BEYOND CLEANSING

Transitioning Towards Socio-Ecological Resilience in the Ganges River Basin through an Adaptive Spatial Planning Model

Jahnavi Bhatt

P5 Presentation | 03-07-2020

Tutors:
Dr. D. A. Sepulveda Carmona
Dr. ir. Claudiu Forgaci

Delegate of Board of Examiner:
Dr.ir. E. Mlecnik

MSc. in Architecture, Urbanism and Building Sciences,
Technische Universiteit Delft

PRESENTATION STRUCTURE

Introduction

Problem

Research Questions

Theories and Notions

Conceptual Framework

Strategic Interventions at Different Scales

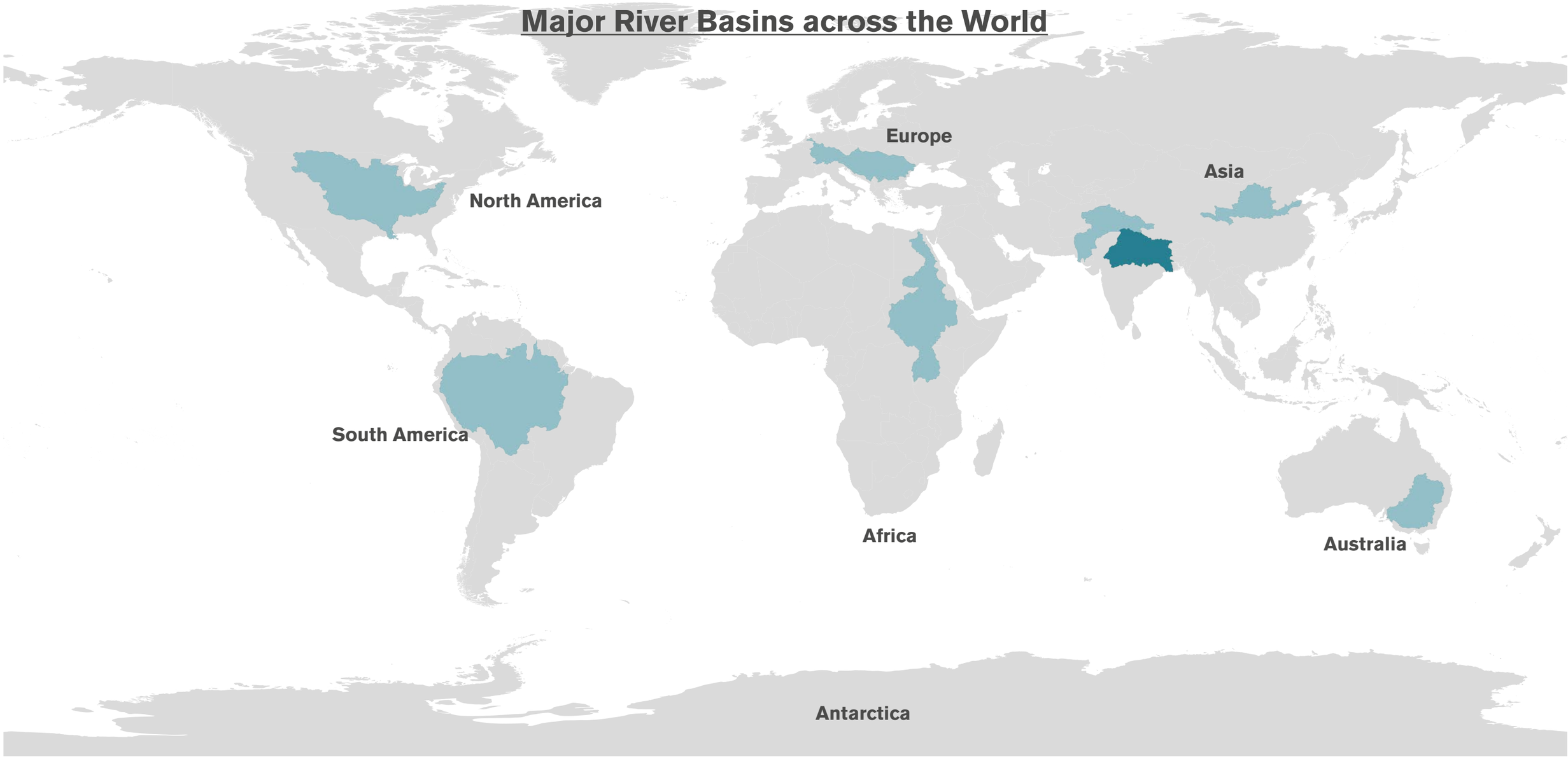
Adaptive Planning Pathways

Stakeholders Engagement

Scenarios

Conclusions

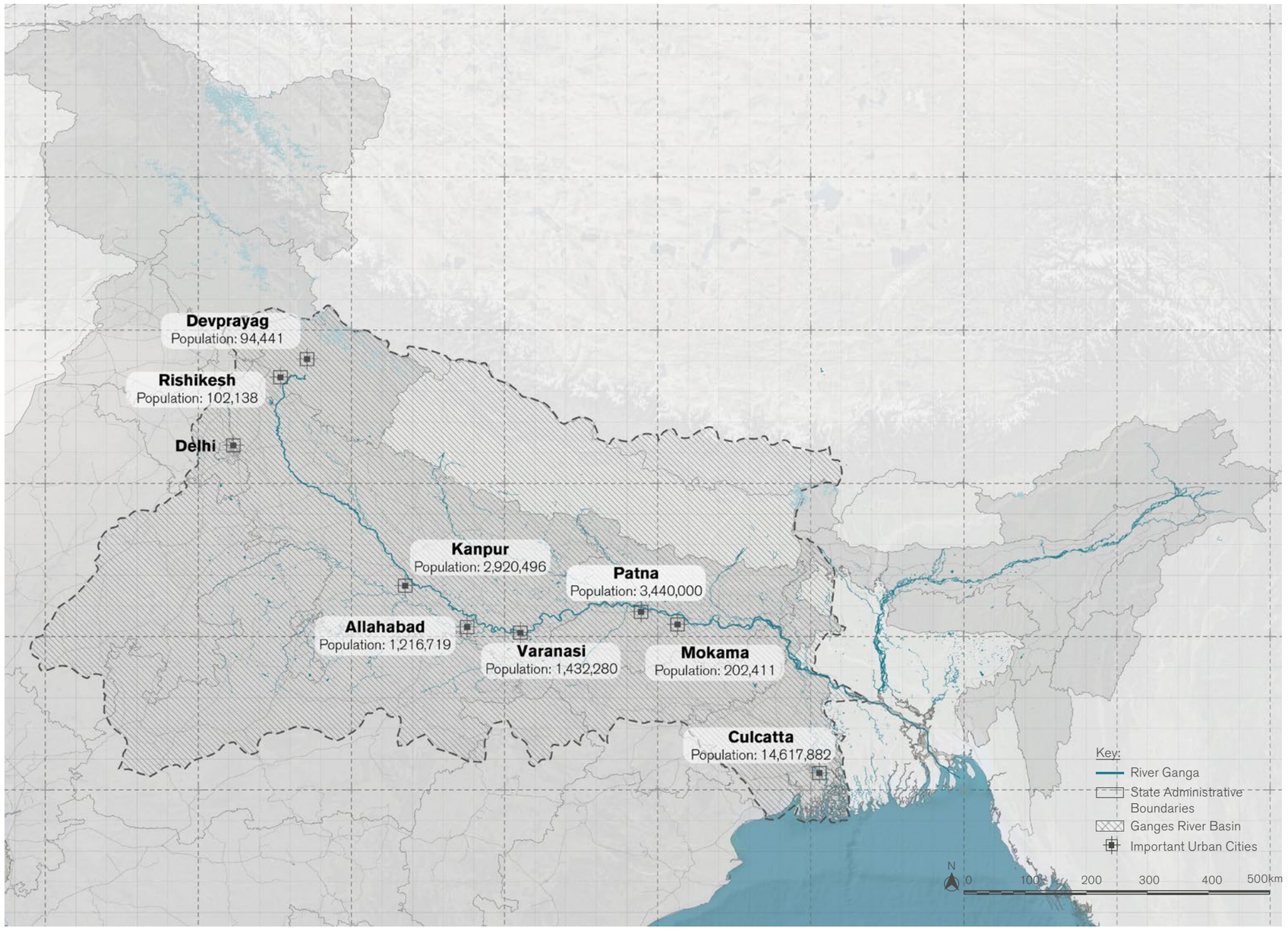
Major River Basins across the World



	Mississippi	Amazon	Nile	Rhine	Danube	Indus	Yellow	Murray-Darling	Ganges
									
Population	72,000,000	10,000,000	300,000,000	54,000,000	79,500,000	178,483,000	147,415,000	2,000,000	**407,466,000**
Area	3,202,230 km^2	**6,144,727 km^2**	3,254,555 km^2	185,260 km^2	801,463 km^2	1,081,718 km^2	944,970 km^2	1,059,000 km^2	1,016,124 km2
Density (p/km^2)	22.5 persons/km^2	1.6 persons/km^2	92 persons/km^2	291.5 persons/km^2	99 persons/km^2	165 persons/km^2	156 persons/km^2	1.8 persons/km^2	**401 persons/km2**

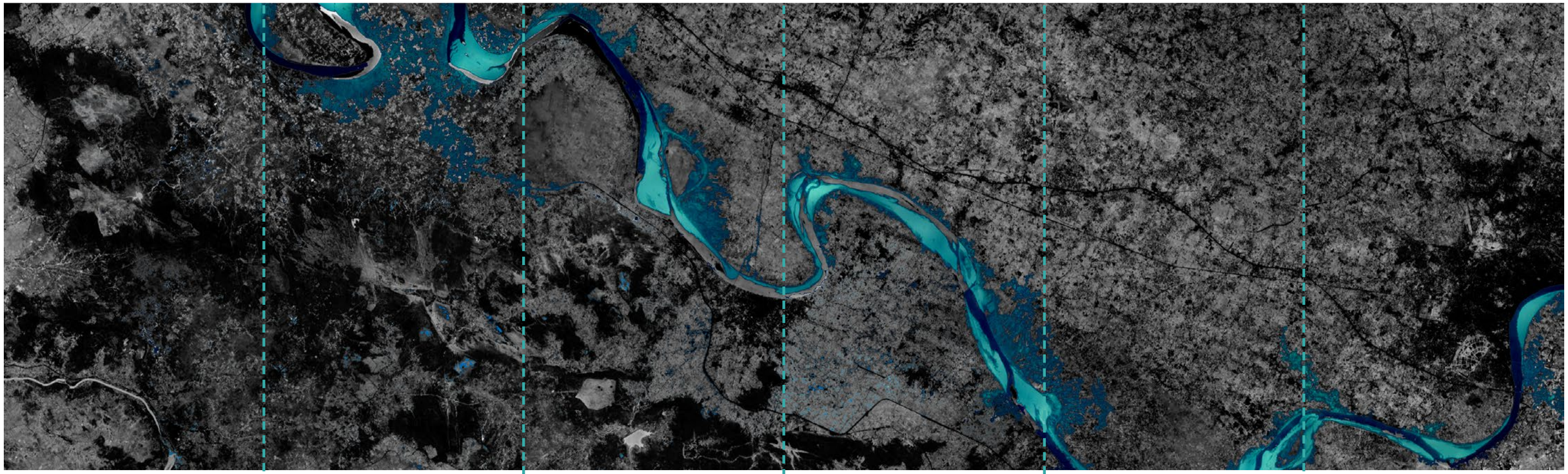
Source: Anthony Acciavatti, 2015

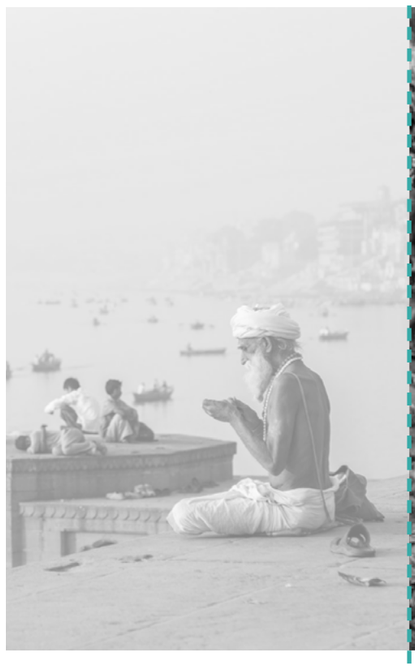
Ganges River Basin

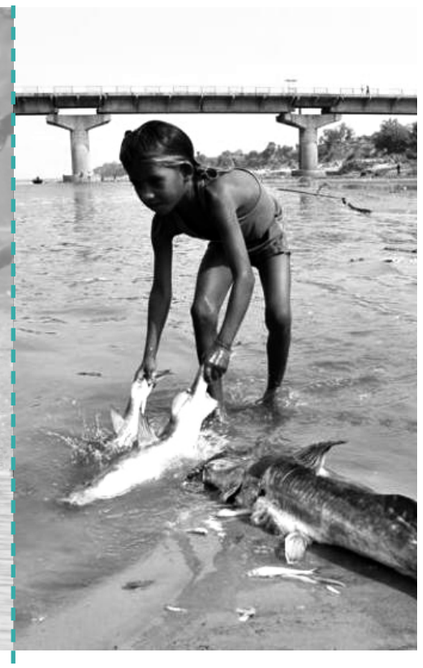


Source: Bhuvan, 2019

Ganges River Basin







Social

Economic

Environmental

Drivers of Change

Urbanization

Infrastructure Development

Climate Change

Drivers of Change: Urbanization

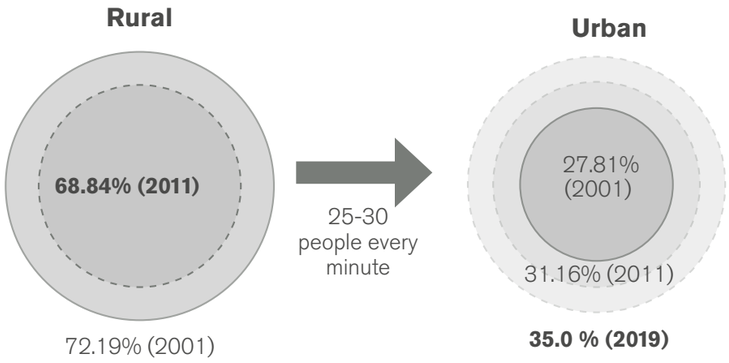
Urbanization

Infrastructure Development

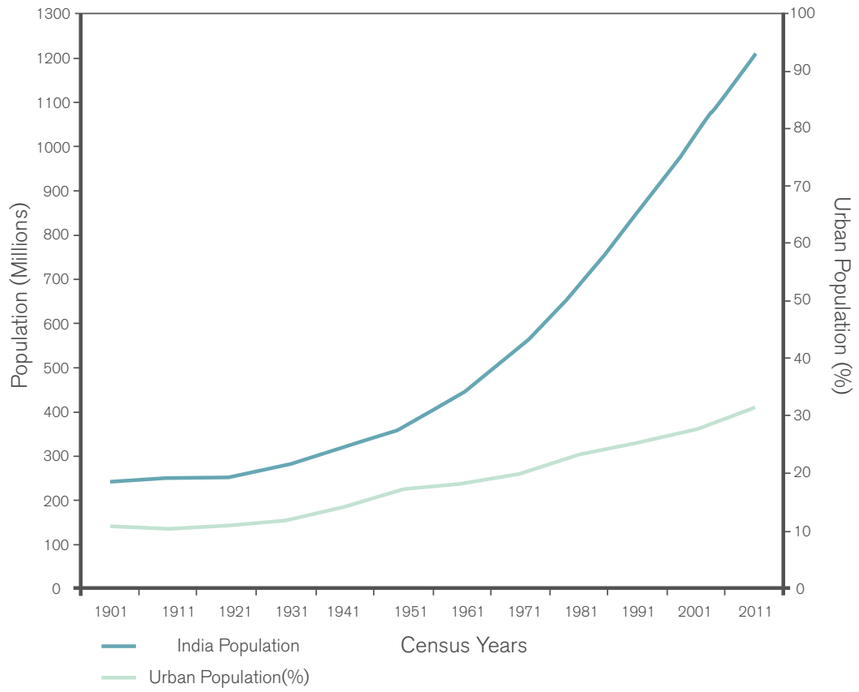
Climate Change

Drivers of Change: Urbanization

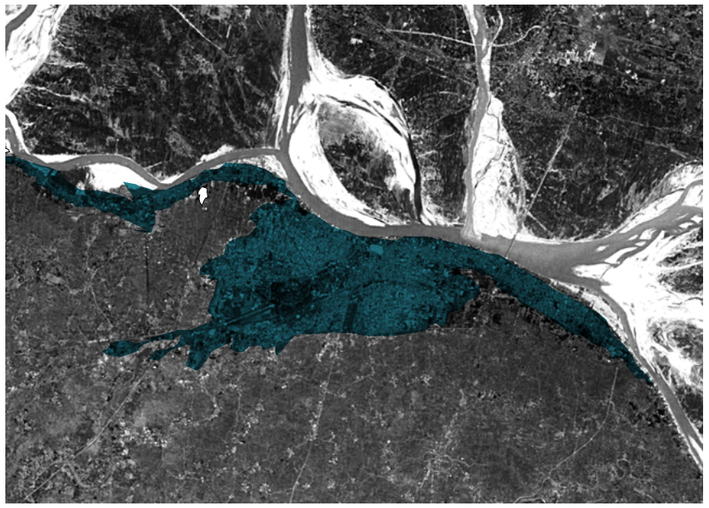
Migration



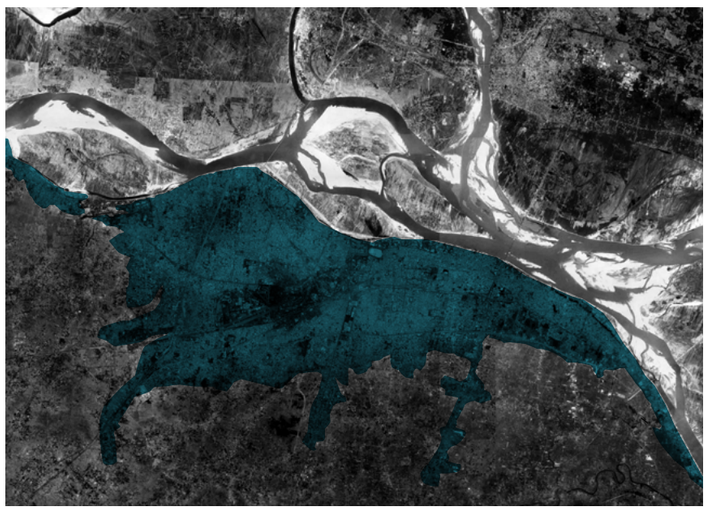
Population Growth



Urban Sprawl



Patna: 1990



Patna: 2019

Source: Census, 2011; Google Earth, 2019

Drivers of Change: Infrastructure Development

Urbanization

Infrastructure Development

Climate Change

Drivers of Change: Infrastructure Development

First Irrigation Canal: 1842

Source: Google Earth, 2019

Inequality of Distribution

Source: Arjun Swaminathan, idronline.org

Source: UNICEF India, 2017, Flicker.com

Drivers of Change: Climate Change

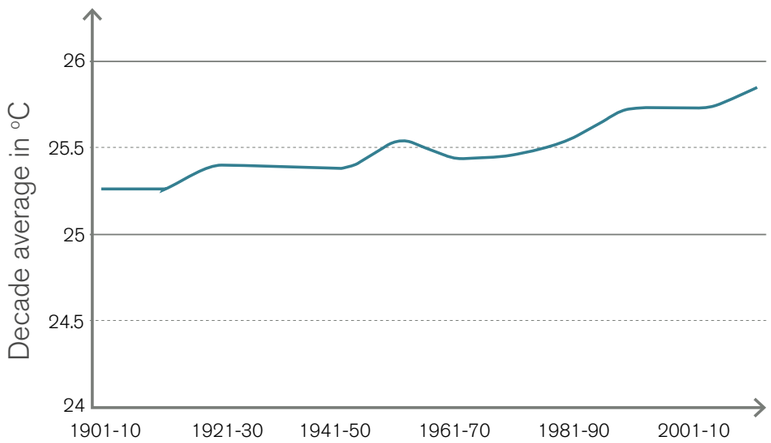
Urbanization

Infrastructure Development

Climate Change

Drivers of Change: Climate Change

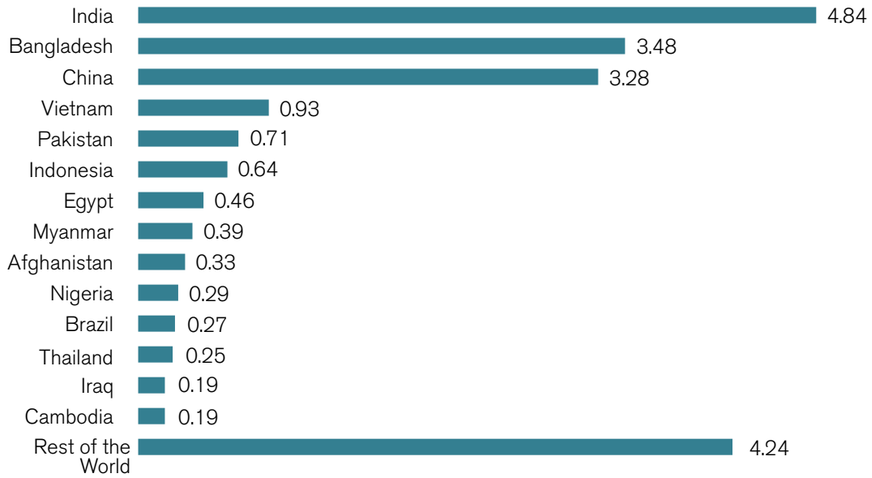
Increasing Temperature



Source: Environment Statistics 2019, MOSPI (LiveMint, 21 Jul 2019)

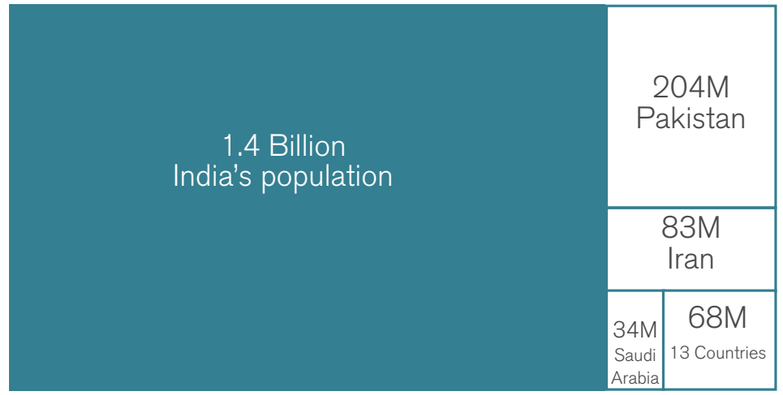
Flooding

15 Countries account for 80% of population exposed to river flood risk worldwide



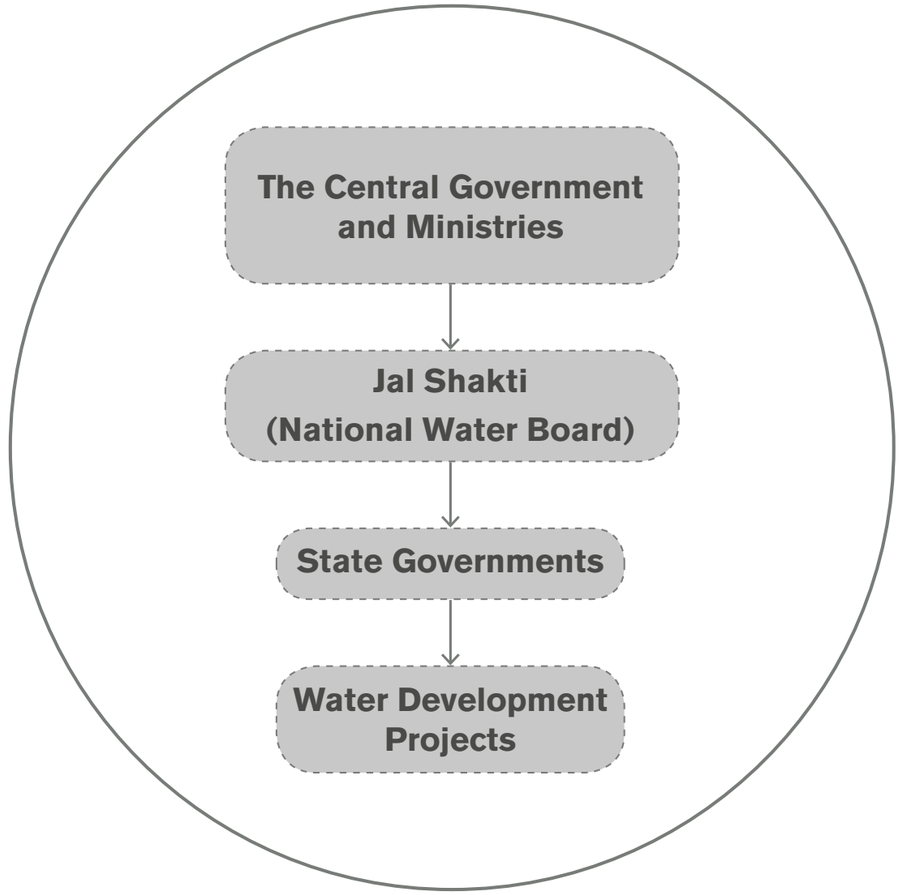
Source: World Resource Institute, 2013

Water Crisis



Source: World Bank Statistics, Dormido, 2019

Governance and Planning of Ganges River Basin



1. Linear Planning Process

2. Top-Down Approach

3. Lack of Integration within different Departments

4. Lack of Community Participation

5. No Local Management

6. Gap between Policy and Practice

Problem Statement

Population Growth
Rate : 1.01%
Current Population : 1.37 billion (2019)

Source: World Population Review

\+
Continuous Migration from Rural to Urban

Increasing demands of Housing and Resources

Rapid Urbanization
(Economy driven development)
(Capitalist Approach)

Lack of synergies between different scales of ecology and governance

Environmental Injustice

Social Injustice

Economic Inequalities

Lack of Participation

Spatial Injustice

Distributional and Procedural

Line of Inquiry : The Dual Nature of Externalities

Human-engineered Externalities

Climate change induced Externalities

Externalities

↓

The externalities increase the vulnerabilities which directly impact risk.

↓

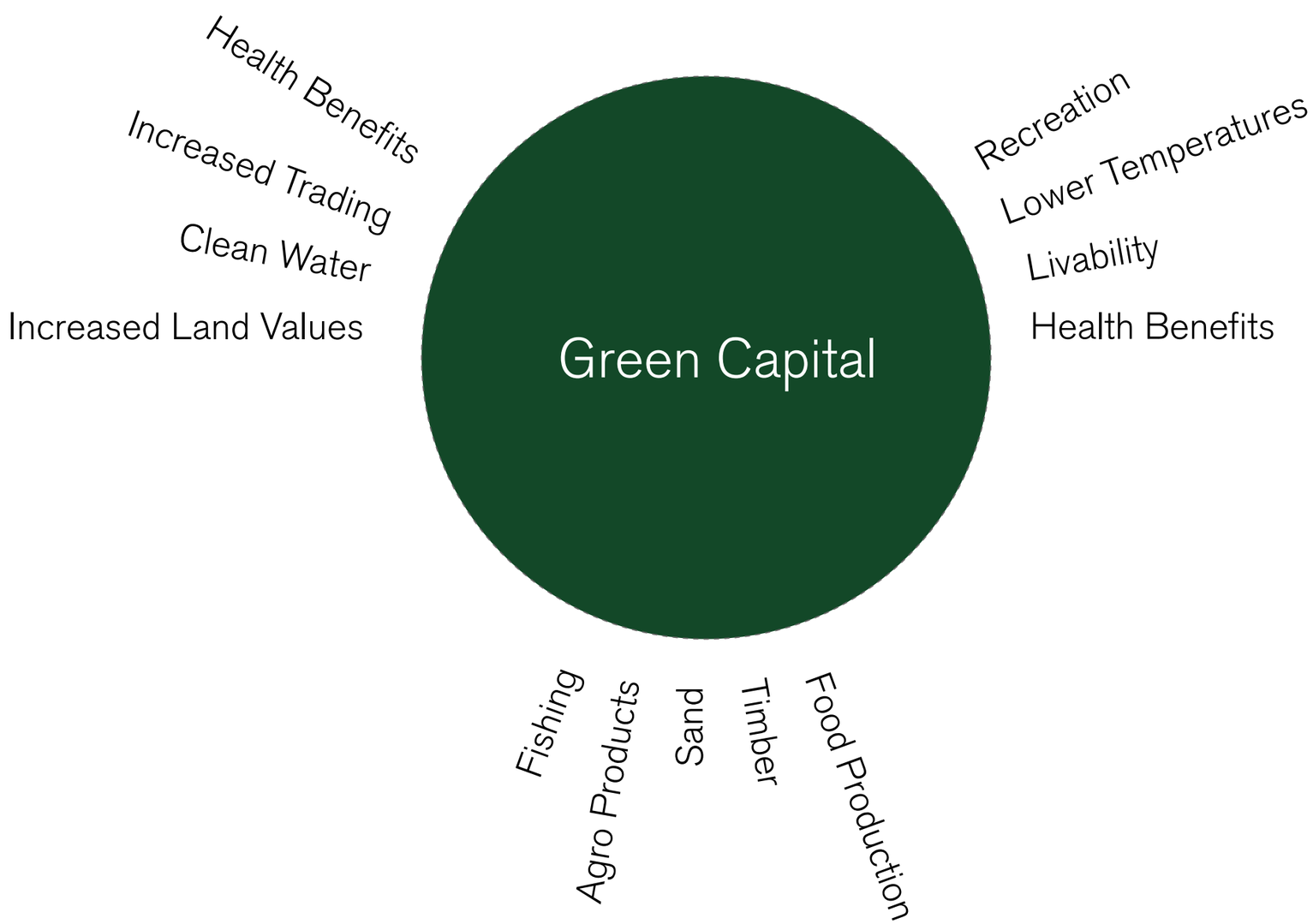
Risk

Risk is the possibility or chance of loss, danger or injury.

$$\textbf{Risk} = \frac{\textbf{Hazard} \textit{ (chance; probability)} \times \textbf{Exposure} \text{ (Vulnerability) } \textit{(the state of having no protection from something harmful.)} \downarrow}{\textbf{Coping Capacity } \textit{(assuming it 1)} \uparrow}$$

Source: IPCC, 2014

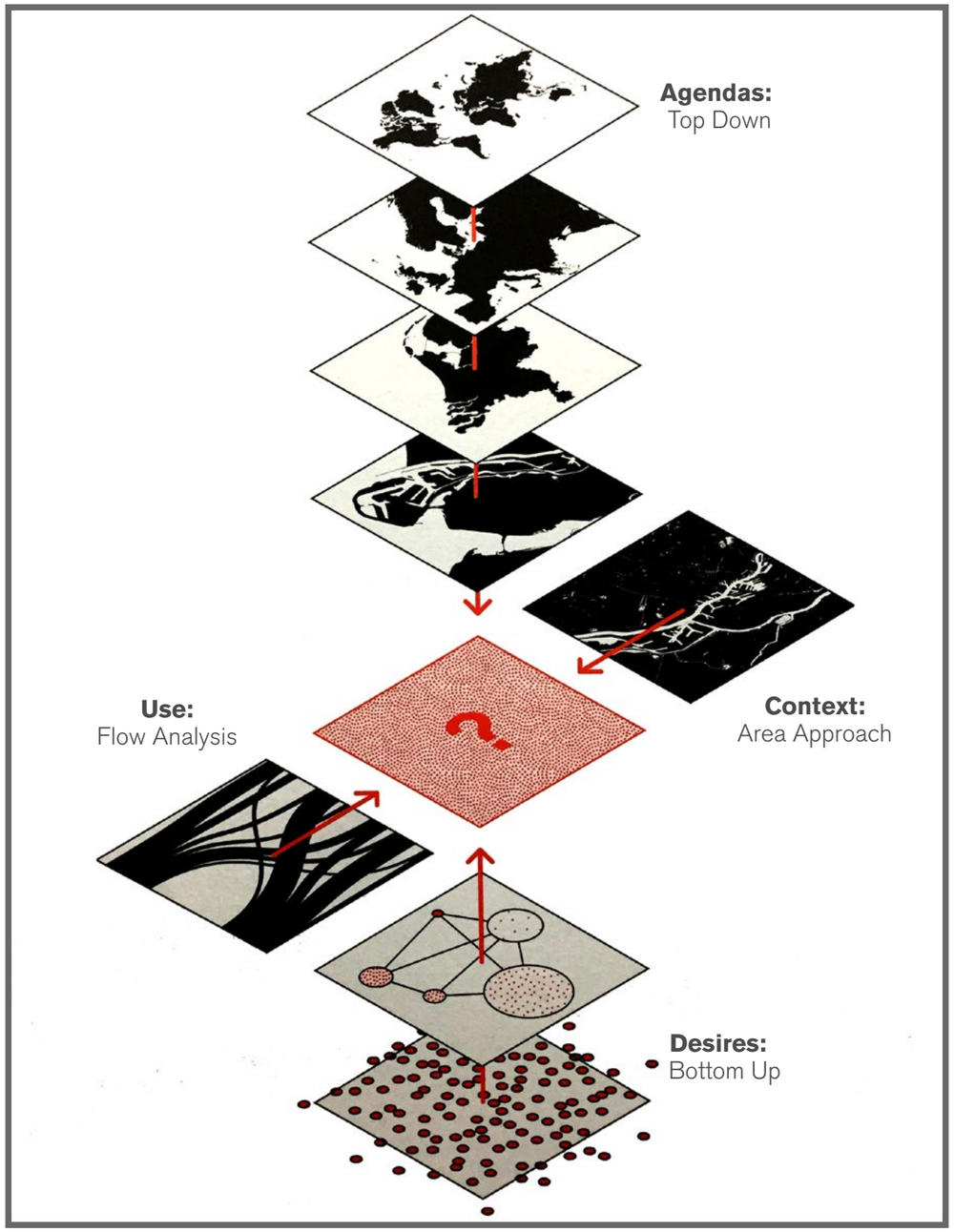
Line of Inquiry : Capital



Research Question

How can the development of water centric infrastructures help to cope the dynamic economic, social and environmental vulnerabilities along the banks of River Ganges through an Adaptive Spatial Planning Model within the basin?

Theoretical Notion 1



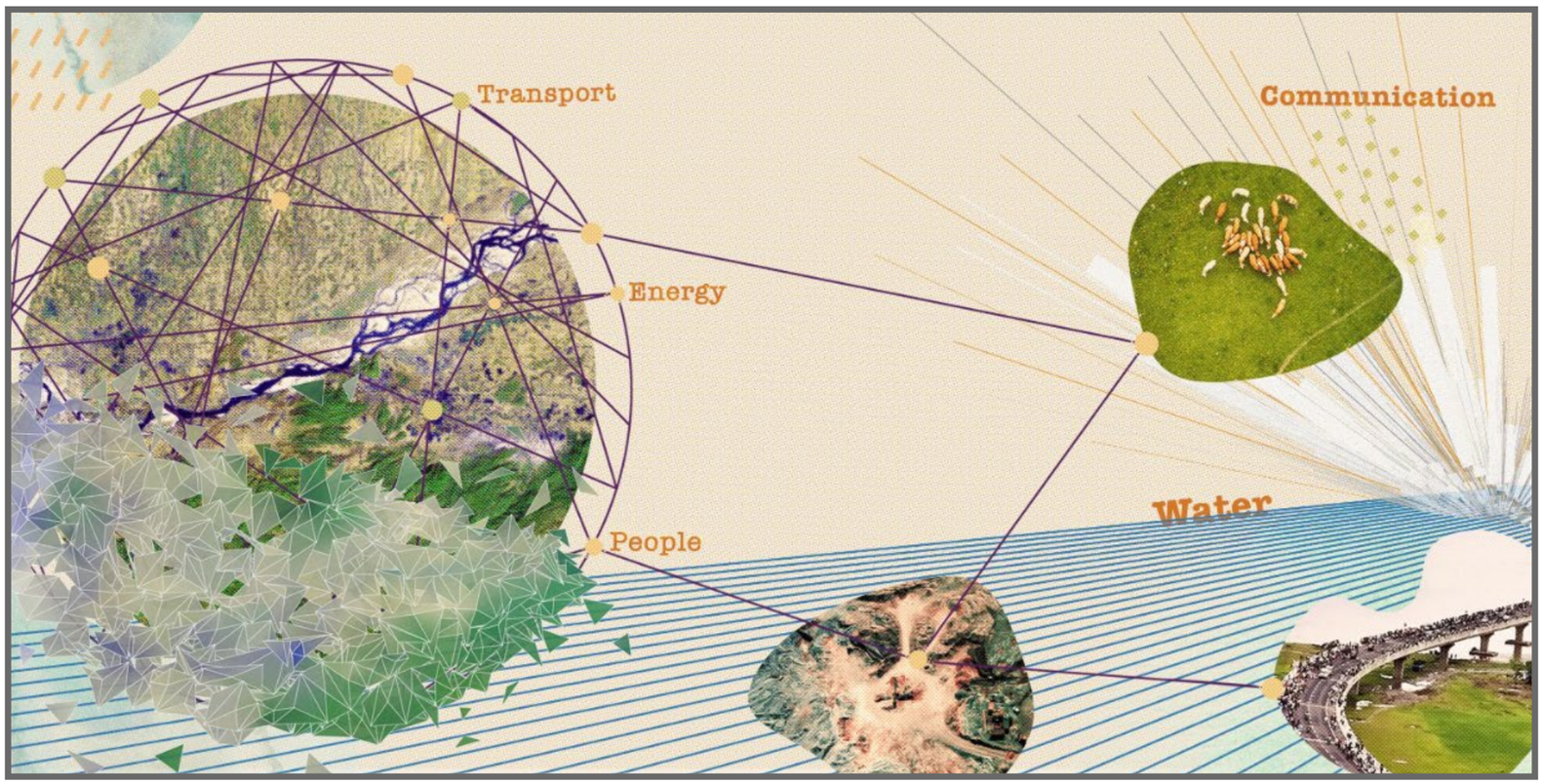
The field of activity - four angles

Interdependence - Integration

Every element in a system has its own infrastructure, every scale has its own flows within the system. For a system to function, integration of flows is necessary rather than optimum use of infrastructure.

Source: Sandra van Assen, T. v. (n.d.). Urban Challenges, Resilient Solutions. Future Urban Regions.

Theoretical Notion 2



Web dossier of infrastructure interactions
- Heinrich Boll Stiftung

Infrastructure Ecology

"Infrastructure ecology views urban systems as complex adaptive systems; the sustainability and resilience of which emerge from the complex interactions and co-evolution of a city's interdependent engineering, ecological, and socio-economic infrastructure through time and space."
-A. Pandit (2017)

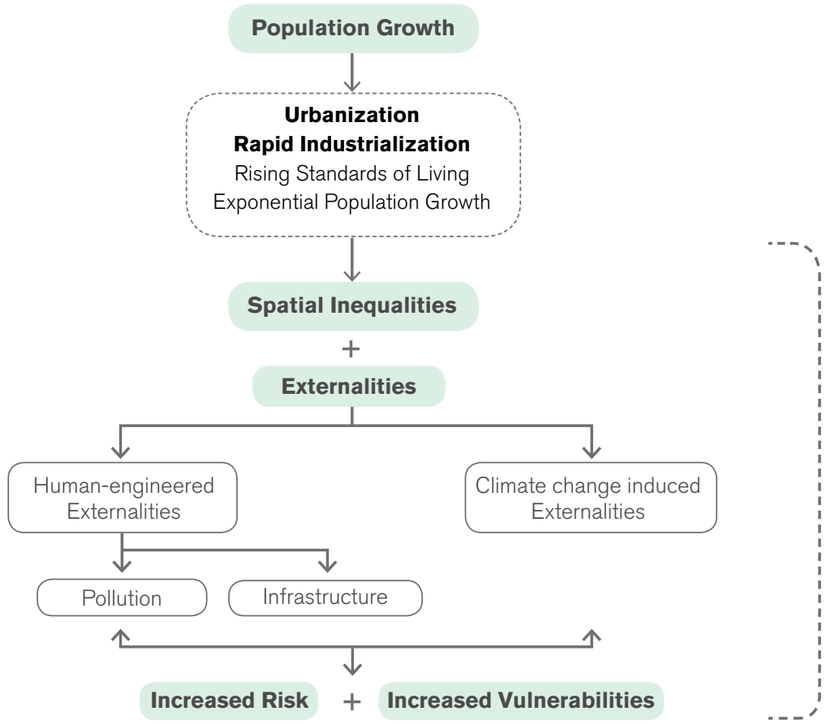
Theoretical Notion 3

Endless Rhythm', Robert Delaunay, 1934

Evolutionary Resilience

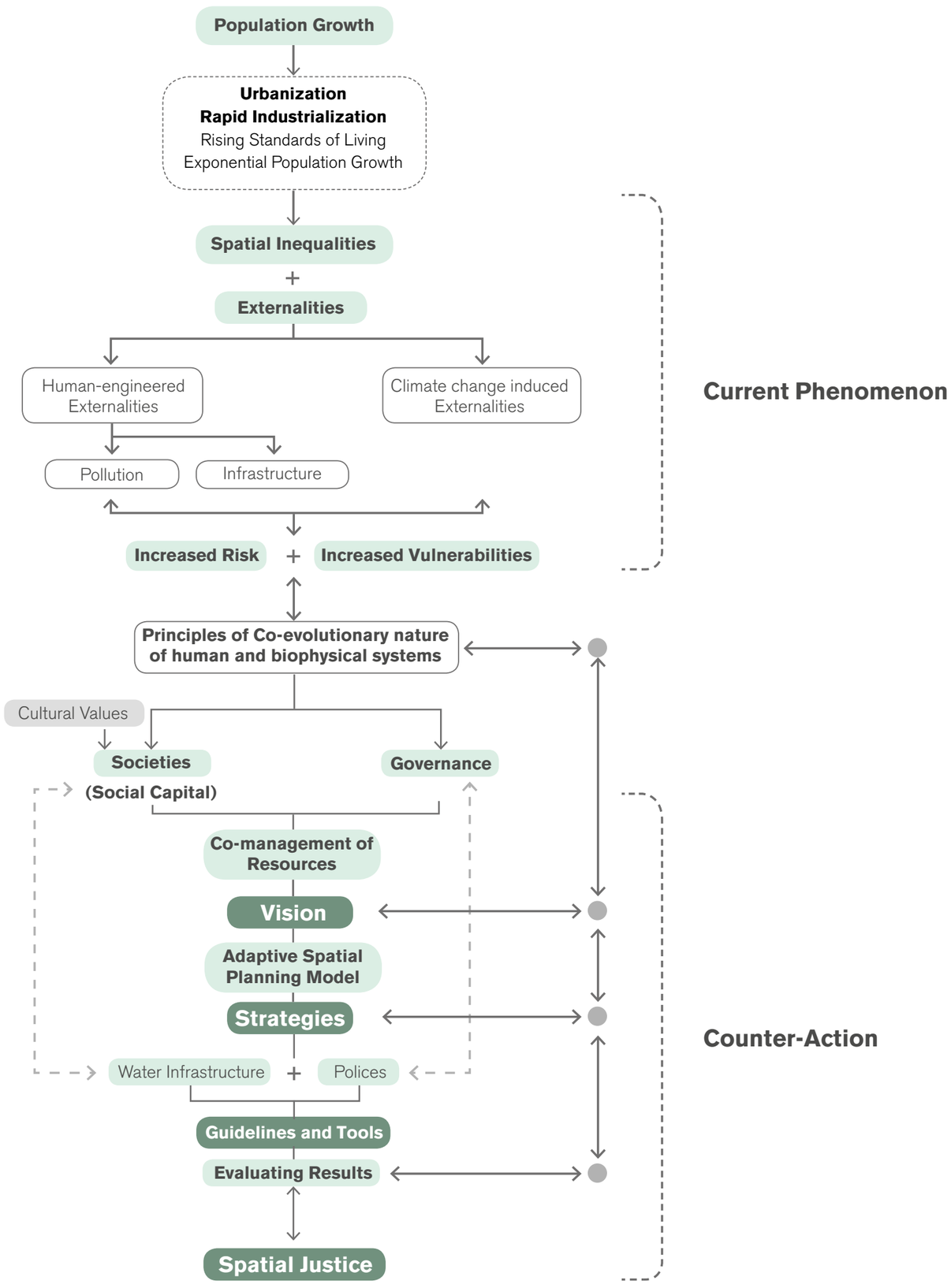
The social and the ecological systems are interdependent systems.
The system remains to continue in loops of adaptive cycles.

Roadmap



Current Phenomenon

Roadmap

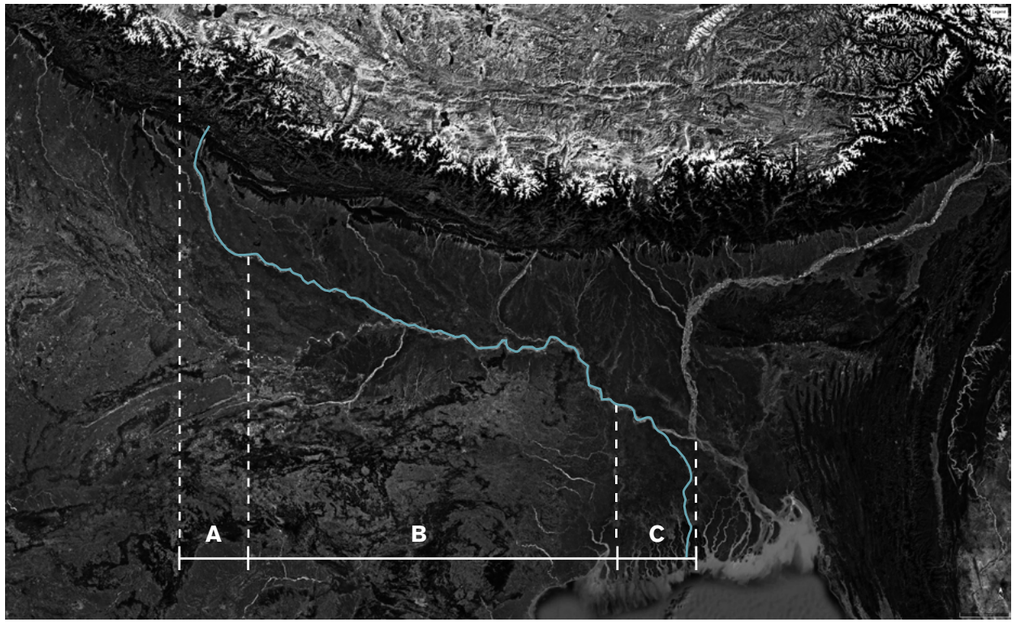

Population Growth
Urbanization
Rapid Industrialization
Rising Standards of Living
Exponential Population Growth
Spatial Inequalities
+
Externalities
Human-engineered Externalities
Climate change induced Externalities
Pollution
Infrastructure
Increased Risk
+
Increased Vulnerabilities
Current Phenomenon
Principles of Co-evolutionary nature of human and biophysical systems
Cultural Values
Societies
(Social Capital)
Governance
Co-management of Resources
Vision
Adaptive Spatial Planning Model
Strategies
Water Infrastructure
+
Polices
Guidelines and Tools
Evaluating Results
Spatial Justice
Counter-Action

Research Question

How can the development of water centric infrastructures help to cope the dynamic economic, social and environmental vulnerabilities along the banks of River Ganges through an Adaptive Spatial Planning Model within the basin?

Across Scales

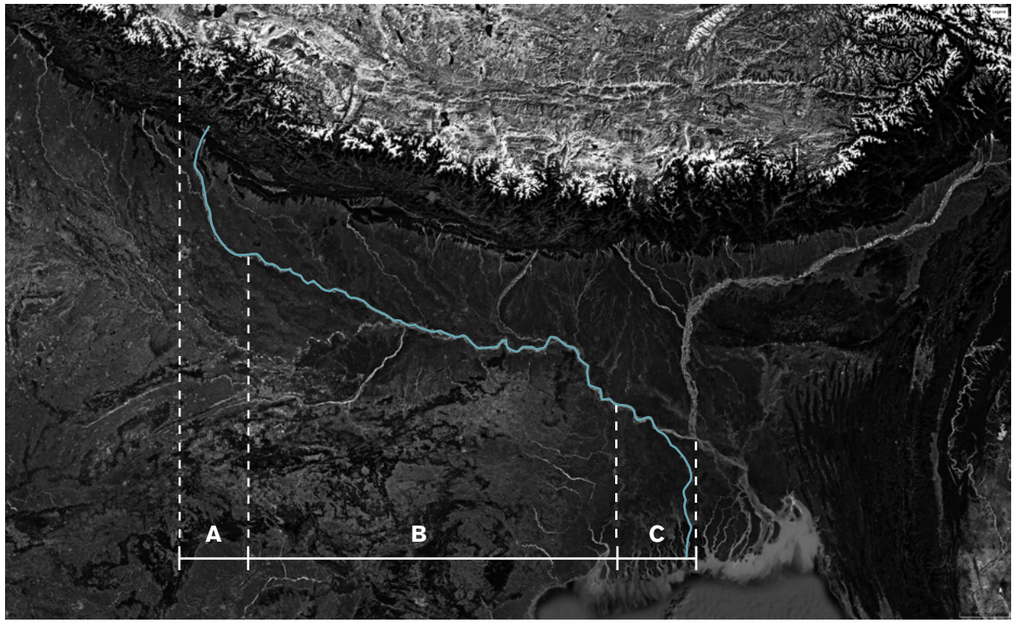
Ganges River Basin



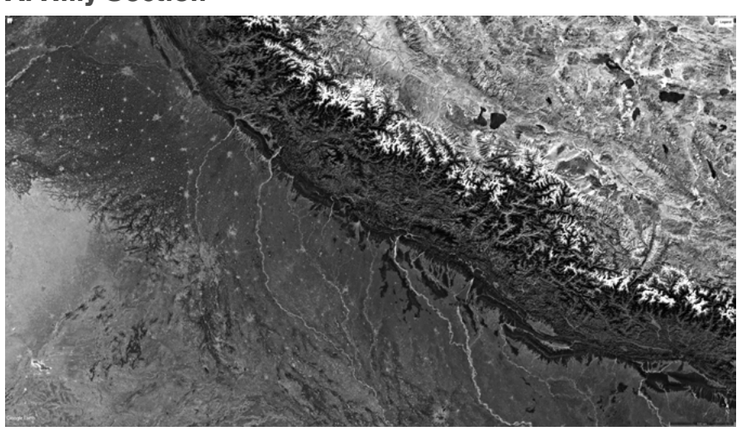
Source: Google Earth

Across Scales

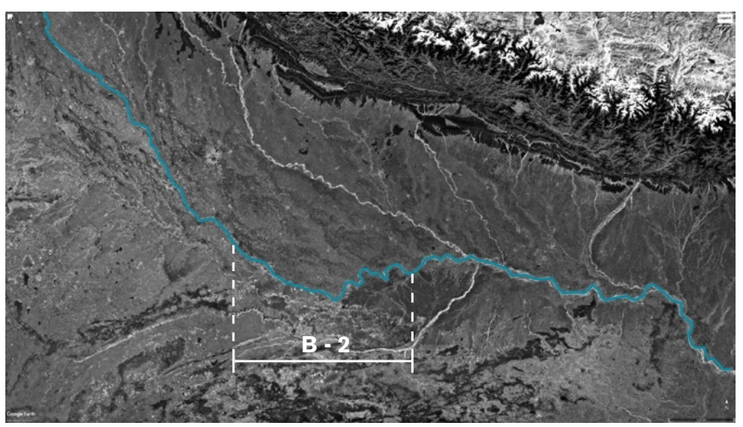
Ganges River Basin



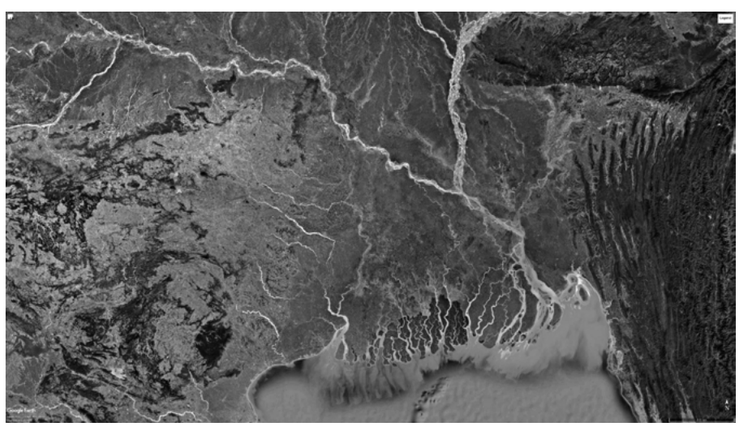
A. Hilly Section



B. Flat Plains



C. River Delta

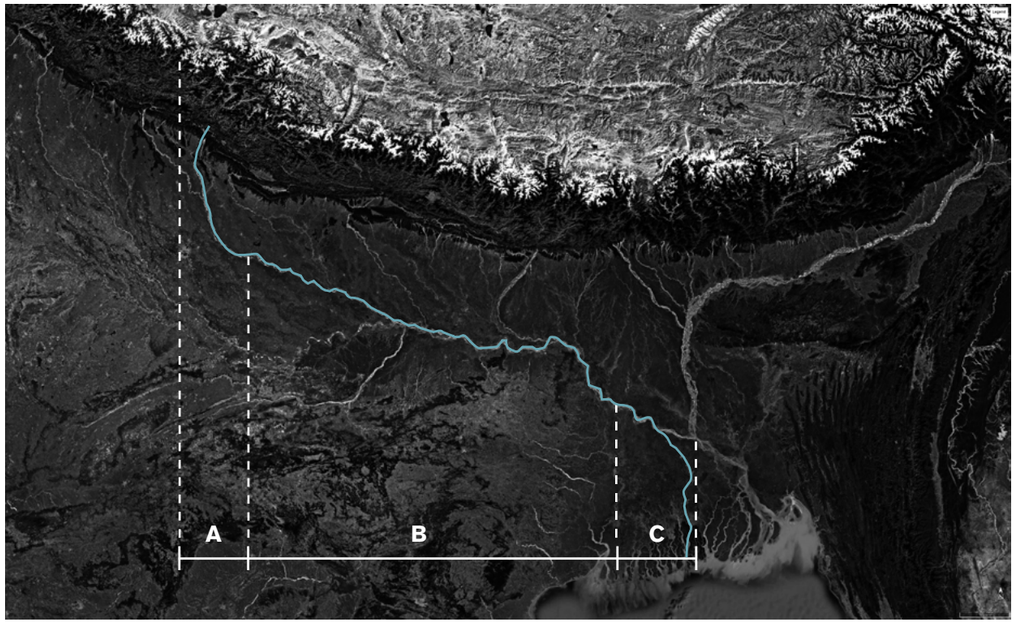


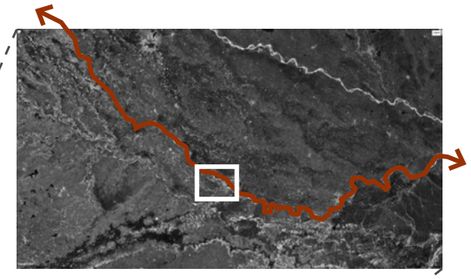
Sections of River

Source: Google Earth

Across Scales

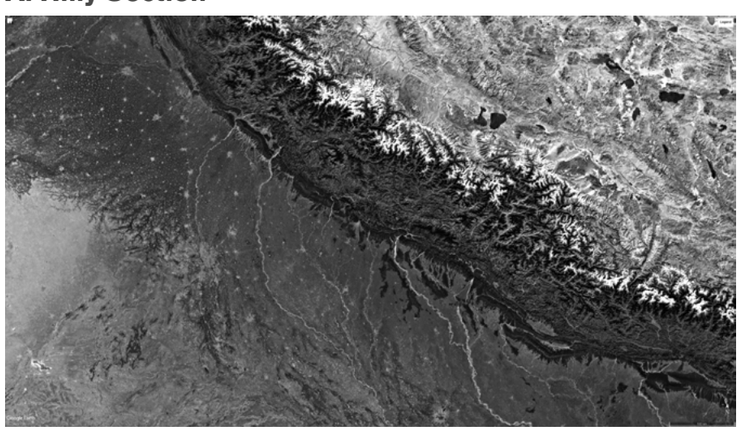
Ganges River Basin



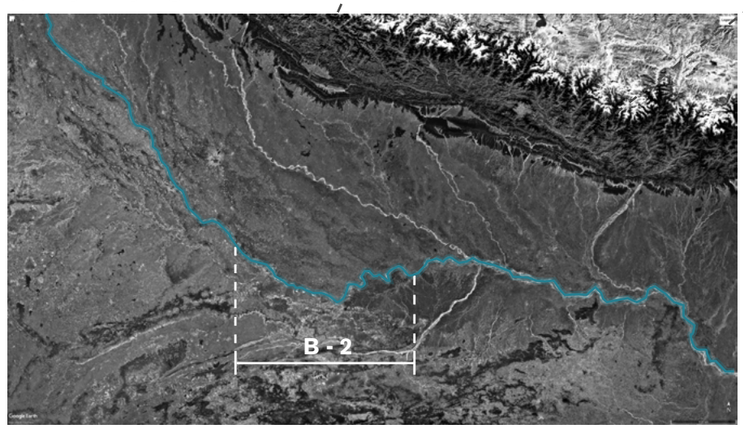


The Polluted Segment

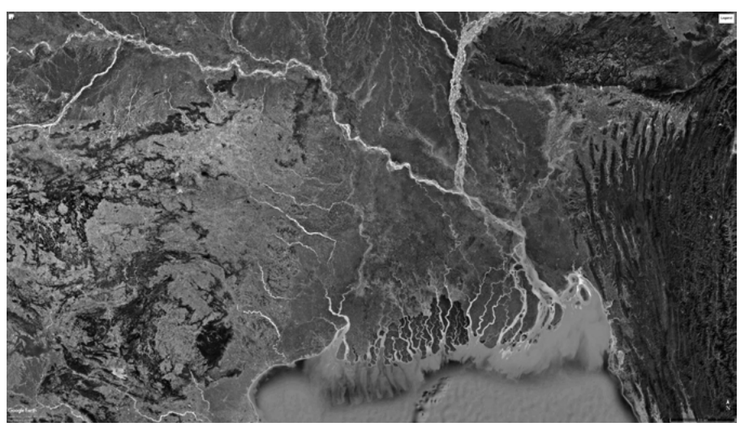
A. Hilly Section



B. Flat Plains



C. River Delta

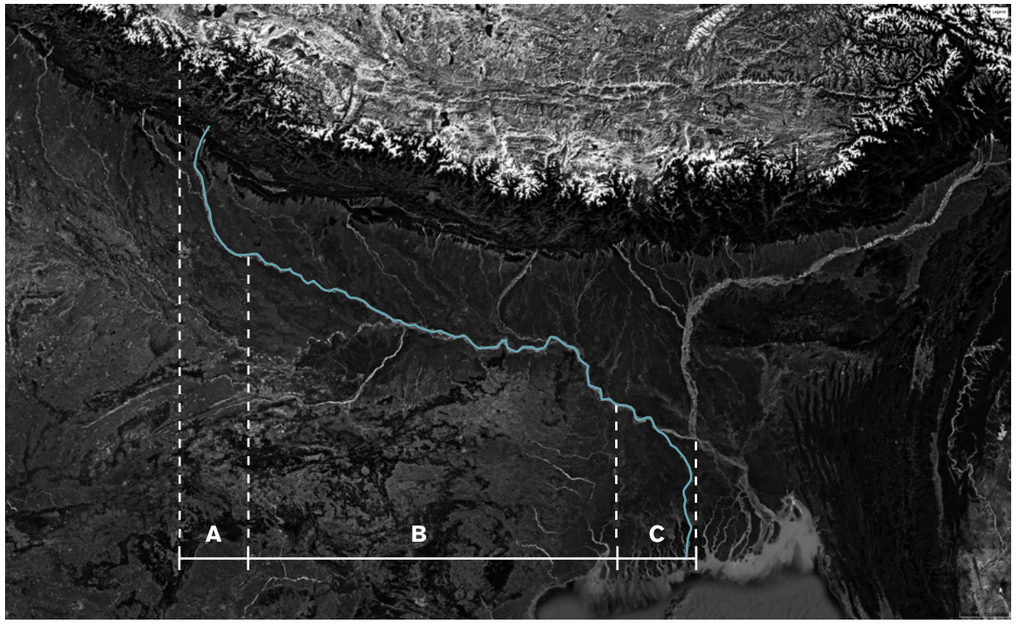


Sections of River

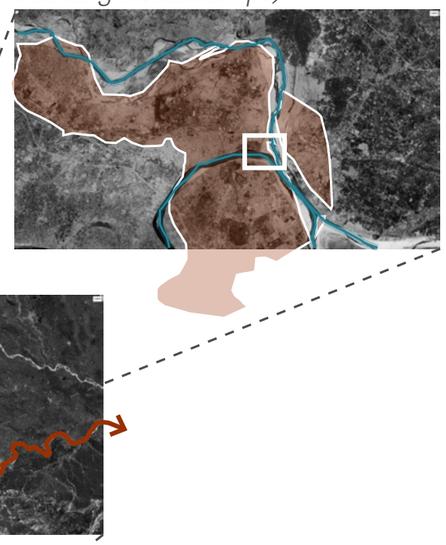
Source: Google Earth

Across Scales

Ganges River Basin

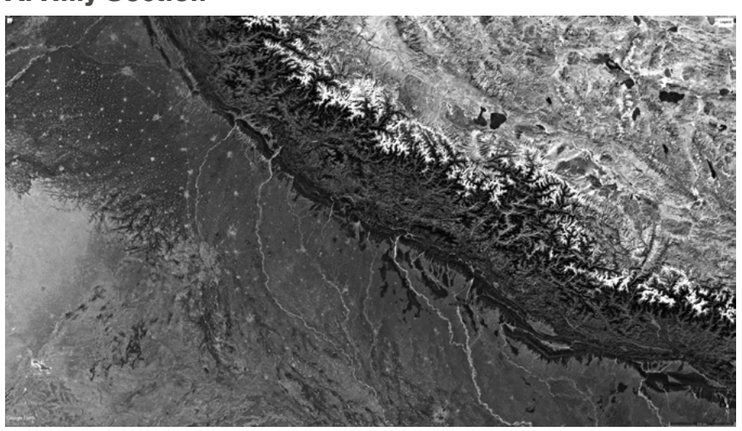


The City and The River *(Understanding Relationships)*

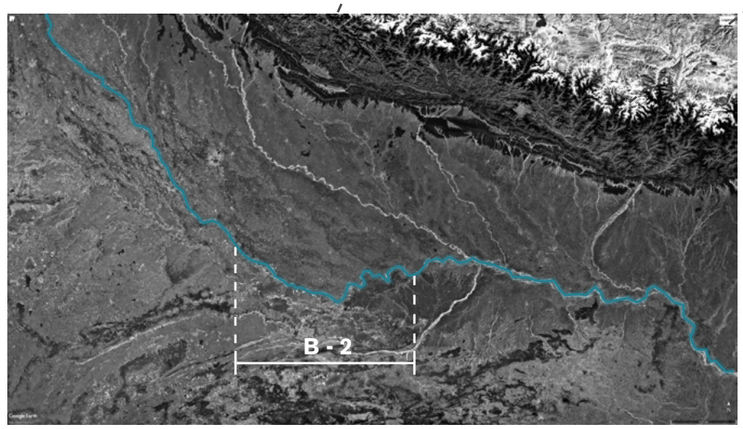


The Polluted Segment

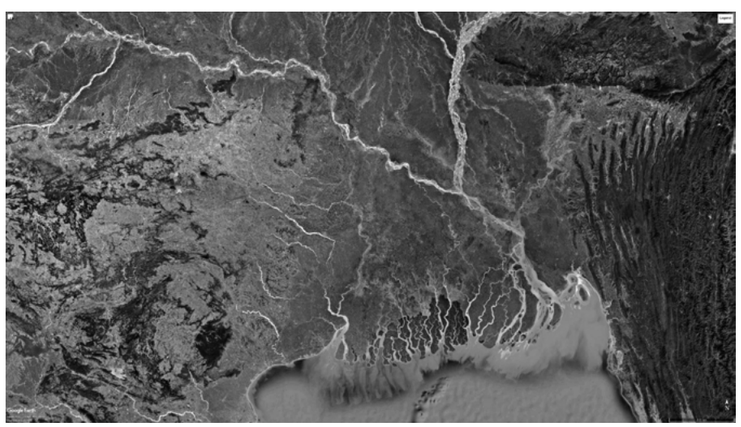
A. Hilly Section



B. Flat Plains



C. River Delta

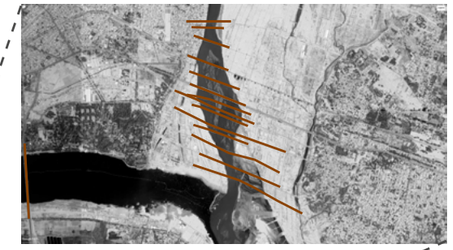


Sections of River

Source: Google Earth

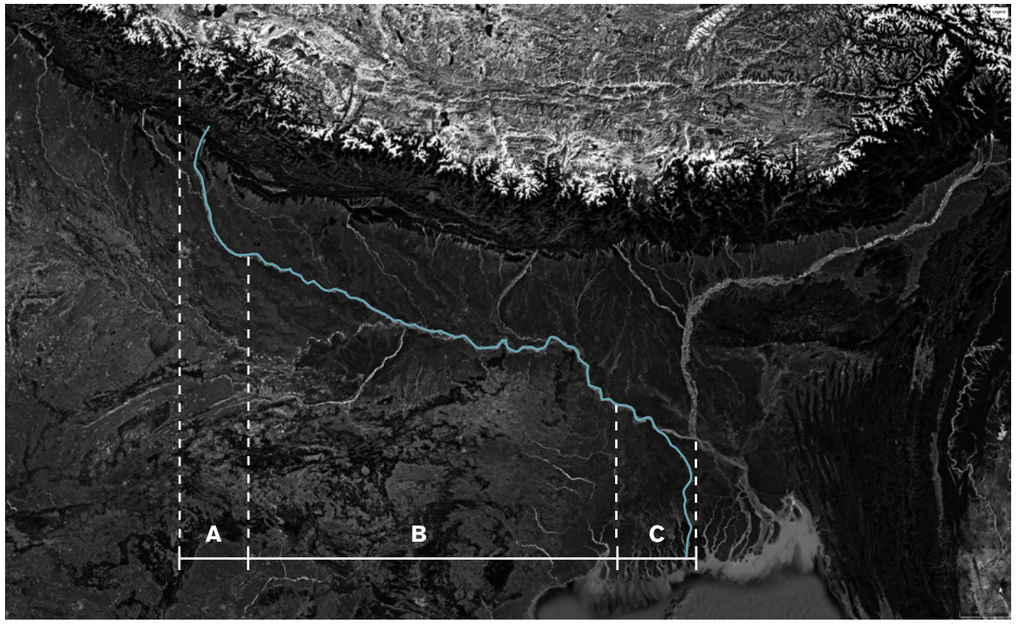
Across Scales

Zoom-in *(Eco-Sensitive : Highly Engineered)*

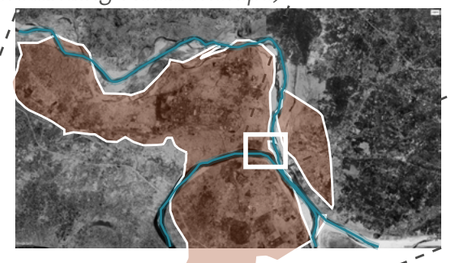


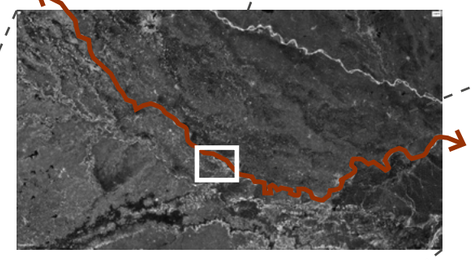
Designing and Testing at Different Scales

Ganges River Basin



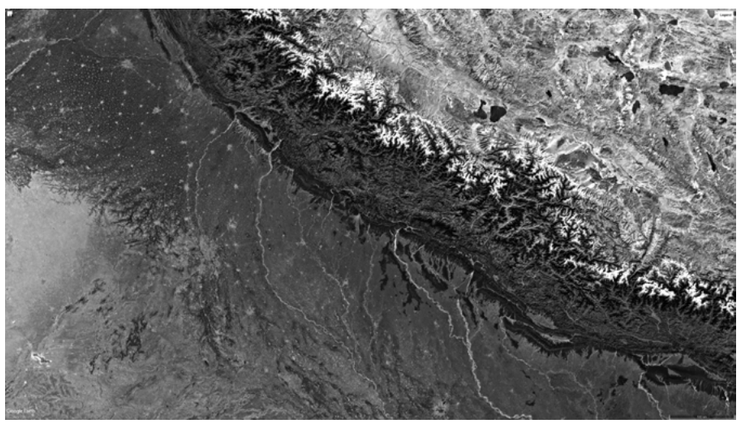
The City and The River *(Understanding Relationships)*



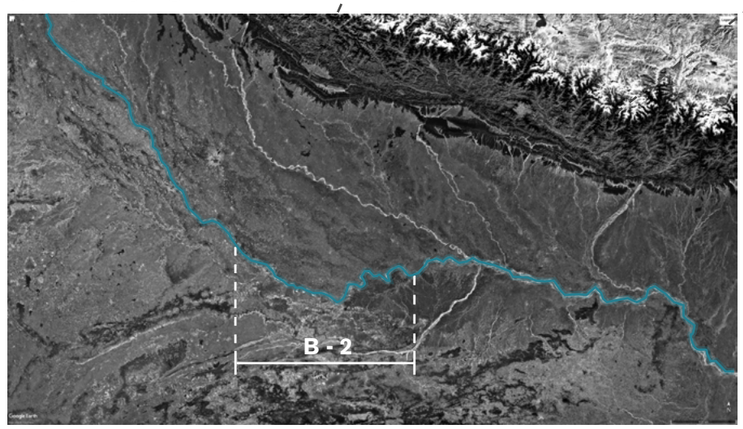


The Polluted Segment

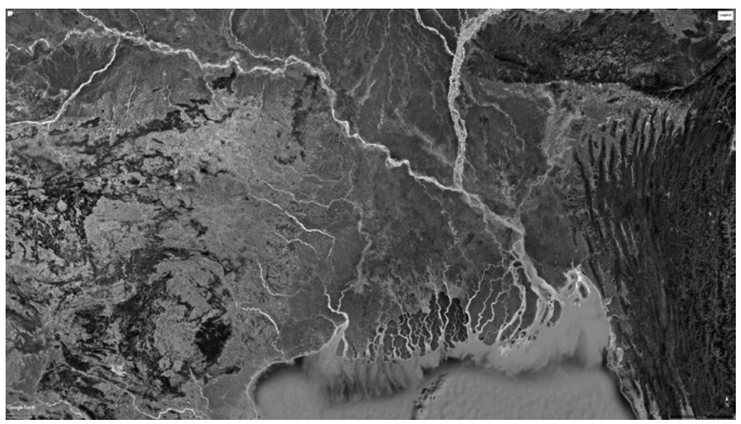
A. Hilly Section



B. Flat Plains



C. River Delta



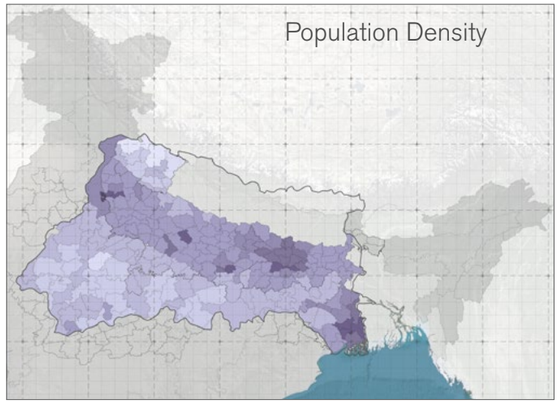
Sections of River

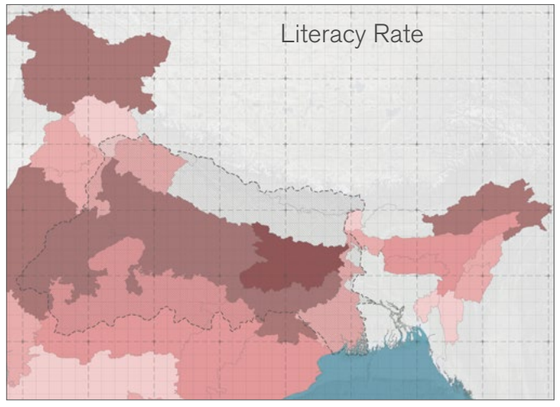
Source: Google Earth

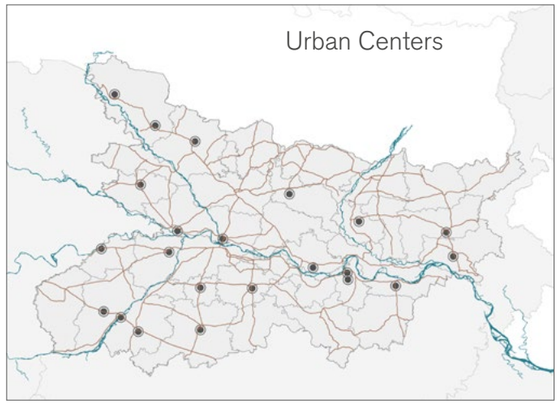
Vulnerability

(Analytical Framework ; Context)

Social:



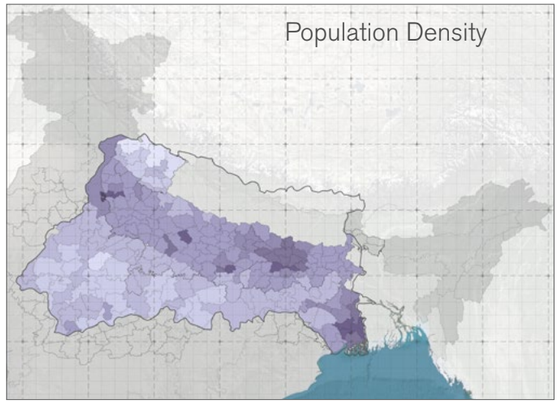


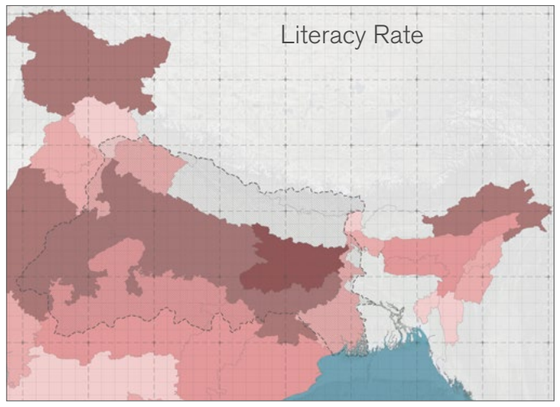


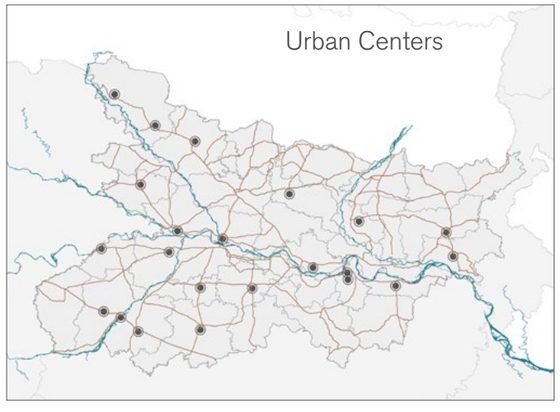
Vulnerability

(Analytical Framework ; Context)

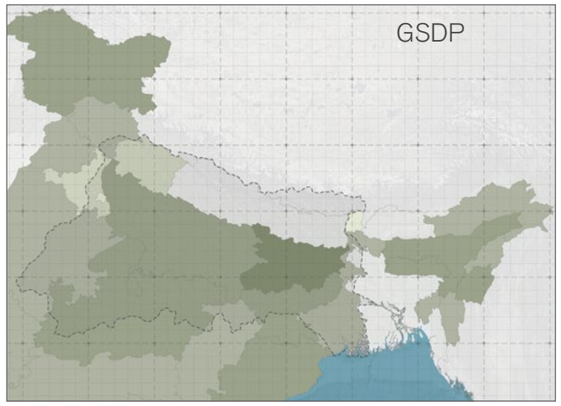
Social:

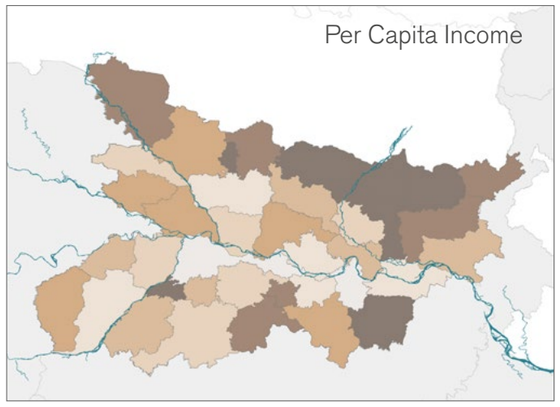






Economic:

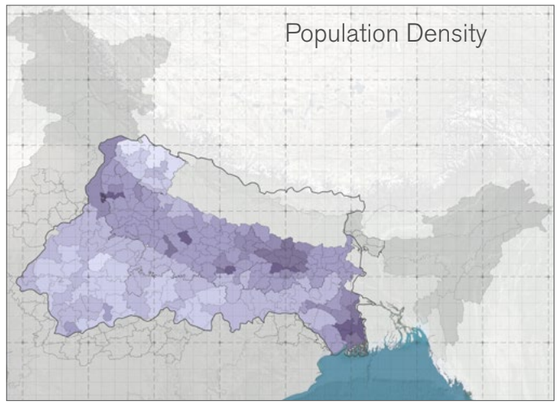


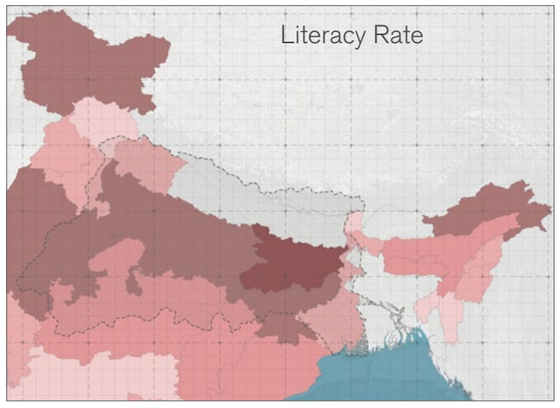


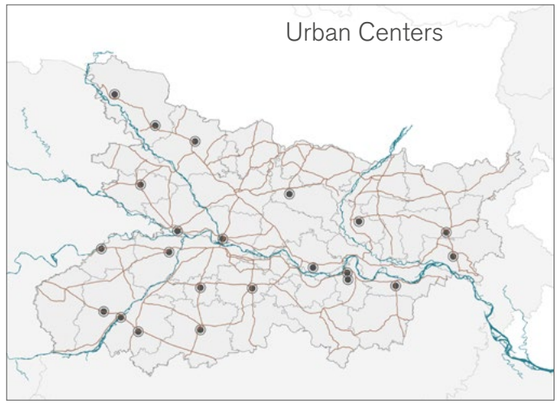
Vulnerability

(Analytical Framework : Context)

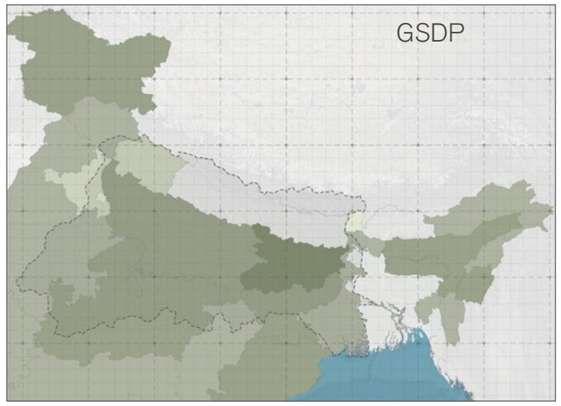
Social:

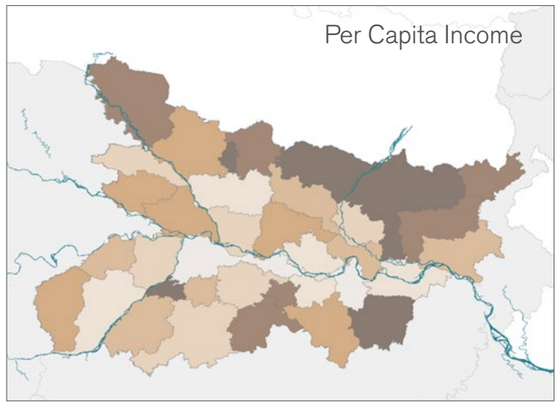




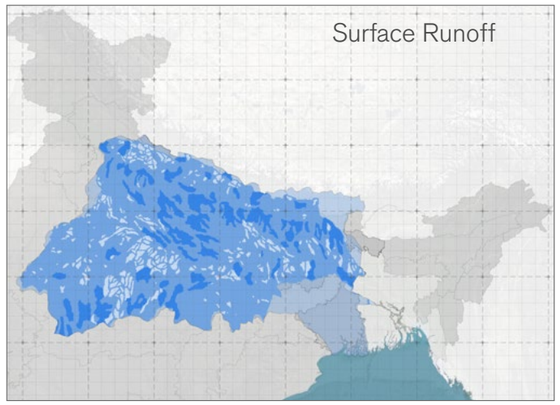


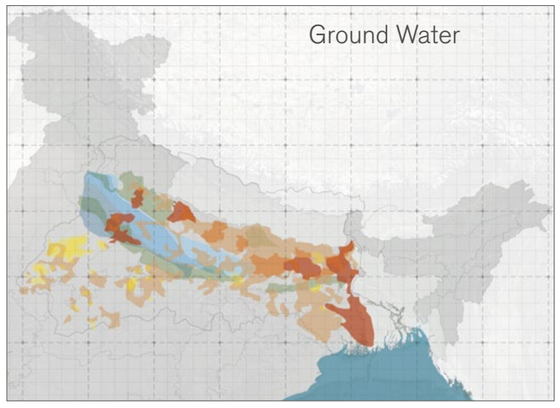
Economic:

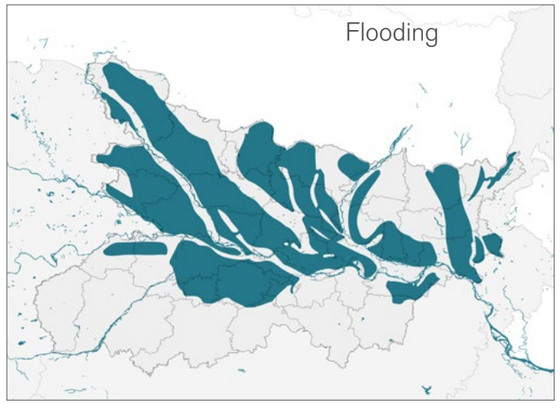




Ecological:



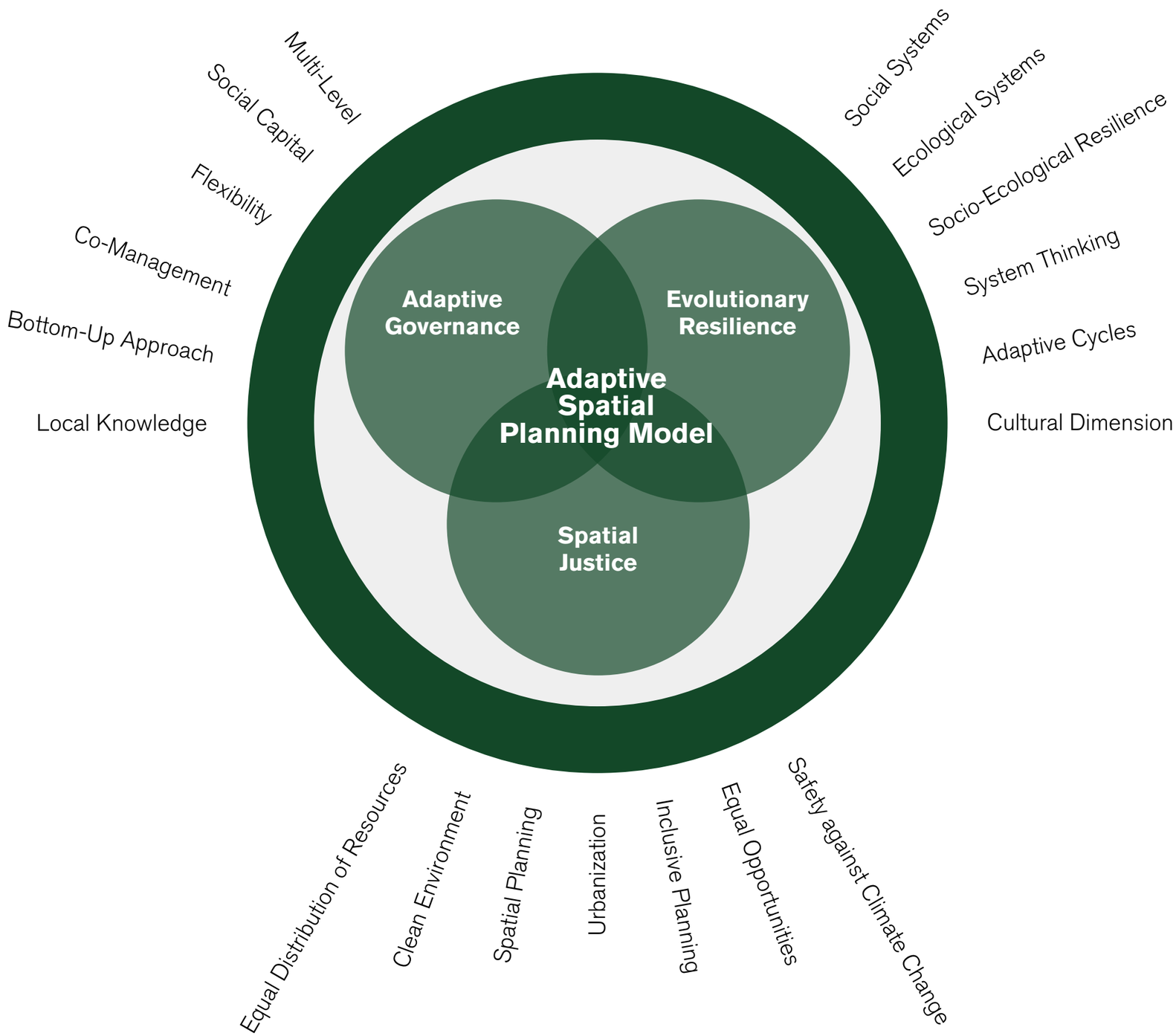




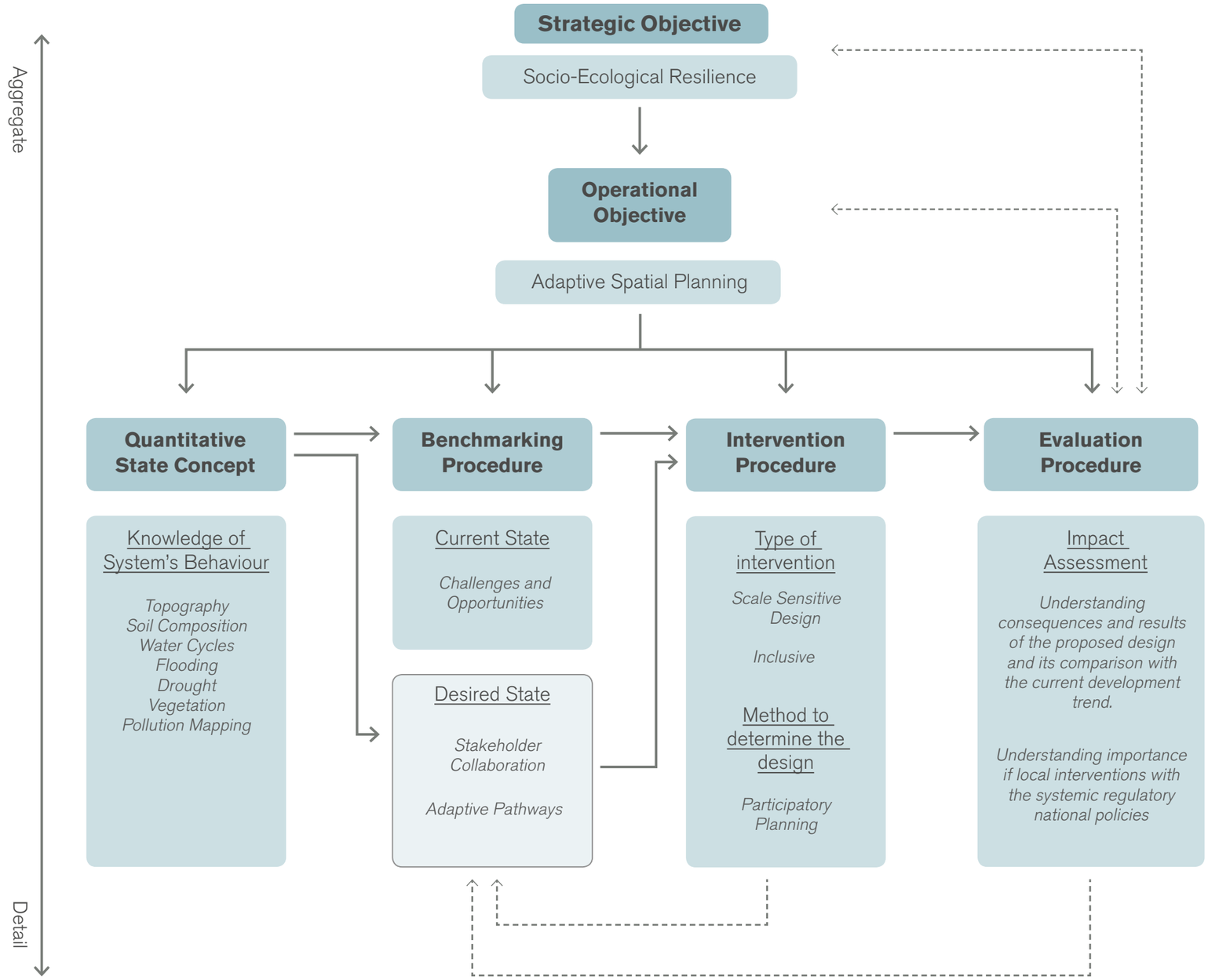
Research Question

How can the development of water centric infrastructures help to cope the dynamic economic, social and environmental vulnerabilities along the banks of River Ganges through an Adaptive Spatial Planning Model within the basin?

Conceptual Framework

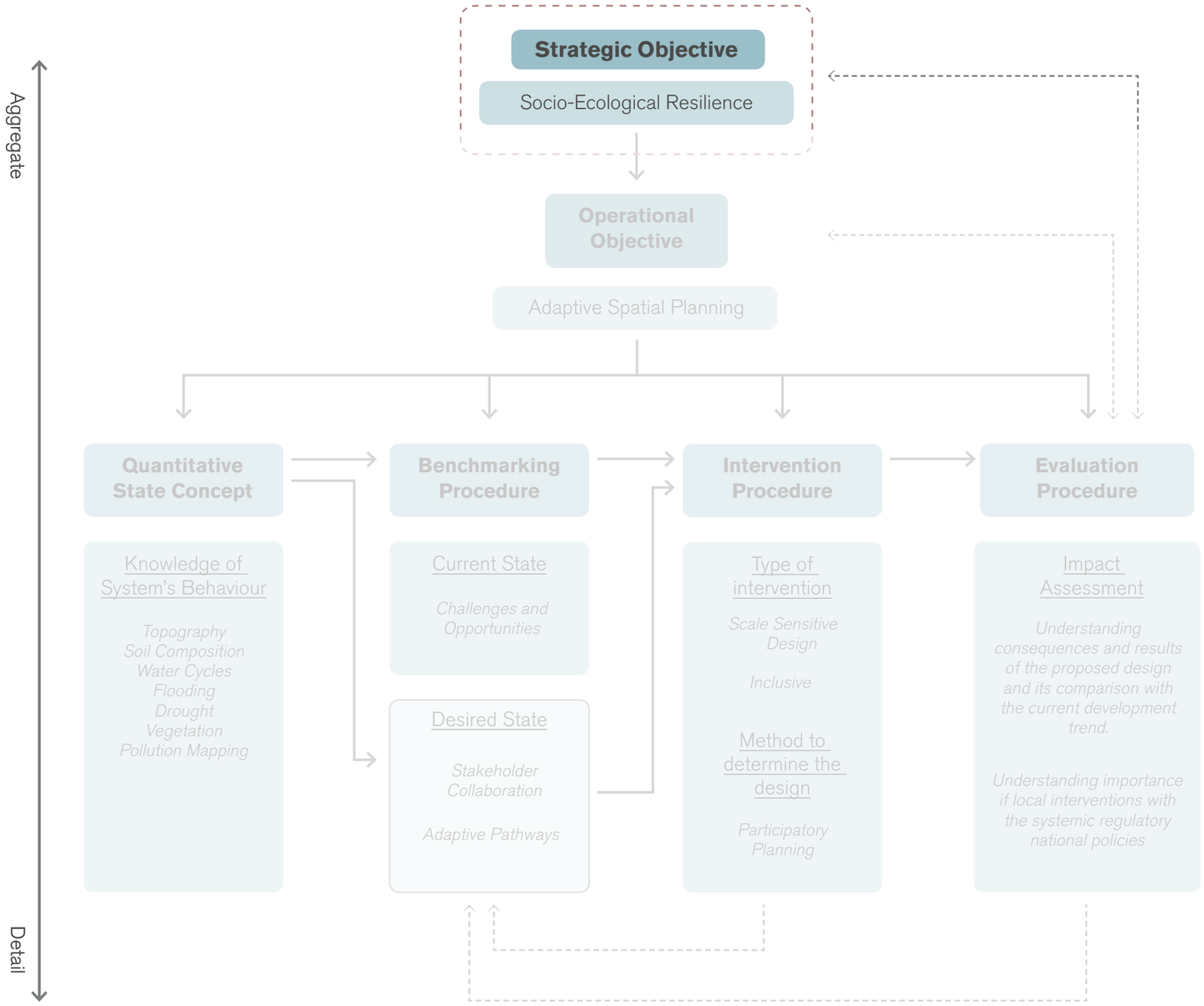


Frame of Reference



Source: Van Koningsveld, 2003, modified by author

Frame of Reference: Strategic Objective

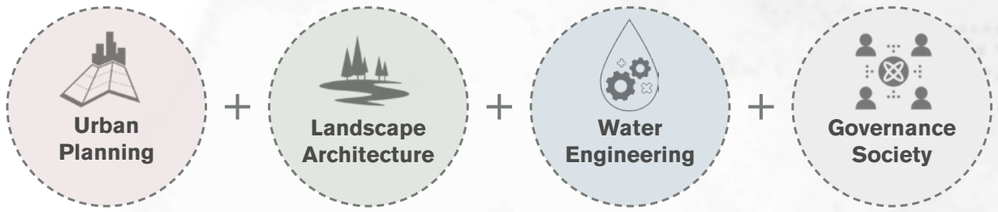


Source: Van Koningsveld, 2003, modified by author

Frame of Reference: Strategic Objective

Vision

"By 2050, the project aims to achieve adaptation towards the on-going water challenges of flooding and drought in the Ganges River Basin, by enhancing, protecting and connecting various environmental sensitive areas, through re-arranging and re-programming of the existing urban landscape and urban morphology, by including local communities and actors in the planning process."



Frame of Reference: Strategic Objective

Principles of Resilience

Robustness

Responsive

Renewable

Robust

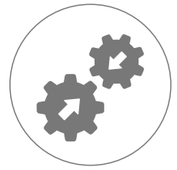
Adaptivity

Flexible

Community Based

Connectedness

Across Scales



Co-ordinated

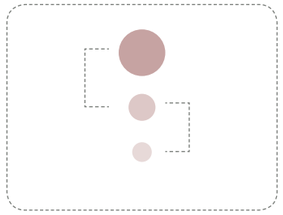
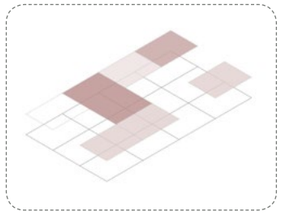
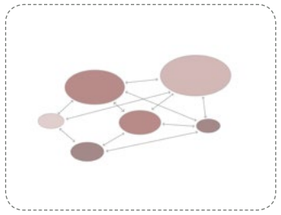
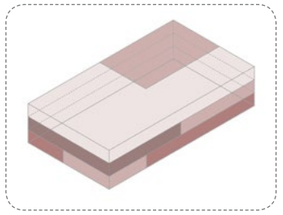
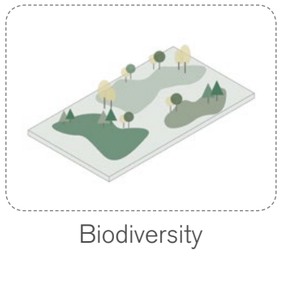
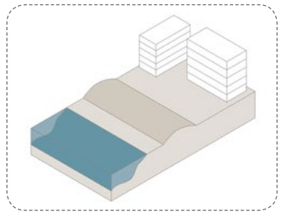
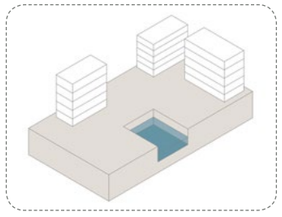
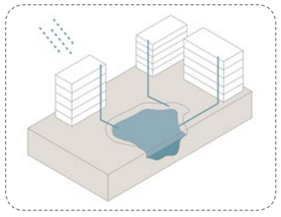
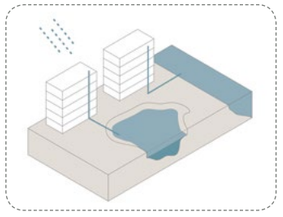
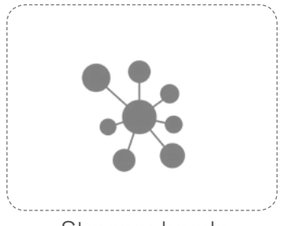
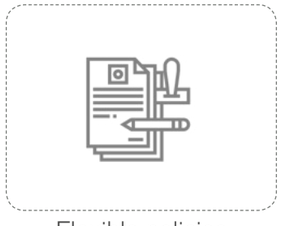
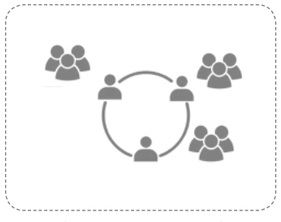
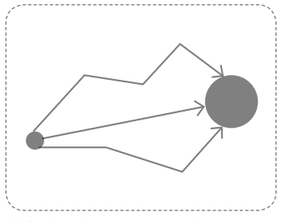
Diversity

Socially Just

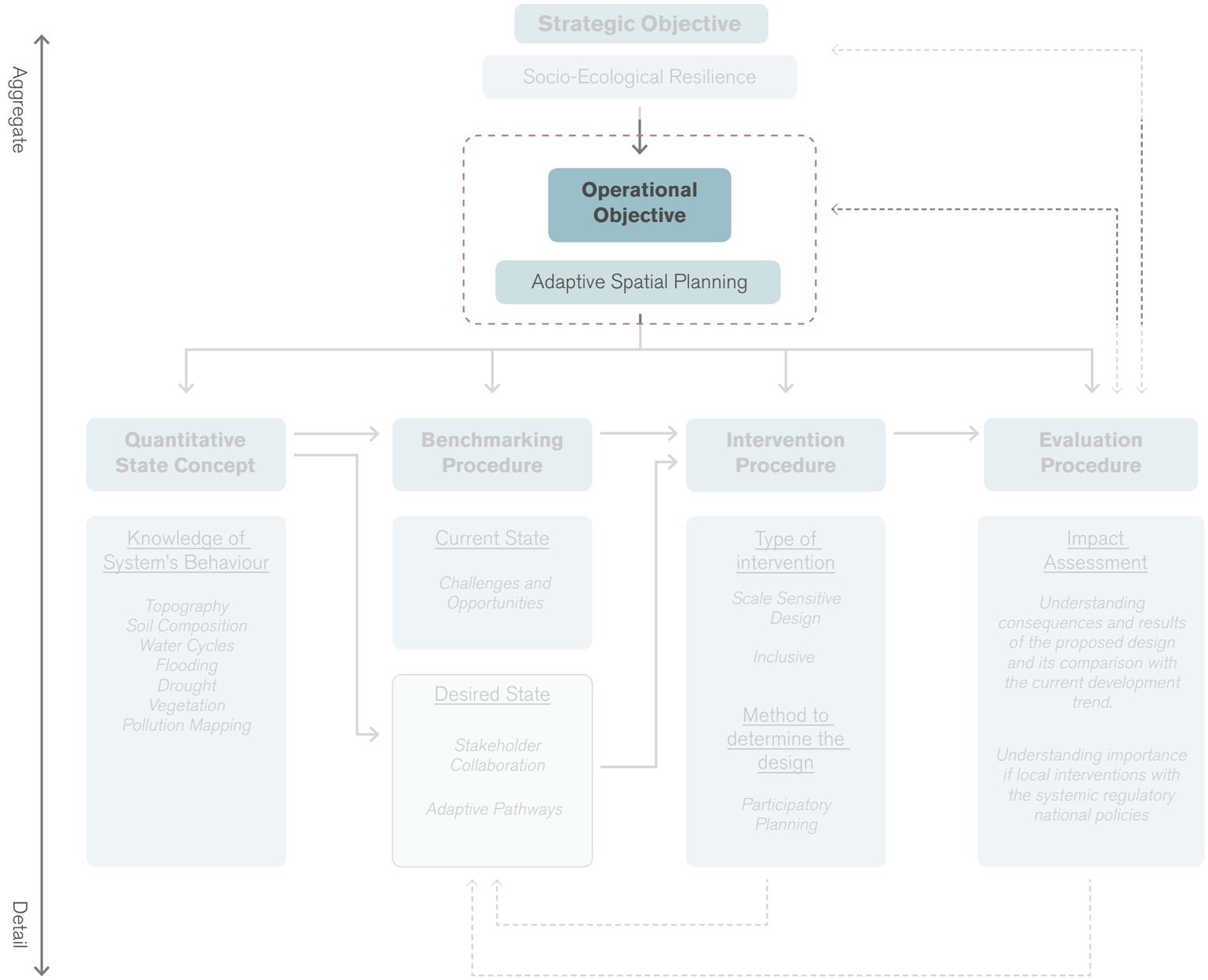
Diverse

Frame of Reference: Strategic Objective

Spatiality of Resilience

	Robustness	Adaptivity	Connectedness	Diversity
Urban Planning	 Systemic goals and vision	 Flexible design framework	 Connecting functions (Polycentricity)	 Mix-use development
Landscape Architecture		 Flood-able, multi-purpose landscape	 Connecting ecology	 Biodiversity
Water Management and Engineering	 100 year disaster protection	 Flexible capacity system	 Integrated water management	 Multiple water source and storage
Governance and Society	 Stronger bonds between community and government	 Flexible policies	 Awareness and participation	 Multiple approach route

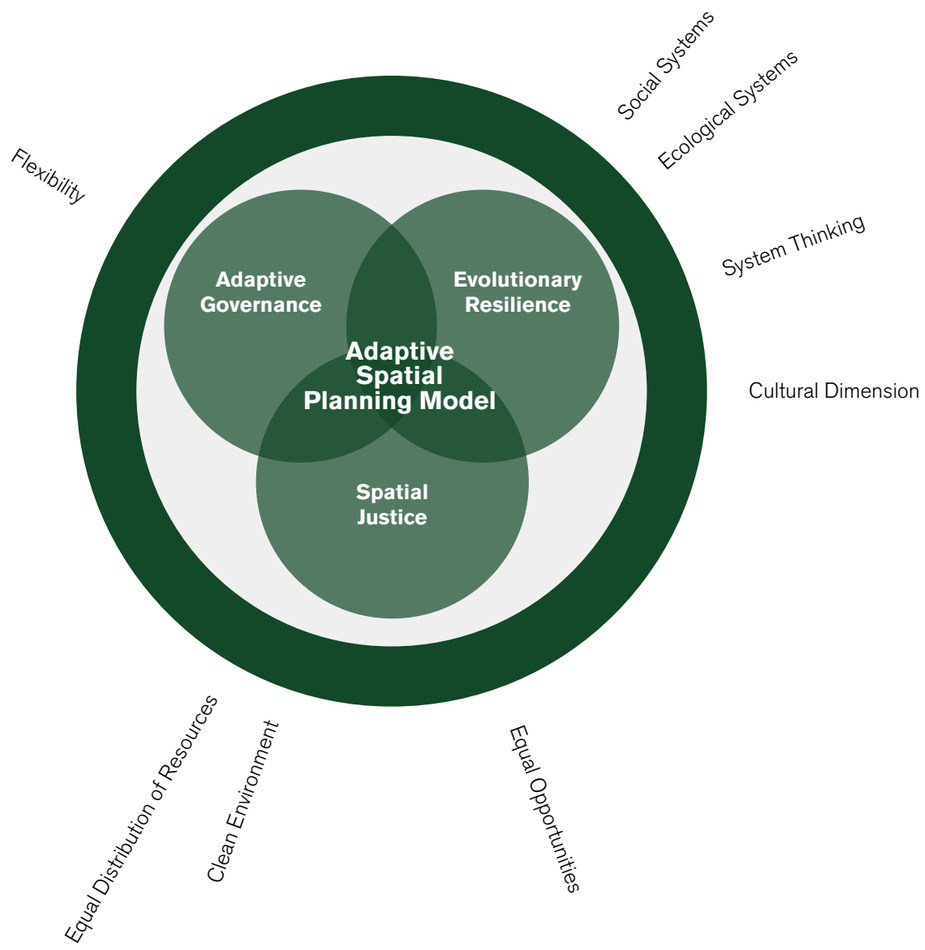
Frame of Reference: Operational Objective



Source: Van Koningsveld, 2003, modified by author

Frame of Reference: Operational Objective

Adaptive Spatial Planning

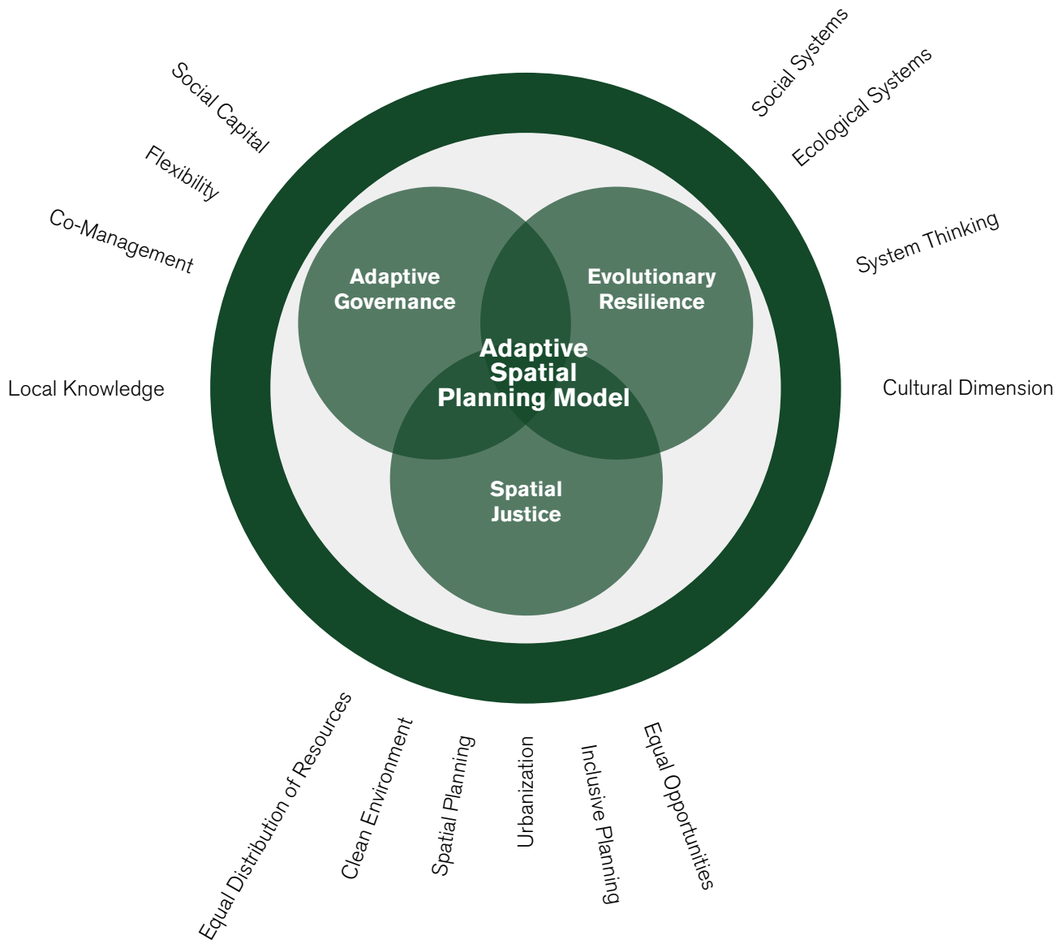


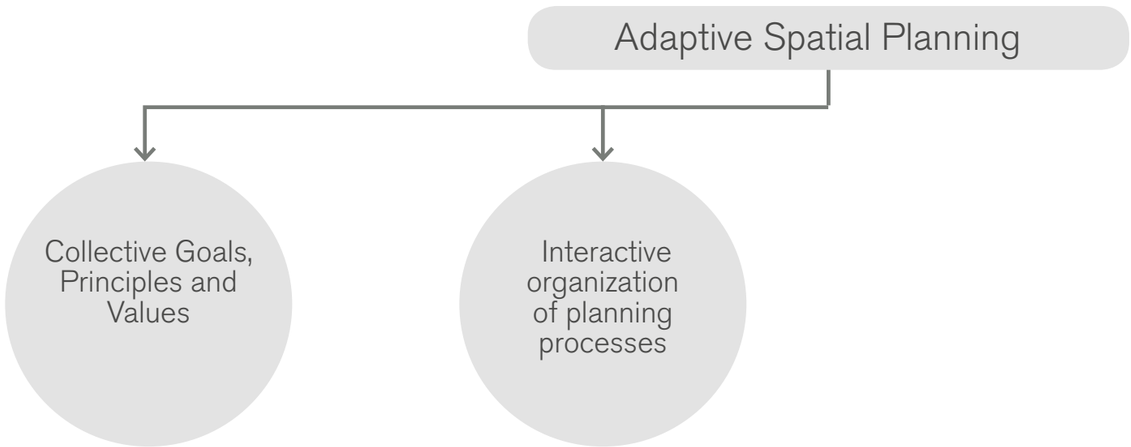
Adaptive Spatial Planning

Collective Goals, Principles and Values

Frame of Reference: Operational Objective

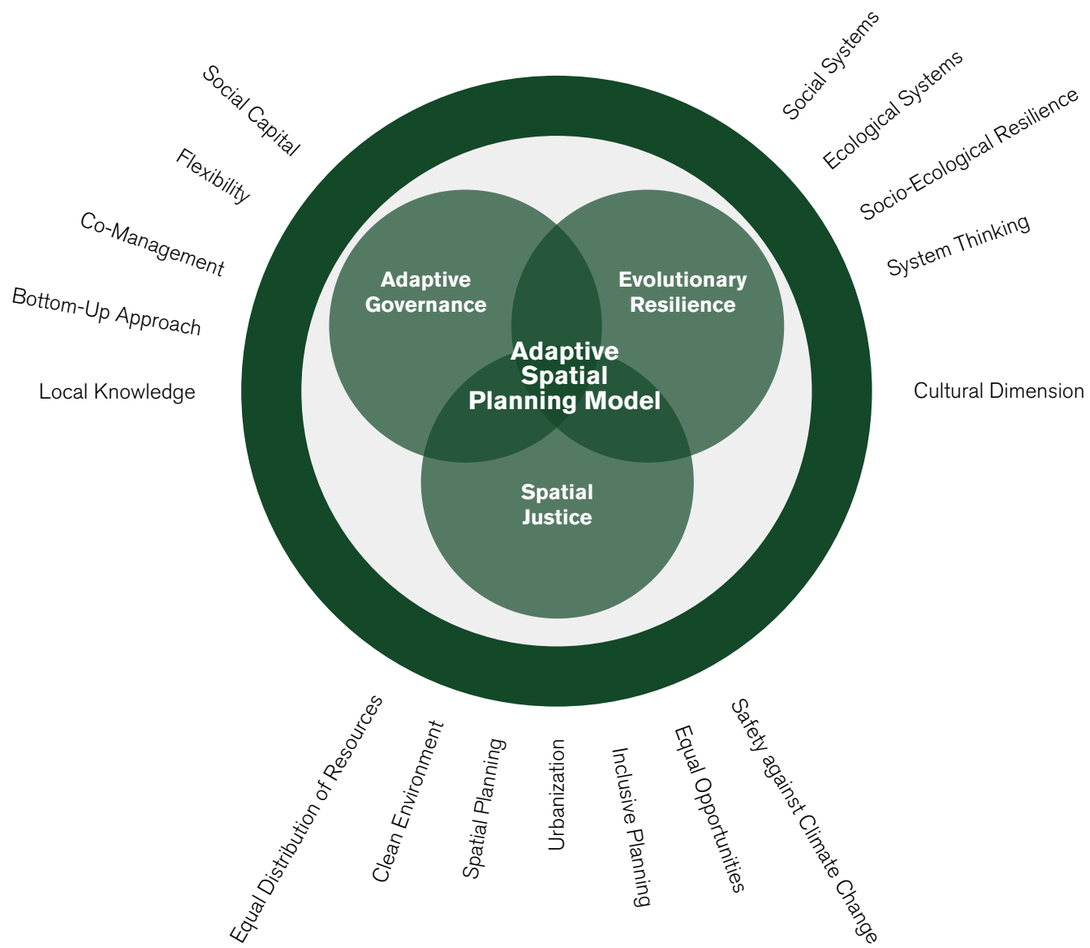
Adaptive Spatial Planning

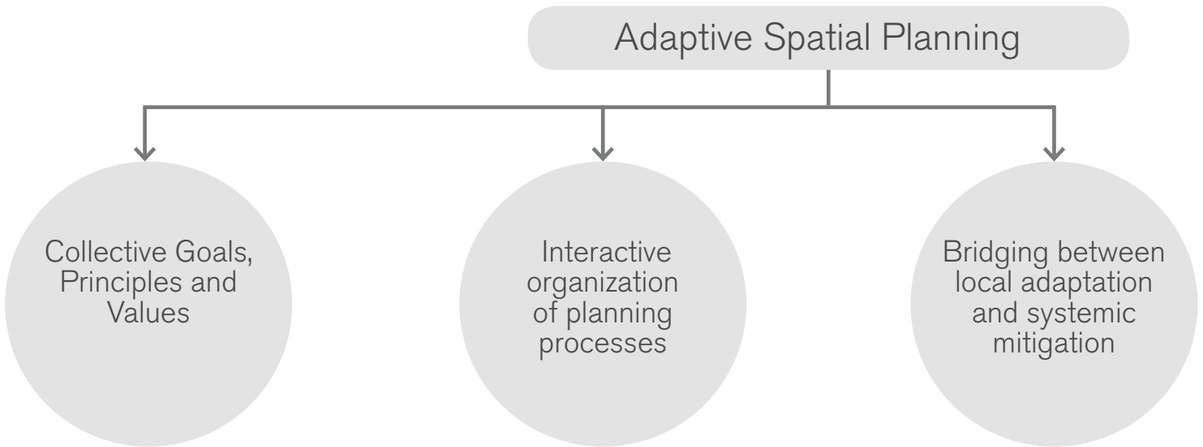




Frame of Reference: Operational Objective

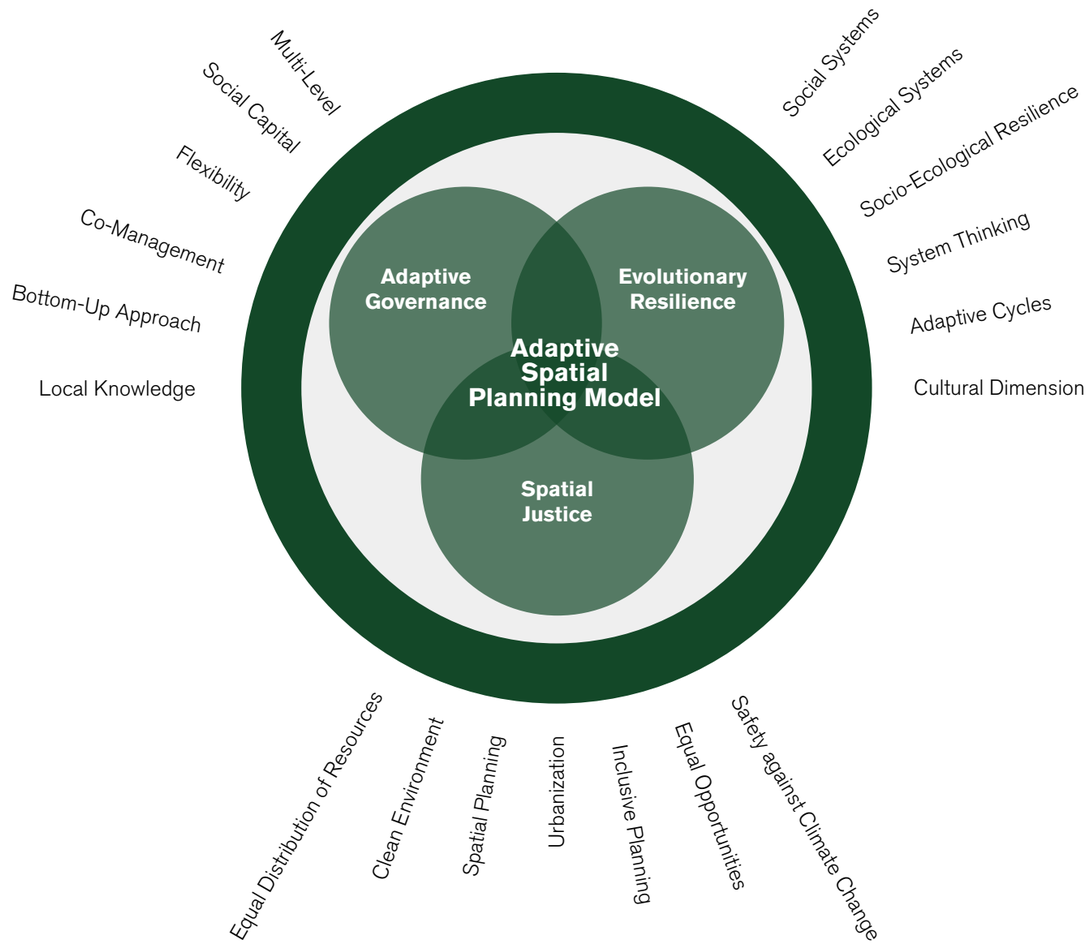
Adaptive Spatial Planning

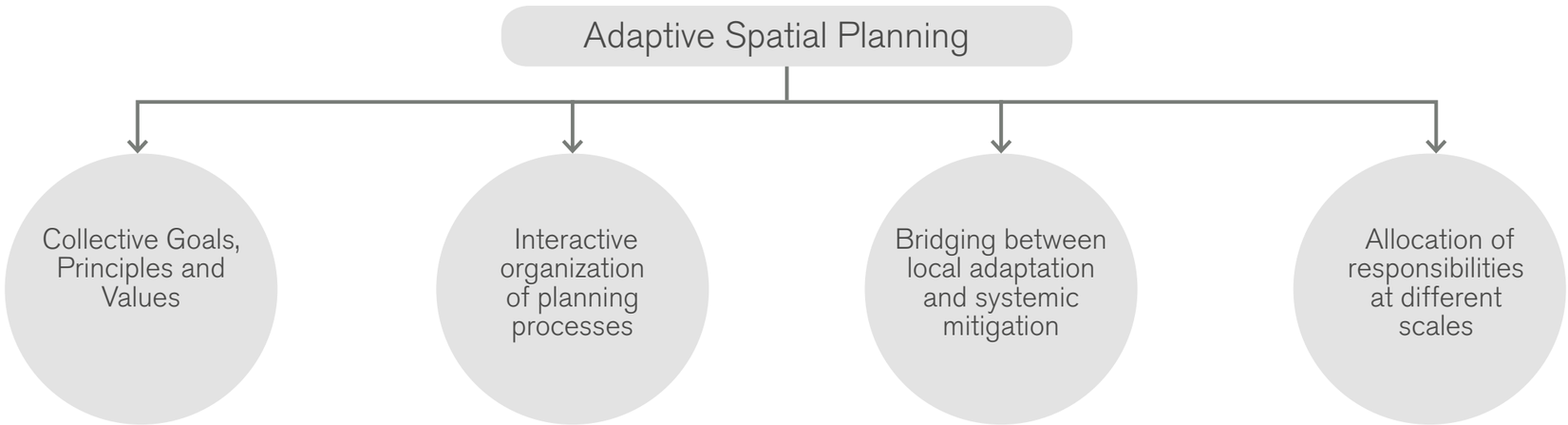




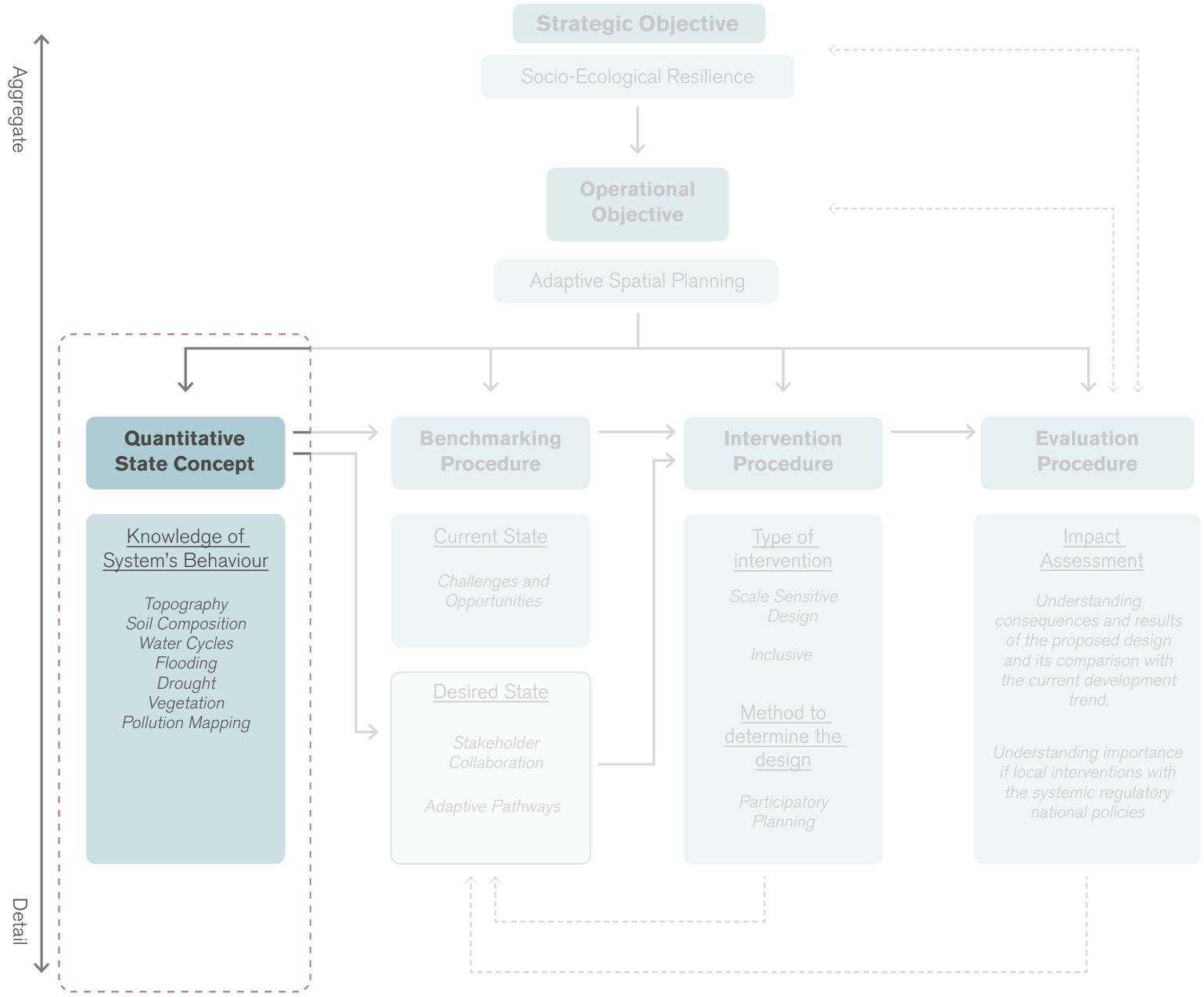
Frame of Reference: Operational Objective

Adaptive Spatial Planning





Frame of Reference: Quantitative State Concept



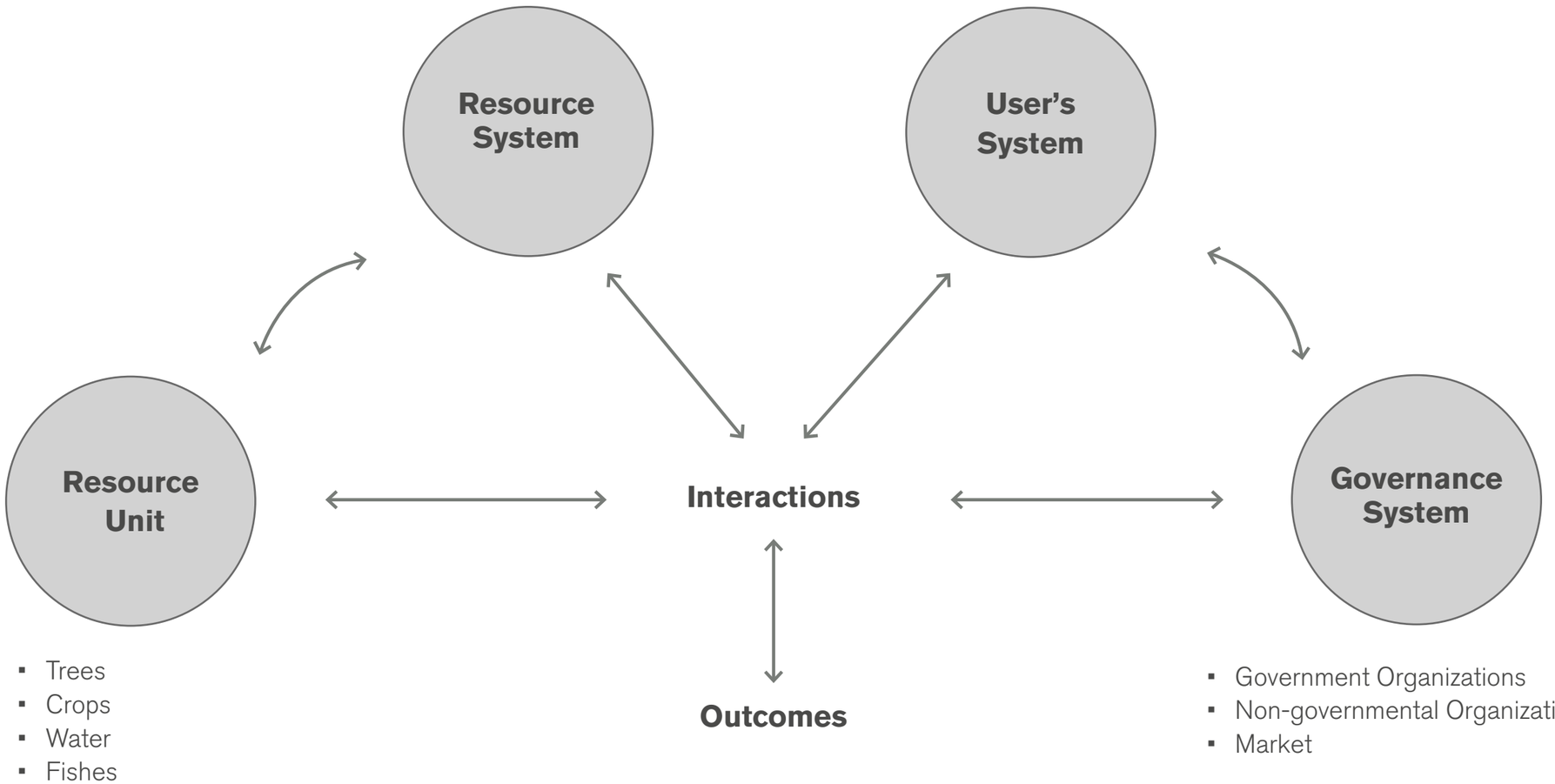
Source: Van Koningsveld, 2003, modified by author

Frame of Reference: Quantitative State Concept

Knowledge of System's Behaviour

- Forest
- Agricultural Fields
- Ground Water System
- Surface Water System
- Urban Vegetation

- Farmers
- Fishermen
- Tourists
- Local Community



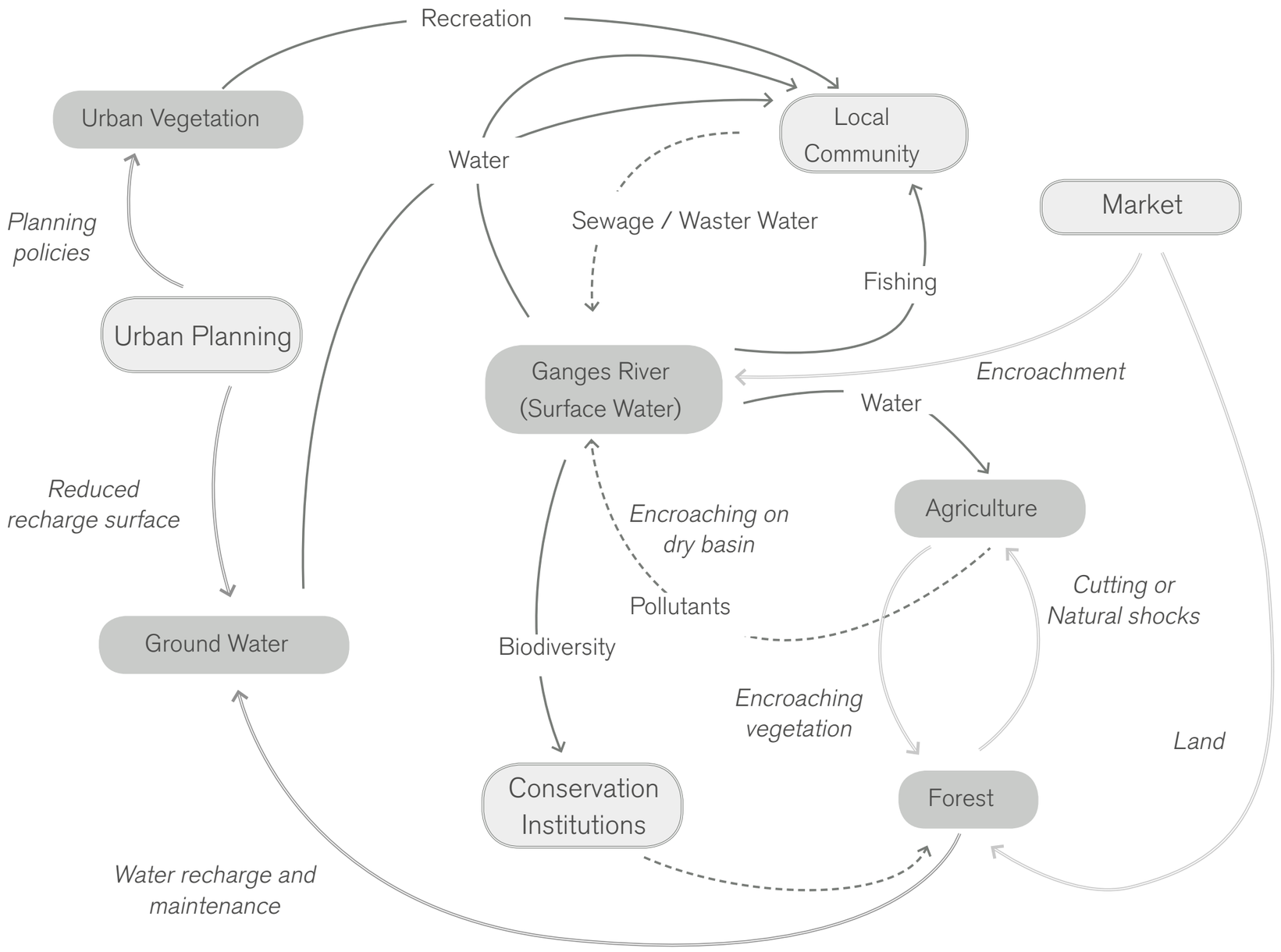
- Trees
- Crops
- Water
- Fishes

- Government Organizations
- Non-governmental Organizations
- Market

Source: Ostrom, 2009, adapted by author

Frame of Reference: Quantitative State Concept

Knowledge of System's Behaviour

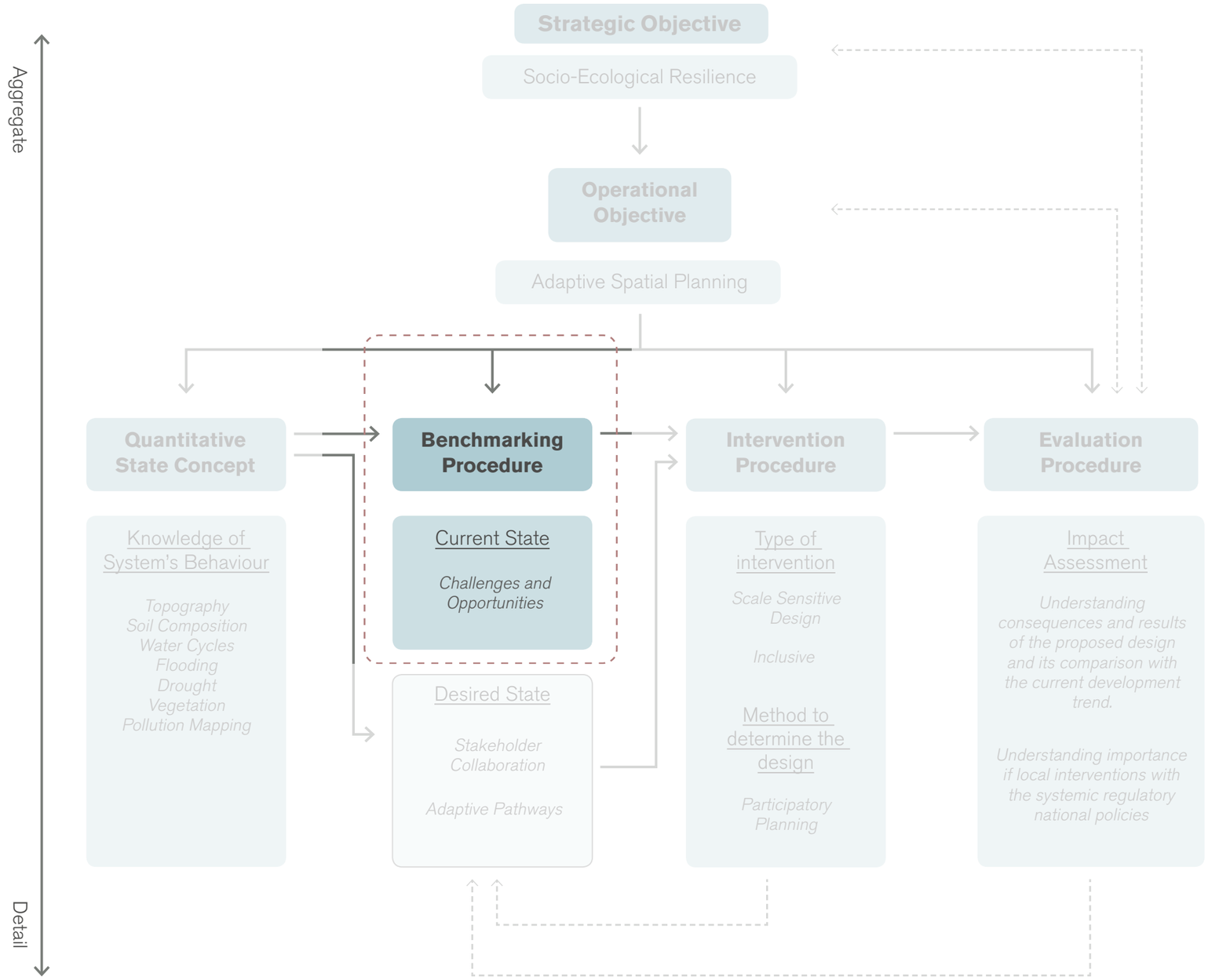


Multi-level external systems that govern resource systems → Pressures/uses generated by user system

Resource systems → Flows of resources

Source: Ostrom, 2009, adapted by author

Frame of Reference: Current State

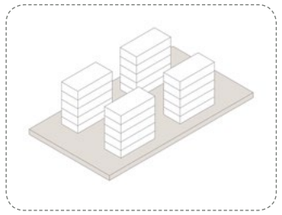


Source: Van Koningsveld, 2003, modified by author

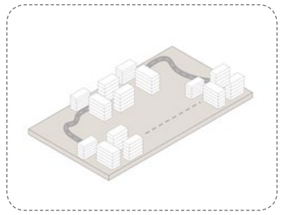
Frame of Reference: Current State

Challenges and Opportunities

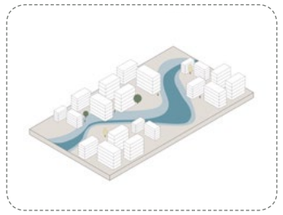
Urban Planning



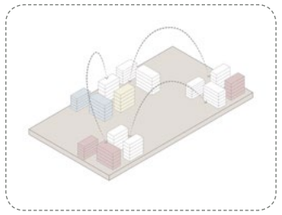
1. Rural areas and 2nd tier cities lack diversity in function and depend on urban centres



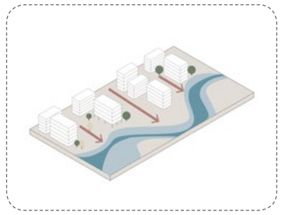
2. Lack of robust infrastructure networks



3. High population and dense urban fabric, leading to high pressure on land



1. Connecting 2nd tier cities and rural areas to reduce pressure on urban centres



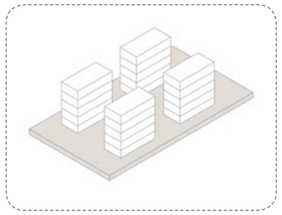
2. Re-orienting cities towards river to establish relation

3. Diverse and ecologically integrated urban fabric.

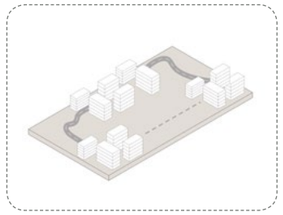
Frame of Reference: Current State

Challenges and Opportunities

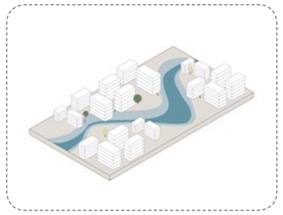
Urban Planning



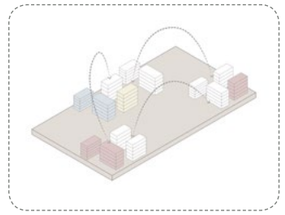
1. Rural areas and 2nd tier cities lack diversity in function and depend on urban centres



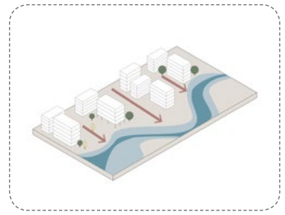
2. Lack of robust infrastructure networks



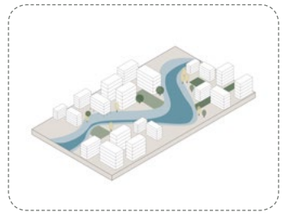
3. High population and dense urban fabric, leading to high pressure on land



1. Connecting 2nd tier cities and rural areas to reduce pressure on urban centres

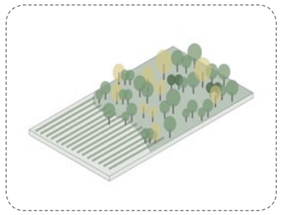


2. Re-orienting cities towards river to establish relation



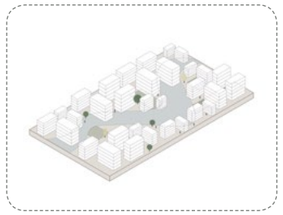
3. Diverse and ecologically integrated urban fabric.

Landscape Architecture

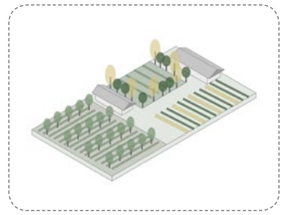


1. Invasion of landscapes by cash crops and exotic species

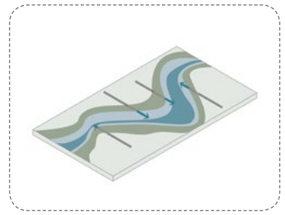
2. Lack of priority and funding for ecology centric landscape development projects.



3. Insufficient land for ecological nature based interventions.



1. Potential for development of agro-forestry for ecological and economic gains



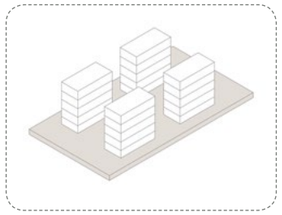
2. Plantations to reduce ground and river pollution

3. Exploit potentials of social use of landscape

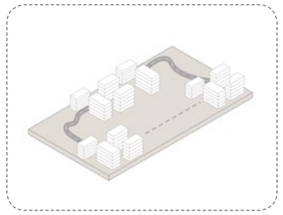
Frame of Reference: Current State

Challenges and Opportunities

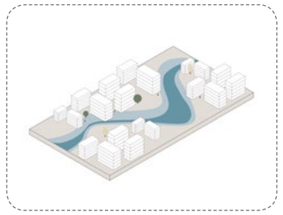
Urban Planning



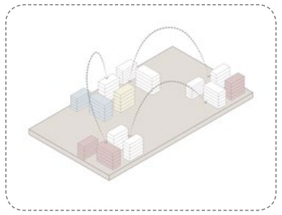
1. Rural areas and 2nd tier cities lack diversity in function and depend on urban centres



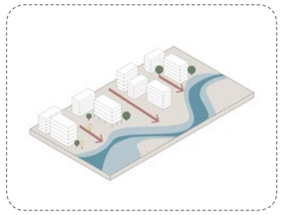
2. Lack of robust infrastructure networks



3. High population and dense urban fabric, leading to high pressure on land



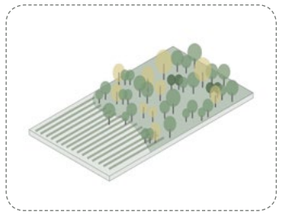
1. Connecting 2nd tier cities and rural areas to reduce pressure on urban centres



2. Re-orienting cities towards river to establish relation

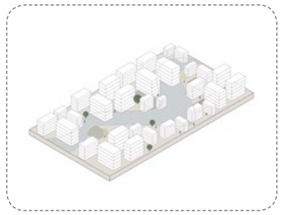
3. Diverse and ecologically integrated urban fabric.

Landscape Architecture

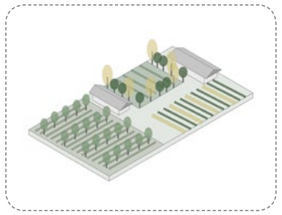


1. Invasion of landscapes by cash crops and exotic species

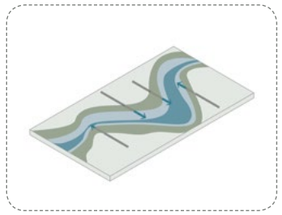
2. Lack of priority and funding for ecology centric landscape development projects.



3. Insufficient land for ecological nature based interventions.



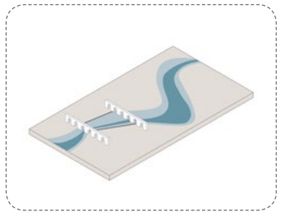
1. Potential for development of agro-forestry for ecological and economic gains



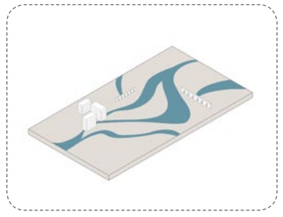
2. Plantations to reduce ground and river pollution

3. Exploit potentials of social use of landscape

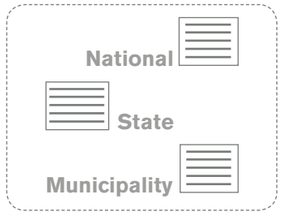
Water Management and Engineering



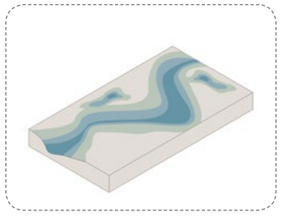
1. Extreme engineering and privatization of water resources



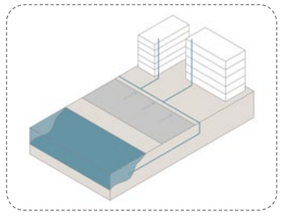
2. Fragmented water system.



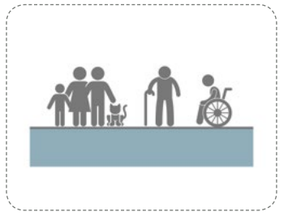
3. Multiple governance systems due to trans-state river basin.



1. Nature based, soft solutions to tackle flooding challenges



2. Integration of water management with new infrastructure.

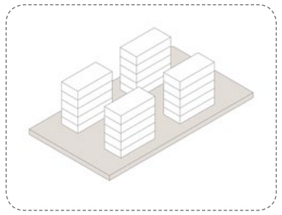


3. Equal distribution and access to water resources

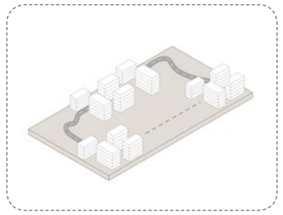
Frame of Reference: Current State

Challenges and Opportunities

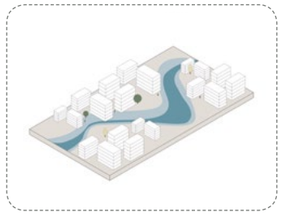
Urban Planning



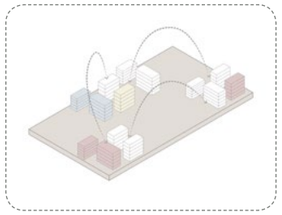
1. Rural areas and 2nd tier cities lack diversity in function and depend on urban centres



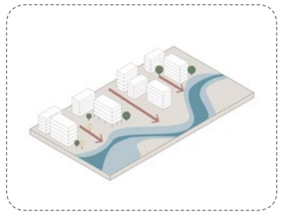
2. Lack of robust infrastructure networks



3. High population and dense urban fabric, leading to high pressure on land



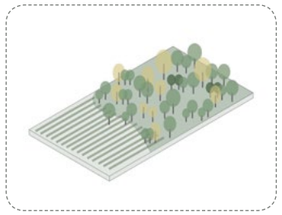
1. Connecting 2nd tier cities and rural areas to reduce pressure on urban centres



2. Re-orienting cities towards river to establish relation

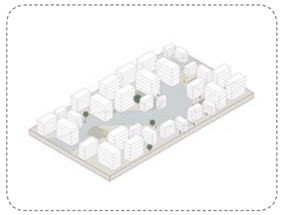
3. Diverse and ecologically integrated urban fabric.

Landscape Architecture

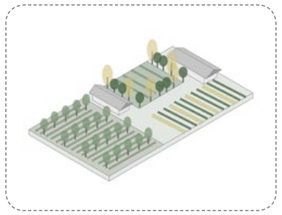


1. Invasion of landscapes by cash crops and exotic species

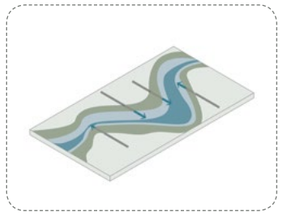
2. Lack of priority and funding for ecology centric landscape development projects.



3. Insufficient land for ecological nature based interventions.



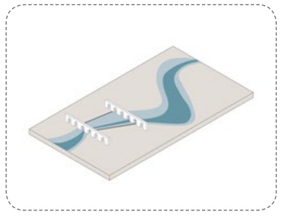
1. Potential for development of agro-forestry for ecological and economic gains



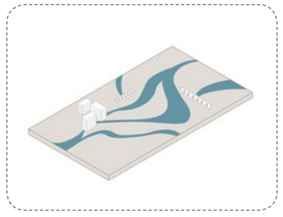
2. Plantations to reduce ground and river pollution

3. Exploit potentials of social use of landscape

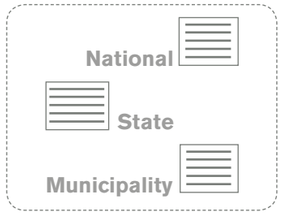
Water Management and Engineering



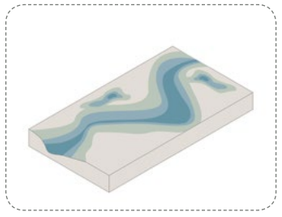
1. Extreme engineering and privatization of water resources



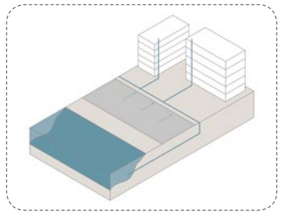
2. Fragmented water system.



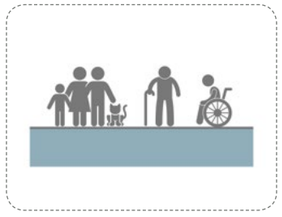
3. Multiple governance systems due to trans-state river basin.



1. Nature based, soft solutions to tackle flooding challenges



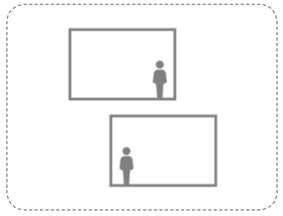
2. Integration of water management with new infrastructure.



3. Equal distribution and access to water resources

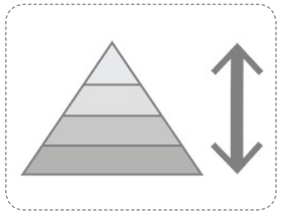
Governance and Society

1. Cultural practices and habits

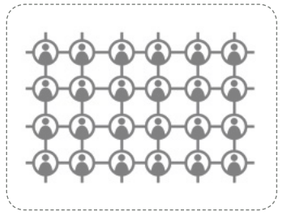


2. Low public engagement capacity

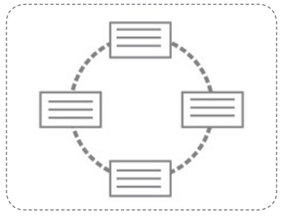
3. Lack of education and awareness



1. Bottom up planning to include local expertise

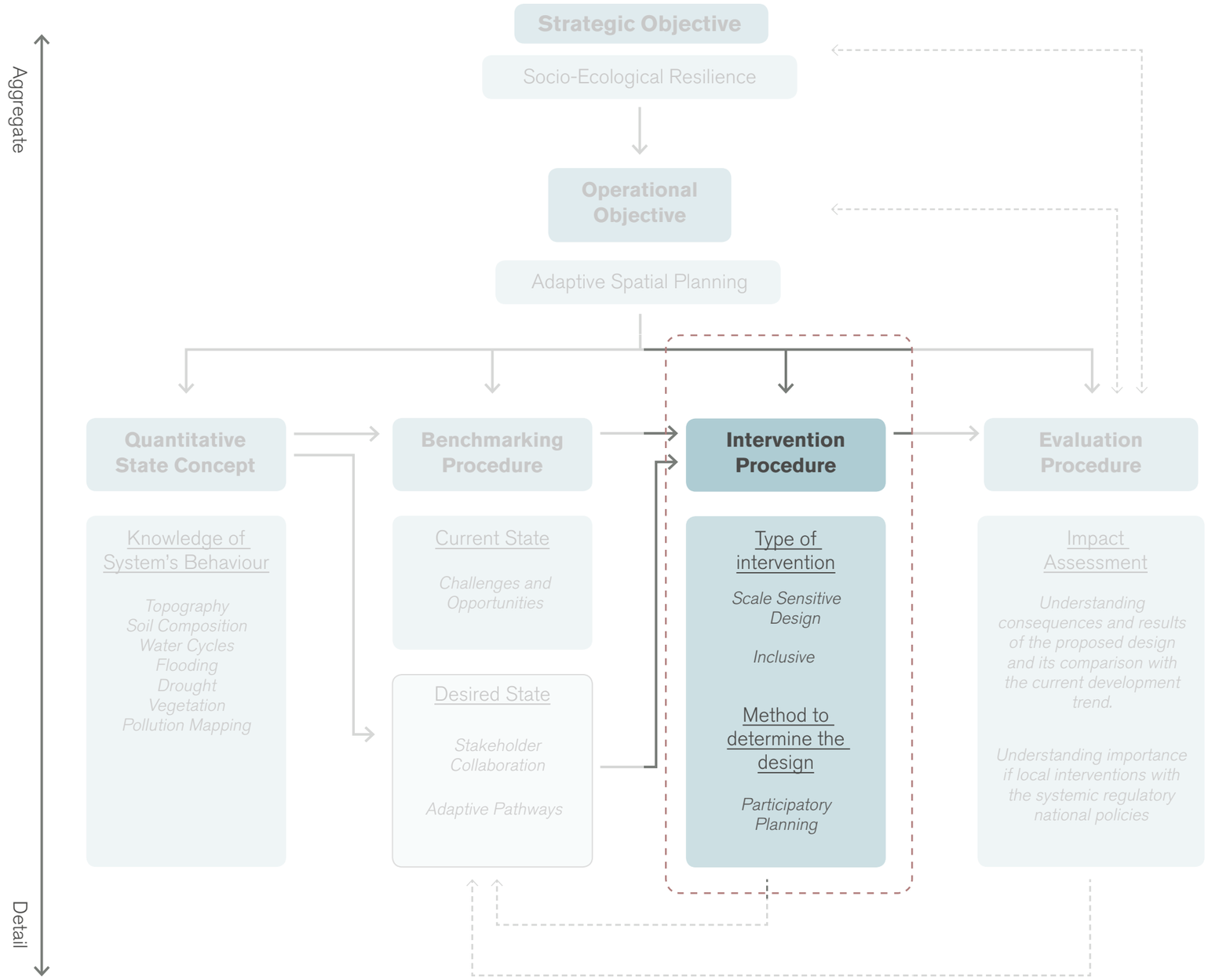


2. Existing social bonds and strong sense of community



3. Multi-sectoral and multi-level stakeholder collaboration and distribution of responsibilities.

Frame of Reference: Intervention Procedure

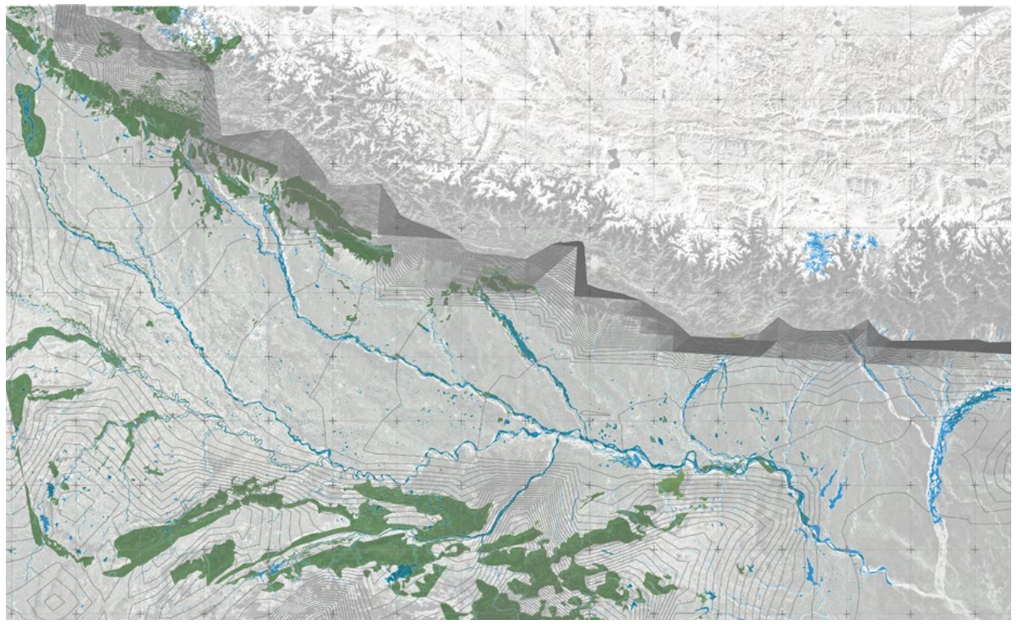


Source: Van Koningsveld, 2003, modified by author

Frame of Reference: Intervention Procedure

Scale Sensitive Design

Scale 1:
Regional Strategies for Macro Scale:

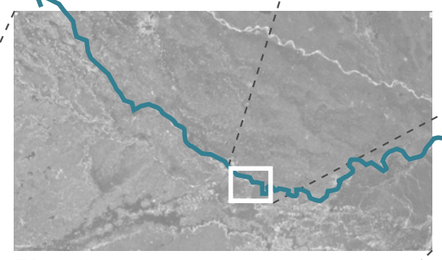


RS1: Room for the River
RS2: Landscape Interventions
RS3: Comprehensive Connectivity
RS4: Pollution Management

Designing and Testing at Different Scales

Scale 2:
Design Strategies at Metropolitan Scale

MS1: Infrastructure Interventions
MS2: Landscape Interventions
MS3: Activating River-edge
MS4: Industrial Development

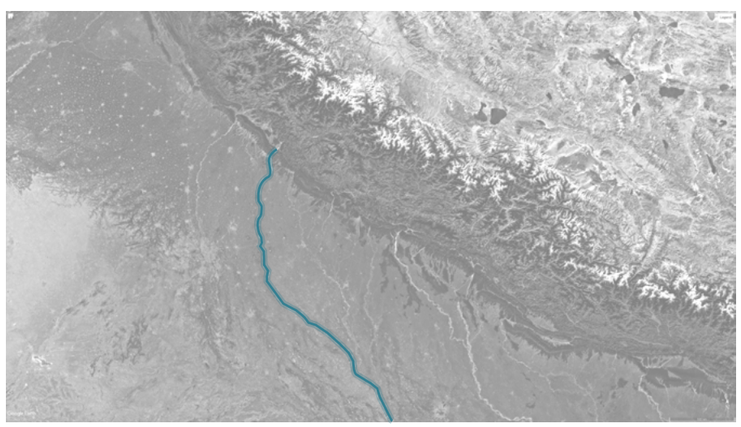


River Segment

Scale 3:
Local adaptation of Strategies

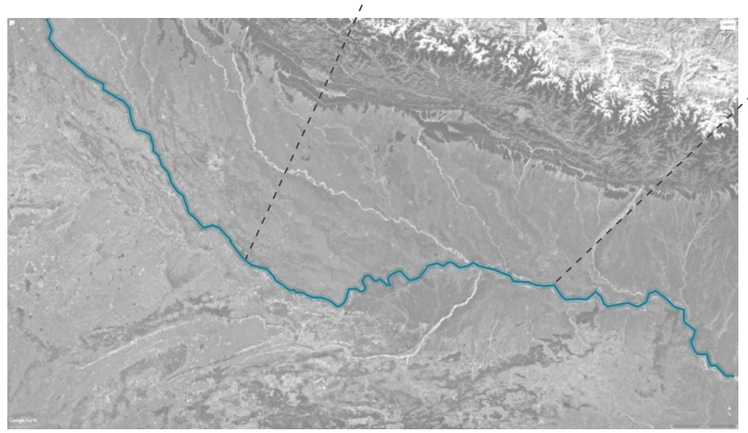
1. Urban
2. Peri-Urban
3. Rural

A. Hilly Section

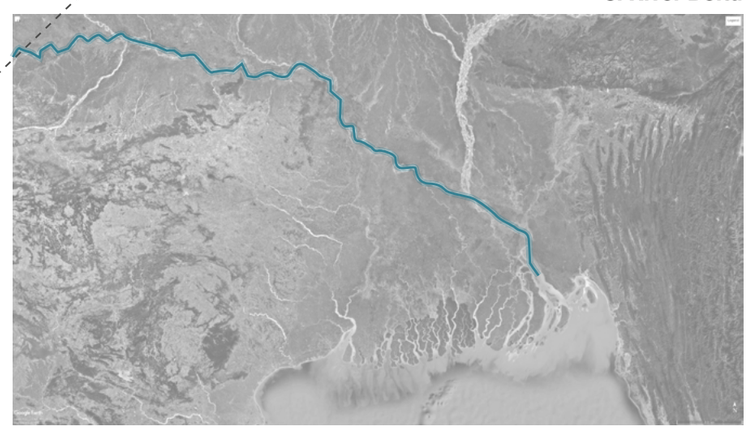


Sections of River

B. Flat Plains



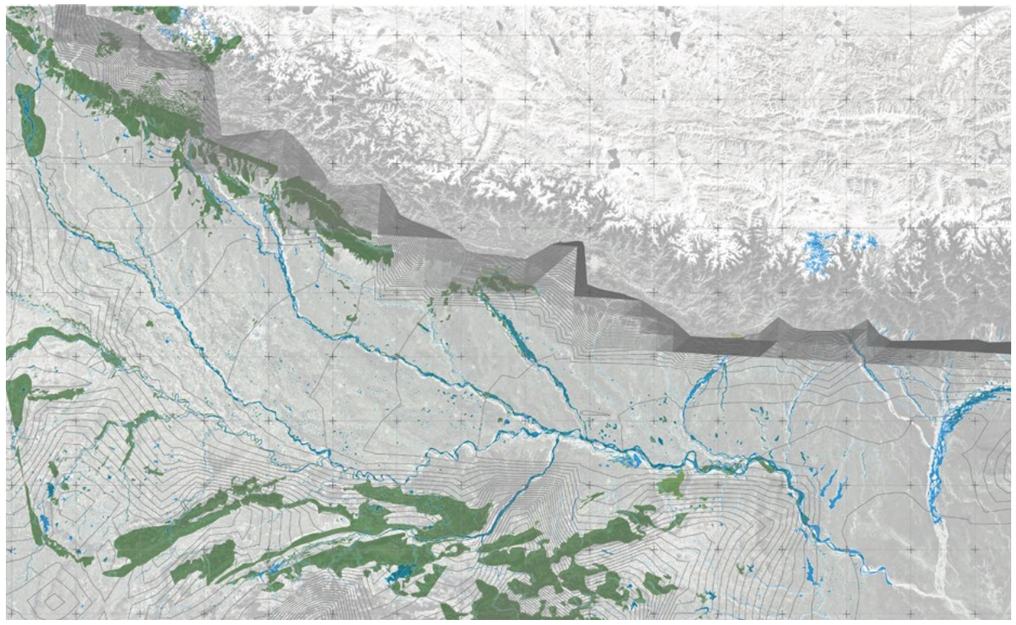
C. River Delta



Frame of Reference: Intervention Procedure

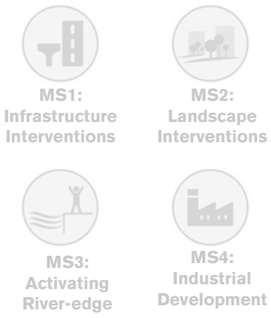
Scale Sensitive Design: Regional Scale

Scale 1:
Regional Strategies for Macro Scale:



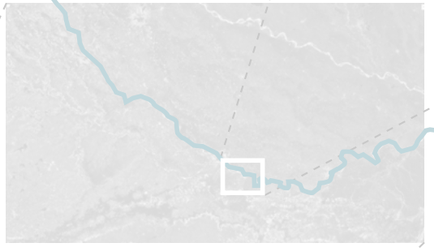
Designing and Testing at Different Scales

Scale 2:
Design Strategies at Metropolitan Scale



Scale 3:
Local adaptation of Strategies

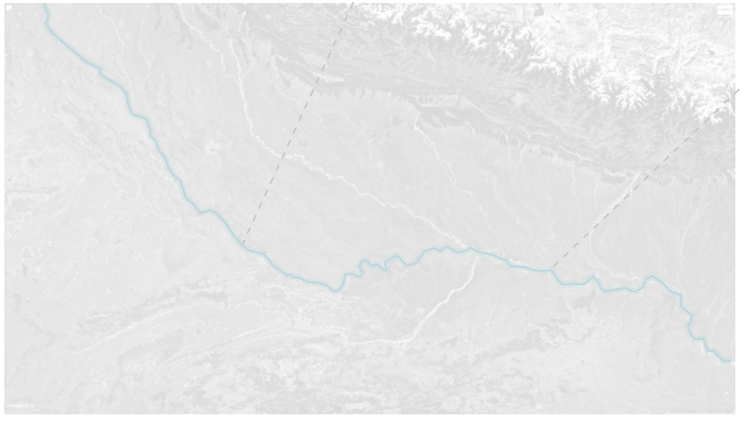
1. Urban
2. Peri-Urban
3. Rural



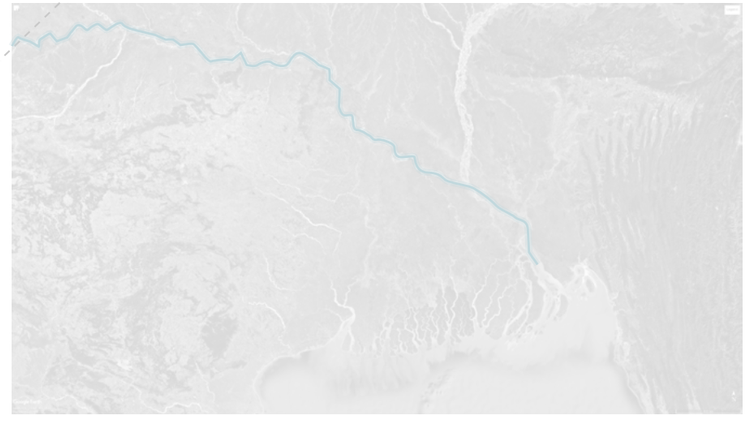
River Segment

A. Hilly Section

B. Flat Plains



C. River Delta



Sections of River

Frame of Reference: Intervention Procedure

Scale Sensitive Design: Regional Scale

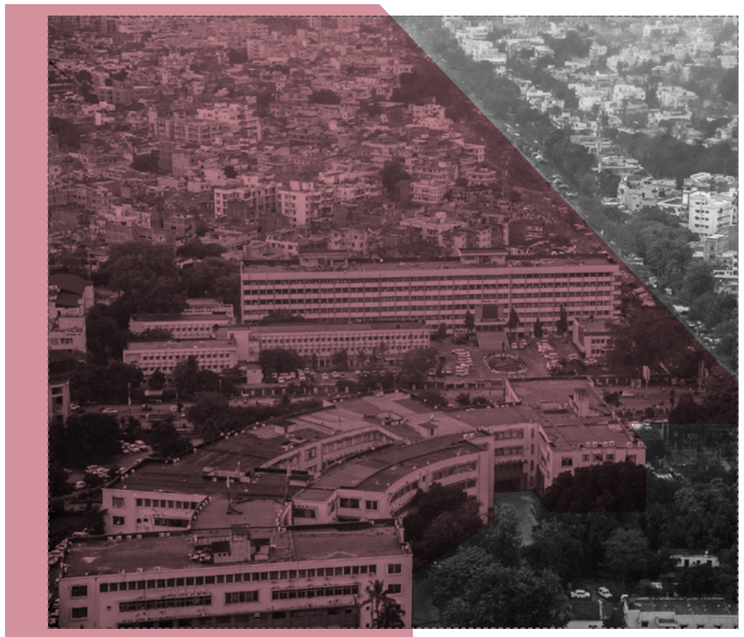
1. Highly engineered river basin

Source: gaonconnection, edited by author

2. Water Crisis and Flooding

Source: ANI Commuters, DNA India, edited by author

3. Pressurized Urban Centers



Source: Saurav Anuraj. Patnabeats, edited by author

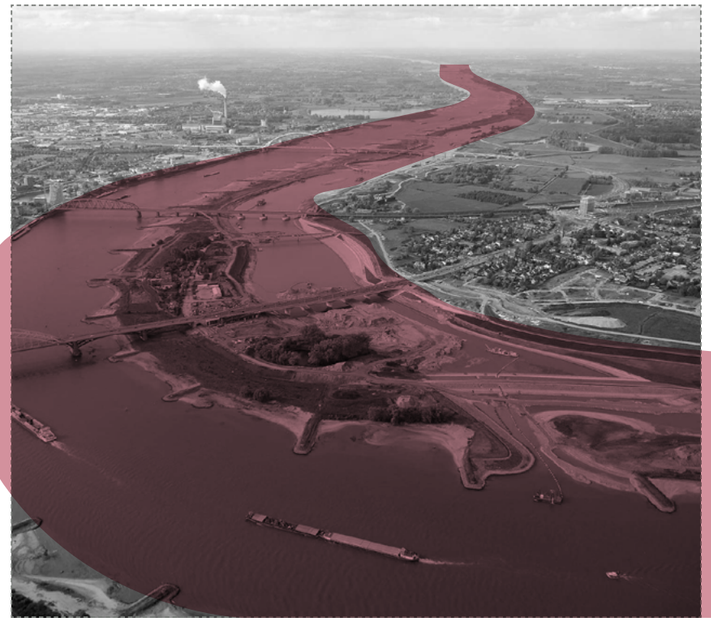
4. Water Pollution

Source: Daniel Bachhuber, Alliance for Water Stewardship, edited by author

Frame of Reference: Intervention Procedure

Scale Sensitive Design: Regional Scale

1. Creating room for the river



Source: Johan Roerink Aeropicture, Landezine, edited by author

RS1

2. Performative landscape strategy for water cycle management

Source: Surindar Singh Hara, thefarmstory, edited by author

RS2

RS3

3. Comprehensive connectivity across the basin

Source: Author

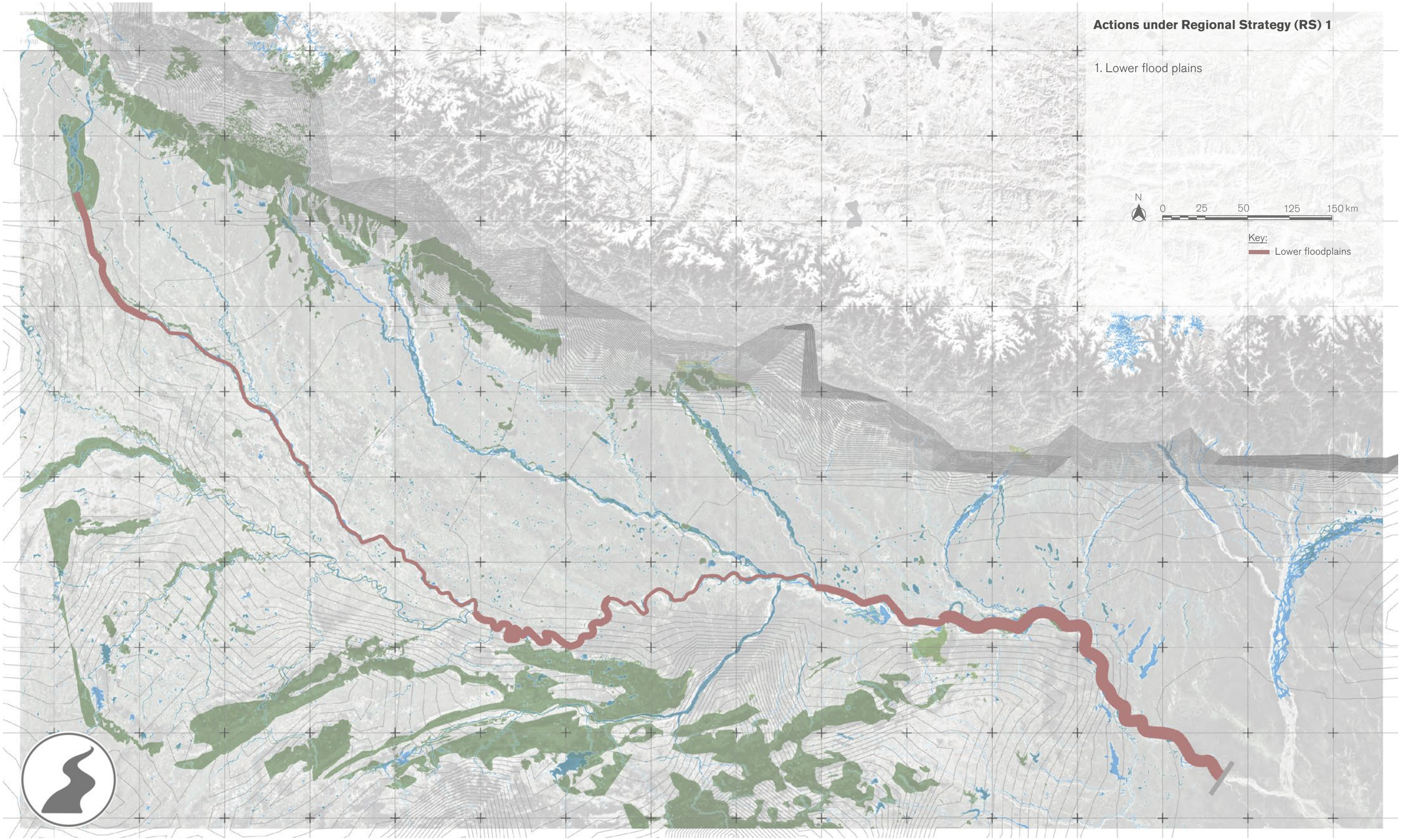
RS4

4. Pollution Management

Source: stormwatersystems, edited by author

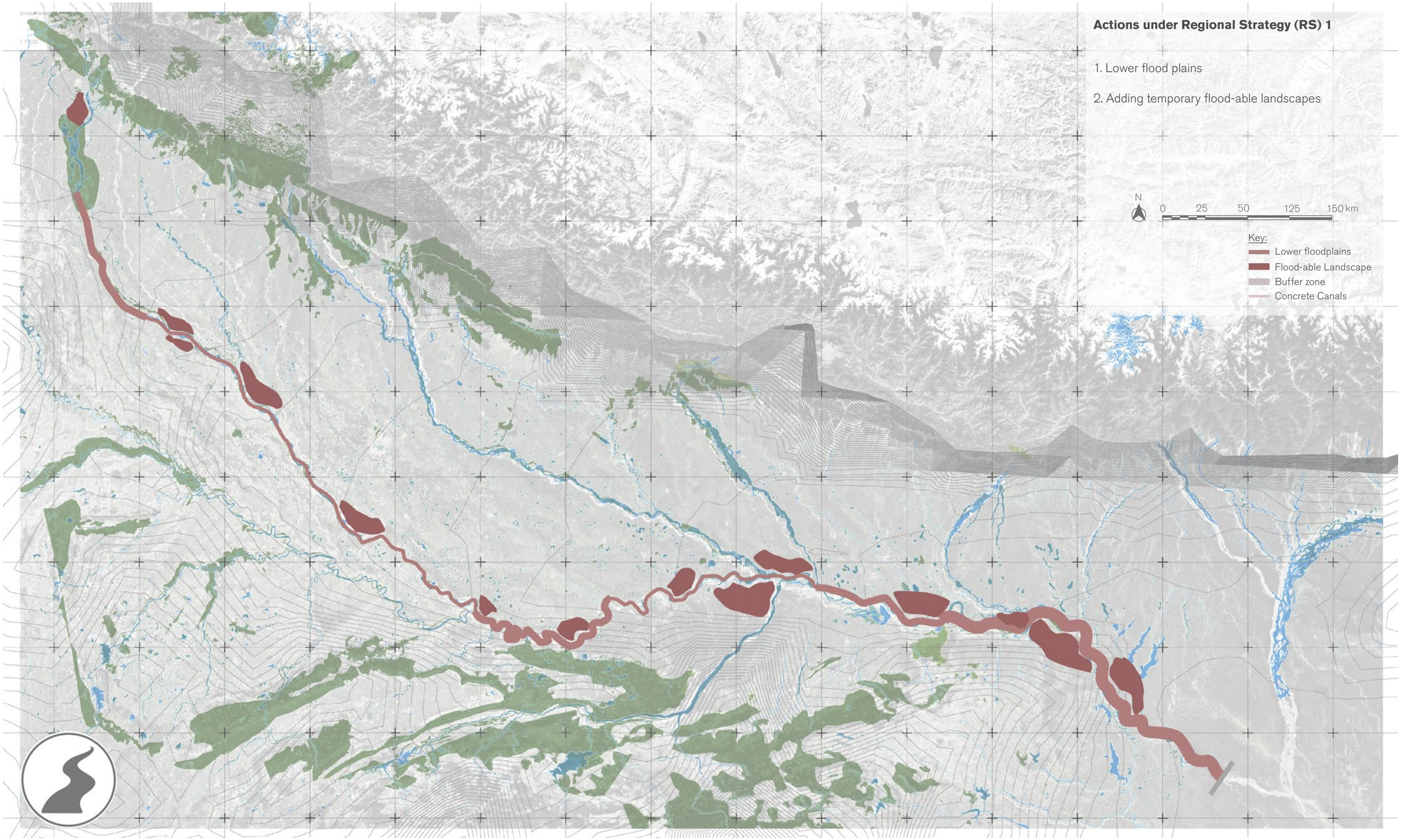
Scale Sensitive Design: Regional Scale

Strategy 1: Creating room for the river



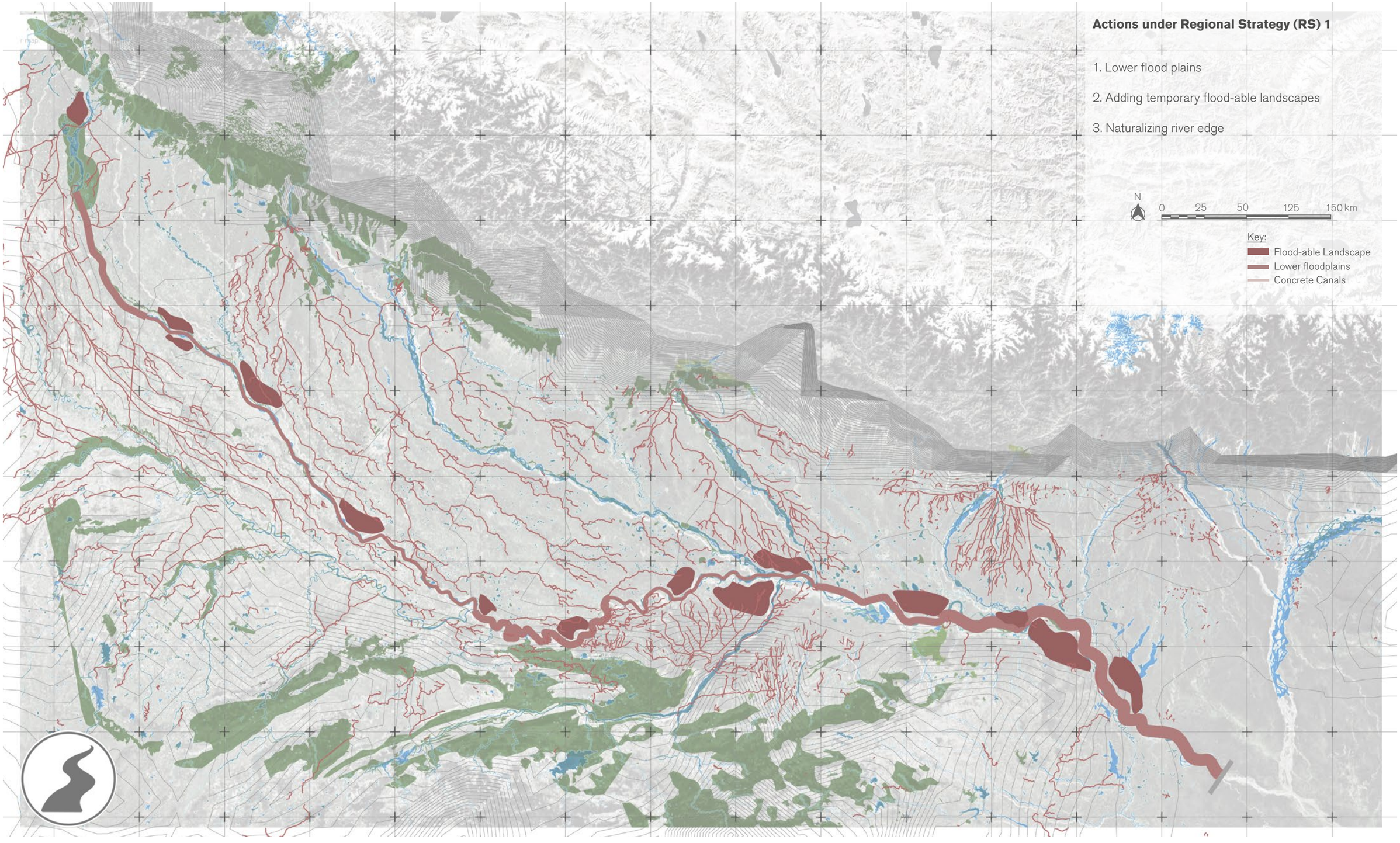
Scale Sensitive Design: Regional Scale

Strategy 1: Creating room for the river



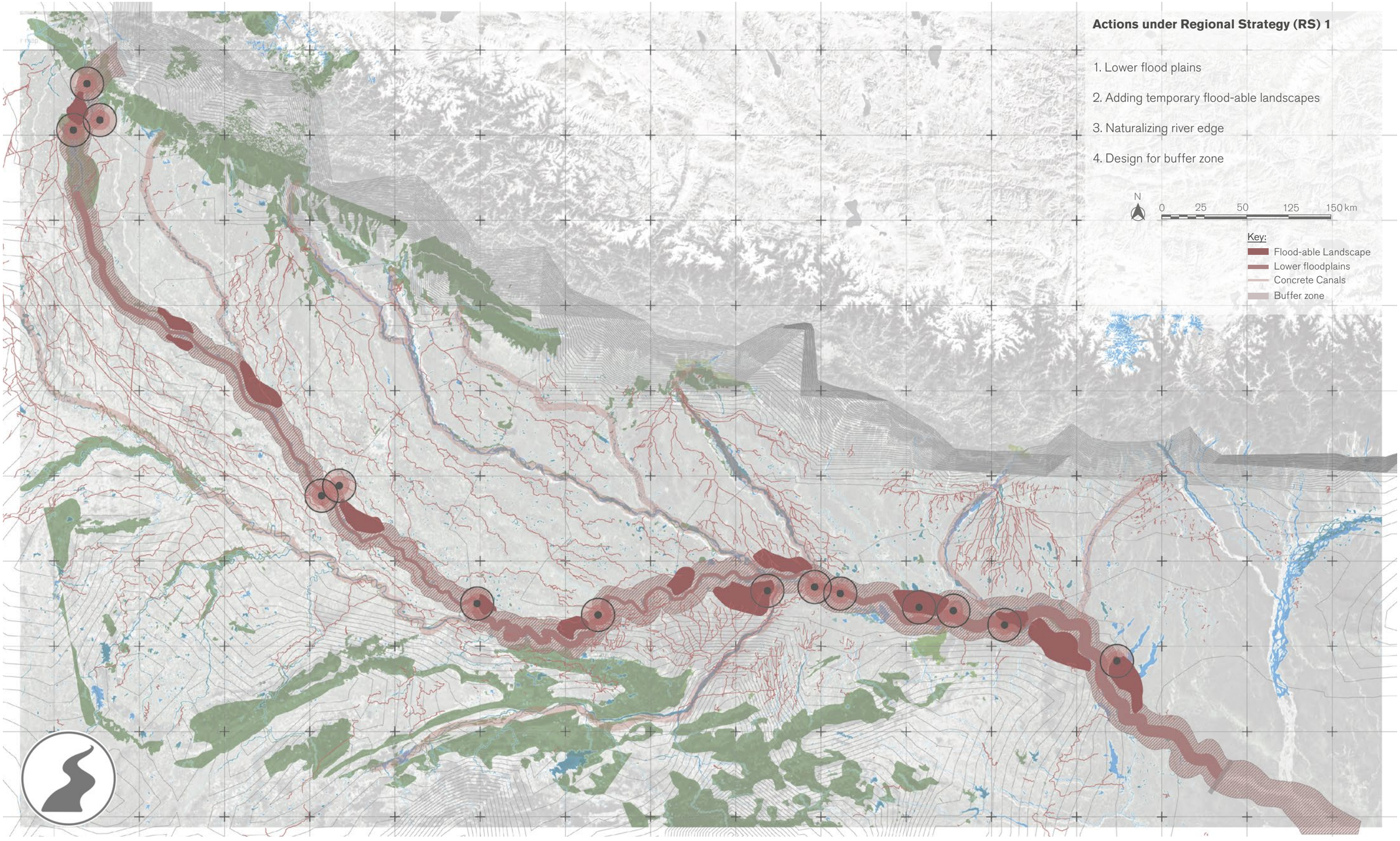
Scale Sensitive Design: Regional Scale

Strategy 1: Creating room for the river



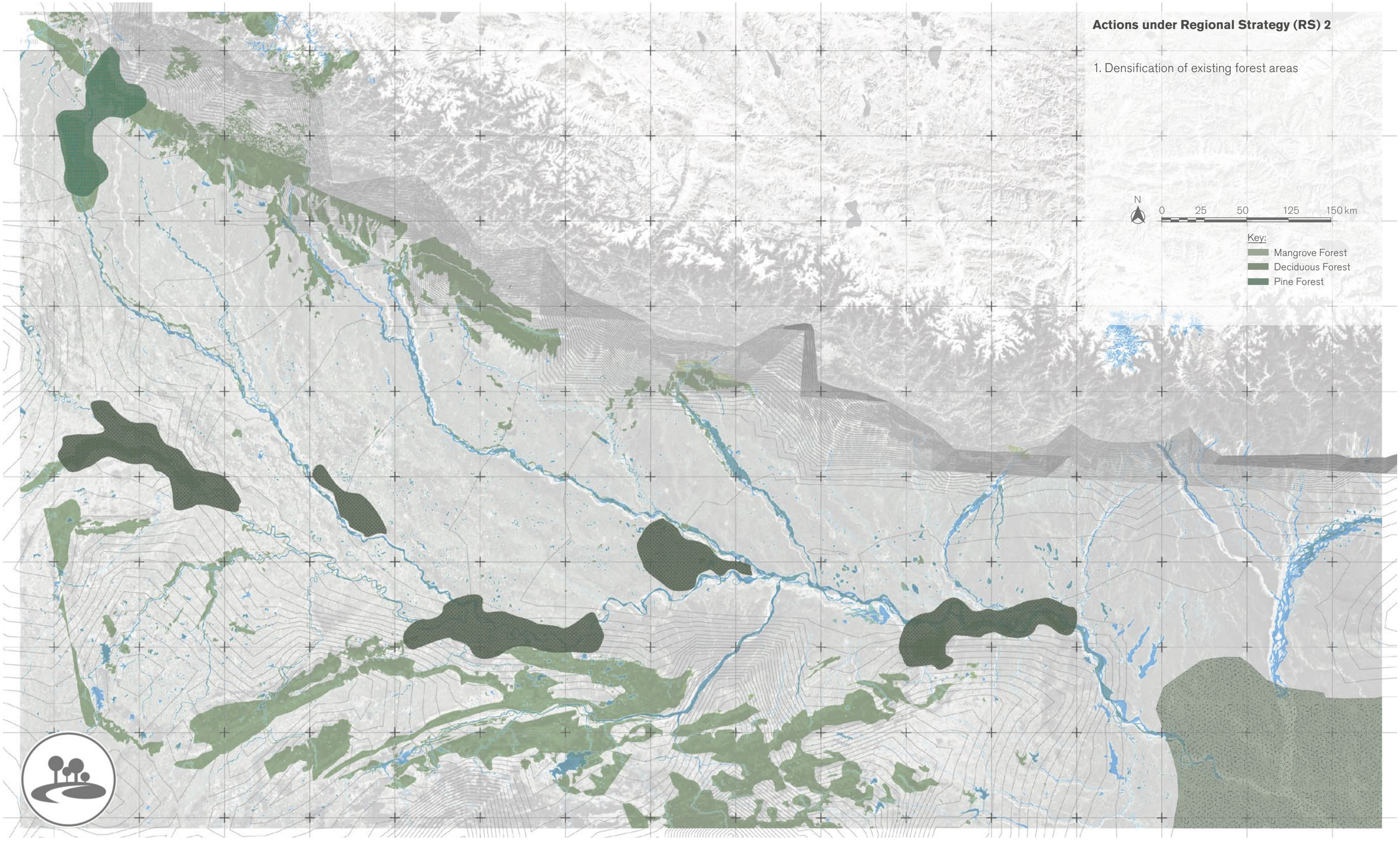
Scale Sensitive Design: Regional Scale

Strategy 1: Creating room for the river



Scale Sensitive Design: Regional Scale

Strategy 2: Performative landscape strategy for water cycle management



Scale Sensitive Design: Regional Scale

Strategy 2: Performative landscape strategy for water cycle management

Integrating diversity and different types of produce

Changing plantation pattern in agricultural fields to boast Agro-forestry

Actions under Regional Strategy (RS) 2

1. Densification of existing forest areas
2. Integrating diversity and different types of produce

N

0 25 50 125 150 km

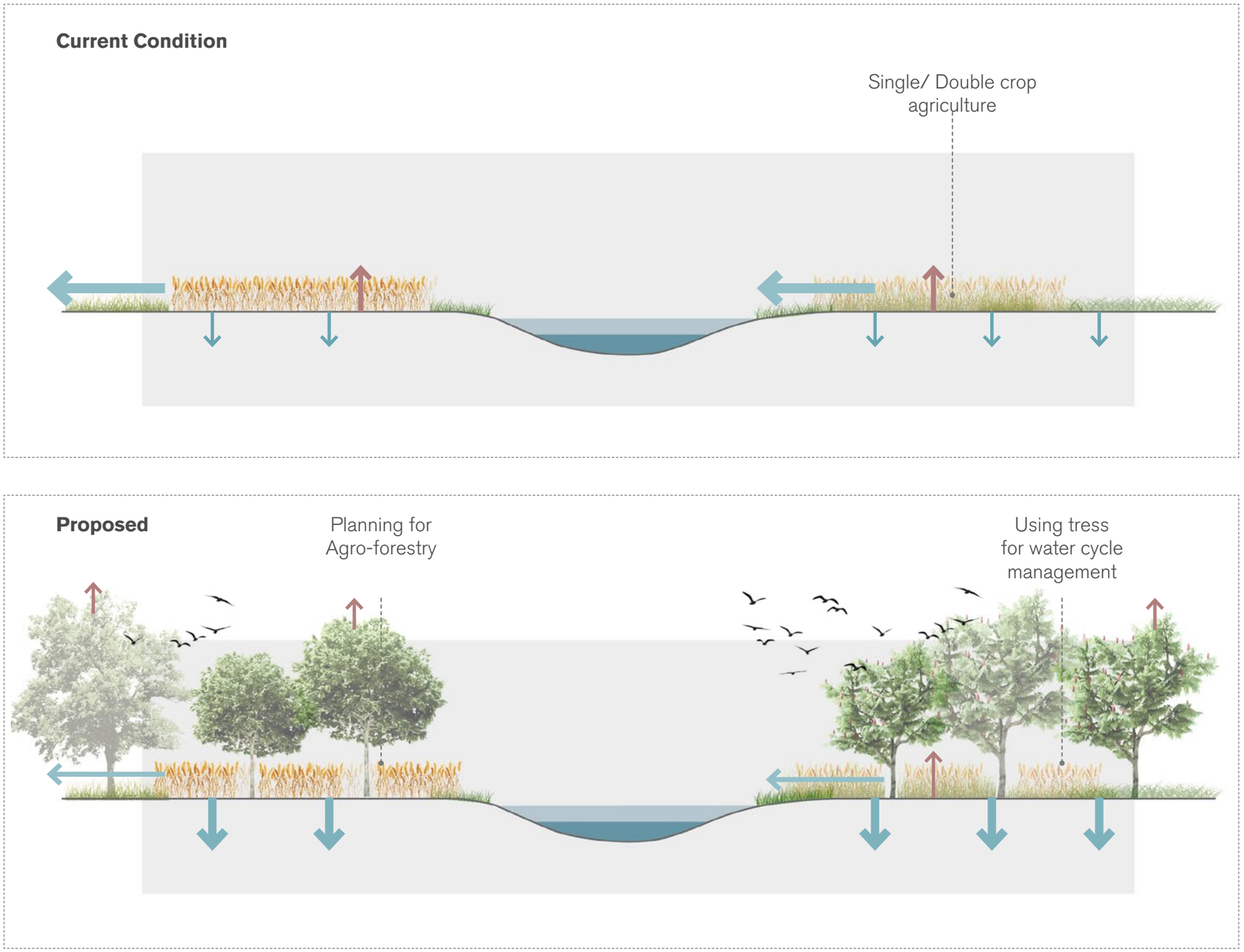
Key:

- Mangrove Forest
- Deciduous Forest
- Pine Forest
- Agriculture Fields

Scale Sensitive Design: Regional Scale

Strategy 2: Performative landscape strategy for water cycle management

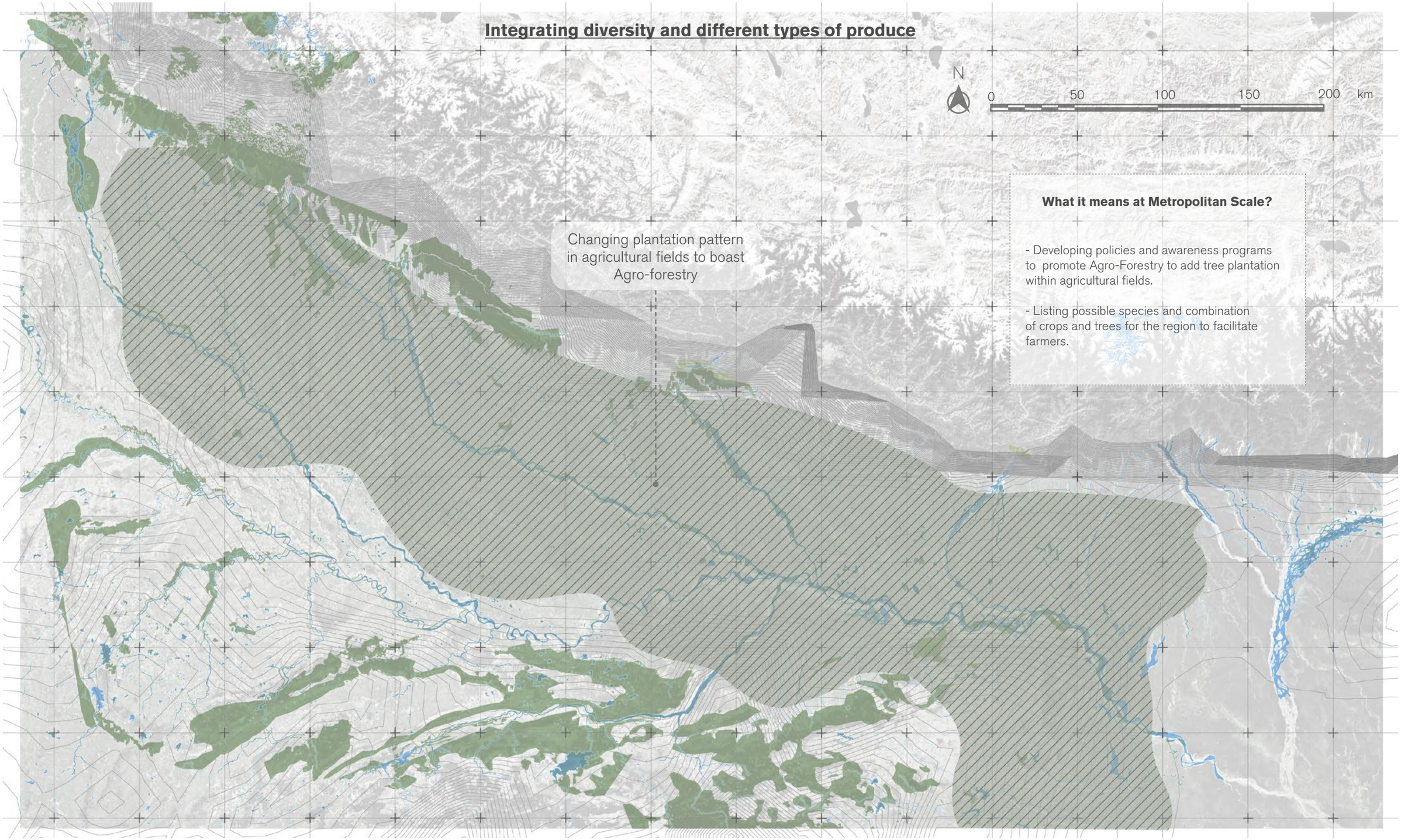
Integrating diversity and different types of produce



Scale Sensitive Design: Regional Scale

Strategy 2: Performative landscape strategy for water cycle management

Integrating diversity and different types of produce



What it means at Metropolitan Scale?

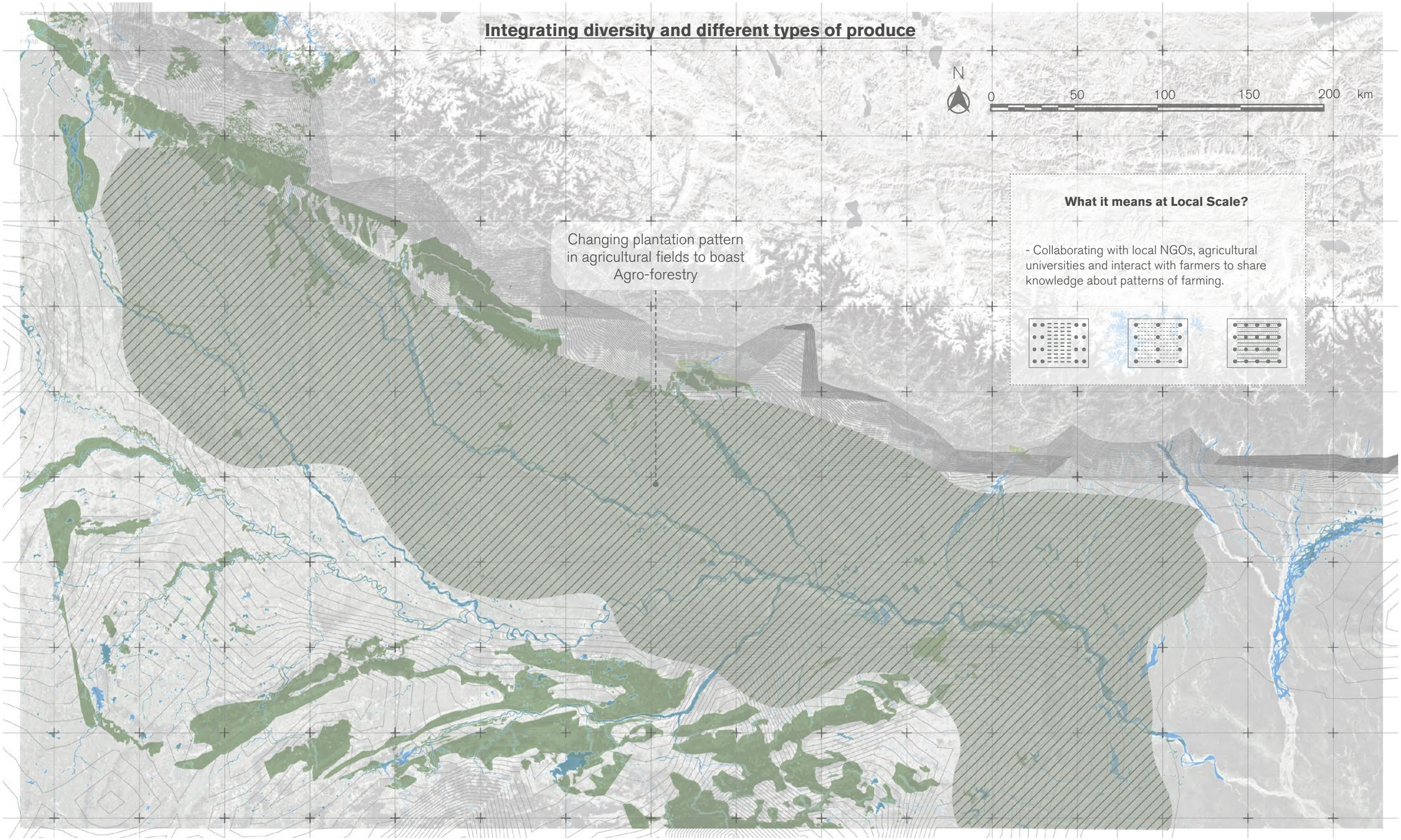
- Developing policies and awareness programs to promote Agro-Forestry to add tree plantation within agricultural fields.

- Listing possible species and combination of crops and trees for the region to facilitate farmers.

Scale Sensitive Design: Regional Scale

Strategy 2: Performative landscape strategy for water cycle management

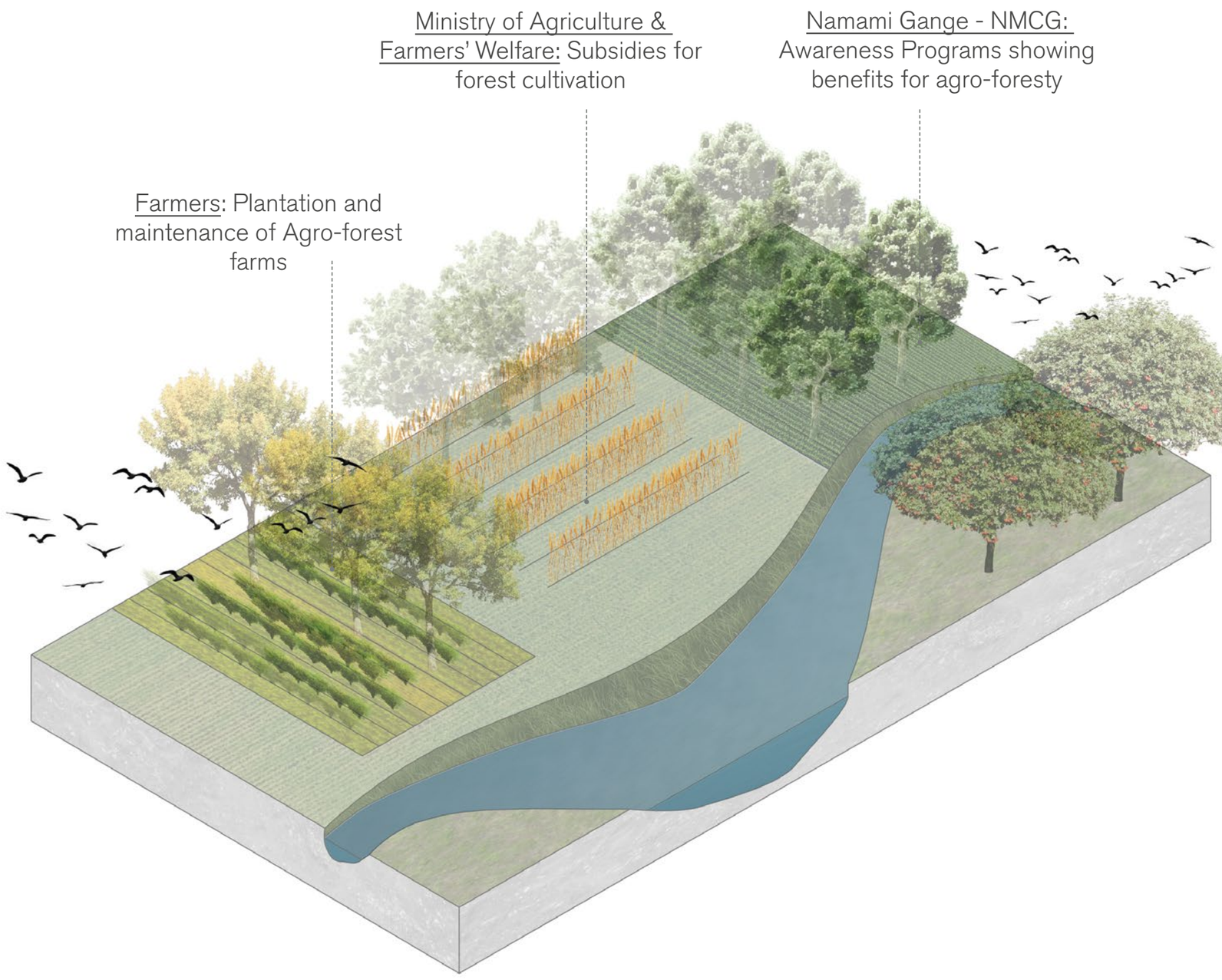
Integrating diversity and different types of produce



Scale Sensitive Design: Regional Scale

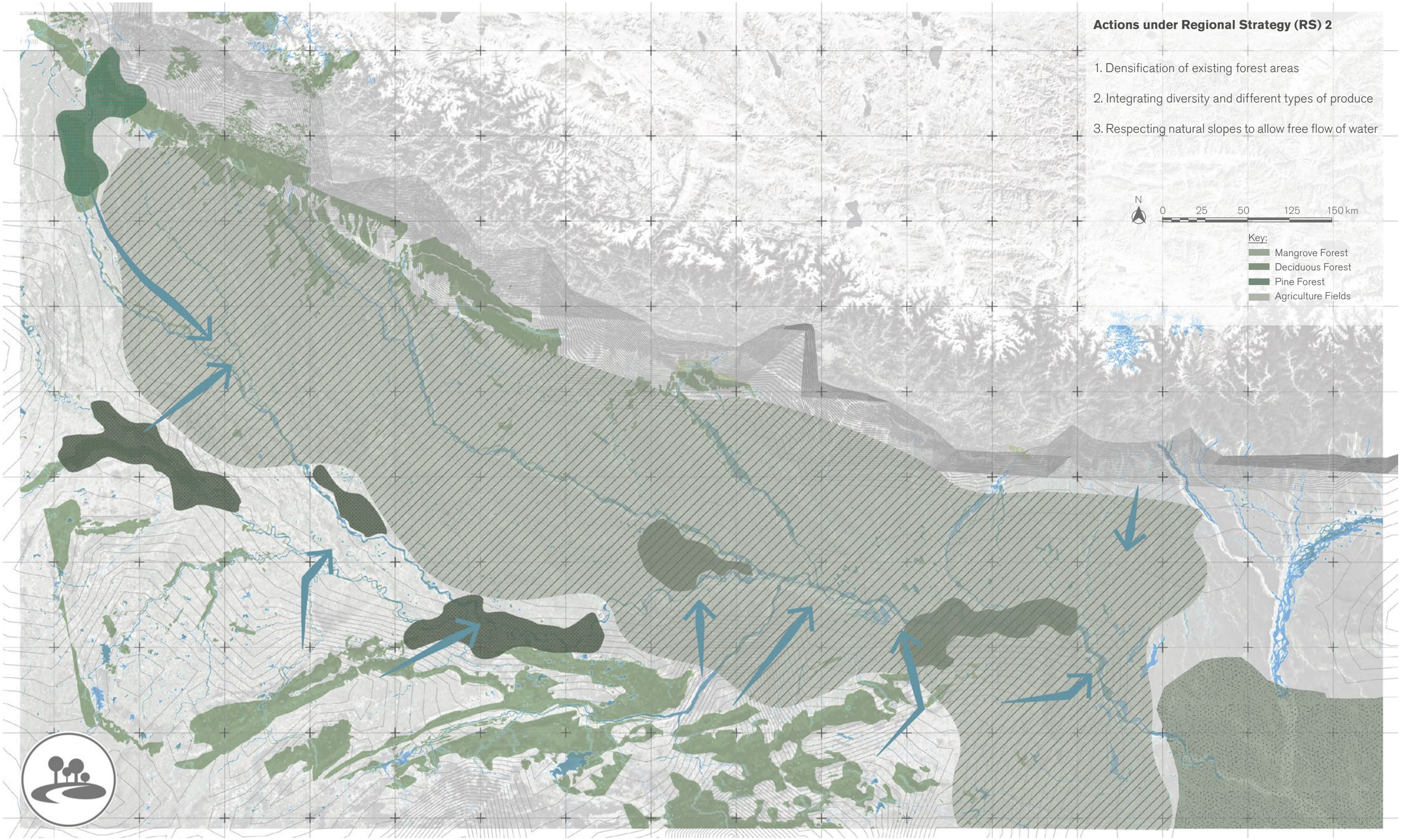
Strategy 2: Performative landscape strategy for water cycle management

Integrating diversity and different types of produce



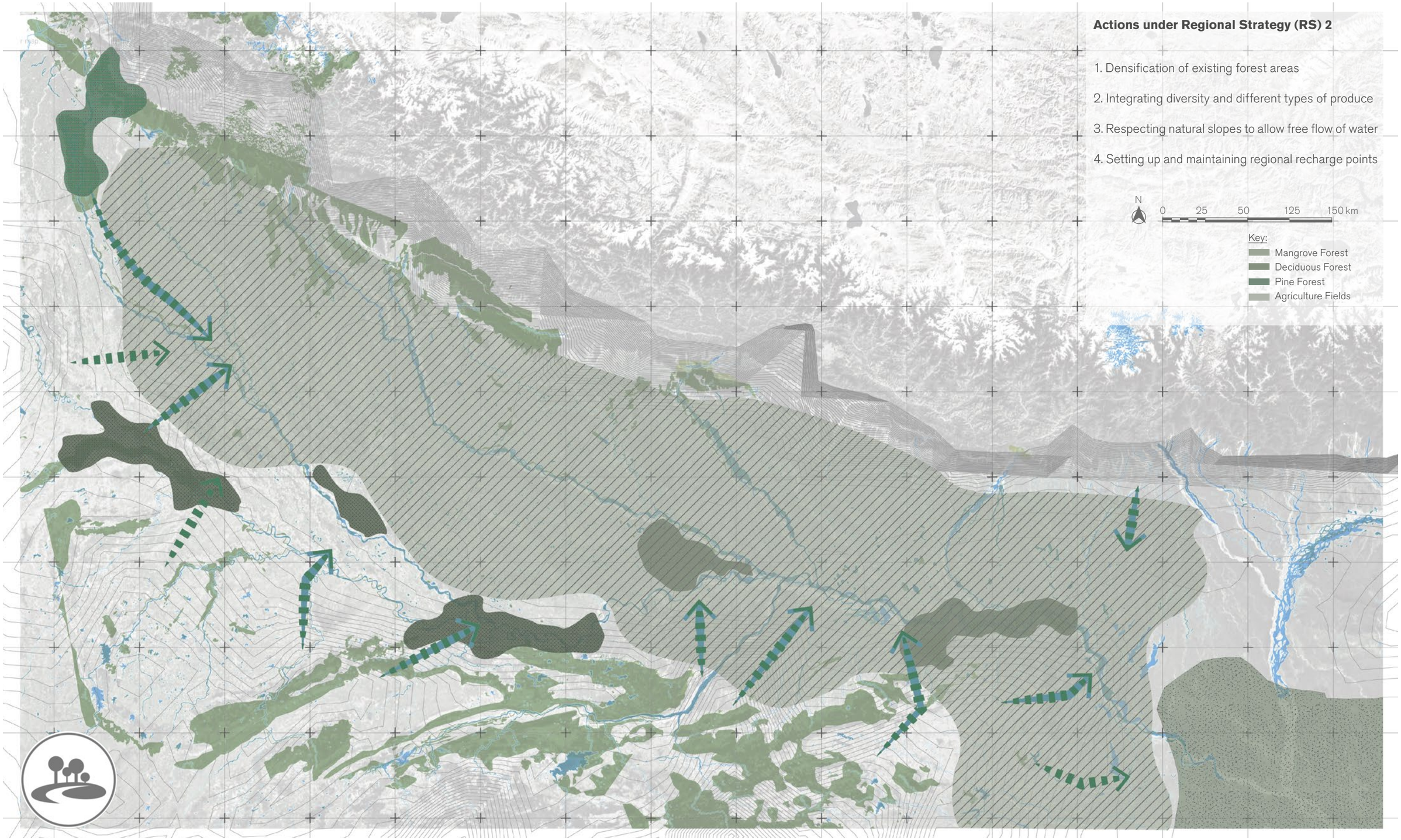
Scale Sensitive Design: Regional Scale

Strategy 2: Performative landscape strategy for water cycle management



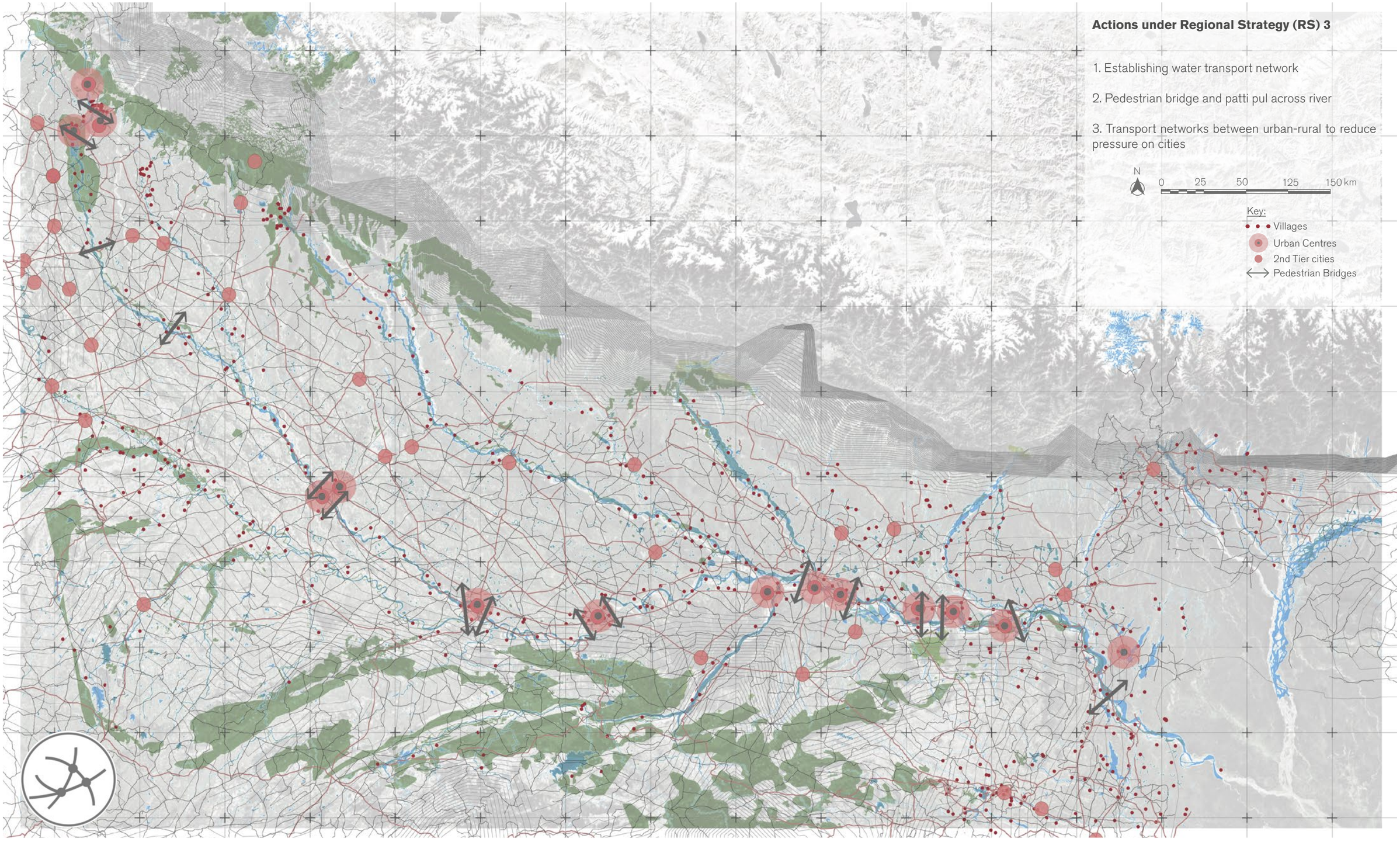
Scale Sensitive Design: Regional Scale

Strategy 2: Performative landscape strategy for water cycle management



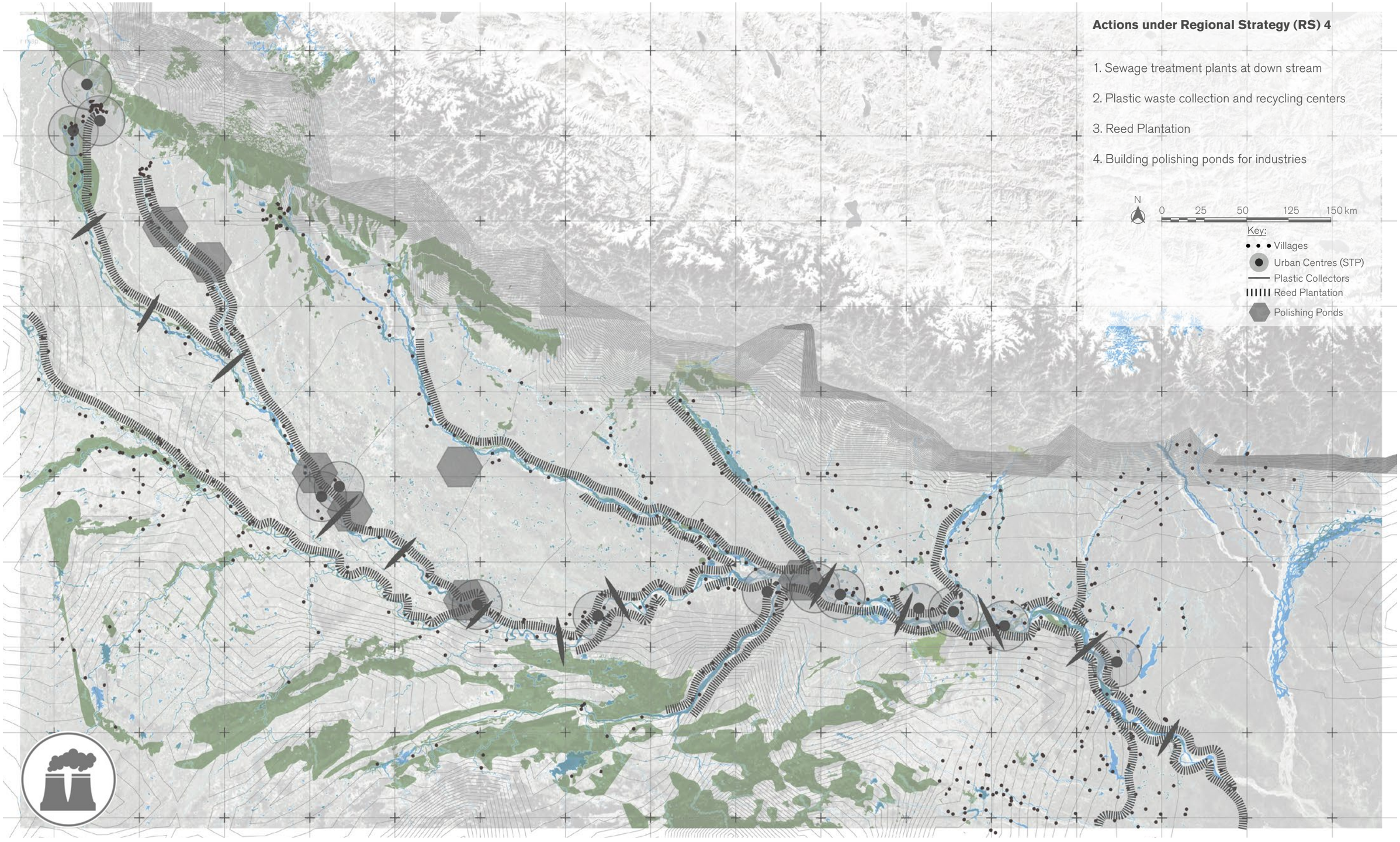
Scale Sensitive Design: Regional Scale

Strategy 3: Comprehensive connectivity across the basin



Scale Sensitive Design: Regional Scale

Strategy 4: Pollution management



Frame of Reference: Intervention Procedure

Scale Sensitive Design: Metropolitan Scale

Scale 1:
Regional Strategies for Macro Scale:

RS1: Room for the River

RS2: Landscape Interventions

RS3: Comprehensive Connectivity

RS4: Pollution Management

Designing and Testing at Different Scales

Scale 2:
Design Strategies at Metropolitan Scale

MS1: Infrastructure Interventions

MS2: Landscape Interventions

MS3: Activating River-edge

MS4: Industrial Development

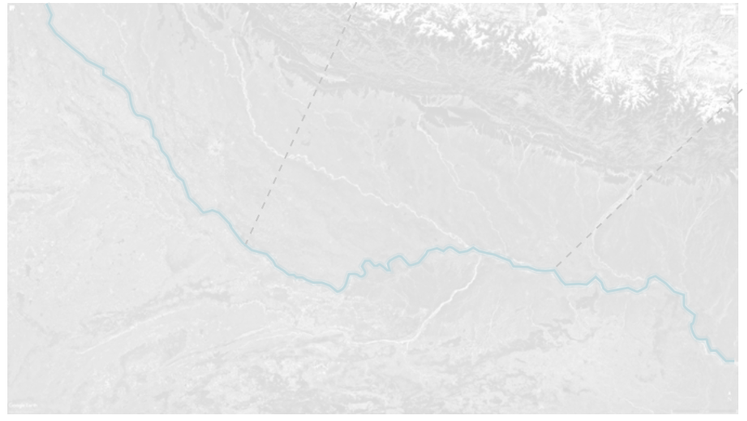
River Segment

Scale 3:
Local adaptation of Strategies

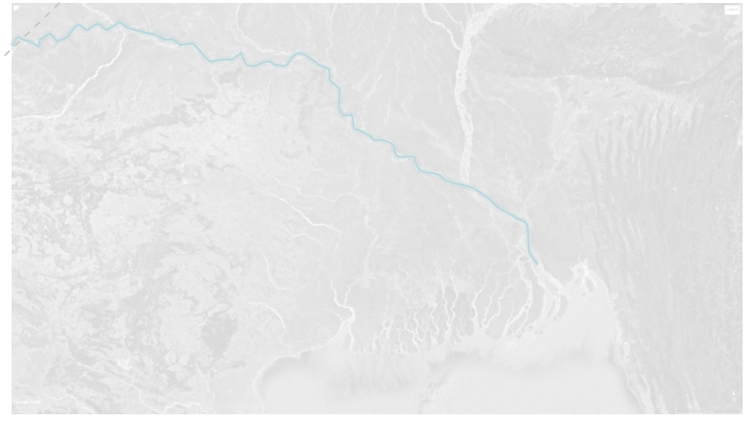
1. Urban
2. Peri-Urban
3. Rural

A. Hilly Section

B. Flat Plains



C. River Delta



Sections of River

Frame of Reference: Intervention Procedure

Scale Sensitive Design: Metropolitan Scale

1. Lack of Infrastructure (Sewage and Water Supply)

2. Dense Urban Fabrics and Loss of green-blue networks

3. Relationship of the city with the river

4. Lack of Industries (Agro)

Frame of Reference: Intervention Procedure

Scale Sensitive Design: Metropolitan Scale

1. Using Infrastructure networks for integrated socio-ecological development

Source: greywateraction, edited by author

MS1

MS3

3. Activating River Edge

Source: Suneet Mohindru. Pintrest, edited by author

2. Designing of performative landscape for ecological and socio-economic benefits

Source: L. Ulrich., 2030palette.org, edited by author

MS2

MS4

4. Establishing Agro industries and small scale industries

Source: MYSiLO, edited by author

Scale Sensitive Design: Metropolitan Scale

Strategy 1: Using Infrastructure networks for integrated socio-ecological development

Scale Sensitive Design: Metropolitan Scale

Strategy 2: Designing of performative landscape for ecological and socio-economic benefits

Actions under Metropolitan Strategy (MS) 2

1. Connecting green patches

Scale Sensitive Design: Metropolitan Scale

Strategy 2: Designing of performative landscape for ecological and socio-economic benefits

Scale Sensitive Design: Metropolitan Scale

Strategy 2: Designing of performative landscape for ecological and socio-economic benefits

Scale Sensitive Design: Metropolitan Scale

Strategy 2: Designing of performative landscape for ecological and socio-economic benefits

Scale Sensitive Design: Metropolitan Scale

Strategy 3: Activating river edge

Actions under Metropolitan Strategy (MS) 3

1. Reconfiguration of plots on river edge

Key:

← Approach Roads

N

0 1 2 3 4 km

Scale Sensitive Design: Metropolitan Scale

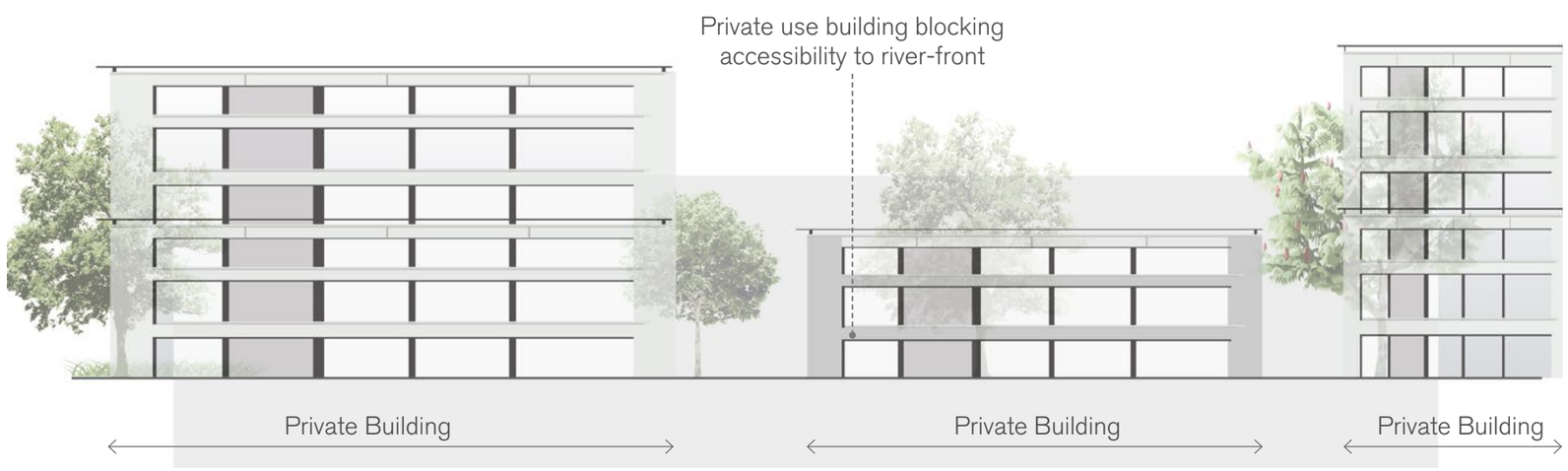
Strategy 3: Activating river edge

Scale Sensitive Design: Metropolitan Scale

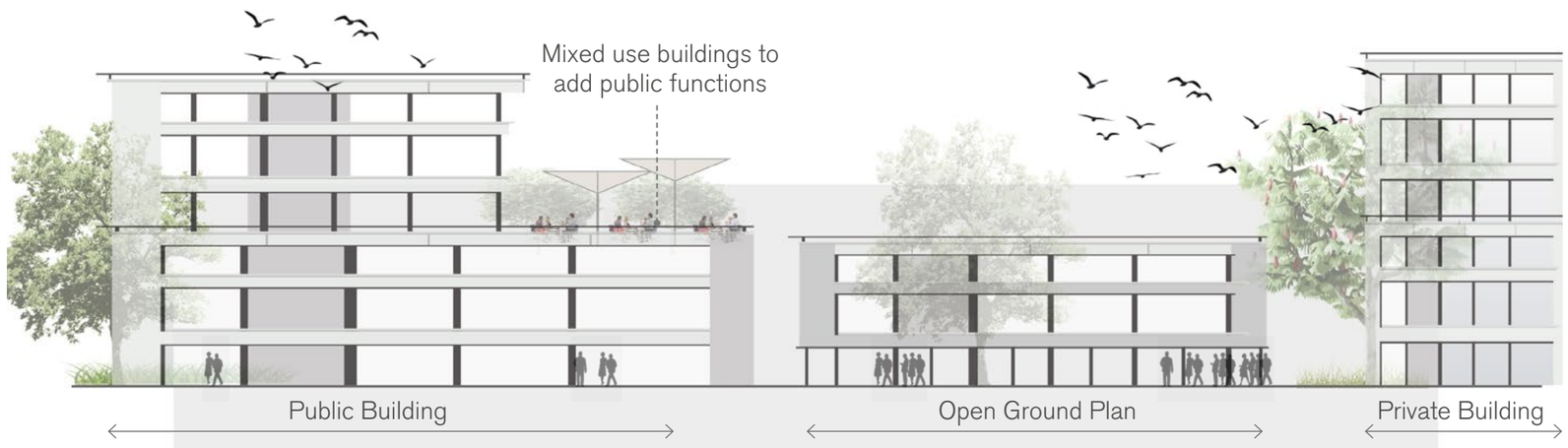
Strategy 3: Activating river edge

Updating land uses along the river

Current Condition



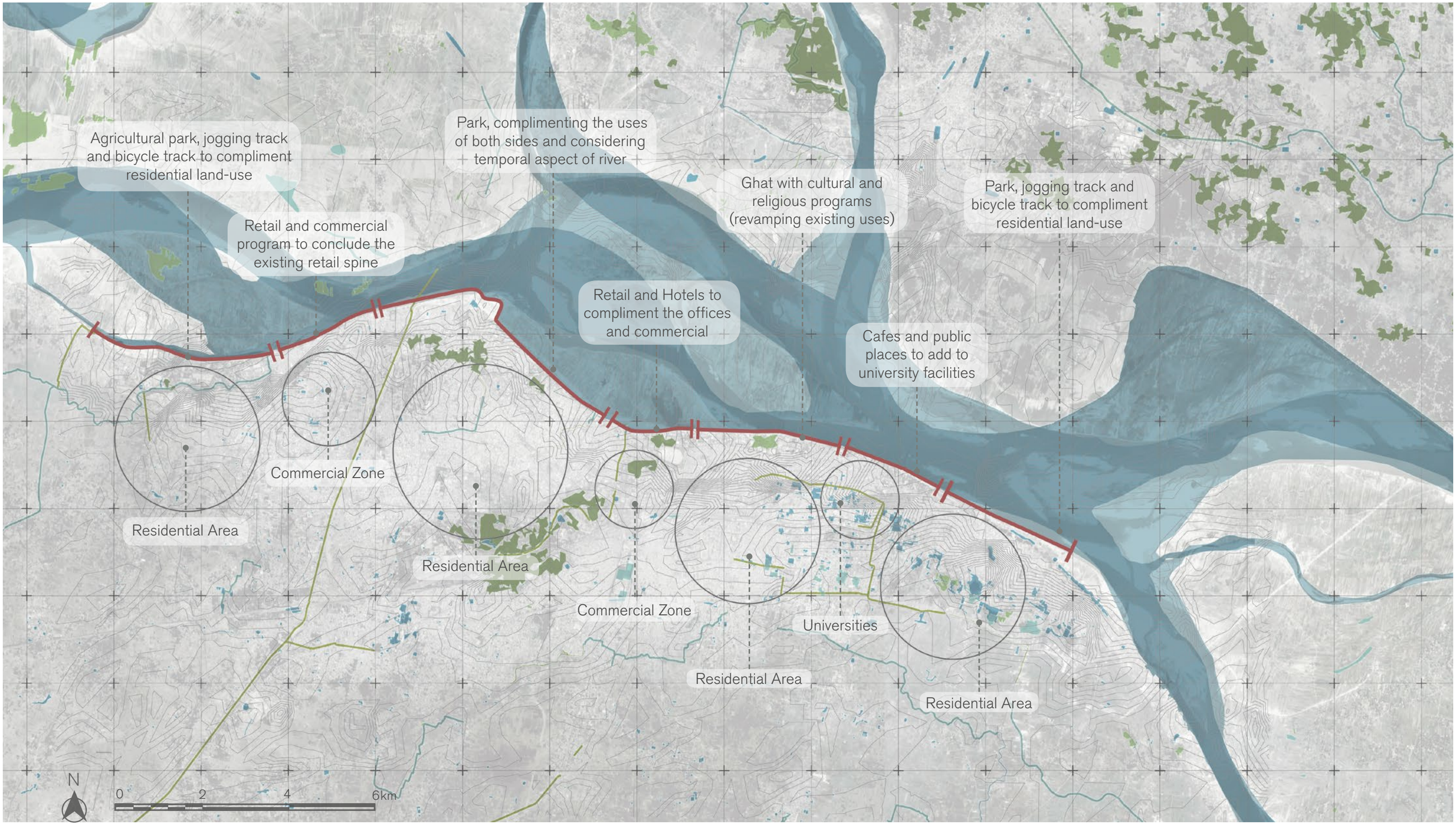
Proposed



Scale Sensitive Design: Metropolitan Scale

Strategy 3: Activating river edge

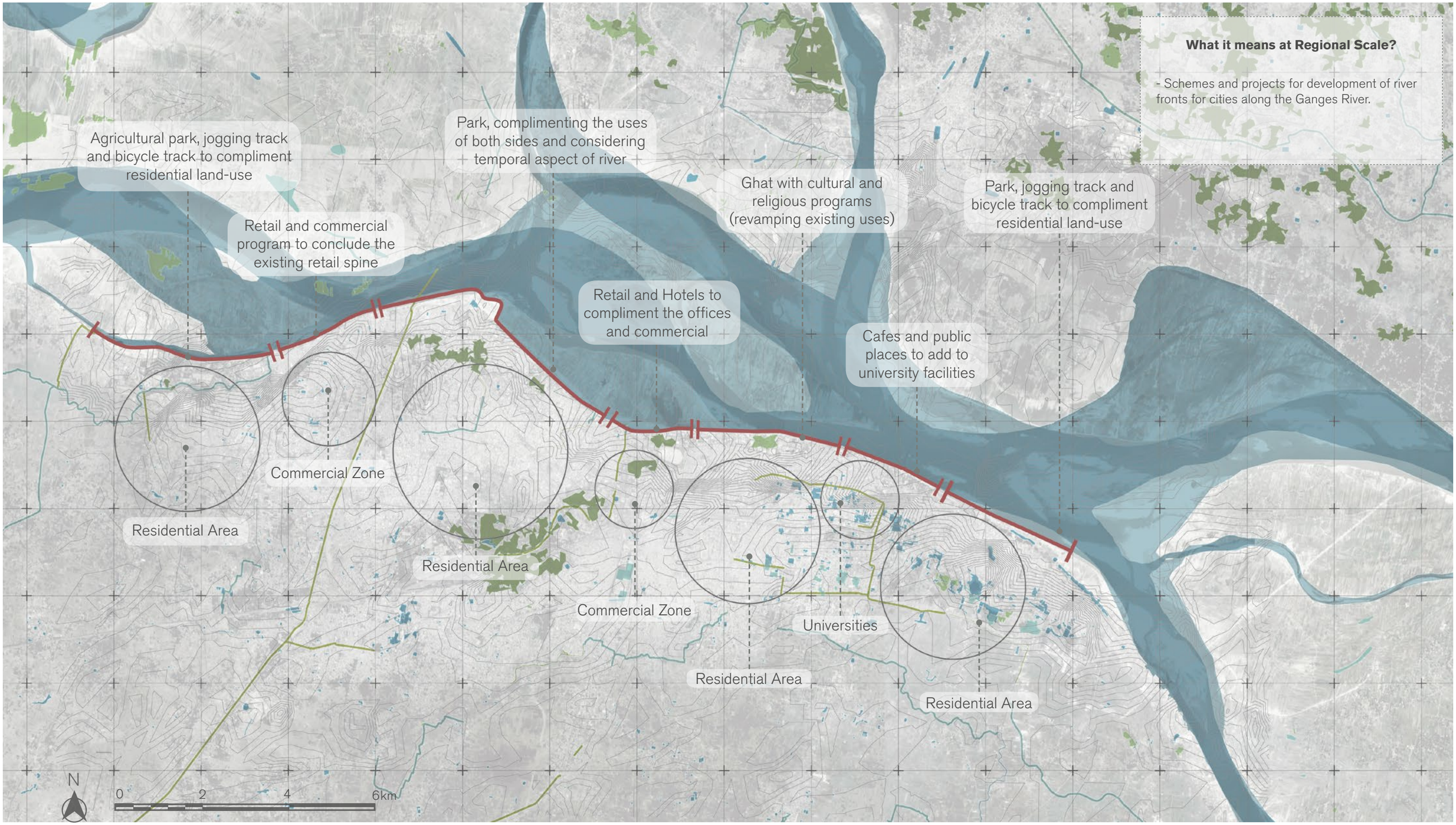
Updating land uses along the river



Scale Sensitive Design: Metropolitan Scale

Strategy 3: Activating river edge

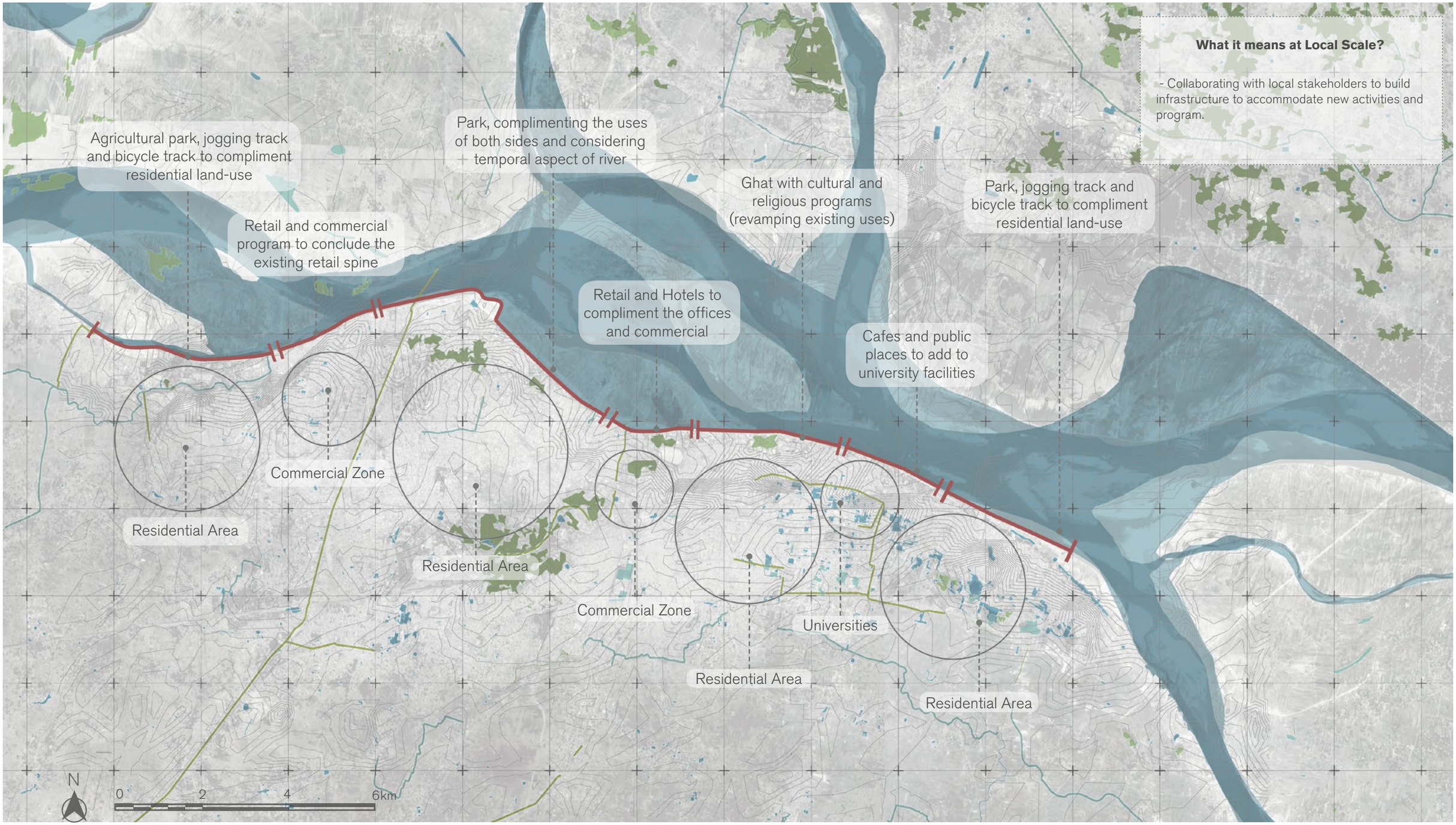
Updating land uses along the river



Scale Sensitive Design: Metropolitan Scale

Strategy 3: Activating river edge

Updating land uses along the river



Scale Sensitive Design: Metropolitan Scale

Strategy 3: Activating river edge

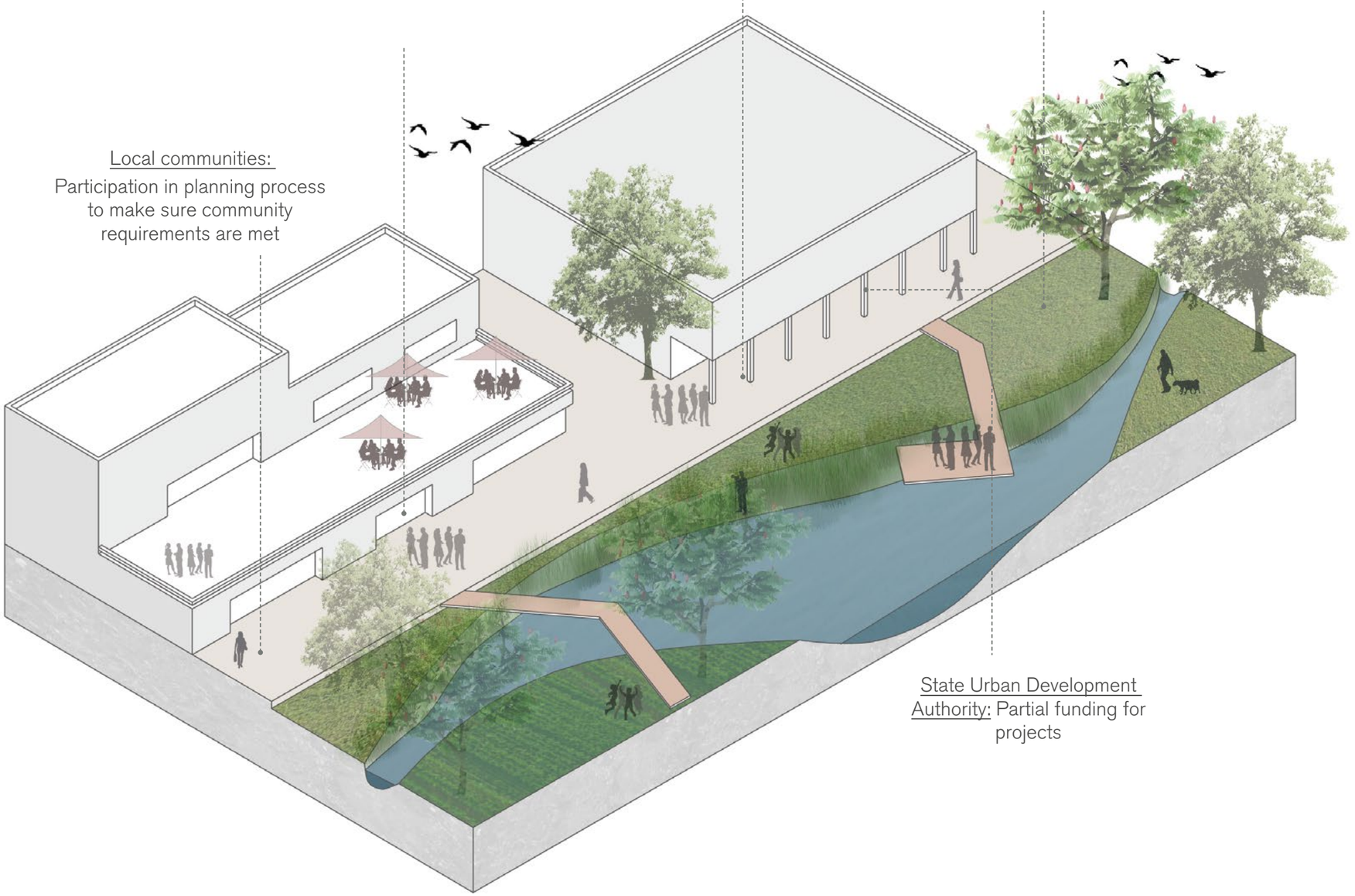
Updating land uses along the river

Local Municipal Corporation: Over looking the planning and execution process of the project. Setting up independent river-front development authorities for expedition of project

Independent Investors:
Private investment into project for hotels, restaurant and retail

Namami Gange - NMCG:
Monitoring protect to check if environmental and social requirements are met

Local communities:
Participation in planning process to make sure community requirements are met



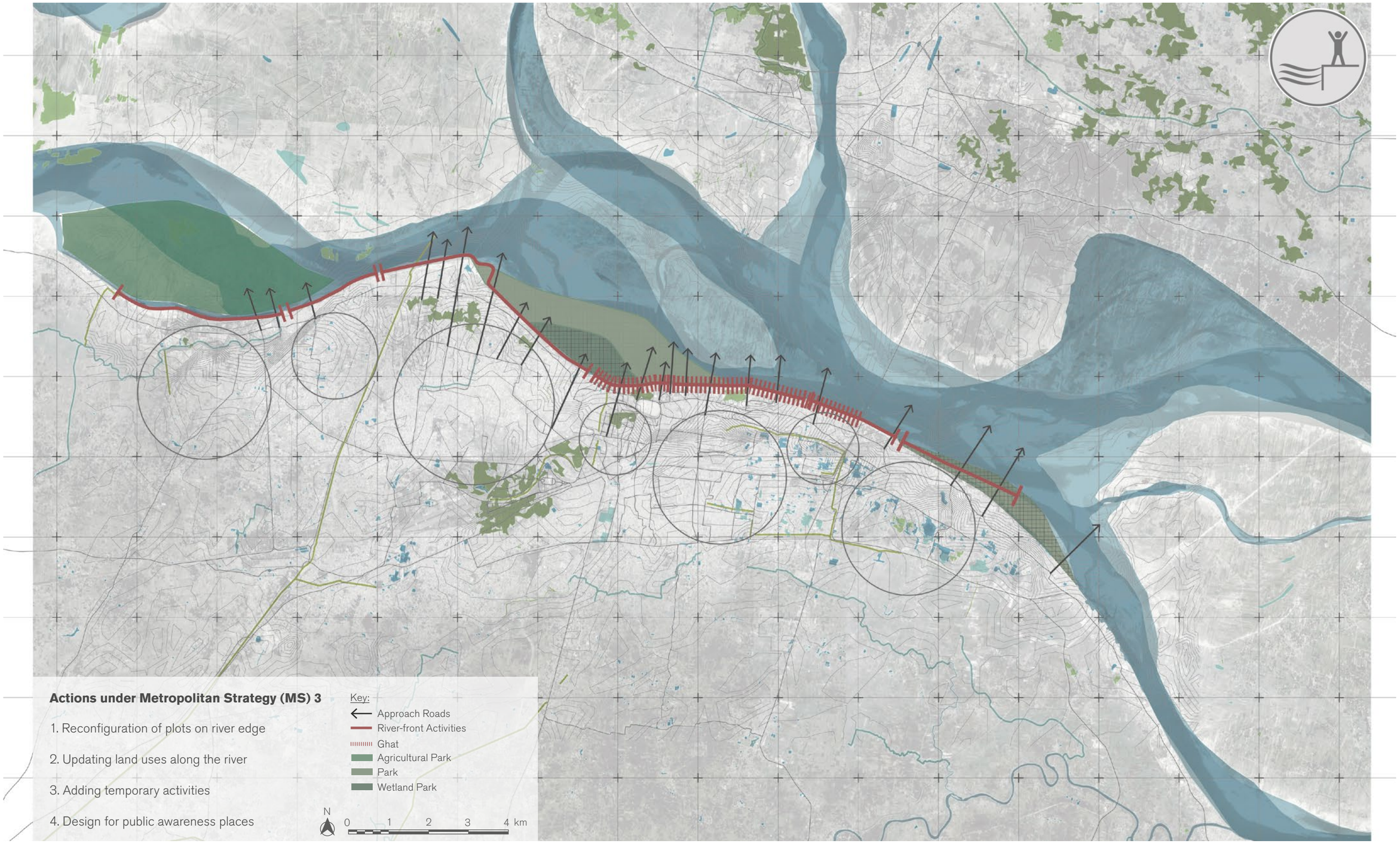
State Urban Development Authority: Partial funding for projects

Scale Sensitive Design: Metropolitan Scale

Strategy 3: Activating river edge

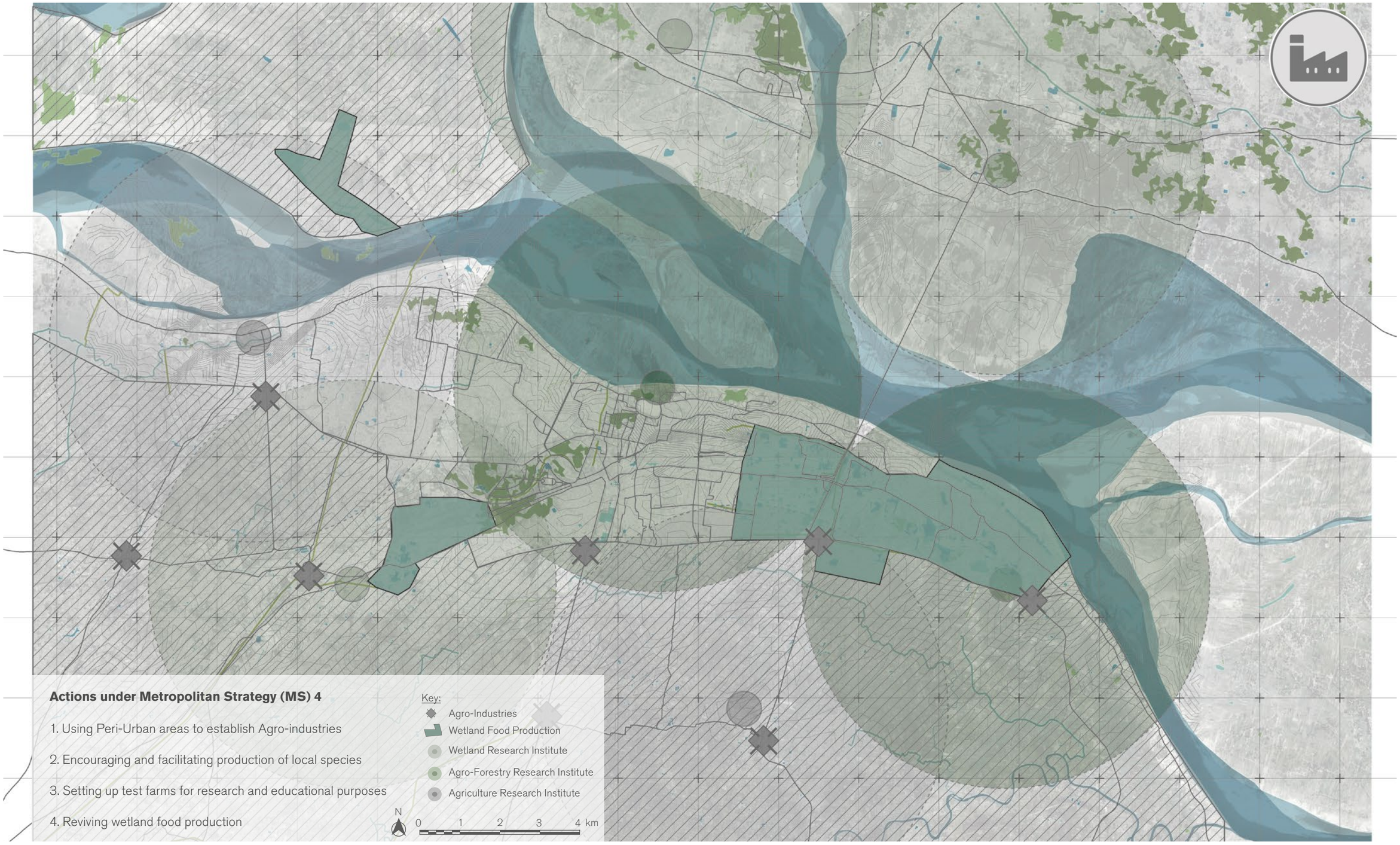
Scale Sensitive Design: Metropolitan Scale

Strategy 3: Activating river edge



Scale Sensitive Design: Metropolitan Scale

Strategy 4: Establishing Agro-industries and small scale industries



Actions under Metropolitan Strategy (MS) 4

1. Using Peri-Urban areas to establish Agro-industries
2. Encouraging and facilitating production of local species
3. Setting up test farms for research and educational purposes
4. Reviving wetland food production

Scale Sensitive Design: Metropolitan Scale

Scale Sensitive Design: Local Adaptation of Strategies

Scale 1:
Regional Strategies for Macro Scale:

RS1: Room for the River

RS2: Landscape Interventions

RS3: Comprehensive Connectivity

RS4: Pollution Management

Designing and Testing at Different Scales

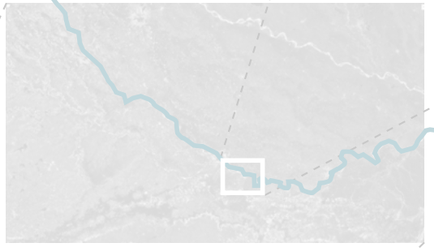
Scale 2:
Design Strategies at Metropolitan Scale

MS1: Infrastructure Interventions

MS2: Landscape Interventions

MS3: Activating River-edge

MS4: Industrial Development



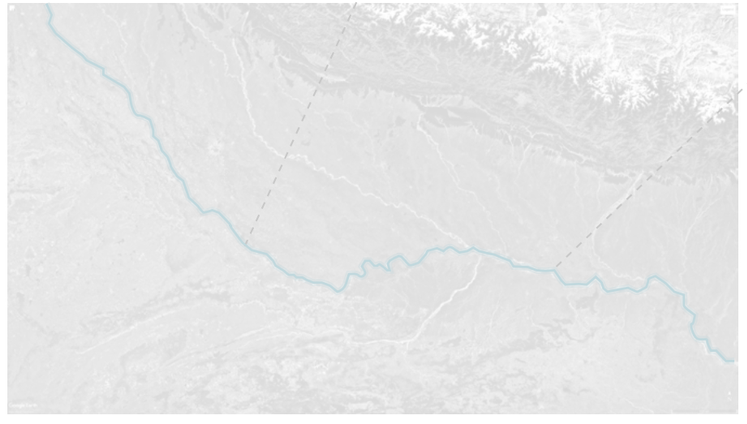
River Segment

Scale 3:
Local adaptation of Strategies

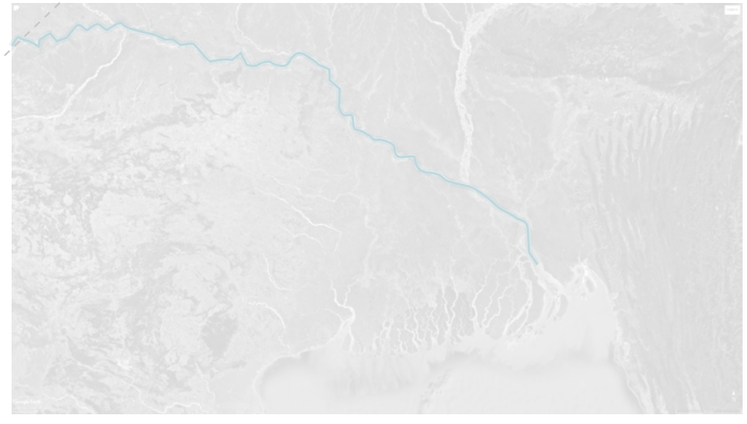
1. Urban
2. Peri-Urban
3. Rural

A. Hilly Section

B. Flat Plains



C. River Delta



Sections of River

Frame of Reference: Intervention Procedure

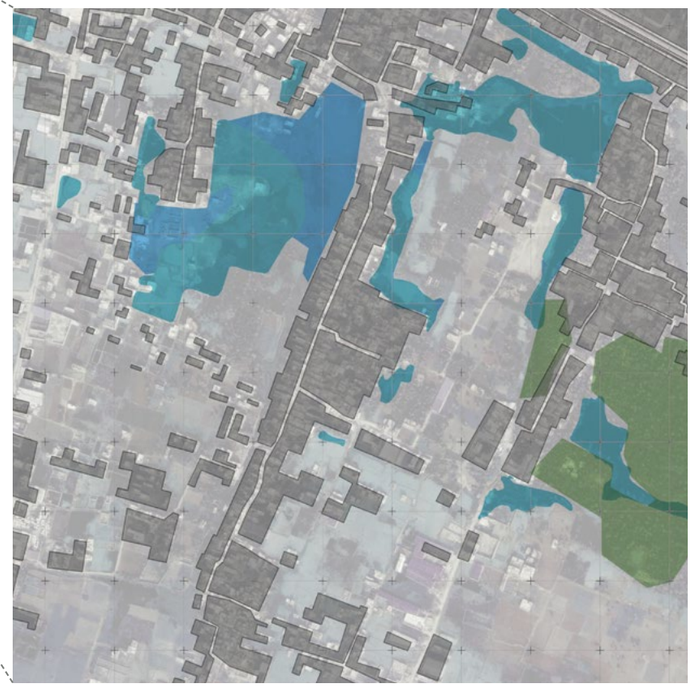
Scale Sensitive Design: Local Adaptation of Strategies

1. Urban

Frame of Reference: Intervention Procedure

Scale Sensitive Design: Local Adaptation of Strategies

1. Urban



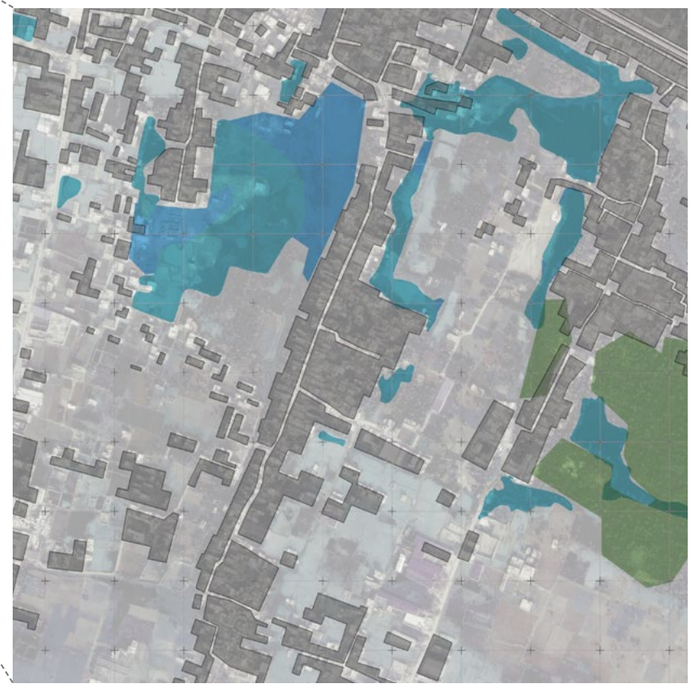
2. Peri-Urban

Frame of Reference: Intervention Procedure

Scale Sensitive Design: Local Adaptation of Strategies

1. Urban

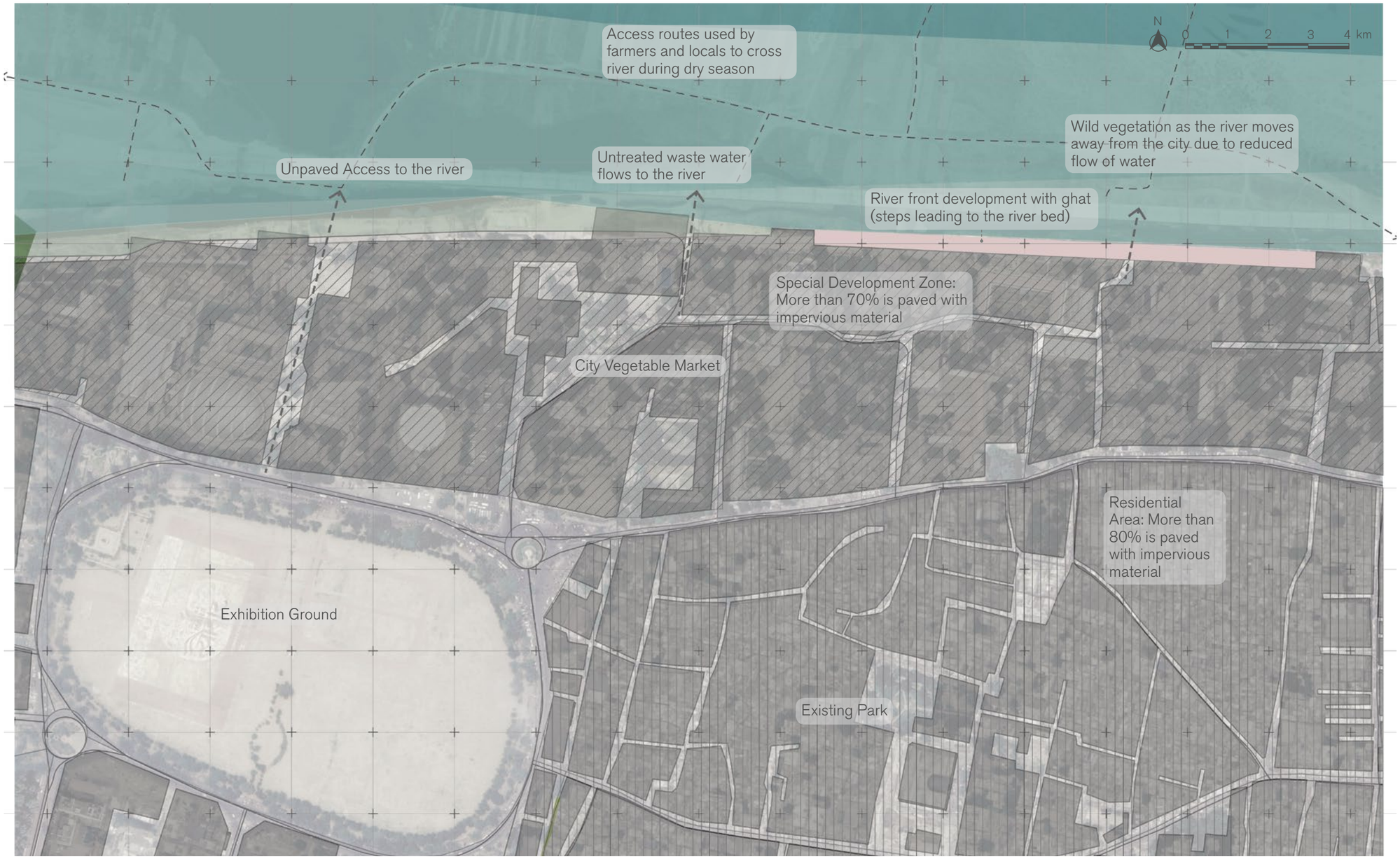
3. Rural



2. Peri-Urban

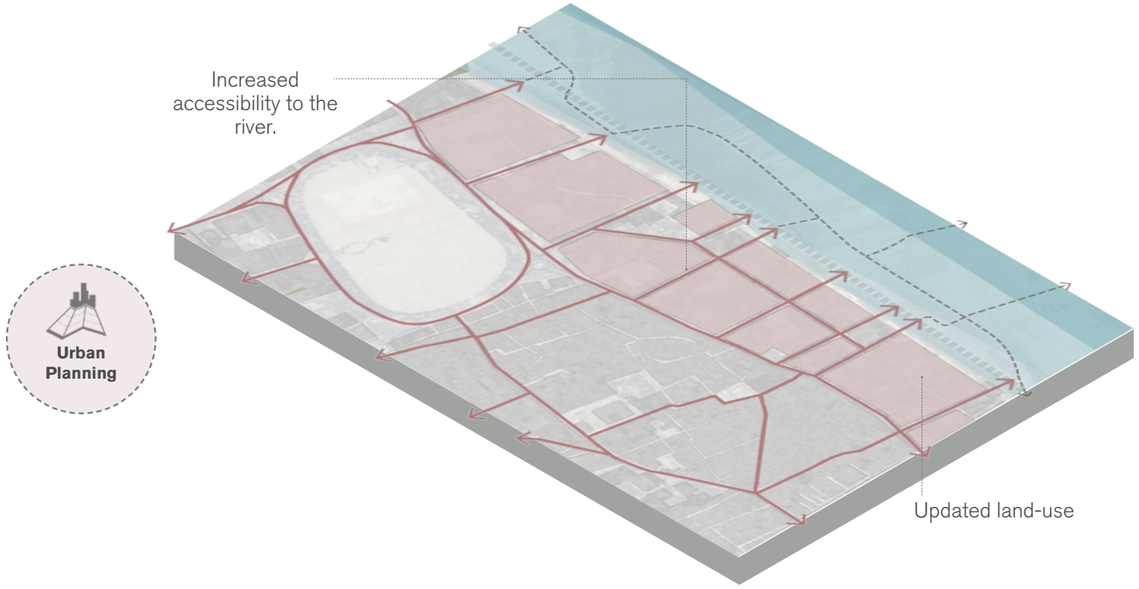
Scale Sensitive Design: Local Adaptation of Strategies

Manifestation 1: Urban Area (Existing Conditions)



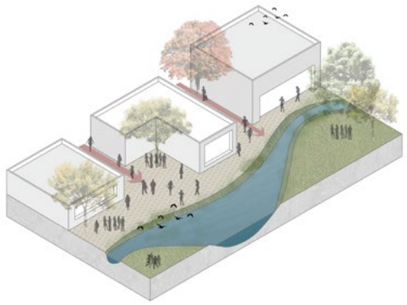
Scale Sensitive Design: Local Adaptation of Strategies

Manifestation 1: Urban Area (Urban Planning)

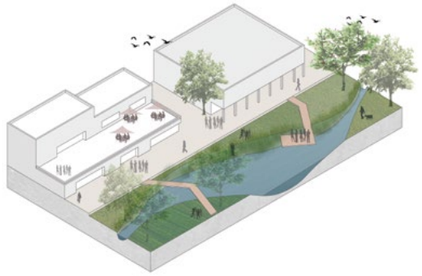


Urban Planning

MS3: Activating River-edge



Reconfiguration urban plots on river side

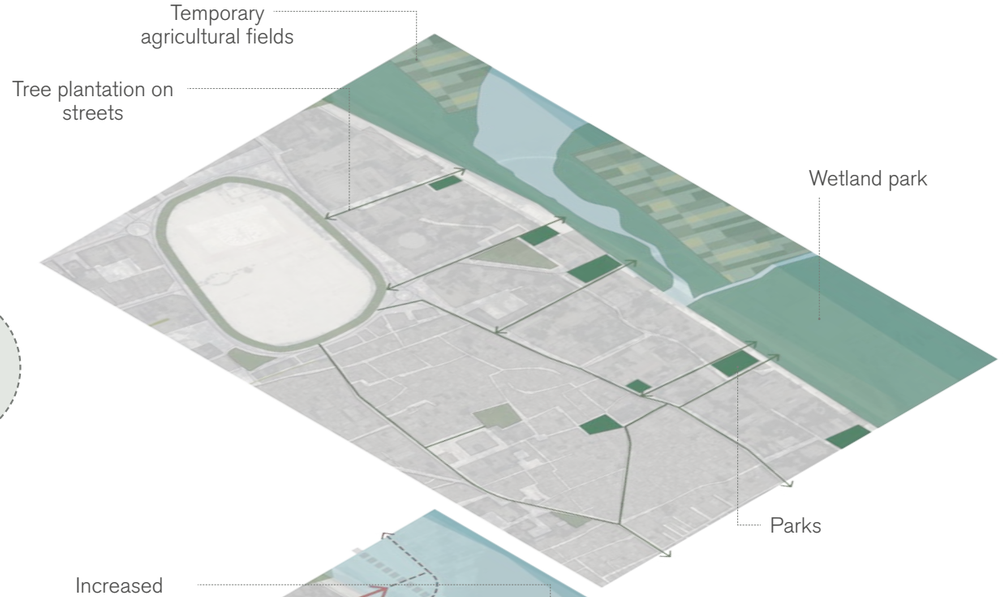


Updating land uses along the river

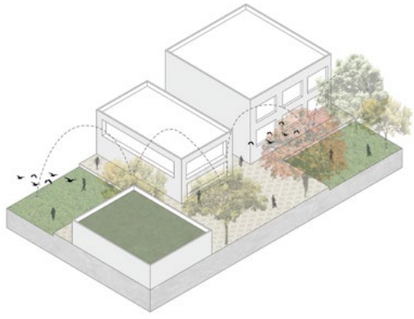
Scale Sensitive Design: Local Adaptation of Strategies

Manifestation 1: Urban Area (Landscape Architecture)

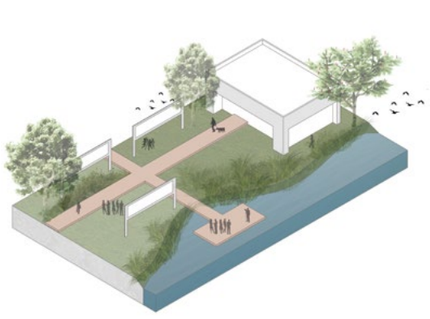
Landscape Architecture



MS2: Landscape Interventions



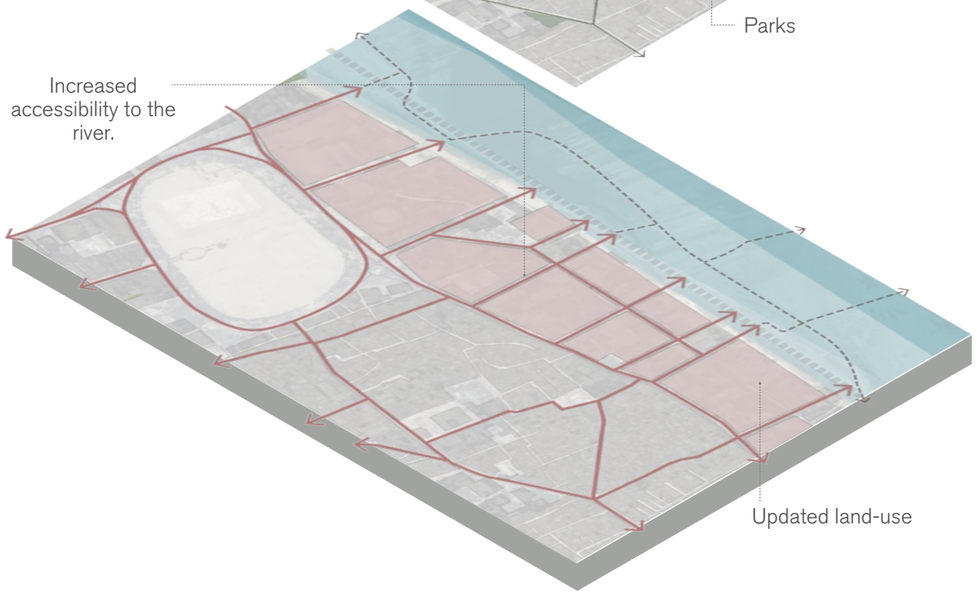
Connecting green patches



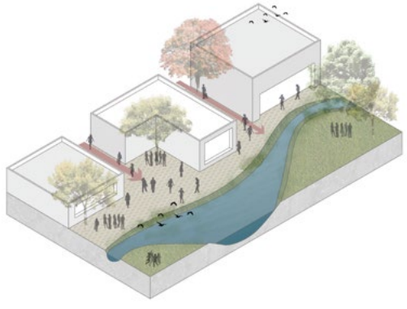
Design for public places and awareness programs

MS3: Activating River-edge

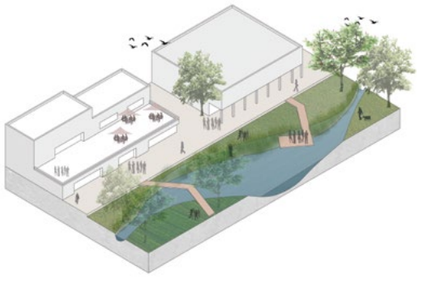
Urban Planning



MS3: Activating River-edge



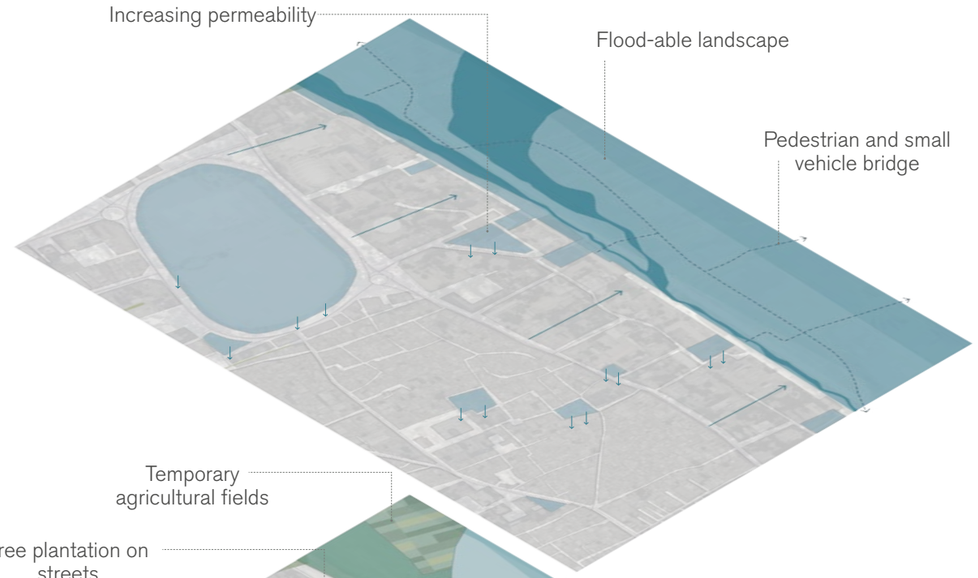
Reconfiguration urban plots on river side



Updating land uses along the river

Scale Sensitive Design: Local Adaptation of Strategies

Manifestation 1: Urban Area (Water Engineering)



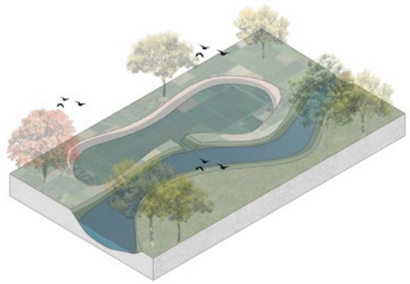
Water Engineering

Landscape Architecture

Urban Planning

RS1: Room for the River

RS3: Comprehensive Connectivity

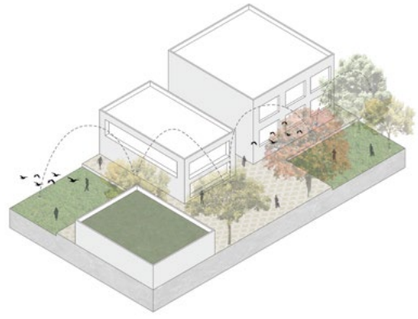


Adding temporary flood-able landscapes

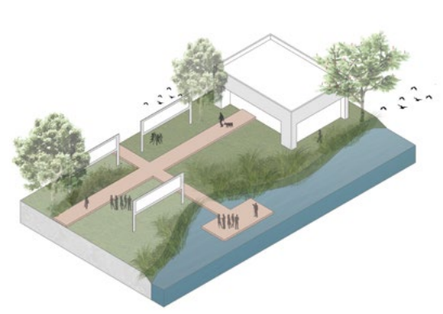
Pedestrian and small scale bridges across river

MS2: Landscape Interventions

MS3: Activating River-edge

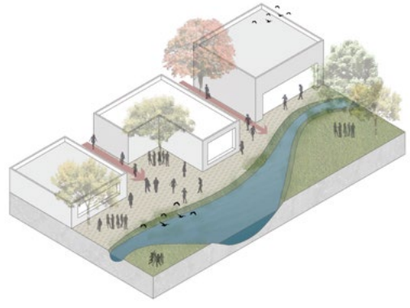


Connecting green patches

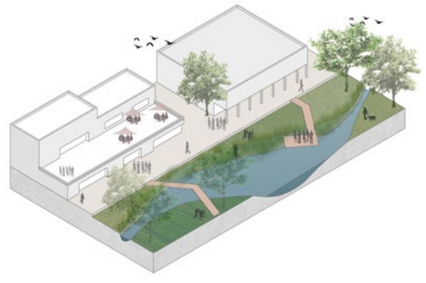


Design for public places and awareness programs

MS3: Activating River-edge



Reconfiguration urban plots on river side



Updating land uses along the river

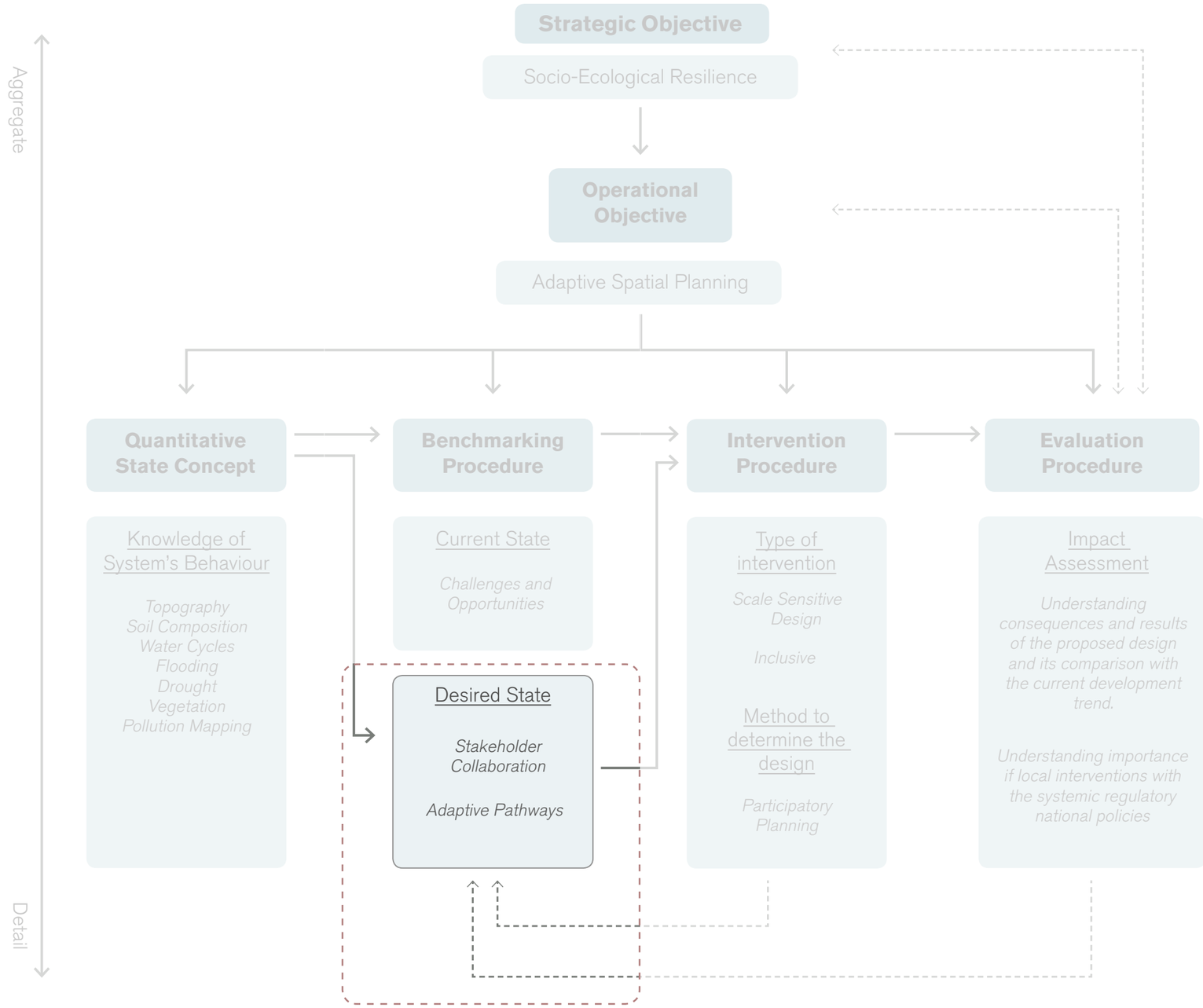
Scale Sensitive Design: Local Adaptation of Strategies

Manifestation 1: Urban Area

Scale Sensitive Design: Local Adaptation of Strategies

Manifestation 1: Urban Area

Frame of Reference: Desired State



Source: Van Koningsveld, 2003, modified by author

Frame of Reference: Desired State

Stakeholder Engagement

- Namami Gange (NMCG)
- Ganga Flood Control Department (GFCD)
- Ministry of Human Resource Development
- Ministry of Environment, Forest and Climate Change (Central) (EFCC)
- Bihar State Government (BSGov)
- Bihar: Urban Development Department (BUDD)
- Developers (Dev)
- Independent investors (Retail/ Restaurants) (I Inv)
- Landowners (Lo)
- Farmers (Fm)
- Research Institutions (RI)
- Patna Municipal Corporation (PMC)
- Urban Planners (UP) / Landscape Architects (LA)
- Ward Office/ Ward Committee (WO)
- NGOs
- Local Communities / Citizens (Cit)

Existing Stakeholder Relationships

Proposed Stakeholder Relationships

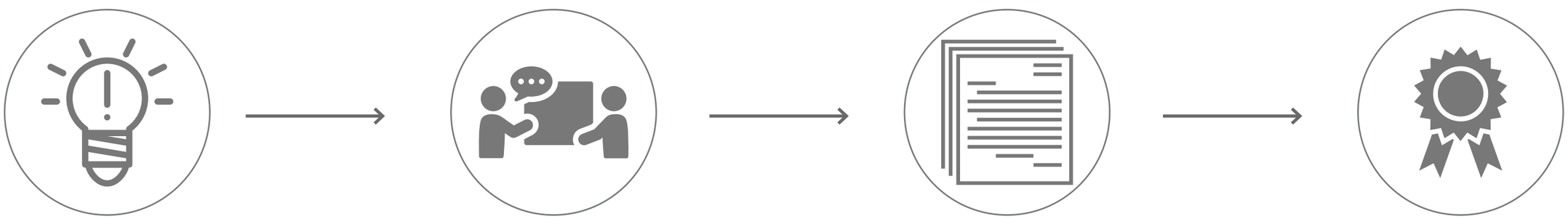
Low Power

Medium Power

High Power

Frame of Reference: Intervention Procedure

Community Participatory Planning



Create

Do a Local Deed towards Climate Change Adaptation

Planting Trees

Water Management Setup

Educate

Spread Awareness and Engage Community

Formalize

Inform Local Government

Gain

Gain Benefits in form of subsides / rewards

Source: SOCC, Asia Initiative, adapted by author

Frame of Reference: Desired State

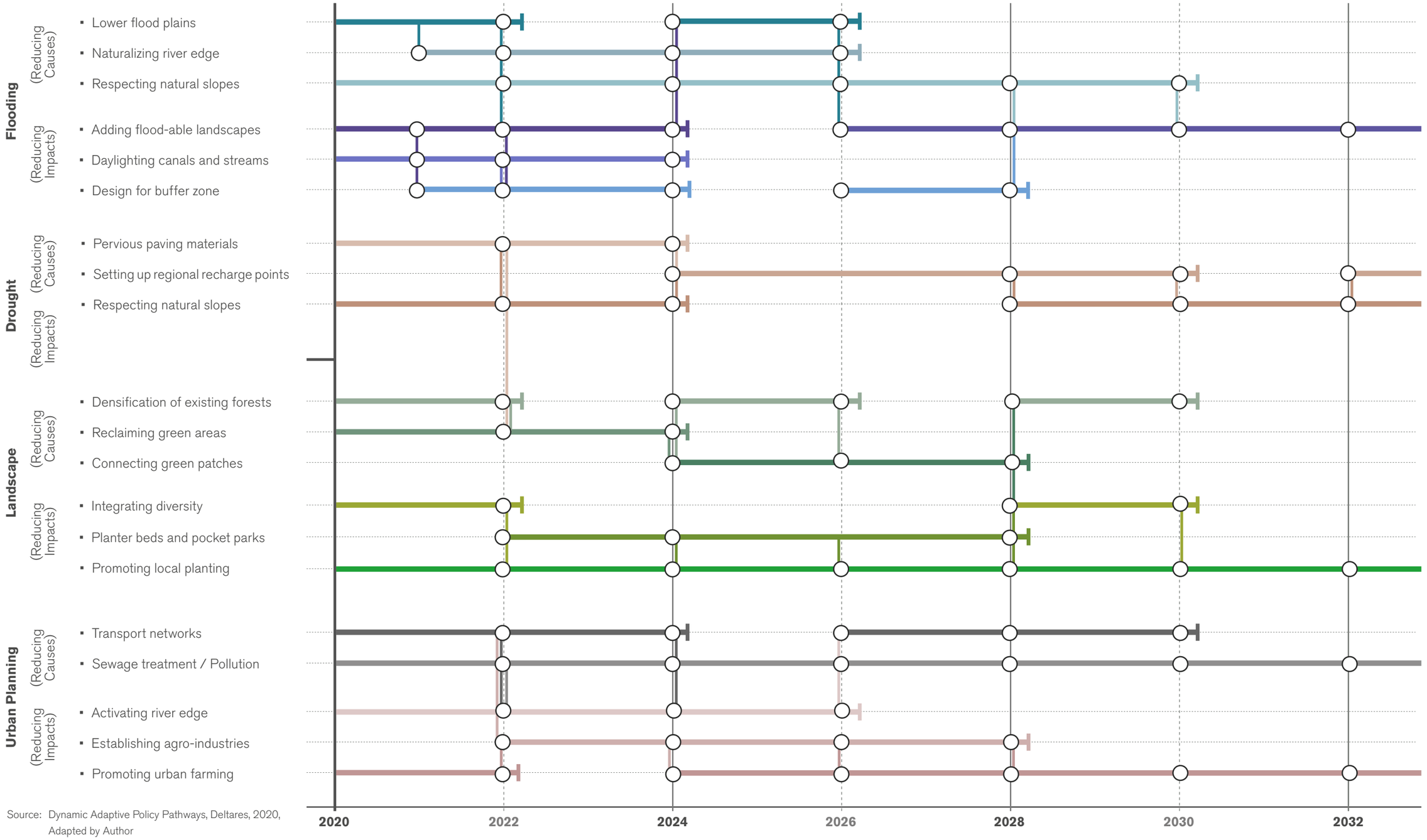
Adaptive Pathways

Water Management: (a) Increased temperatures and possible drought
(b) High rainfall and flooding probability.
Urban Planning: Increased population within the urban centres
Landscape: Reduced local species

Tipping point 1

Water Management: (a) Higher temperature and droughts
(b) Increased flooding frequency
Urban Planning: Land crisis within urban centres
Landscape: Loss of local species

Tipping point 2



Source: Dynamic Adaptive Policy Pathways, Deltares, 2020, Adapted by Author

Frame of Reference: Desired State

Adaptive Pathways

Water Management: (a) Increased temperatures and possible drought
(b) High rainfall and flooding probability.
Urban Planning: Increased population within the urban centres
Landscape: Reduced local species
Tipping point 1

Water Management: (a) Higher temperature and droughts
(b) Increased flooding frequency
Urban Planning: Land crisis within urban centres
Landscape: Loss of local species
Tipping point 2

Flooding
(Reducing Causes)
- Lower flood plains
- Naturalizing river edge
- Respecting natural slopes

(Reducing Impacts)
- Adding flood-able landscapes
- Daylighting canals and streams
- Design for buffer zone

Drought
(Reducing Causes)
- Pervious paving materials
- Setting up regional recharge points
- Respecting natural slopes

(Reducing Impacts)

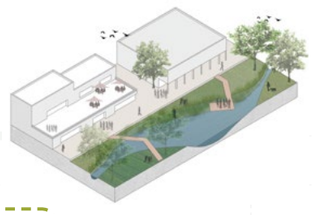
Landscape
(Reducing Causes)
- Densification of existing forests
- Reclaiming green areas
- Connecting green patches

(Reducing Impacts)
- Integrating diversity
- Planter beds and pocket parks
- Promoting local planting

Urban Planning
(Reducing Causes)
- Transport networks
- Sewage treatment / Pollution

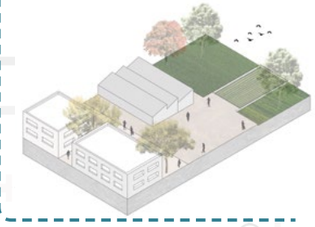
(Reducing Impacts)
- Activating river edge
- Establishing agro-industries
- Promoting urban farming

Peri-Urban Area
Rural Area
Urban Area



Urban Area
Social Impact: +9
Ecological Impact: +1
Spatial Impact: High
Cost: High
Acceptance: High

Rural Area
Social Impact: +1
Ecological Impact: +10
Spatial Impact: High
Cost: High
Acceptance: Low



Peri-Urban Area
Social Impact: +4
Ecological Impact: +5
Spatial Impact: Medium
Cost: Low
Acceptance: High

2020 2022 2024 2026 2028 2030 2032

Source: Dynamic Adaptive Policy Pathways, Deltares, 2020, Adapted by Author

Frame of Reference: Desired State

Adaptive Pathways

Water Management: (a) Increased temperatures and possible drought
(b) High rainfall and flooding probability.
Urban Planning: Increased population within the urban centres
Landscape: Reduced local species
Tipping point 1

Water Management: (a) Higher temperature and droughts
(b) Increased flooding frequency
Urban Planning: Land crisis within urban centres
Landscape: Loss of local species
Tipping point 2

Flooding
(Reducing Causes)
- Lower flood plains
- Naturalizing river edge
- Respecting natural slopes

(Reducing Impacts)
- Adding flood-able landscapes
- Daylighting canals and streams
- Design for buffer zone

Drought
(Reducing Causes)
- Pervious paving materials
- Setting up regional recharge points
- Respecting natural slopes

(Reducing Impacts)

Landscape
(Reducing Causes)
- Densification of existing forests
- Reclaiming green areas
- Connecting green patches

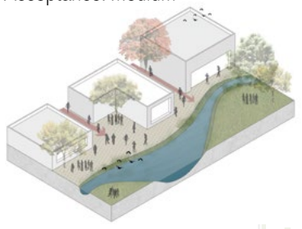
(Reducing Impacts)
- Integrating diversity
- Planter beds and pocket parks
- Promoting local planting

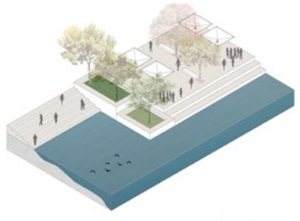
Urban Planning
(Reducing Causes)
- Transport networks
- Sewage treatment / Pollution

(Reducing Impacts)
- Activating river edge
- Establishing agro-industries
- Promoting urban farming

Civil Societies
Public Sector
Private Sector

Social Impact: +6
Ecological Impact: +3
Spatial Impact: Medium
Cost: Medium
Acceptance: Medium





Social Impact: +11
Ecological Impact: 0
Spatial Impact: High
Cost: High
Acceptance: High

Social Impact: +8
Ecological Impact: +1
Spatial Impact: High
Cost: High
Acceptance: High

2020 2022 2024 2026 2028 2030 2032

Source: Dynamic Adaptive Policy Pathways, Deltares, 2020, Adapted by Author

Frame of Reference: Desired State

Adaptive Pathways

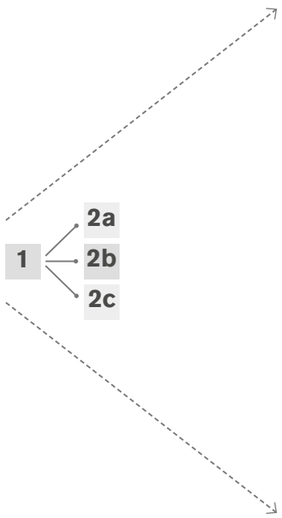
1

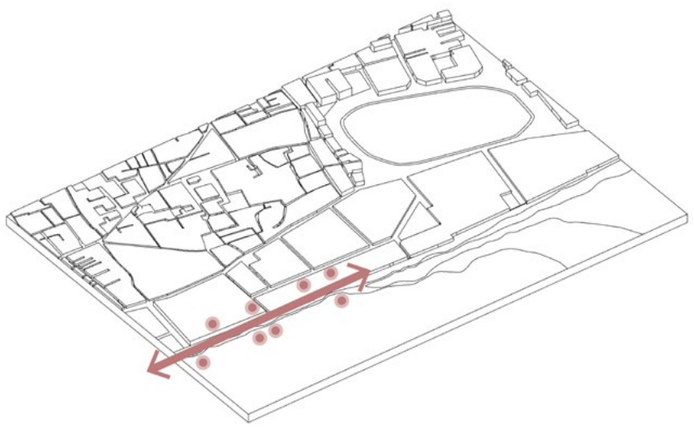
Local Adaptation Urban Areas

	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
Operability	**1**							
Actors:	- Patna Municipal Corporation - Water and Sanitation Department							
Instruments:	- Sewage Network Plan							
Objectives:	- Stop Sewage flow into the River (Social + Ecological Benefits)							
Co-Management	**Public Sector**							

Frame of Reference: Desired State

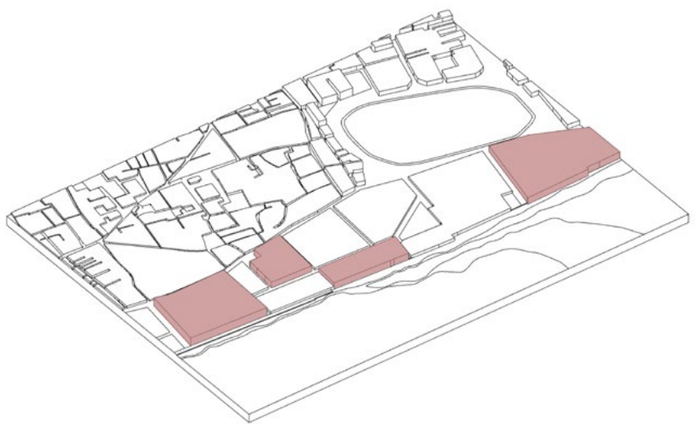
Adaptive Pathways





2a: Activating riverfront, adding temporary structures to existing Ghats

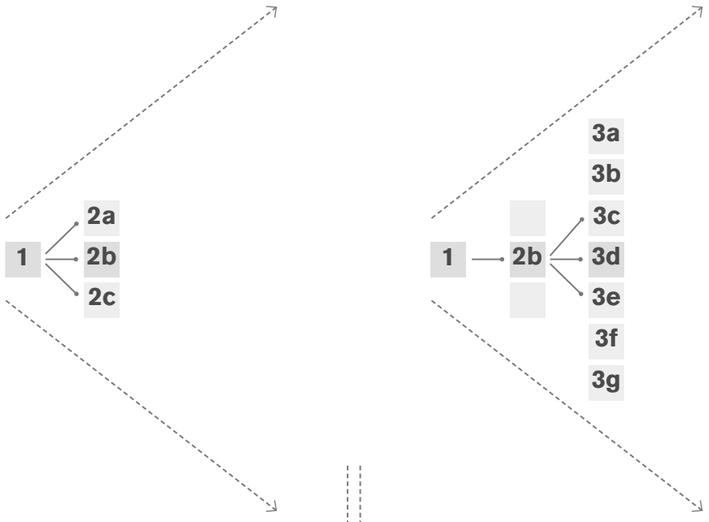
2b: Planning and construction of access roads to the riverfront



2c: Changing land use for a few buildings along the riverfront

Frame of Reference: Desired State

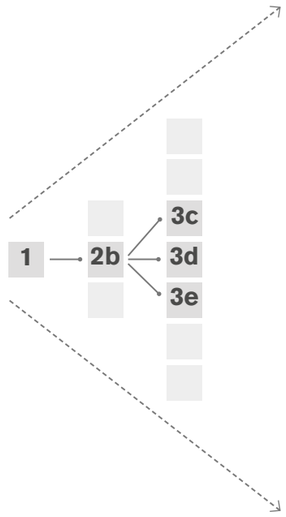
Adaptive Pathways



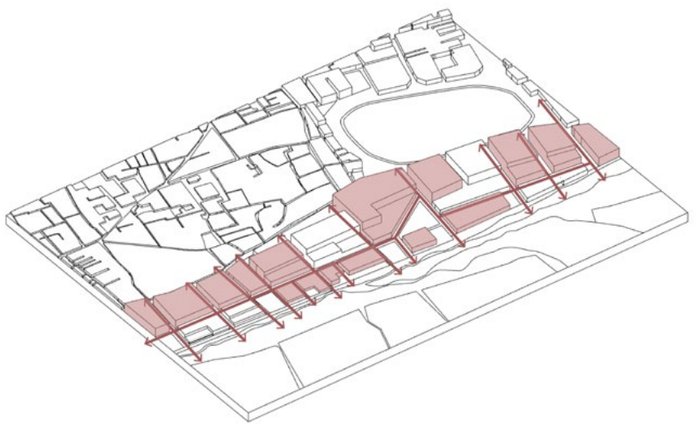
Local Adaptation Urban Areas	**Step 1** Assessment	**Step 2** Decision	**Step 3**	**Step 4**	**Step 5**	**Step 6**	**Step 7**	**Step 8**
Operability	**1**	**2b**						
Actors:	- Patna Municipal Corporation - Water and Sanitation Department	- Patna Municipal Corporation - Ward Office - Road Construction Department						
Instruments:	- Sewage Network Plan	- Workshops, Compensation Plan - Revised Town Planning Scheme						
Objectives:	- Stop Sewage flow into the River (Social + Ecological Benefits)	- Access Roads to the River (Social Benefits)						
Co-Management	**Public Sector**	**Public Sector + Private Owners**						

Frame of Reference: Desired State

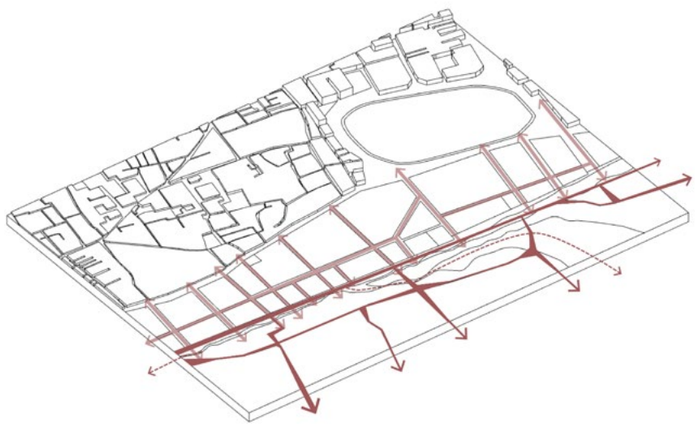
Adaptive Pathways



2b+3c: Constructing parks along the riverfront



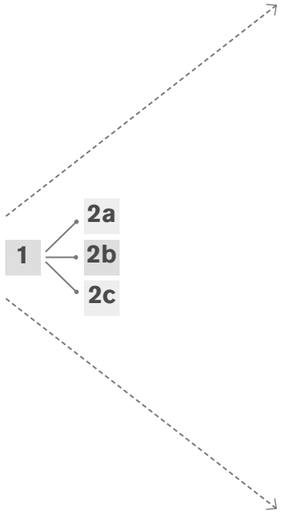
2b+3d: Re-development of the plots by private developers to add programs like restaurants, shopping malls etc.

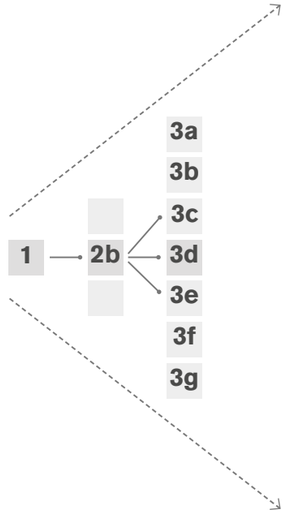


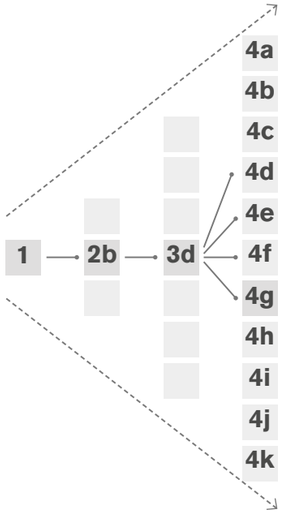
2b+3e: Establishing water connectivity with boat routes and pathways.

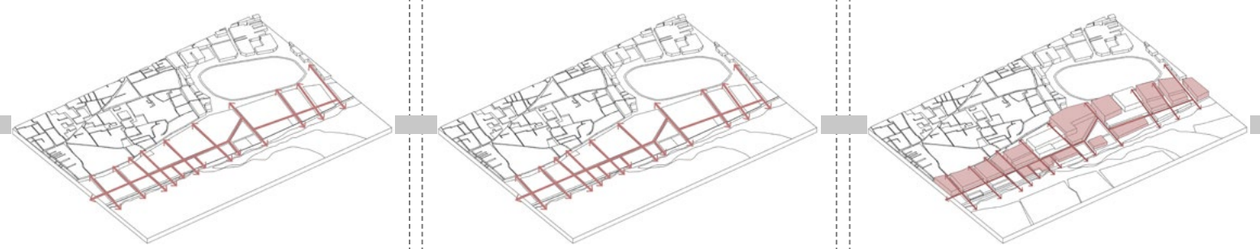
Frame of Reference: Desired State

Adaptive Pathways





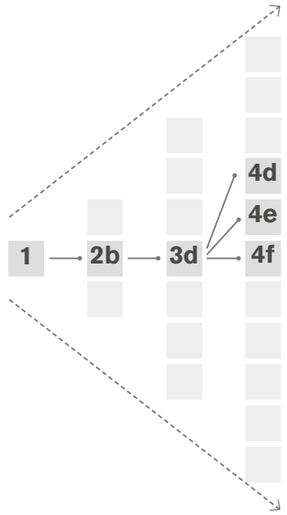


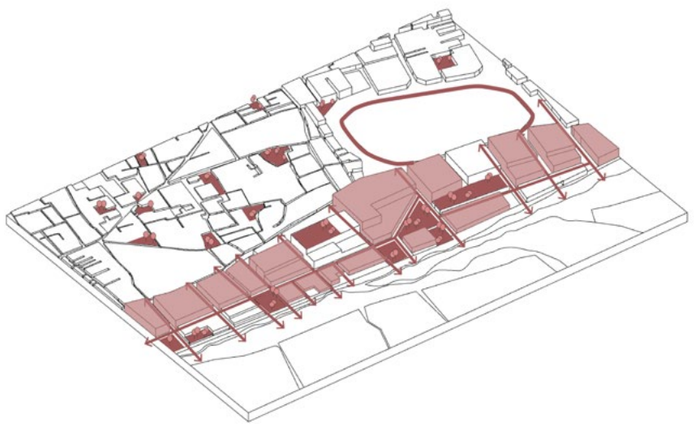


Local Adaptation Urban Areas	**Step 1**	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**	**Step 7**	**Step 8**
	Assessment	Decision Assessment	Decision					
Operability	**1**	**2b**	**3d**					
Actors:	- Patna Municipal Corporation - Water and Sanitation Department	- Patna Municipal Corporation - Ward Office - Road Construction Department	- Patna Municipal Corporation					
Instruments:	- Sewage Network Plan	- Workshops, Compensation Plan - Revised Town Planning Scheme	- Programming Plan - Updated Land Use Plan					
Objectives:	- Stop Sewage flow into the River (Social + Ecological Benefits)	- Access Roads to the River (Social Benefits)	- Creating Activities along the River (Social + Economic Benefits)					
Co-Management	**Public Sector**	**Public Sector + Private Owners**	**Public Sector**					

Frame of Reference: Desired State

Adaptive Pathways





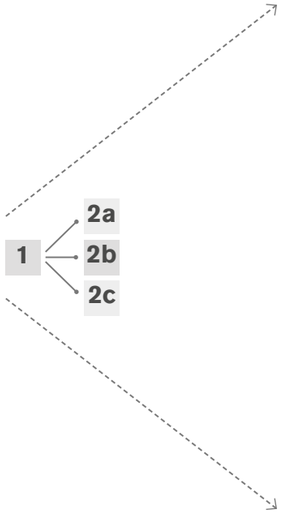
2b+3d+4d: Connecting green patches, taking greens along the river into the city

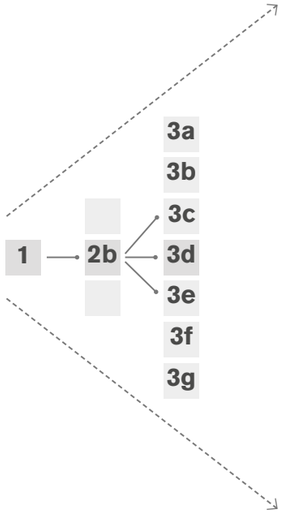
2b+3d+4e: Increasing permeability by promoting permeable paver blocks, maintaining slopes to river

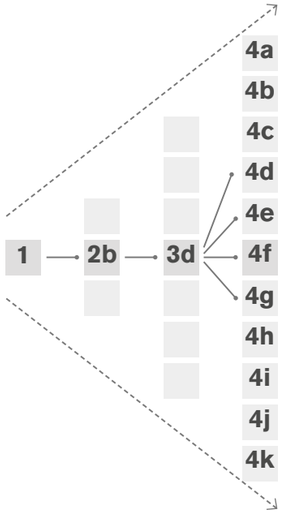
2b+3d+4f: Constructing wetland parks and regulating temporary agricultural fields for dry seasons on the river bed

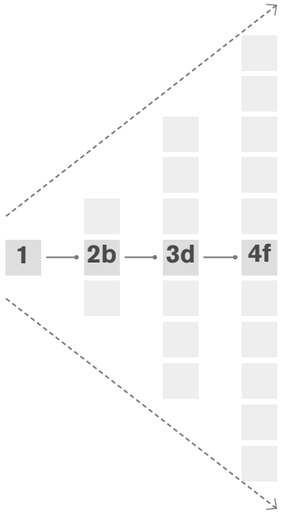
Frame of Reference: Desired State

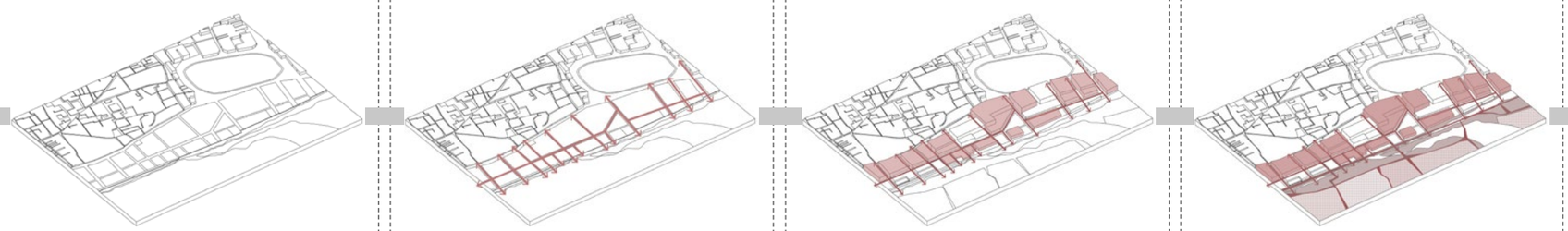
Adaptive Pathways











Local Adaptation Urban Areas	**Step 1**	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**	**Step 7**	**Step 8**
	Assessment	Decision / Assessment	Decision / Assessment	Decision / Assessment				
Operability	**1**	**2b**	**3d**	**4f**				
Actors:	- Patna Municipal Corporation - Water and Sanitation Department	- Patna Municipal Corporation - Ward Office - Road Construction Department	- Patna Municipal Corporation	- Independent Investors + NGOs - Landscape Architects - Farmers				
Instruments:	- Sewage Network Plan	- Workshops, Compensation Plan - Revised Town Planning Scheme	- Programming Plan - Updated Land Use Plan	- Design Plan - Planting Plan				
Objectives:	- Stop Sewage flow into the River (Social + Ecological Benefits)	- Access Roads to the River (Social Benefits)	- Creating Activities along the River (Social + Economic Benefits)	- Buffer with temporary landscapes (Social + Ecological Benefits)				
Co-Management	**Public Sector**	**Public Sector + Private Owners**	**Public Sector**	**Citizens + Civil Societies**				

Frame of Reference: Desired State

Permeable Paving
(Increased groundwater recharge)

Source: Permeable Holland - Angelus Paving Stones

Terrace Farming
(Establishing Micro-ecology)

Source: Urban Rooftop Farming

Farmlands
(Temporary water retention and sediment collection)

Source: Monteith, 2020

Agro Forestry
(Increased groundwater retention)

Source: Agroforestry at 40: how tree-farm science has changed the world

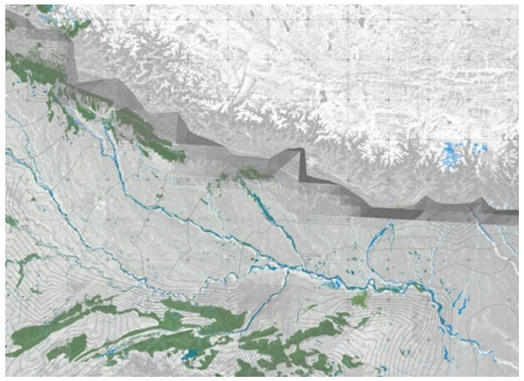
Wetland Park
(Temporary water storage and drainage)

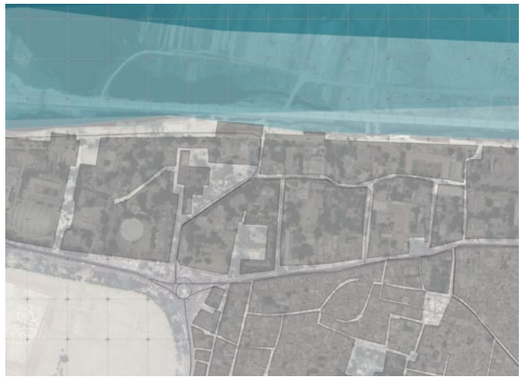
Source: Gallery of Turenscape, Archdaily

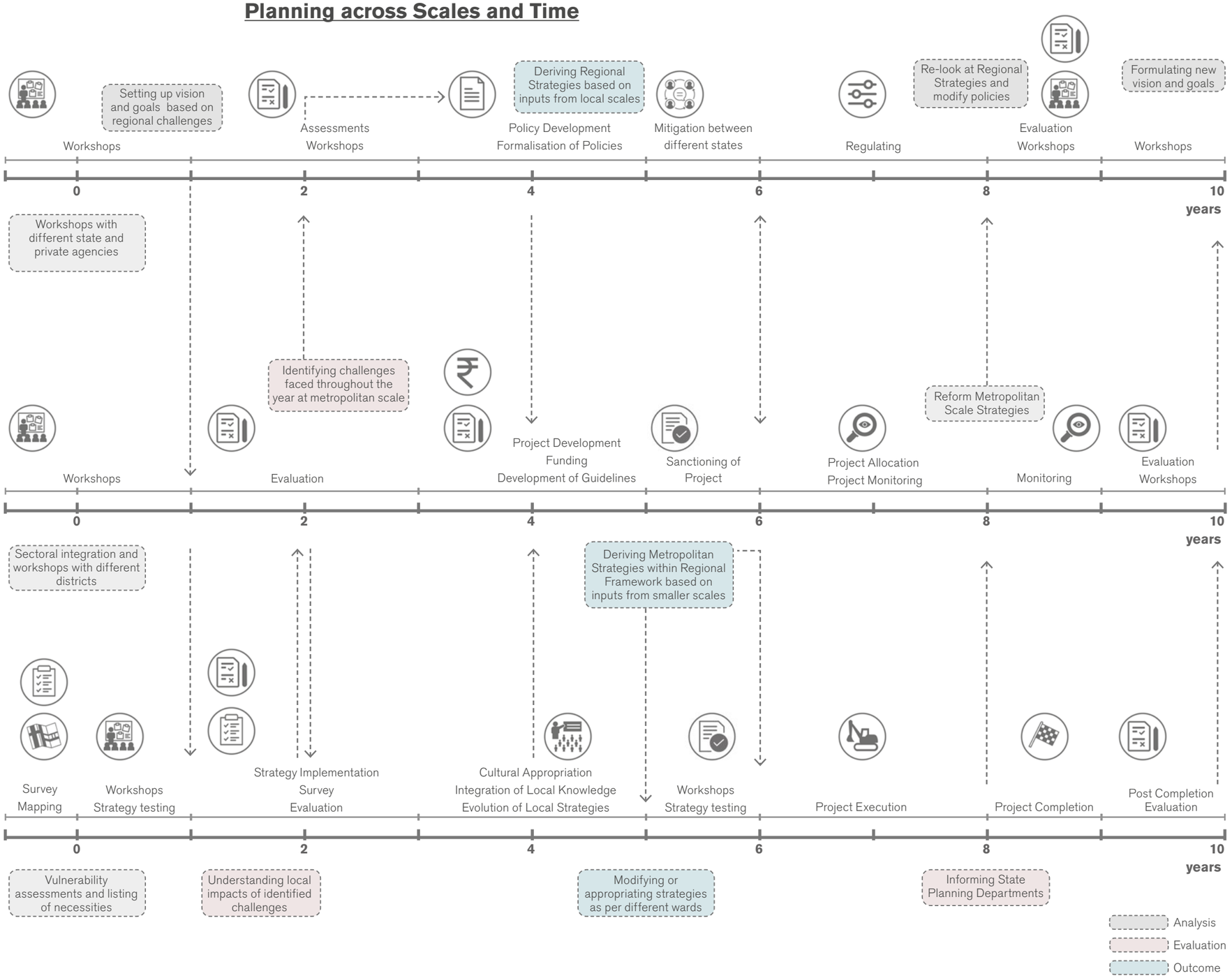
Frame of Reference: Desired State

Adaptive Pathways

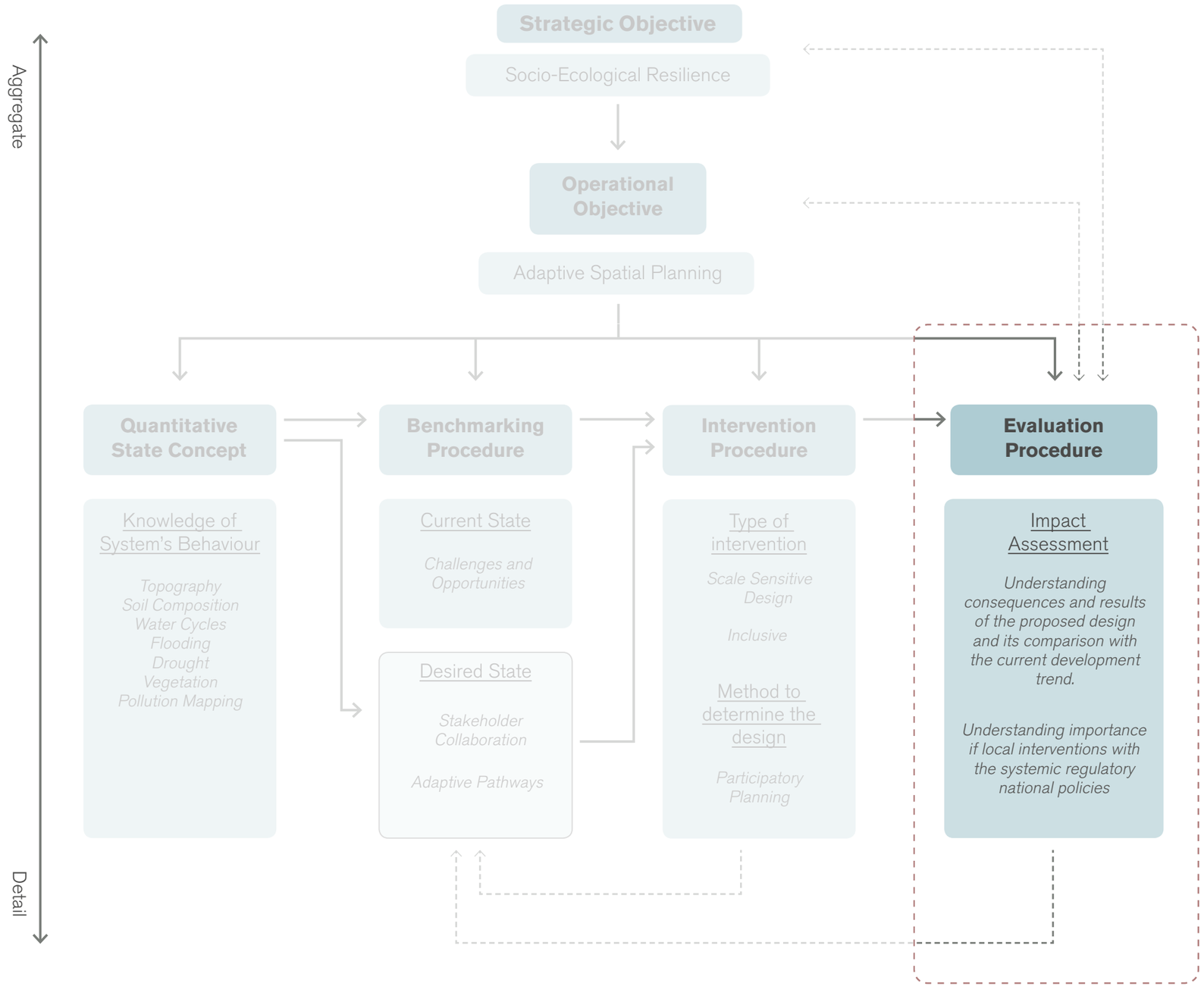
Planning across Scales and Time







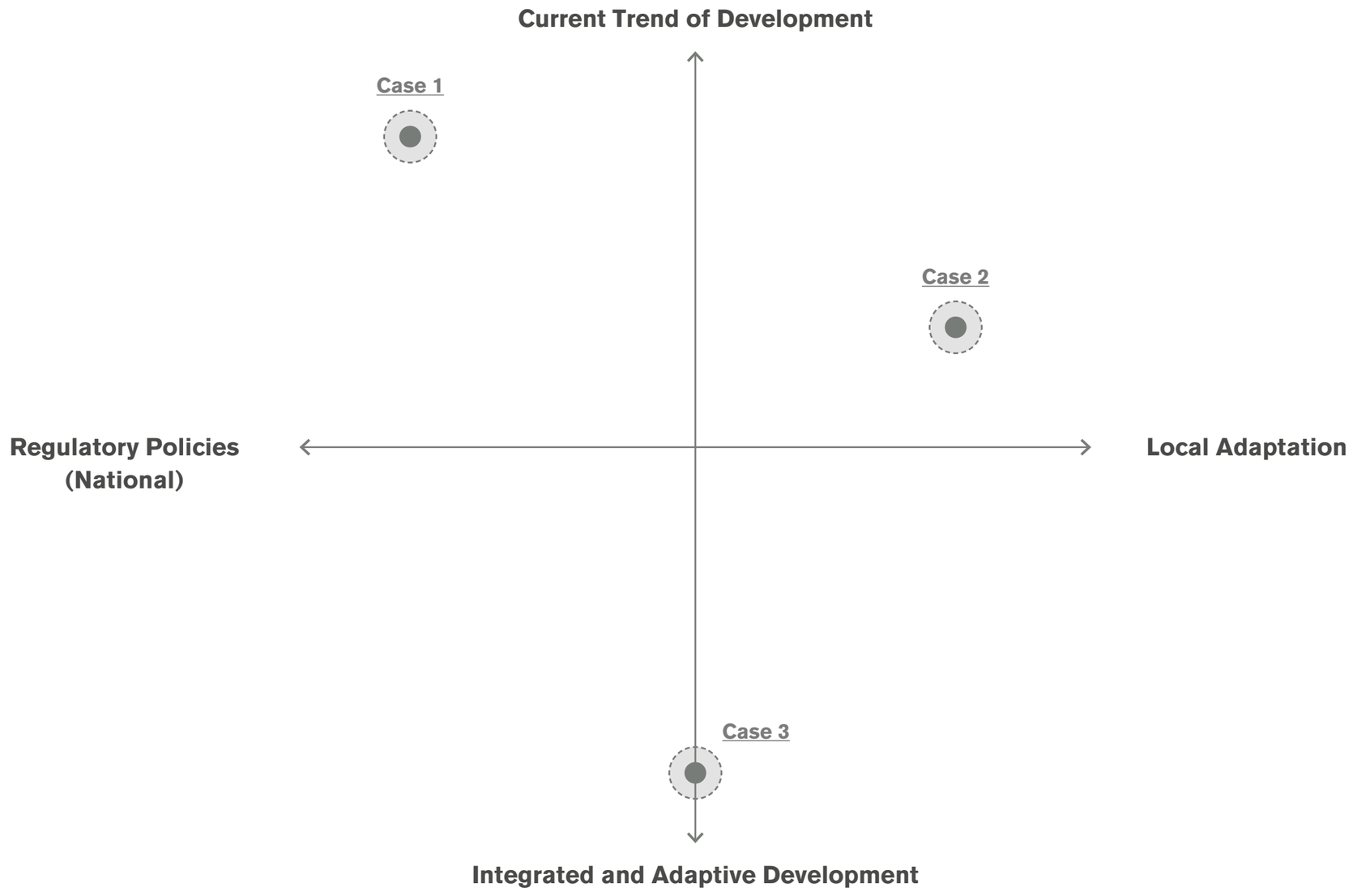
Frame of Reference: Evaluation Procedure



Source: Van Koningsveld, 2003, modified by author

Frame of Reference: Evaluation Procedure

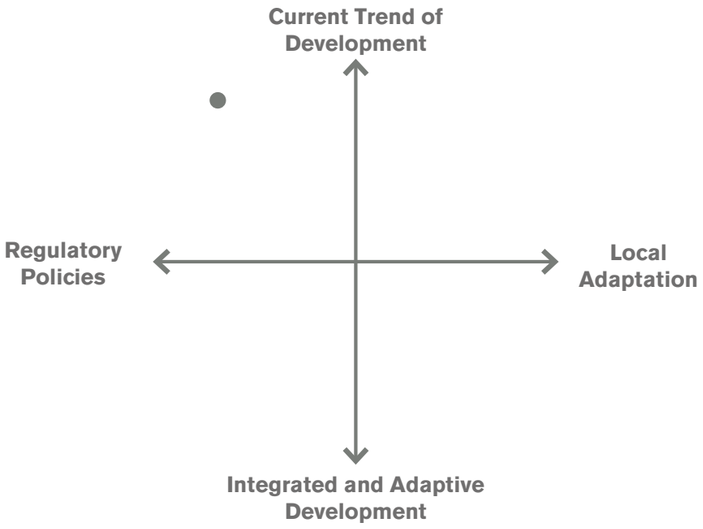
Scenarios



Frame of Reference: Evaluation Procedure

Scenario Case 1

Proposing strategies within the current trend of development (Speculative)



Tipping point 1:

Water Management:
-Increased temperatures and possible drought

-High rainfall and flooding probability.

Urban Planning:
-Increased population within the urban centres

Landscape:
-Reduced local species

Tipping point 2:

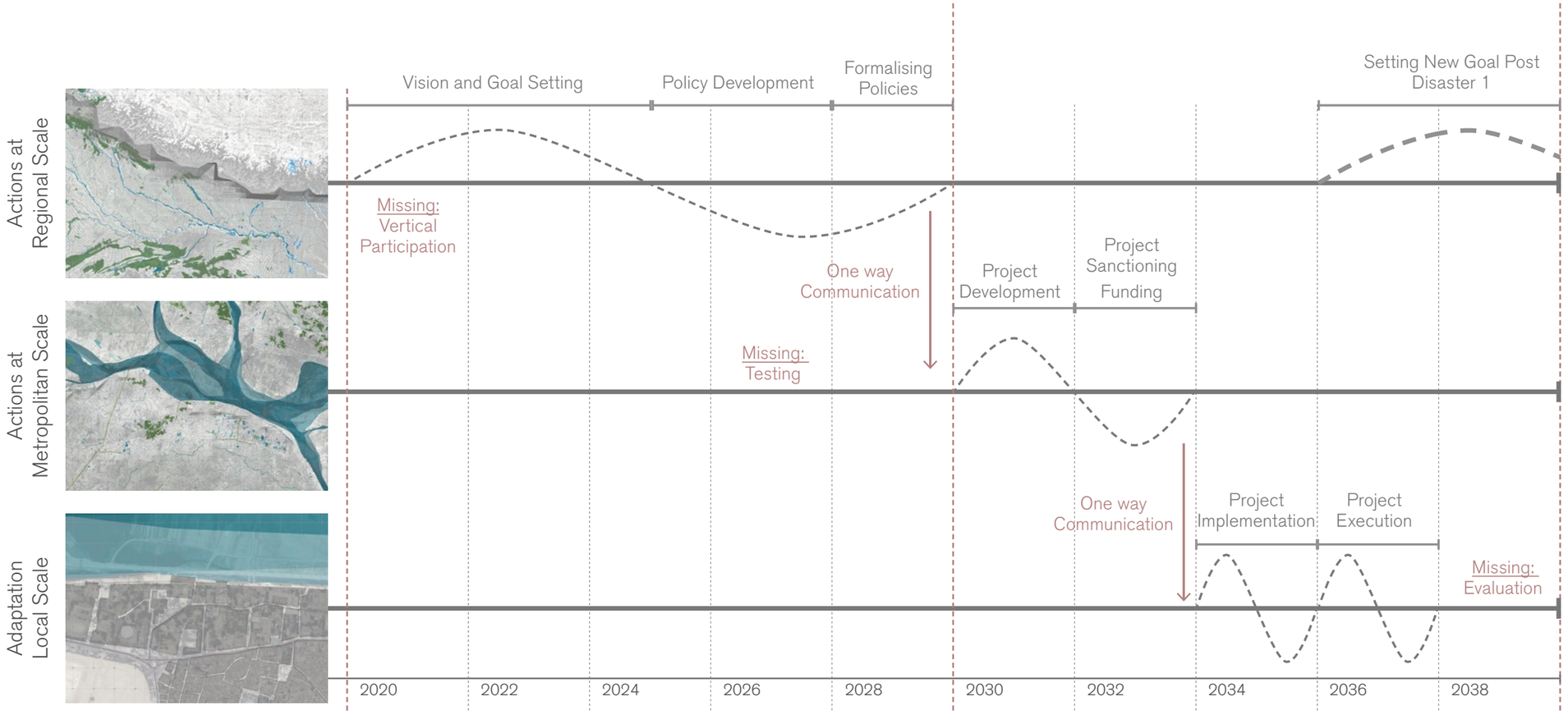
Water Management:
-Higher temperature and droughts

-Increased flooding frequency

Urban Planning:
-Land crisis within urban centres

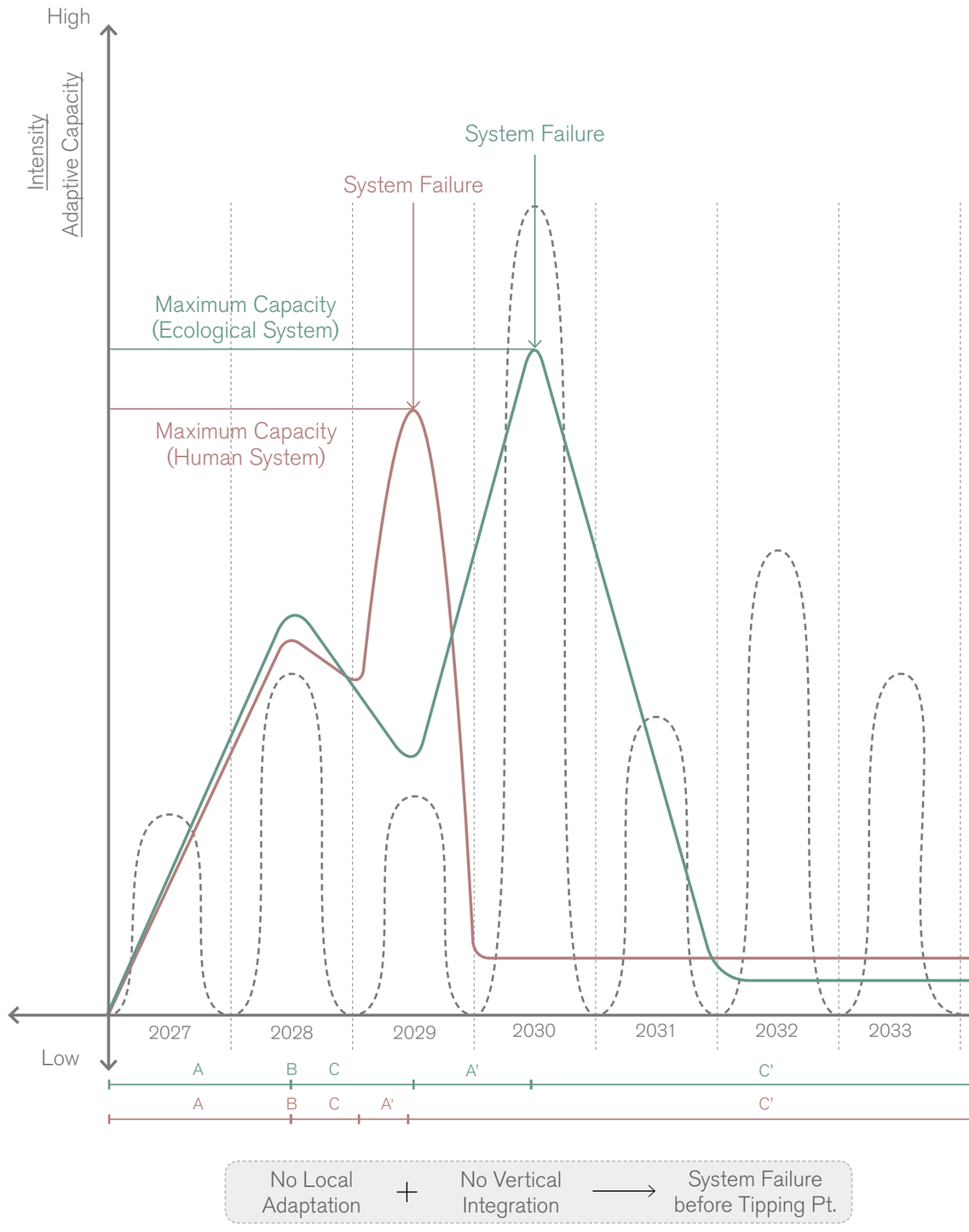
Landscape:
-Loss of local species

Planning Pathway across time and scale



Scenario Case 1

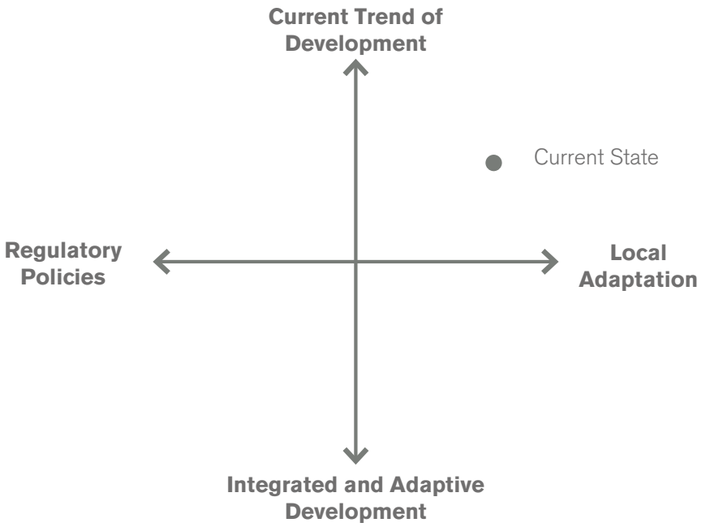
Proposing strategies within the current trend of development (Speculative)



Frame of Reference: Evaluation Procedure

Scenario Case 2

Local adaptation of strategies within the current planning framework (Current condition)



Tipping point 1:

Water Management:
-Increased temperatures and possible drought

-High rainfall and flooding probability.

Urban Planning:
-Increased population within the urban centres

Landscape:
-Reduced local species

Tipping point 2:

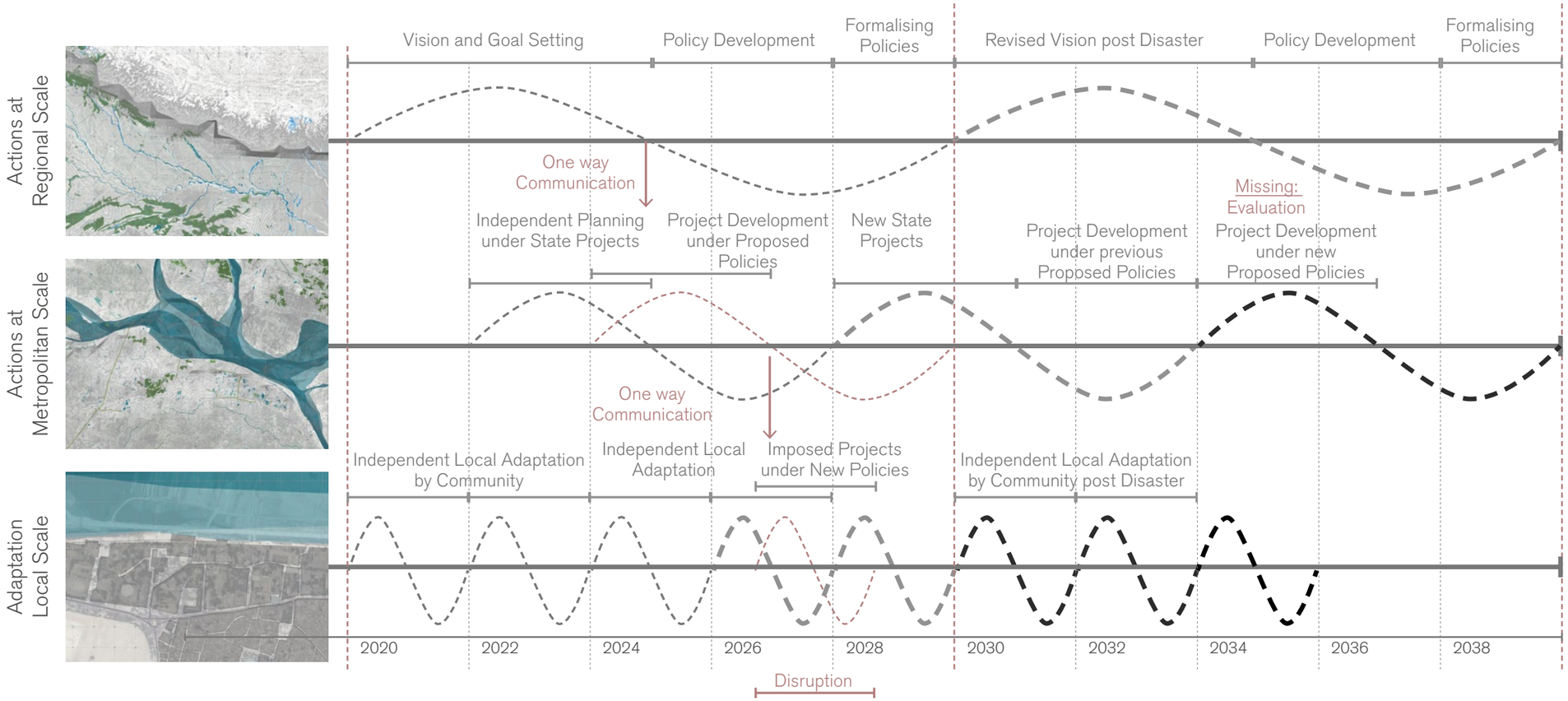
Water Management:
-Higher temperature and droughts

-Increased flooding frequency

Urban Planning:
-Land crisis within urban centres

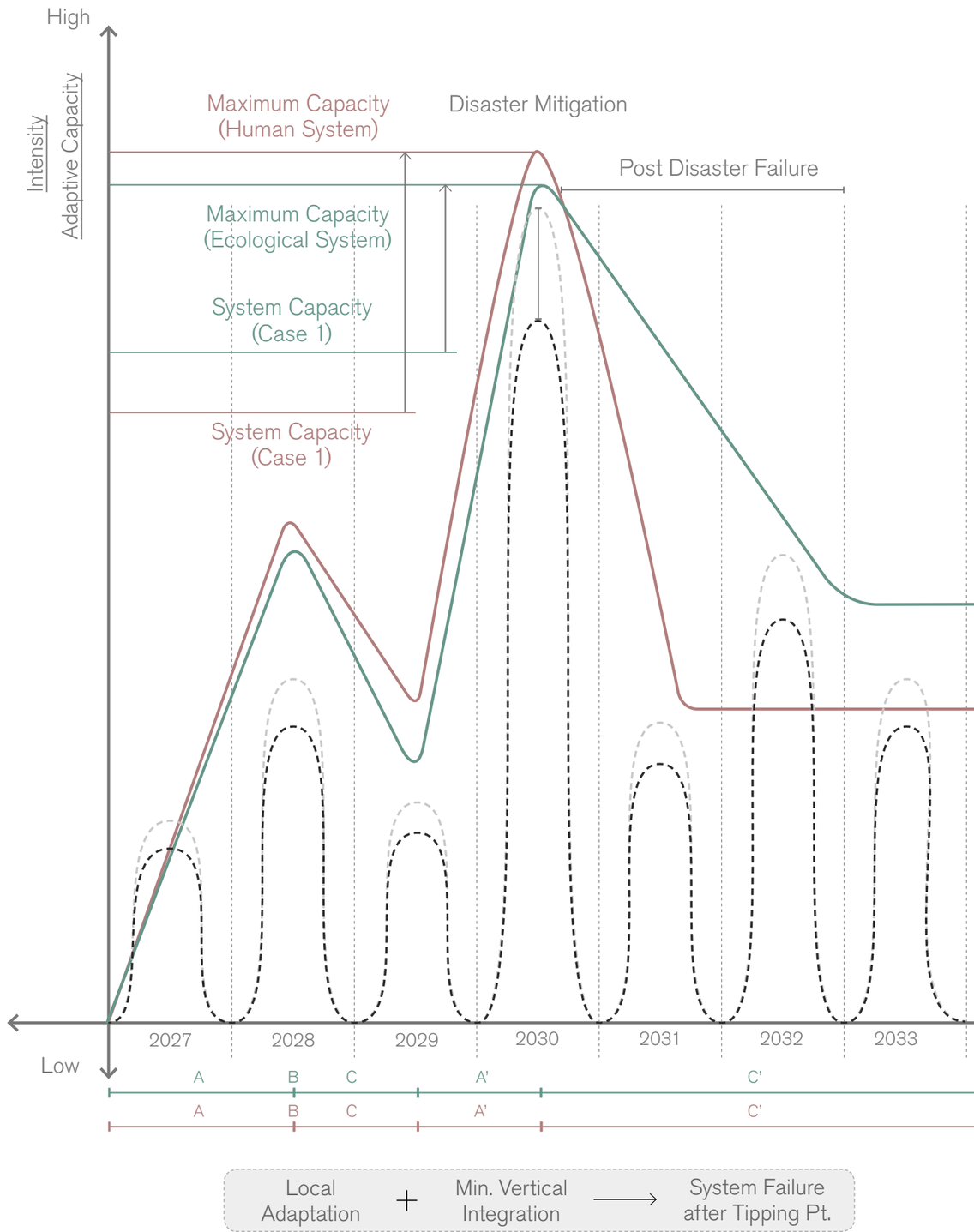
Landscape:
-Loss of local species

Planning Pathway across time and scale



Scenario Case 2

Local adaptation of strategies within the current planning framework (Current condition)



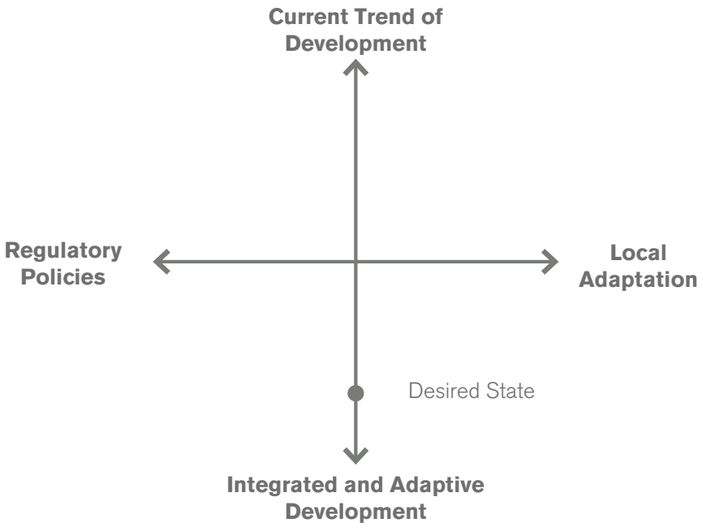
Local Adaptation + Min. Vertical Integration → System Failure after Tipping Pt.

Phase A Growth
Phase B Momentary Equilibrium
Phase C Collapse
Impact on Ecological System
Impact on Human System
Disaster Intensity
(Assume Flooding with 2 year moderate and 10 year high intensity cycle)

Frame of Reference: Evaluation Procedure

Scenario Case 3

Local adaptation of strategies within the adaptive planning framework (Desired)



Tipping point 1:

Water Management:
-Increased temperatures and possible drought

-High rainfall and flooding probability.

Urban Planning:
-Increased population within the urban centres

Landscape:
-Reduced local species

Tipping point 2:

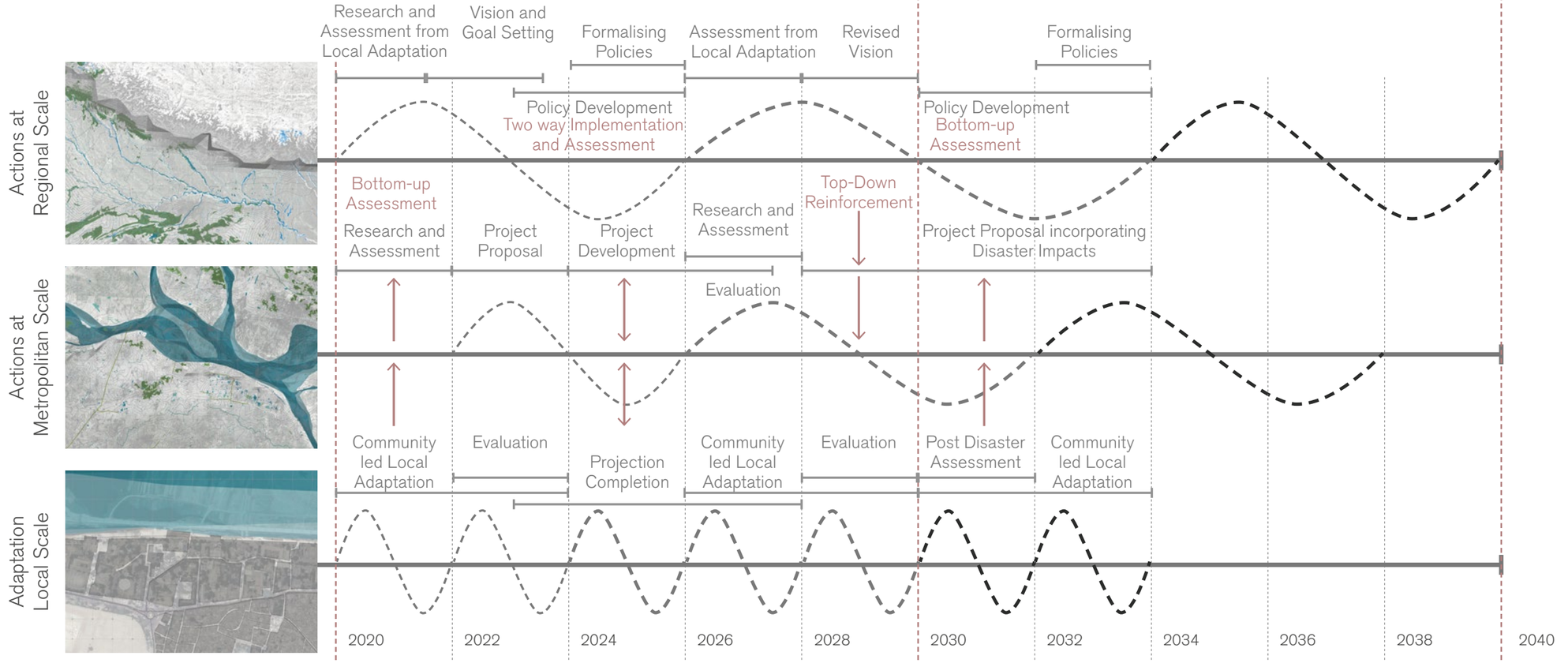
Water Management:
-Higher temperature and droughts

-Increased flooding frequency

Urban Planning:
-Land crisis within urban centres

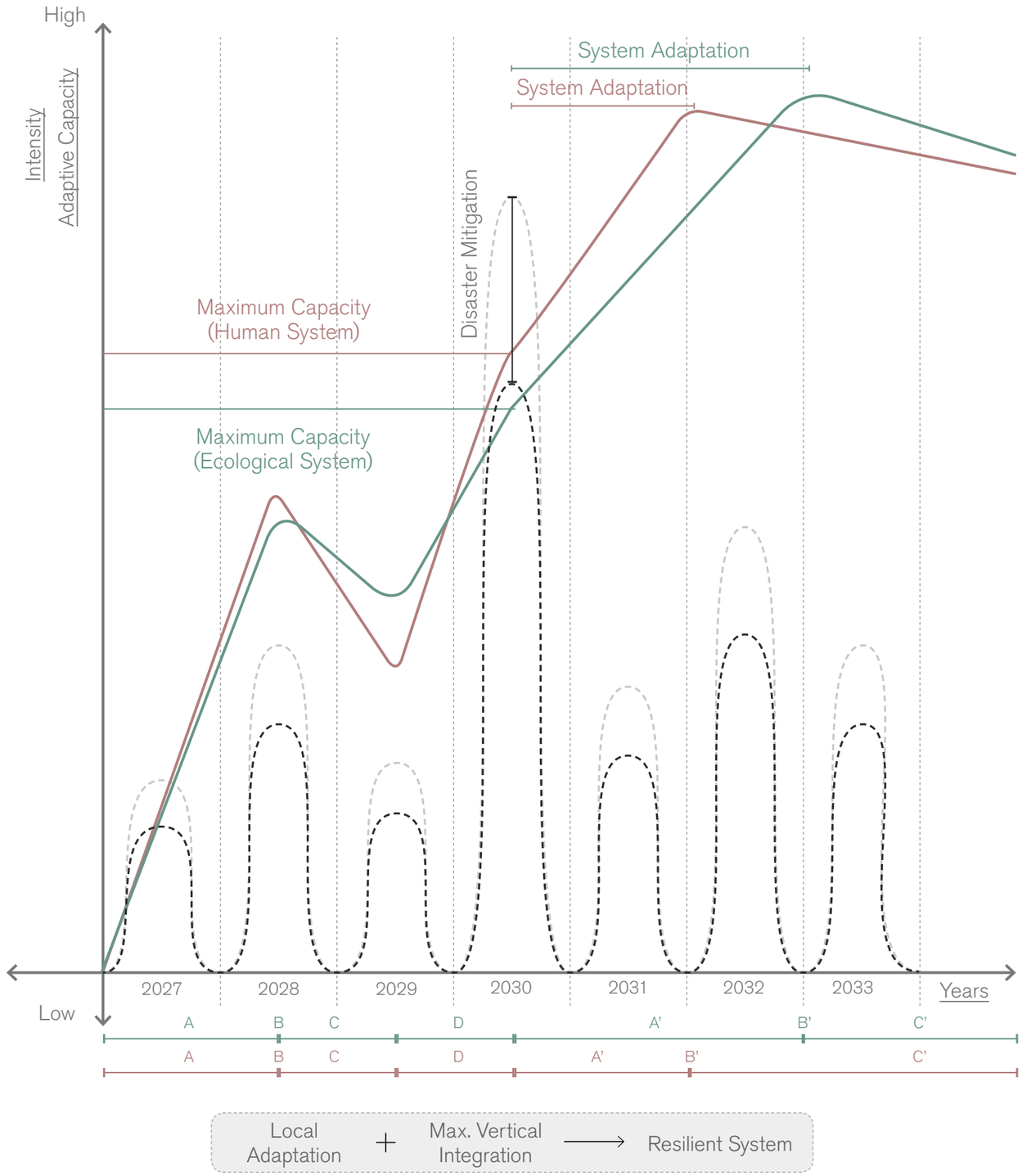
Landscape:
-Loss of local species

Planning Pathway across time and scale



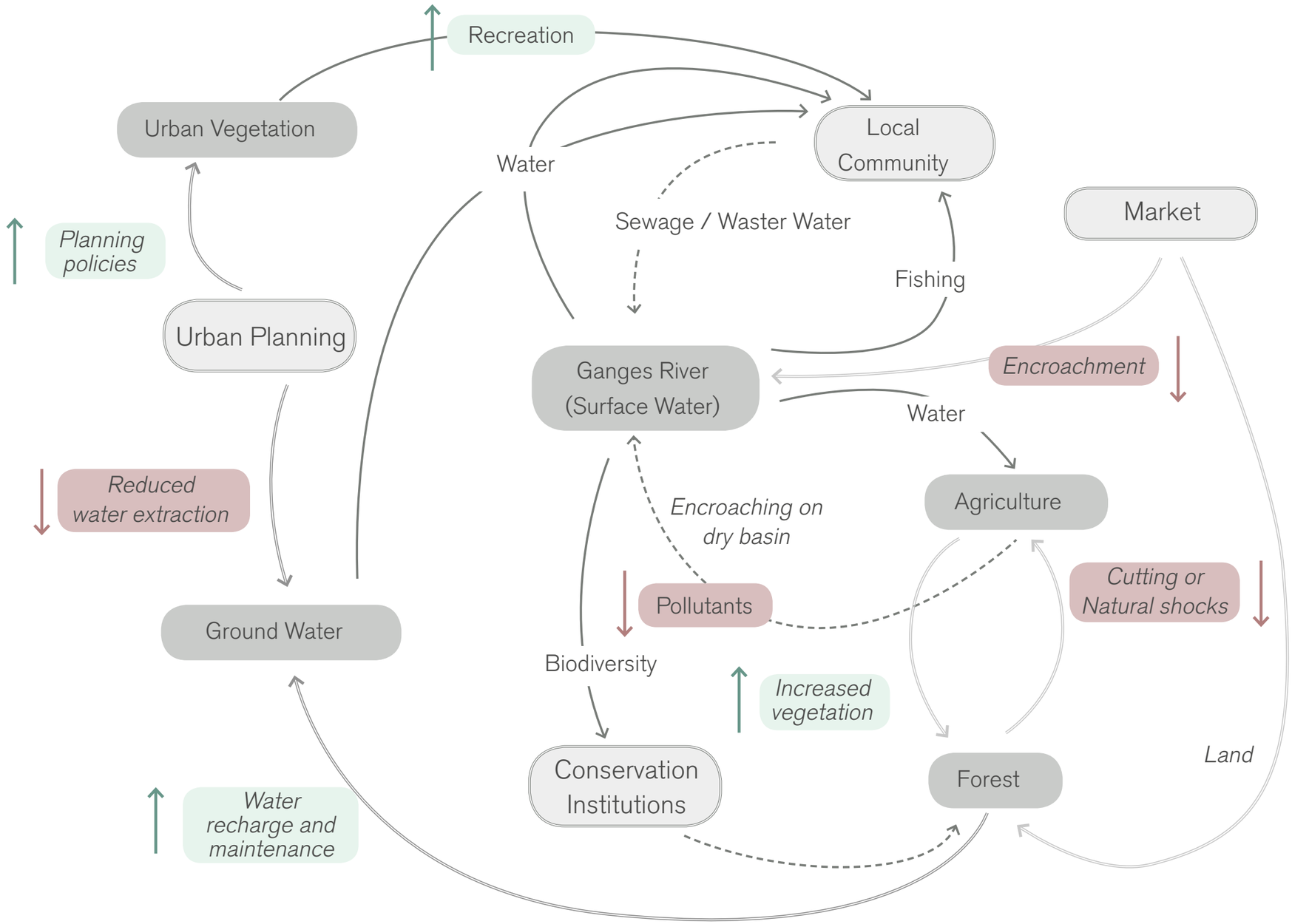
Scenario Case 3

Local adaptation of strategies within the adaptive planning framework (Desired)



Phase A Growth
Phase B Momentary Equilibrium
Phase C Collapse
Phase D Re-orientation
Impact on Ecological System
Impact on Human System
Disaster Intensity
(Assume Flooding with 2 year moderate and 10 year high intensity cycle)

Conclusion



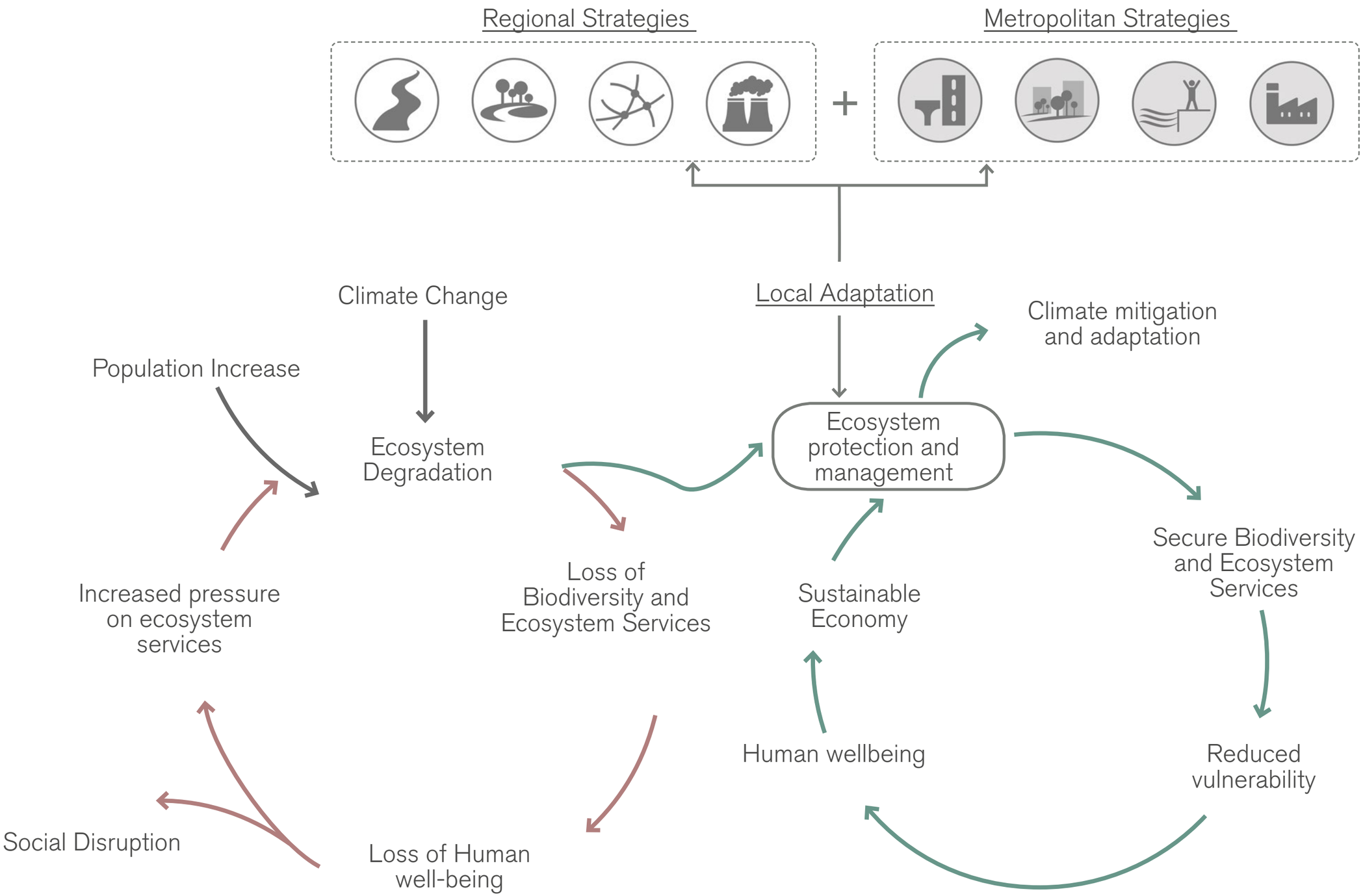
Multi-level external systems that govern resource systems

Pressures/uses generated by user system

Resource systems

Flows of resources

Conclusion

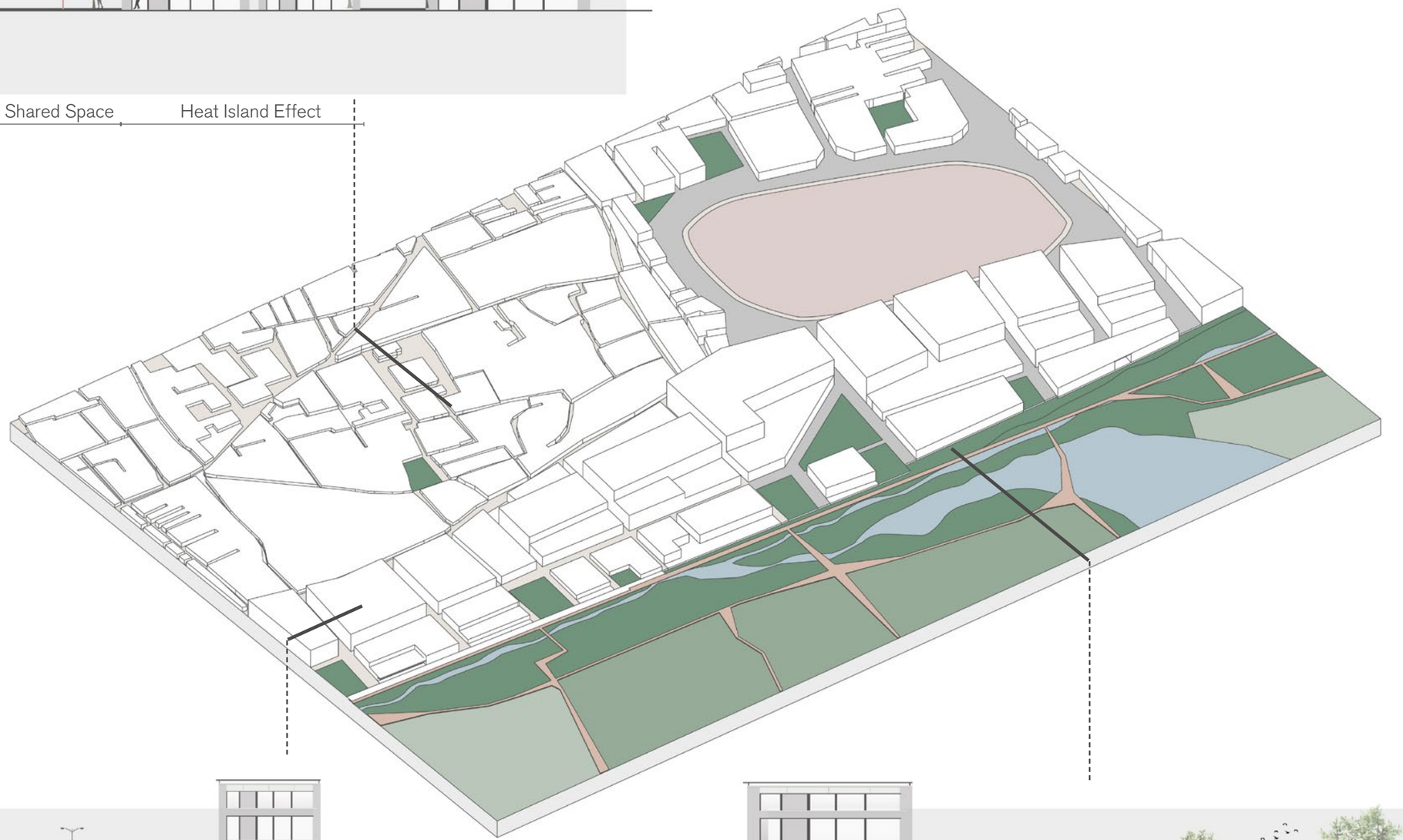


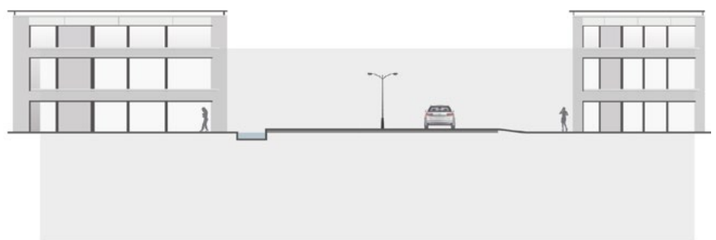
Source: Munang et al., 2013

Conclusion

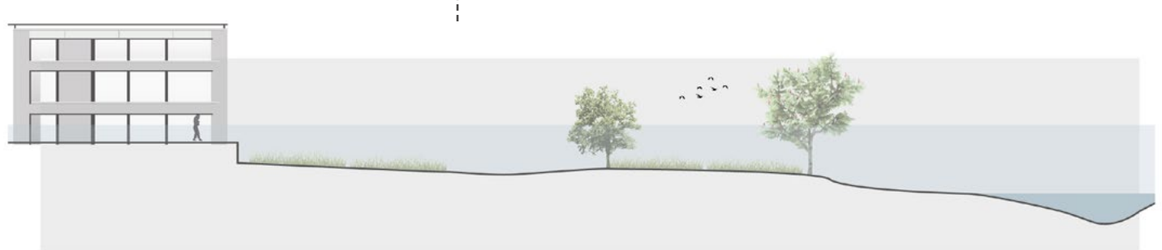
Current Condition

Paved Shared Space | Heat Island Effect





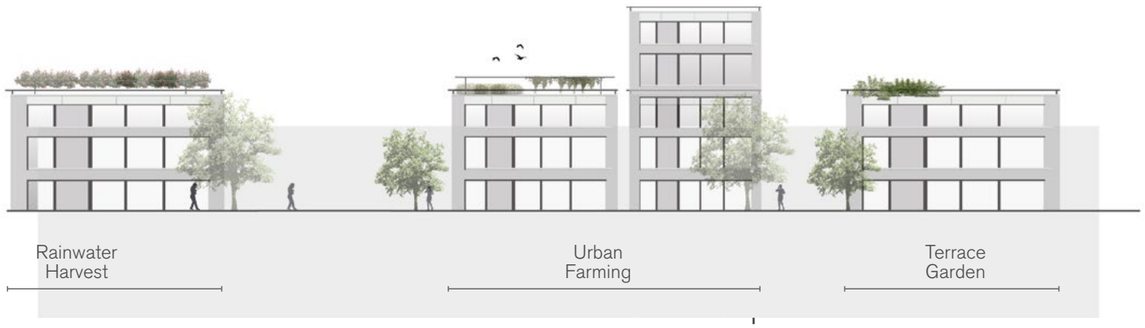
Rainwater Collector | Typical Street Section

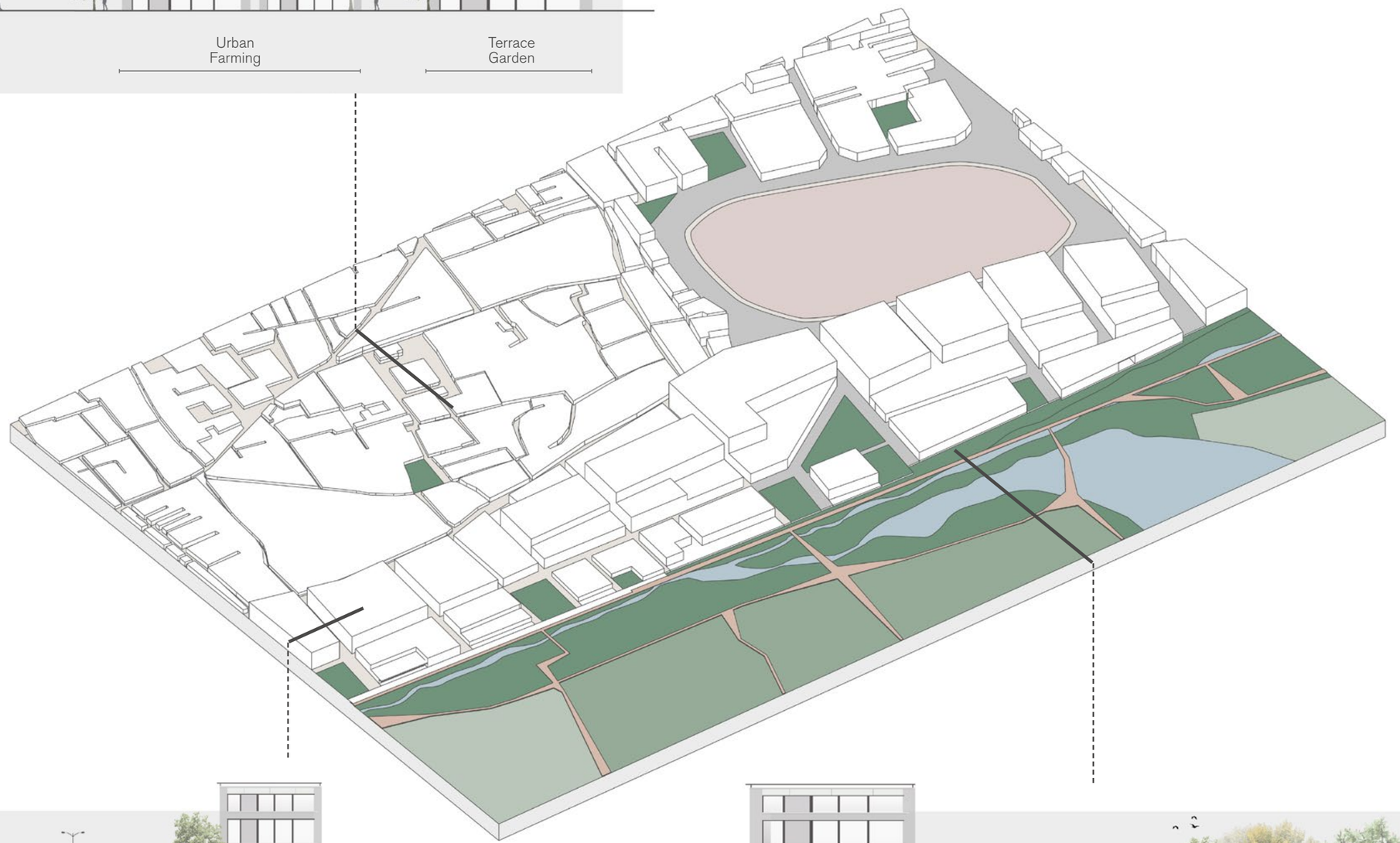


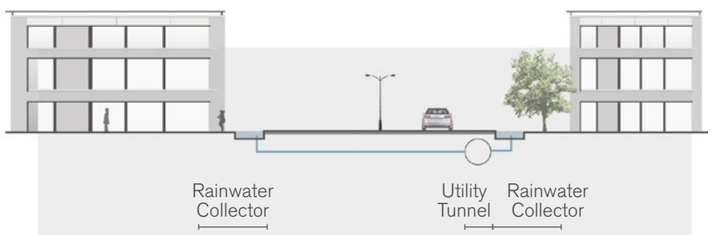
Floodplain | Current Capacity

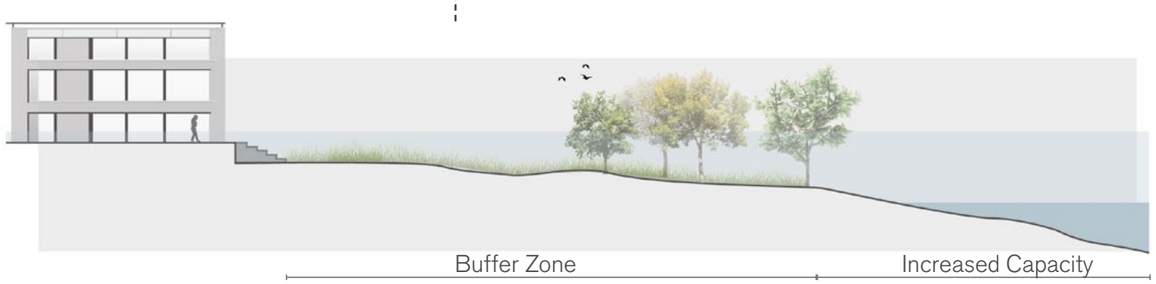
Conclusion

Climate Mitigation Strategies



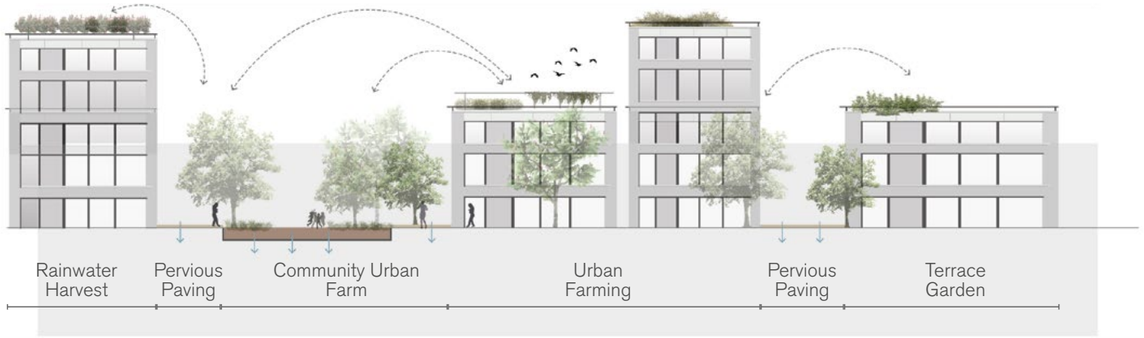


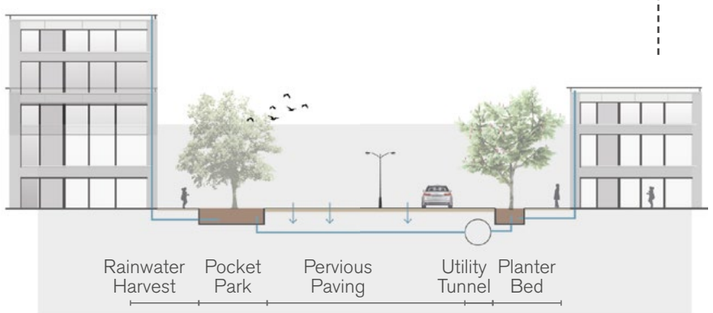


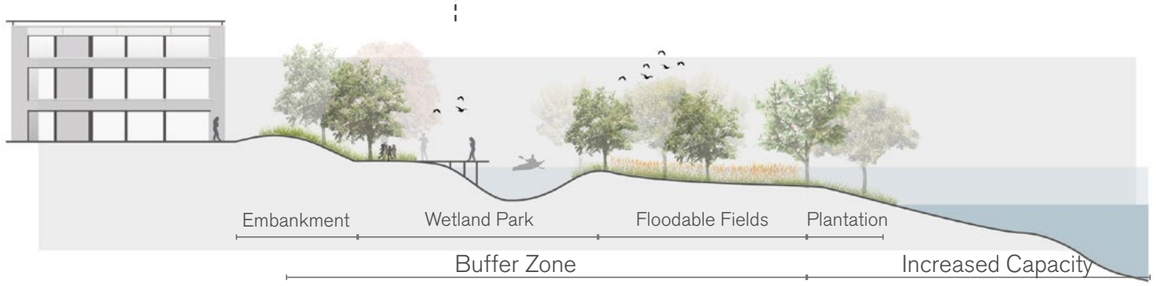


Conclusion

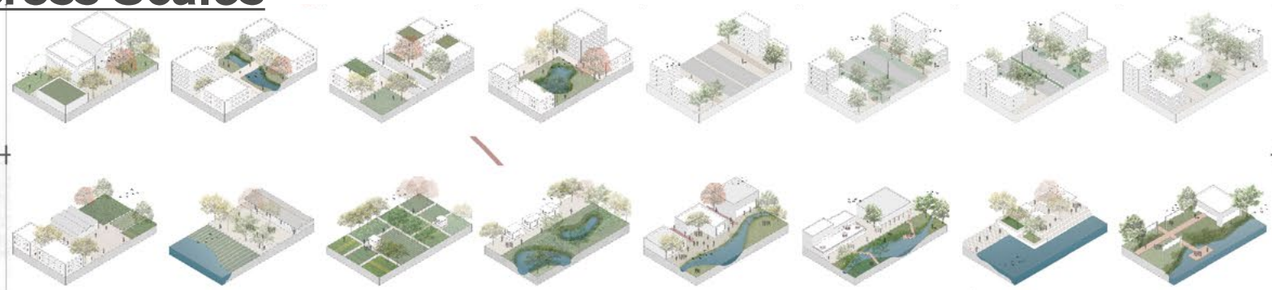
Local Adaptation

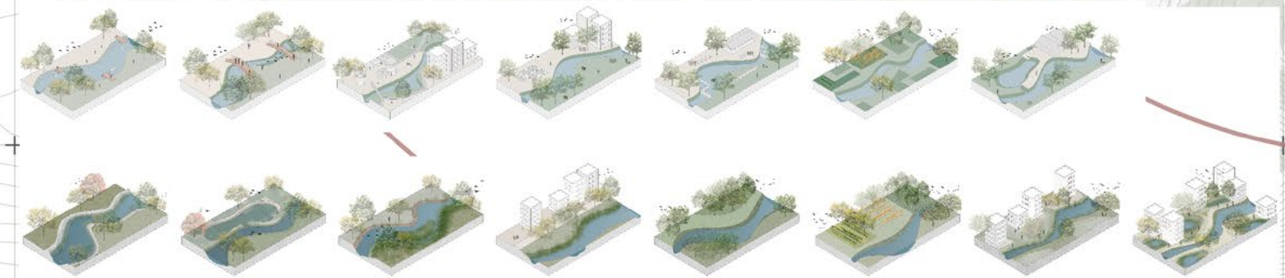






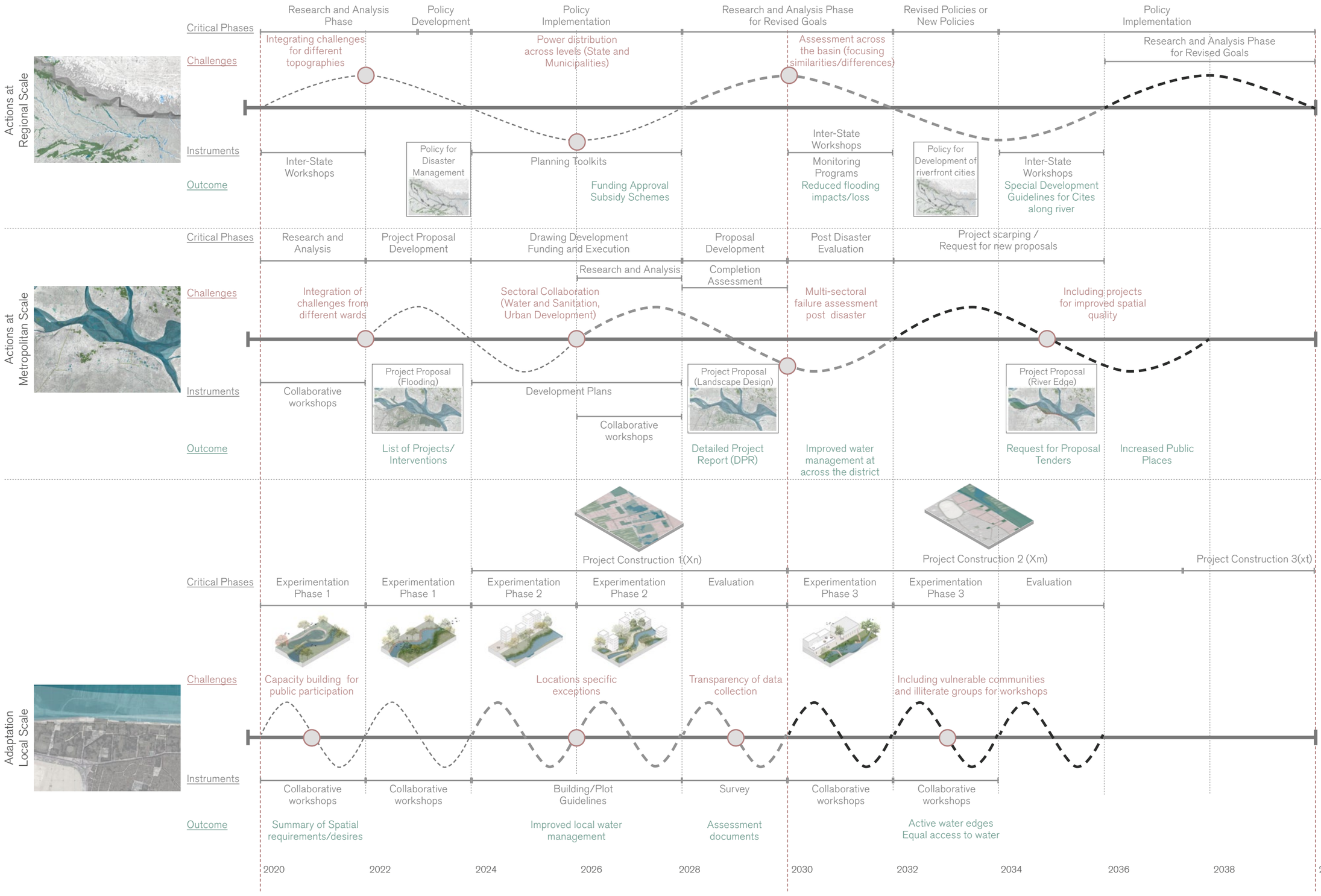
Synergies Across Scales





THANK YOU

Detailed Proposed Planning Pathway and Challenges within the Current Capacities



Frame of Reference: Desired State

Stakeholder Engagement

(Current Capacities vs Proposed Roles)

Level of Governance	Current Roles	Redefined Roles
Level 0: Ward Offices	▪ Represent ideas ▪ Zero decision power	▪ Conduct participatory meetings ▪ Power to formulate projects and overlook execution (eg: pervious paving, rain water harvesting) planned within metropolitan strategic framework
Level 1: Local Municipalities	▪ Develop Land Use Plan ▪ Execution of State planned water infrastructure	▪ Participatory planning and conduct meetings ▪ Inform State departments of local challenges ▪ Design within the framework of state strategies
Level 2: State Government	▪ Planning of Infrastructure Projects ▪ Deciding/Approving funds for Spatial Planning	▪ Bridge between Local Planning and National Policies ▪ Developing strategies under Regional Vision
Level 3: Central Government	▪ Independently setting up Policies ▪ Allocation of funds to States	▪ Work as Mediator between different States for cross state projects ▪ Development of Policies with Inputs from several sectors and levels of governance.