

RESILIENCE IN MOTION

Designing a Spatial Framework with Nature-Based Solutions for Flood Challenges in Rhonda and Kaptembwo, Nakuru, Kenya

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Lab: Urban Ecology

MSc. Landscape Architecture P4 Presentation

Fascination

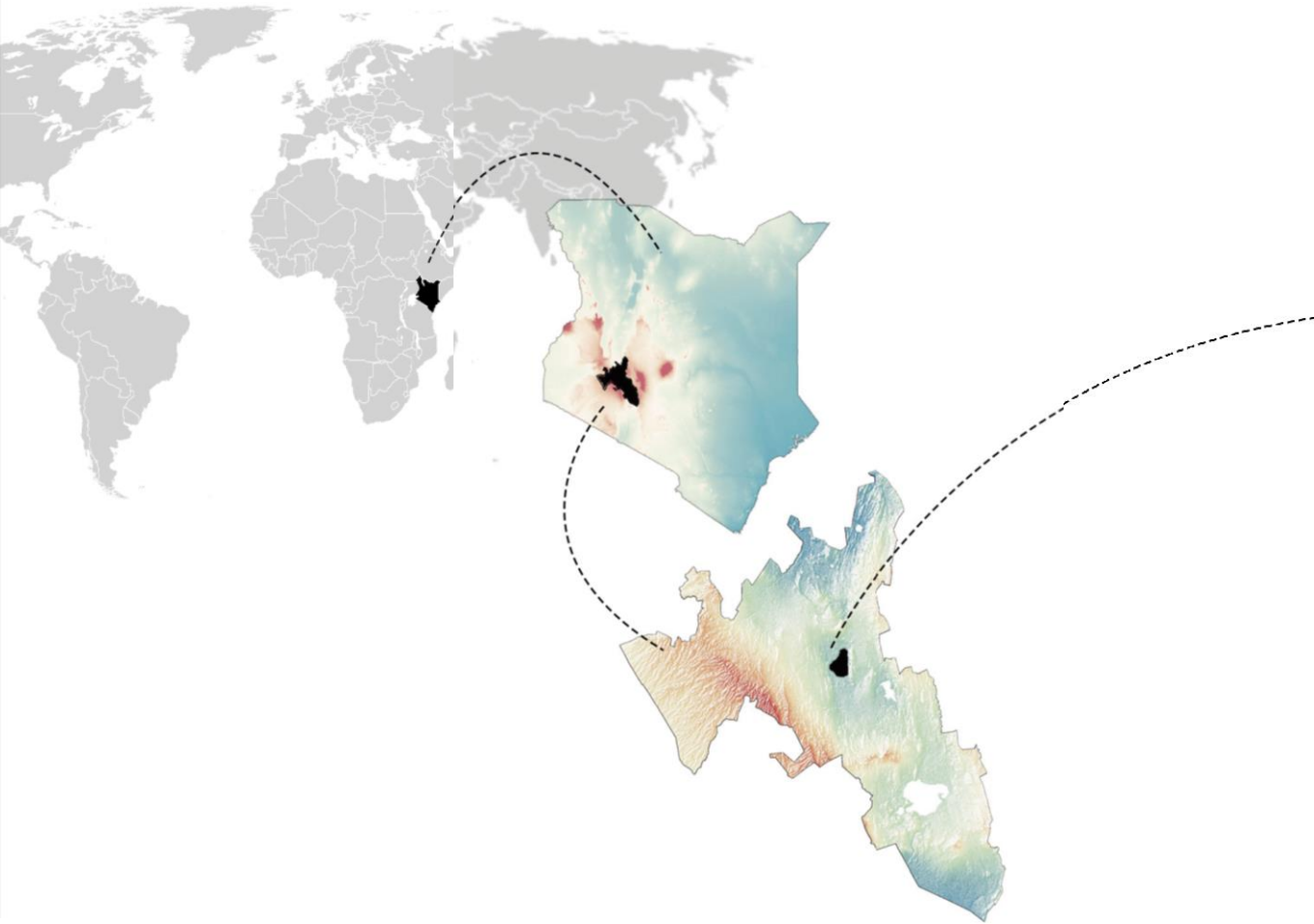


Nanjing, China
Photo credits: Chinanews.com



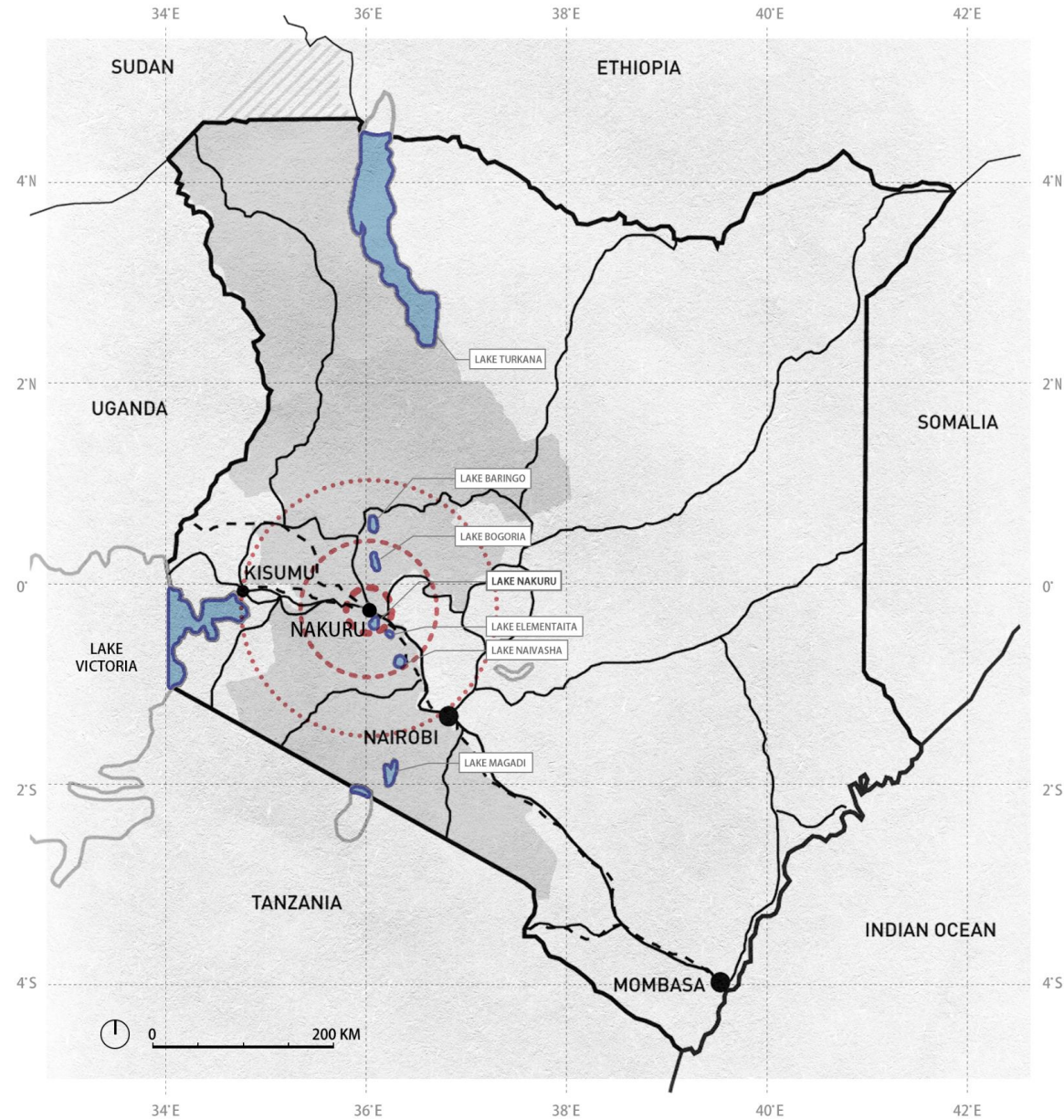
Johannesburg, South Africa
Photo credits: Author

Water Level Rising Problem



Water Level rising of the Lake Nakuru
Photo credits: Google earth

Rift Valley water patterns





Nakuru, Kenya
Photo credits: Google.com



Nakuru Lake
Photo credits: Google.com

An aerial, black-and-white photograph of a coastal city. The city features a dense grid of streets and buildings. A large, dark body of water is visible on the right side of the image. The text "Research Approach & Theoretical Framework" is overlaid in white, sans-serif font in the center of the image.

Research Approach & Theoretical Framework

Research Question

How to achieve **socio-ecological resilience**

by addressing **urban flood** challenges

through **nature-based solutions** within
a **community-based** spatial framework
in Rhonda and Kaptembwo ward, Nakuru?

Sub-Research Question 1

Enhancing Socio-Ecological Resilience

What is the concept of socio-ecological resilience in the context of urban informal settlements?

Sub-Research Question 2

Addressing Urban Flooding Challenges

What are the underlying causes and spatial patterns of urban flooding in Rhonda and Kaptembwo?

Sub-Research Question 3

Empowering Community-Based Spatial Frameworks

What local knowledge and adaptive practices exist in the community regarding flooding and environmental management?

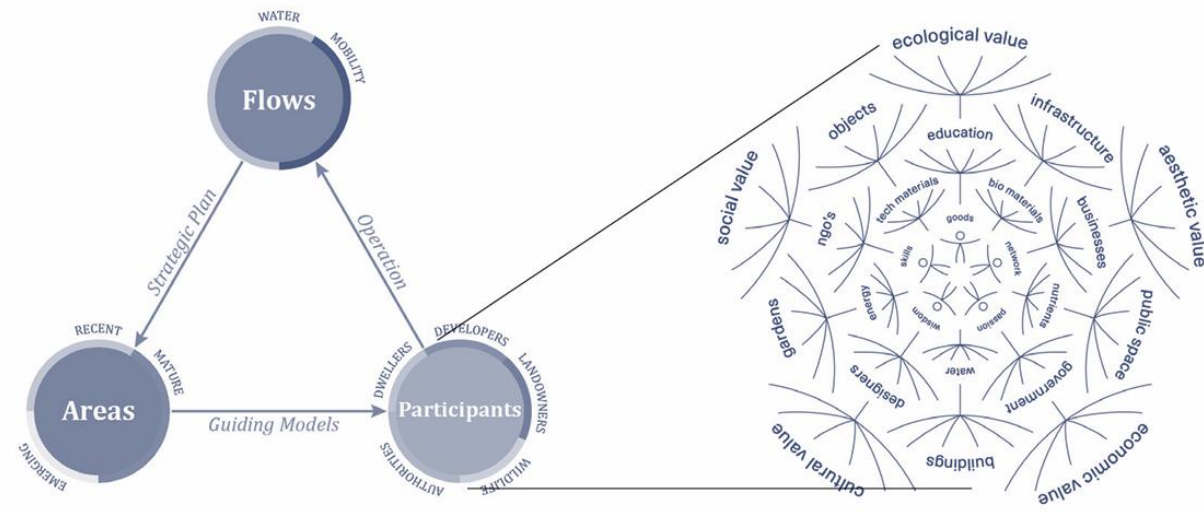
Research Objectives

- Propose spatial strategies rooted in hydrology and community needs;
- Develop a flexible model that can be scaled to other African cities.



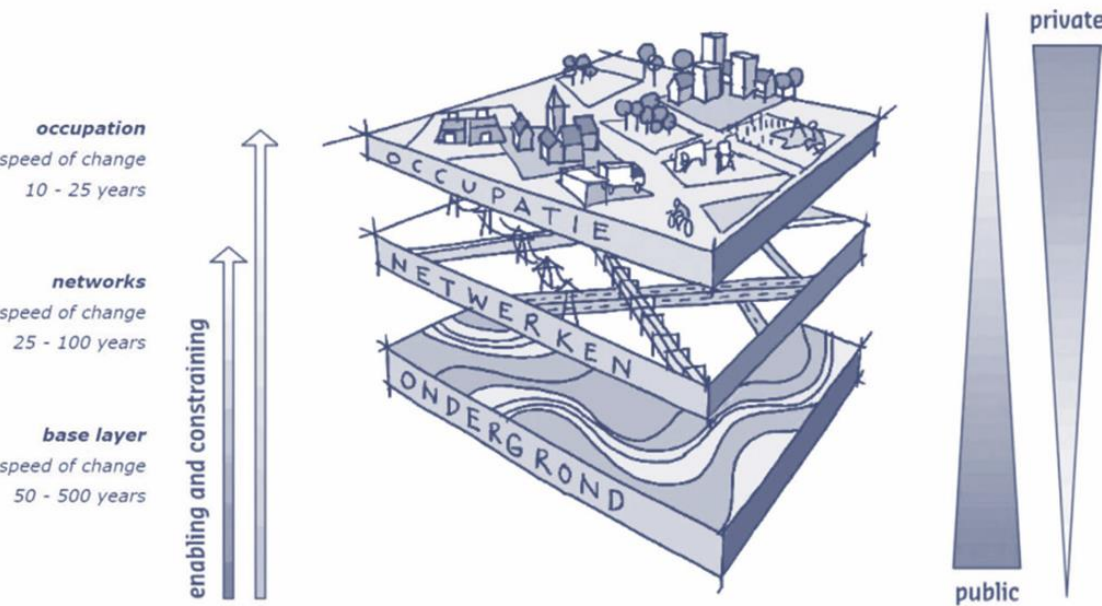
SDGs with sub-goals relating to project
Photo credits: unitednation.org

Theoretical Frameworks



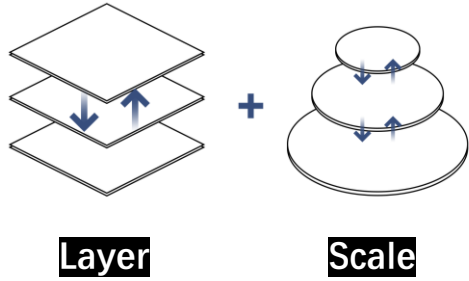
Three action-oriented integration perspectives
Photo credits: Tjallingi

Circular Value Flower
Photo credits: circularcommunity.org



Dutch layer approach
Photo credits: van Schaick, Klaasen

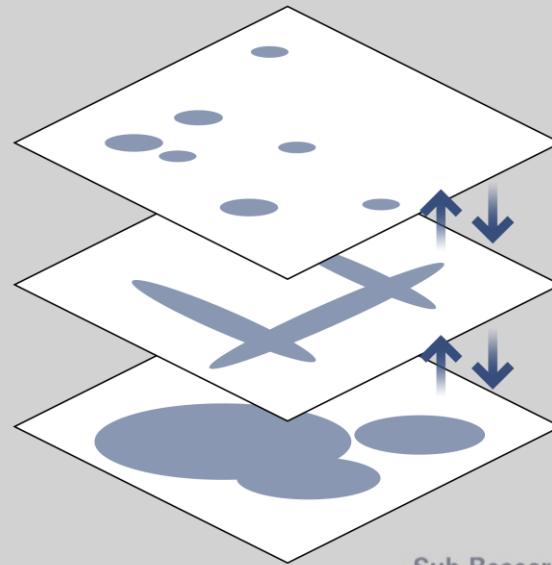
Methodology Framework



Sub-Research Question 1

Enhancing Socio-Ecological Resilience

What is the concept of socio-ecological resilience in the context of urban informal settlements?



Sub-Research Question 2

Addressing Urban Flooding Challenges

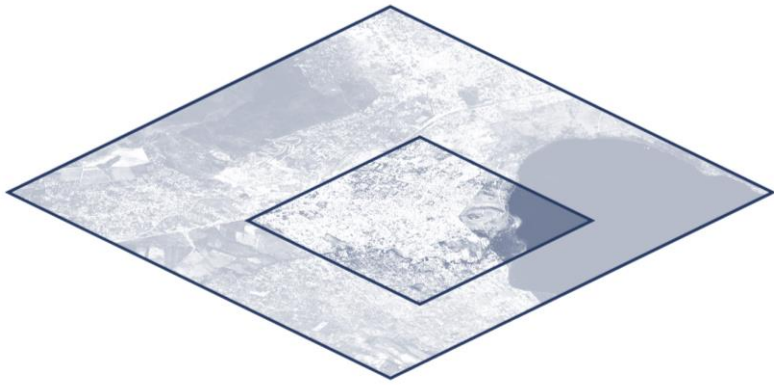
What are the underlying causes and spatial patterns of urban flooding in Rhonda and Kaptembwo?

Sub-Research Question 3

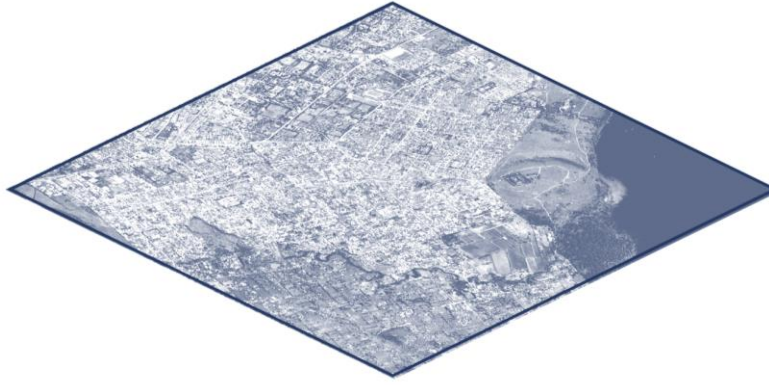
Empowering Community-Based Spatial Frameworks

What local knowledge and adaptive practices exist in the community regarding flooding and environmental management?

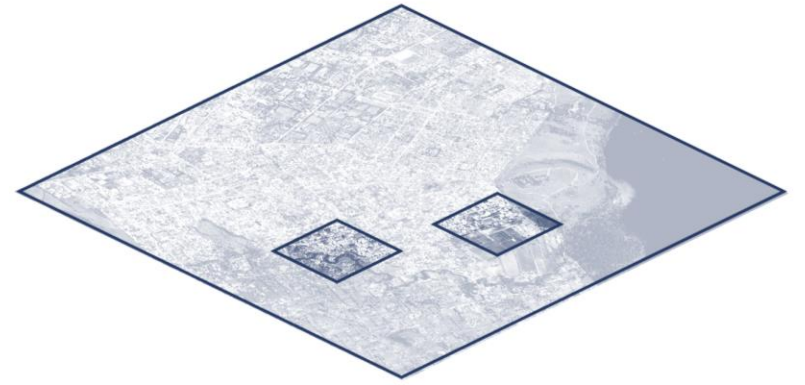
Project Structure



Nakuru county scale



Regional scale

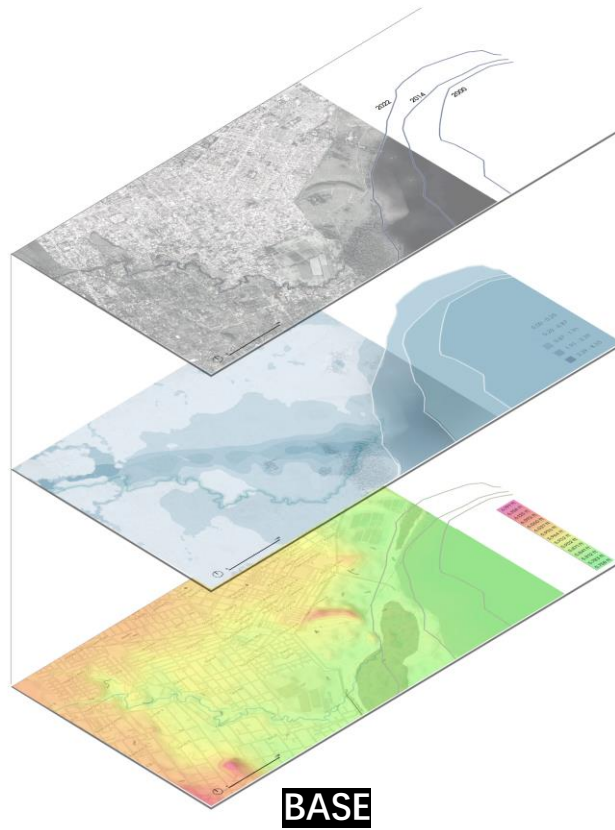


Local scale

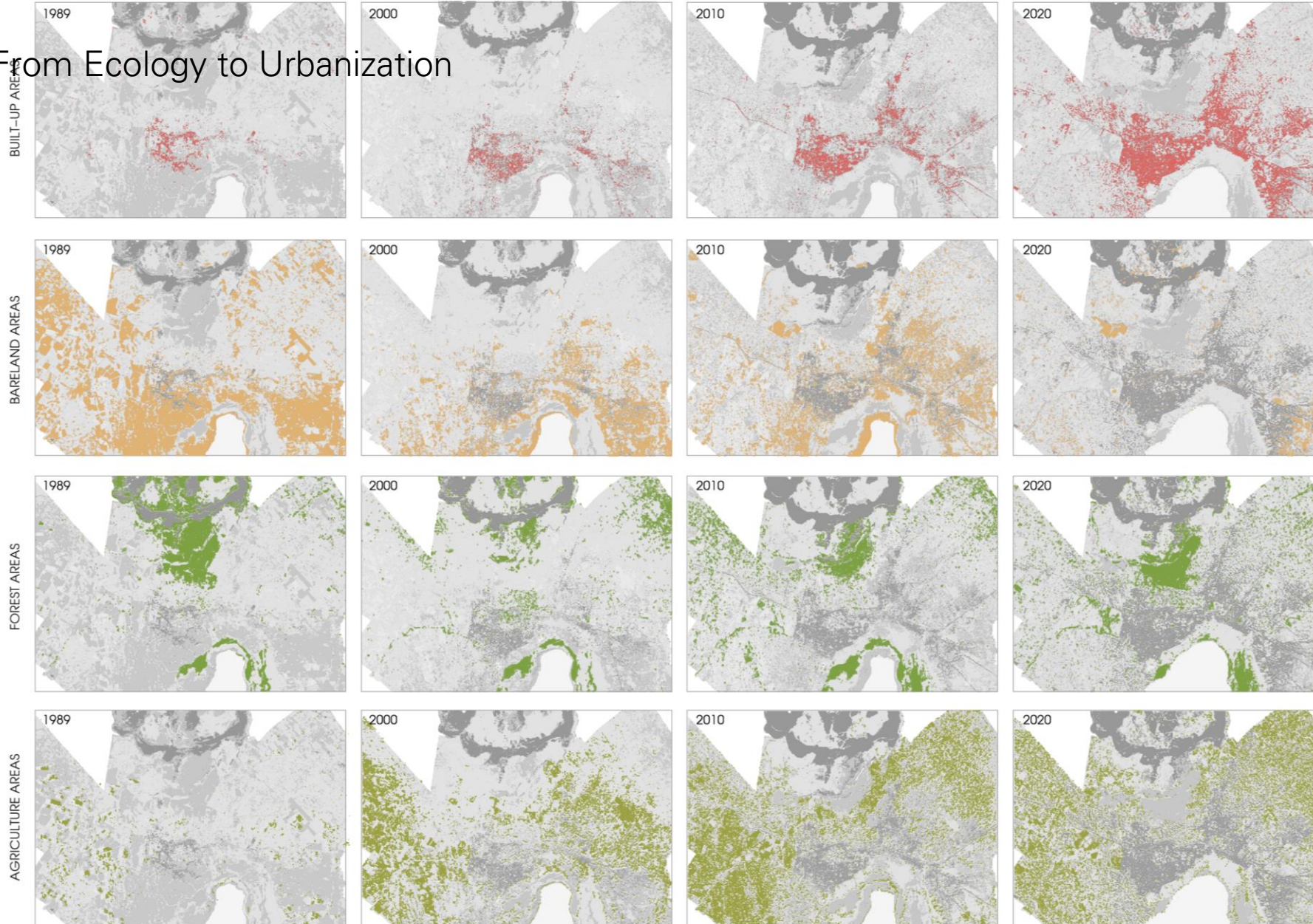
An aerial, black-and-white photograph of a coastal city. The city features a dense grid of streets and buildings. A large, dark body of water is visible on the right side of the image. The text "Context & Diagnosis" is overlaid in the center of the image.

Context & Diagnosis

3- Layered Analysis



From Ecology to Urbanization



URBAN AGRICULTURE

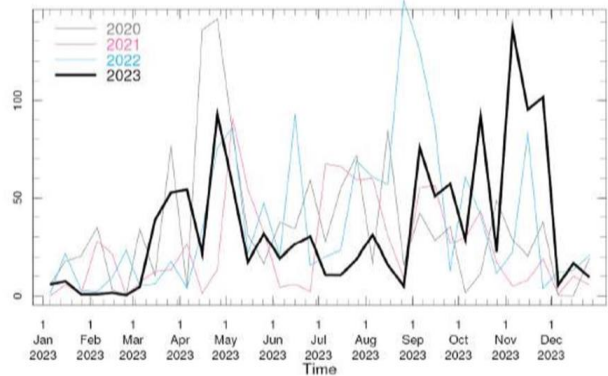
Photo credits: Author
Base map: qgis.com

Nakuru's urban expansion has not occurred in harmony with its ecological rhythms.

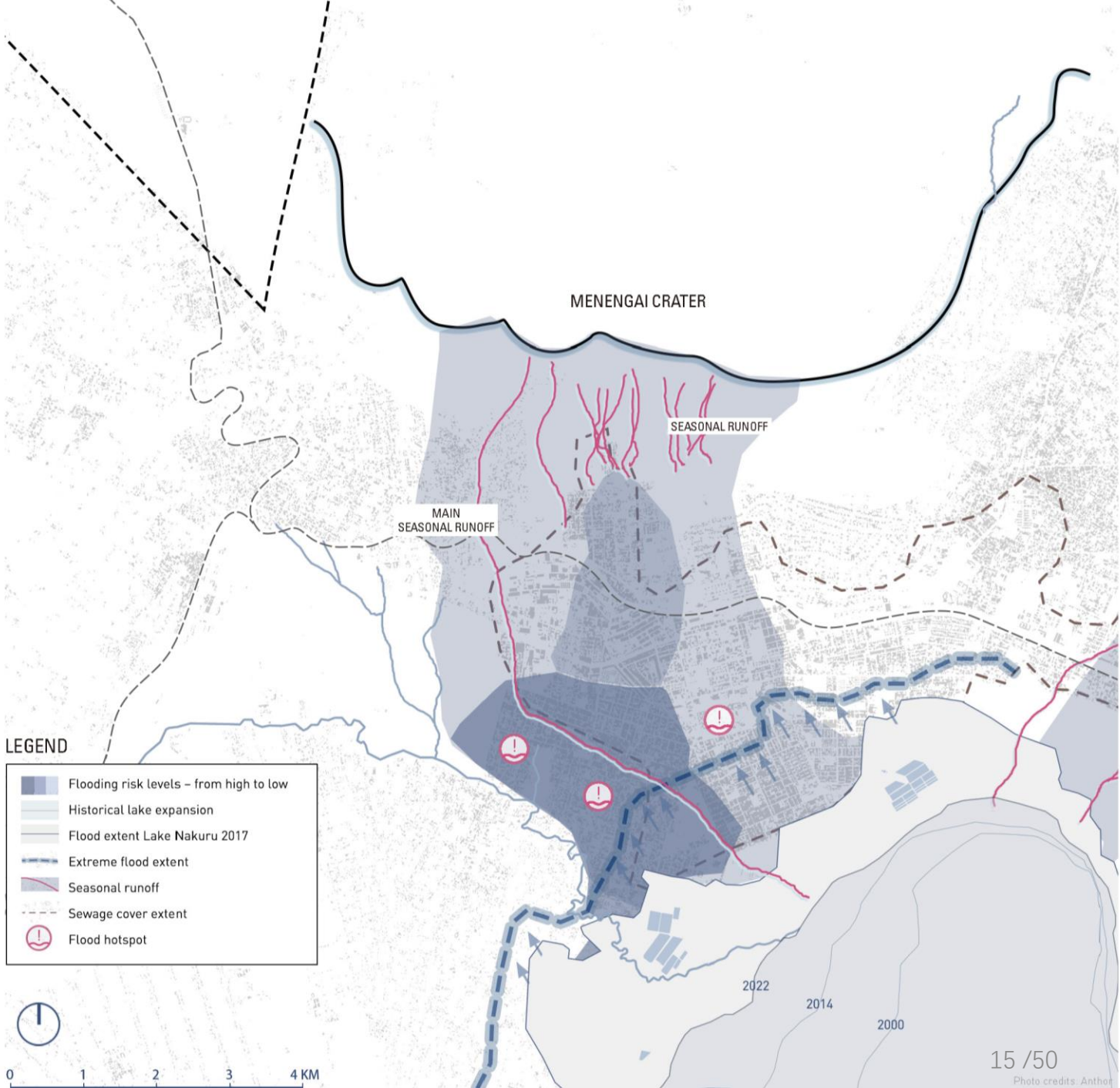
Eco-hydrological Context



Polluted Riverbanks in Nakuru
Photo credits: Google



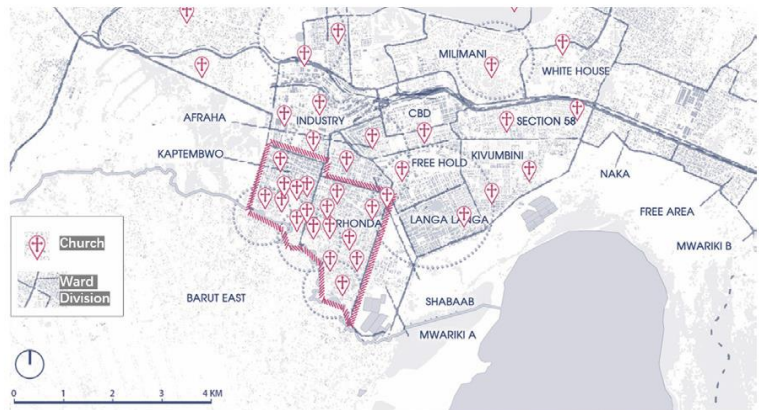
Changing Rainfall Intensities in Kenya's Main Rainy Seasons
Photo credits: Kenyan Meteorological Department, 2024



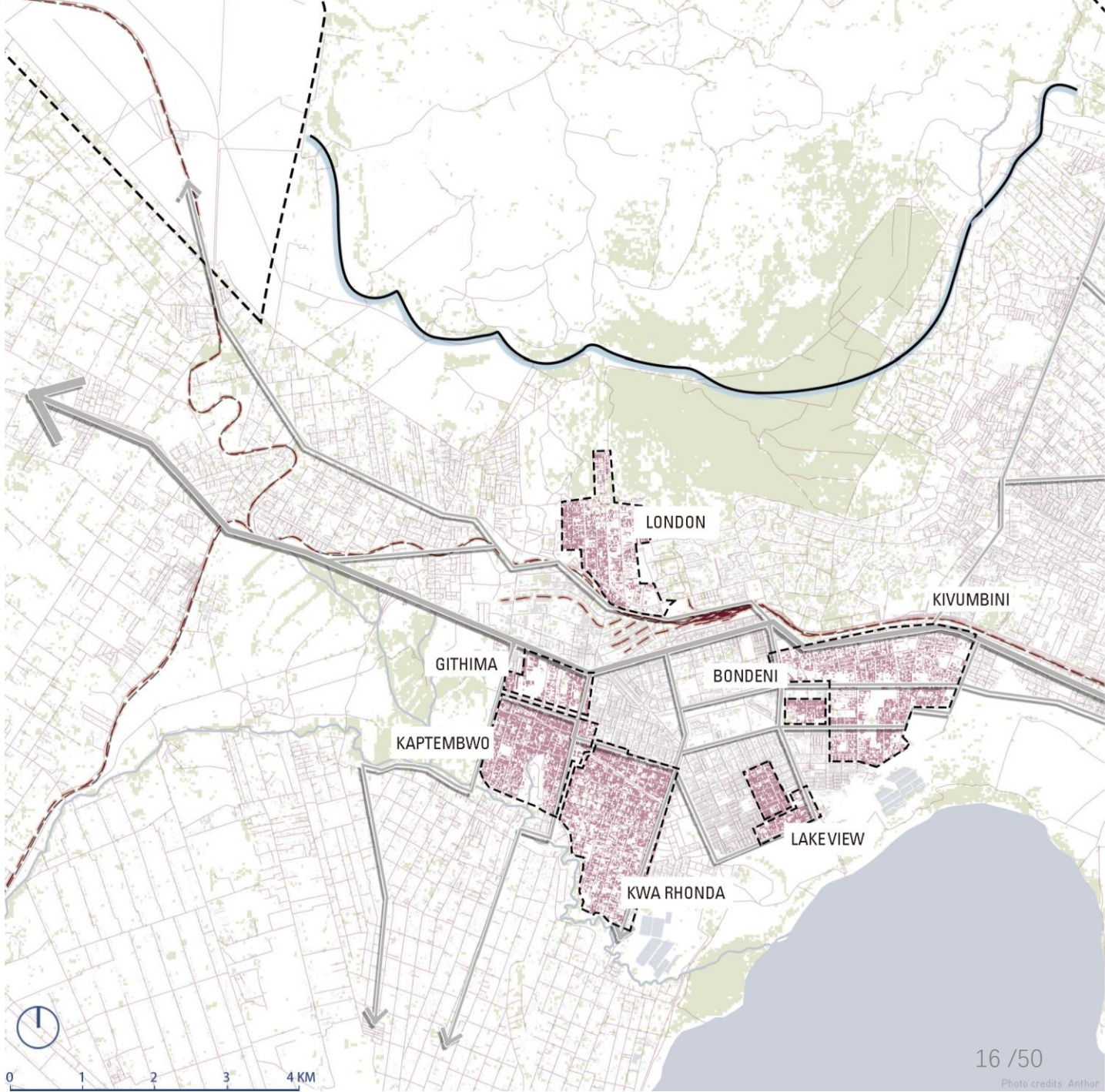
Social-Cultural Context

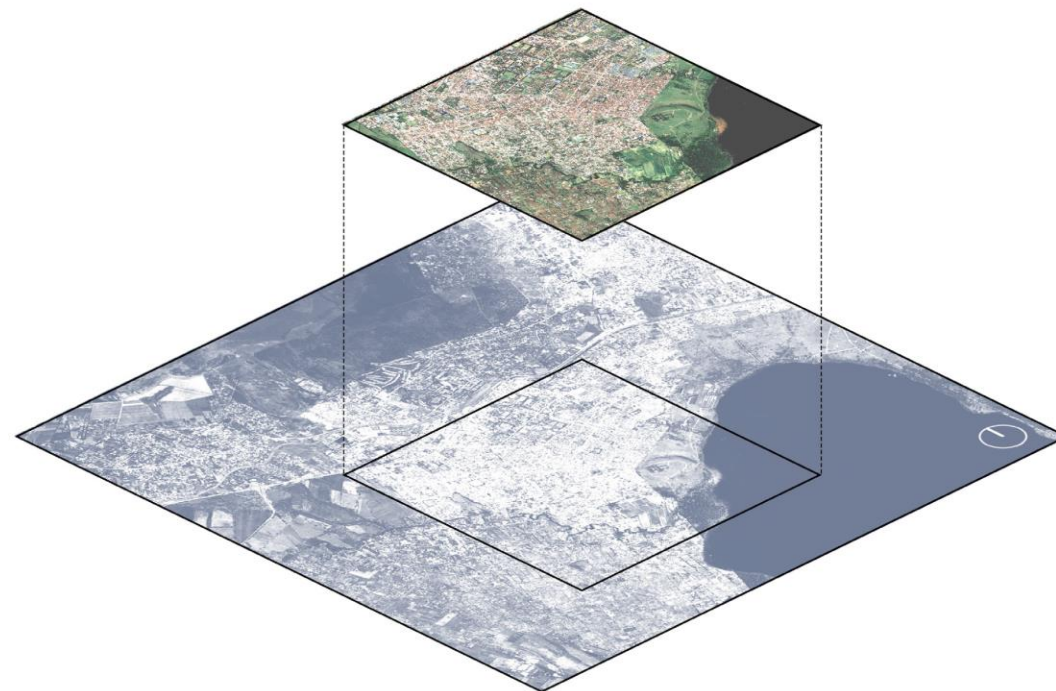


Nakuru's ethnic diversity
Photo credits: Google



Distribution of churches in Nakuru
Photo credits: Author



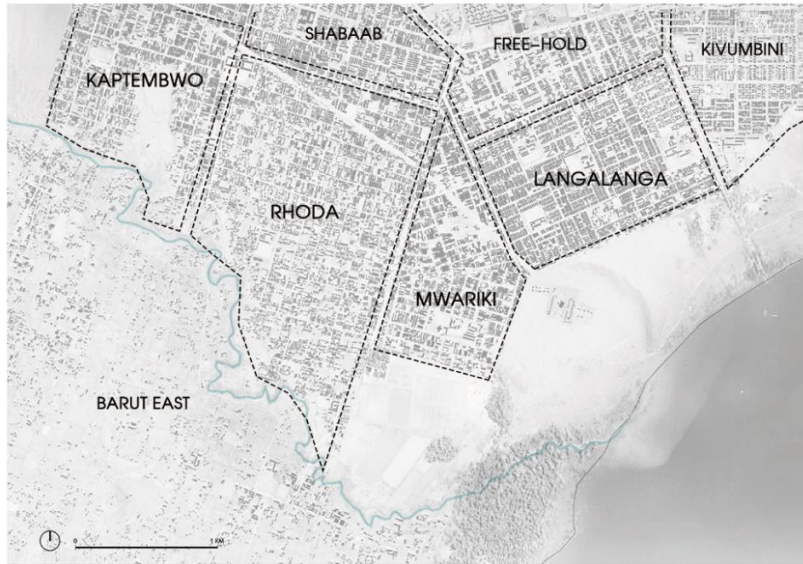


An aerial, black-and-white photograph of a coastal city. The city features a dense grid of streets and buildings. A large, dark body of water is visible on the right side of the image. The text "Design Hypothesis & Strategic Vision" is overlaid in white, centered horizontally.

Design Hypothesis & Strategic Vision

Urban Vulnerability Typologies

Residential Morphology Typology



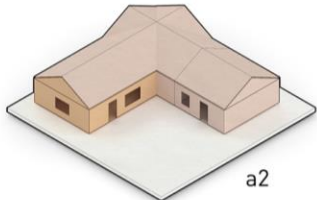
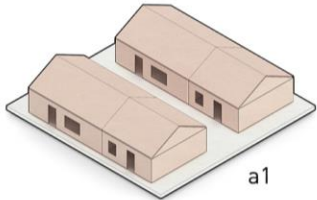
Open Space Ecological Typology



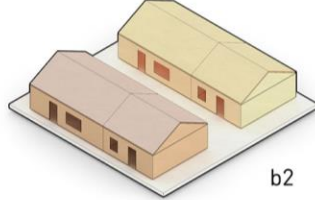
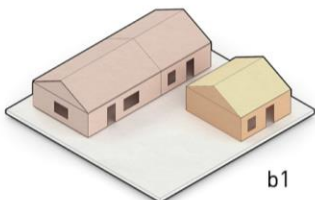
Photo credits: Author

Residential Morphology Typology

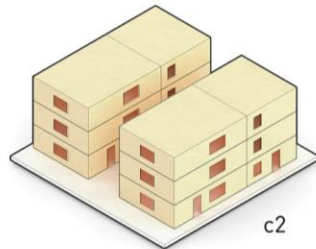
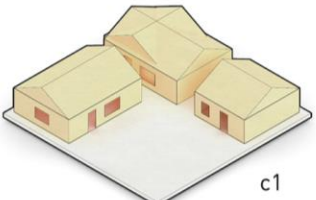
INFORMAL SETTLEMENTS



SEMI-FORMAL SETTLEMENTS

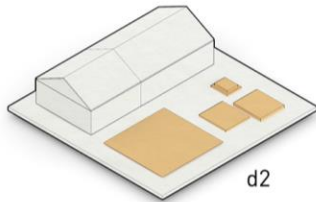
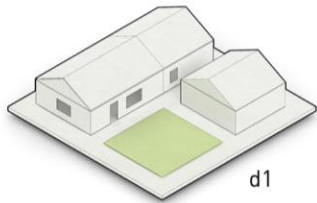


FORMAL SETTLEMENTS

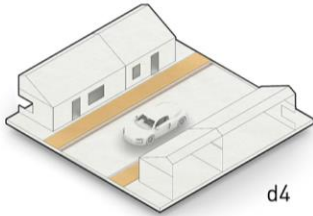
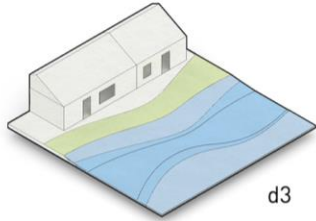


Open Space Ecological Typology

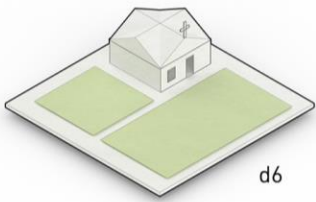
SMALL OPEN SPACES



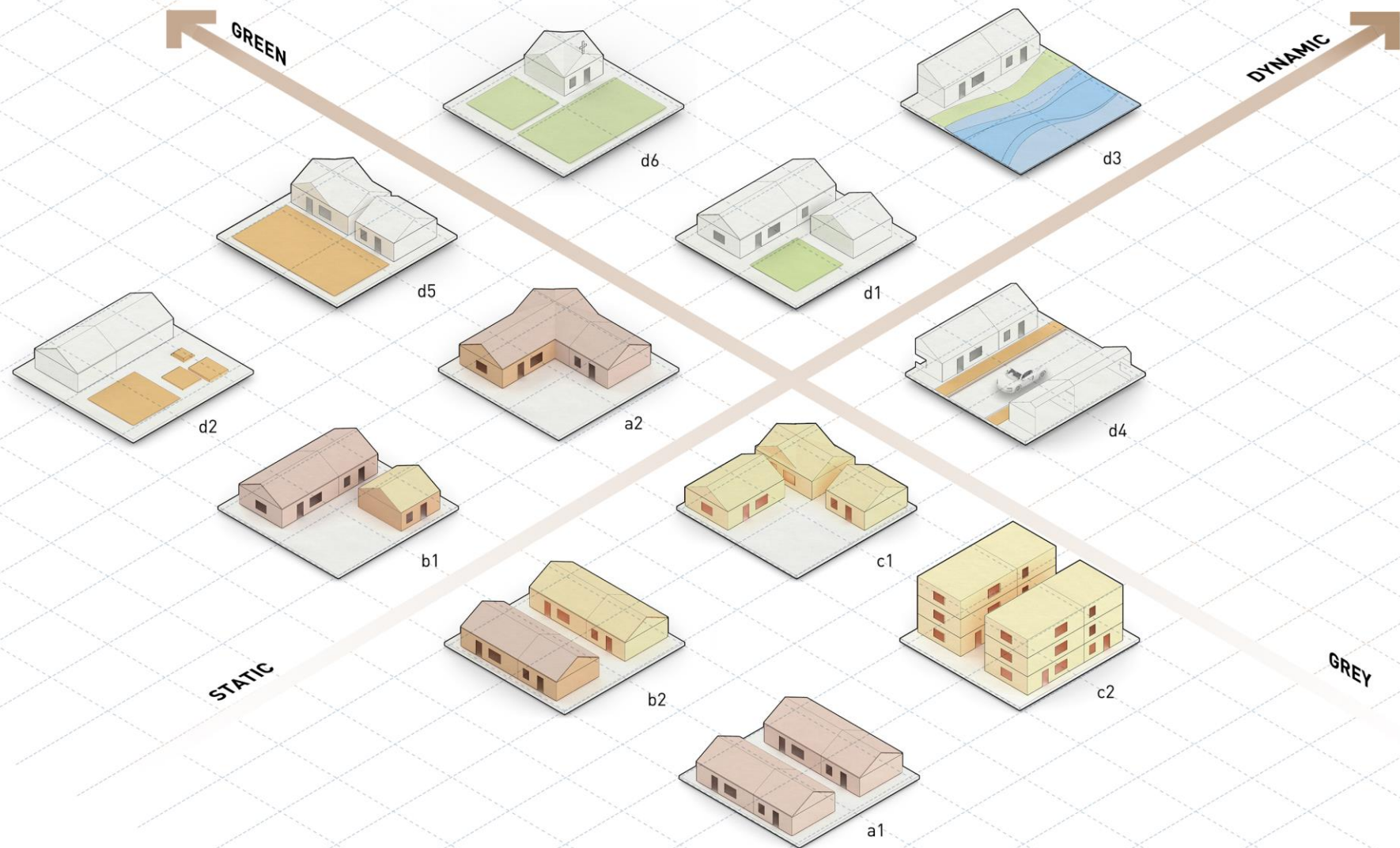
MEDIUM OPEN SPACES



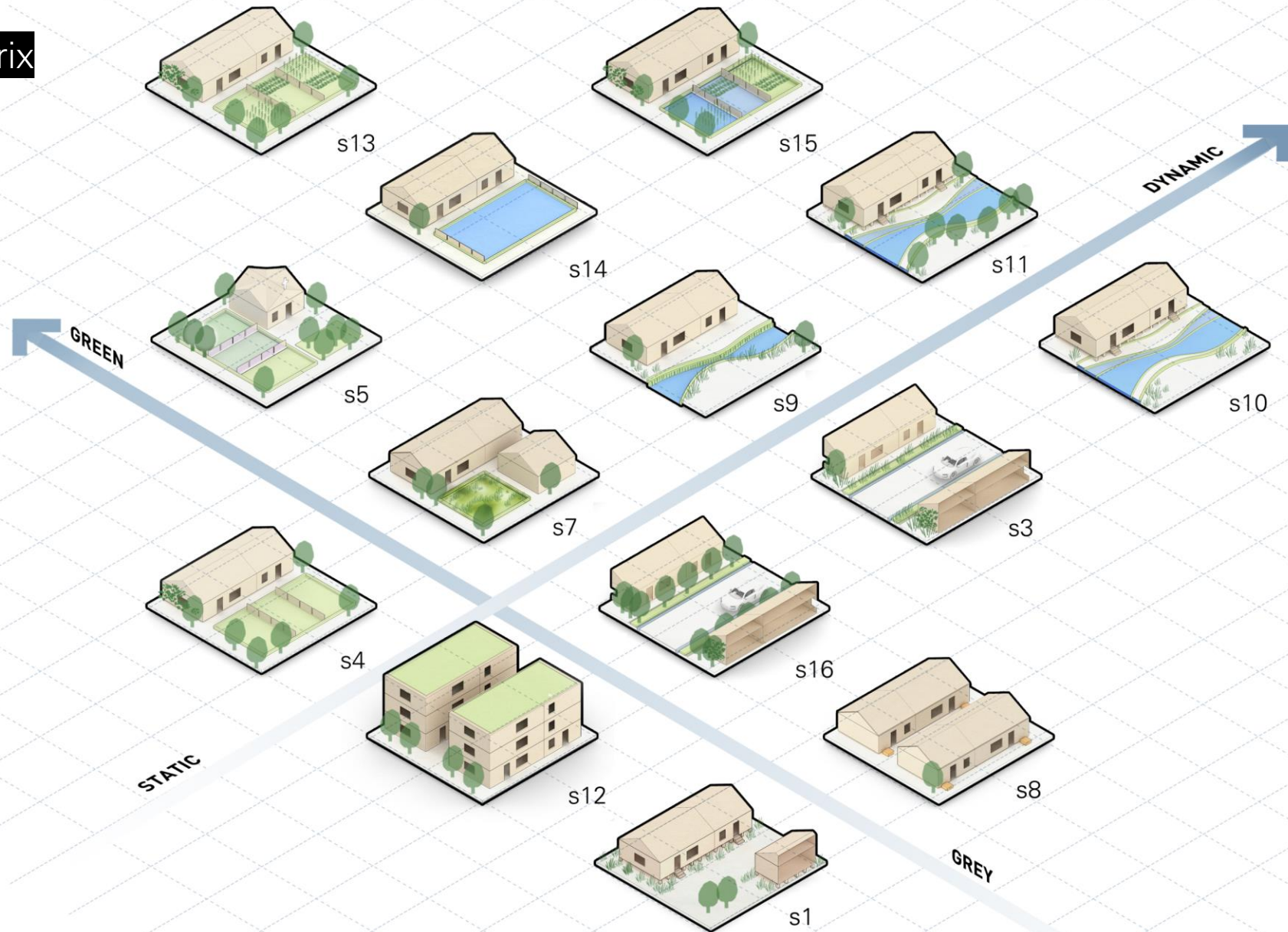
LARGE OPEN SPACES

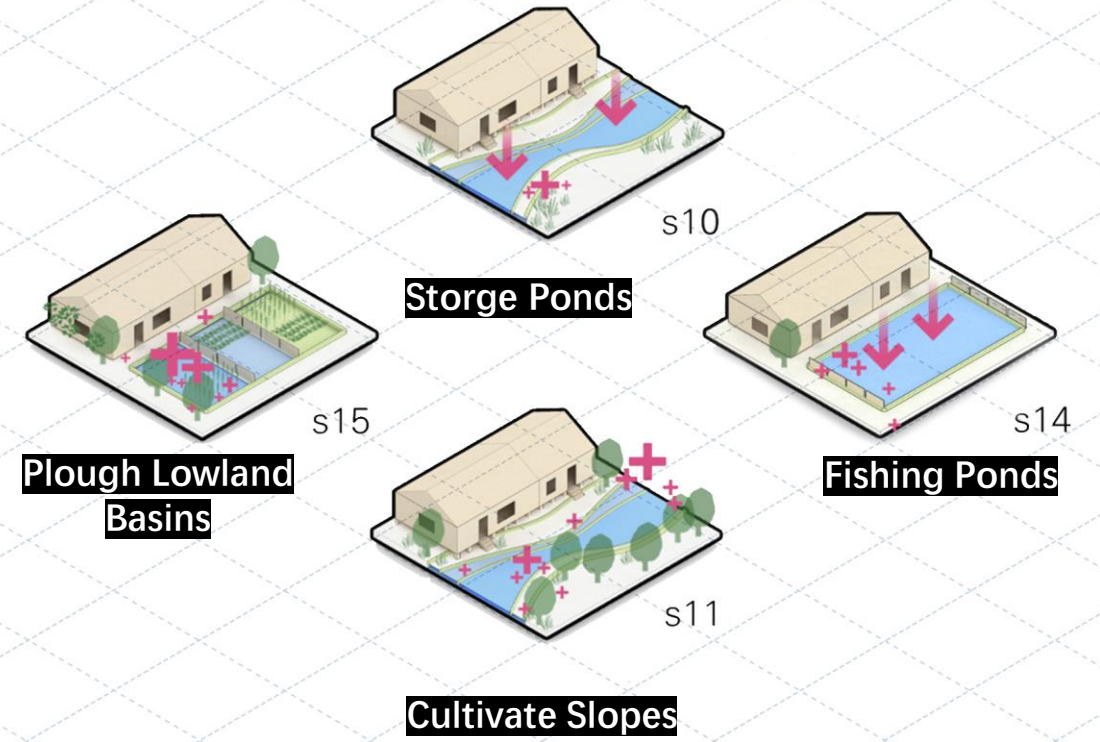
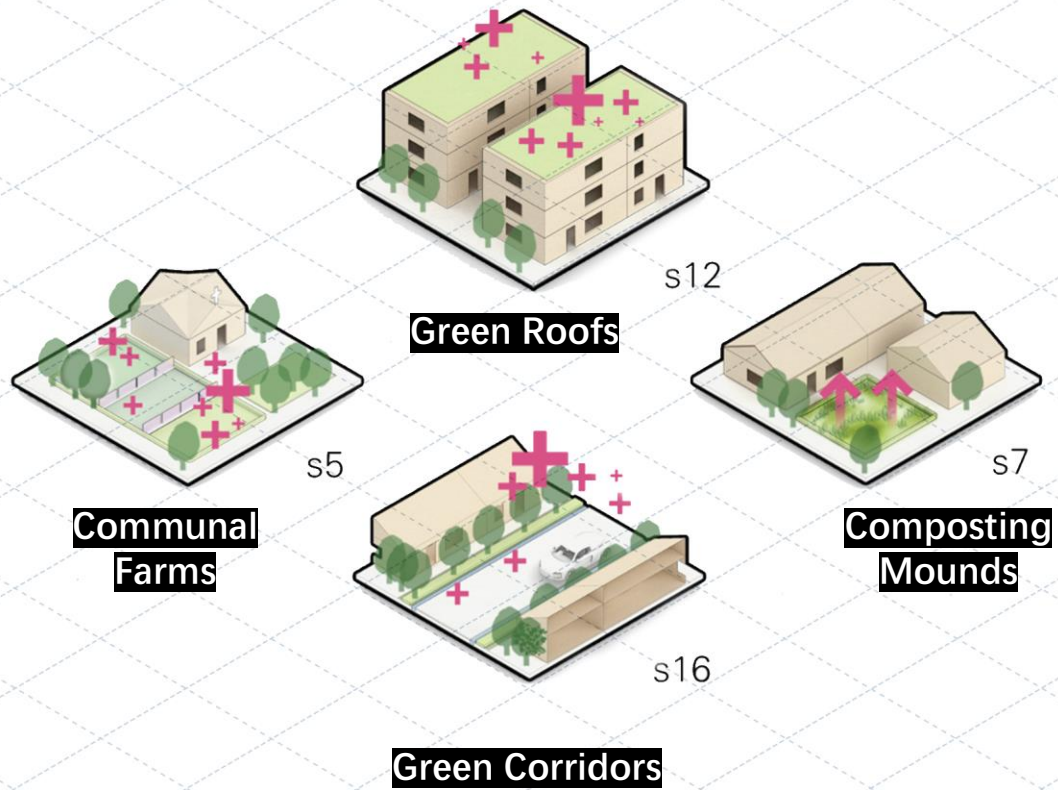


Typological Matrix

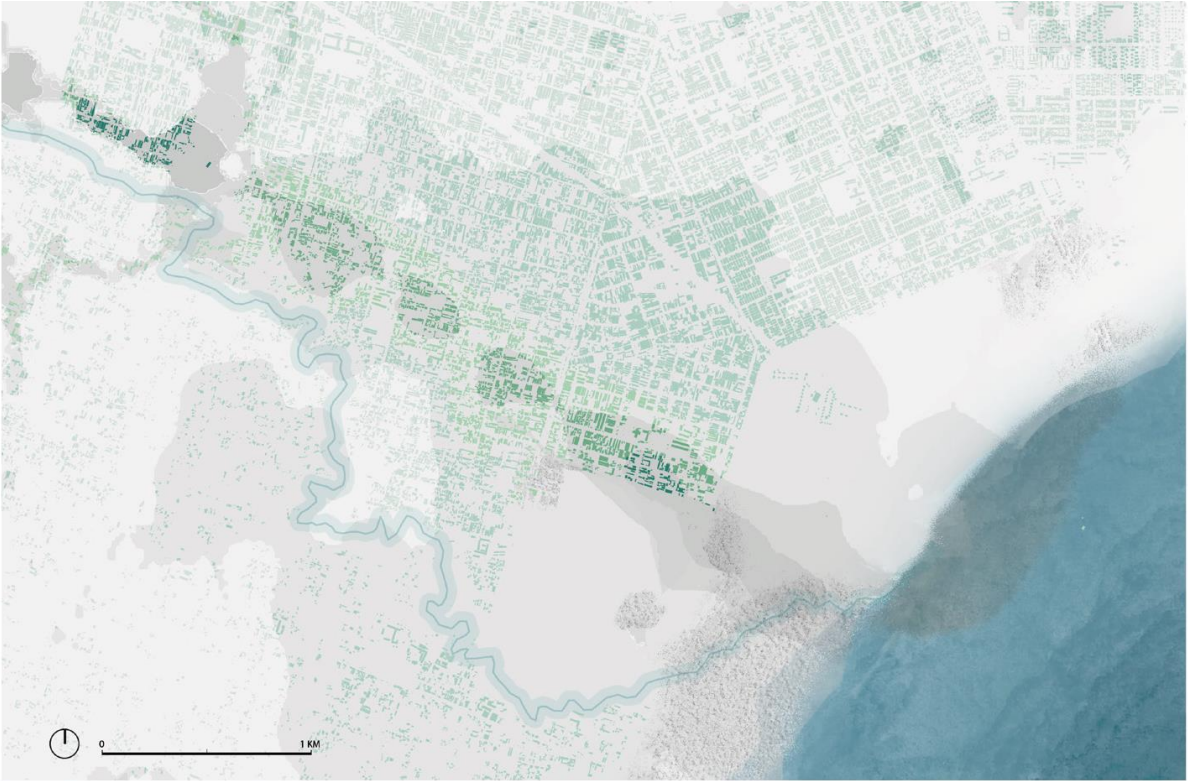


Typological Matrix





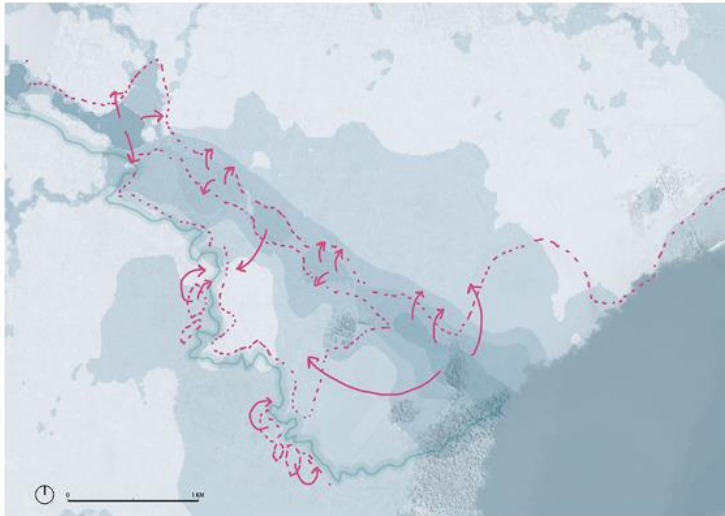
Flood Zoning Overview



	📍 Level	≡ Description	≡ Rerence Quantitative Thresholds
●	High	Strong flood resistance, low maintenance requirement	Raised foundation of at least 0.5 meters; floodwater retention time < 2 hours
●	Medium	Moderate protection, effective only with rapid drainage	Raised foundation of 0.2–0.5 meters; floodwater retention time 2–6 hours
●	Low	Highly vulnerable, requires extensive maintenance	No significant elevation of foundation or floodwater retention time > 6 hours

Flood Vulnerability Map
Photo credits: Author

BASE LAYER



Reshaping the terrain



Dry seasons



Rainy season

Drawn by author

NETWORK LAYER



Hybrid Embankment System



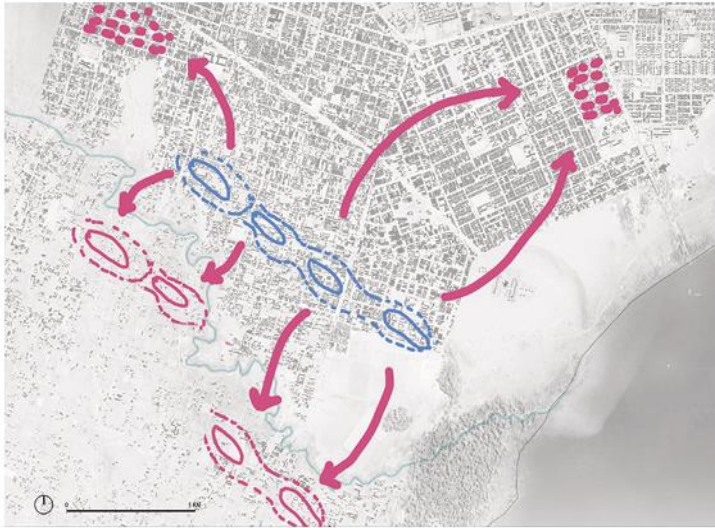
Restructured Mobility Network



Green Corridor Network

Drawn by author

OCCUPATION LAYER



Planned Resettlement

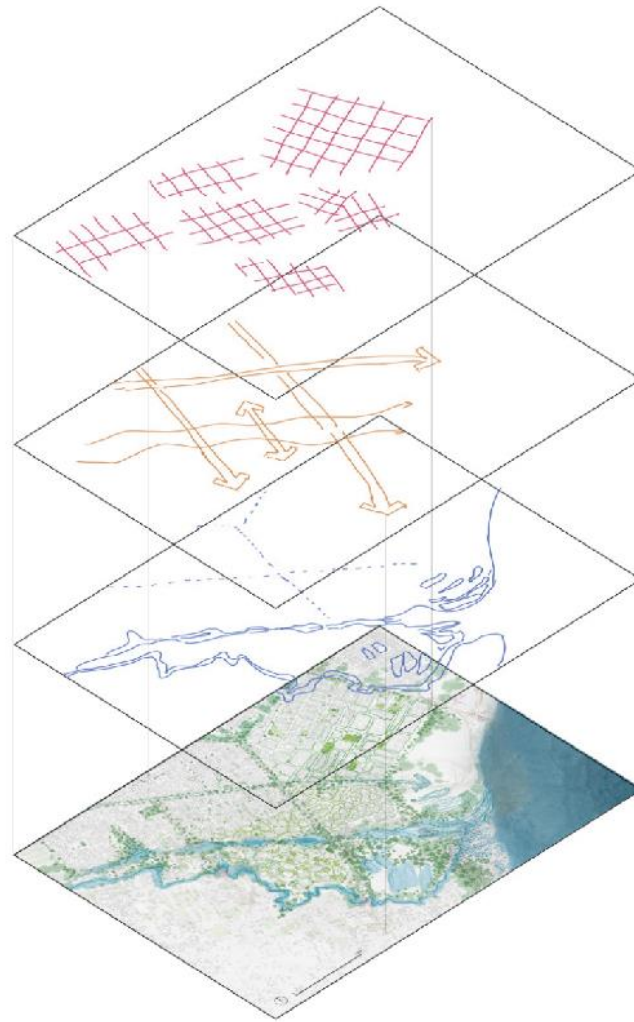


**Water-Integrated
Productive Landscape**















Layered Urban Agriculture System

Drawn by author



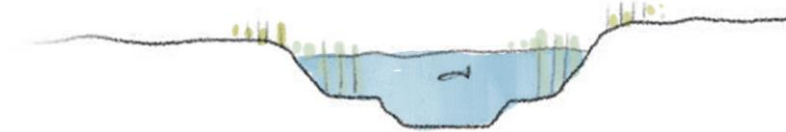
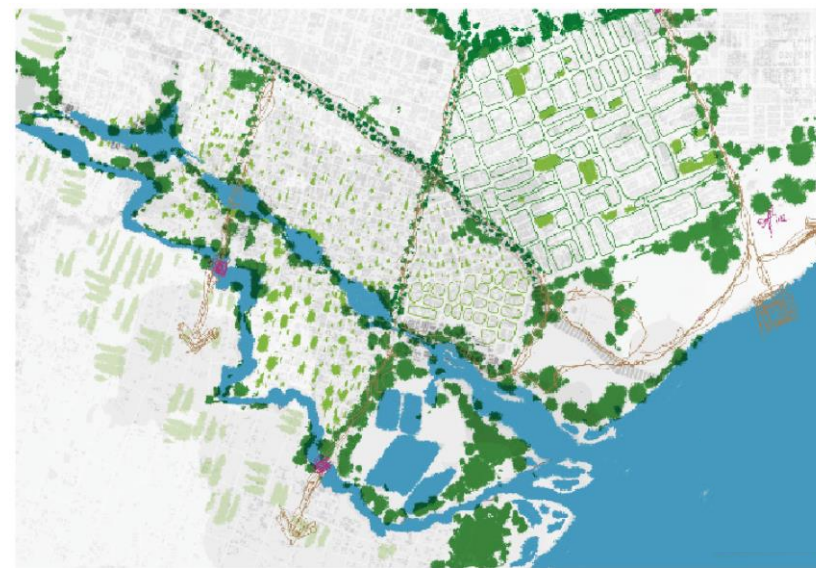
Vision



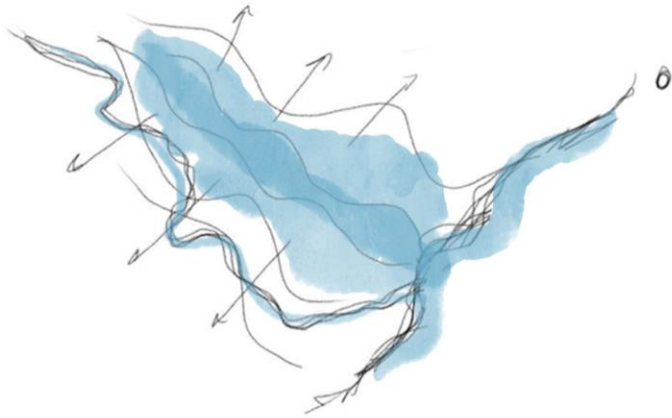
- | | | | |
|------------------|---|-------------------|---|
| Green corridors |  | Food Gardens |  |
| Plough Basins |  | Rain Gardens |  |
| Green Roofs |  | Composting Mounds |  |
| Vertical Farming |  | Communal Farms |  |
| Ecological Bank |  | Assemble Farms |  |
| Fishing Ponds |  | Storage Ponds |  |



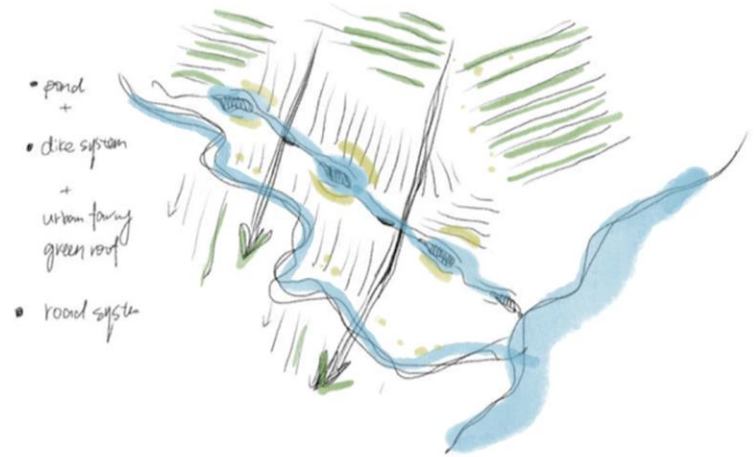
Vision in Dry and Wet Seasons



Phasing



Present



0-5 years



5-20 years

An aerial photograph of a coastal region. The left side shows a dense urban grid with numerous small, rectangular blocks. A winding waterway or canal cuts through the city. To the right, the city gives way to a more open area with larger, rectangular plots, possibly agricultural or industrial. The rightmost edge of the image is dominated by a dark, calm body of water, likely a bay or harbor. The overall tone is grayscale, with varying shades of gray representing different land uses and textures.

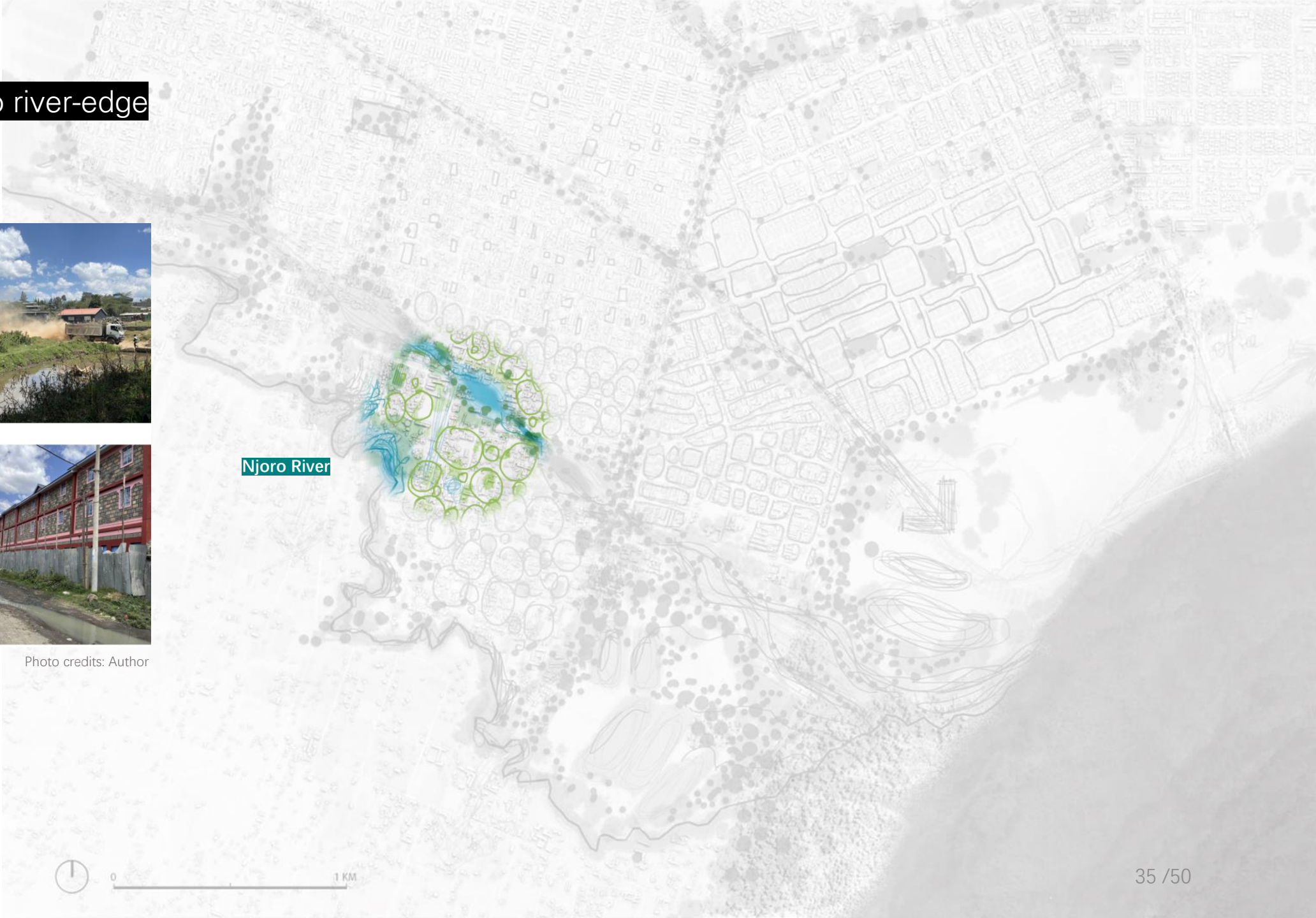
Design Elaboration: Two Pilot Sites



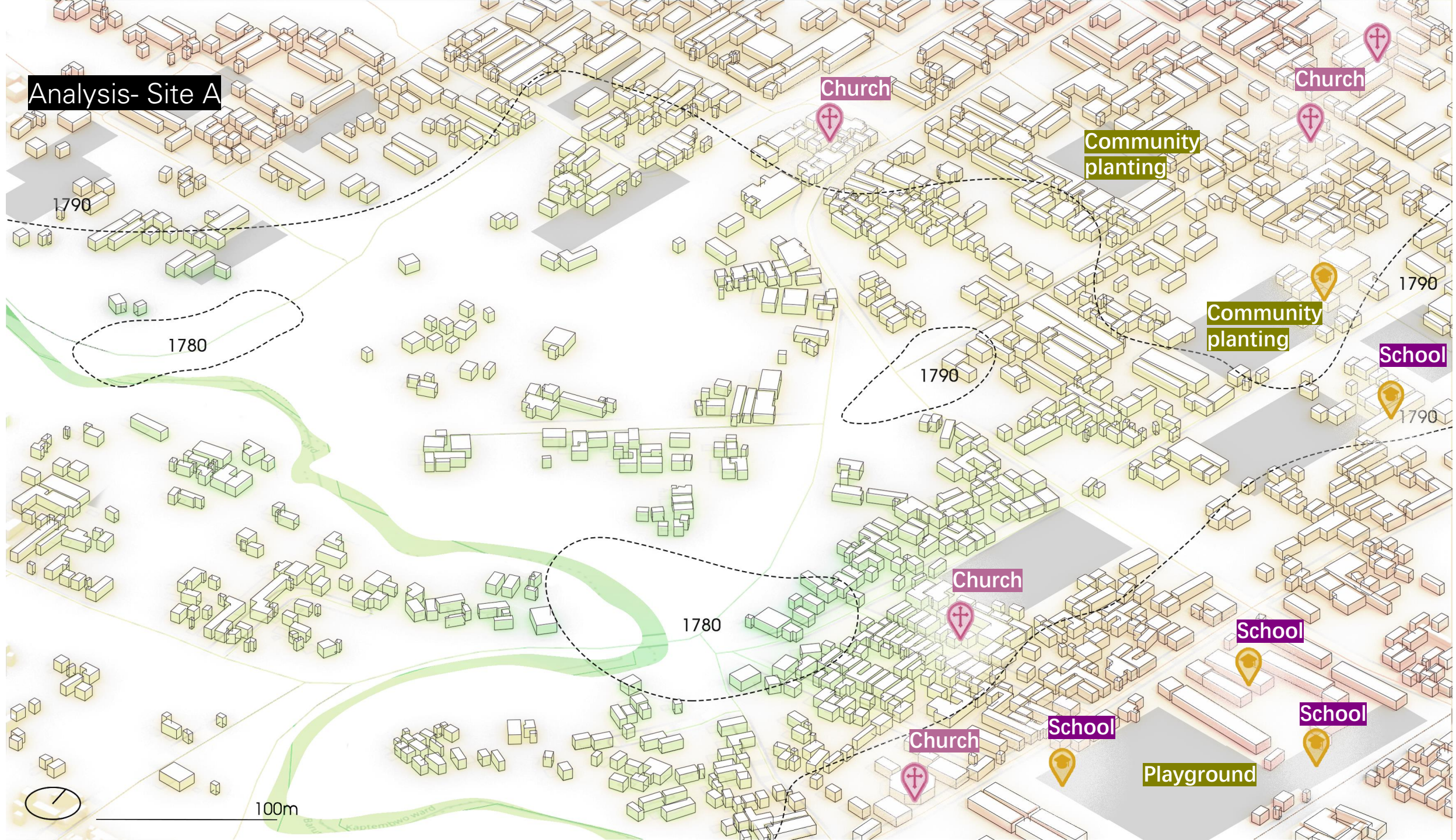
Site A - Kaptembwo river-edge

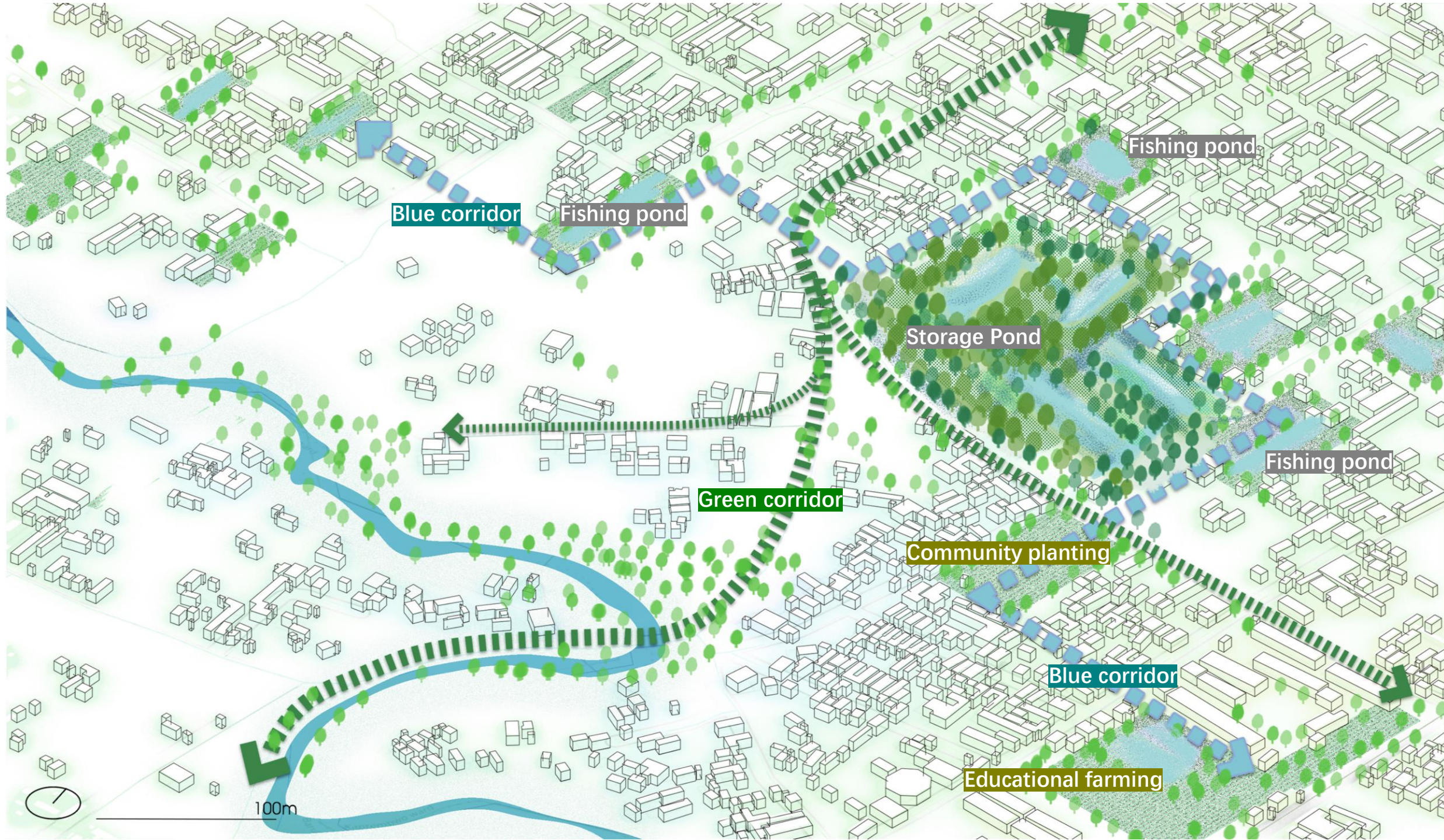


Photo credits: Author

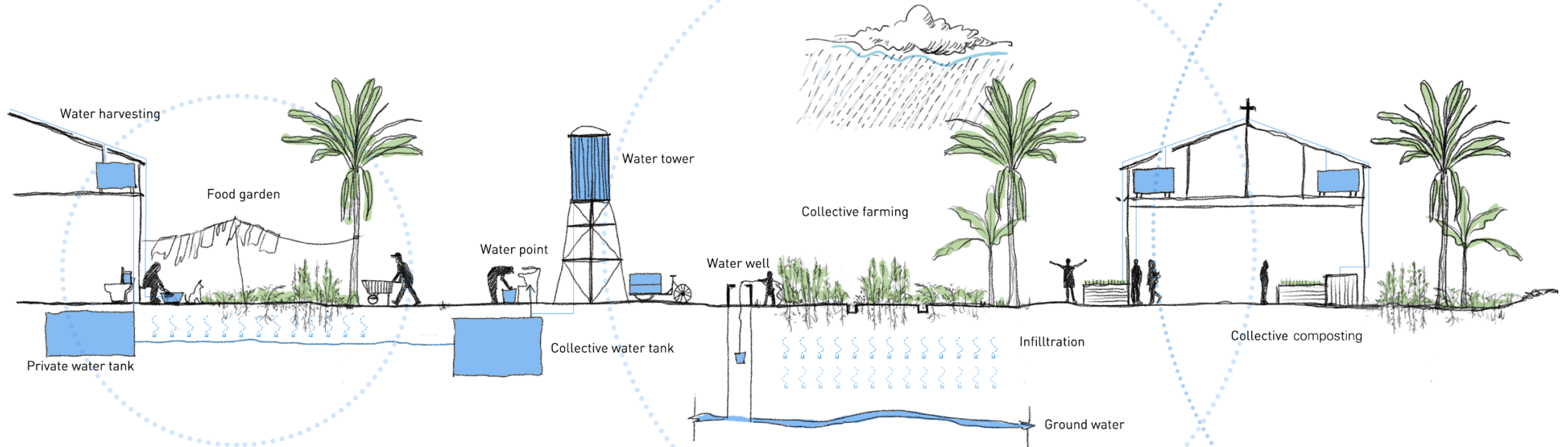


Analysis- Site A

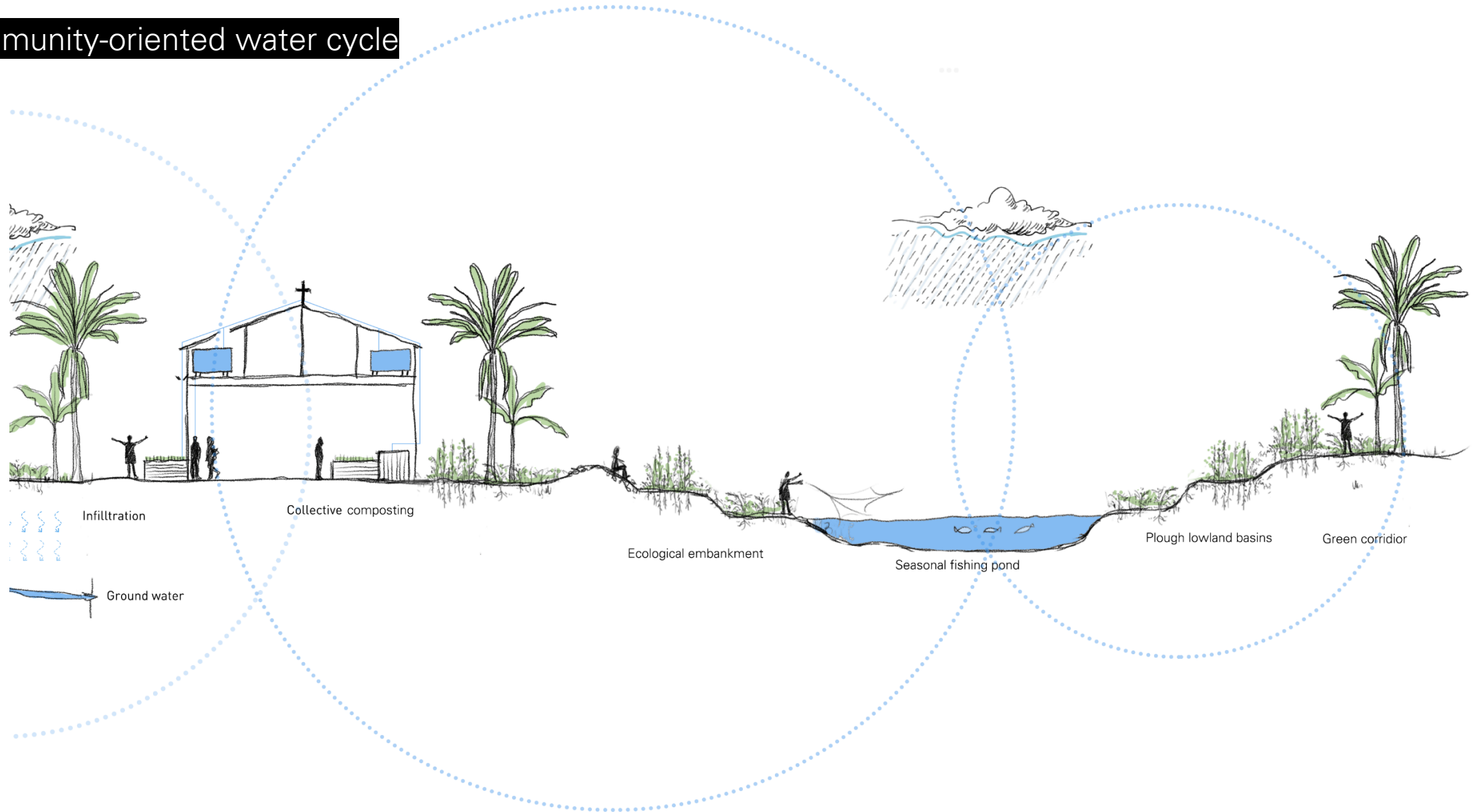




Community-oriented water cycle

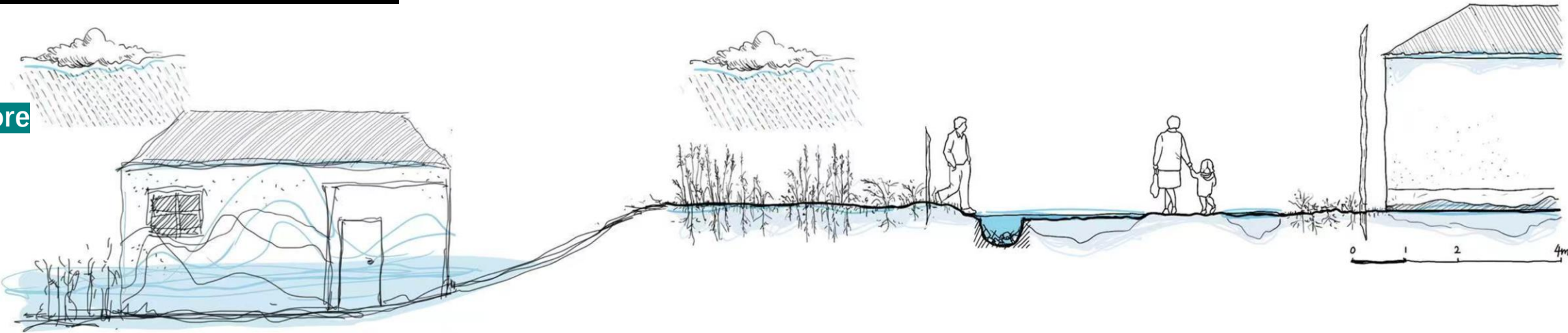


Community-oriented water cycle

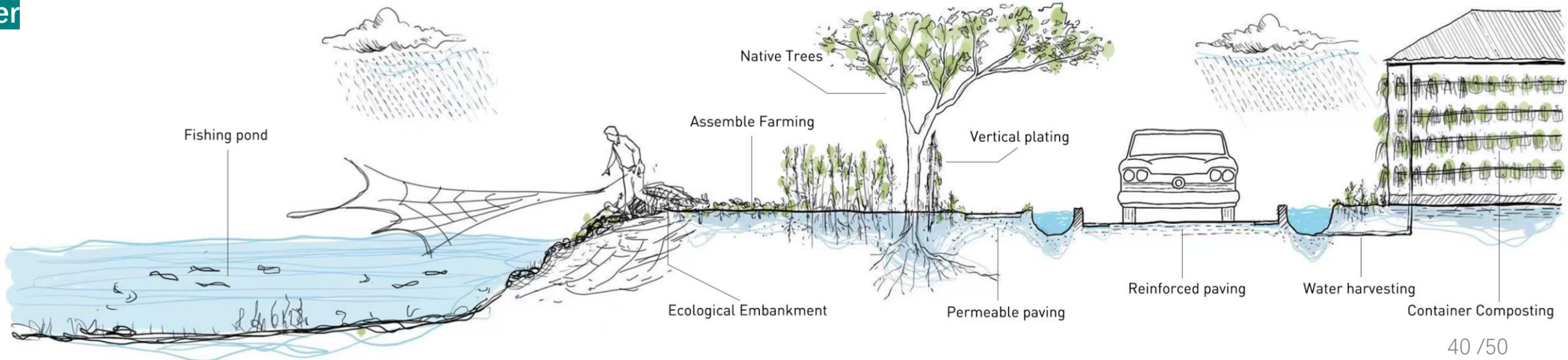


Wet Season – Before and After

Before

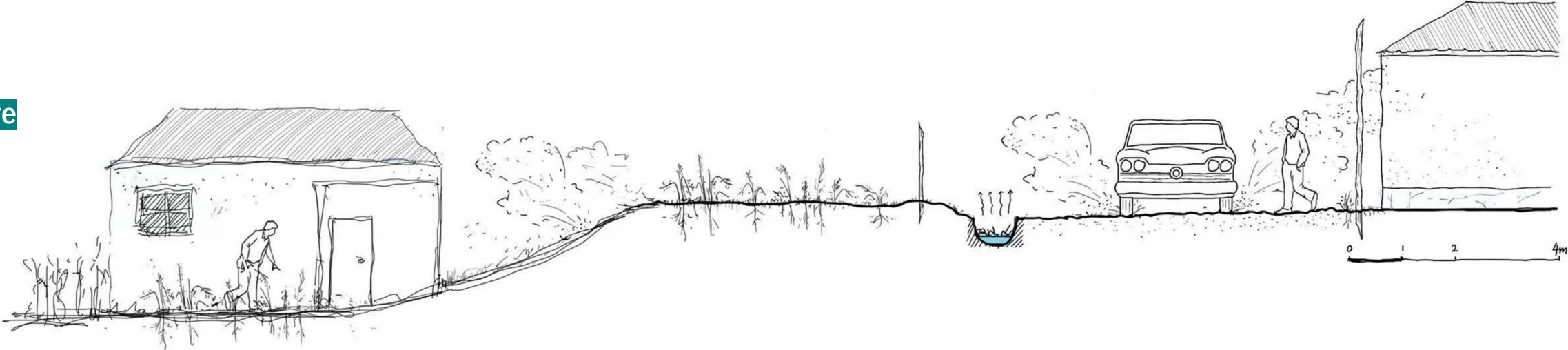


After

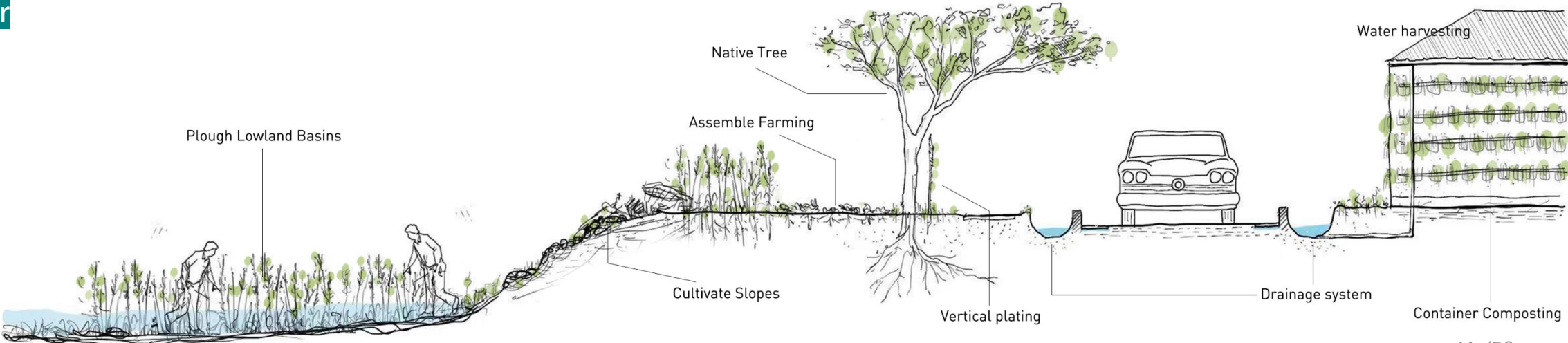


Dry Season – Before and After

Before



After



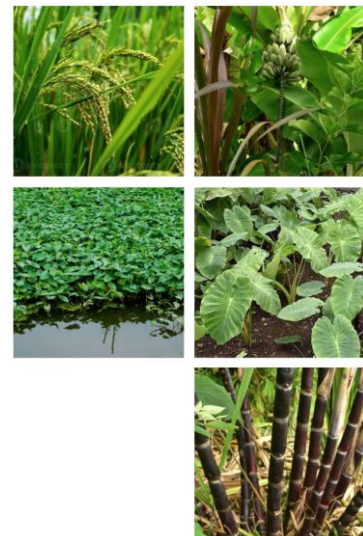
Planting Design - 1

Productive Urban Agriculture

Common Local Crops

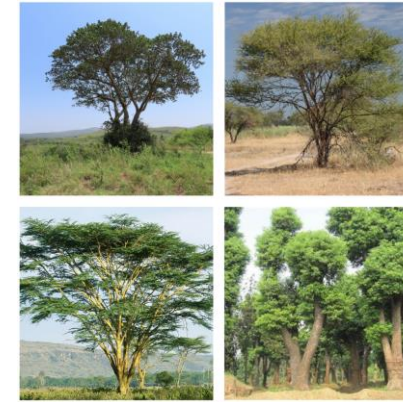


Water-Tolerant Local Crops



Planting Design - 2

Three-Tiered Native Planting



Shrubs



Herbs



Tables drawn
by the author





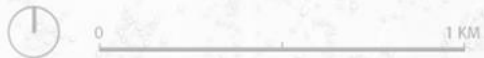
Site B - Rhonda lake-edge



Photo credits: Author



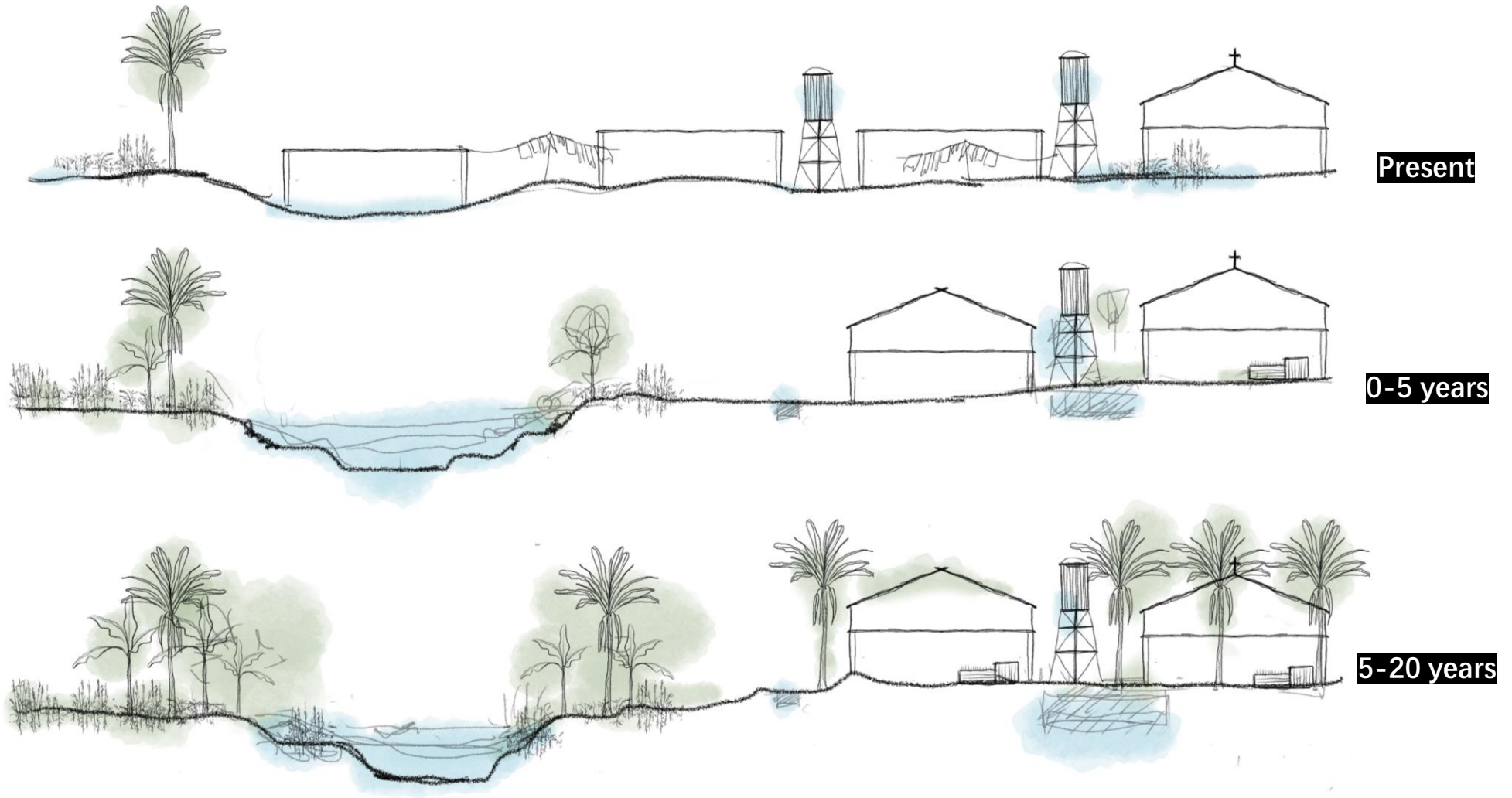
Lake Nakuru







Phasing



An aerial, black-and-white photograph of a coastal city. The city features a dense grid of streets and buildings, with a prominent river or canal winding through the urban landscape. The city is situated next to a large body of water, which occupies the right side of the image. The text "Evaluation & Reflection" is overlaid in the center of the image.

Evaluation & Reflection

What did I learn?

What are the limits?

Did I meet my goals?

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