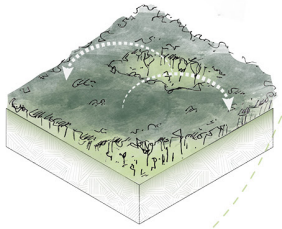


FOREST GRADIENTS

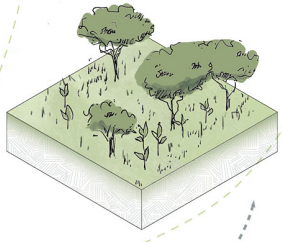
Initiate rainforest succession



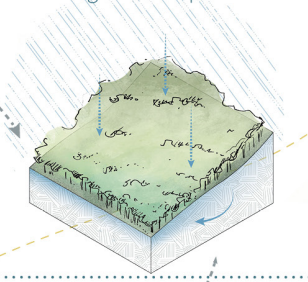
Implement temporary forest cultivation

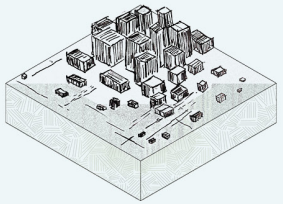


Transition to agroforestry



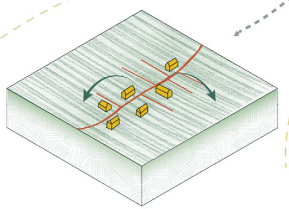
Vegetate steep hills



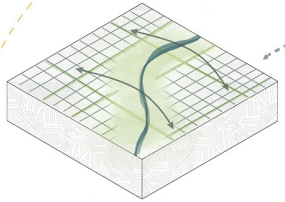


URBAN GRADIENTS

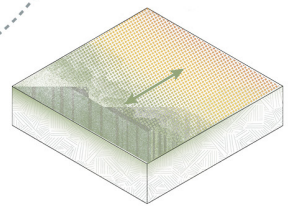
Integrate and adapt existing communities



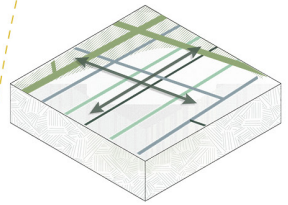
Integrate urban green corridors



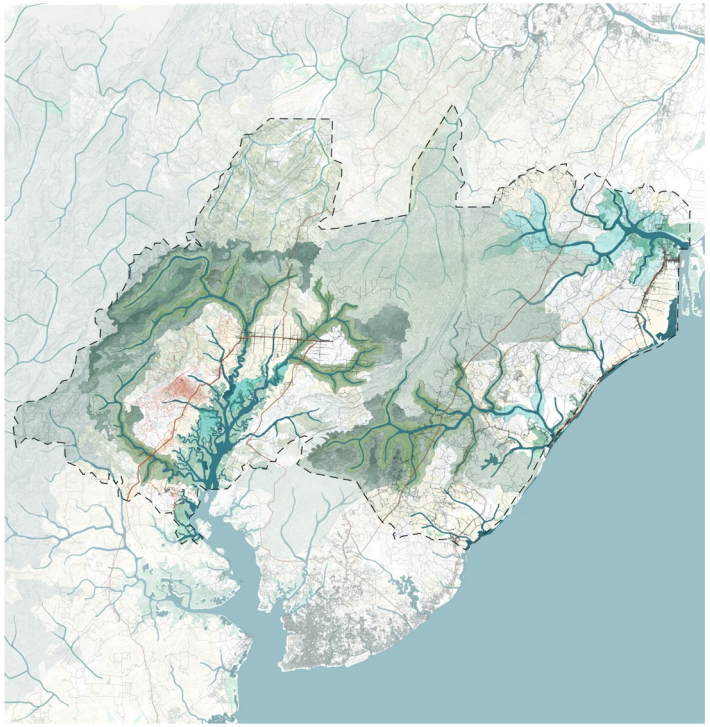
Vary urban densities



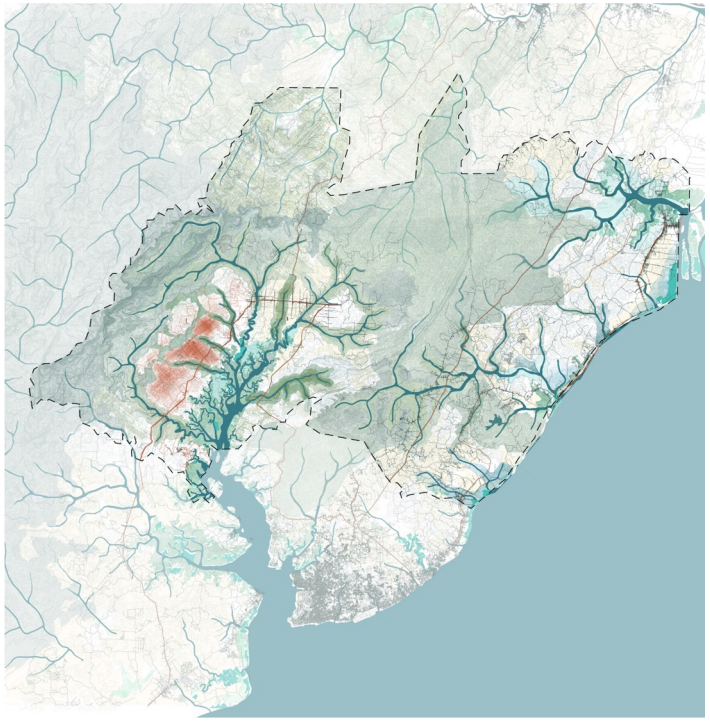
Weave urban green networks



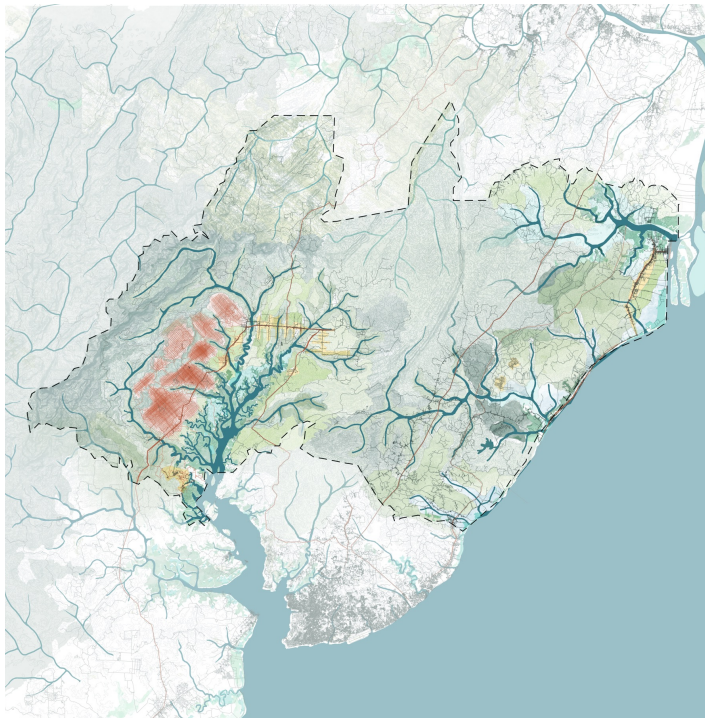
Design Phases



Recover and reconnect

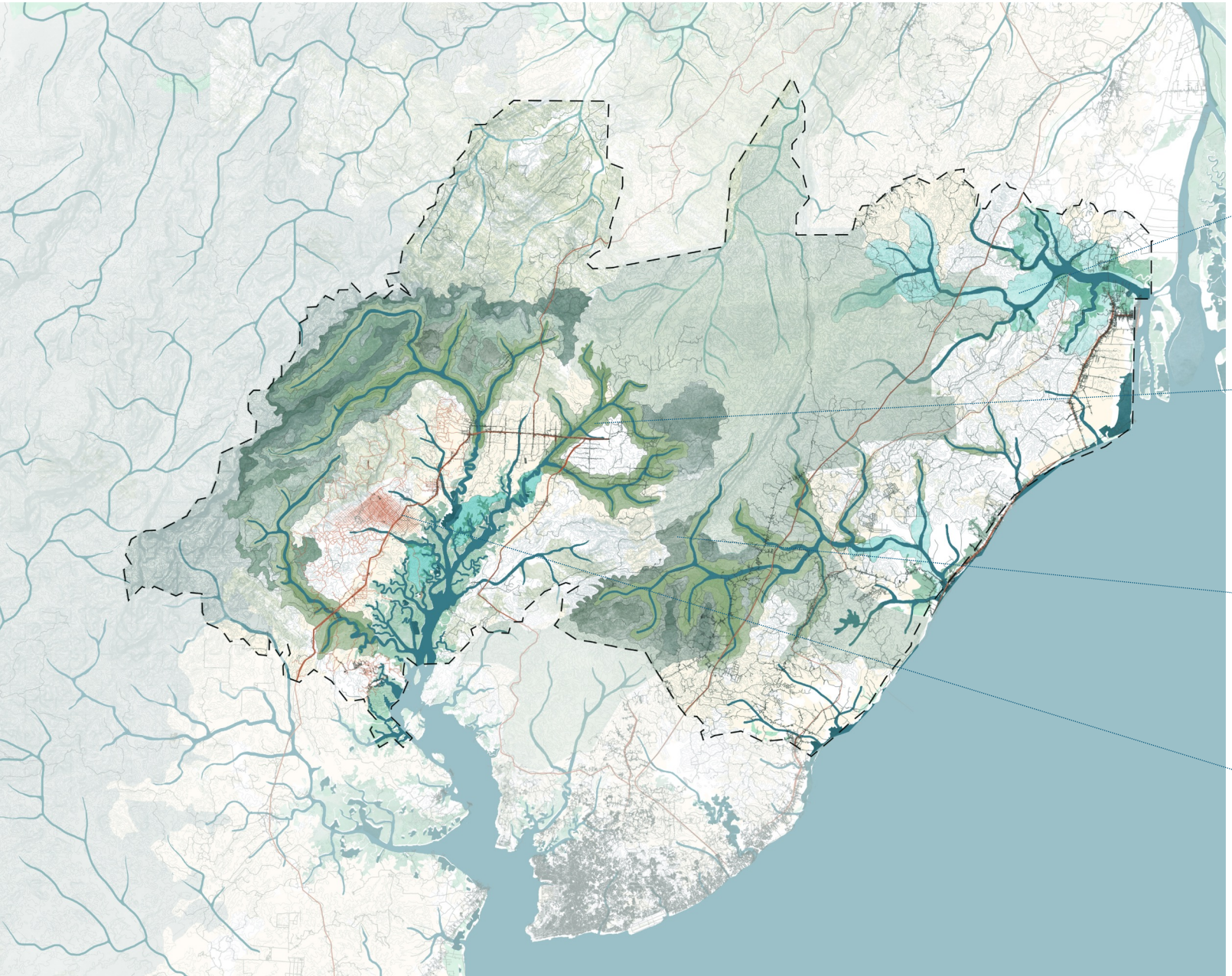


Strengthen and grow

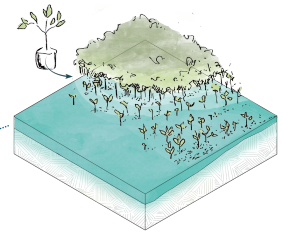


Experiment and adapt

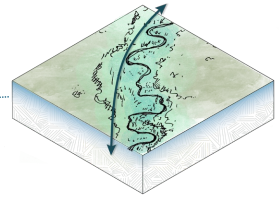
Phase 1: Recover and reconnect



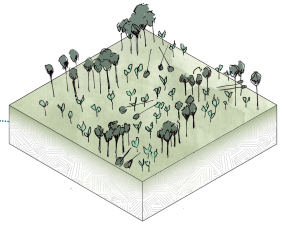
Regenerate Mangroves



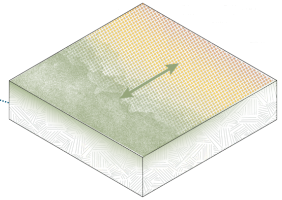
Preserve & repair riparian corridors



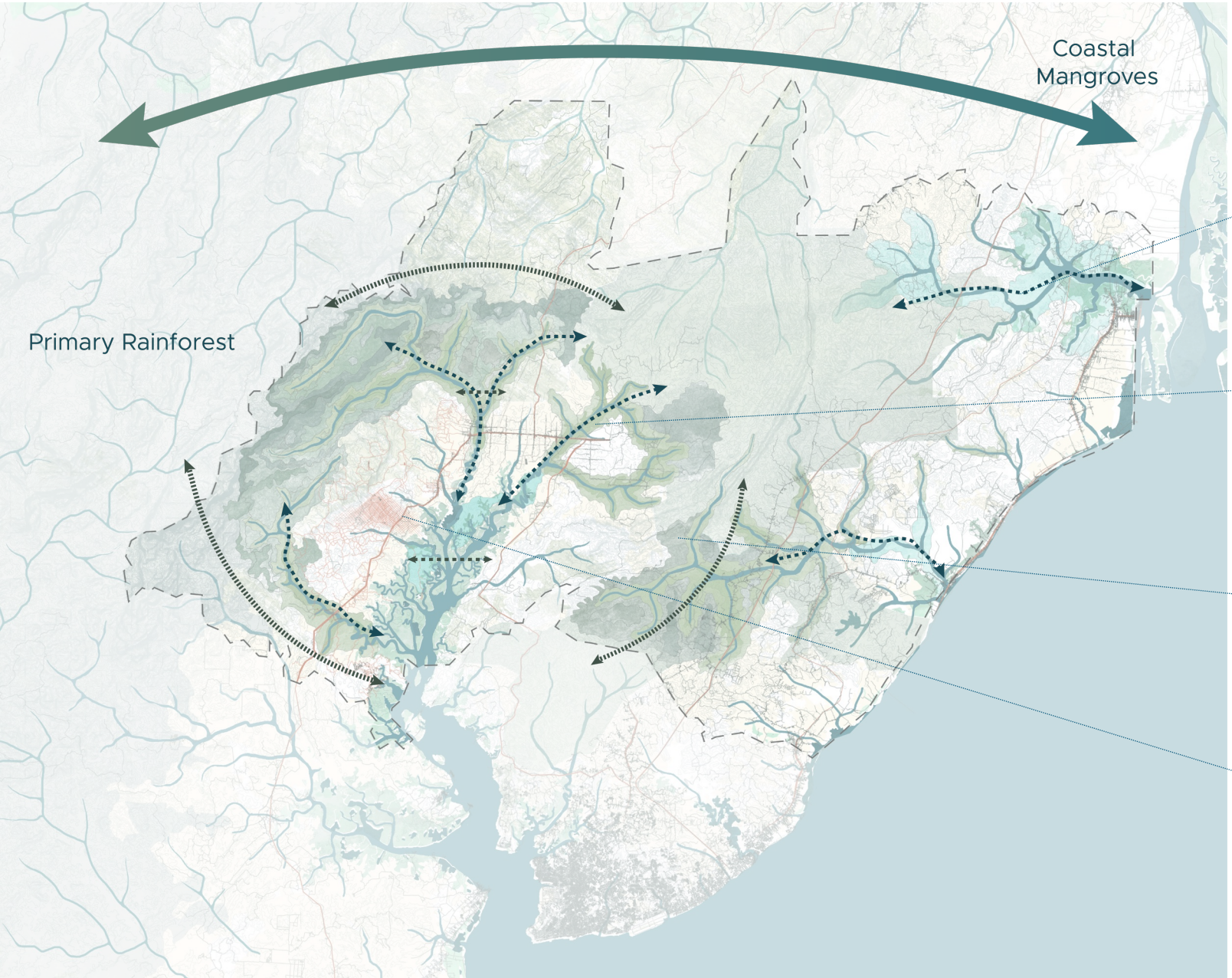
Initiate succession



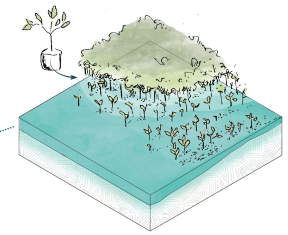
Urban density



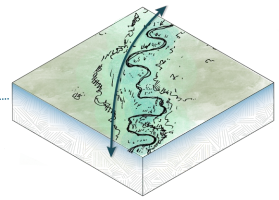
Phase 1: Recover and reconnect



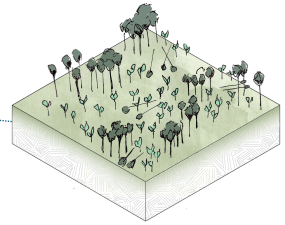
Regenerate Mangroves



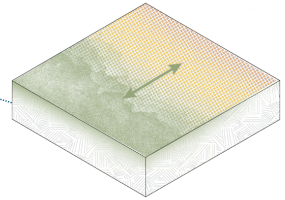
Preserve & repair
riparian corridors



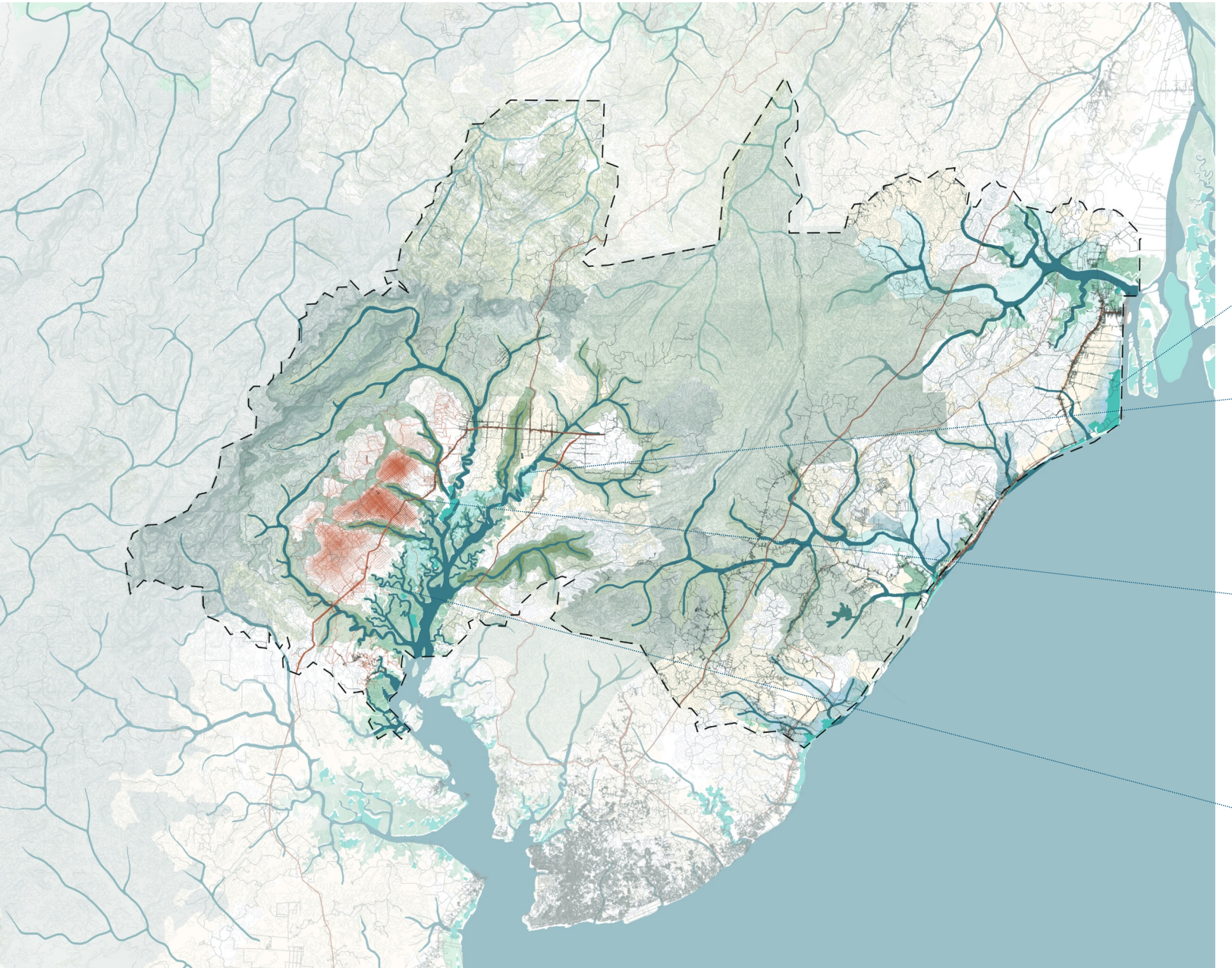
Initiate succession



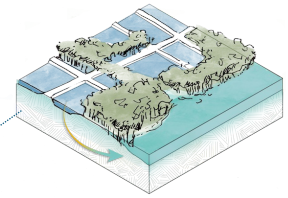
Urban density



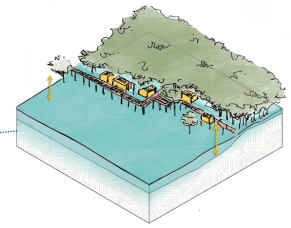
Phase 2: Strengthen and Grow



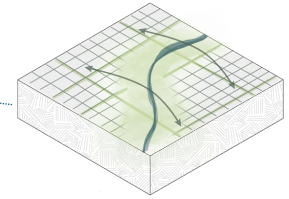
Integrated Mangrove Aquaculture



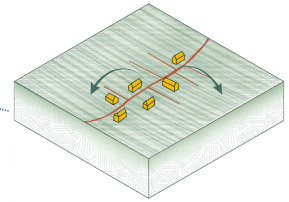
Preserve & repair riparian corridors



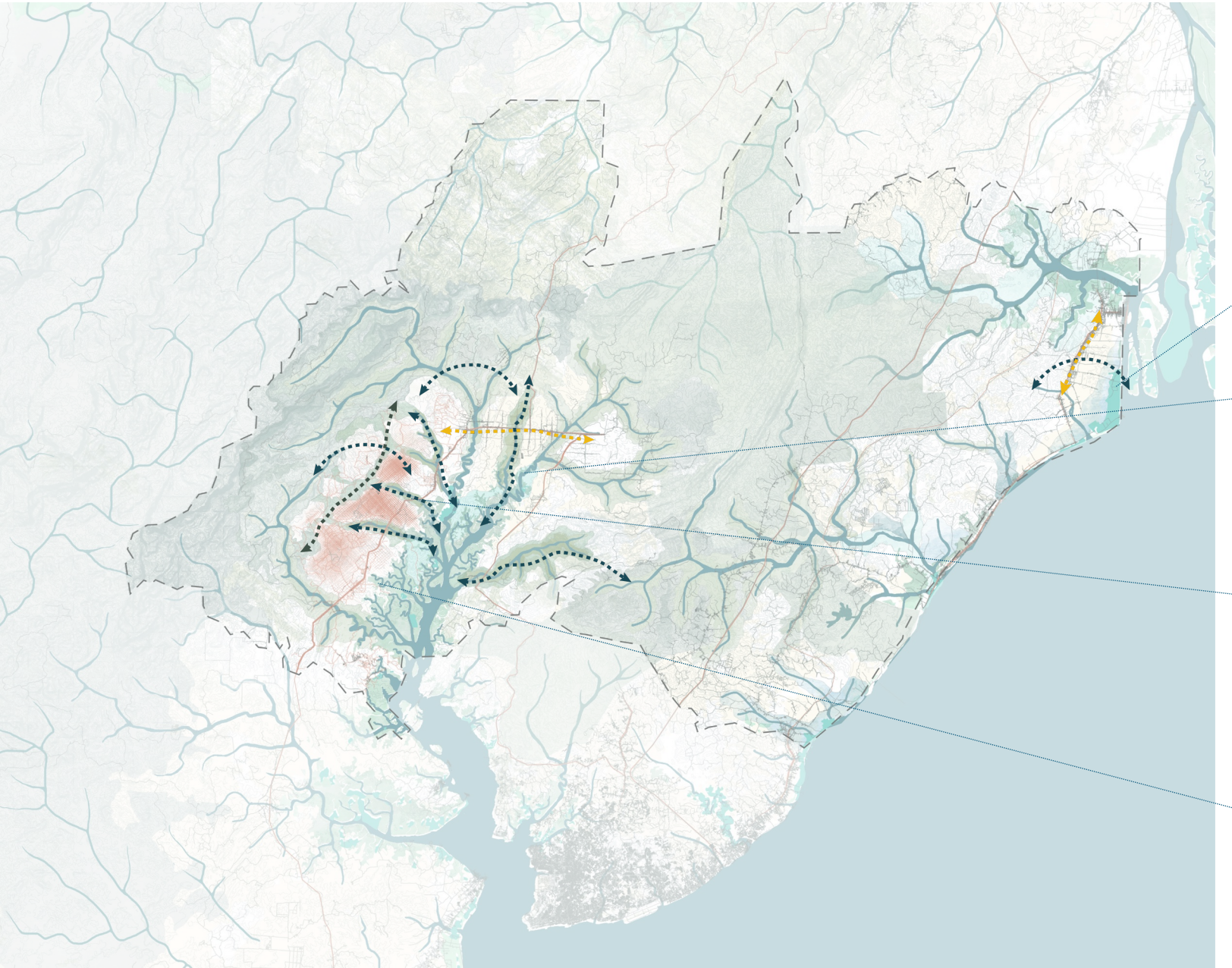
Ecological corridors



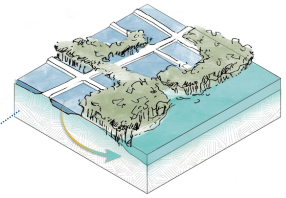
Preserve village typology



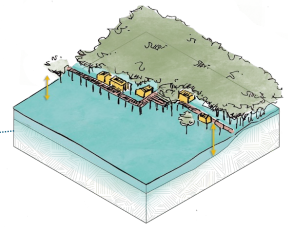
Phase 2: Strengthen and Grow



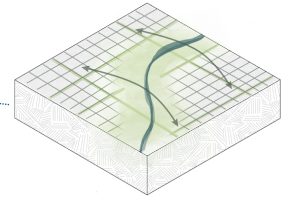
Integrated Mangrove Aquaculture



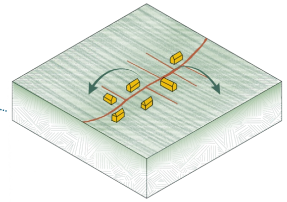
Preserve & repair riparian corridors



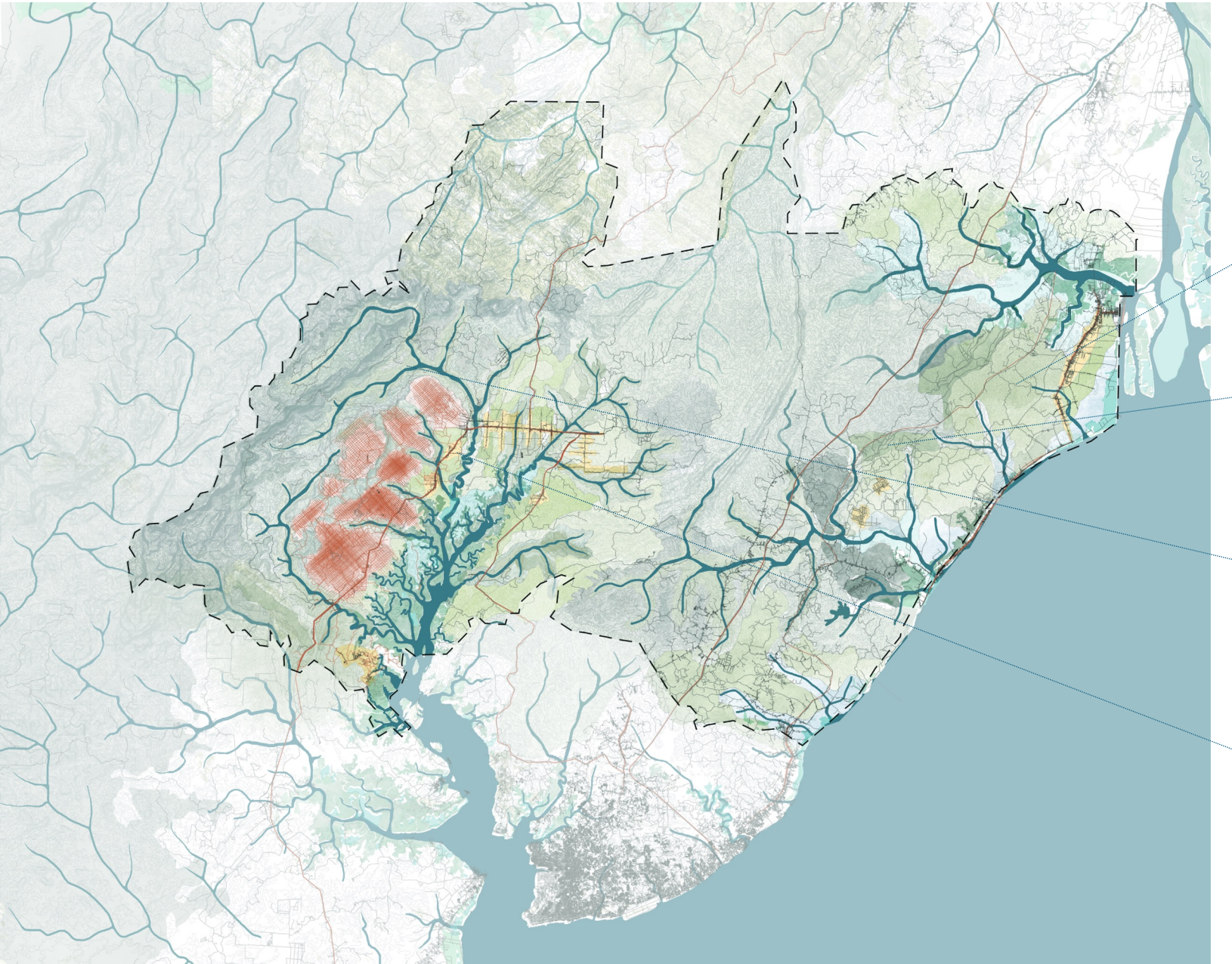
Ecological corridors



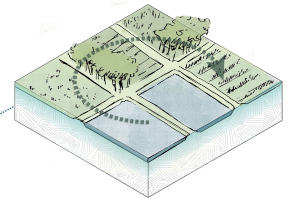
Preserve village typology



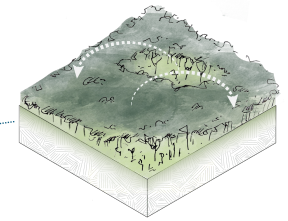
Phase 3: Experiment and Adapt



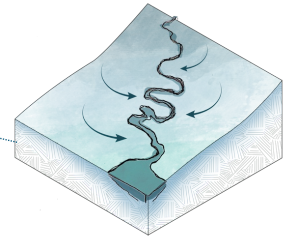
Rotational agriculture



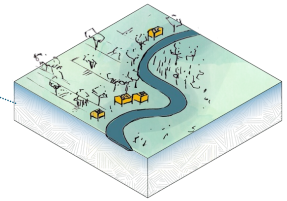
Temporary forest cultivation



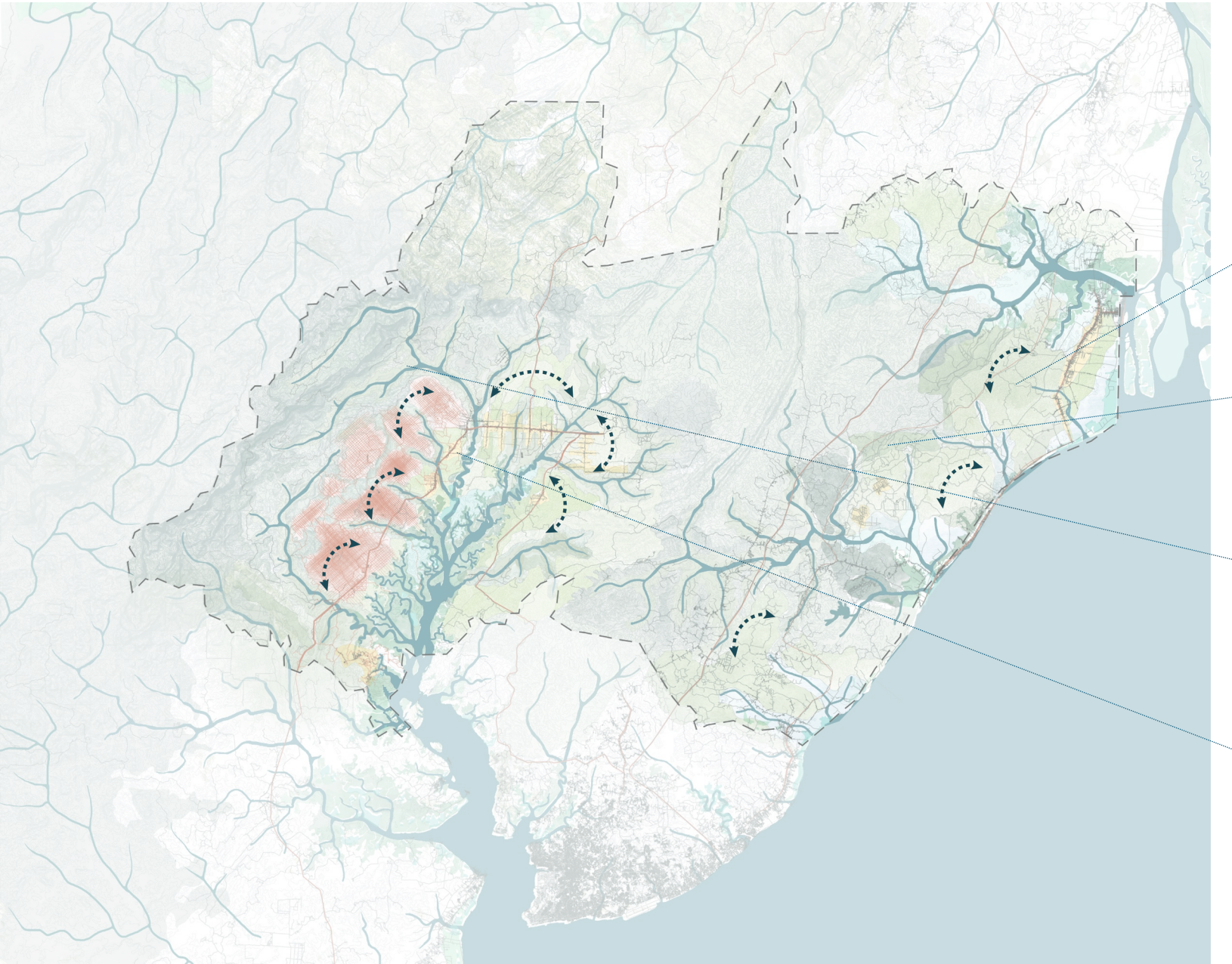
Allow recharge upstream



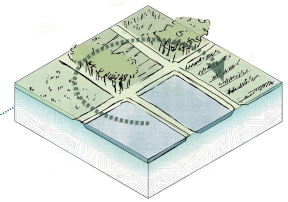
Grow local communities



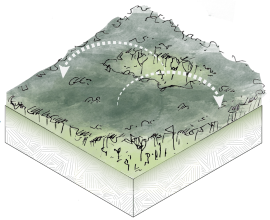
Phase 3: Experiment and Adapt



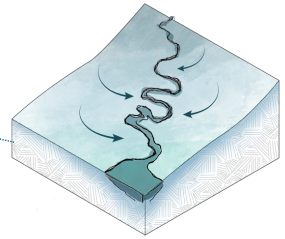
Rotational agriculture



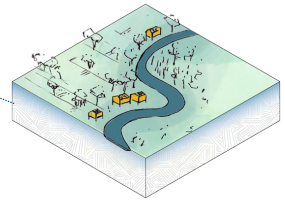
Temporary forest cultivation



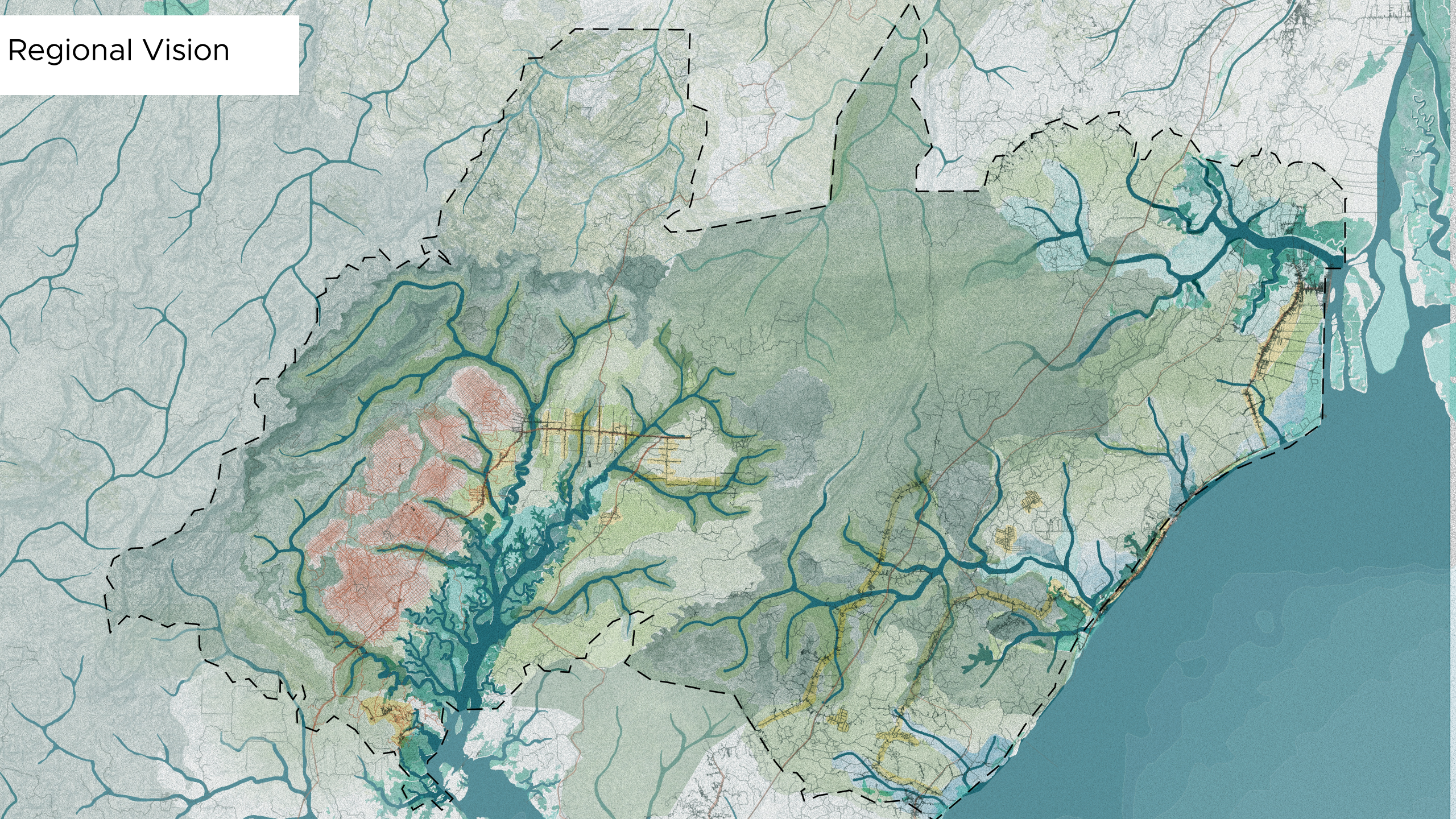
Allow recharge upstream



Grow local communities



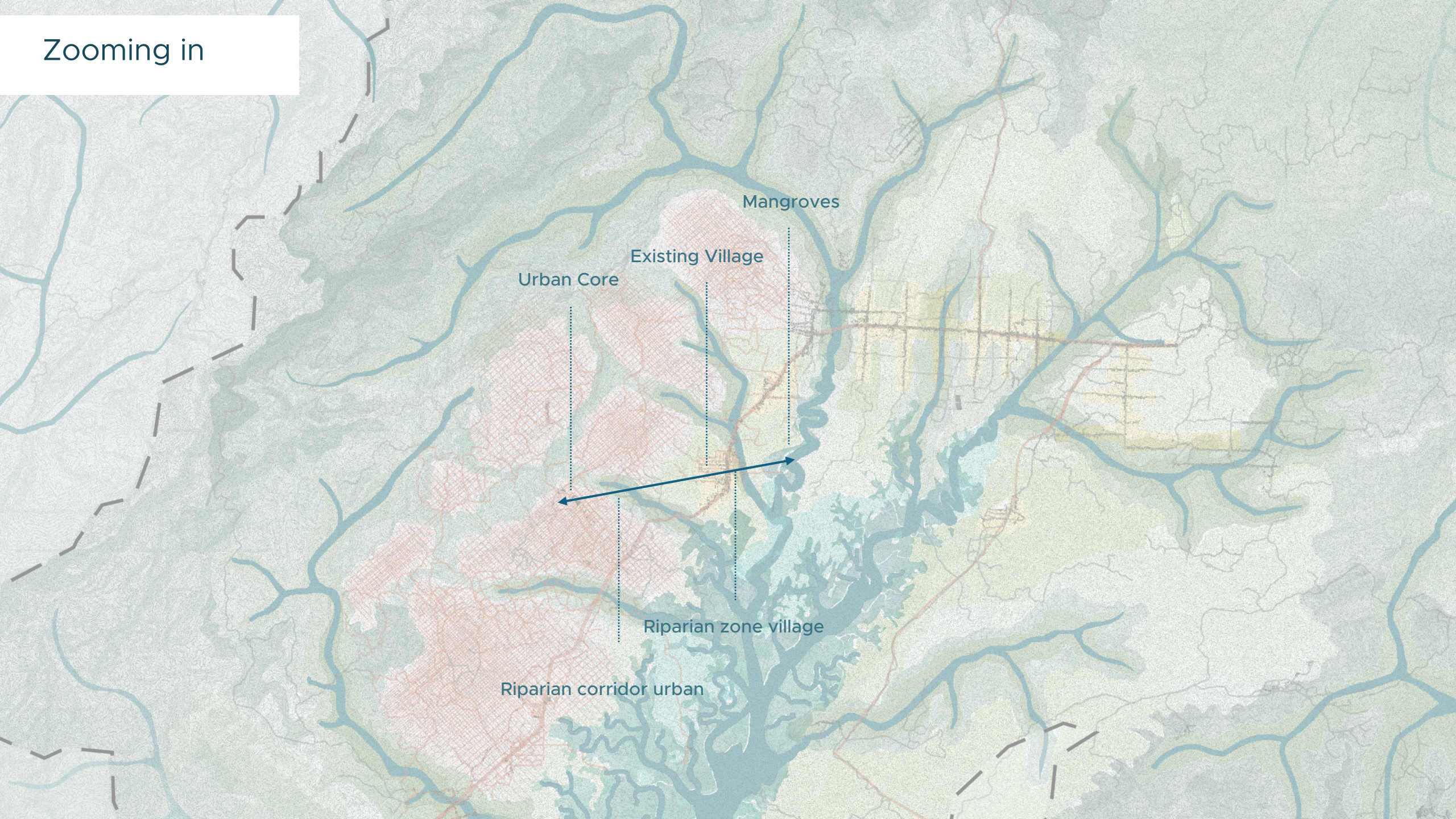
Regional Vision



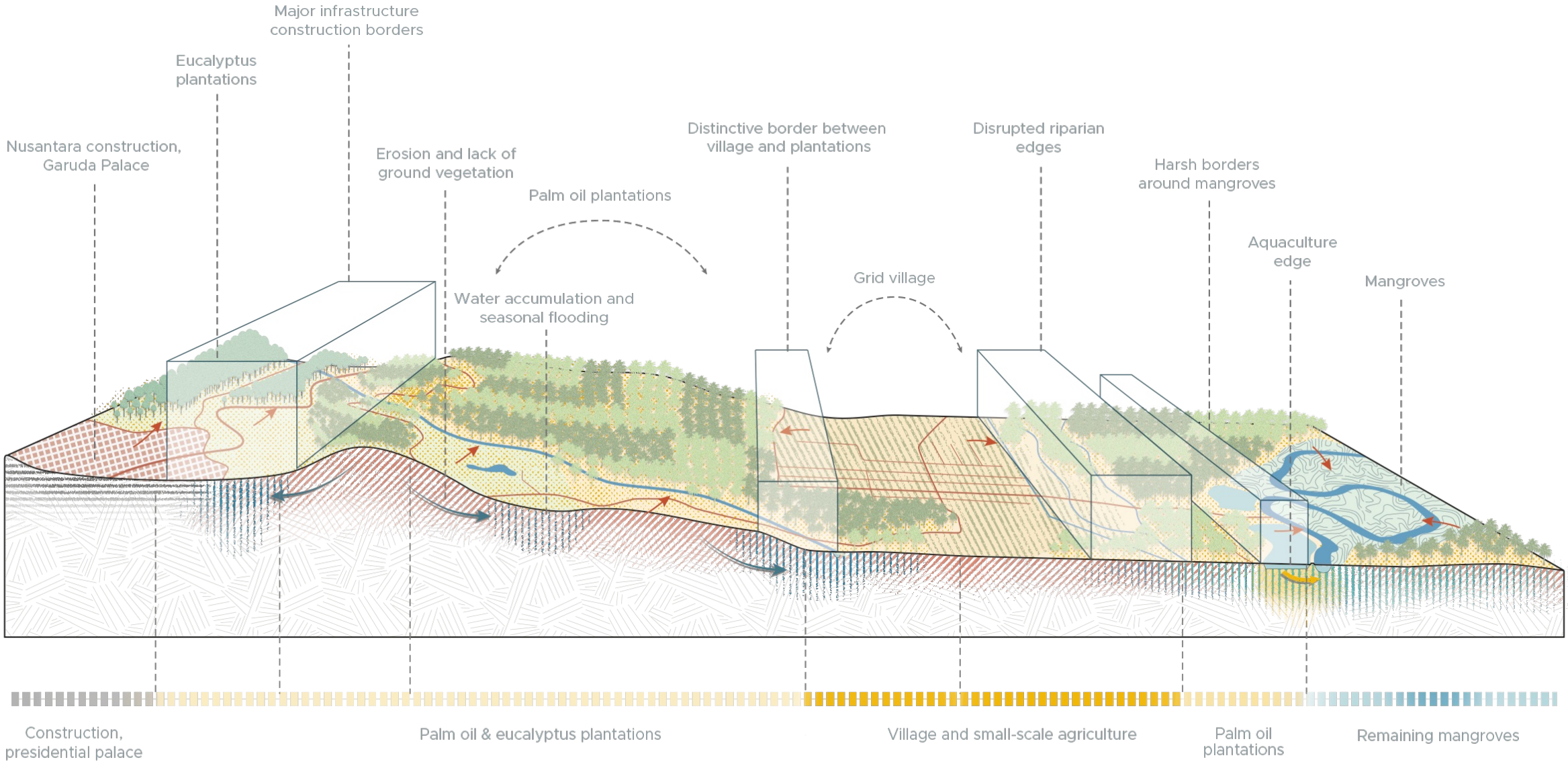
Design Application

SRQ3: How can the selected design principles be applied to the case of Nusantara throughout different scale levels to create spatial experiences?

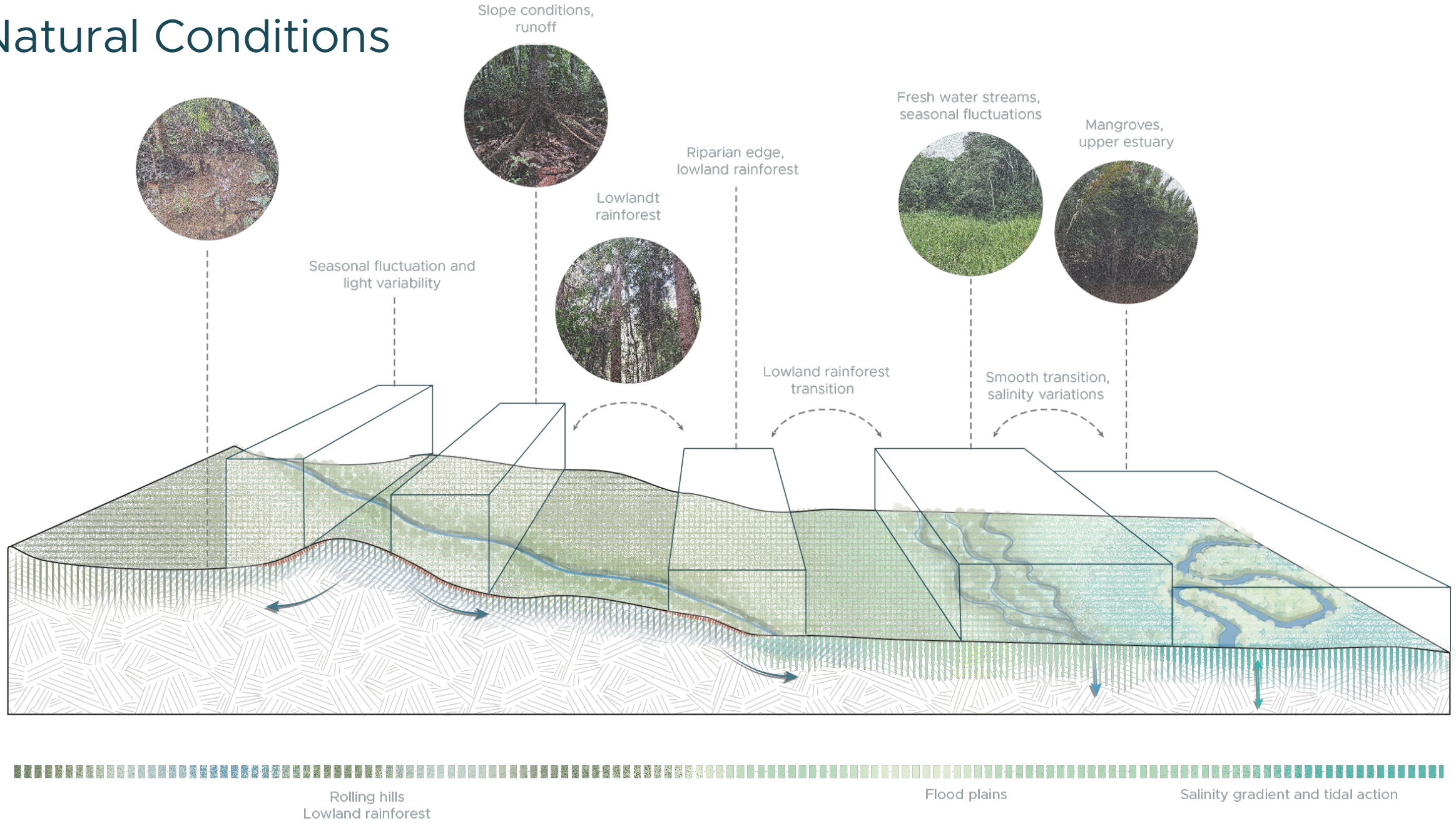
Zooming in


Mangroves
Existing Village
Urban Core
Riparian zone village
Riparian corridor urban

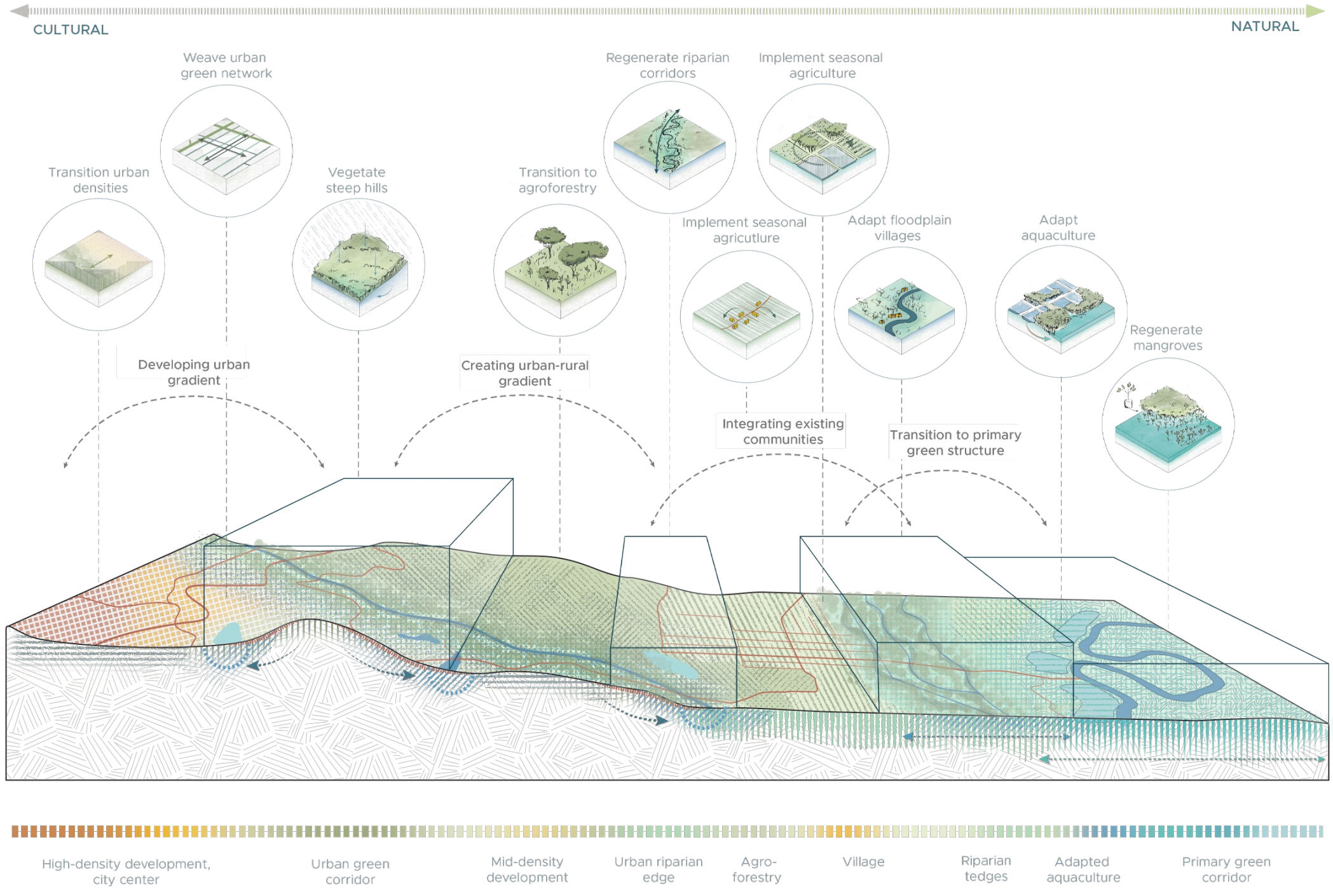
Current Situation



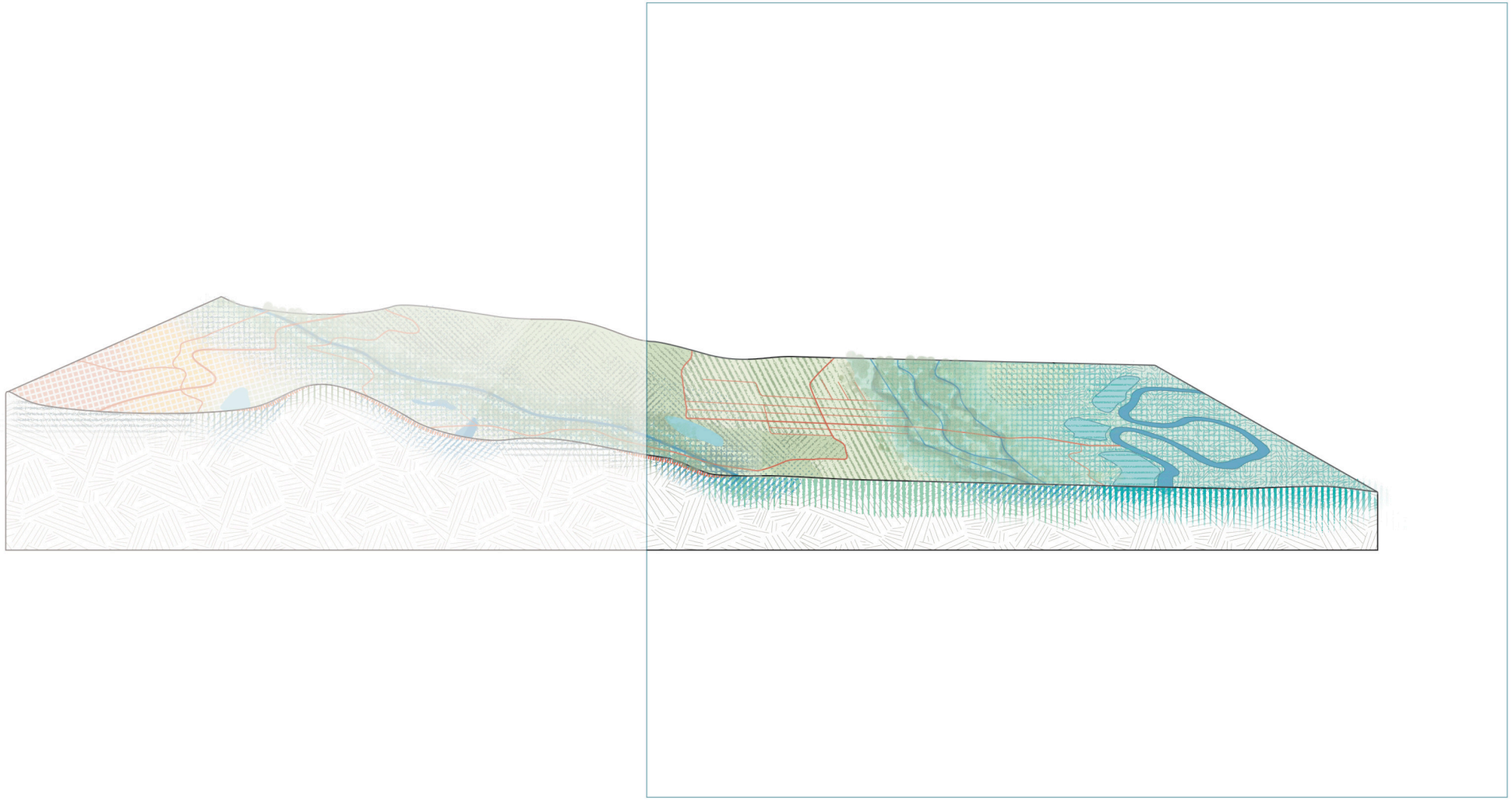
Natural Conditions



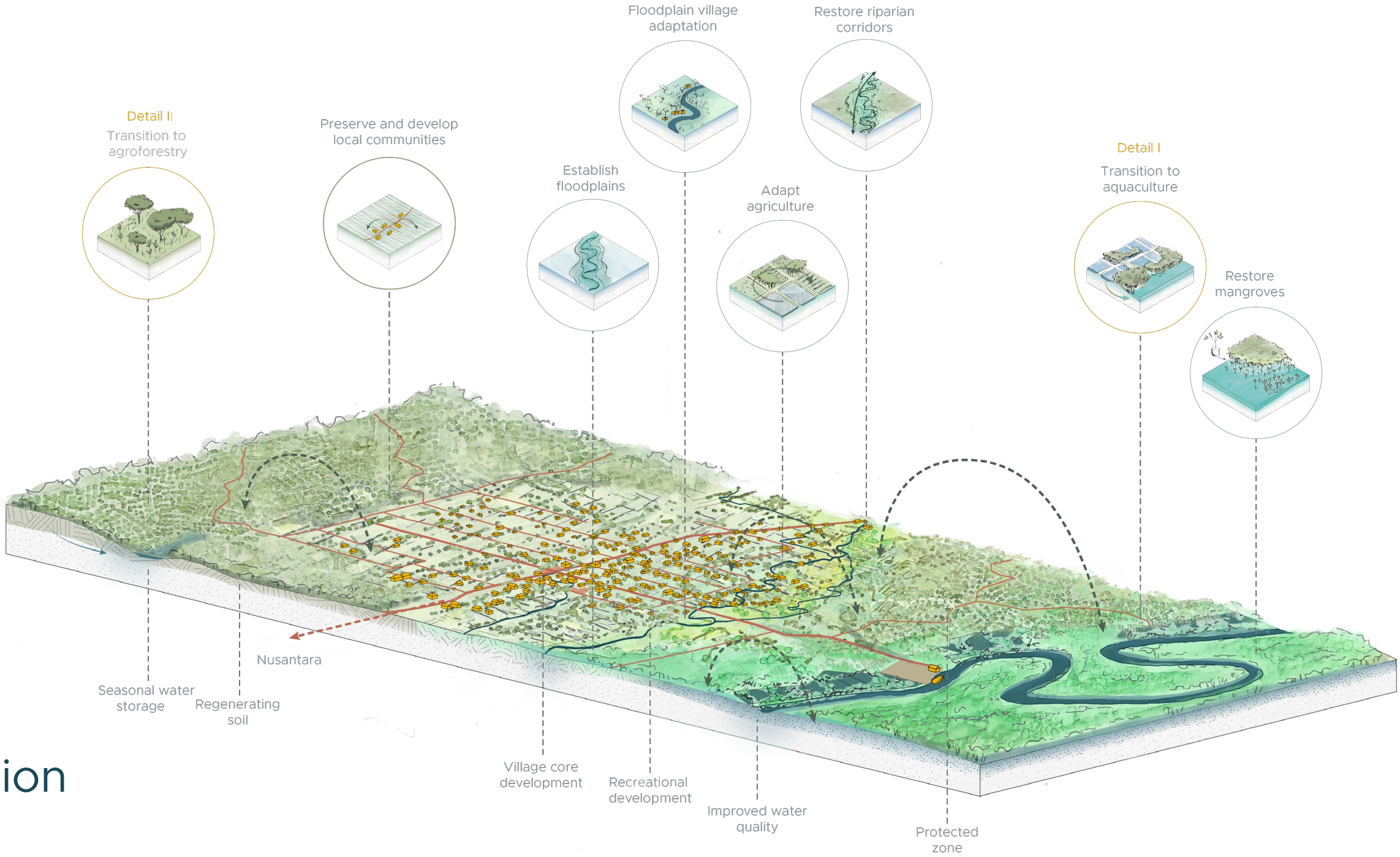
Desing


CULTURAL
NATURAL
Weave urban green network
Regenerate riparian corridors
Implement seasonal agriculture
Transition urban densities
Vegetate steep hills
Transition to agroforestry
Implement seasonal agricutlure
Adapt floodplain villages
Adapt aquaculture
Regenerate mangroves
Developing urban gradient
Creating urban-rural gradient
Integrating existing communities
Transition to primary green structure
High-density development, city center
Urban green corridor
Mid-density development
Urban riparian edge
Agro-forestry
Village
Riparian tedges
Adapted aquaculture
Primary green corridor

Gradient I
Integrating local communities

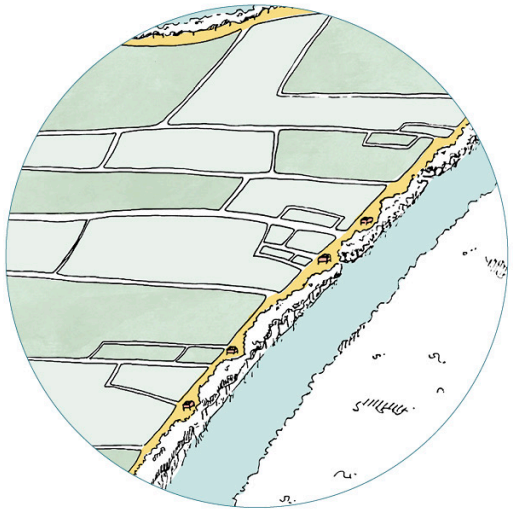


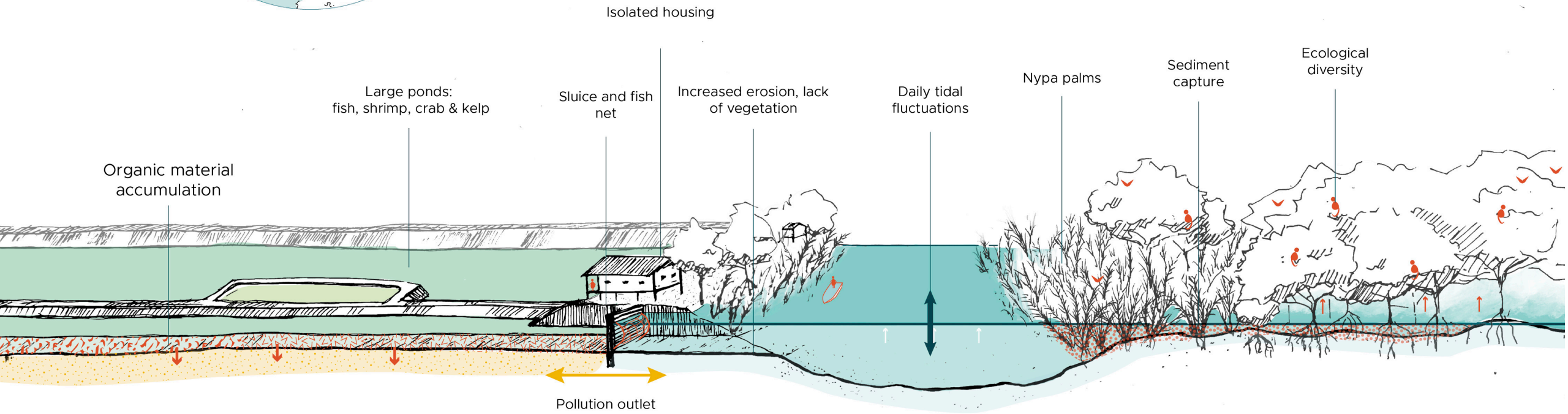
Vision


Detail II
Transition to agroforestry
Preserve and develop local communities
Floodplain village adaptation
Restore riparian corridors
Establish floodplains
Adapt agriculture
Detail I
Transition to aquaculture
Restore mangroves
Nusantara
Seasonal water storage
Regenerating soil
Village core development
Recreational development
Improved water quality
Protected zone

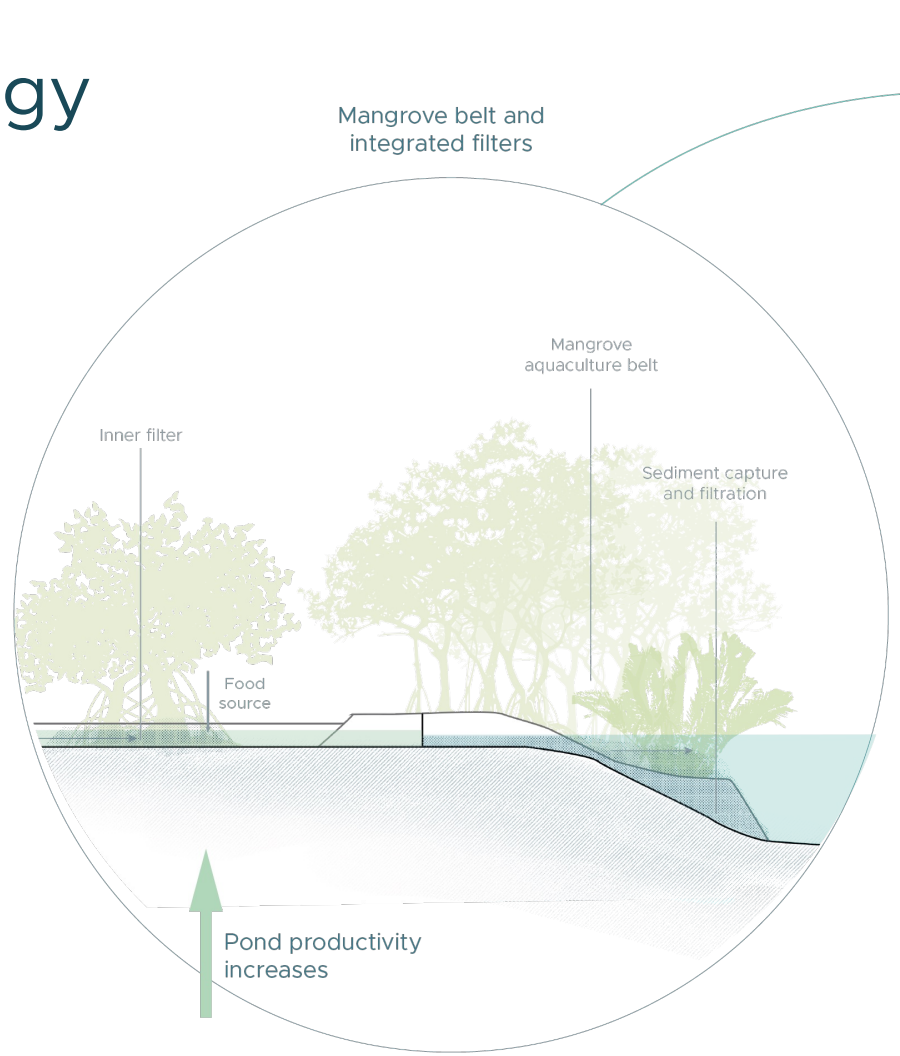
Current Situation

Current pond structure





Strategy

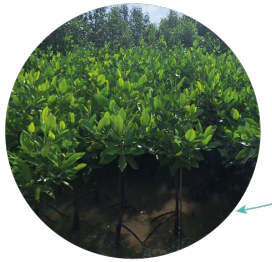




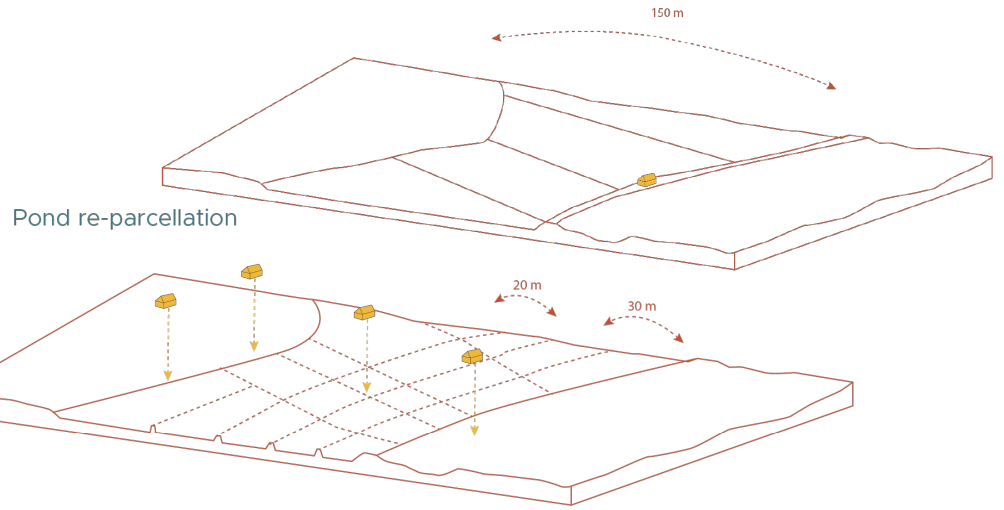
Mangrove seeds



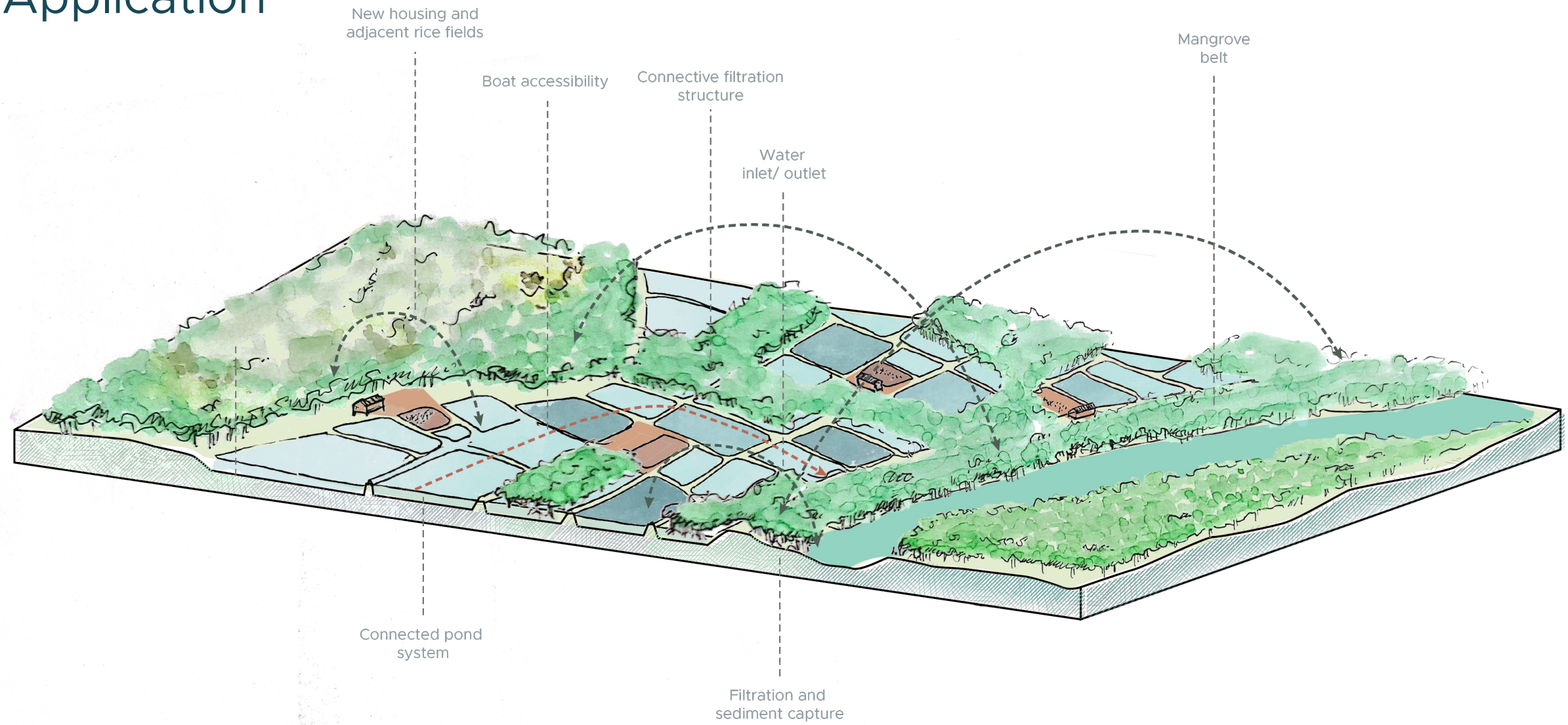
Mangrove seedlings



Supply local
mangrove restoration



Application



Application

Nypa, Rhizophora, Avicenia etc.



Seeds, building material

Shrimp, fish and kelp



Rice

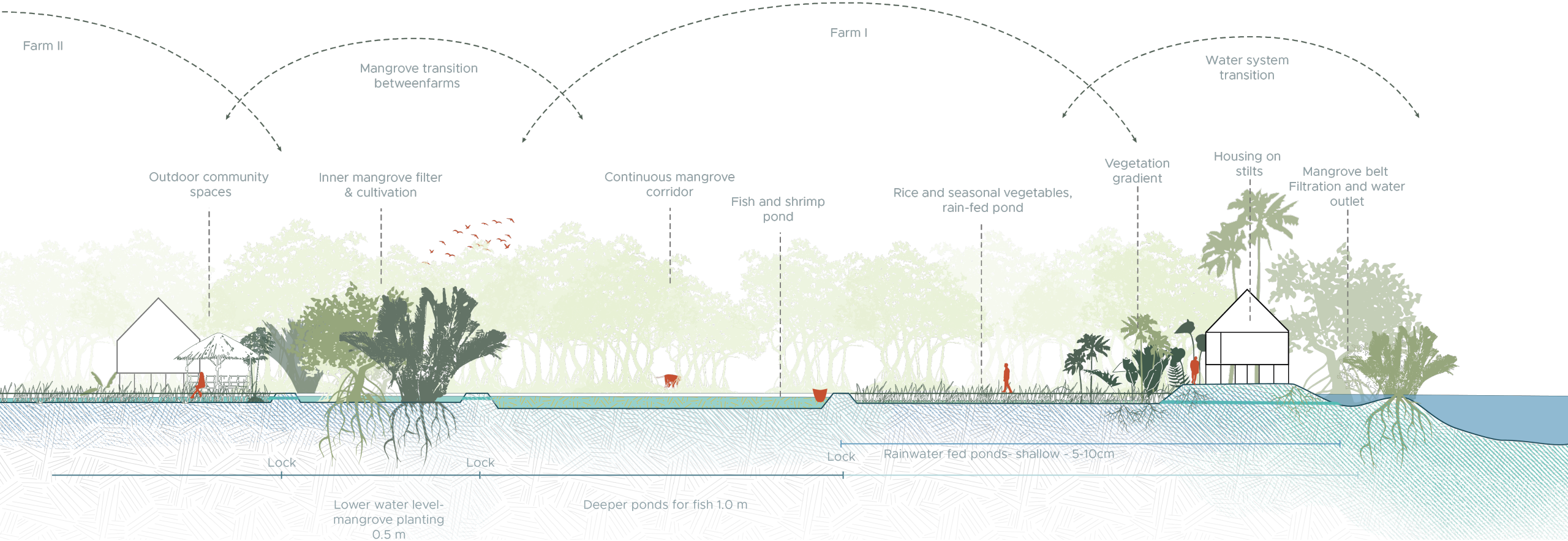


Fruits and vegetables



Nypa & Rhizophora

Production and vegetation



Before

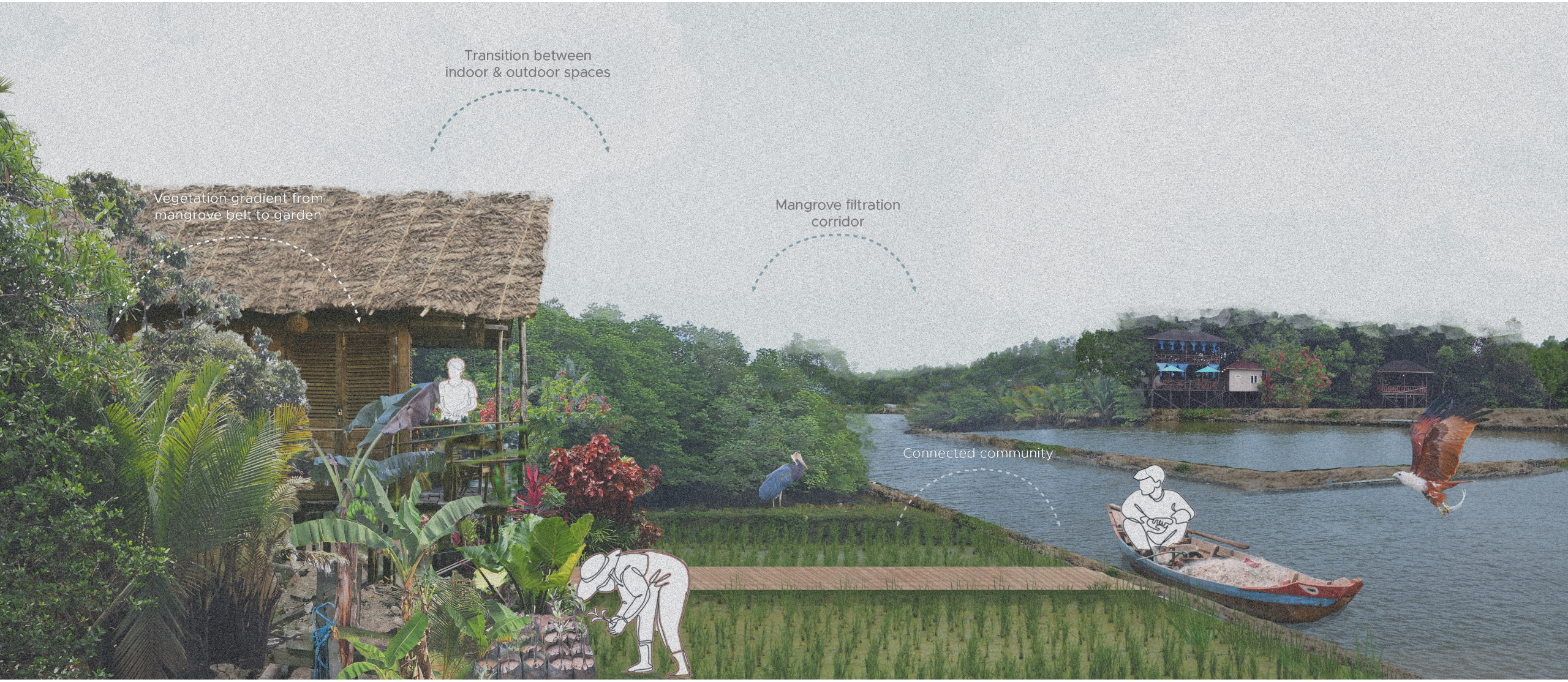


Open ponds with limited vegetation (Frithasya Purba, 2025)

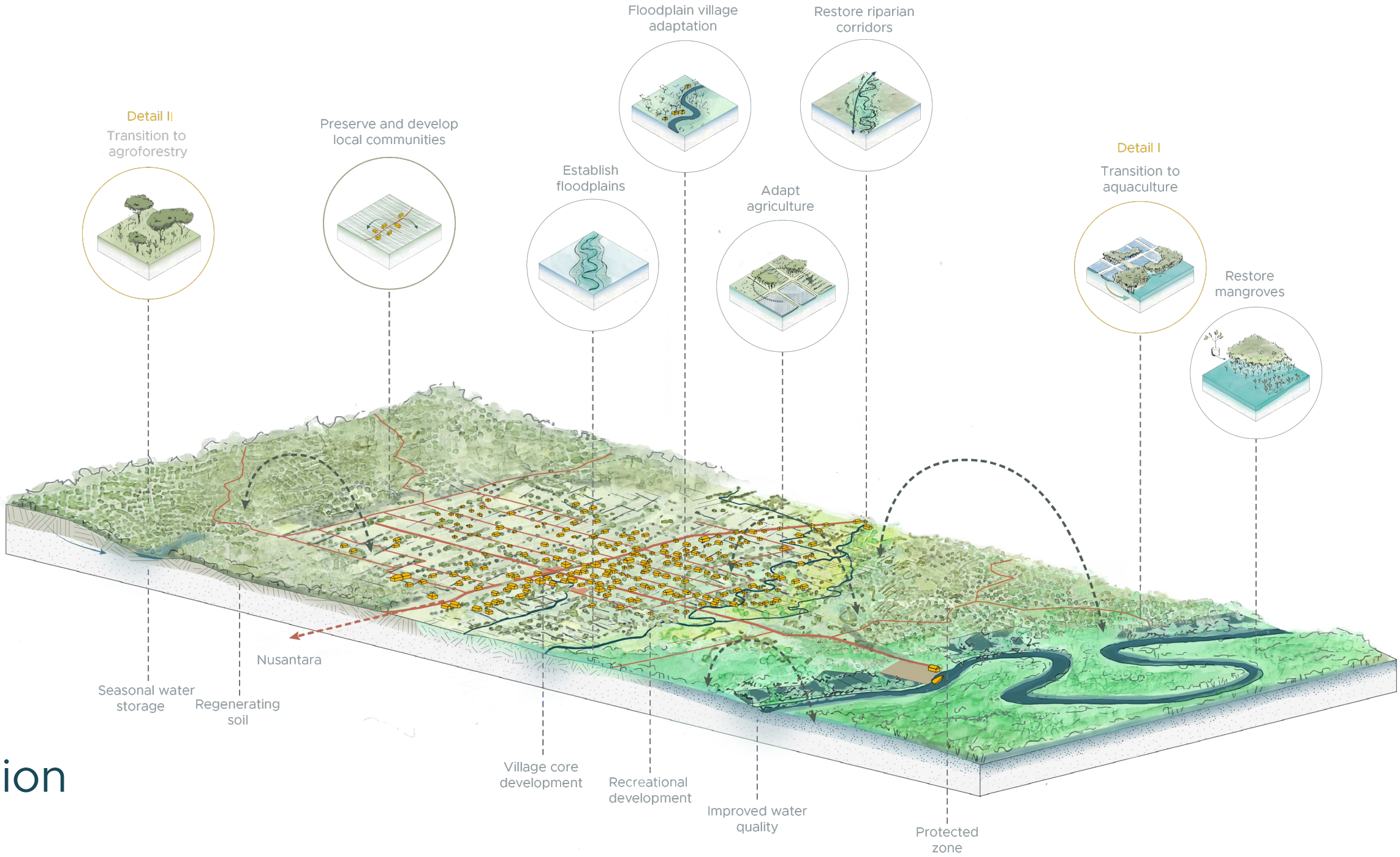


Narrow dike structures with limited space for farmers.(Frithasya Purba, 2025)

After


Transition between
indoor & outdoor spaces
Vegetation gradient from
mangrove belt to garden
Mangrove filtration
corridor
Connected community

Vision


Detail II
Transition to agroforestry
Preserve and develop local communities
Floodplain village adaptation
Restore riparian corridors
Establish floodplains
Adapt agriculture
Detail I
Transition to aquaculture
Restore mangroves
Nusantara
Seasonal water storage
Regenerating soil
Village core development
Recreational development
Improved water quality
Protected zone

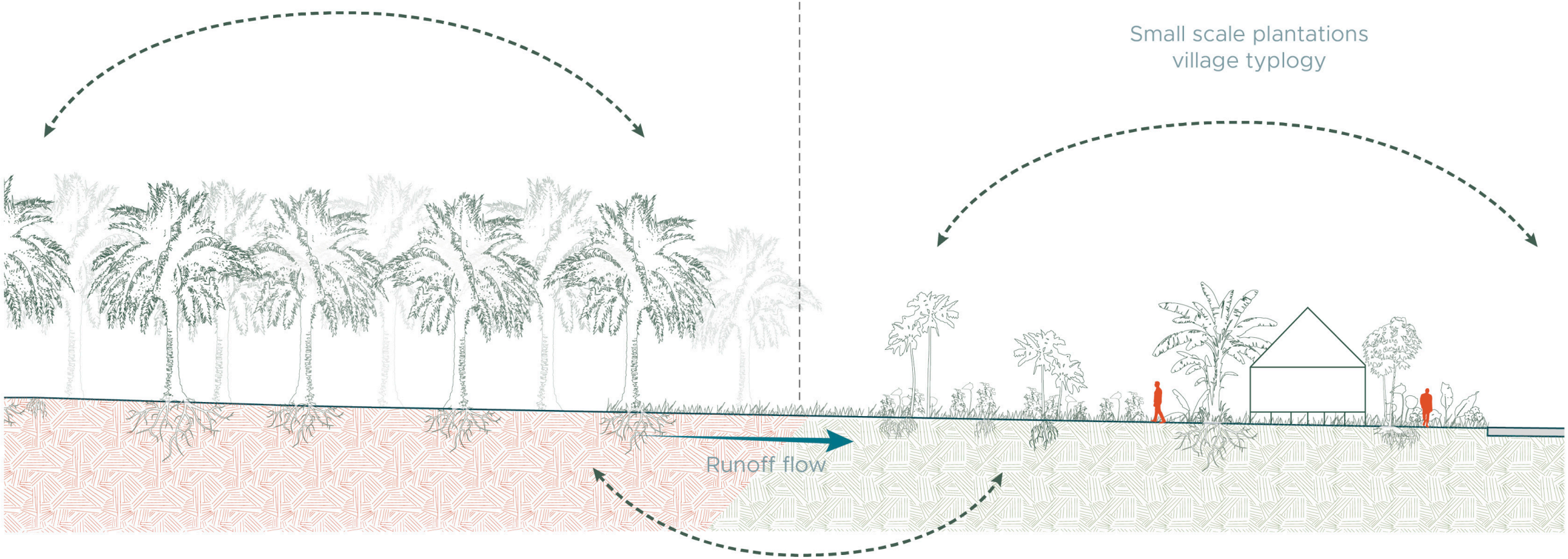
Current Situation



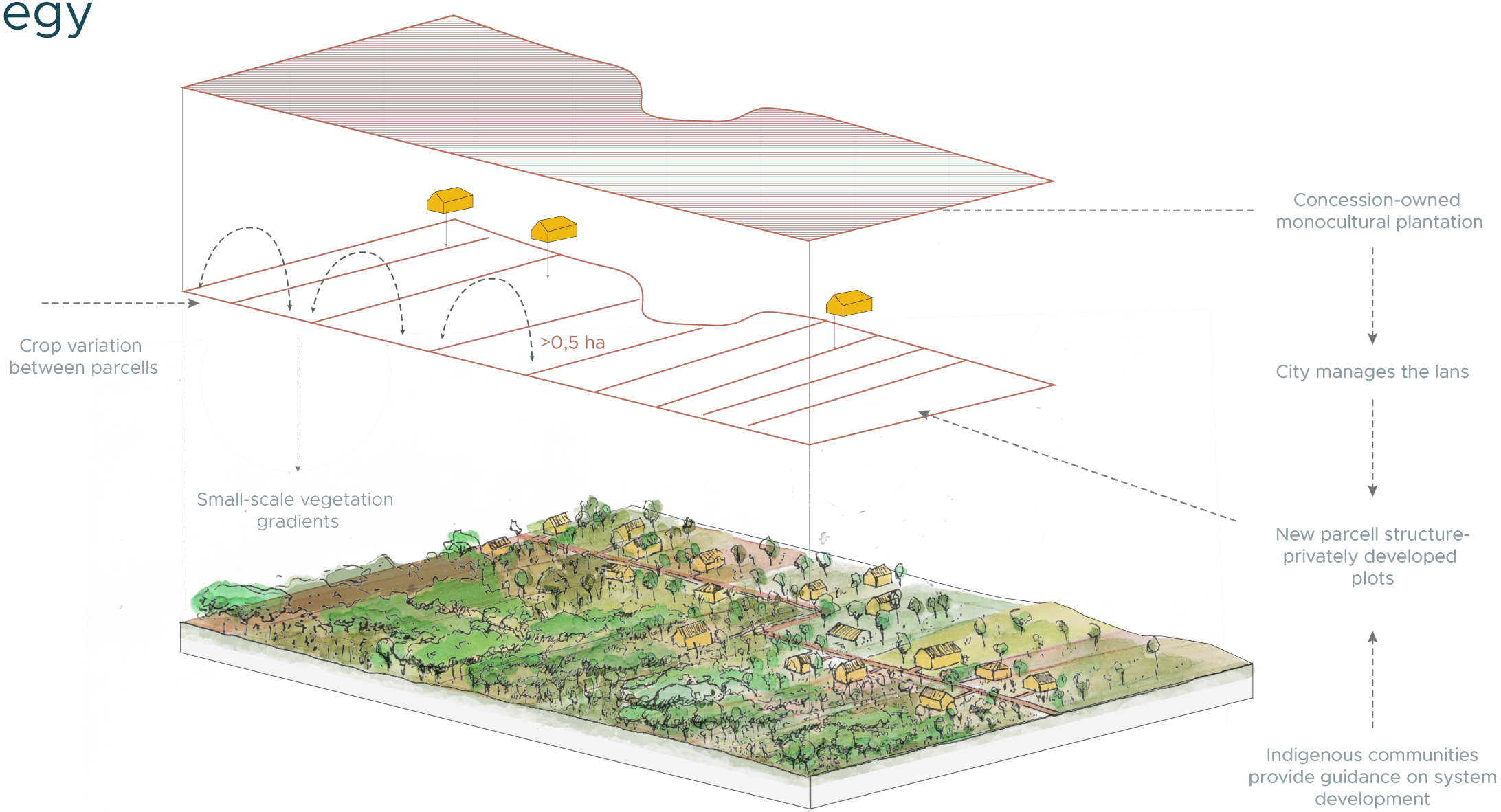


Distinct border conditions

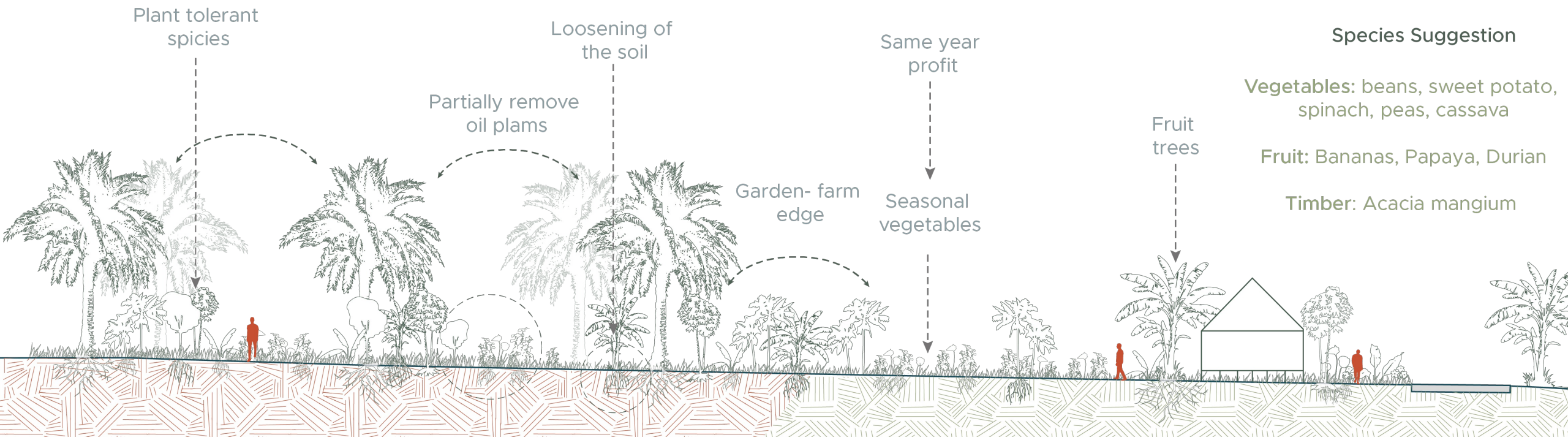
Small scale plantations village typology



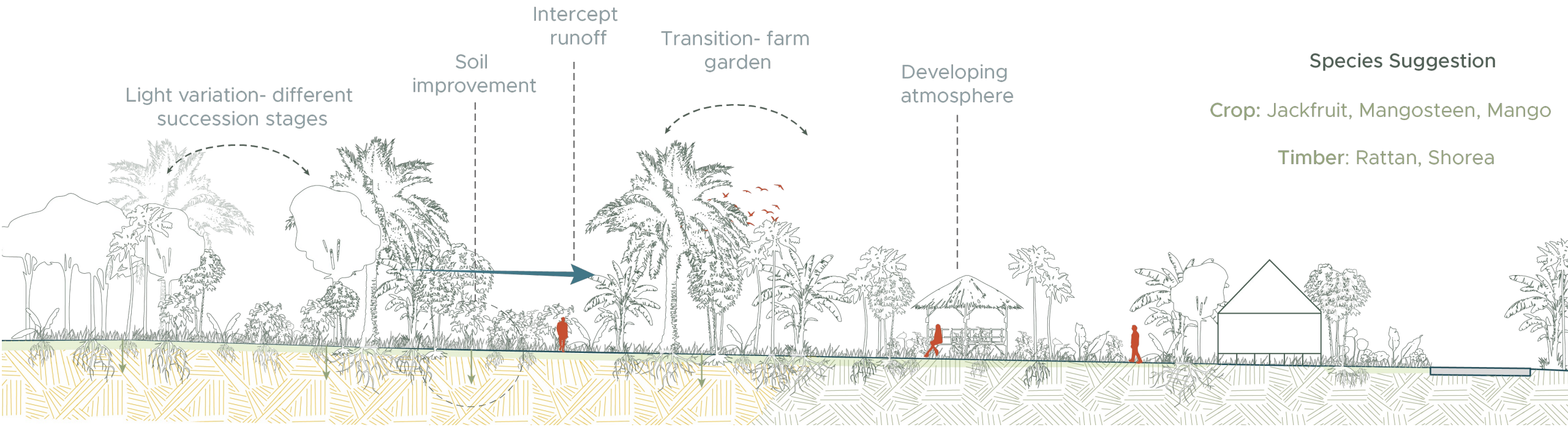
Strategy


Concession-owned
monocultural plantation
City manages the lans
New parcell structure-
privately developed
plots
Indigenous communities
provide guidance on system
development
Crop variation
between parcells
>0,5 ha
Small-scale vegetation
gradients

Application – Phase I



Application – Phase II



Application – Phase III



Before



Small-scale farming in villages.

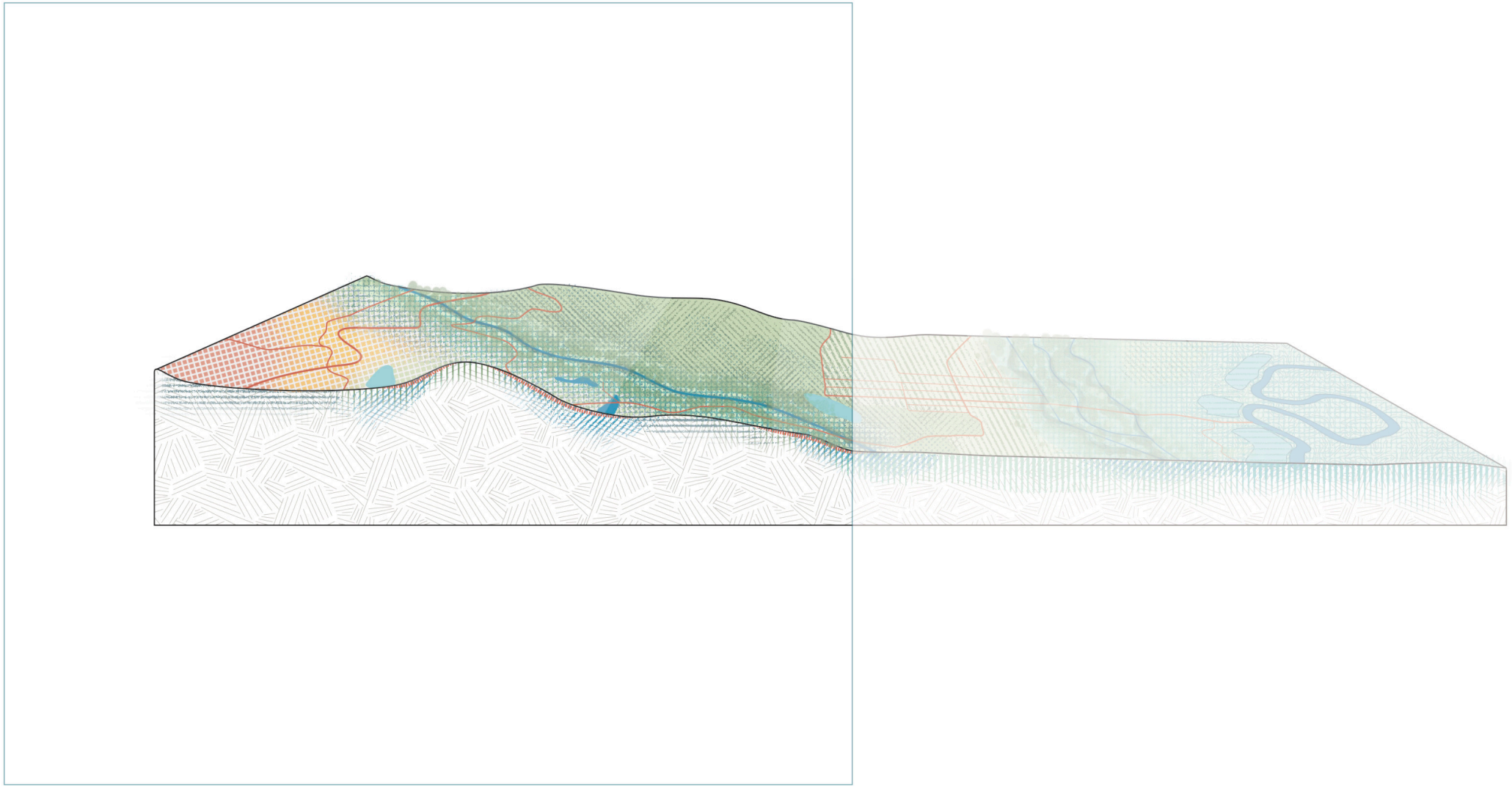


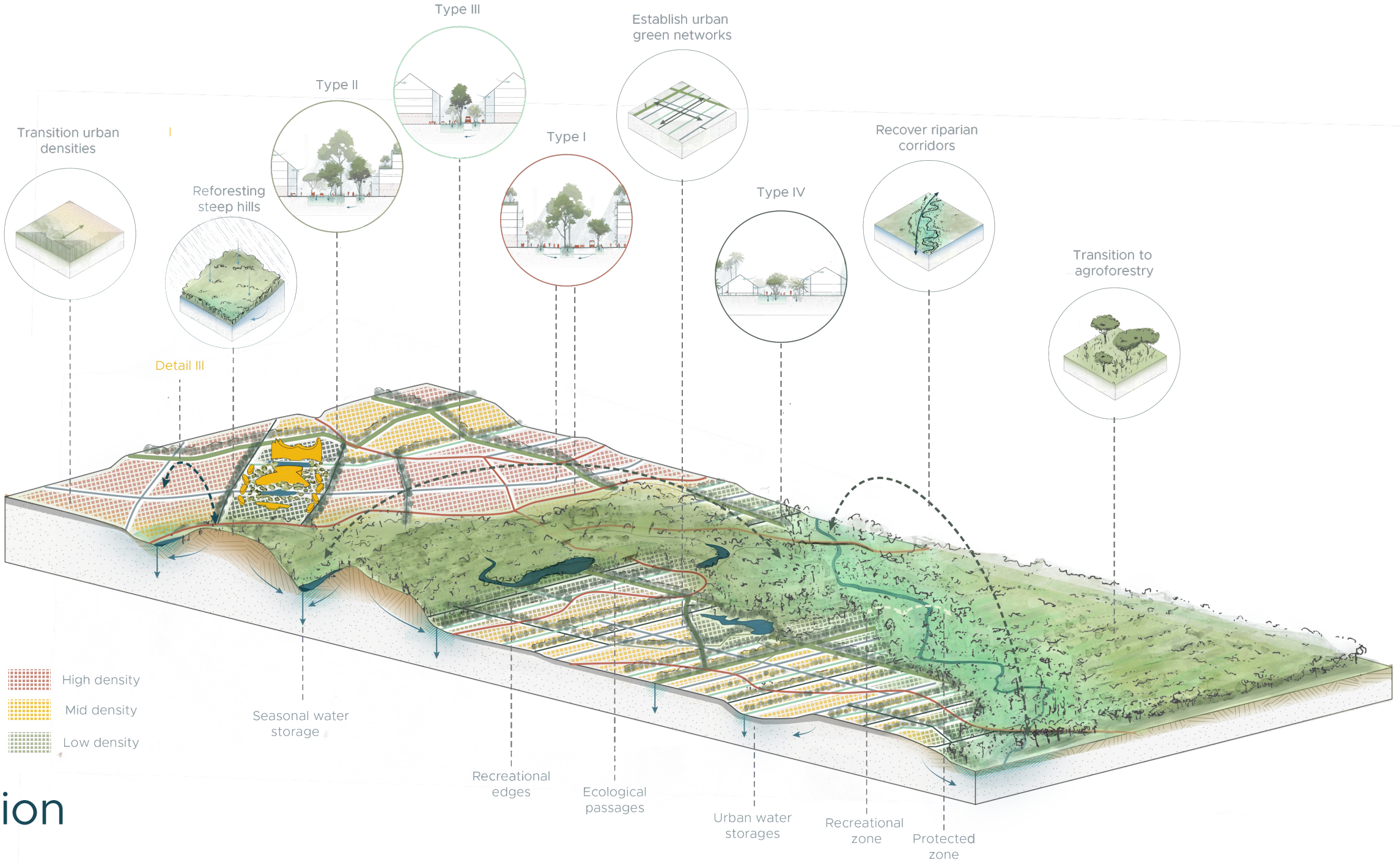
Palm oil plantations with severe soil erosion.

After


Vegetation densifies in the agroforest
Transition from home to garden
Forming a relationship with the system
From garden to plantation

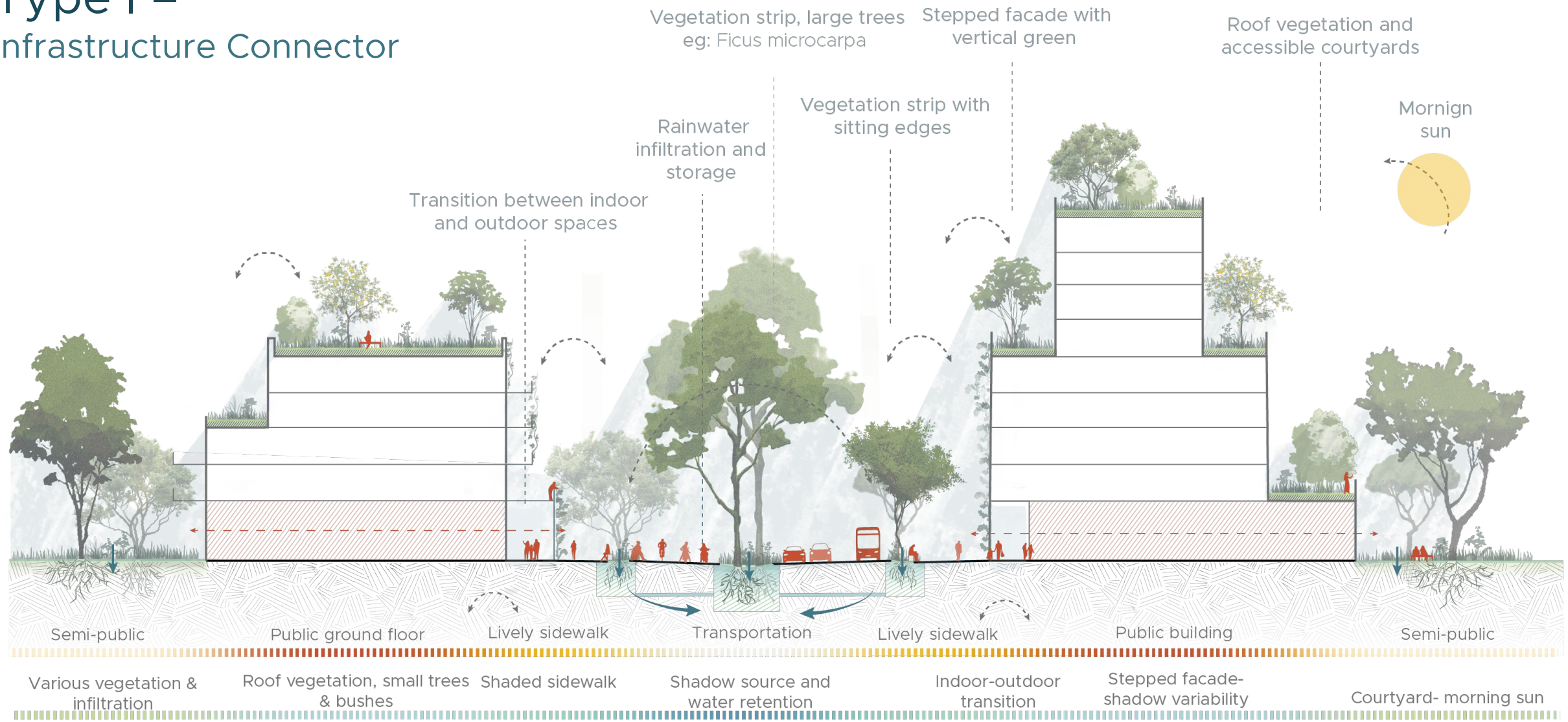
Gradient II
Weaving urban green structures



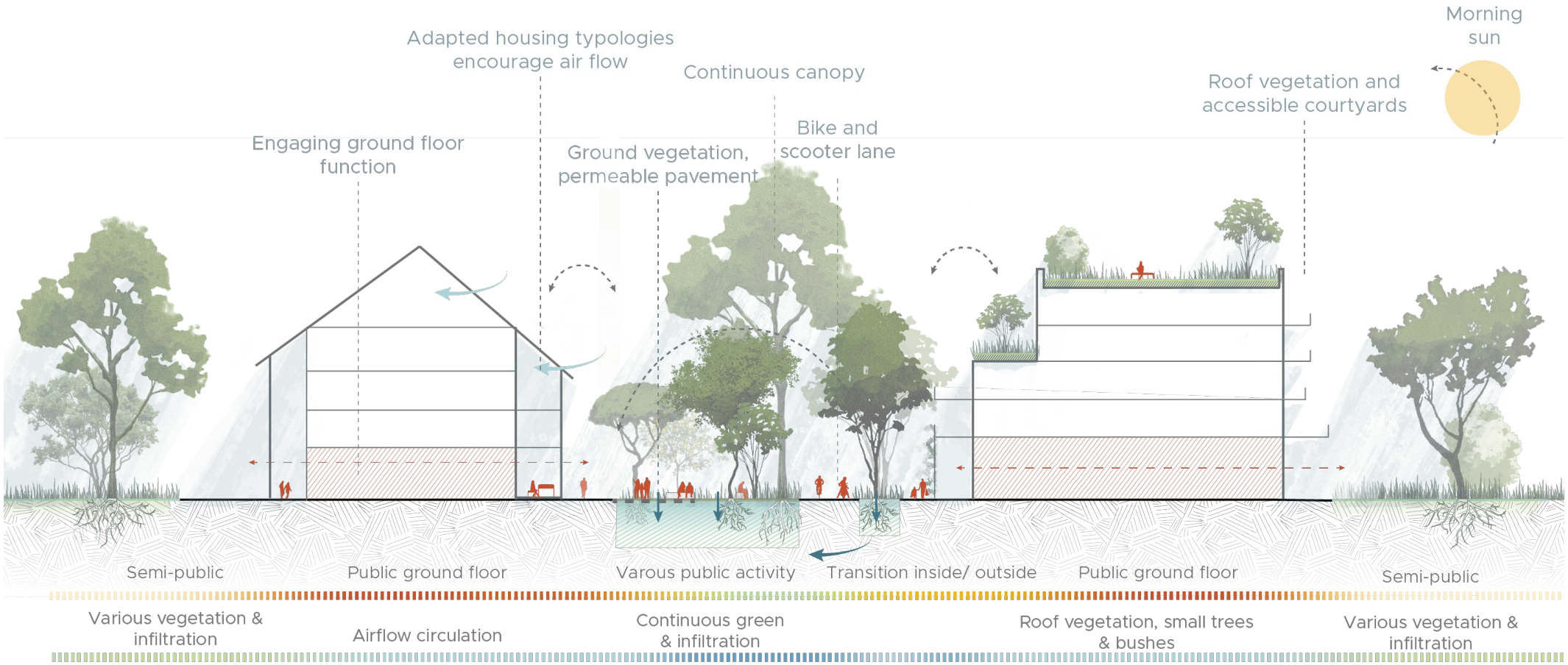

Type III
Establish urban green networks
Type II
Transition urban densities
Reforesting steep hills
Type I
Recover riparian corridors
Type IV
Transition to agroforestry
Detail III
High density
Mid density
Low density
Seasonal water storage
Recreational edges
Ecological passages
Urban water storages
Recreational zone
Protected zone

Vision

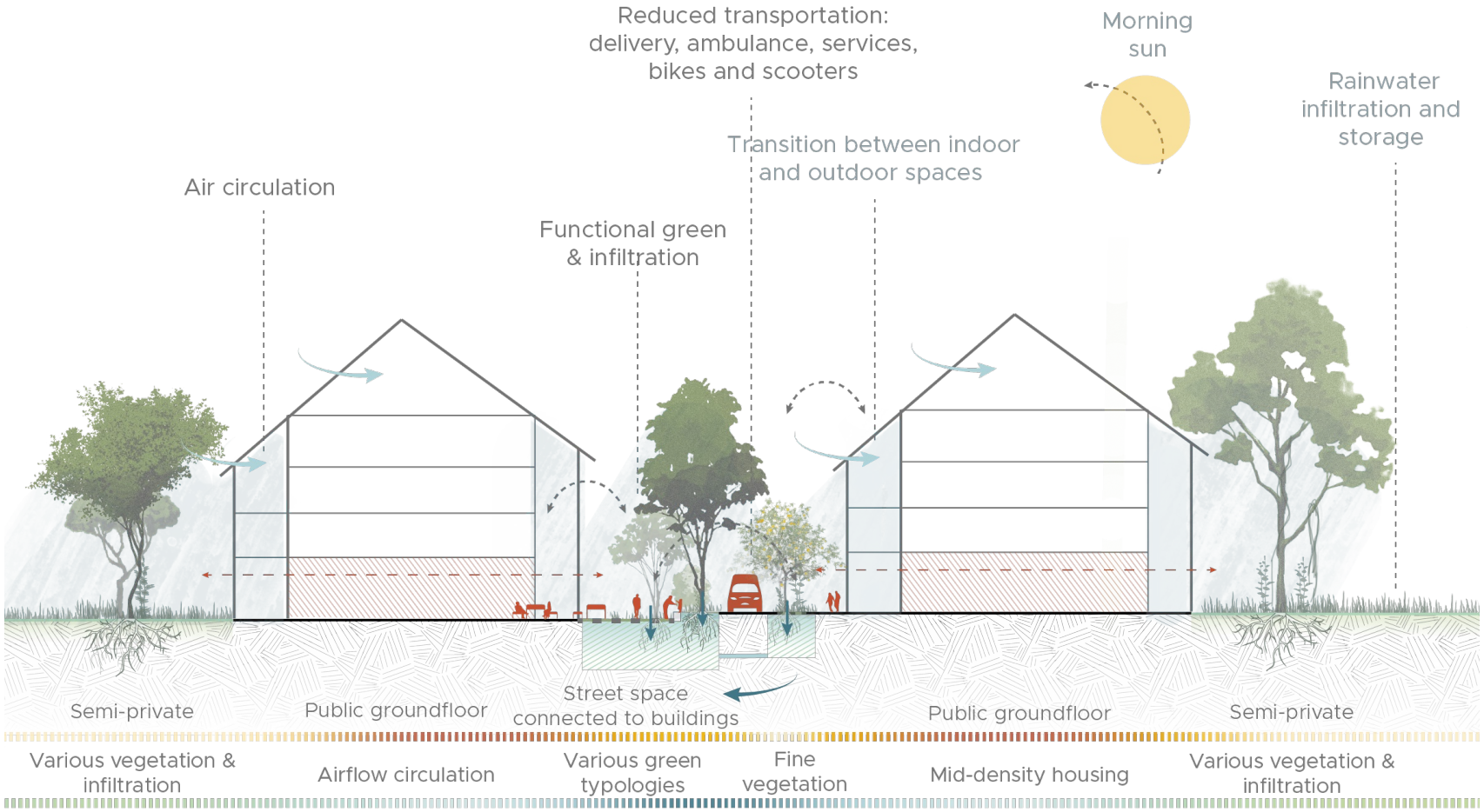
Type I –
Infrastructure Connector



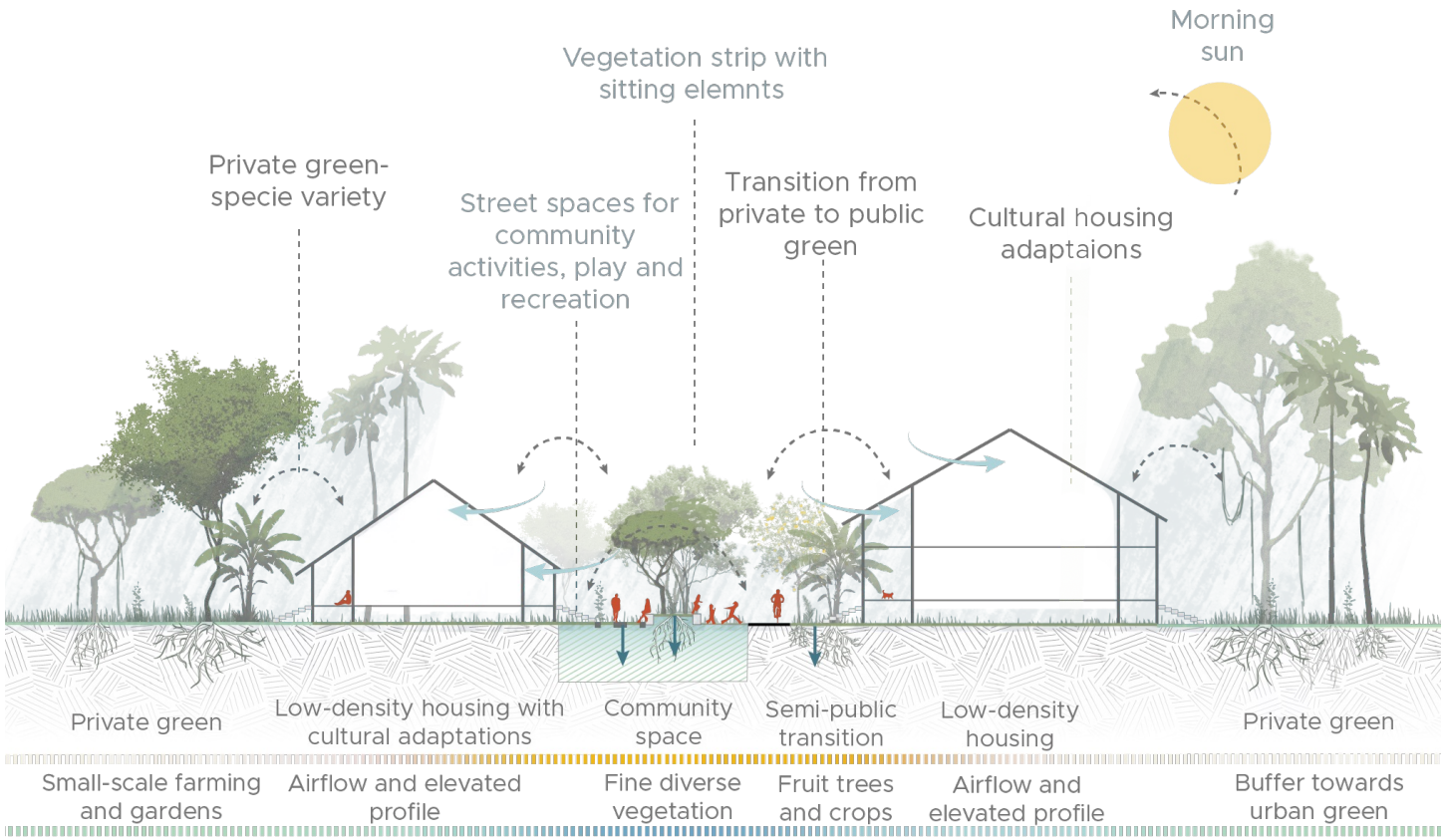
Type II –
Green Connector



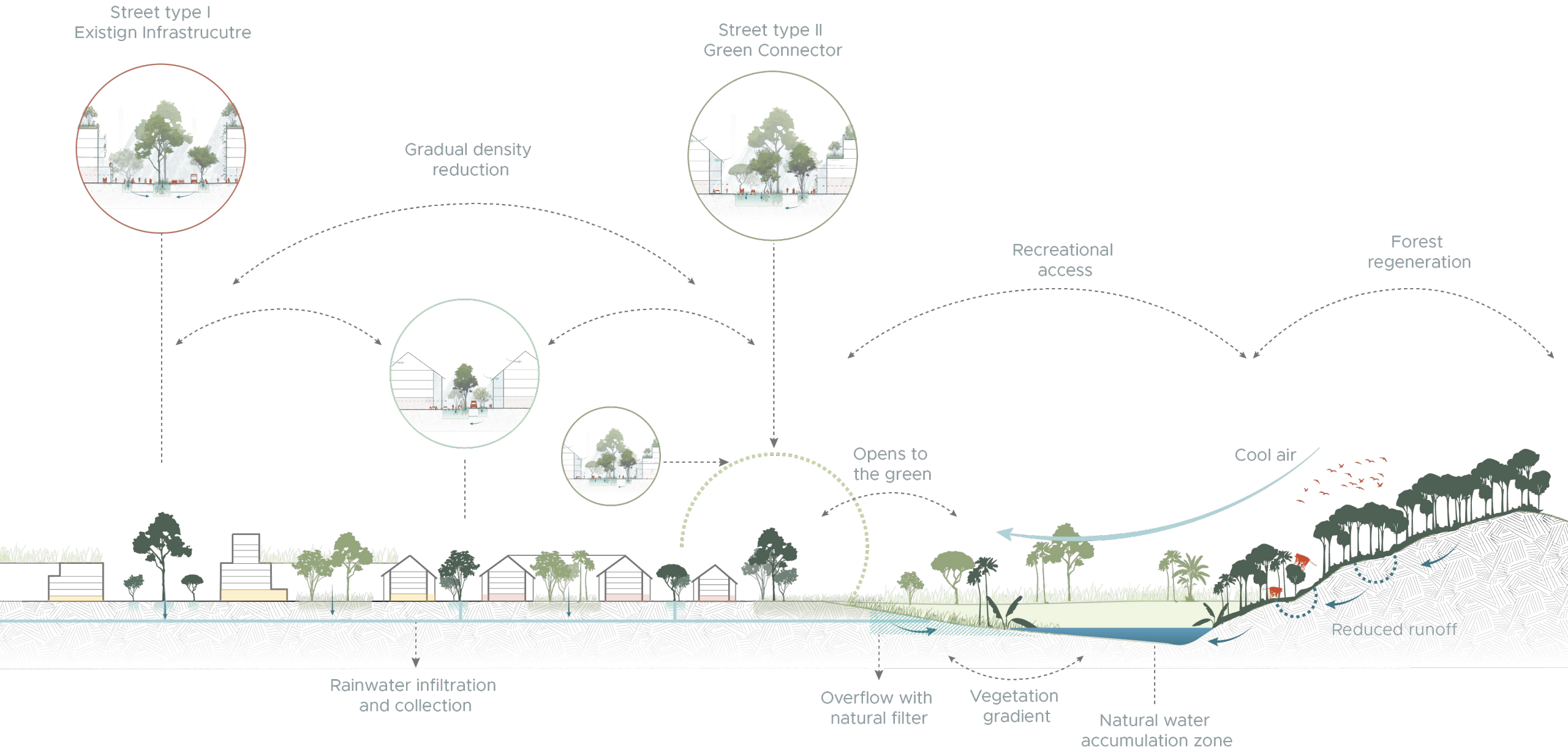
Type III –
Mid-density



Type IV –
Low-density



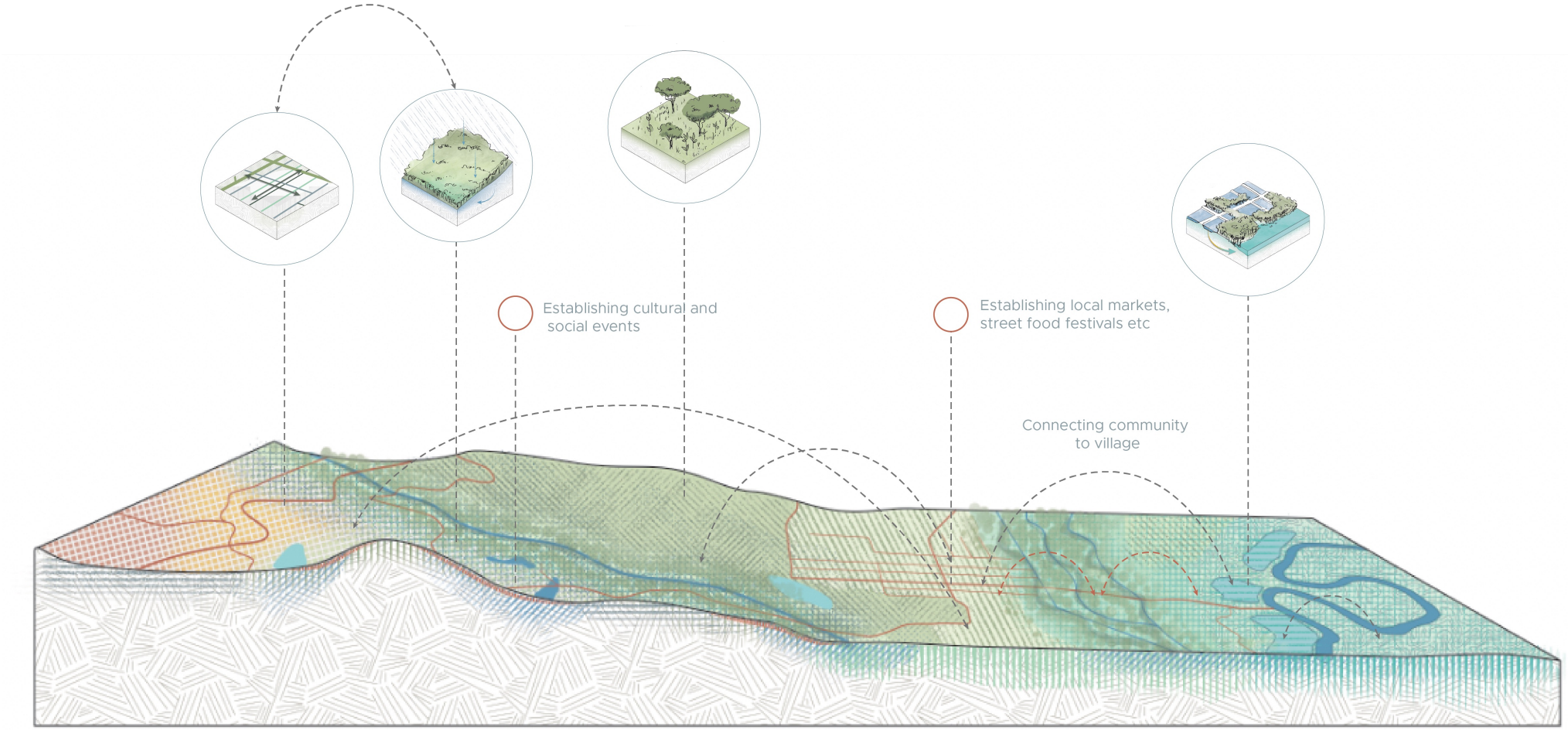
Application

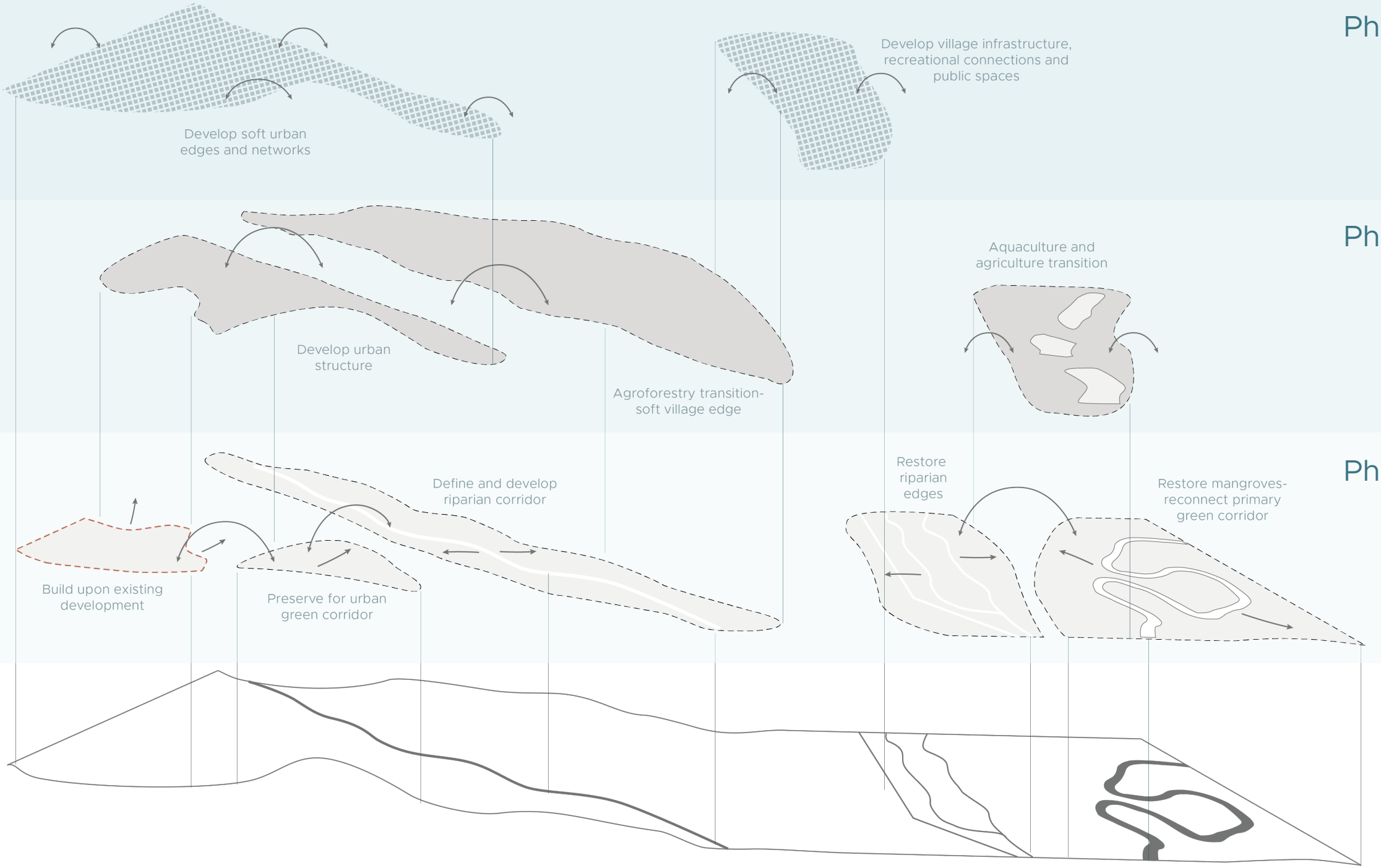


After


Continuous shade
Connect inside and outside spaces
Connecting to street spaces
Vegetation transitions from urban to forested
From city to nature

Connecting the interventions




Phase III
Develop village infrastructure, recreational connections and public spaces
Develop soft urban edges and networks
Phase II
Aquaculture and agriculture transition
Develop urban structure
Agroforestry transition- soft village edge
Phase I
Restore riparian edges
Define and develop riparian corridor
Restore mangroves- reconnect primary green corridor
Build upon existing development
Preserve for urban green corridor

Reflection

SRQ4: What lessons can be learned from the application of a landscape-gradient-based urbanization approach?

Landscape gradients as a basis for urban design?

- Initiate cultural and natural processes
- Flexible across scales
- Create continuity
- Move away from categorical thinking
- Can be difficult to pinpoint



Project Limitations & Perspectives

- Few design explorations to reference
- Lack of data
- Further zoom-ins to explain relations
- Application in other parts of the city
- Expand the principal collection
- Try in an urbanized context



Personal Reflection

- Exploring new concepts
- Recognizing the value of local knowledge
- Working with processes
- Allowing for flexibility and uncertainty



