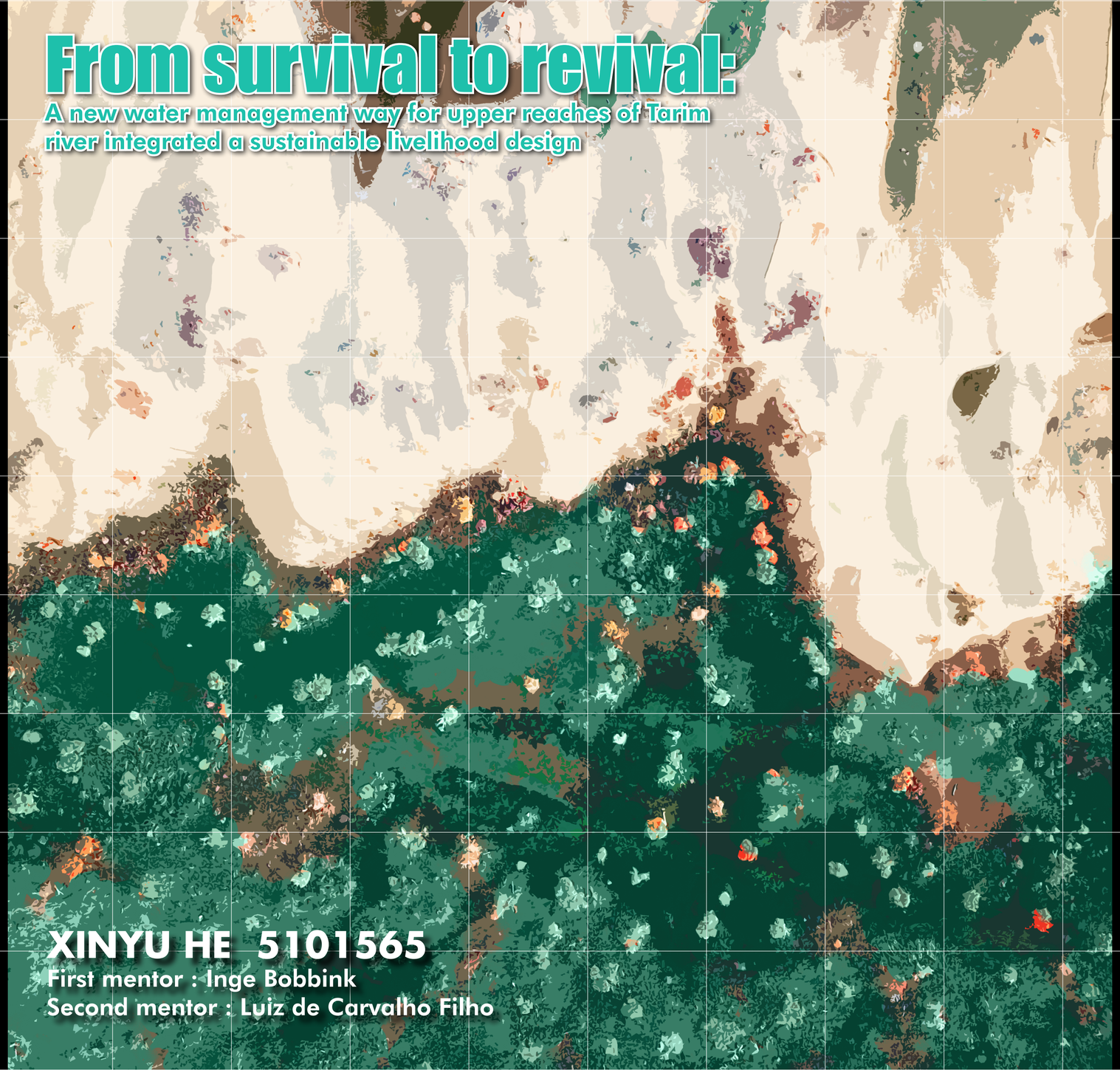
From survival to revival:

A new water management way for upper reaches of Tarim river integrated a sustainable livelihood design



XINYU HE 5101565

First mentor : Inge Bobbink

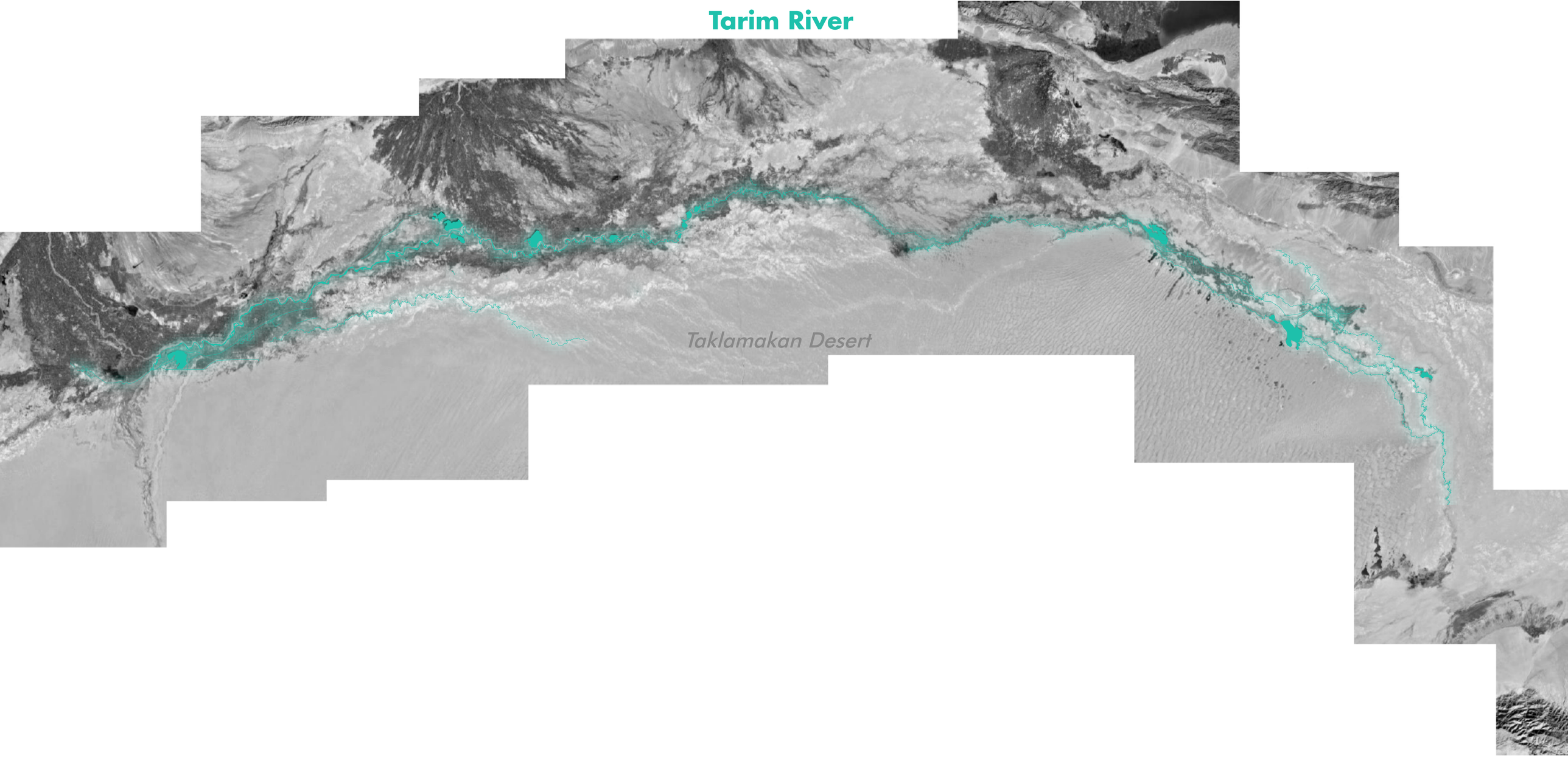
Second mentor : Luiz de Carvalho Filho

Fascination / Impression: Tarim river basin / Definition: Tarim river / Clarification: Upper stream / Research methodology and Principles / Design Exploration / Reflection

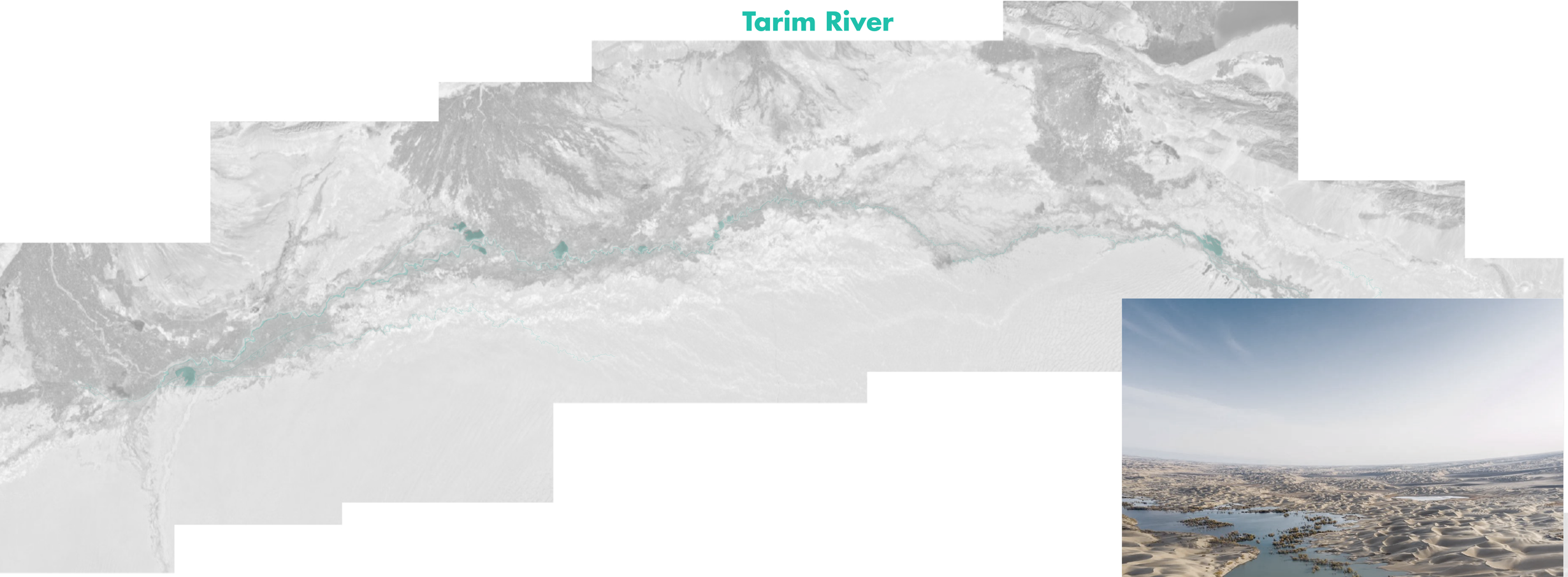
Fascination

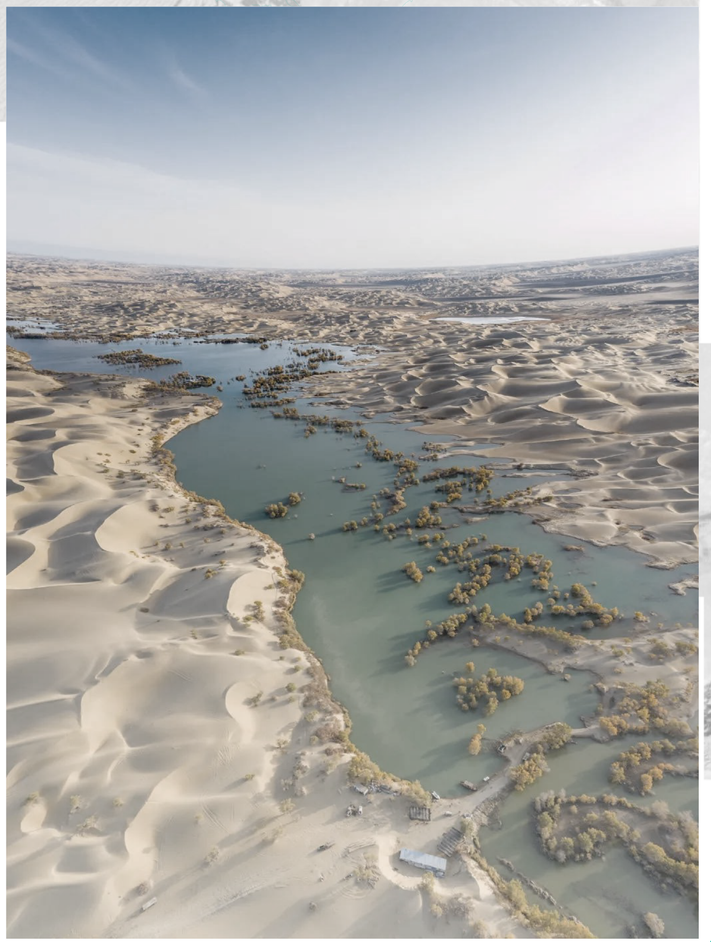


Tarim River

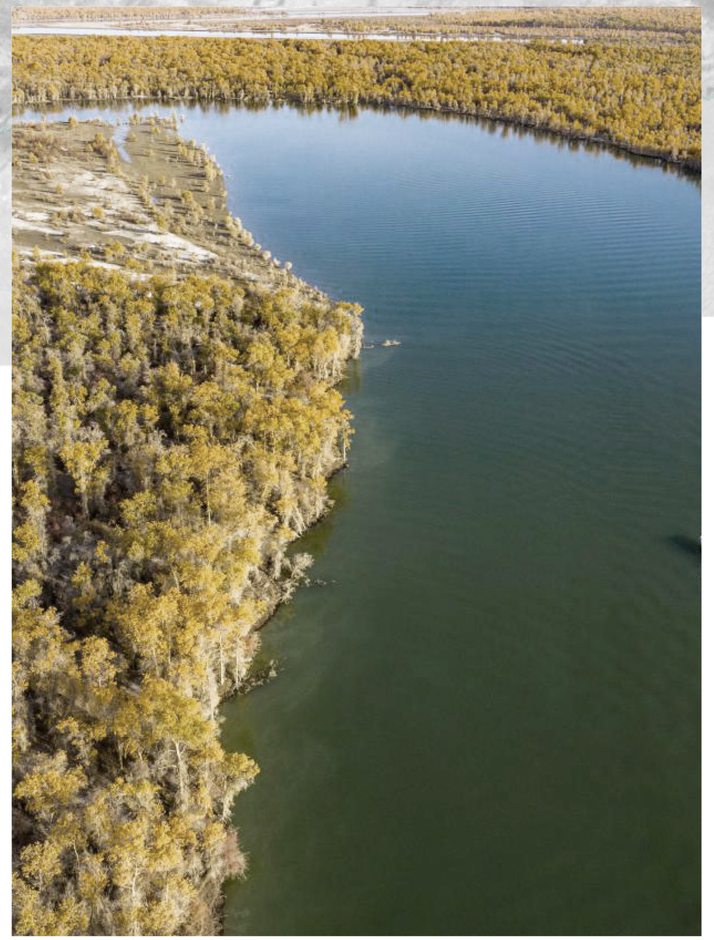


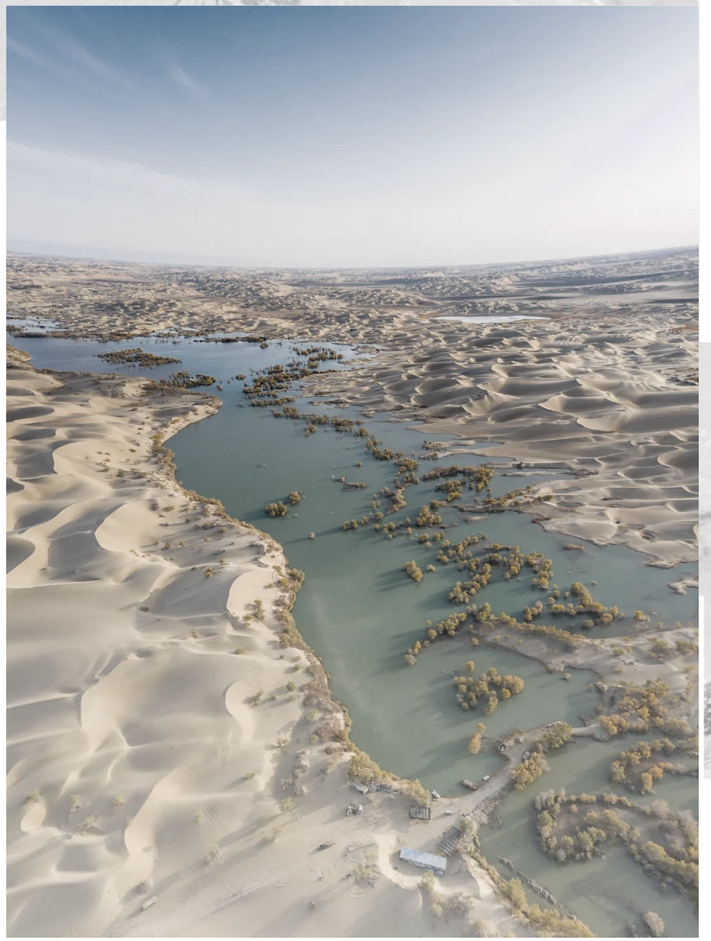
Tarim River





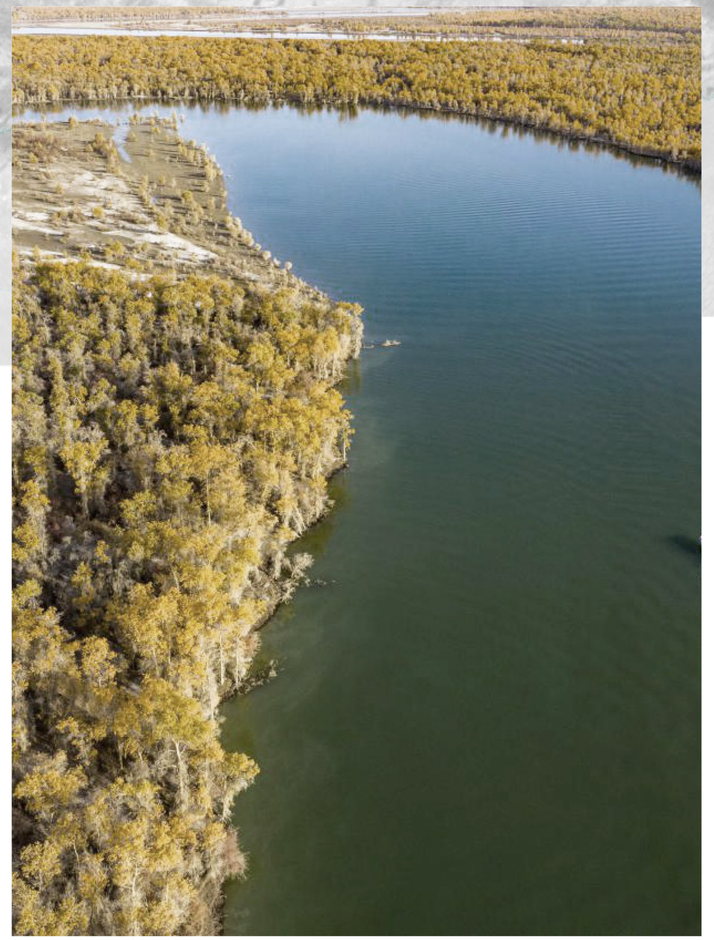
Tarim River





Tarim River







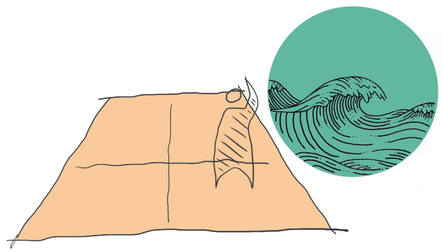




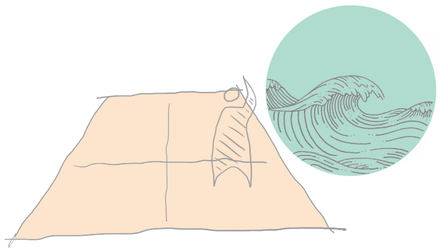




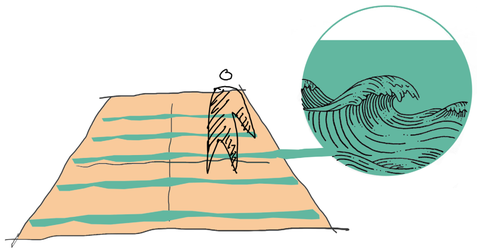




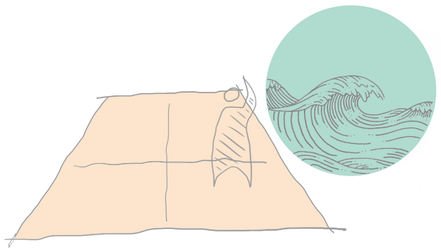
Flood control in the 1950s



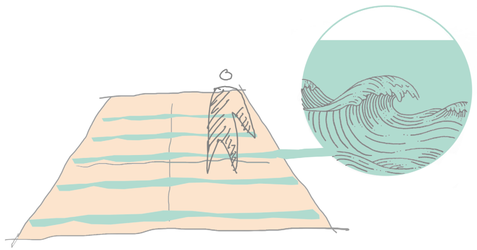
Flood control in the 1950s



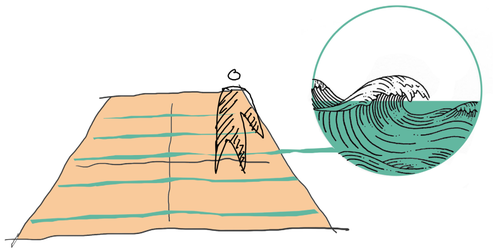
Flood irrigation in the 1960s



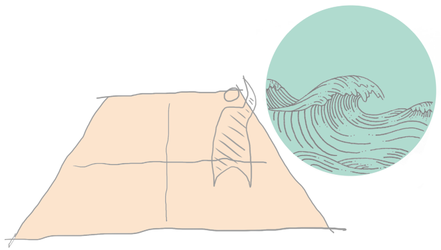
Flood control in the 1950s



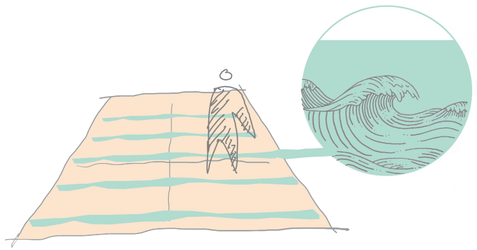
Flood irrigation in the 1960s



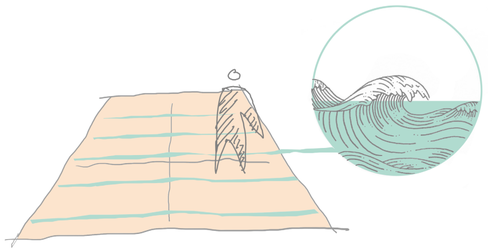
Water saving in the 1970s



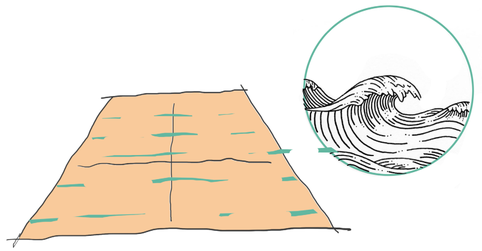
Flood control in the 1950s



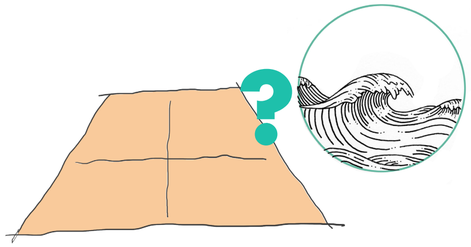
Flood irrigation in the 1960s



Water saving in the 1970s



Flow cut off in the 1990s

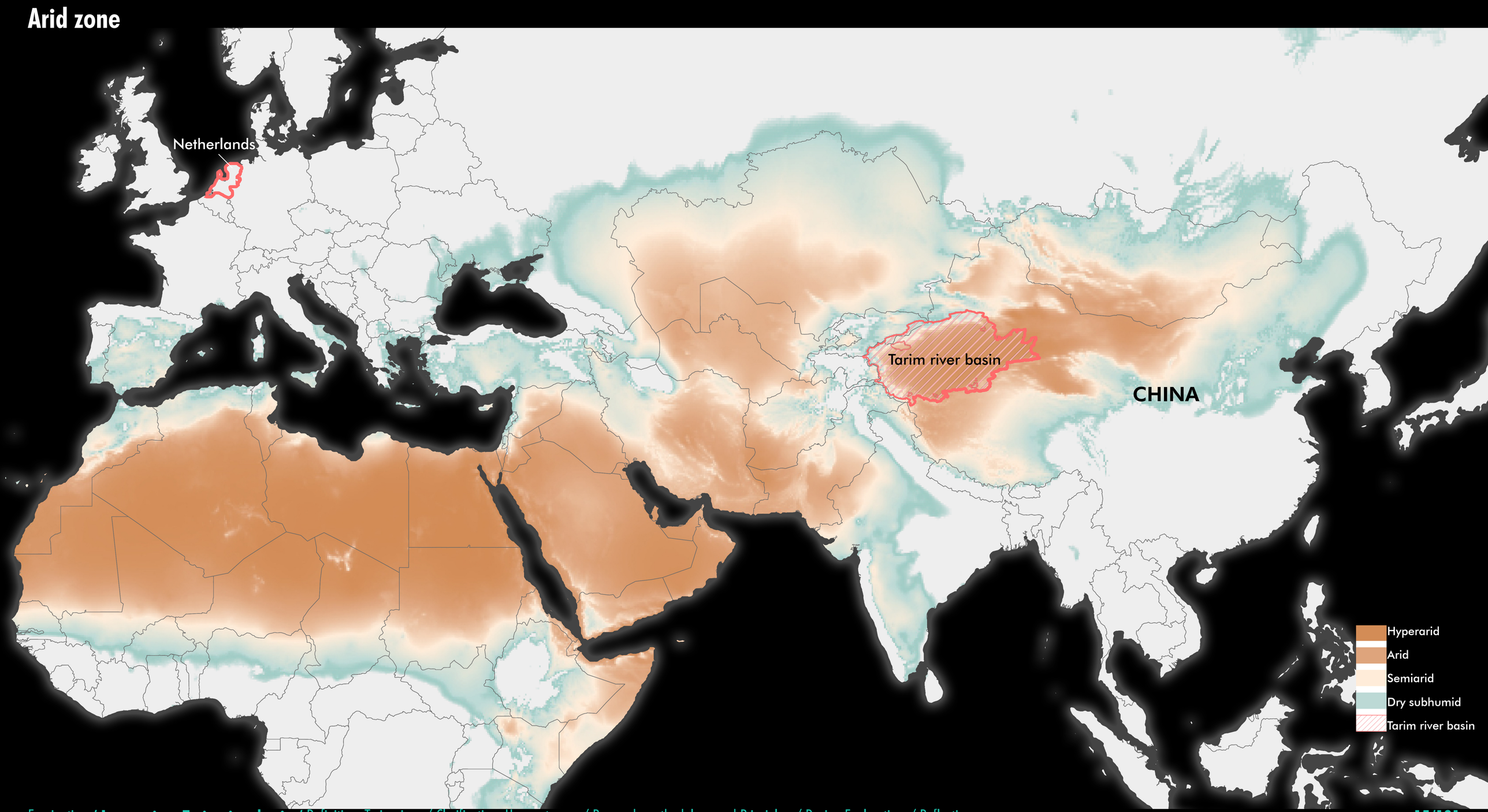


What will happen in 21st century?

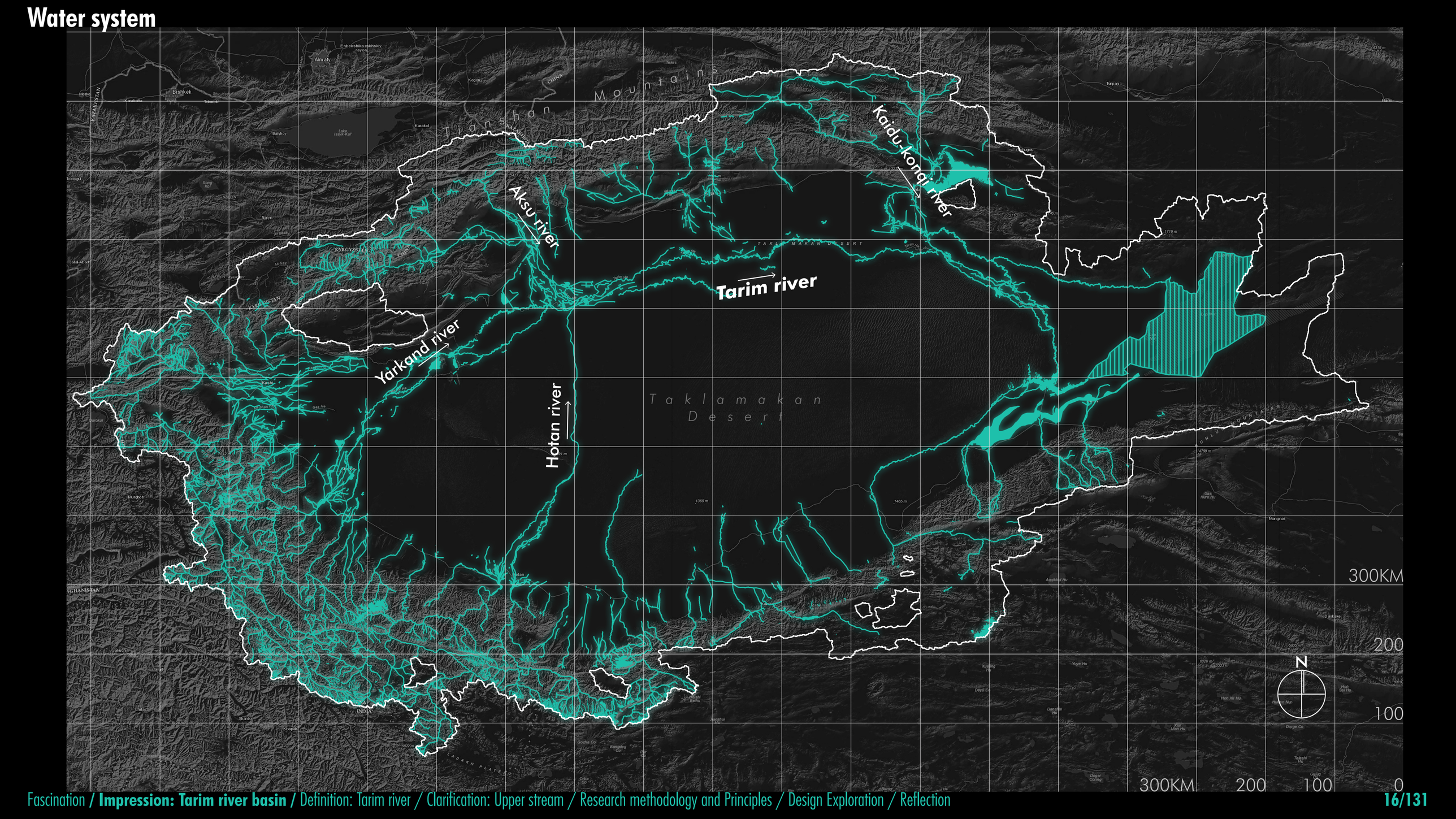
Impression
Tarim River Basin



Arid zone

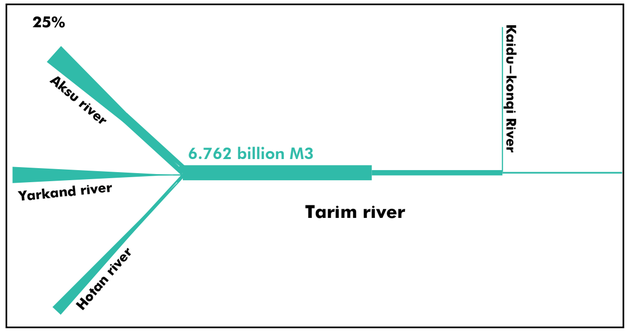

Netherlands
Tarim river basin
CHINA
Hyperarid
Arid
Semiarid
Dry subhumid
Tarim river basin

Water system

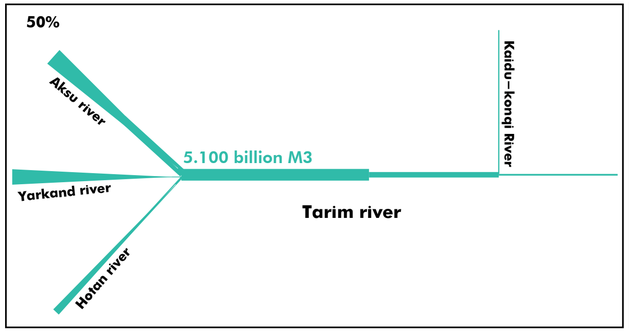


Government controlled flow

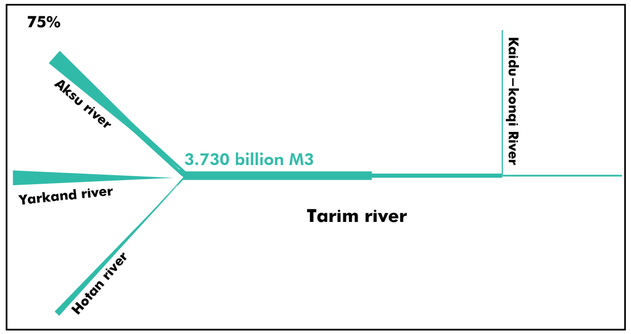
6.762 Billion M^3



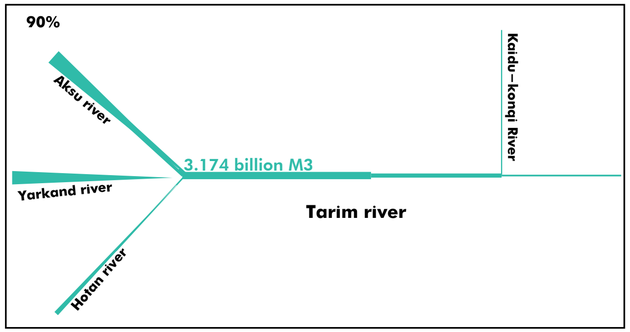
5.100 Billion M^3



3.730 Billion M^3



3.174 Billion M^3



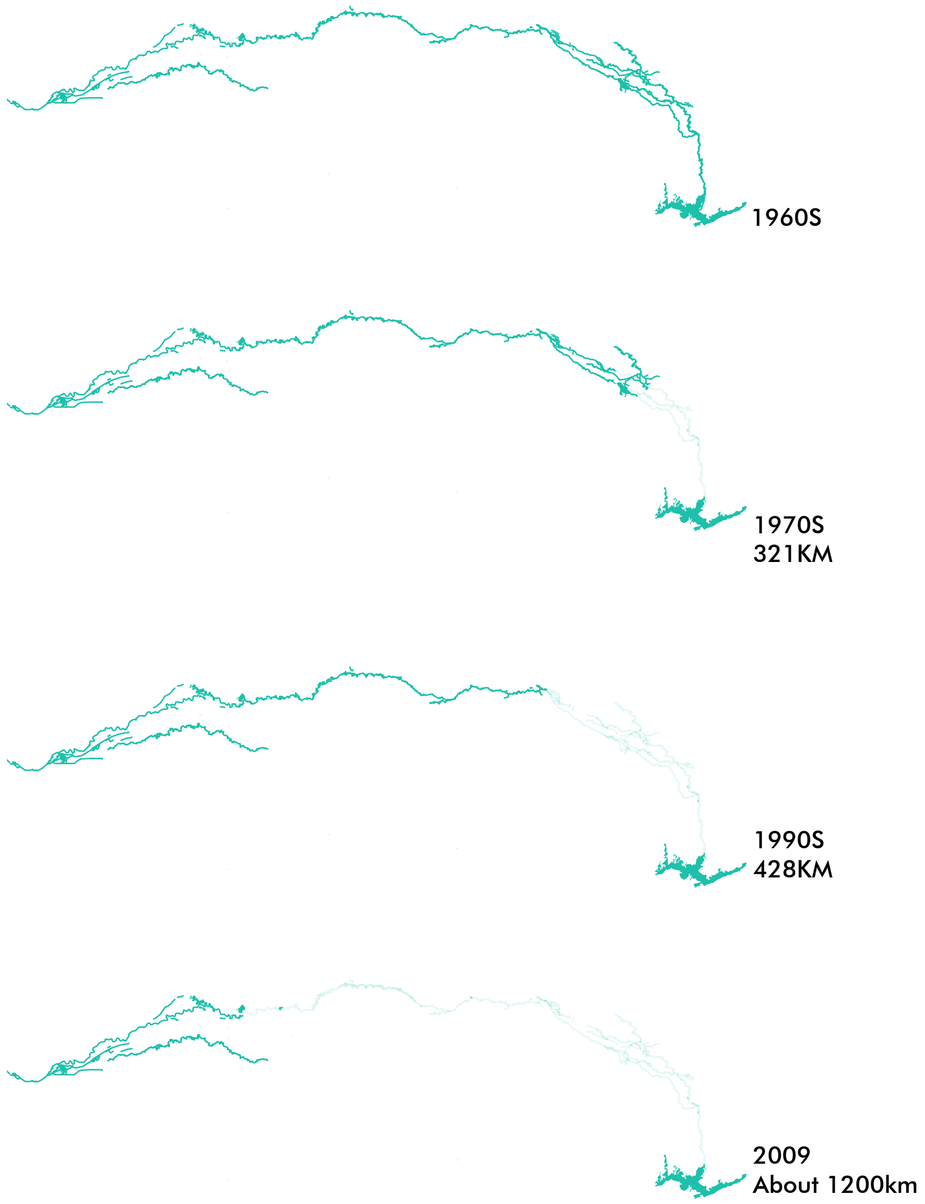
Wet year → Dry year

Definition
-Tarim river



Problem field 1- Water scarcity

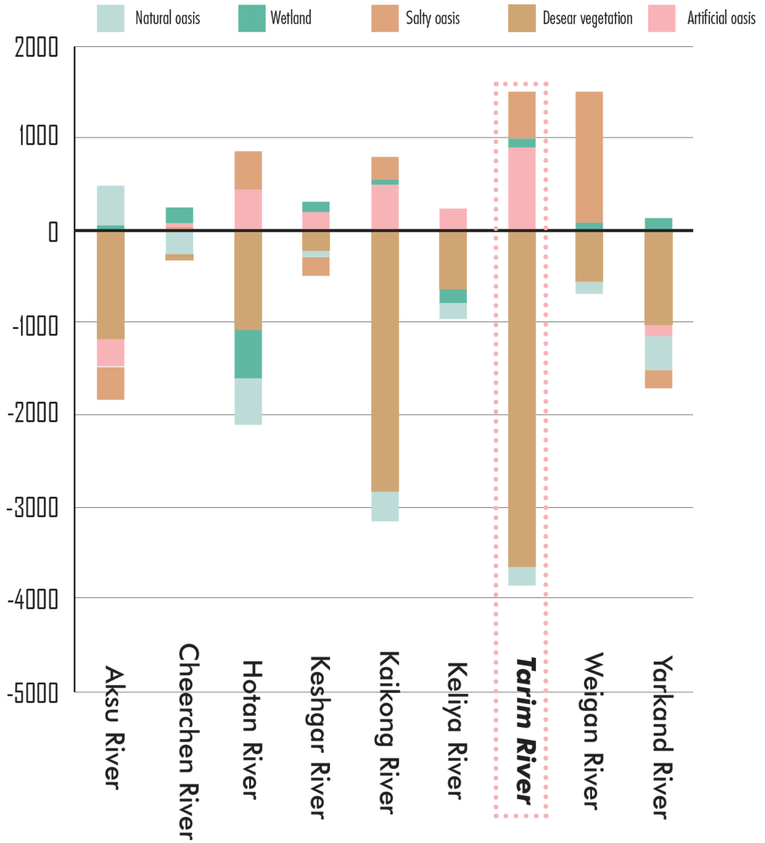
Result- Getting shorter river in dry season



Problem field 1- Water scarcity

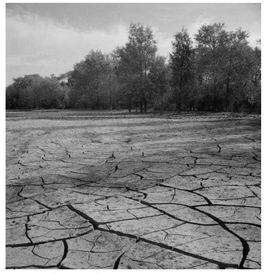
Result- Ecology decreasing

9769.05KM^2 ↓





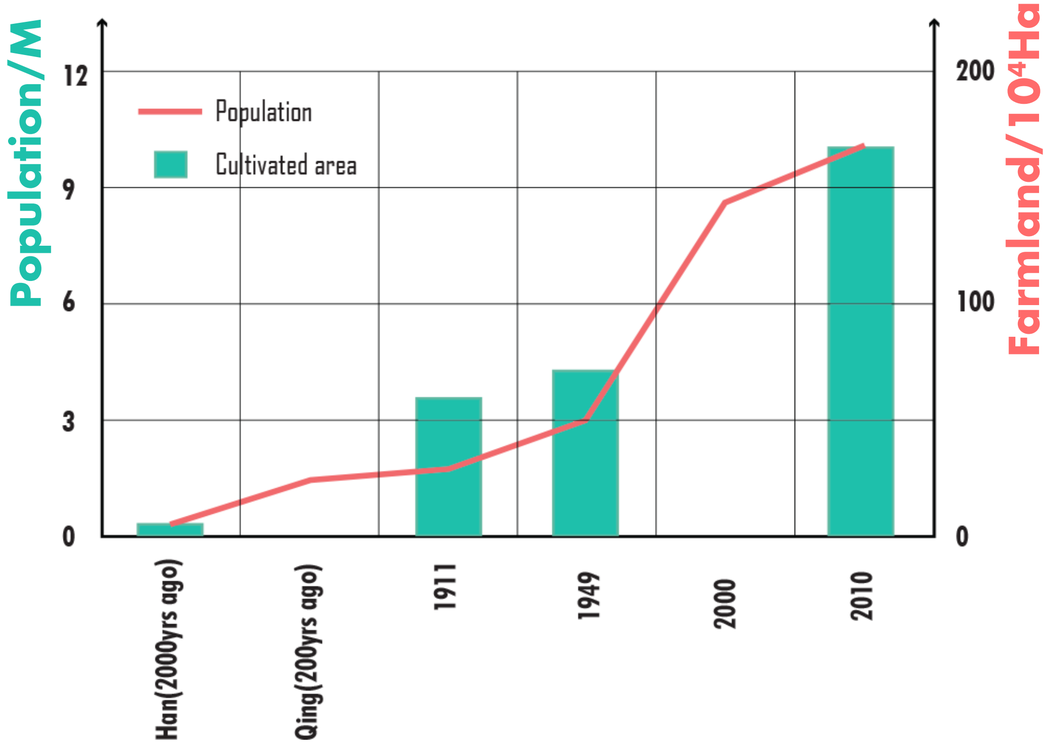
Dead trees



Dry land

Problem field 1- Water scarcity

Reason- Farmland and population explosion





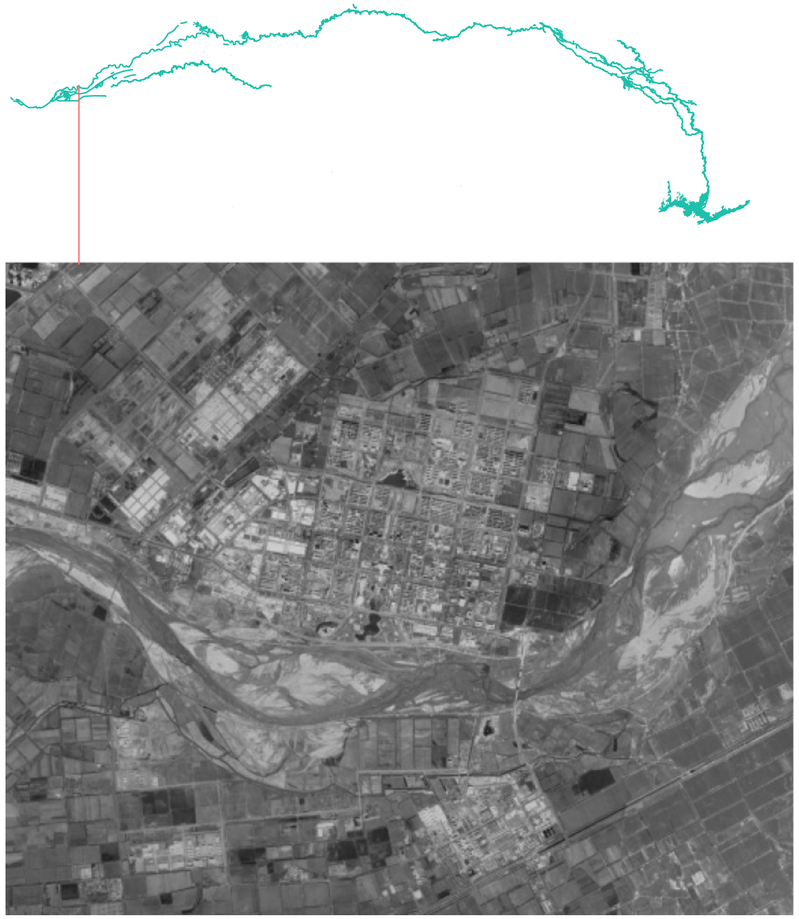
Tripled in last 70 year



Doubled in last 70 year

Problem field 1- Water scarcity

Future trend- Alar city planning

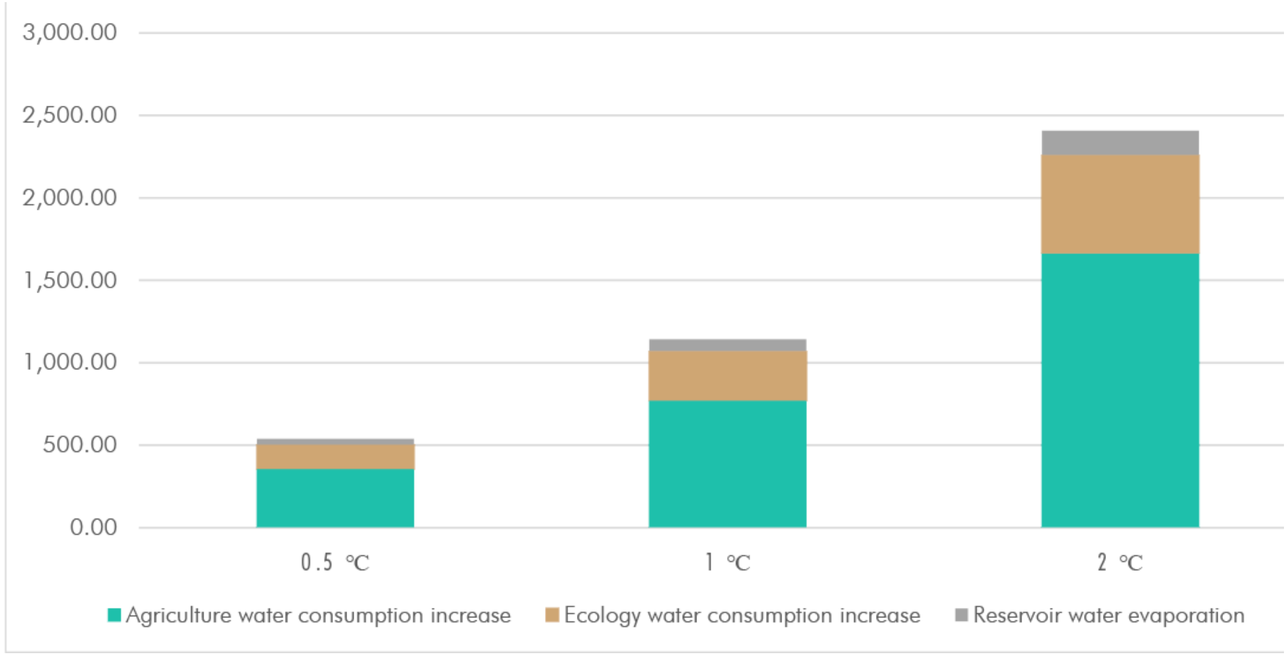


Objective: Regional ***central*** city
Transportation hub
Leisure ***tourism city*** for aging population

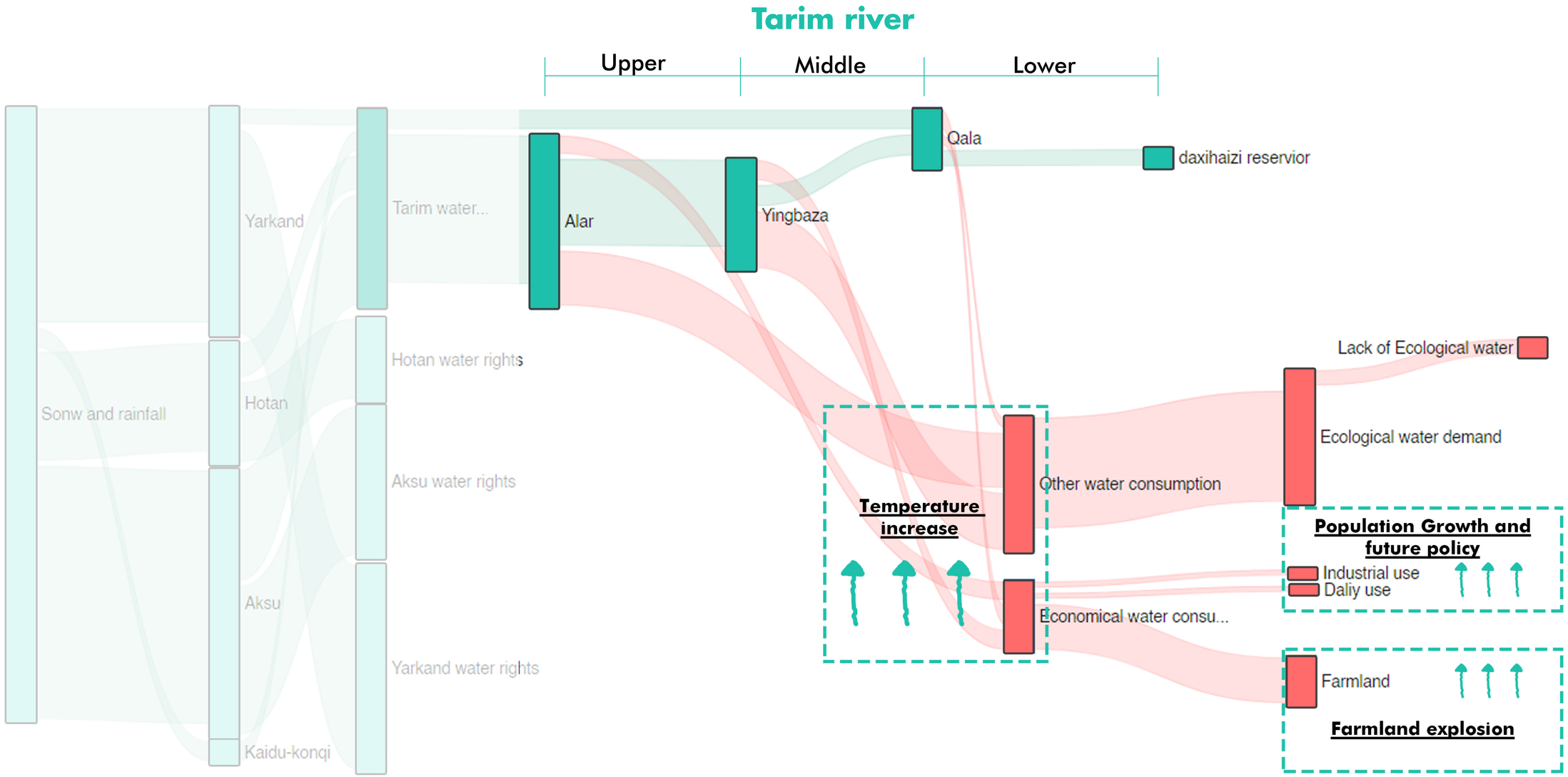
Population: 409,000(2019) - 500,000(2030) – ***1,000,000***(further)

Problem field 1- Water scarcity

Future trend- Climate change



Conclusion- Water scarcity conclusion

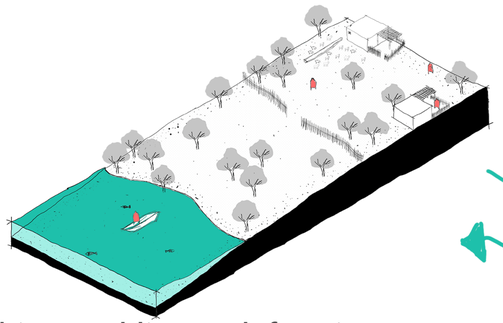


Problem Field 2 - Unsustainable livelihood

Circularity in the past



Silk road



Fishing and livestock farming

Livestock and fish

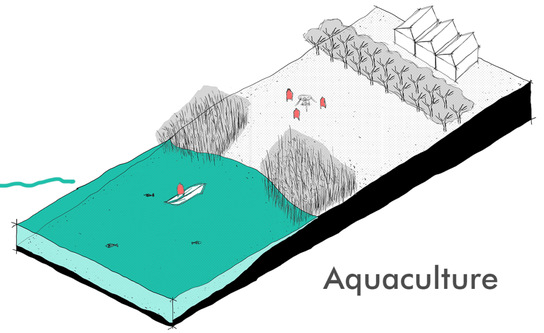
Daily necessities



Bazaar (Market) - 80% Farmer

Fish

Daily necessities



Aquaculture

Fodder

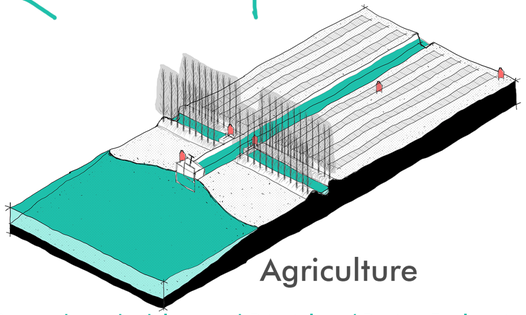
Fertilizer

Crops and Fruits

Daily necessities

Fodder

Fertilizer

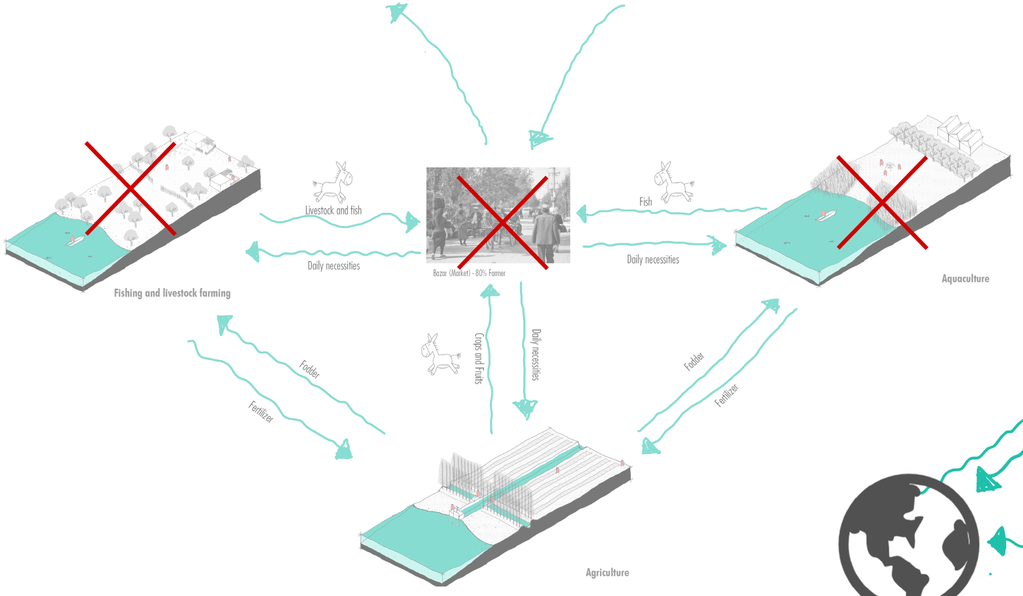


Agriculture

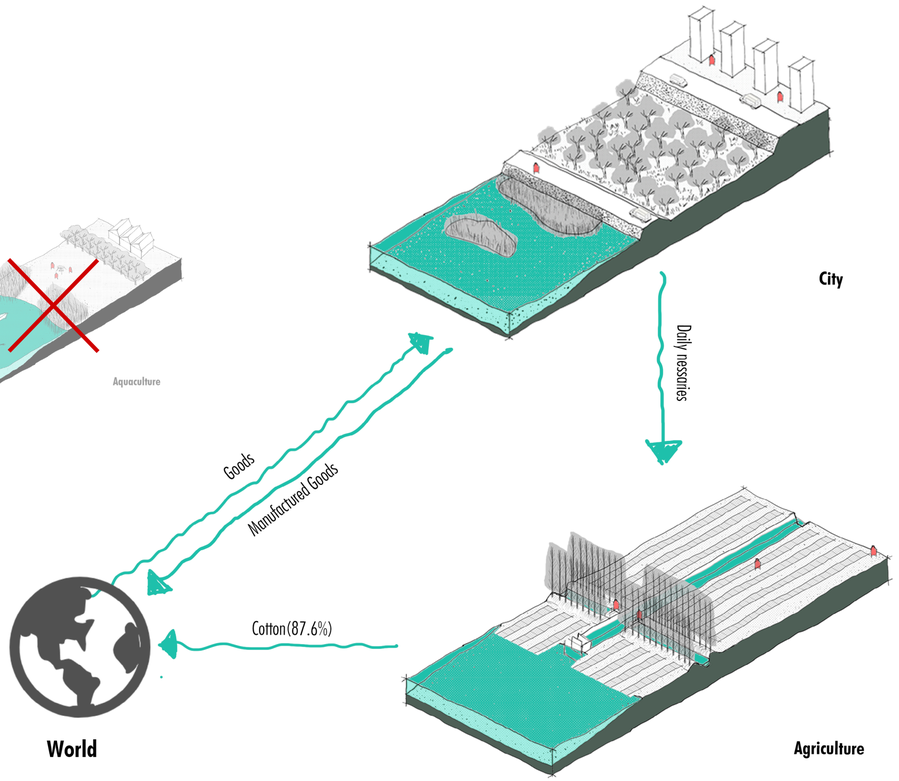
Problem Field 2 - Unsustainable livelihood



Silk road

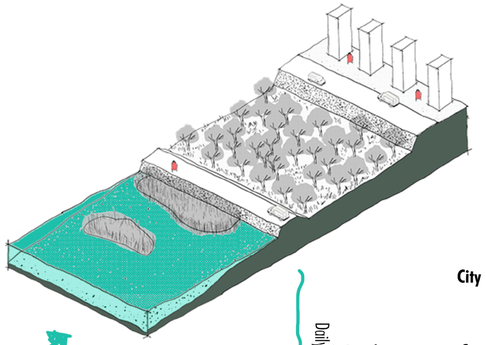


Current Circularity



Problem Field 2 - Unsustainable livelihood

Valuable Circularity



City

Daily necessaries

No income from city

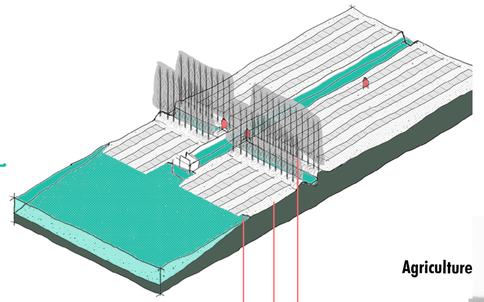
Goods

Manufactured Goods



World

Cotton (87.6%)



Agriculture

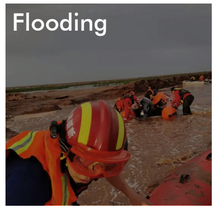
Global market ban cotton

The New York Times

U.S. Bans All Cotton and Tomatoes From Xinjiang Region of China



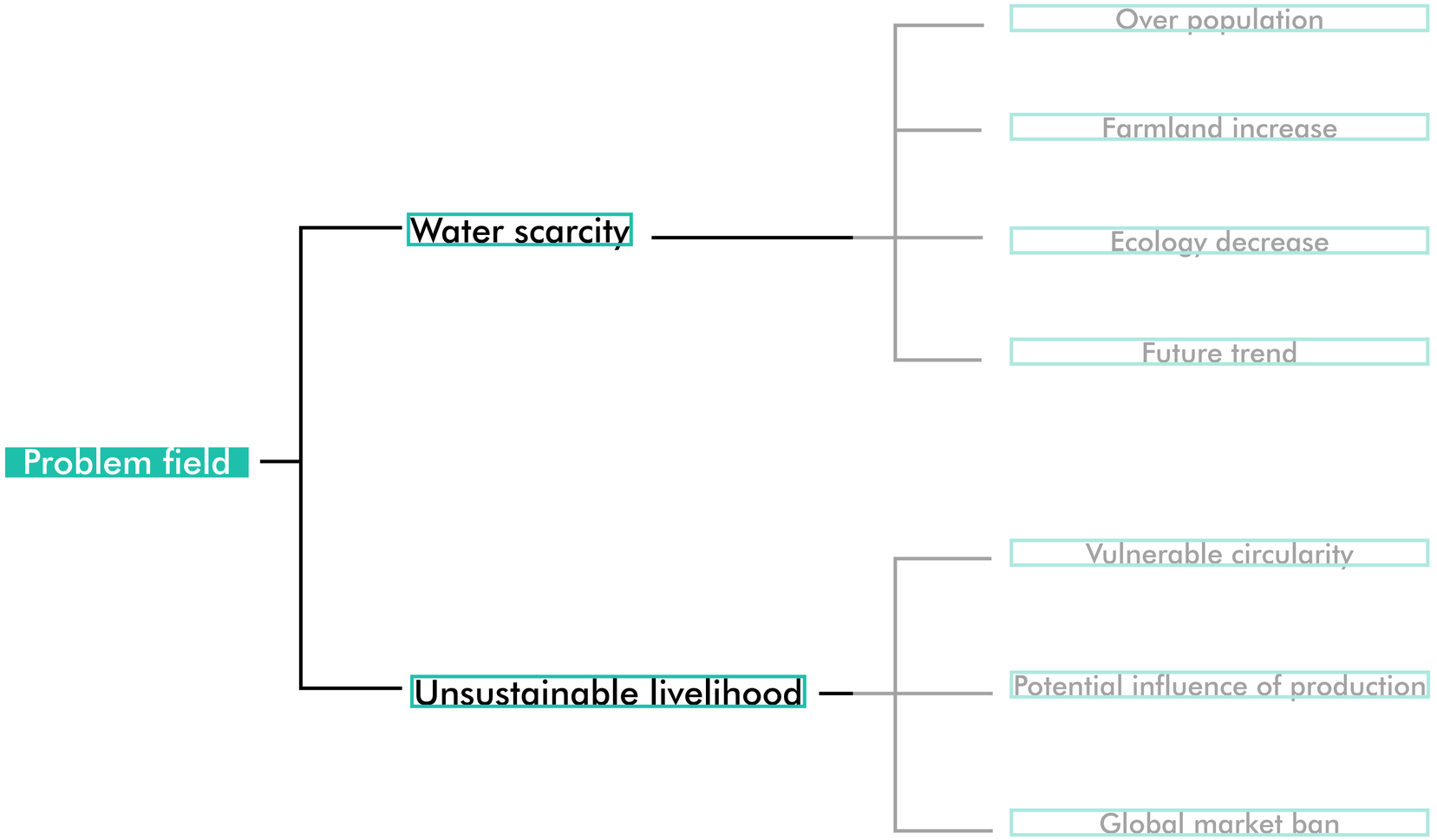




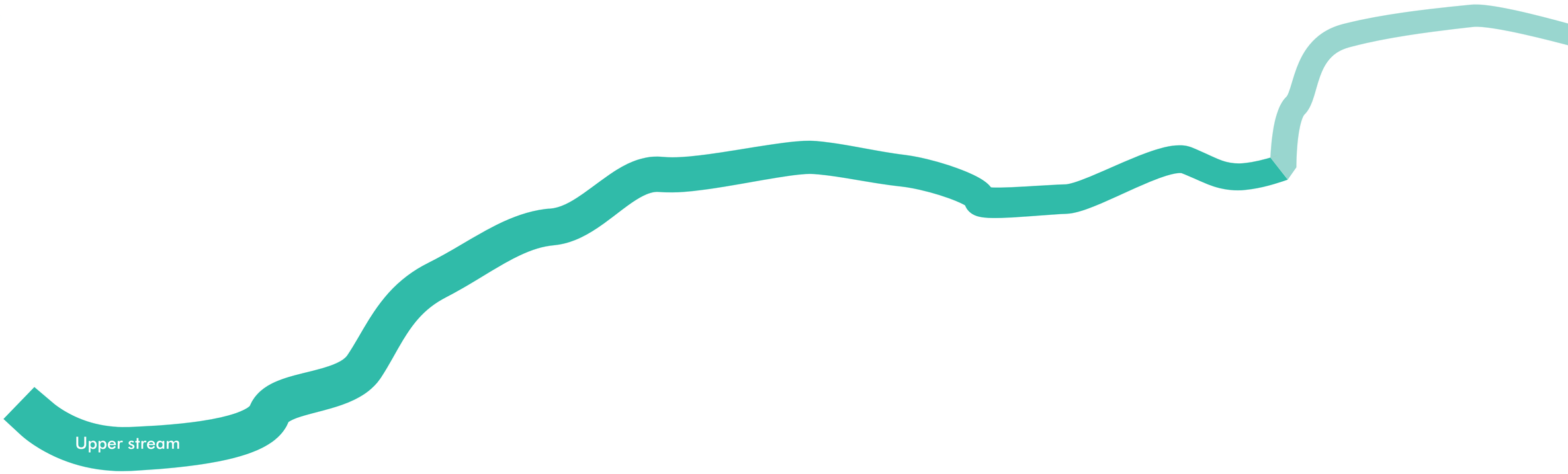




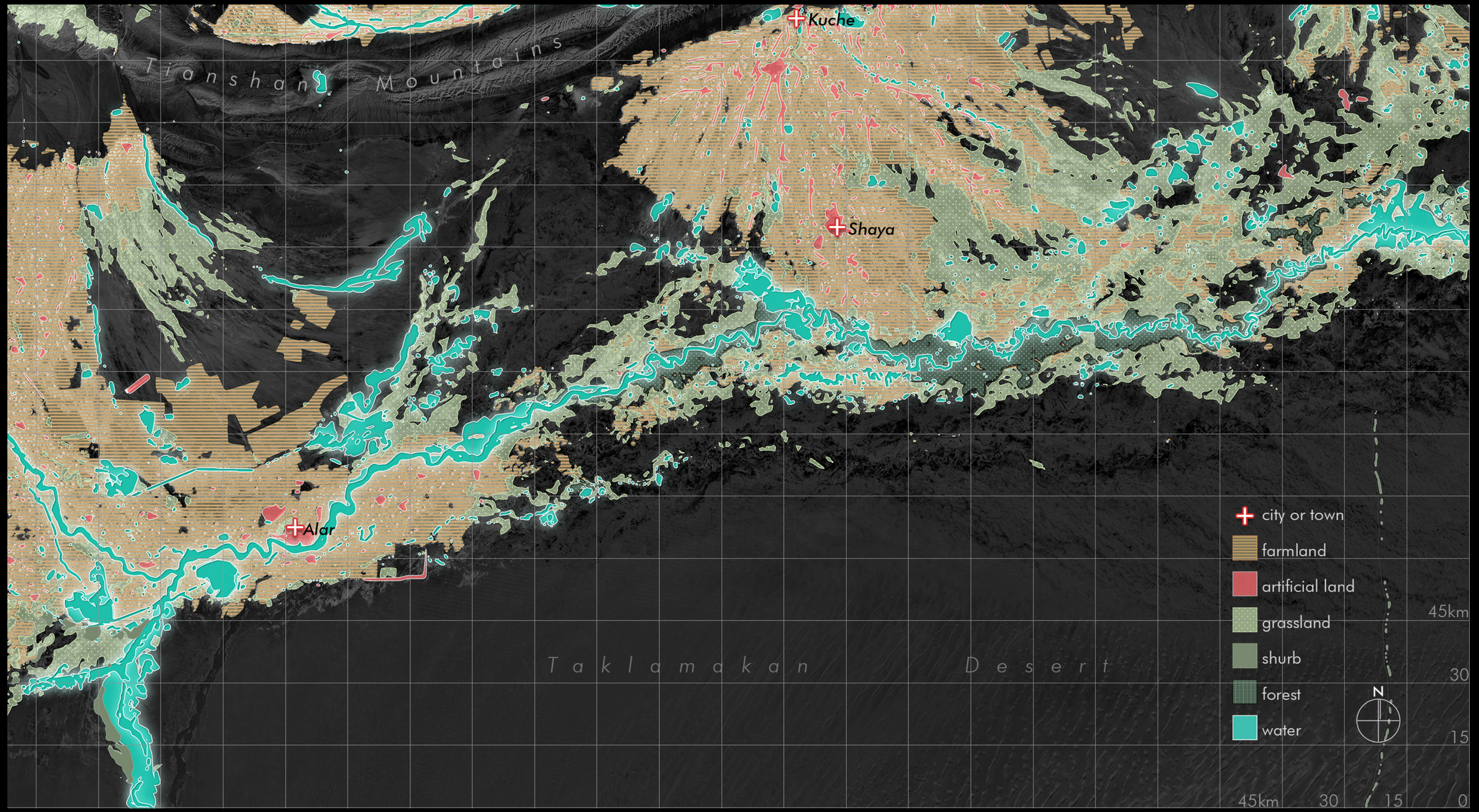
Problem Field - Conclusion



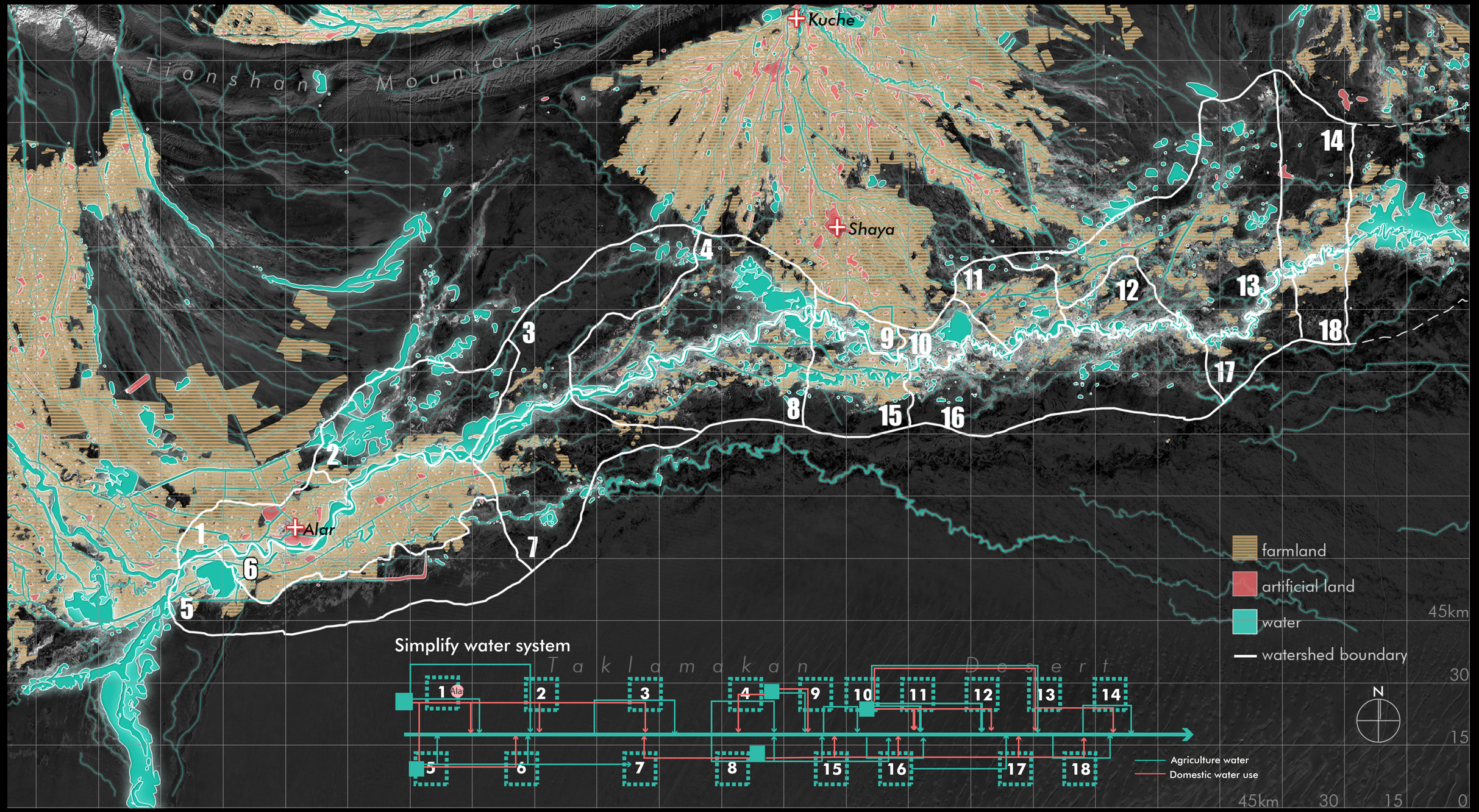
Clarification
Upper stream



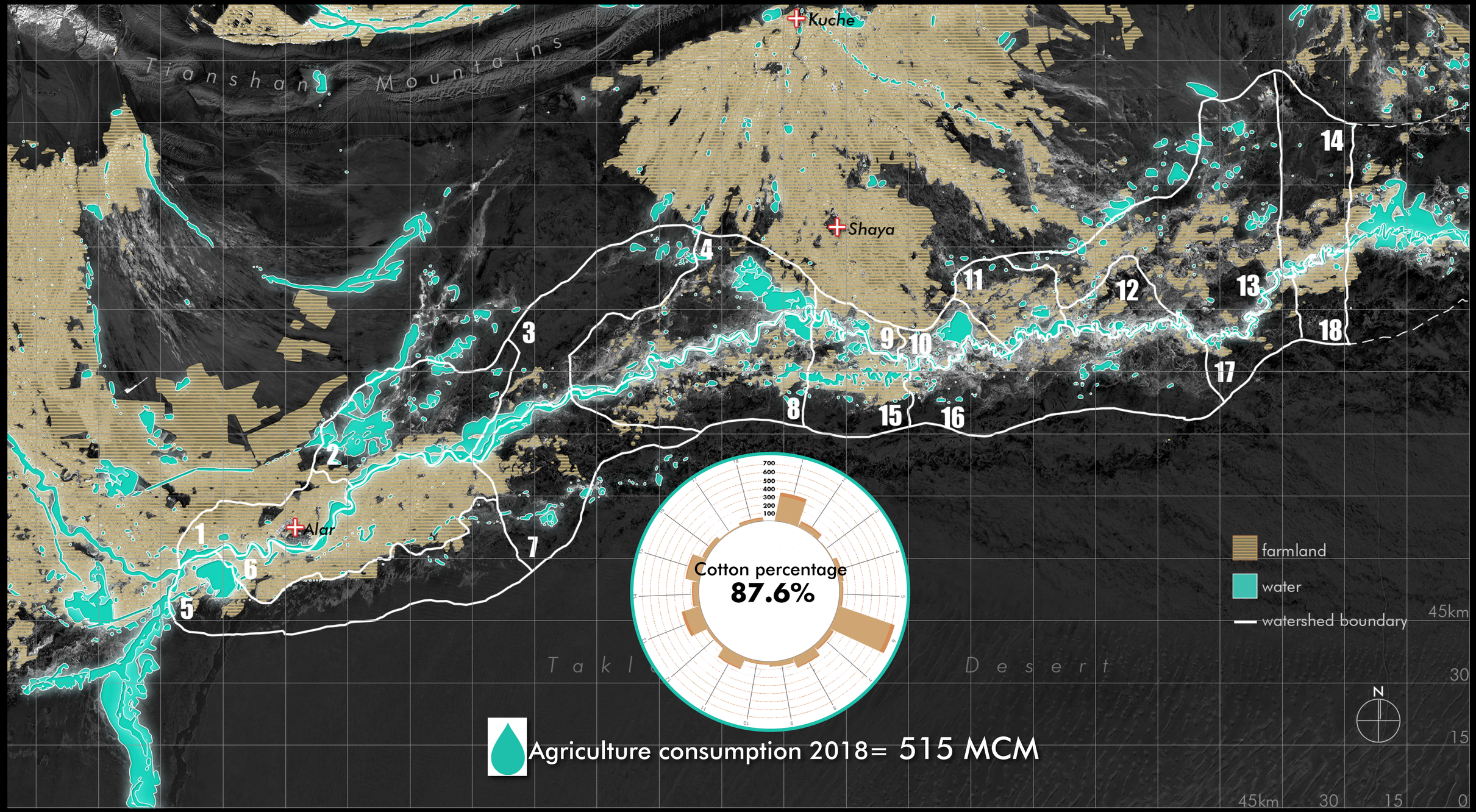
Land use-upper straem



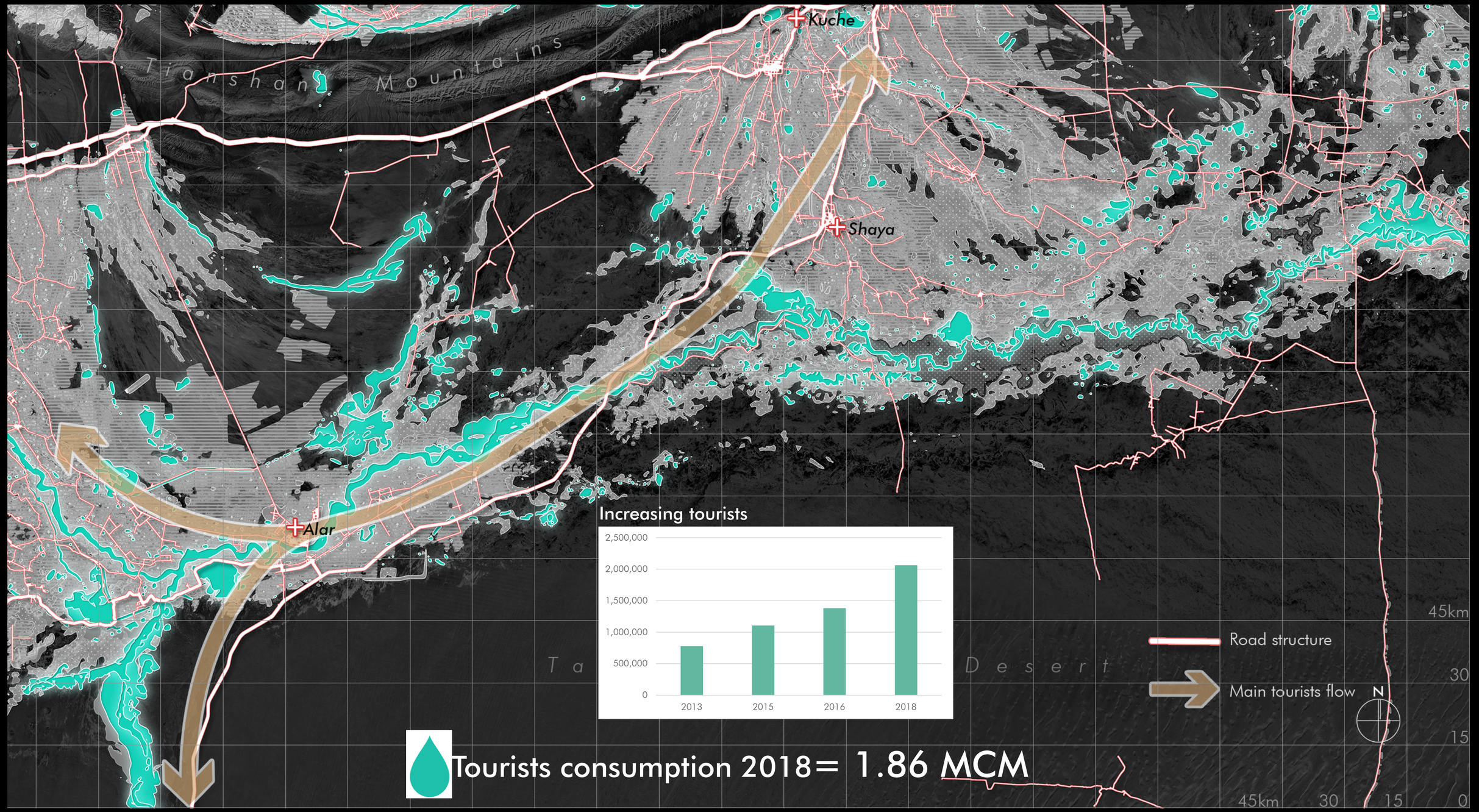
Water consumption- Water system



Water consumption- Agriculture

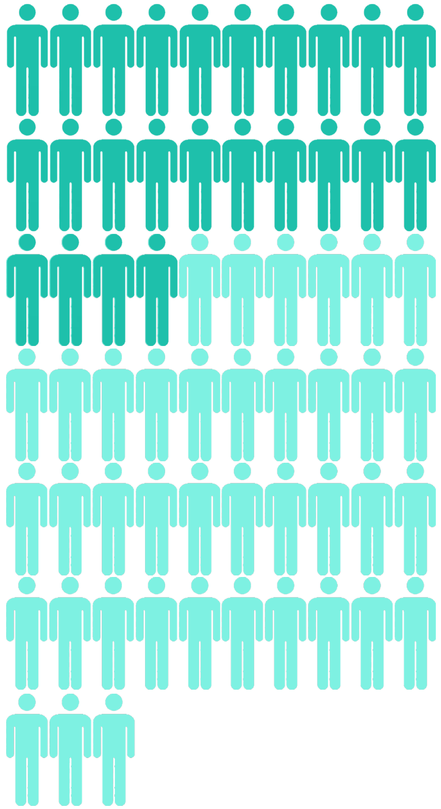


Water consumption- Tourism



Water consumption- Daily usage(Human)

Current population

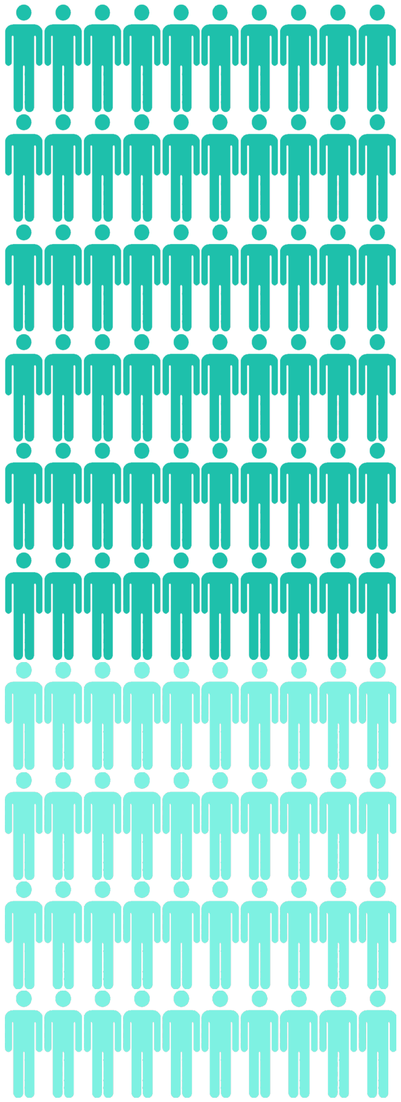


Upper stream population= 673,800

City residents= 242468

Village residents= 431332

Population forecast in 2050



Upper stream population= 1,000,000

City residents= 600,000

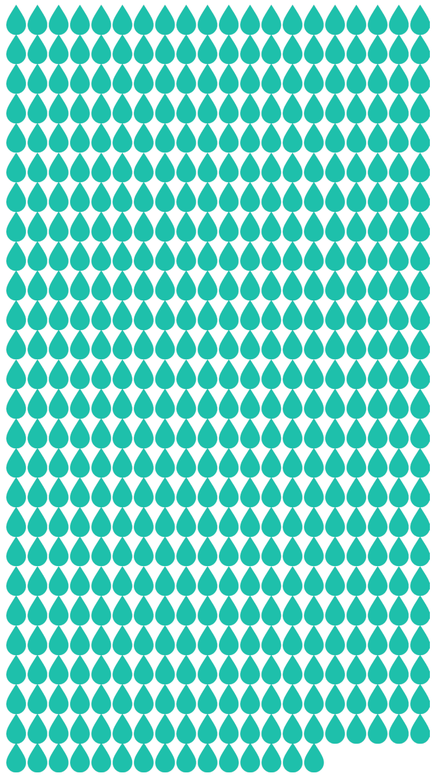
Village residents= 400,000

Daily consumption 2018= 33.48 MCM

Water consumption conclusion

=1MCM=1 million cubic meter

Agriculture 515 MCM



Tourism 1.86MCM

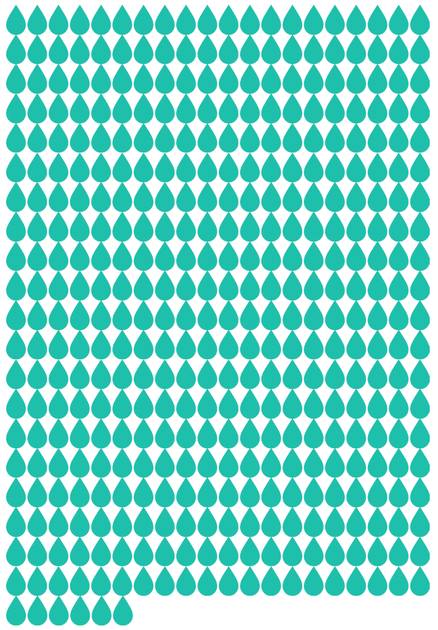


Daily use 33.48 MCM

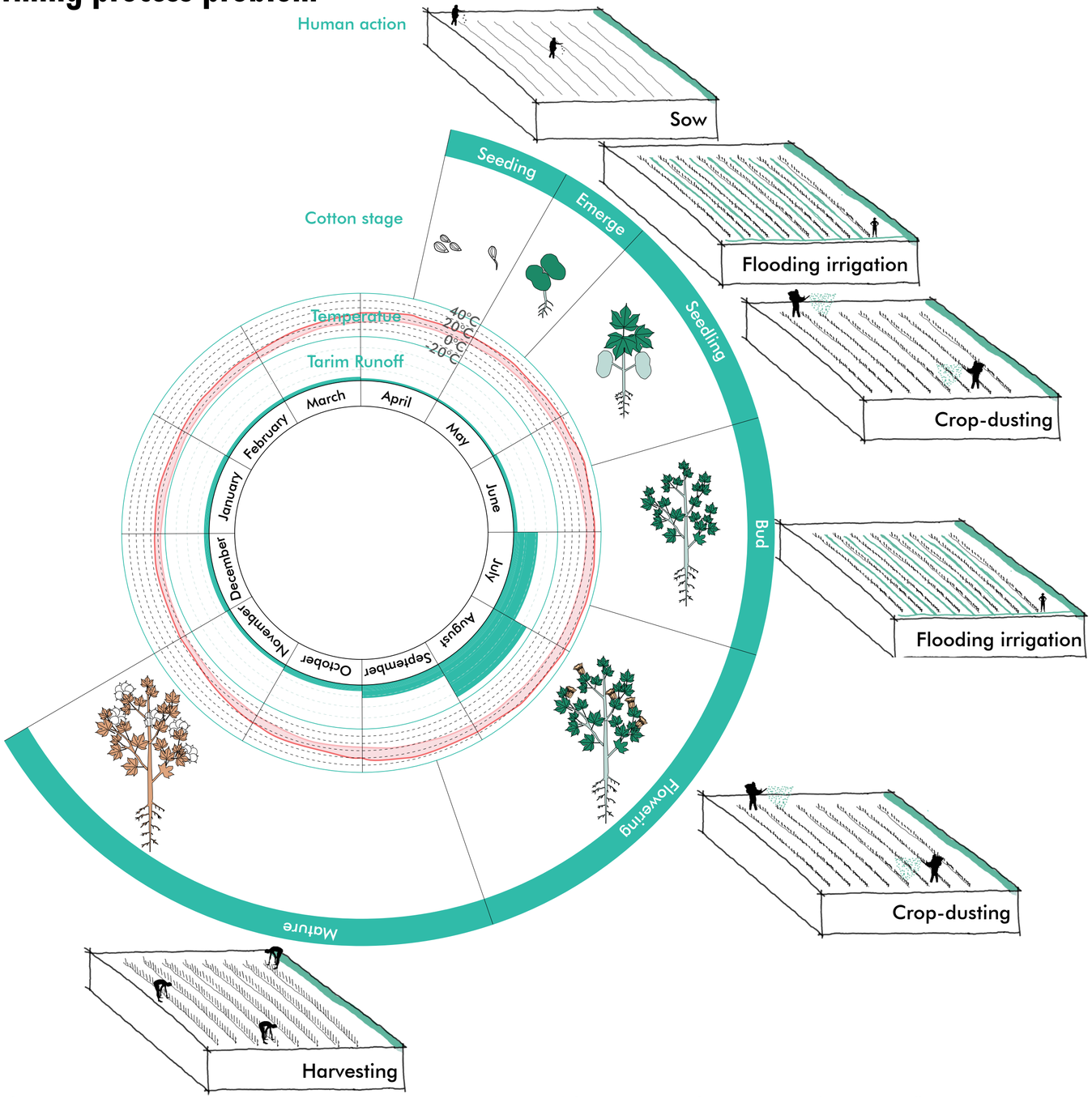


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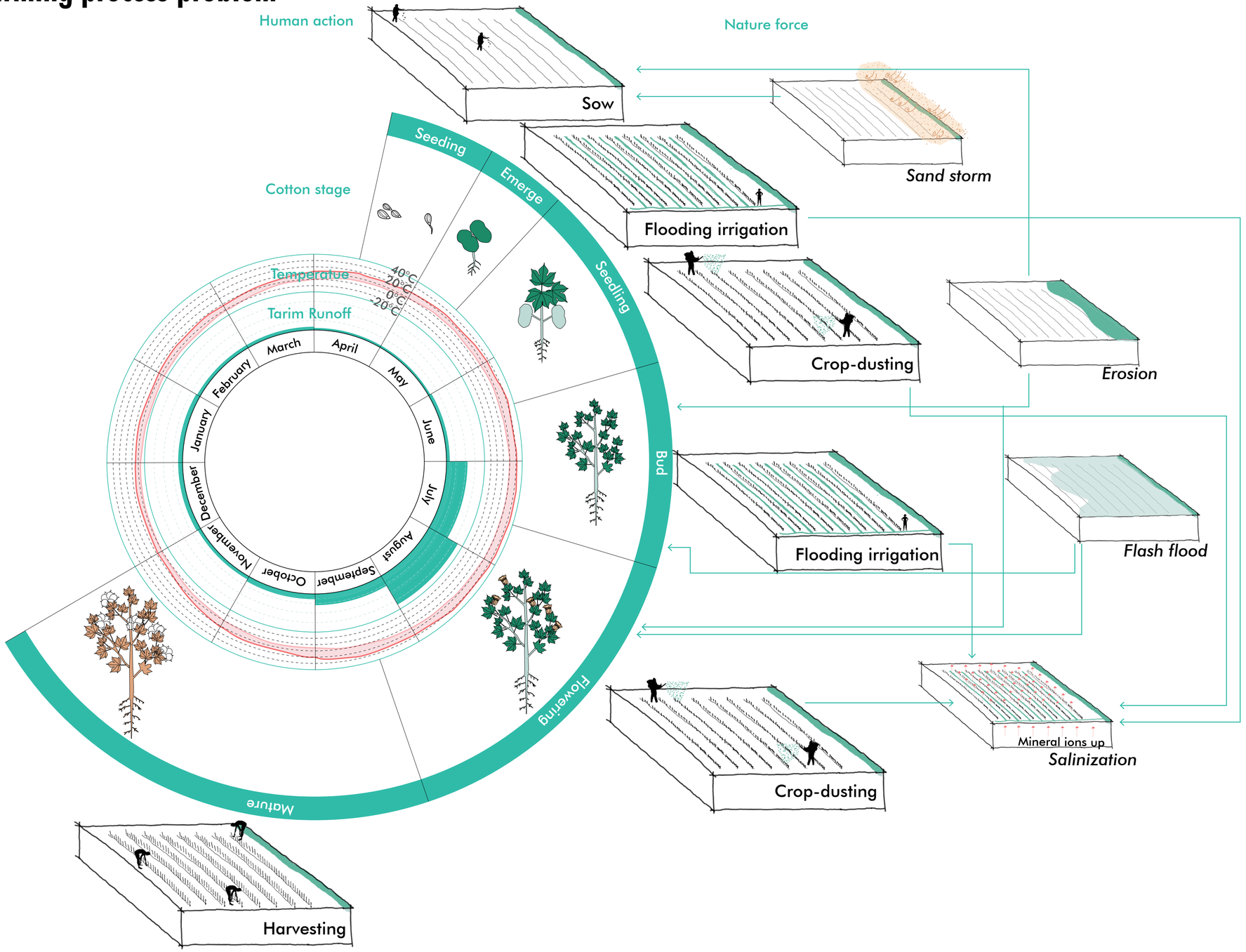
Planned by government
Economic Total 406 MCM



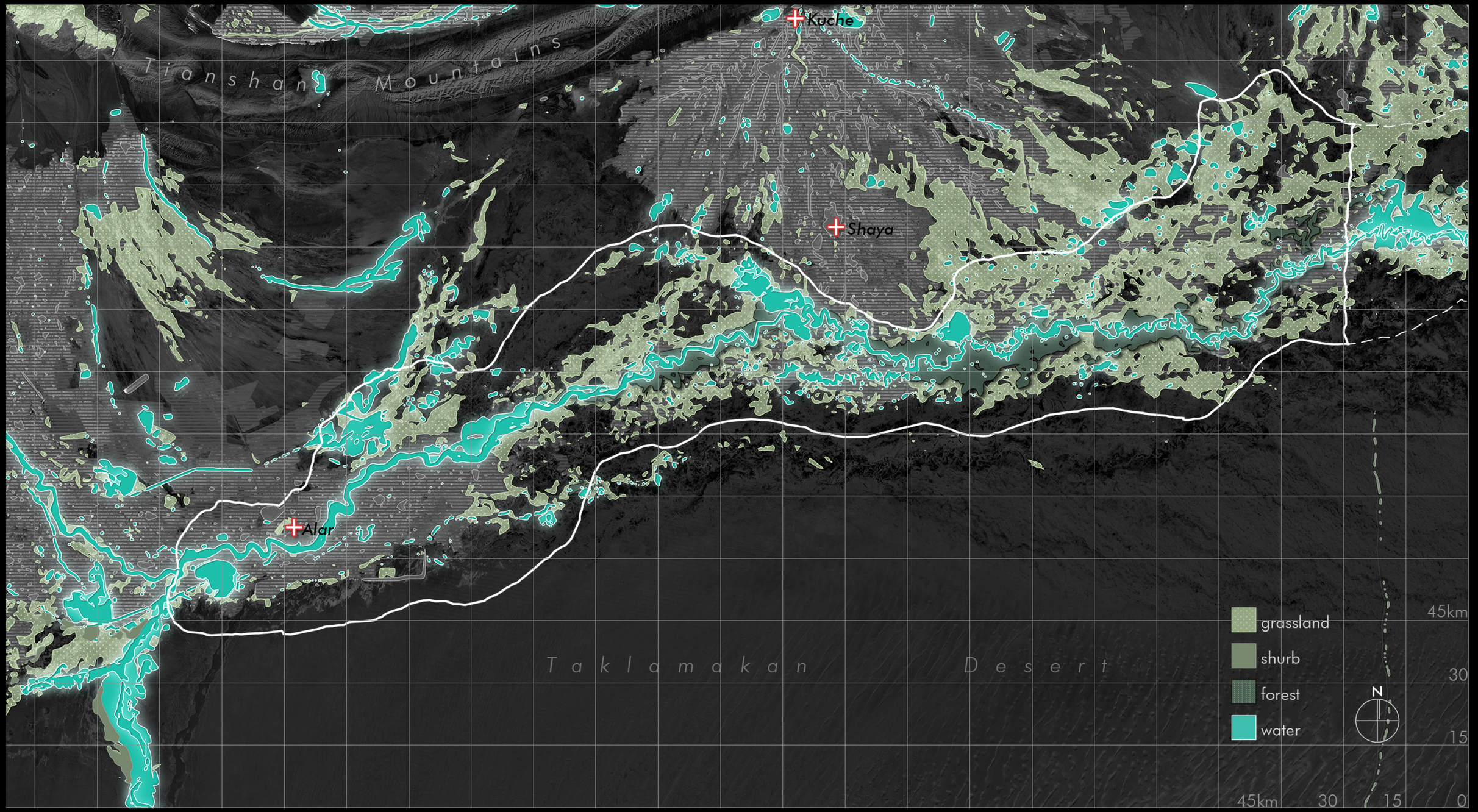
Farming environment- farming process problem



Farming environment- farming process problem

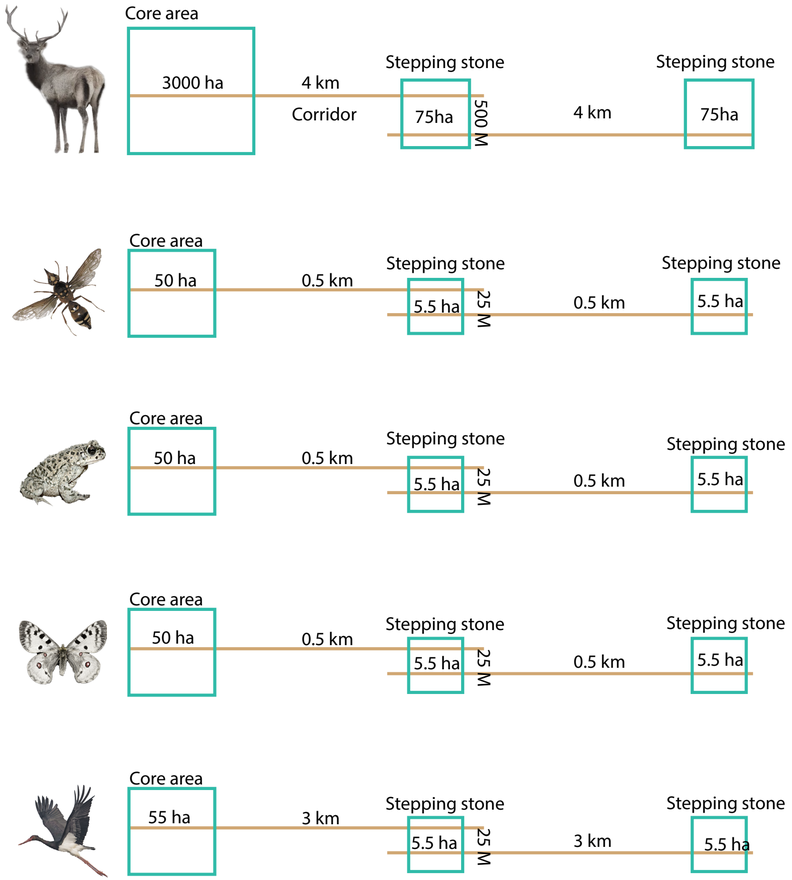


Farming environment- riparian forest

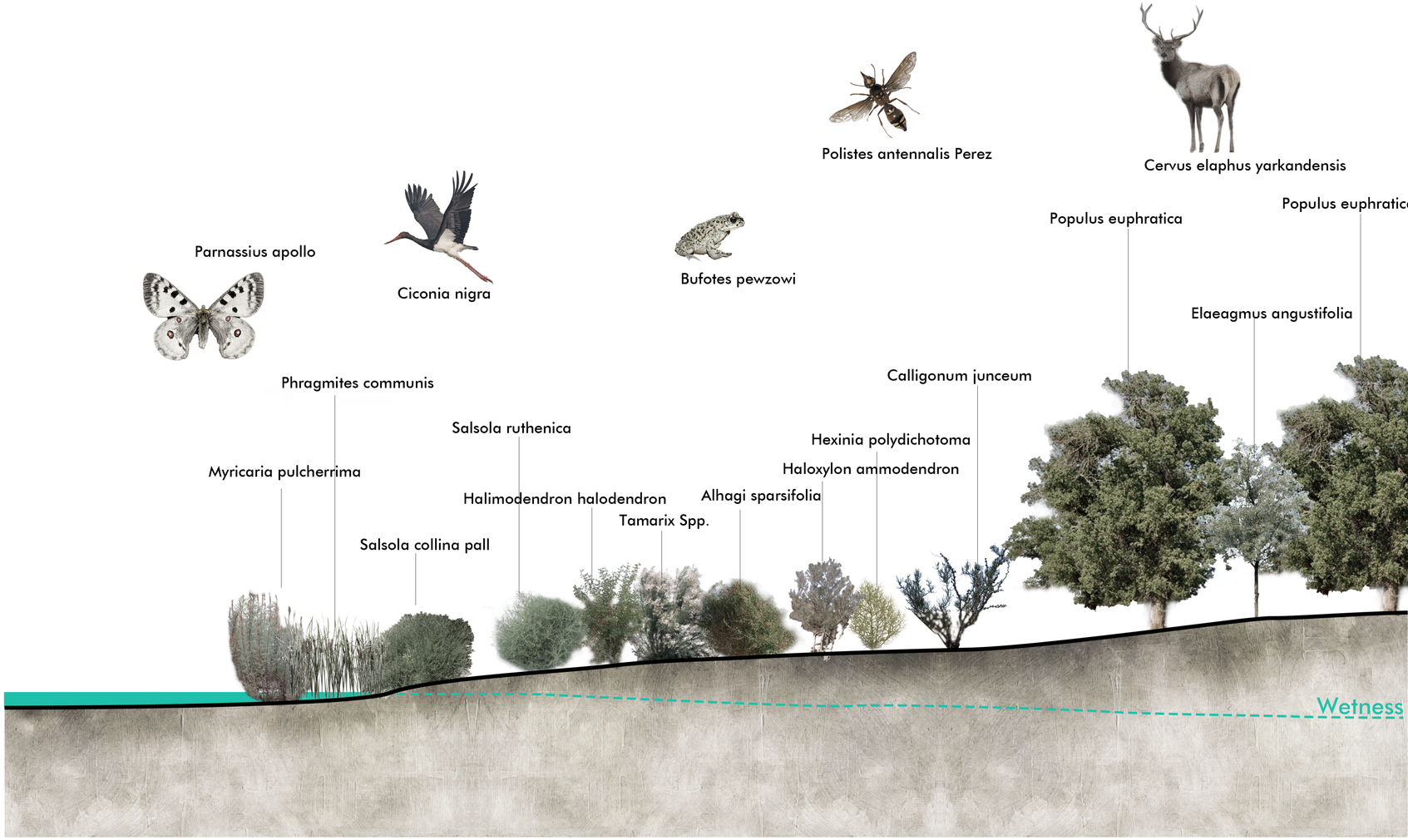


Farming environment- riparian forest community

Requirement habitats

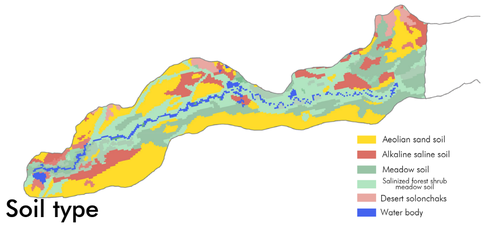


Species and river relation

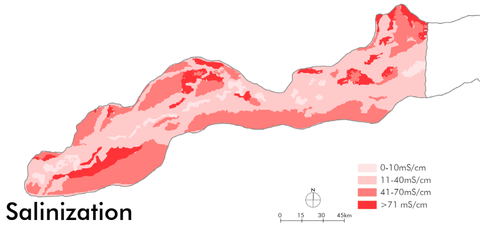


Farming environment- conclusion

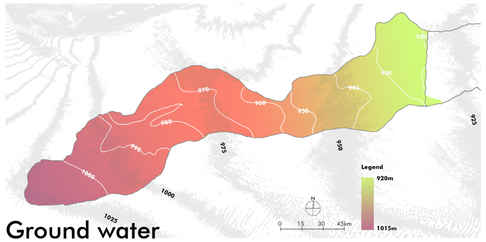
Soil condition



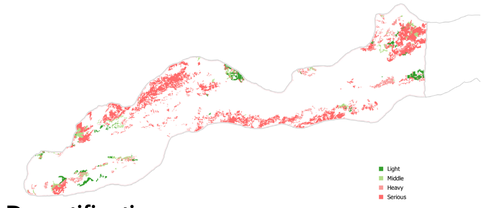
Soil type



Salinization

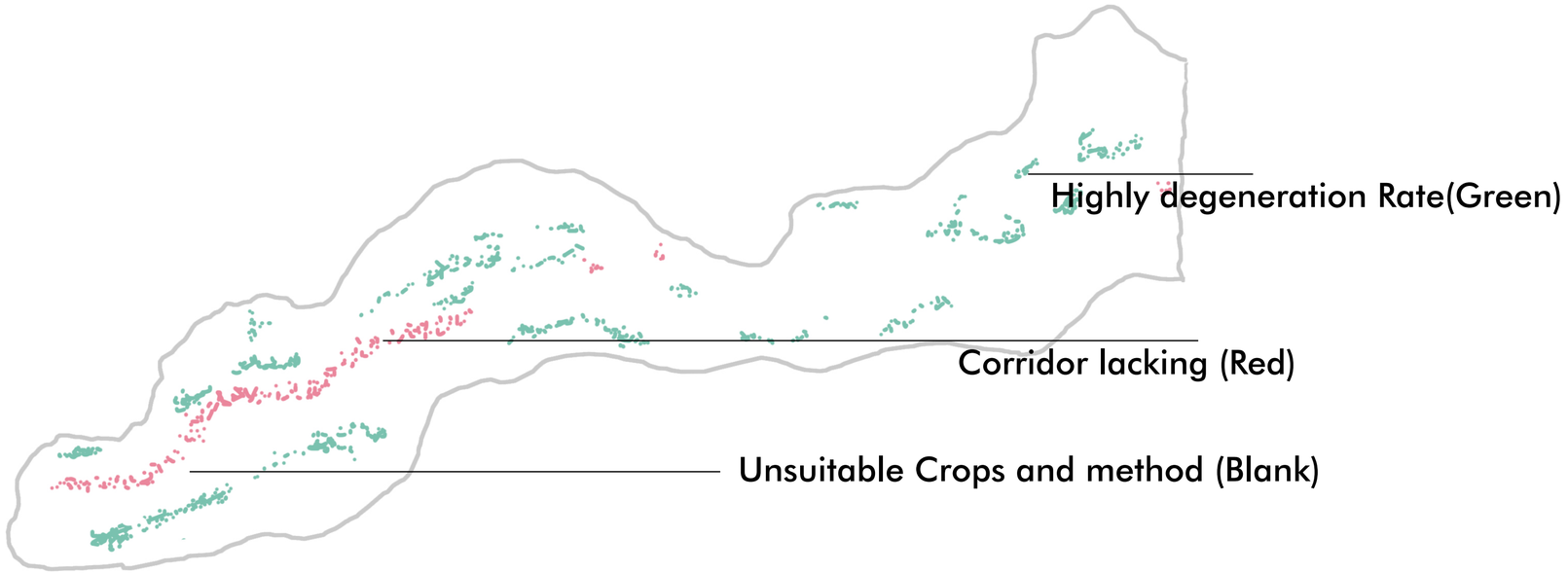


Ground water



Desertification

Conclusion



Methodology and principles

Research question

How to **balance the water demand** of agriculture, ecology, and increasing population and tourism in a resilient way in the upper reaches of Tarim river and **build up a sustainable live-lihood for farmers** by learning from the past and **integrating resilient principles?**

- How to improve **water infrastructure and water efficient**?
- How to form a **sustainable farming environment**?
- How to form a establish a **sustainable circular living** way for farmers?

Based knowledge

Literature

Democratic water management

Design solution for arid region

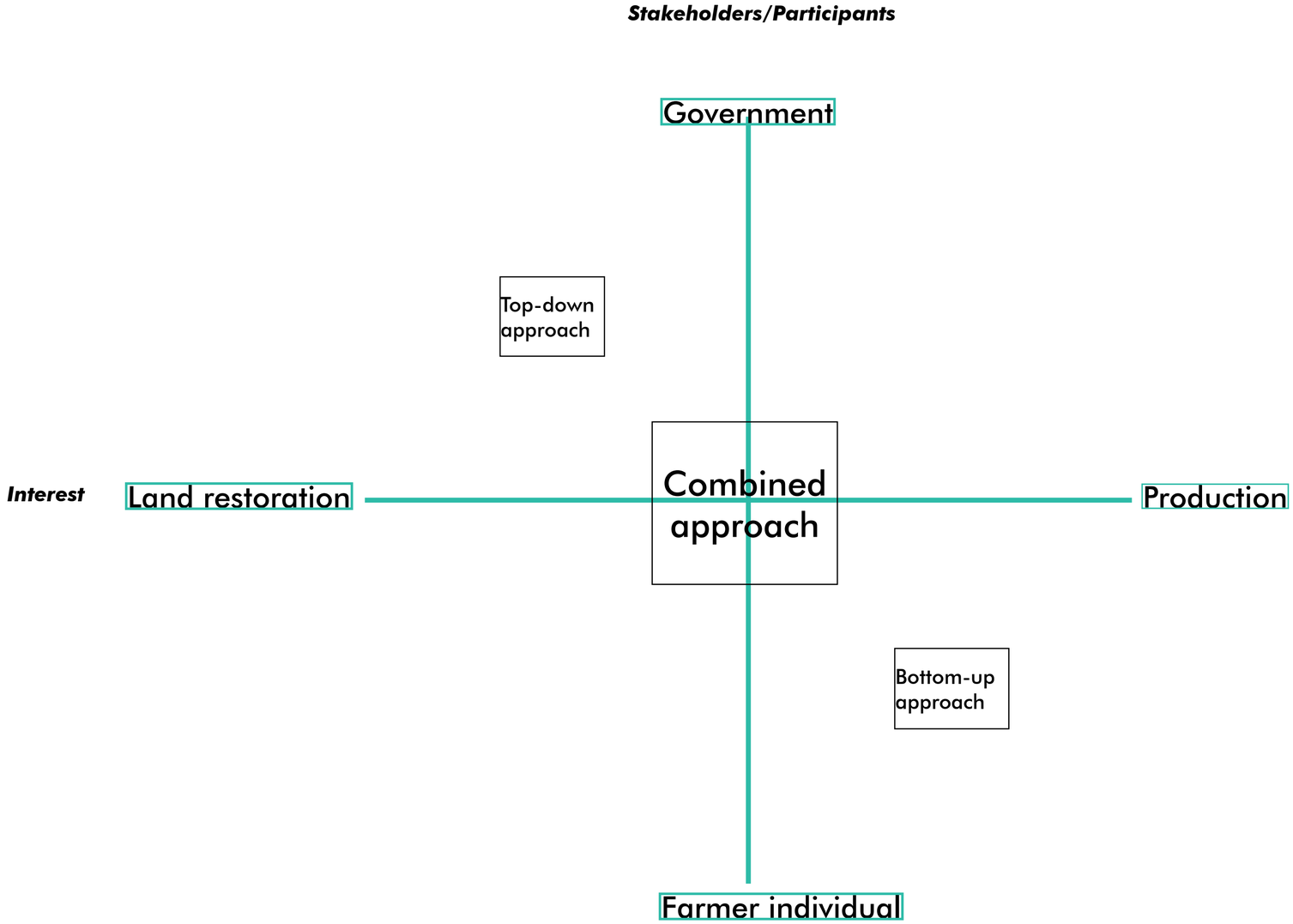
Sustainable agriculture design

Case studies

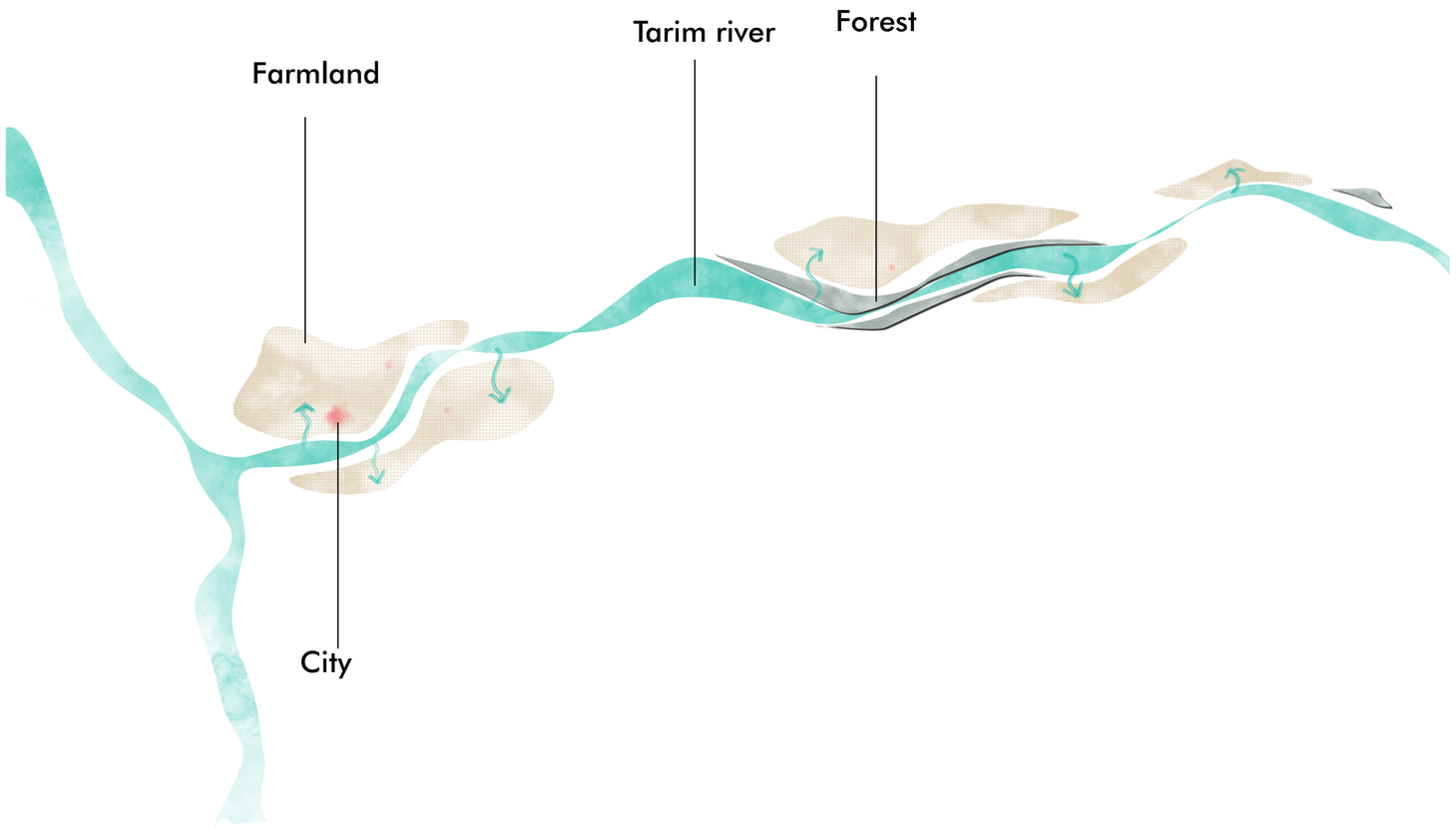




Design approach

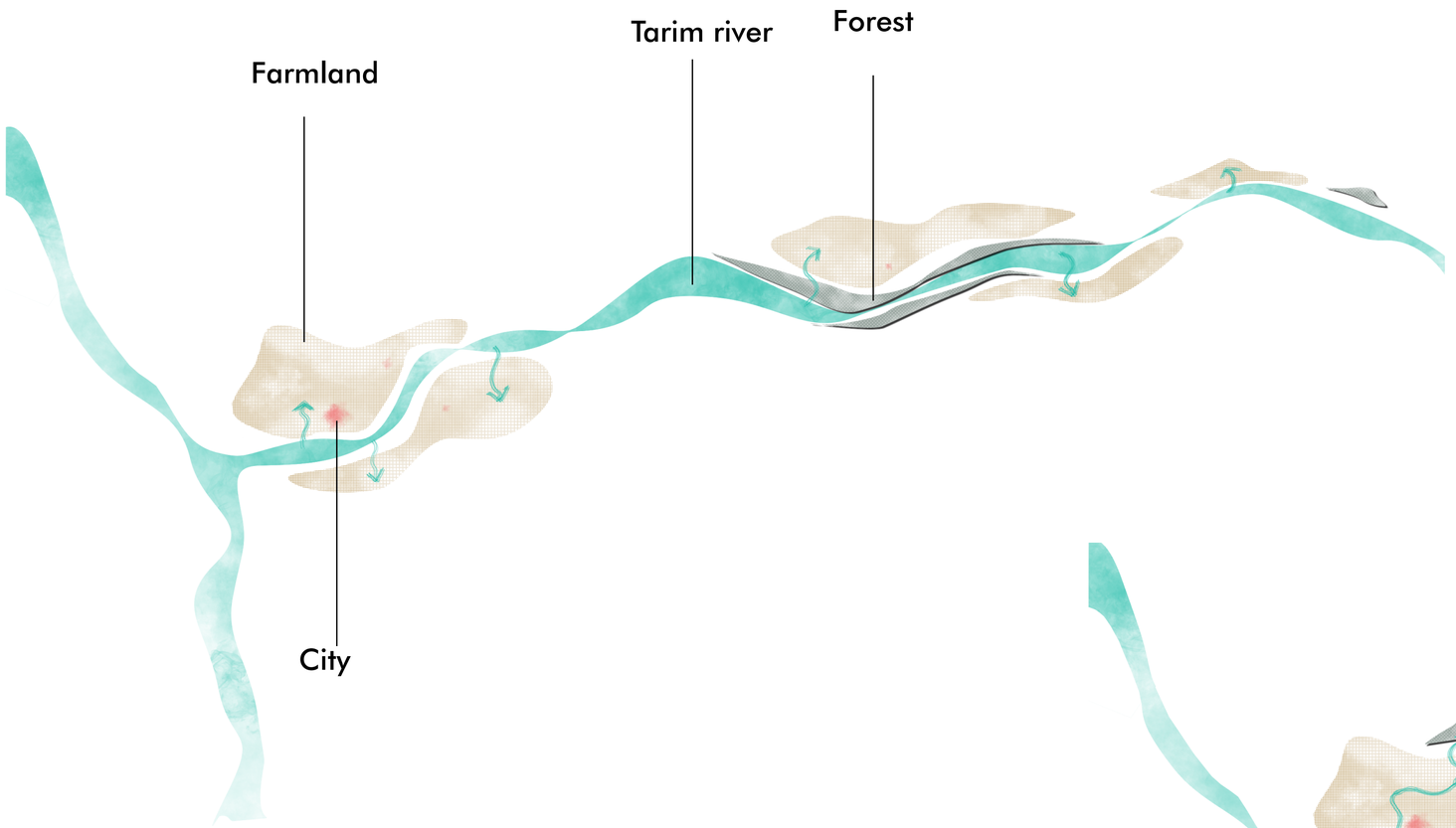


Concept

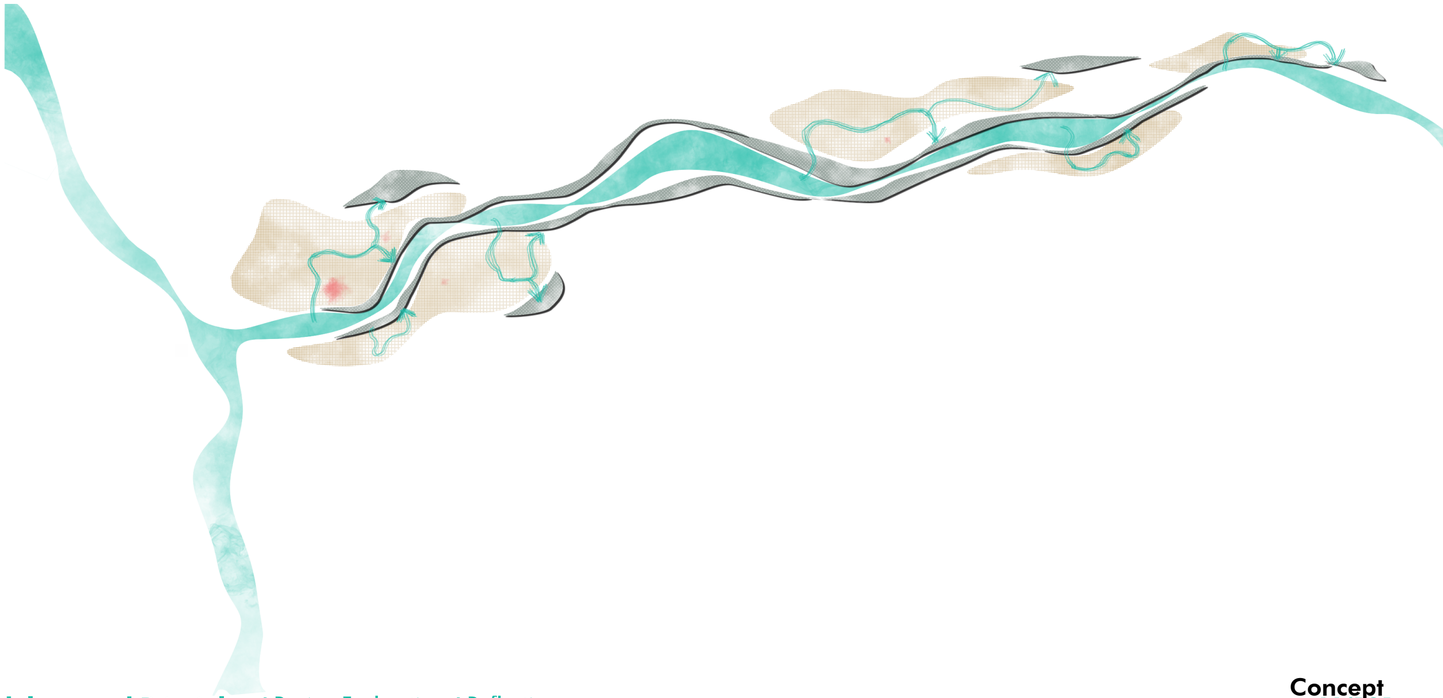


Current

Concept



Current



Scenarios for water system

Current water consumption

=1MCM=1 million cubic meter

Agriculture 515 MCM

Tourism 1.86MCM

Daily use 33.48 MCM

Planed by government
Economic Total 406 MCM

>

Ecology water 1,602.66 MCM

<

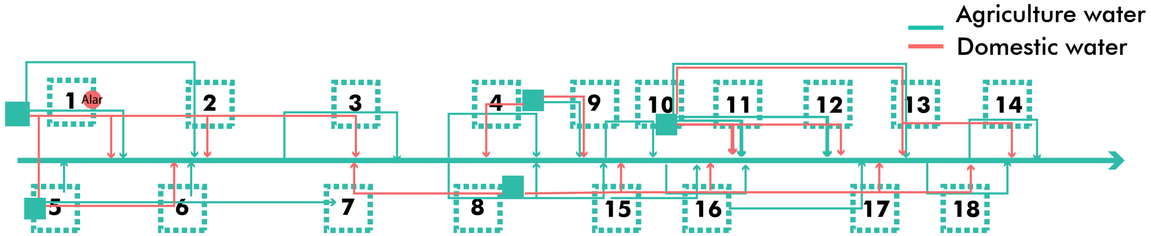
Ecology water needed 1,747 MCM

Support

Agriculture 45,900 Ha

Tourists 2,062,500

Citizens 673,800



Scenarios for water system

Proposed model in 2050

Proposed

Agriculture 257.5 MCM

Tourism 3.16 MCM

Daily 75.58 MCM

Ecology 1,816.76 MCM

<

Government Planned

Economic Total 406 MCM

>

Ecology needed 1,747 MCM

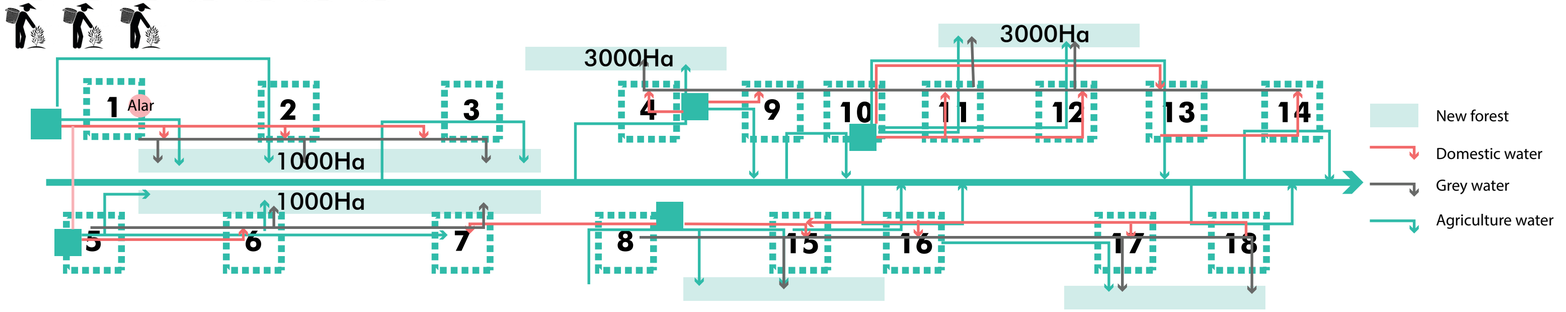
Support

Agriculture 45,900 Ha

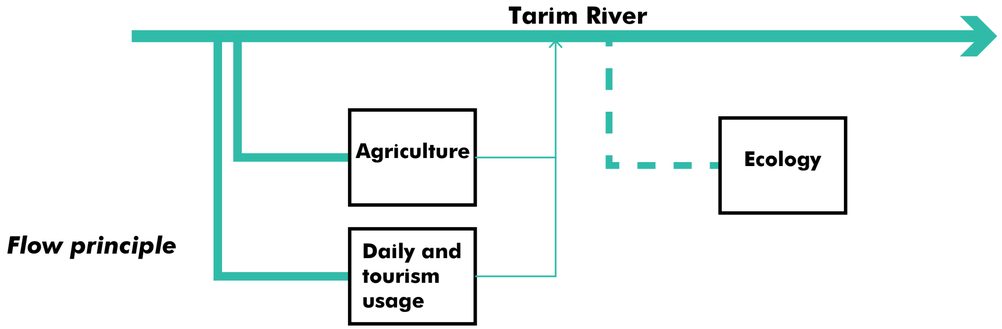
Tourists 5,000,000

Citizens 1,000,000

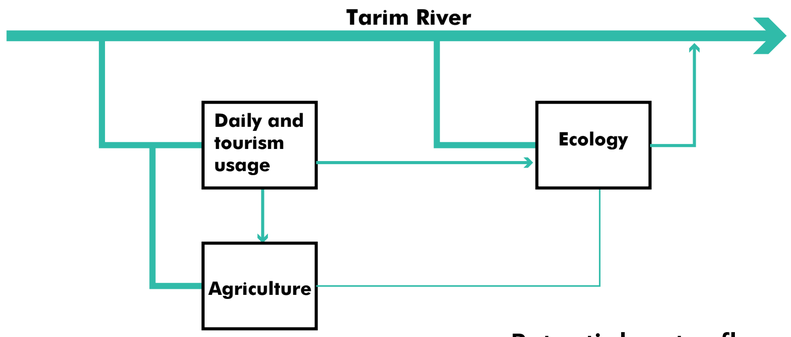
New forest 13,952Ha



Principles



Current situation

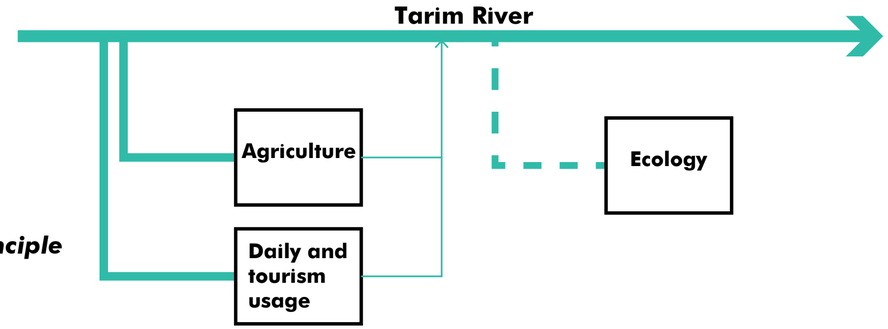


Potential water flow

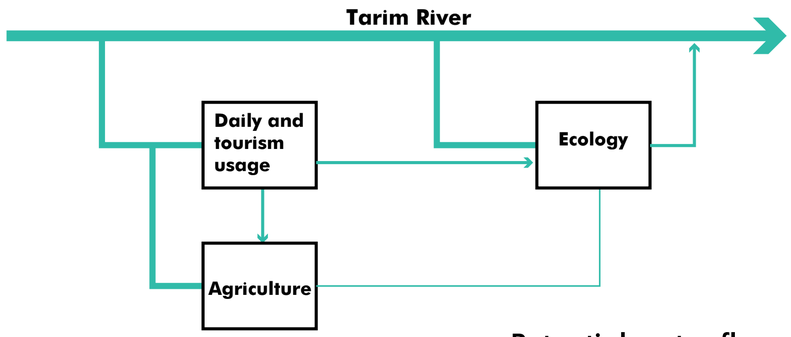
Water saving design

Principles

Flow principle



Current situation



Potential water flow

Water saving design

Tool box

Collect



Grey water collector

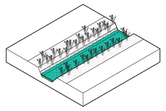
Housing Water pond

Water retention pond

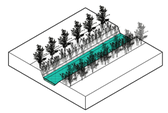
Waster water pond

Water Purification

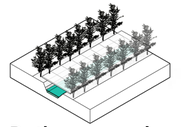
Transport



Semi-hardened canals

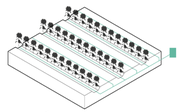


Plants covered canals

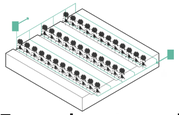


Path covered canals

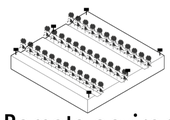
Use



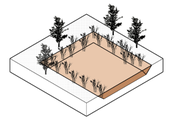
(Subsurface) drip irrigation



Exceed water collection

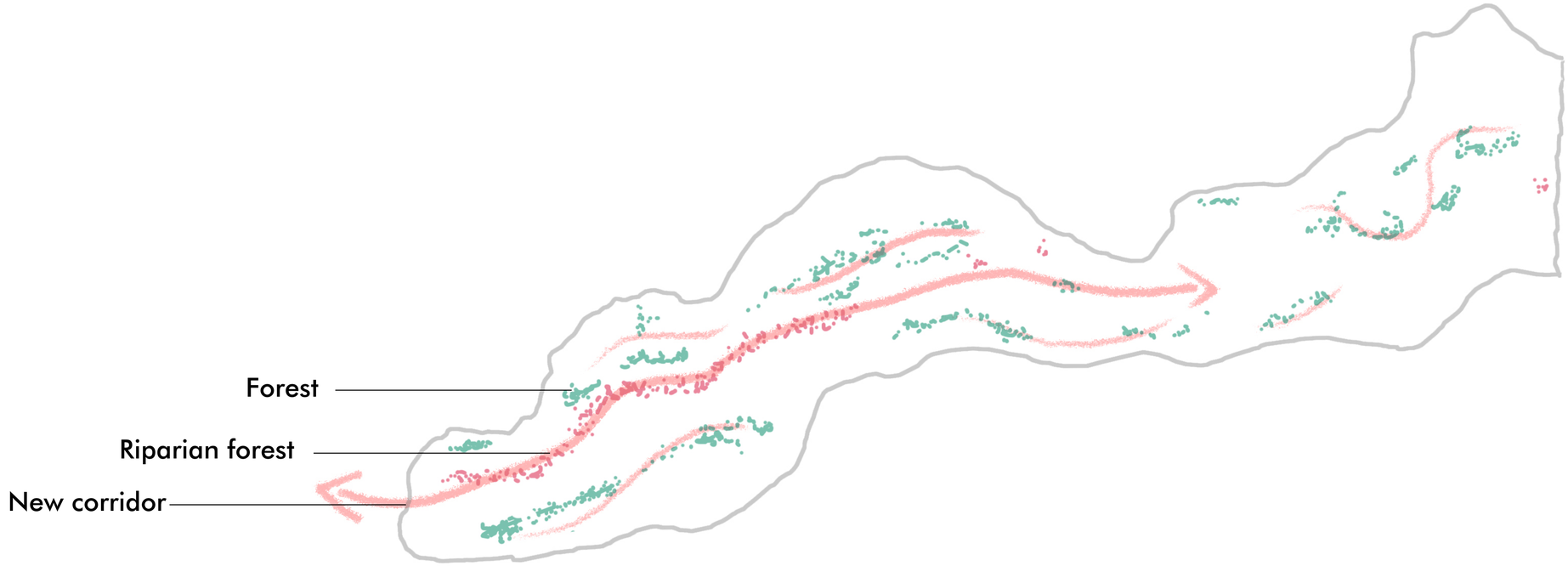


Remote environment Sensor



Ecological fish farm

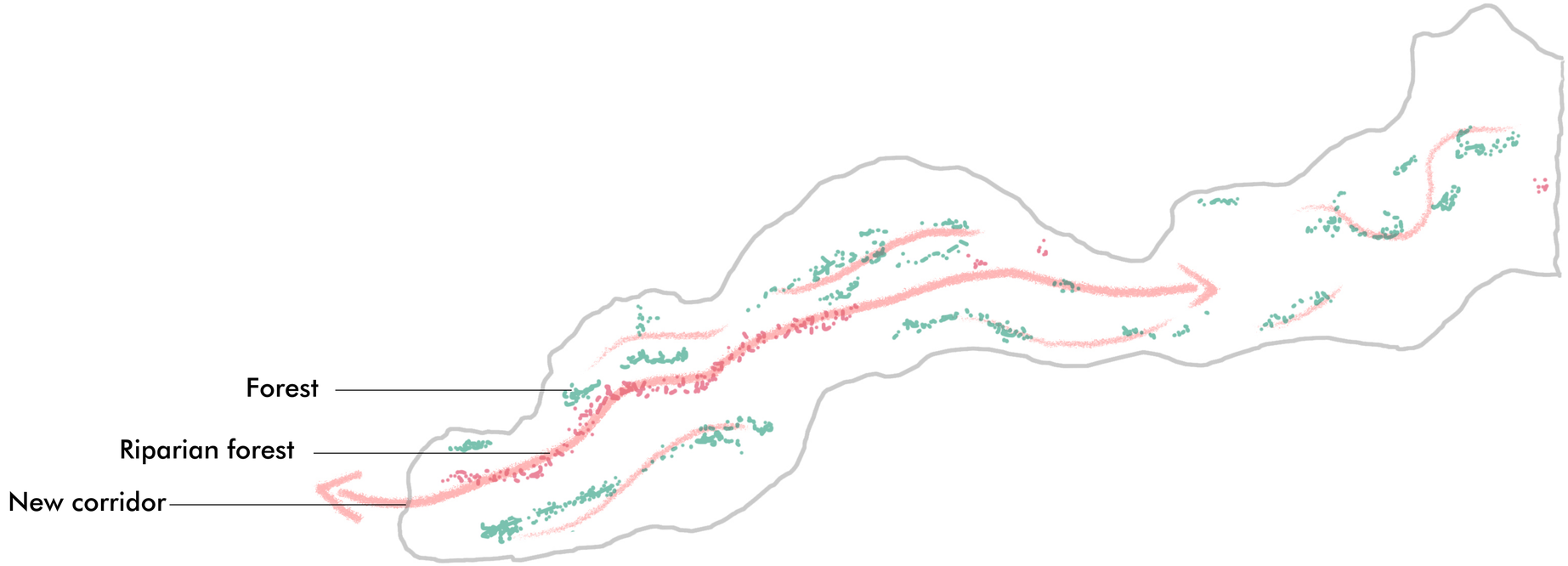
Principles



Afforestation

Principles

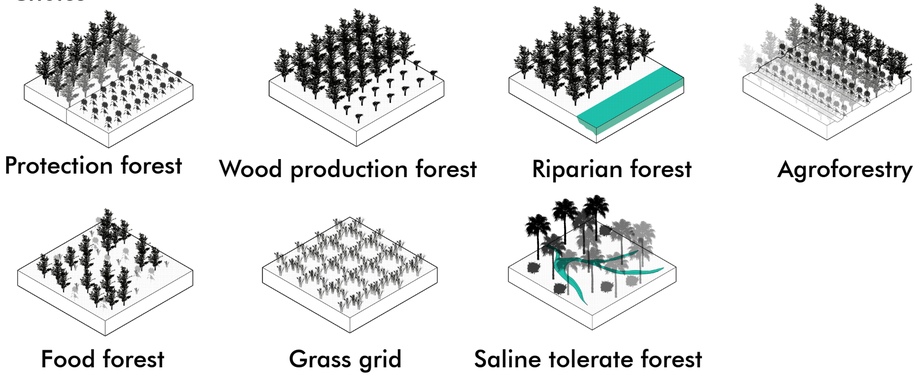
Potential planting



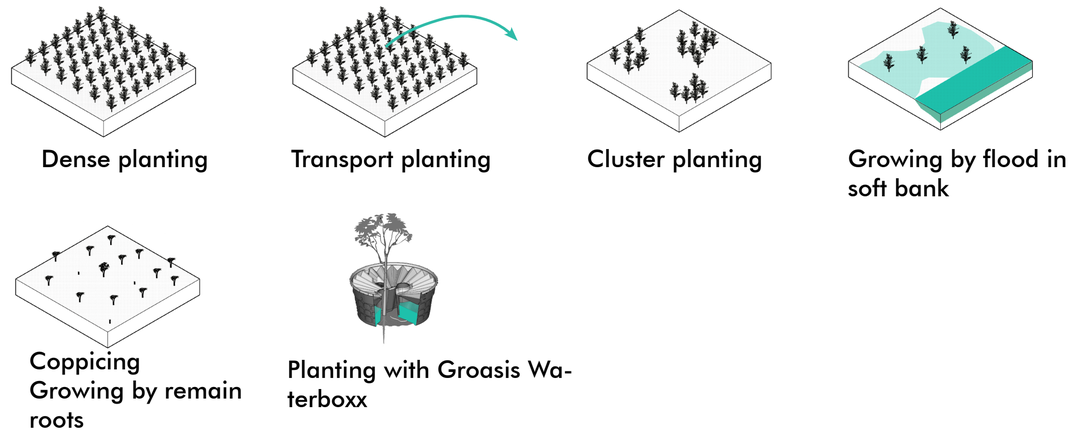
Afforestation

Planting Toolbox

Choice



Method



Principles

New crops



New circularity

Potential Inter-copping/ Agroforestry



Principles

New circularity

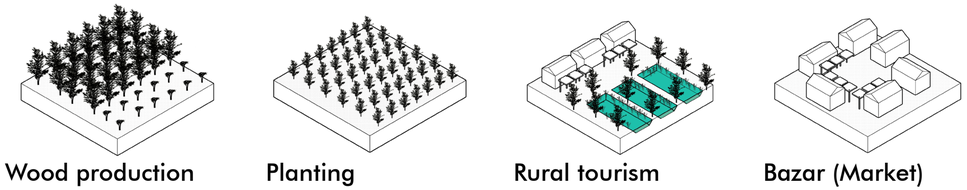
New crops



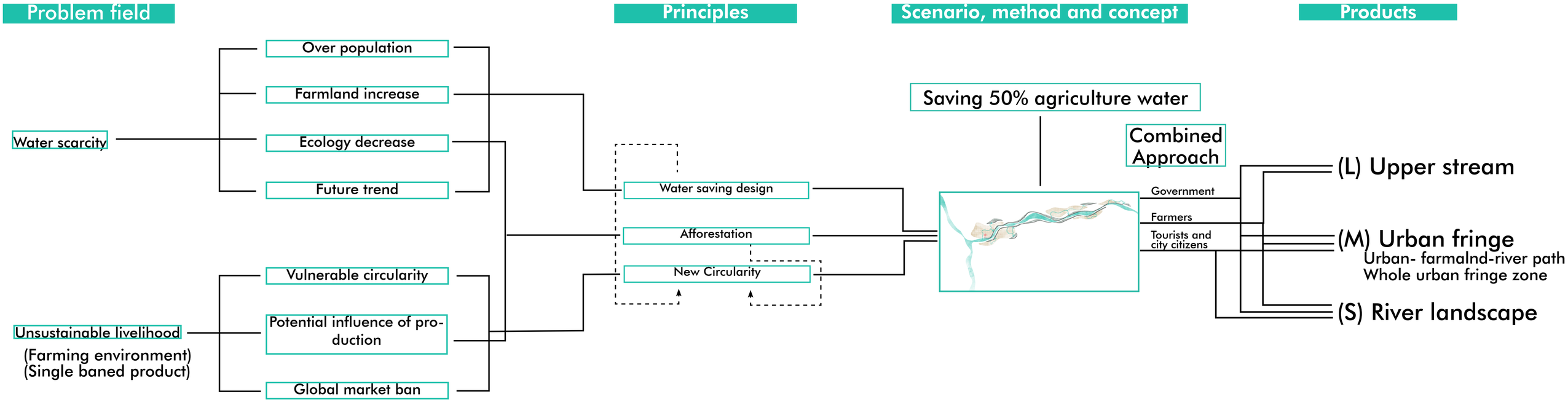
Potential Inter-copping/ Agroforestry



Other possible income



Design through scales



Scales

(L) Upper stream

(M) Urban fringe

Urban- farmalnd-river path

Whole urban fringe zone

(S) River landscape

Image- The big plan

First stork- start of plan

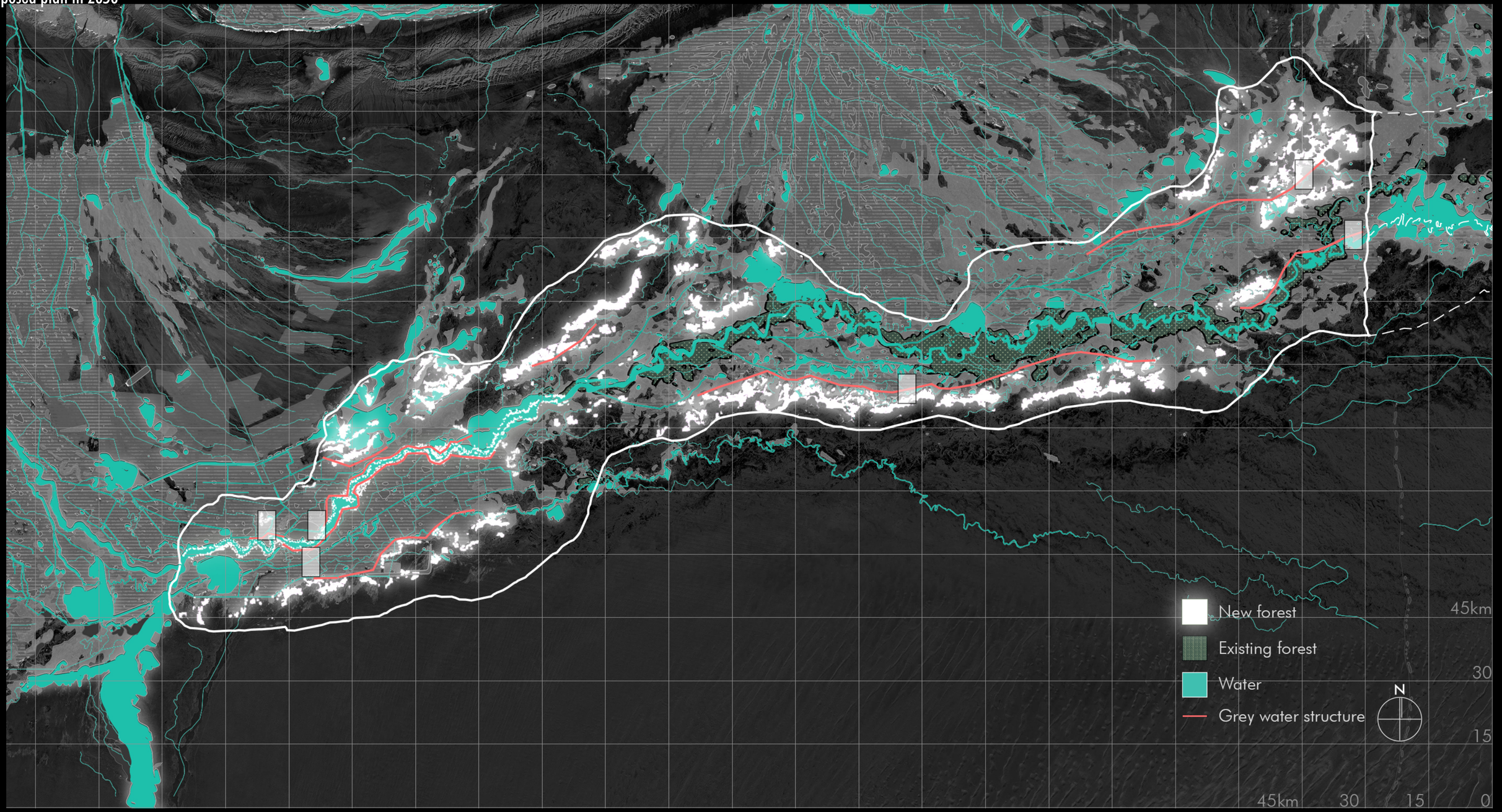
Attract people join

Construction process

Pixel - experience of this plan

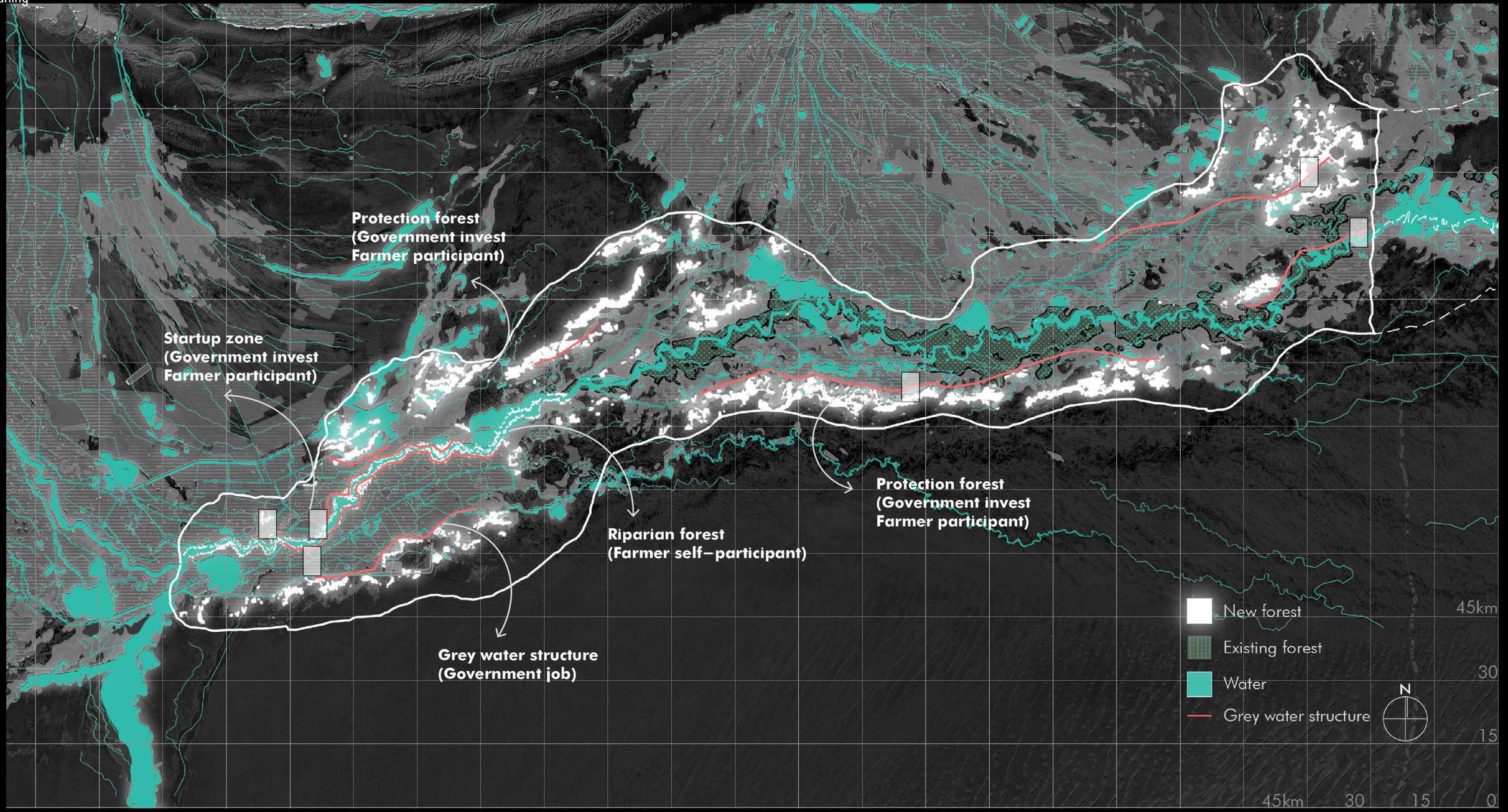
Upper stream scale plan

Proposed plan in 2050



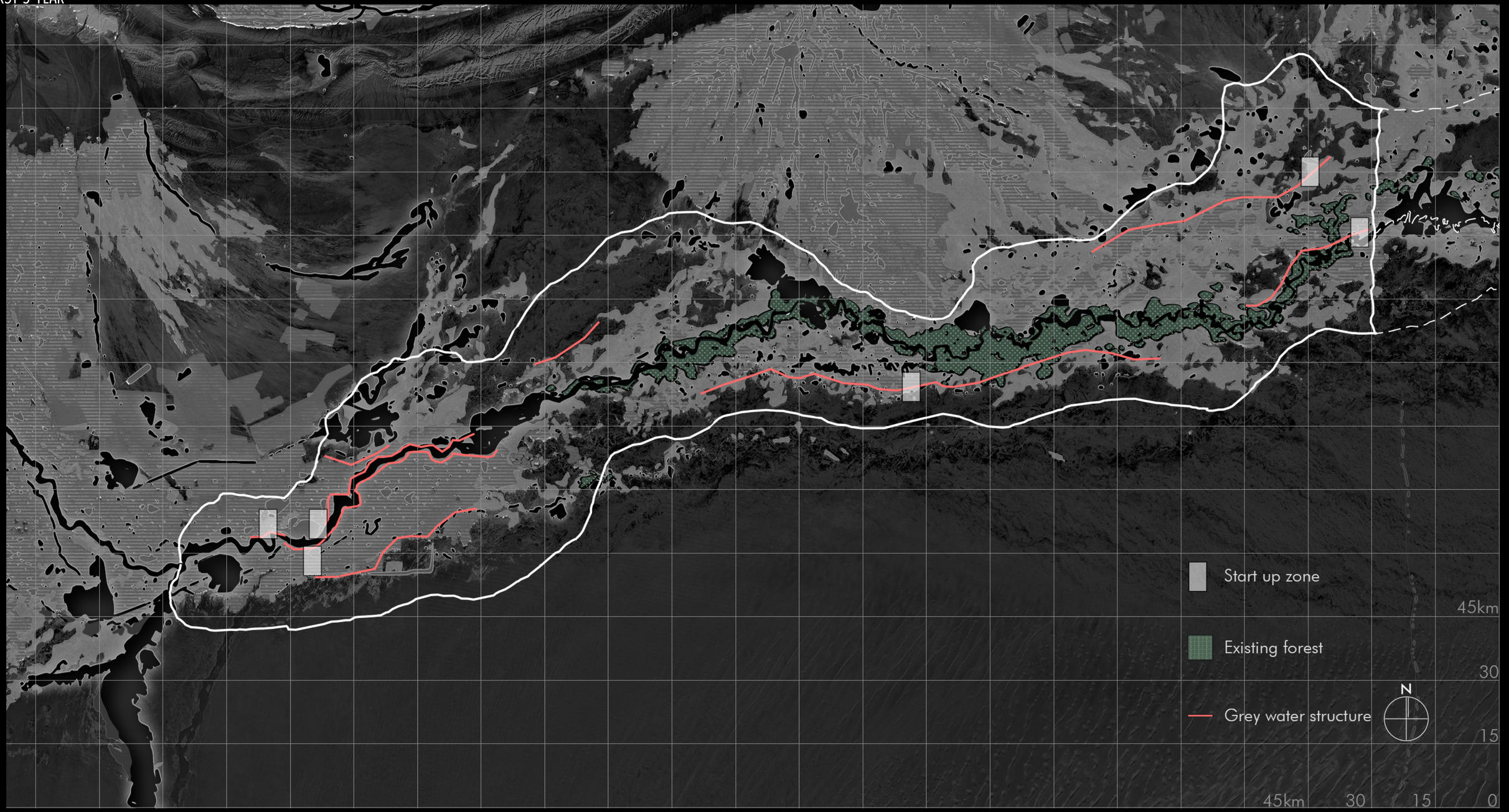
Upper stream scale plan

Meaning



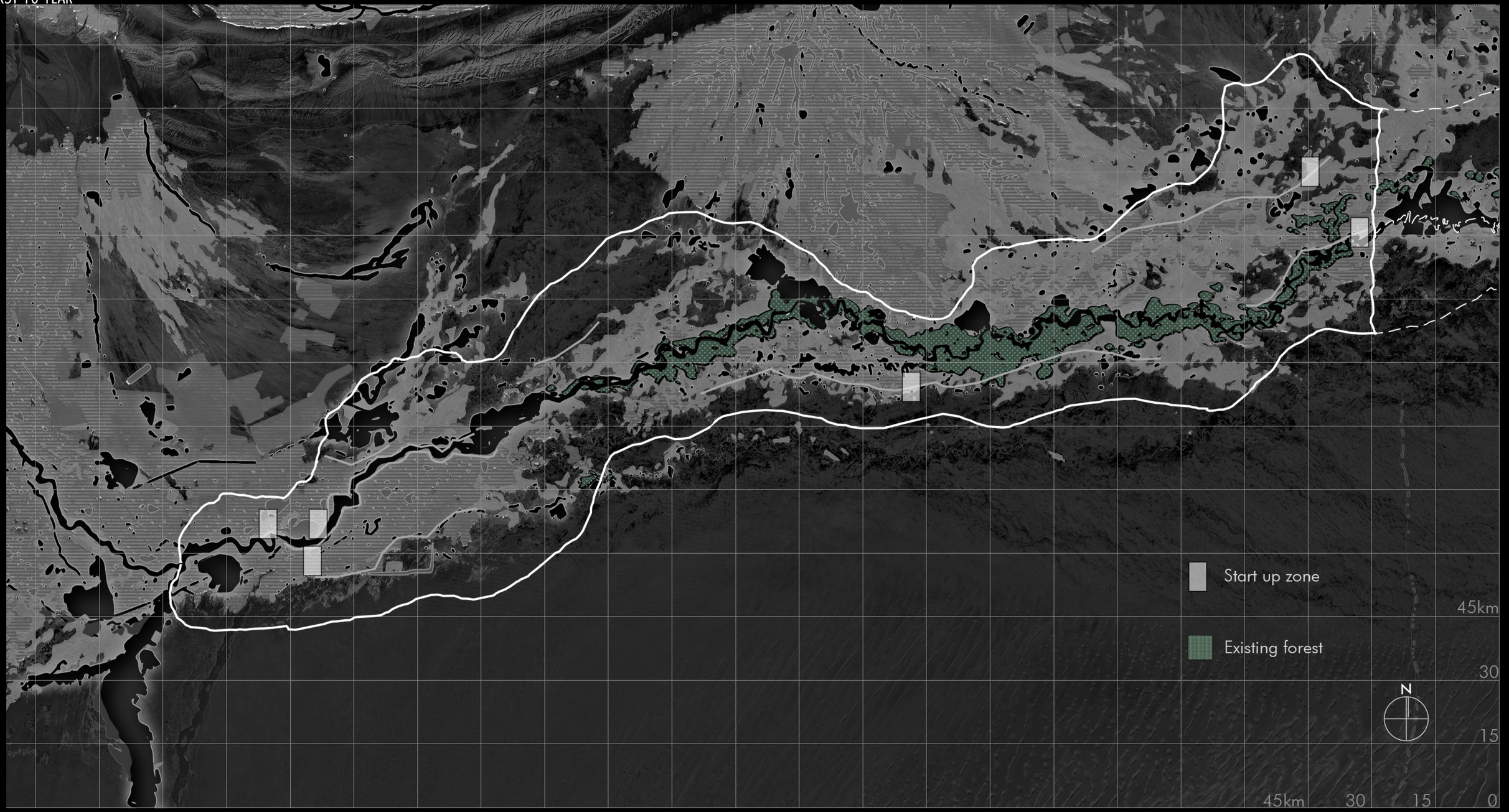
Upper stream scale plan

FIRST 5 YEAR



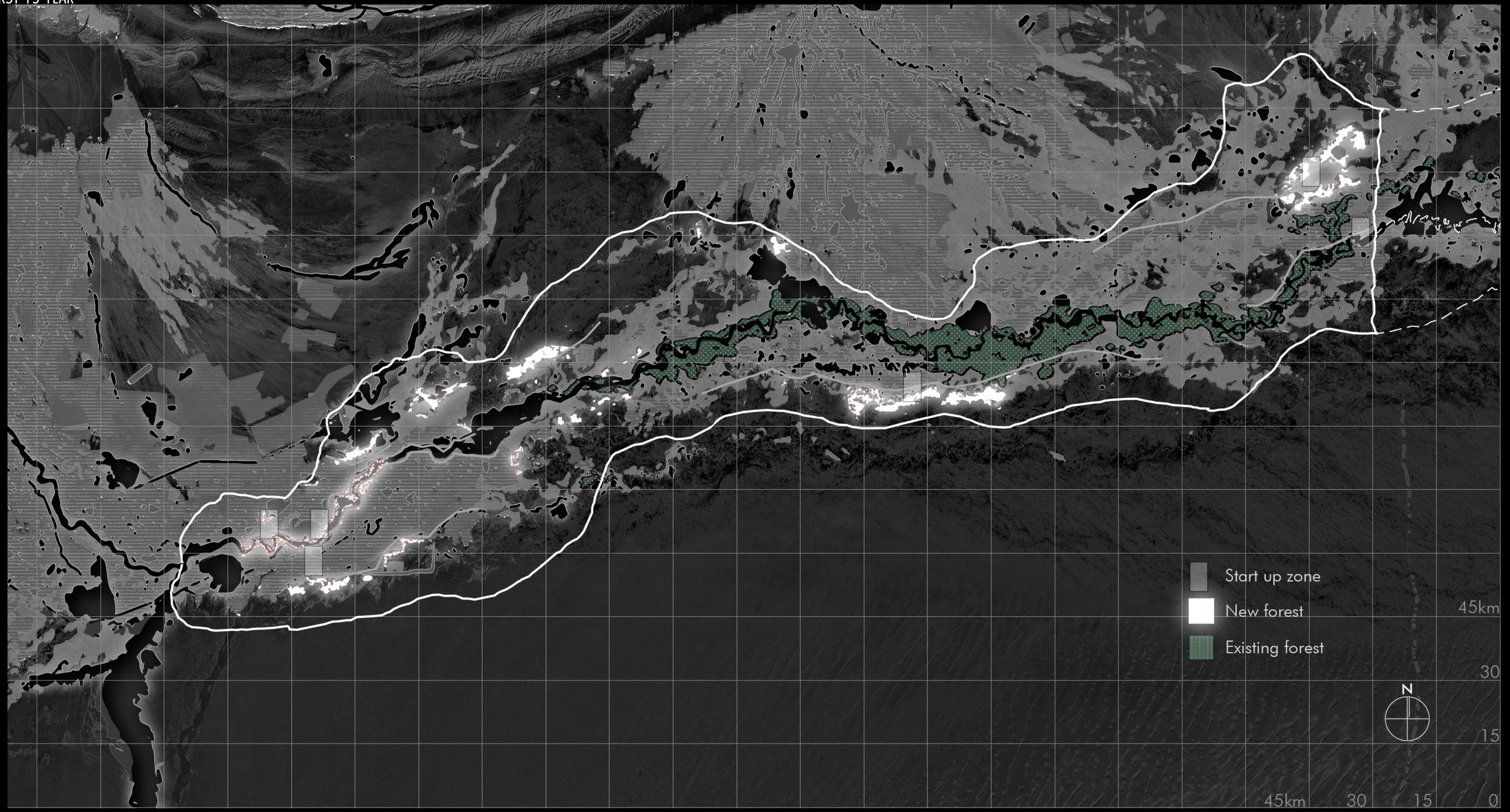
Upper stream scale plan

FIRST 10 YEAR



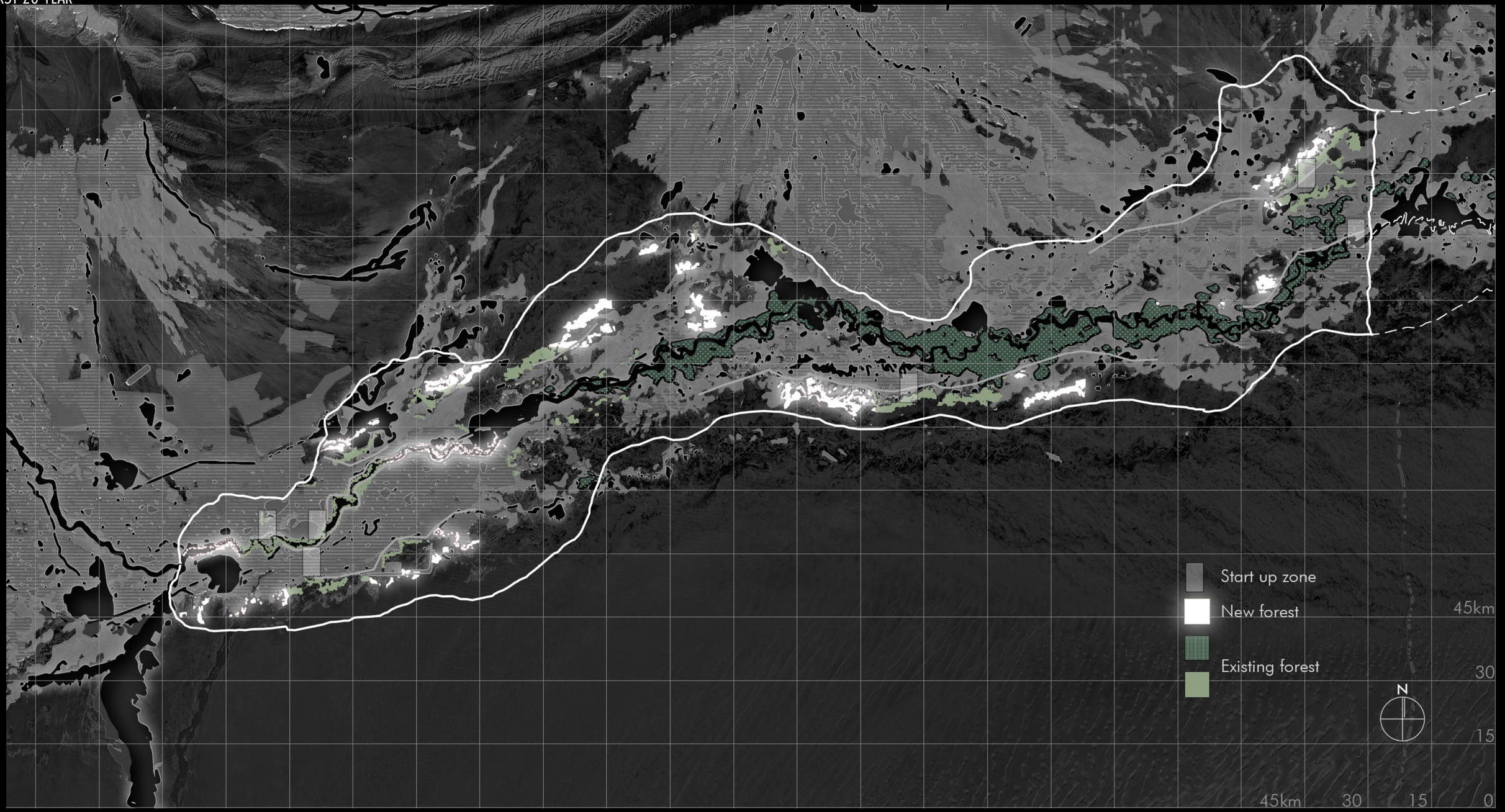
Upper stream scale plan

FIRST 15 YEAR



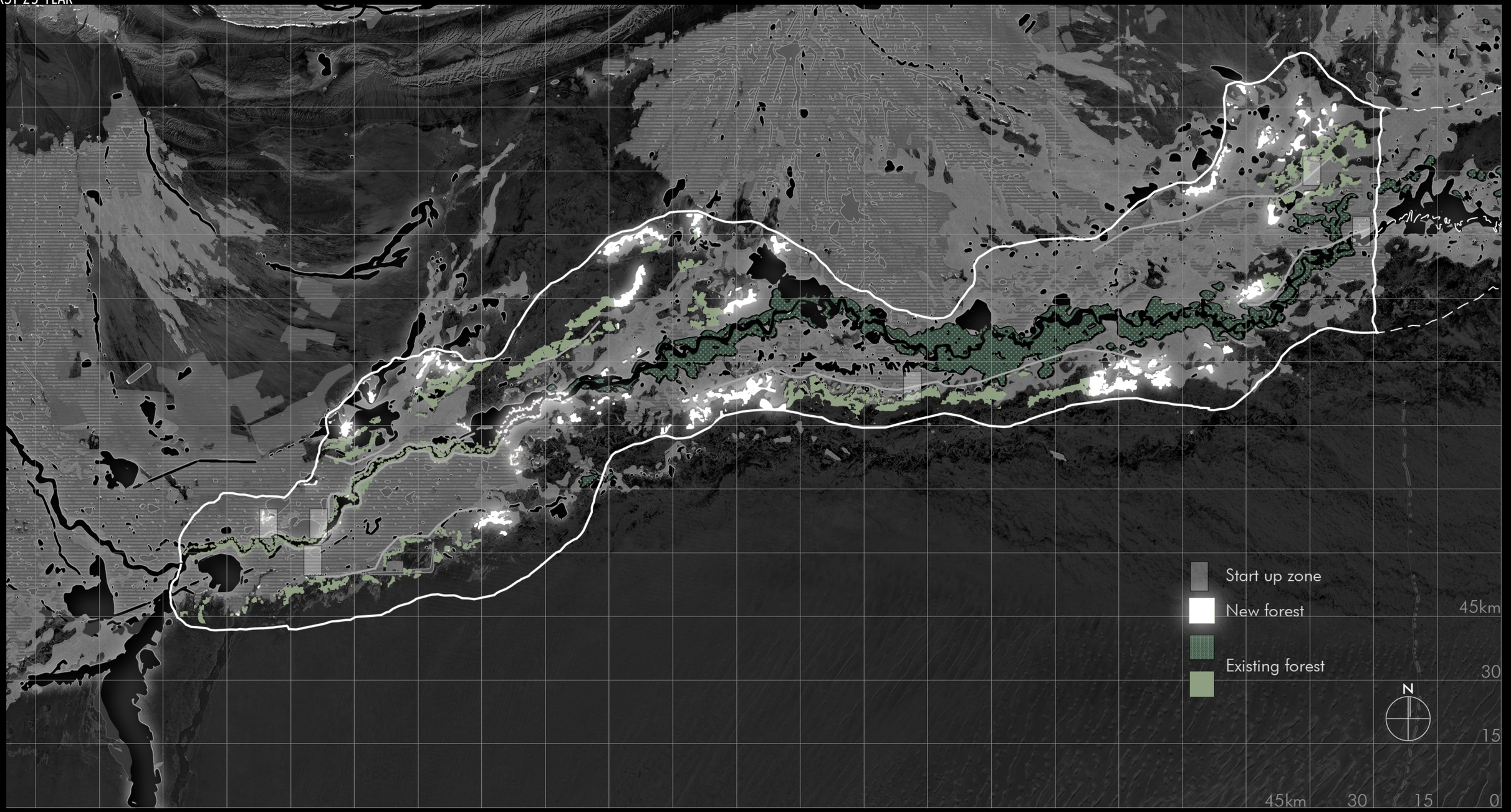
Upper stream scale plan

FIRST 20 YEAR



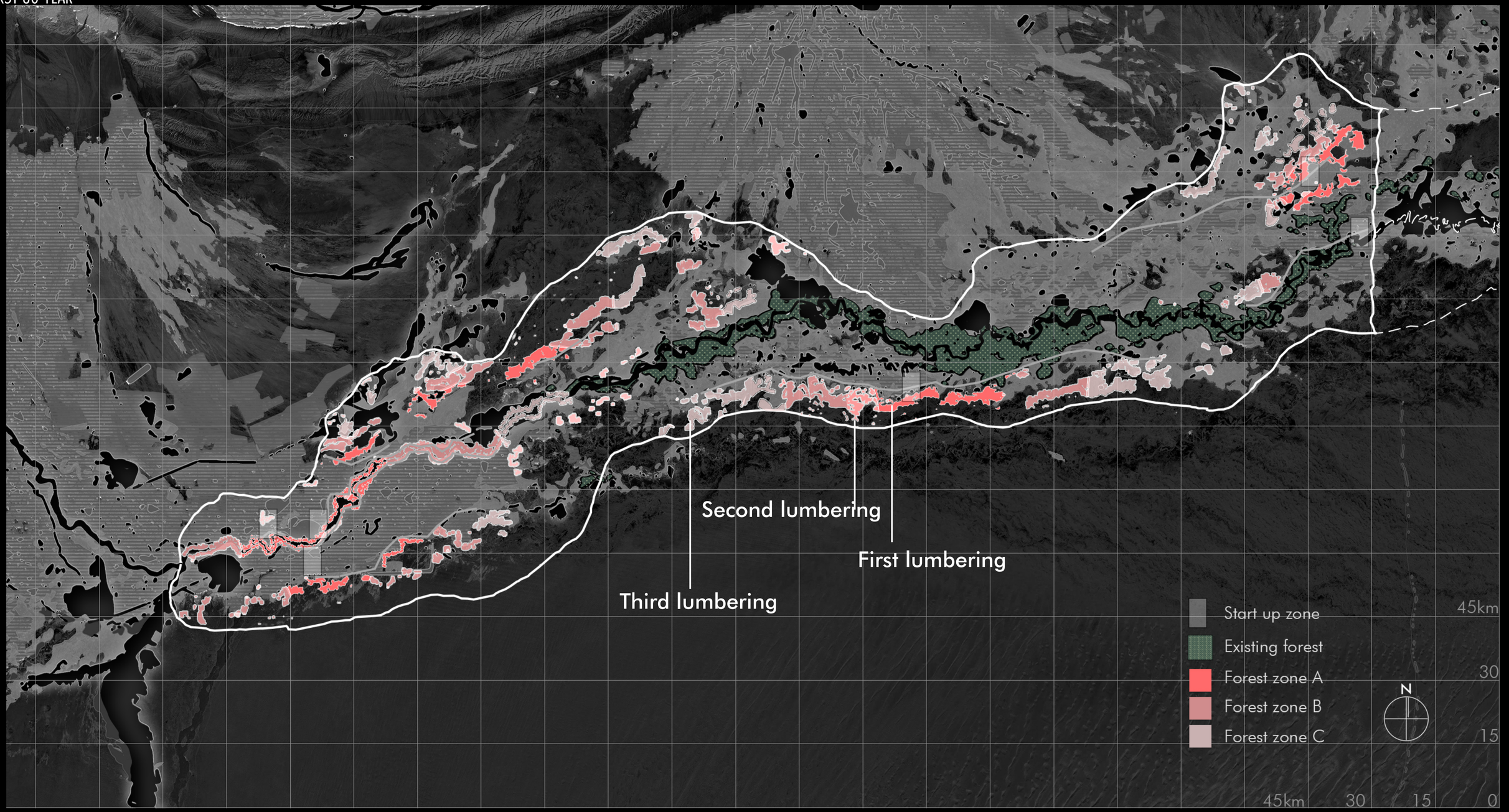
Upper stream scale plan

FIRST 25 YEAR



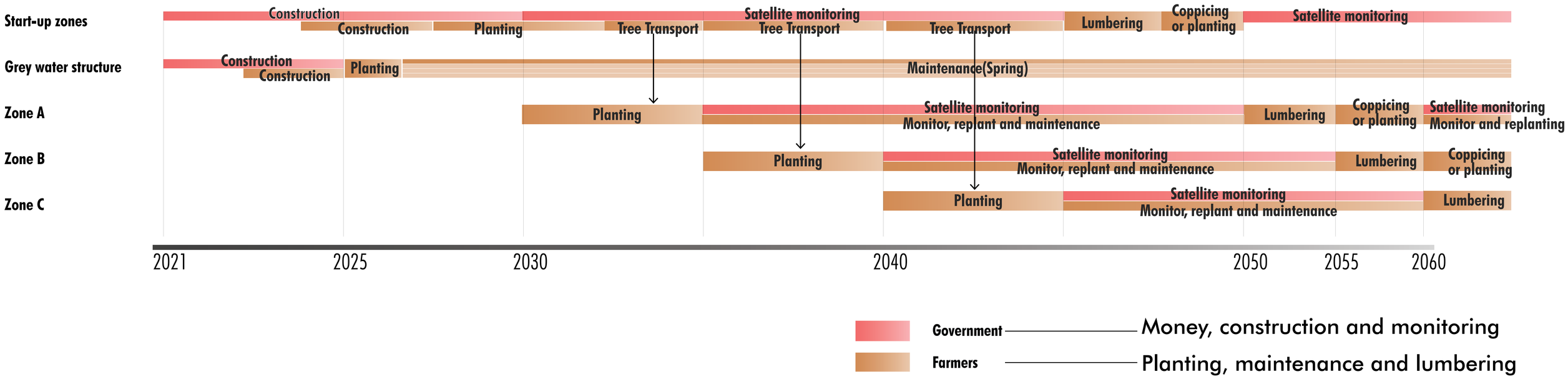
Upper stream scale plan

FIRST 30 YEAR



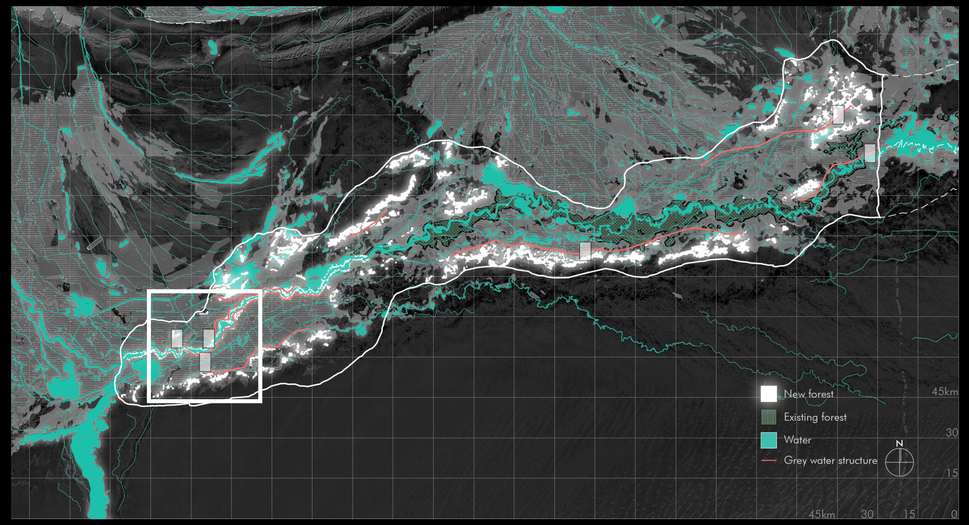
Upper stream scale plan

Construction, maintenance and monitor



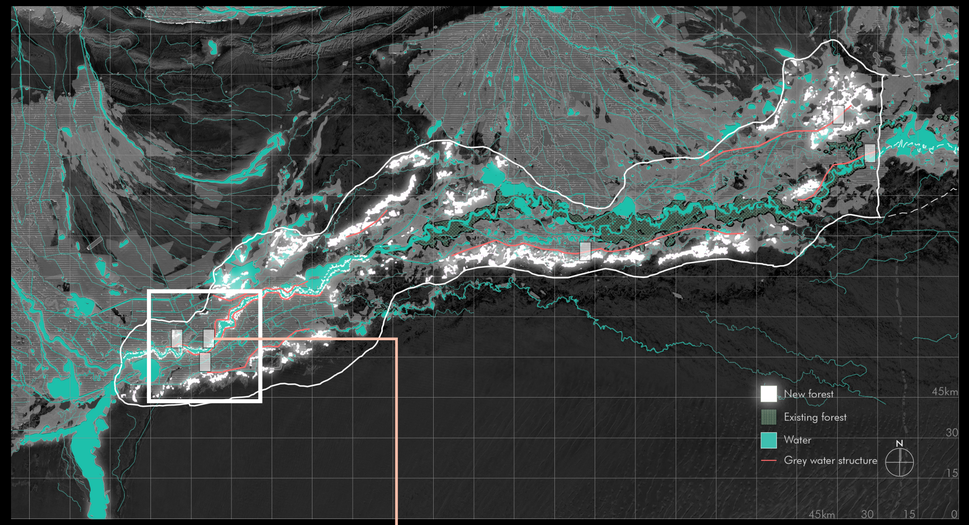
Upper stream scale plan

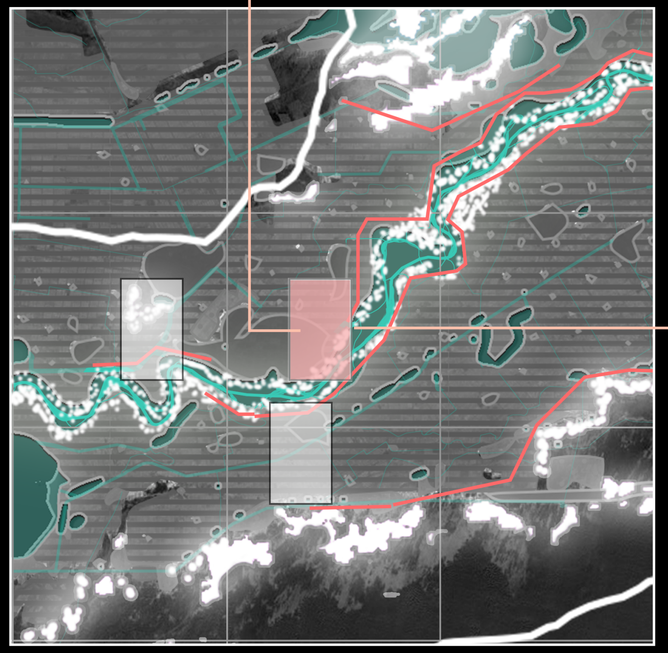
Zoom in startup zone

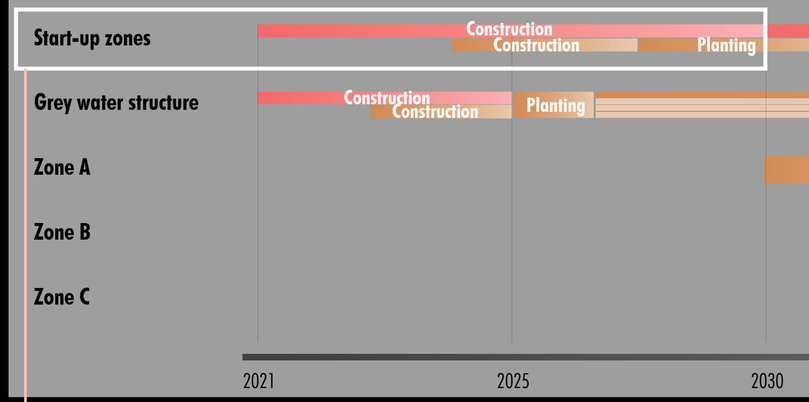


Upper scale design

Zoom in startup zone







Urban fringe imprssion

Landscape (Drought and wet)

Summer


Canal


Cotton feild


Small canal


Canal


Farmland


Vegetation


Tarim river


Tarim river


Tarim river

Urban fringe imprssion

Landscape (Drought and wet)

Summer


Canal


Cotton feild


Small canal


Canal


Farmland


Vegetation


Tarim river


Tarim river


Tarim river

Winter


Pond




Forest


Tarim river


Canal


Road


Traditional housing


Current housing

Urban fringe imprssion

Landscape use



Urban fringe imprssion

4 Structure

Road as barrier



Urban fringe imprssion

4 Structure

Old river palimpsest



Urban fringe imprssion

4 Structure

Hard river boundary



Urban fringe imprssion

4 Structure

Transition
City-farmland-river



Urban fringe imprssion

River change process


14-Jan-2020

2-Feb-2020

21-Mar-2020

21-May-2020


1-Jun-2020


4-Aug-2020


5-Sep-2020

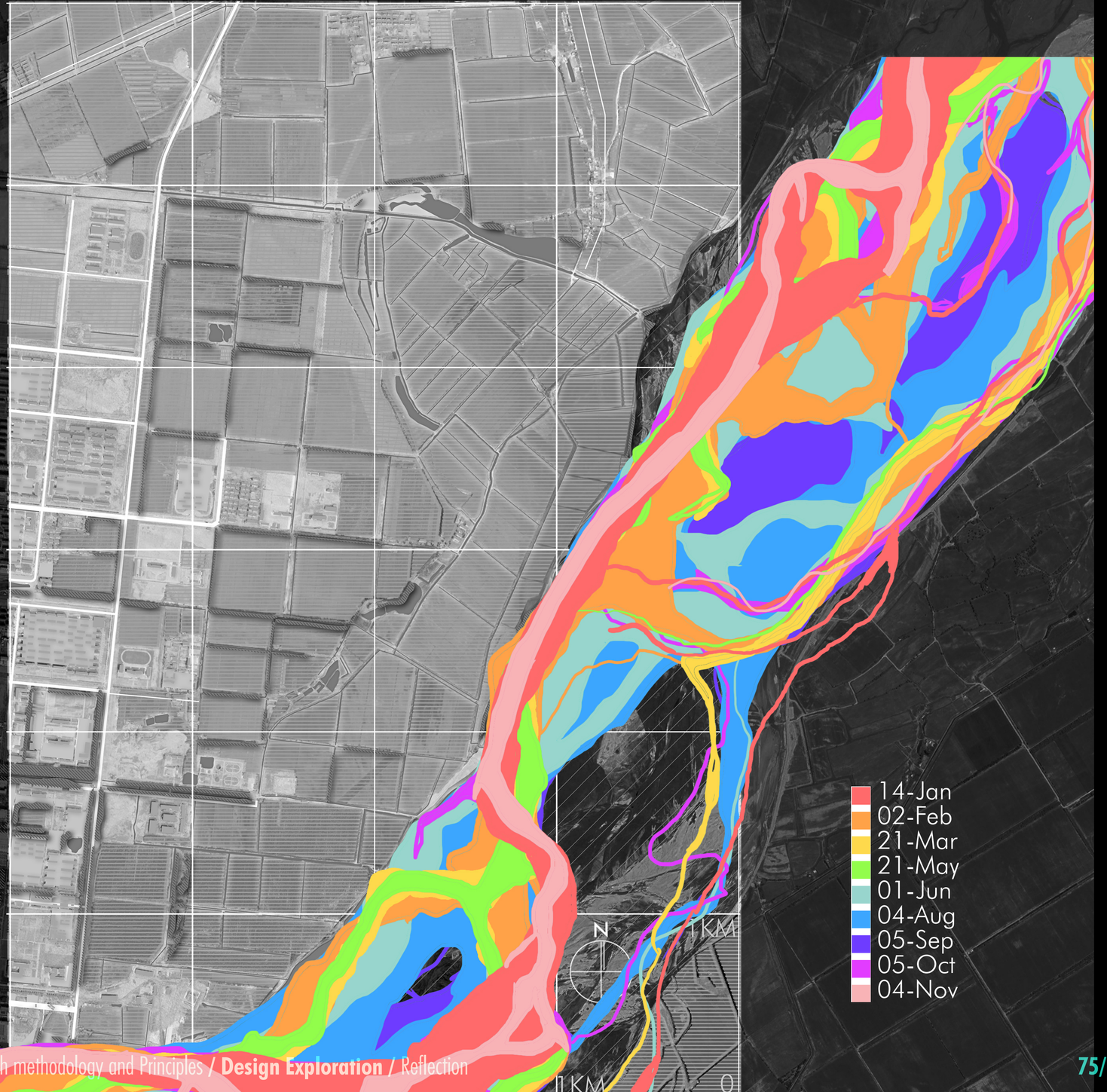

5-Oct-2020


4-Nov-2020


Jun-2016


Aug-2016


Oct-2016



Urban fringe imprssion

Seansons process









Urban fringe imprssion

Overview

3 principles + 4 Structures + 2 process

Urban fringe design

Master plan in 2030



Urban fringe design

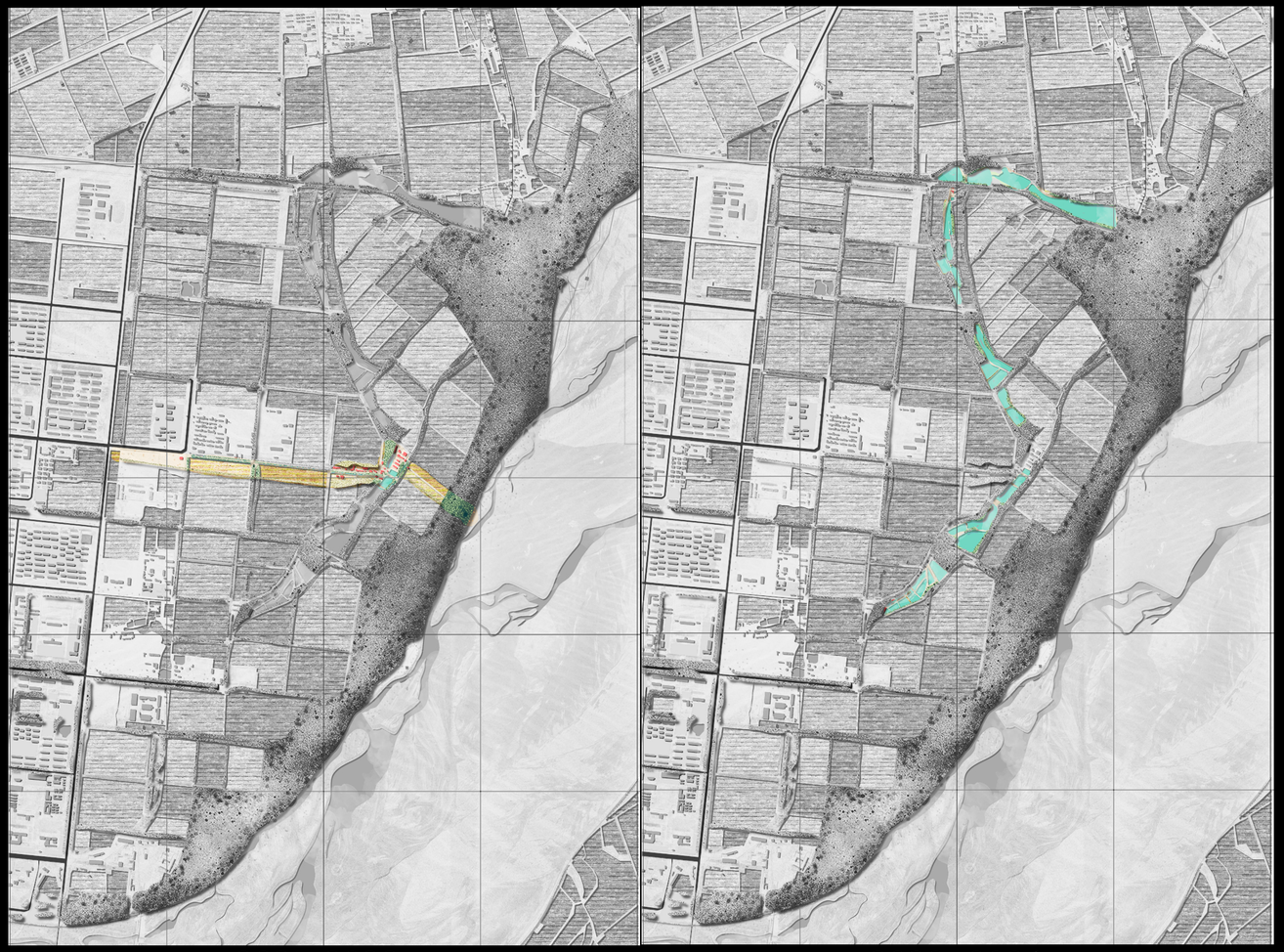
Constrcution process



2021-2023
Construction of starting path

Urban fringe design

Constrcution process



2021-2023
Construction of starting path

2023- 2026
Construction of grey water system

Urban fringe design

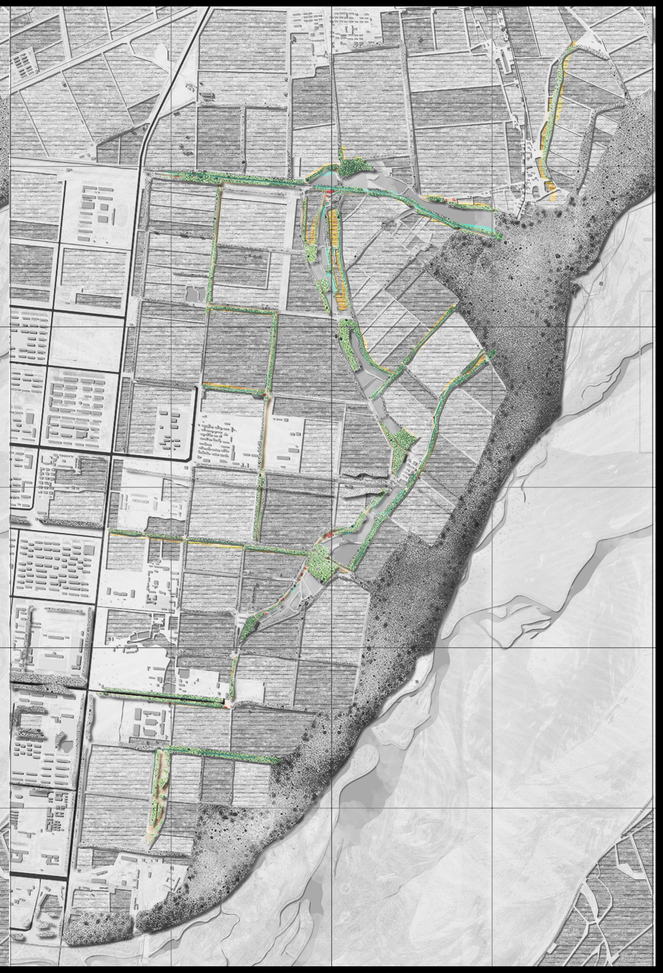
Constrcution process



2021-2023
Construction of starting path



2023- 2026
Construction of grey water system



2026- 2027
Irrigation transformation and Planting along grey water system

Urban fringe design

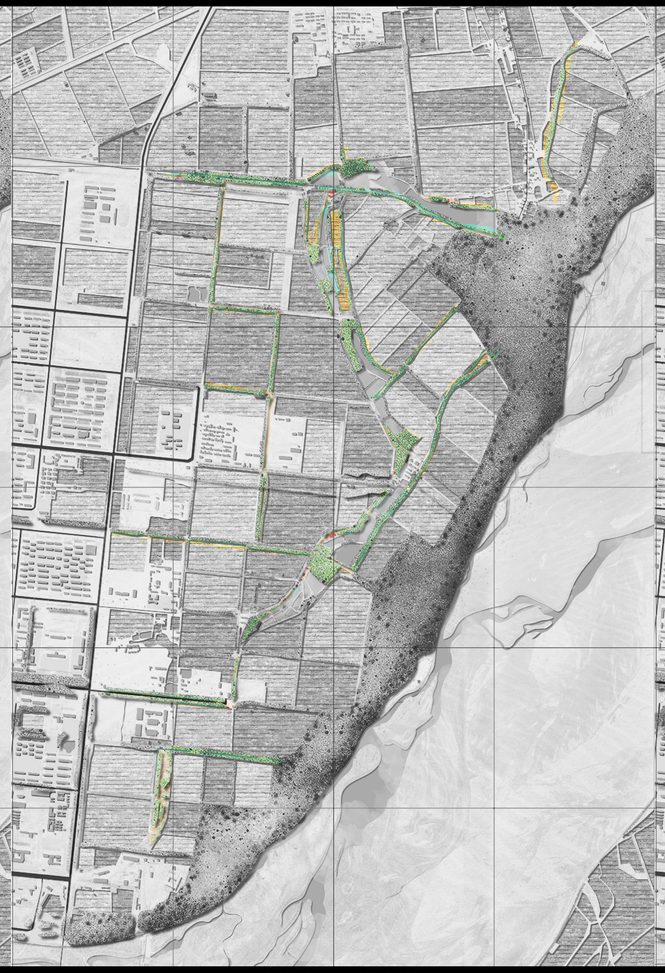
Constrcution process



2021-2023
Construction of starting path



2023- 2026
Construction of grey water system



2026- 2027
Irrigation transformation and Planting along grey water system



2027-2030
Planting the raparian forest

Urban fringe design

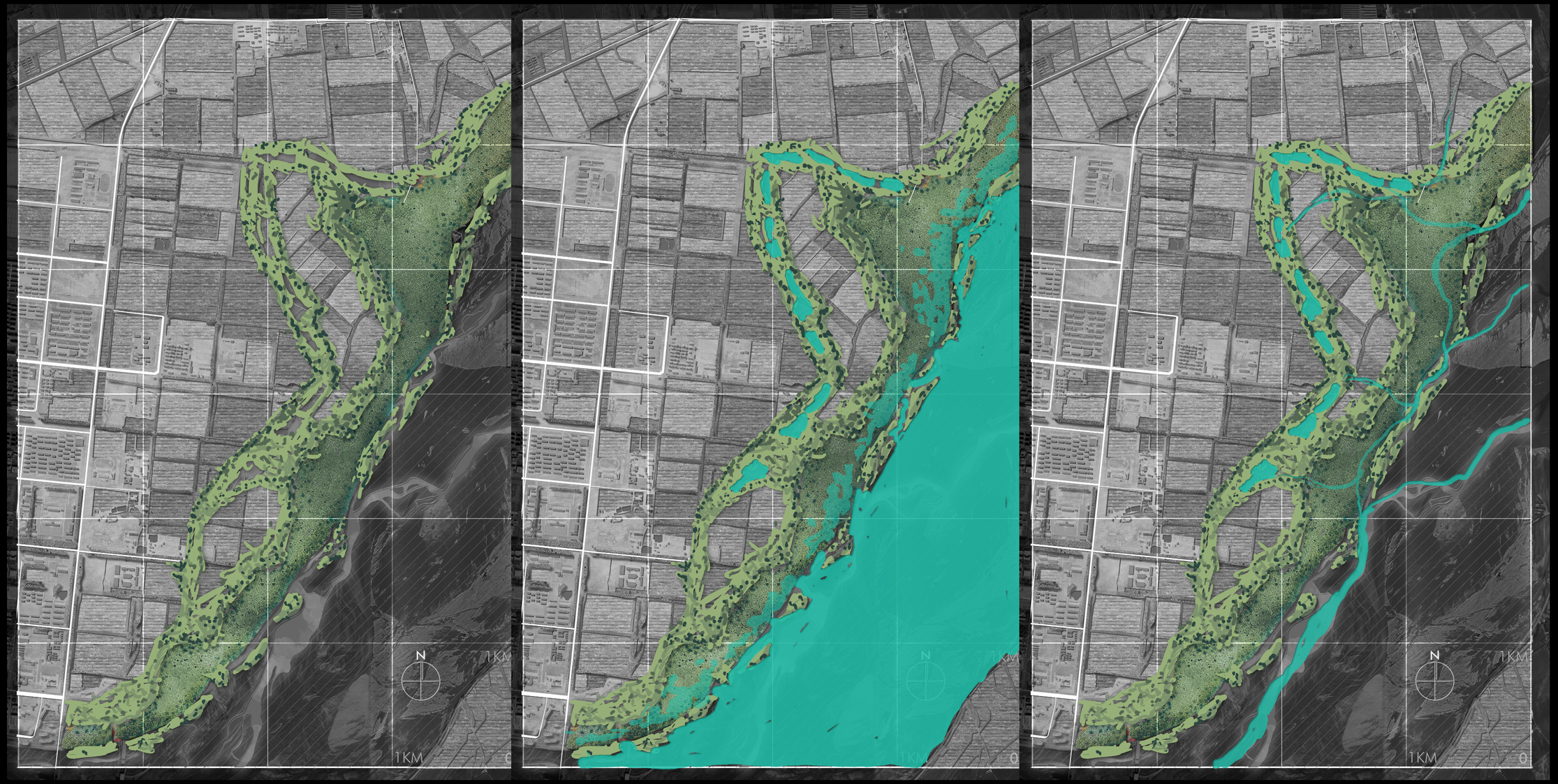
Future prediction



Potential forest map in 2050

Urban fringe design

Future prediction



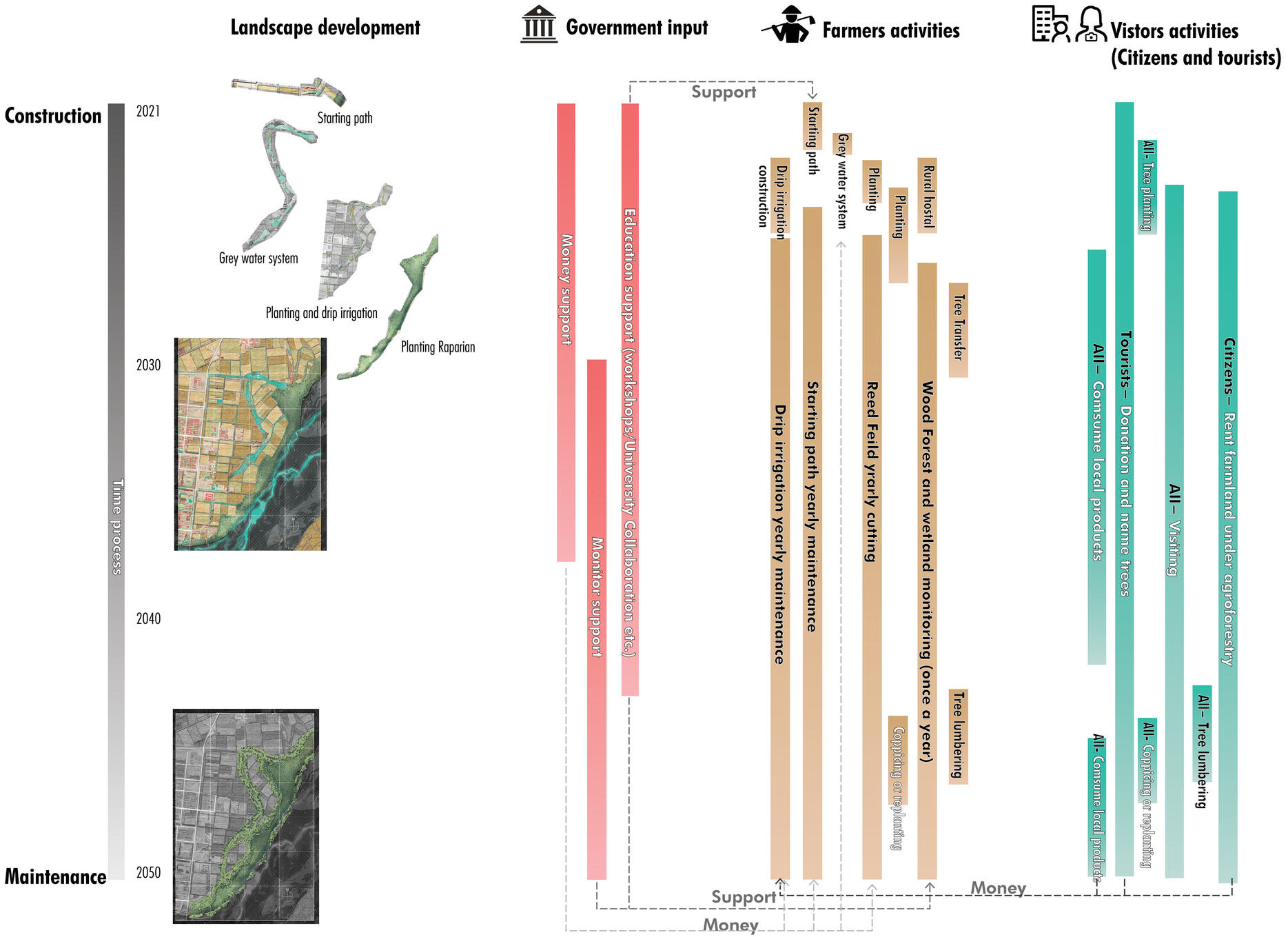
Potential forest map in 2050

Flood season after 2050

Dry season after 2050

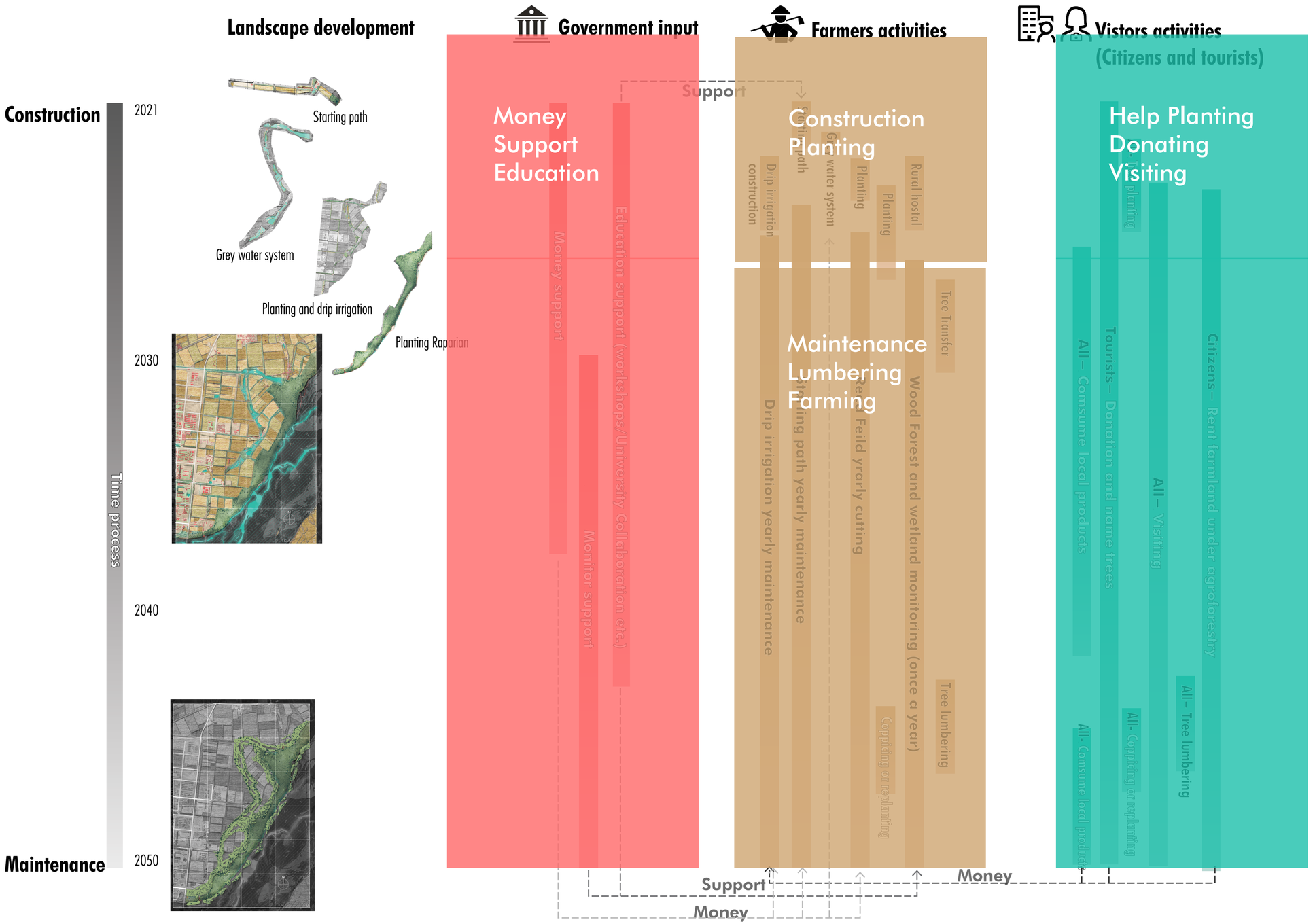
Urban fringe design

Timetable



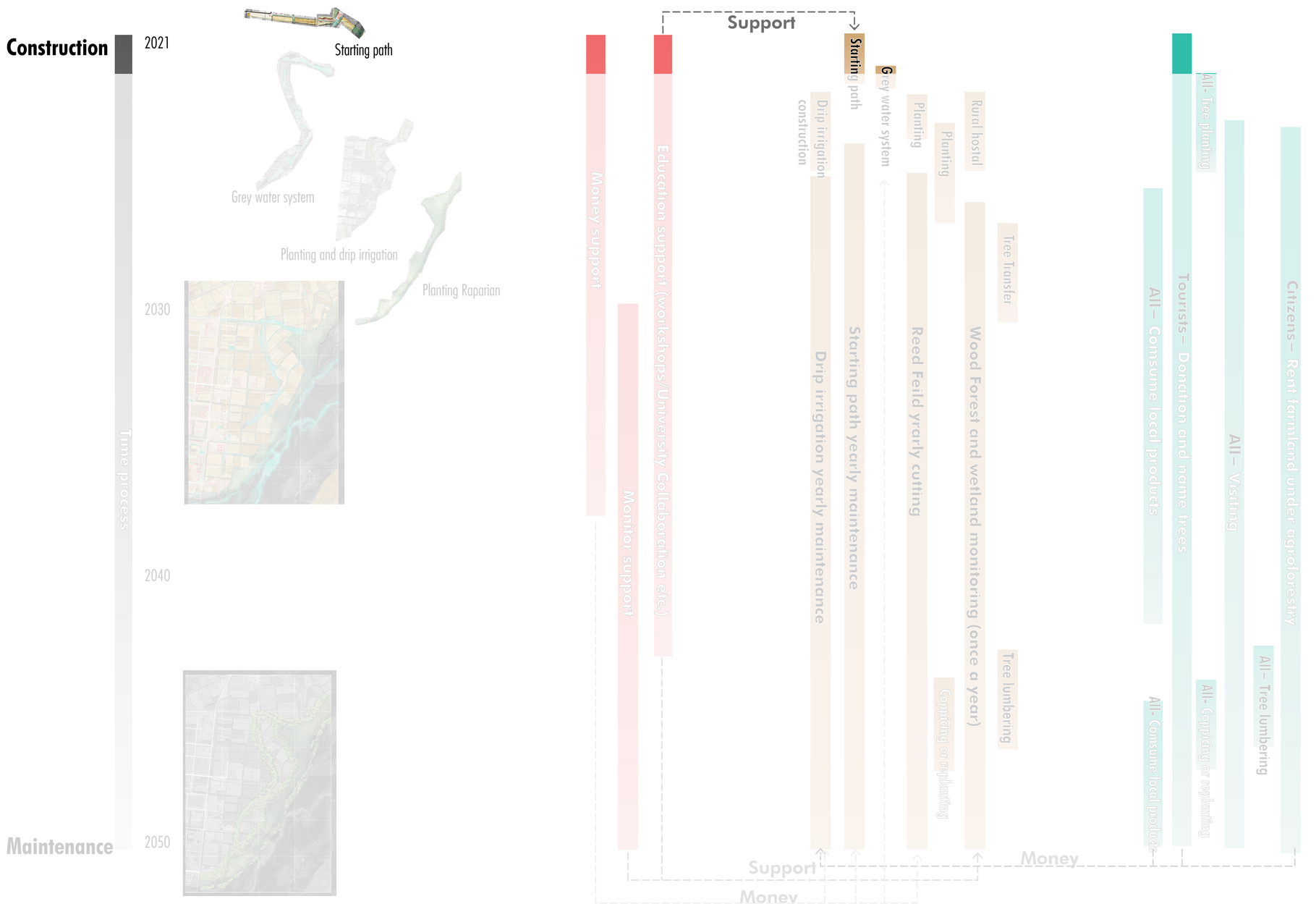
Urban fringe design

Timetable



Urban fringe design

Zone in - Staring path



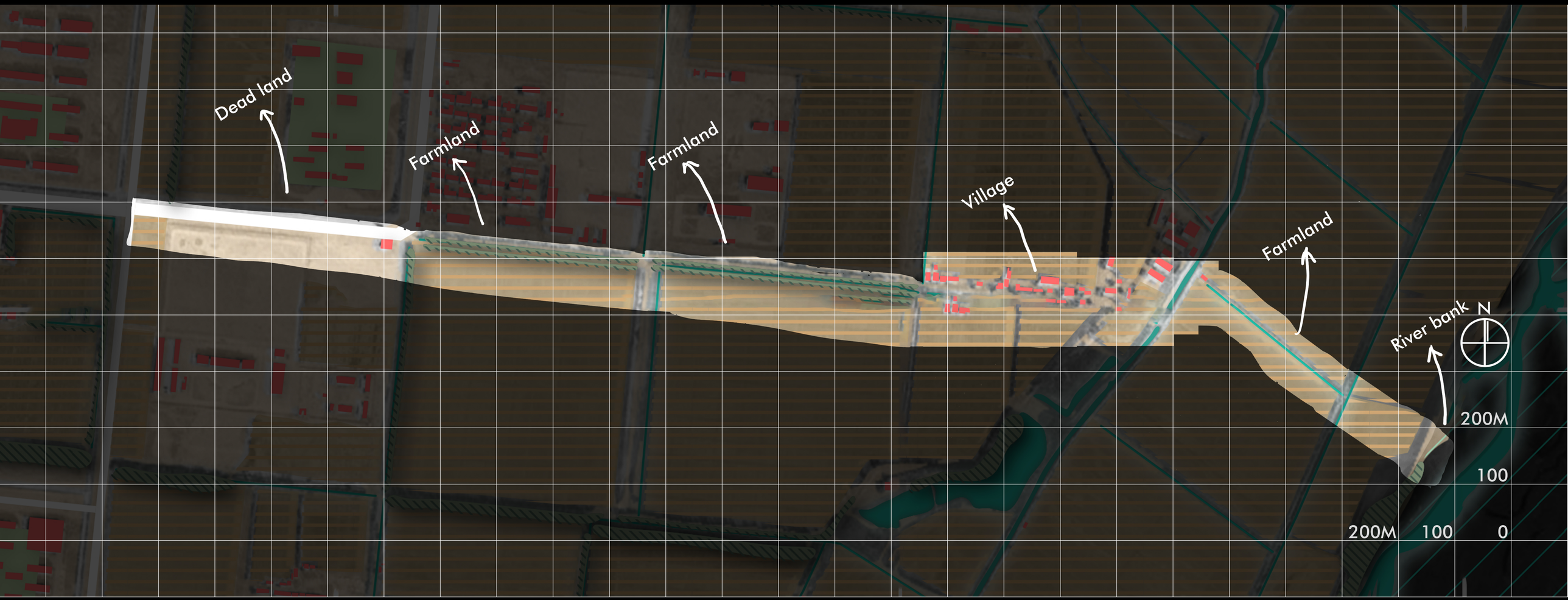
Urban fringe design

Starting- Urban farmlan river path



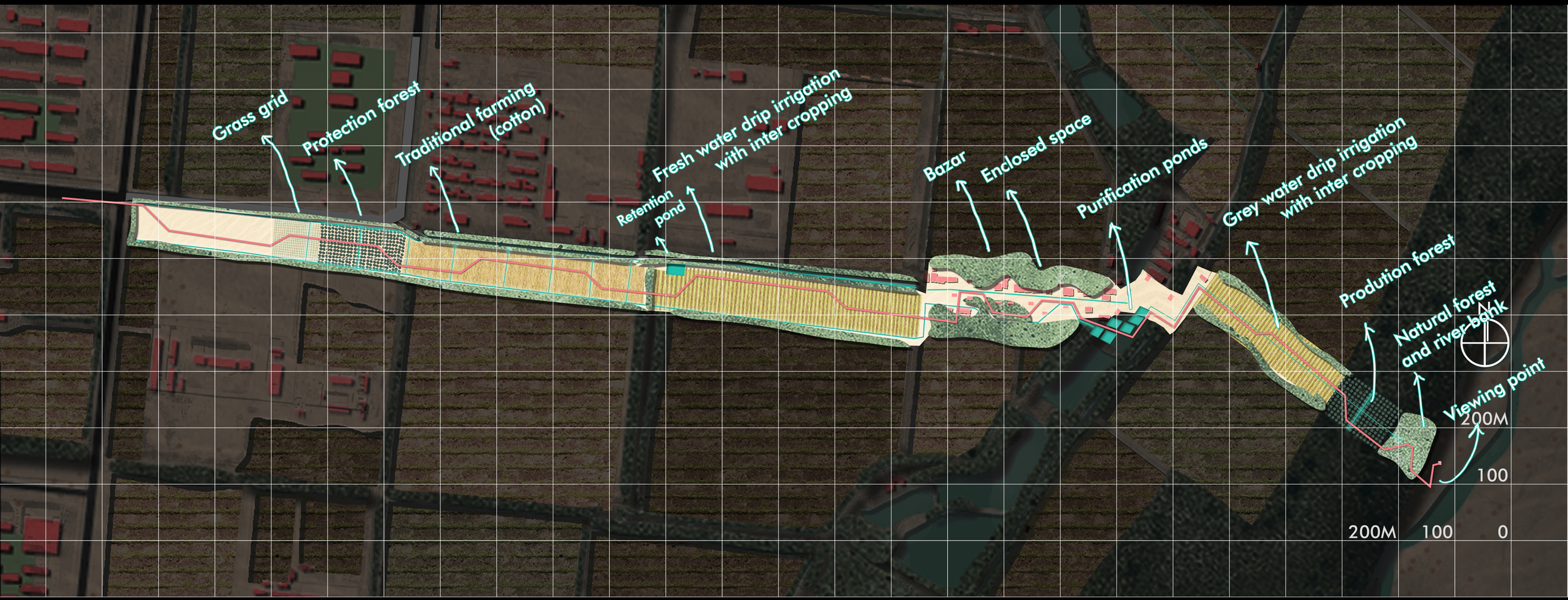
Urban fringe design------Urban-farmland-river path

Starting Path- Transition from urban city -farmland - river



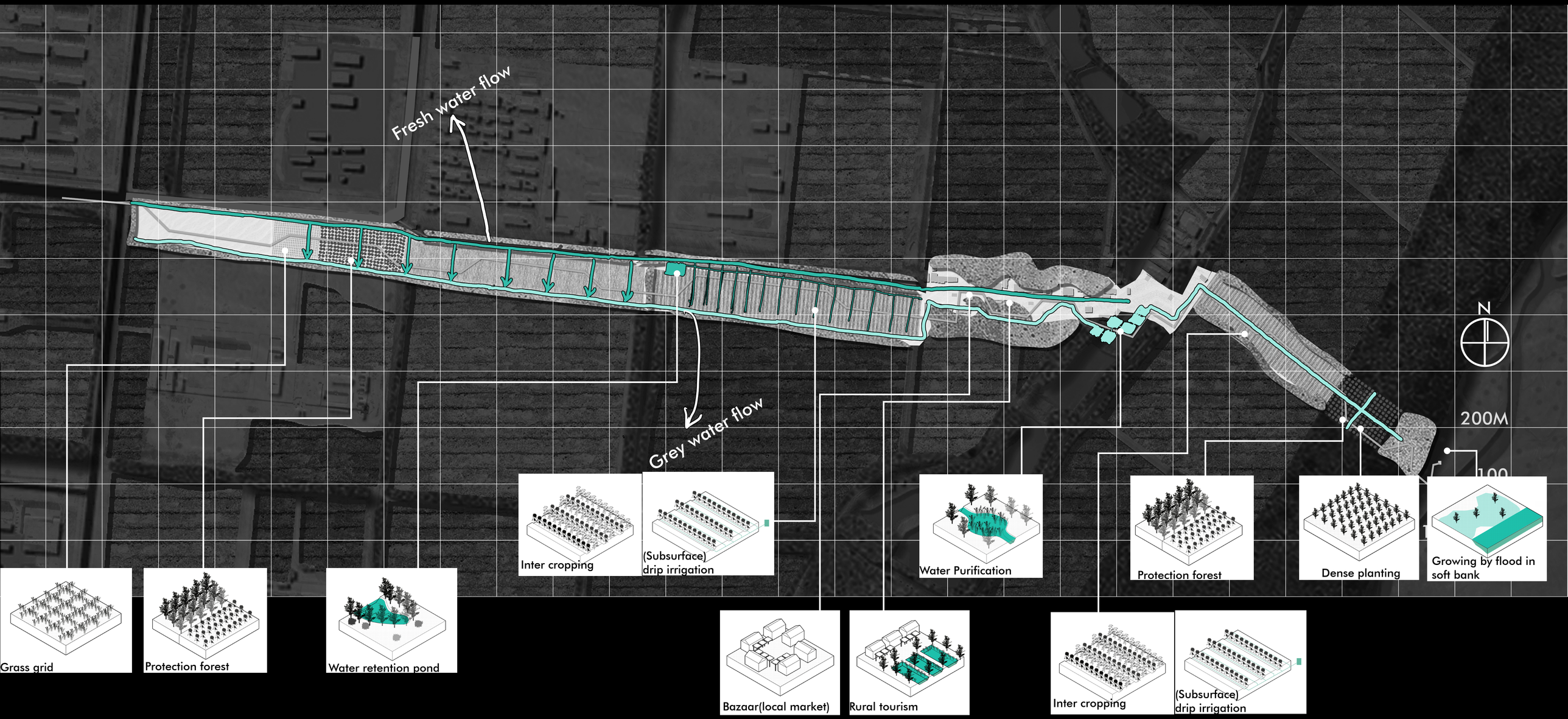
Urban fringe design------Urban-farmland-river path

Starting Path- Design



Urban fringe design------Urban-farmland-river path

system

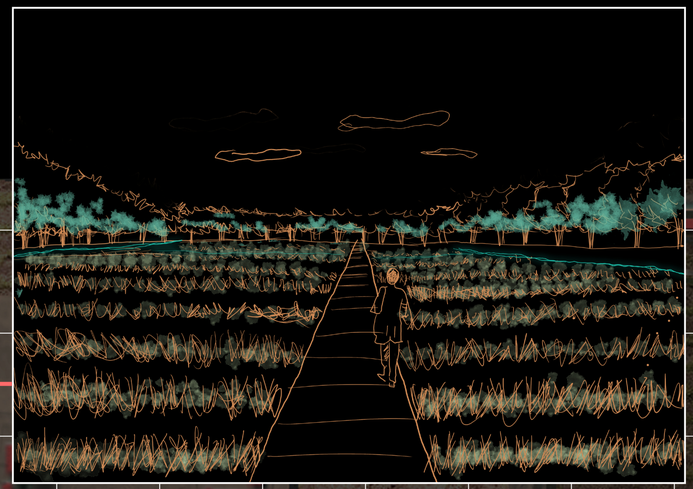


Urban fringe design------Urban-farmland-river path

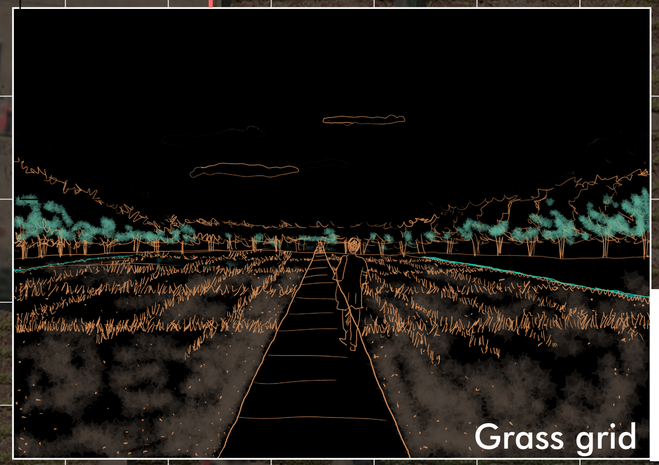
Perspective



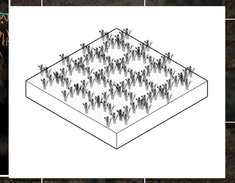
Entrance

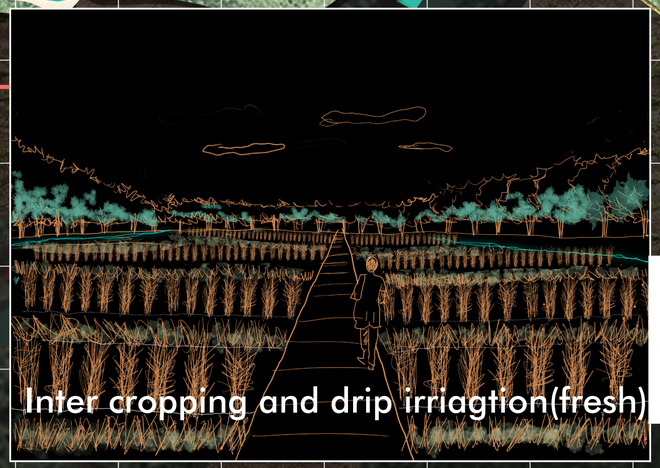


Taditional flood farming

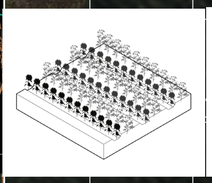


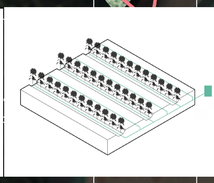
Grass grid





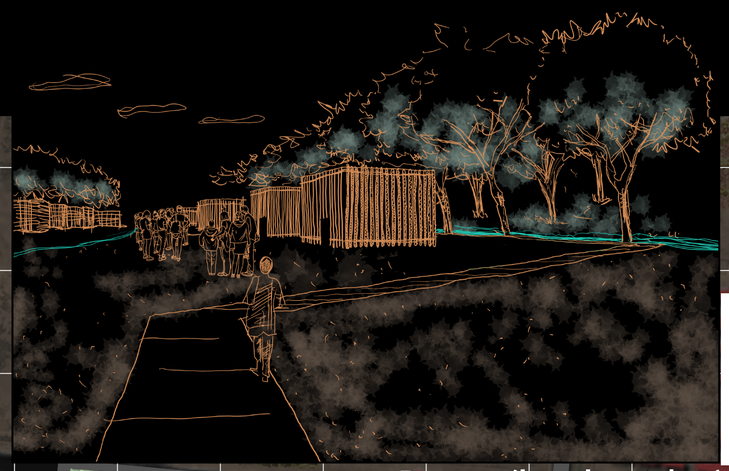
Inter cropping and drip irriagtion(fresh)

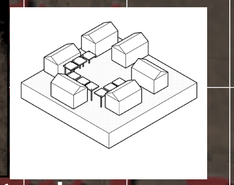


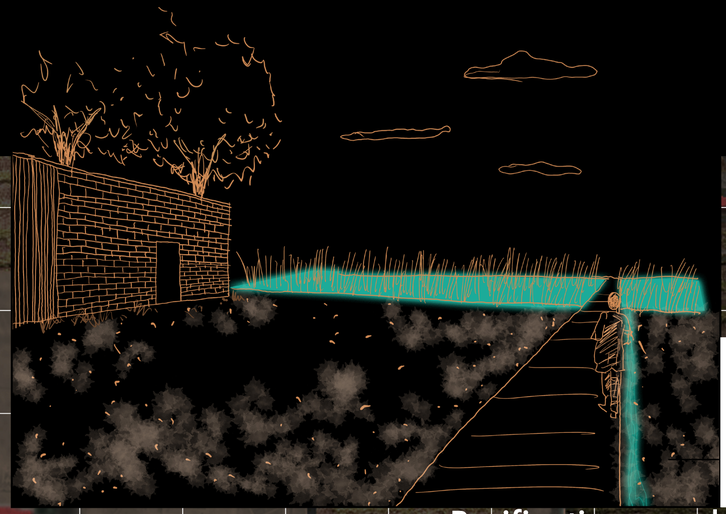


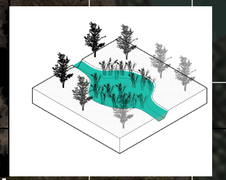
Urban fringe design------Urban-farmland-river path

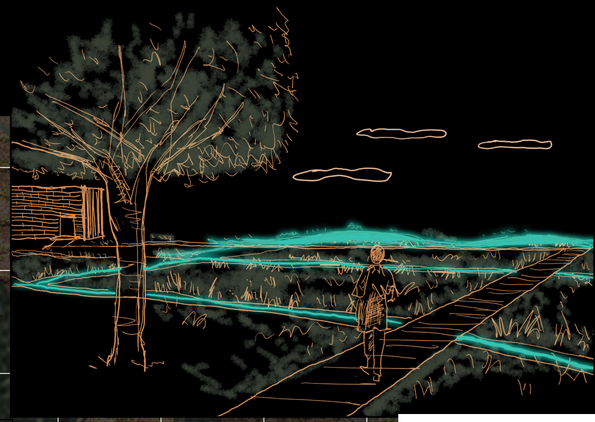
Perspective

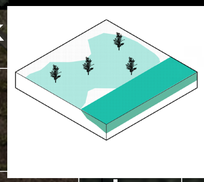








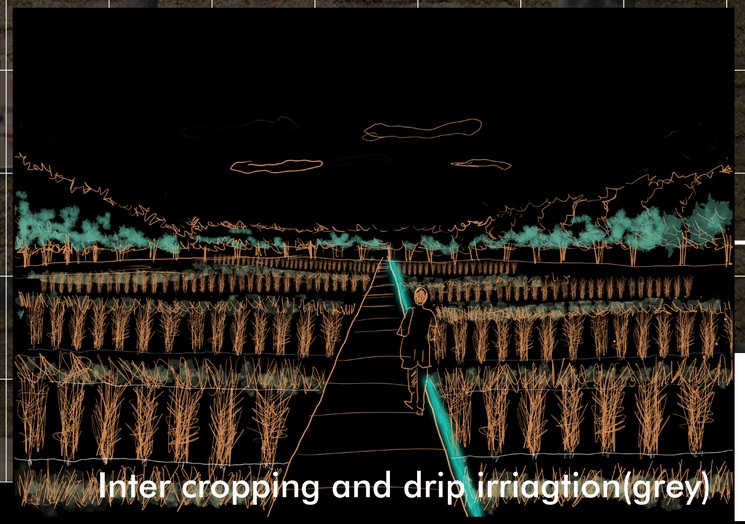




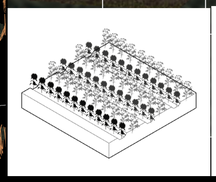
Bazaar(local market)

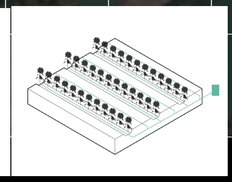
Purification pond

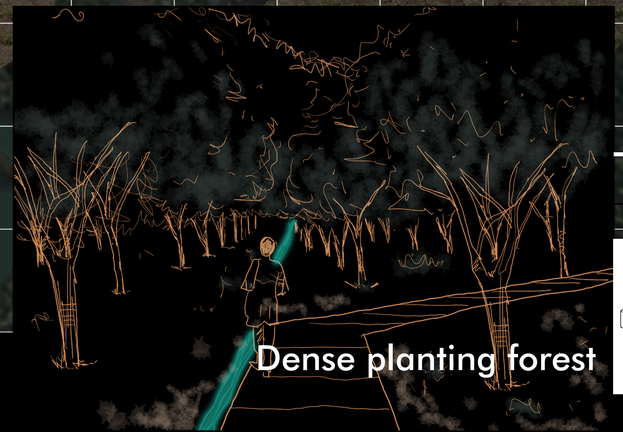
Soft river bank



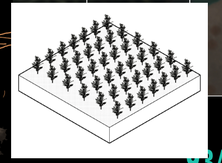
Inter cropping and drip irriagtion(grey)







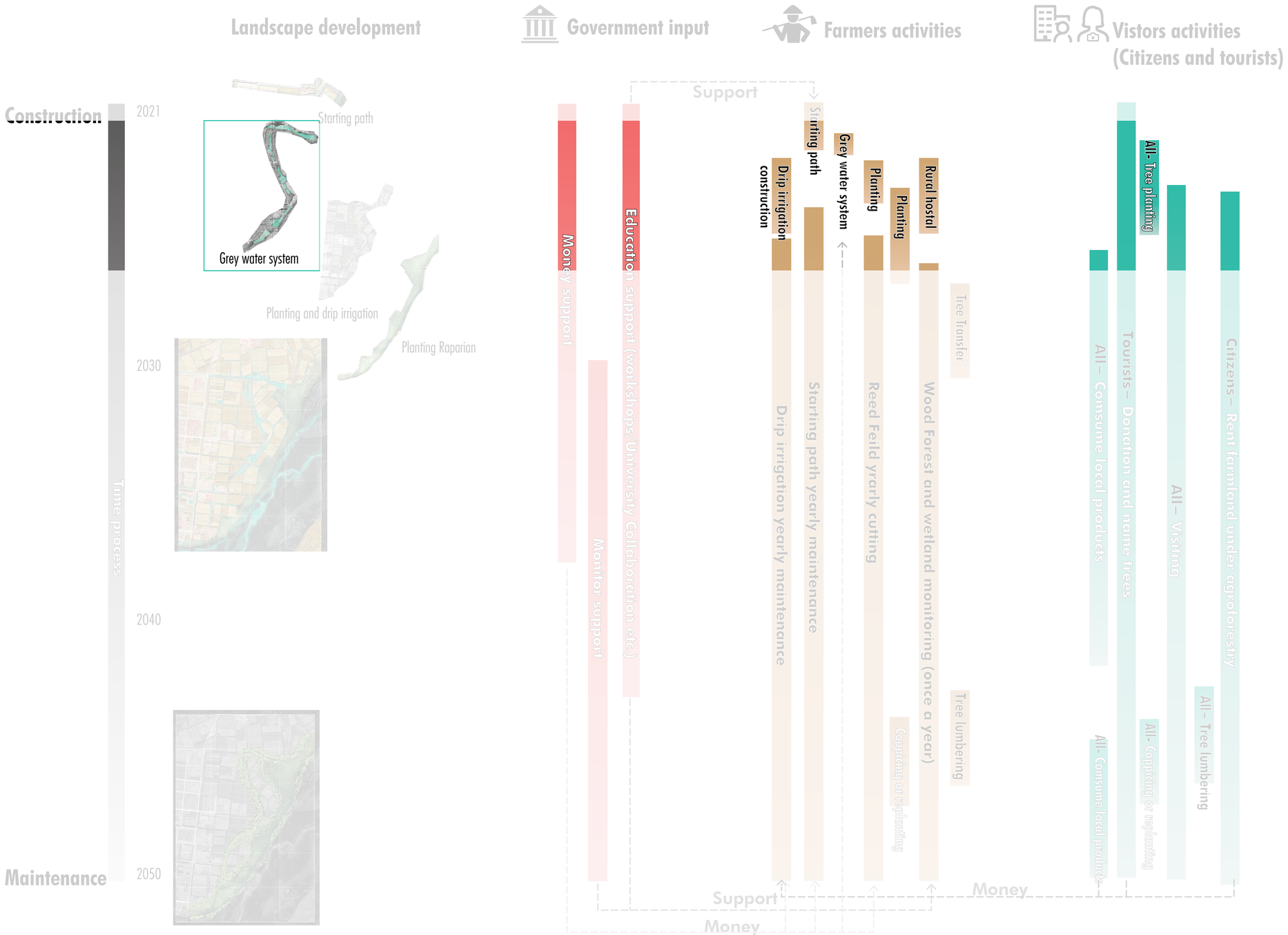
Dense planting forest



200M 100

Urban fringe design

Zone in - Grey water system



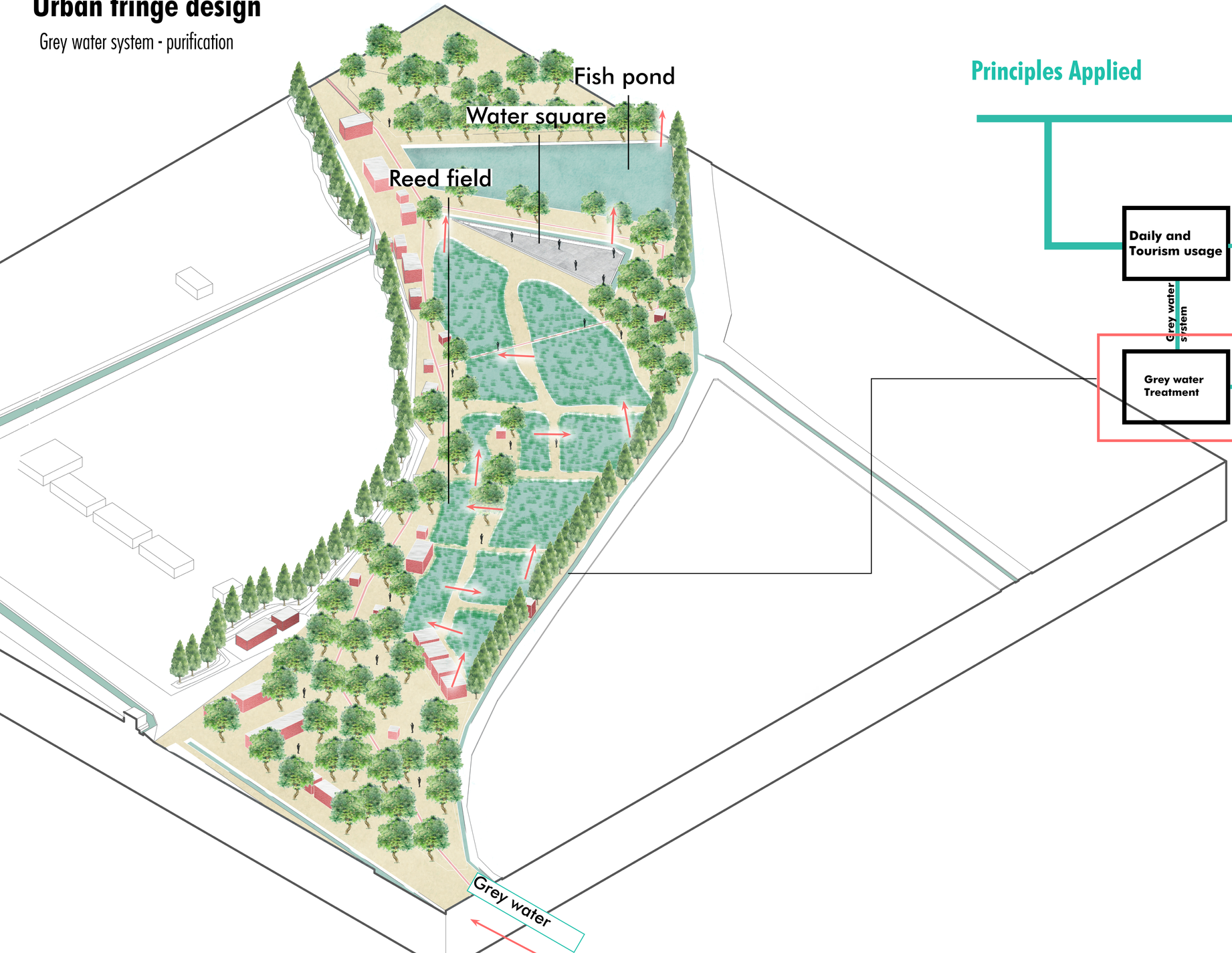
Urban fringe design

Grey water system- purification

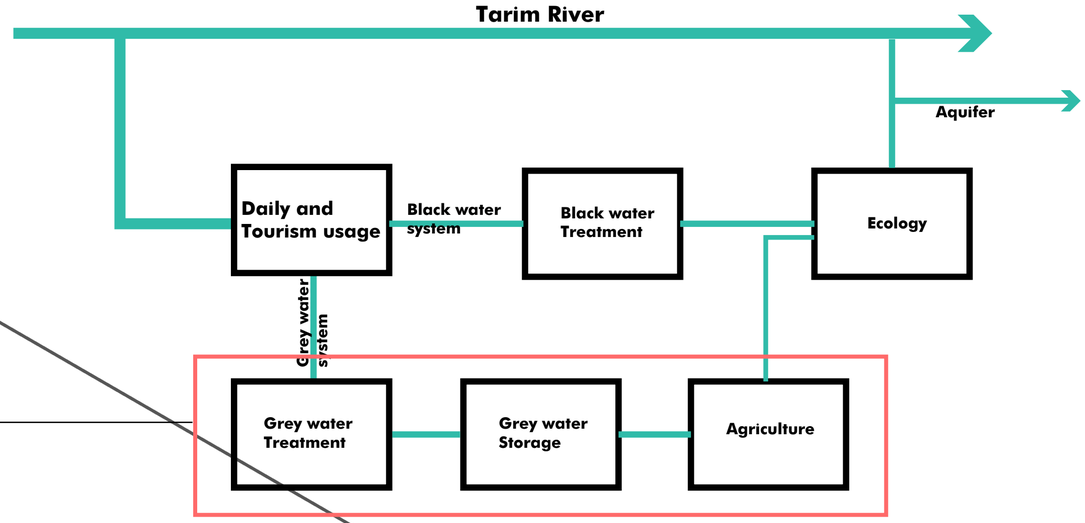


Urban fringe design

Grey water system - purification



Principles Applied

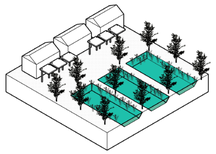


Urban fringe design

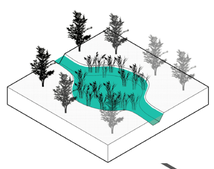
Grey water system - purification



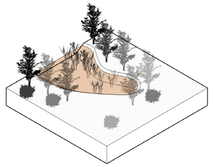
Principles Applied



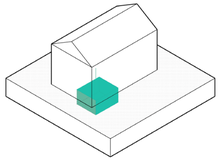
Rural tourism



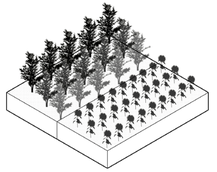
Water Purification



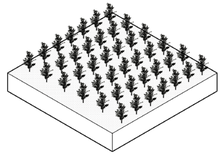
Waster water pond



Grey water collector



Protection forest



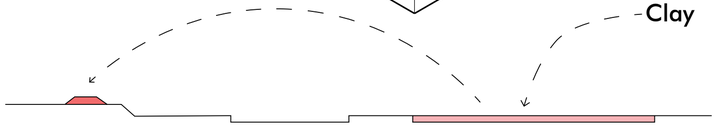
Dense planting

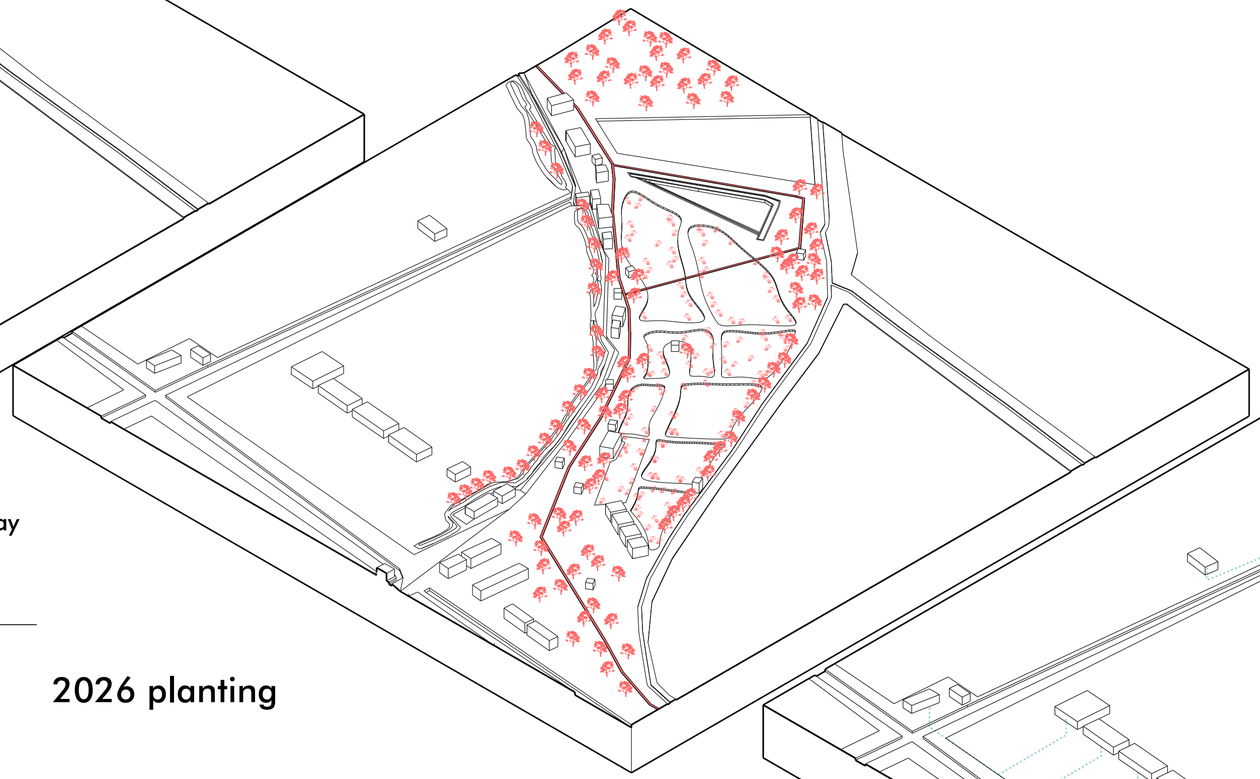
Urban fringe design------whole startup zone

Grey water system - construction process

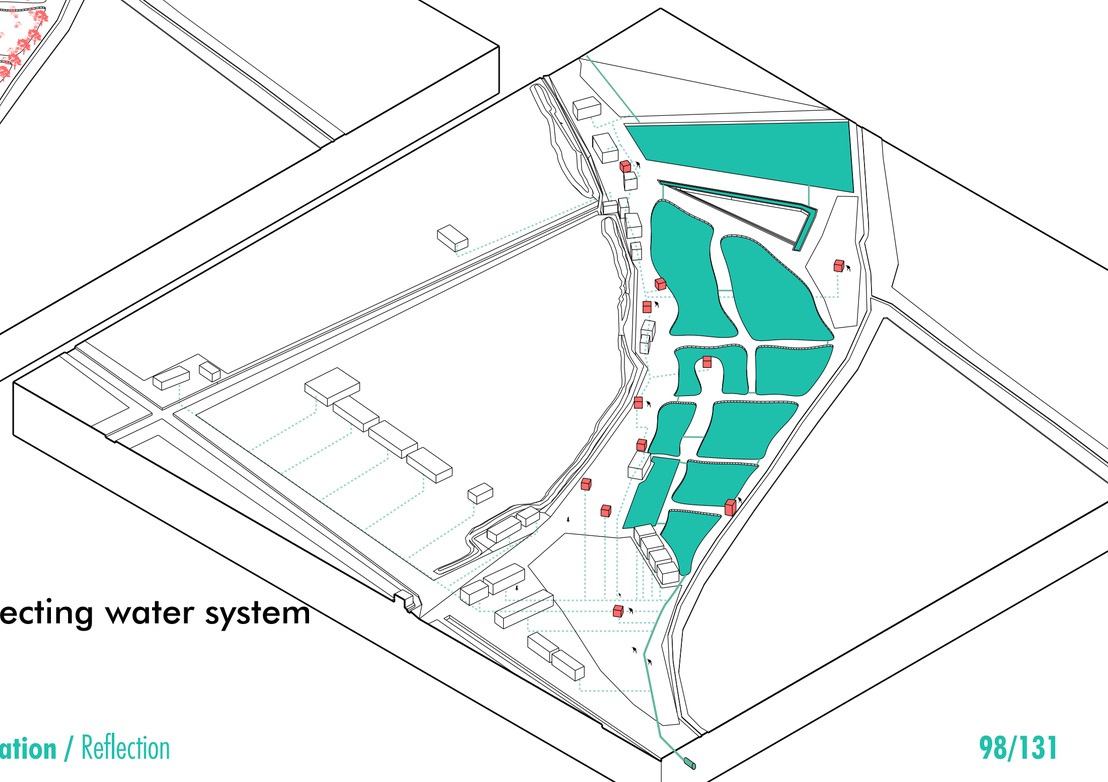


2023 Earth work





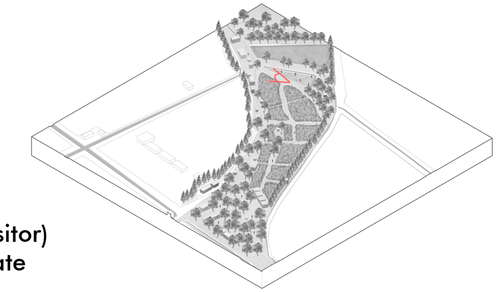
2026 planting

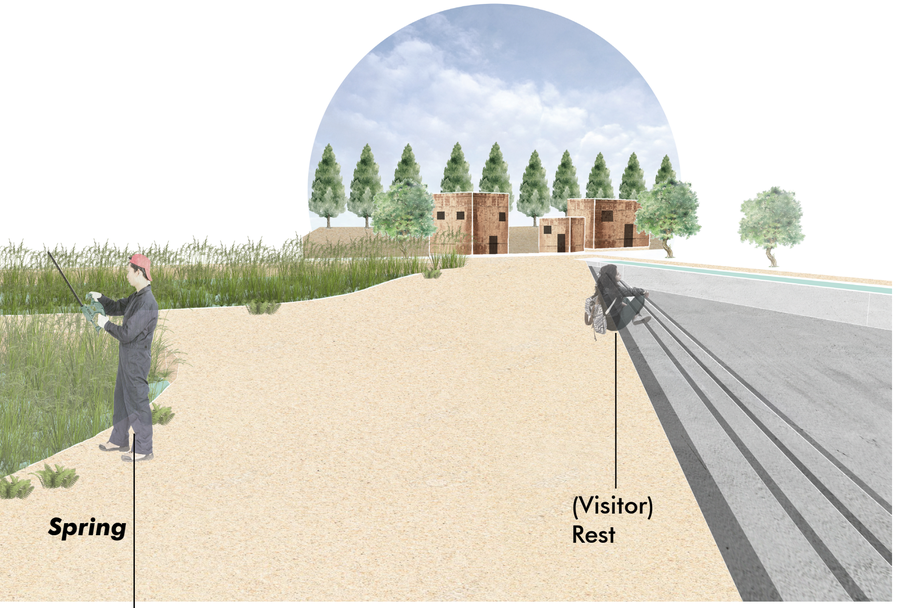


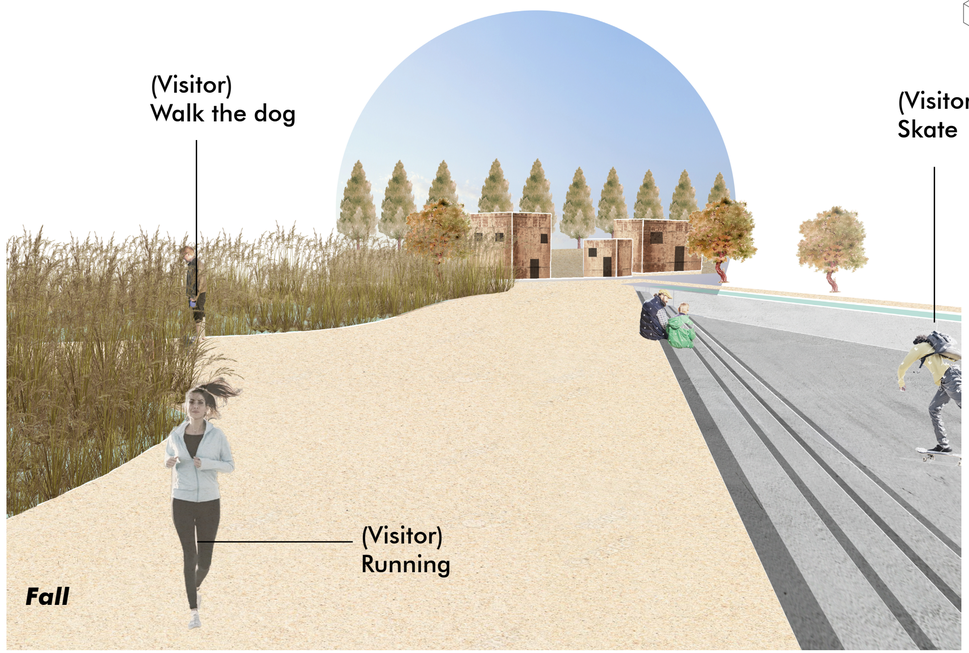
2030 Connecting water system

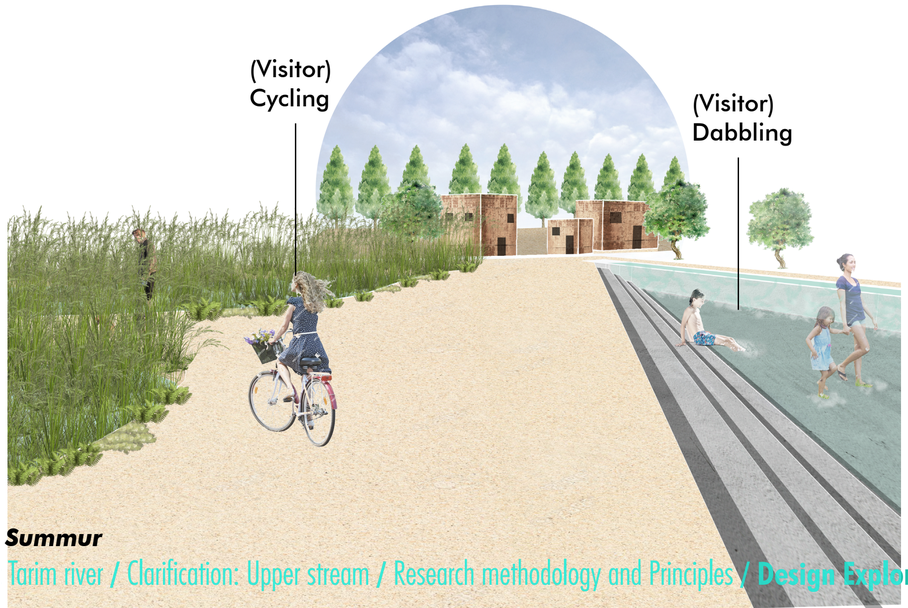
Urban fringe design------whole startup zone

Grey water system - Perspective after construction





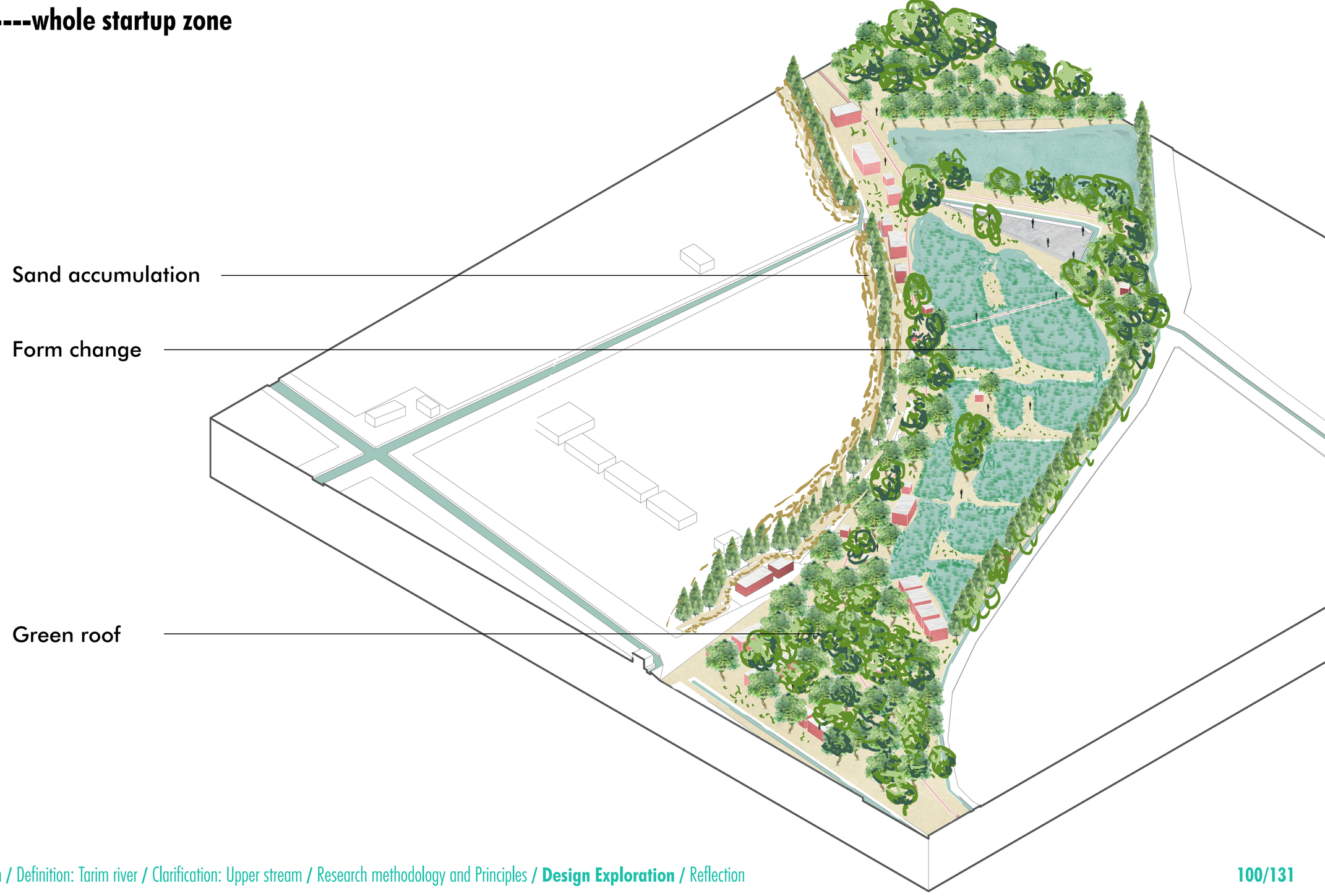






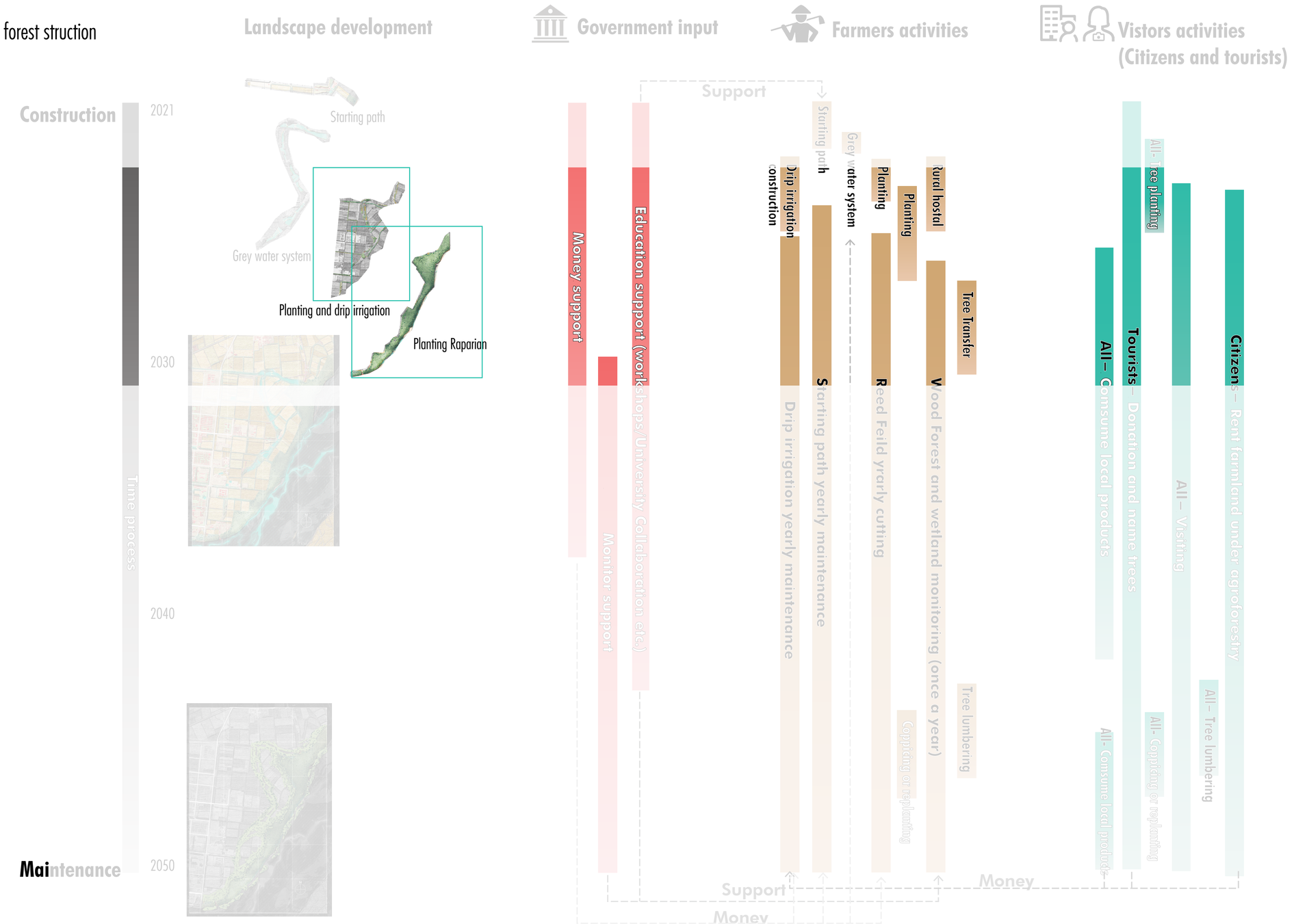
Urban fringe design------whole startup zone

Grey water system - Possible future



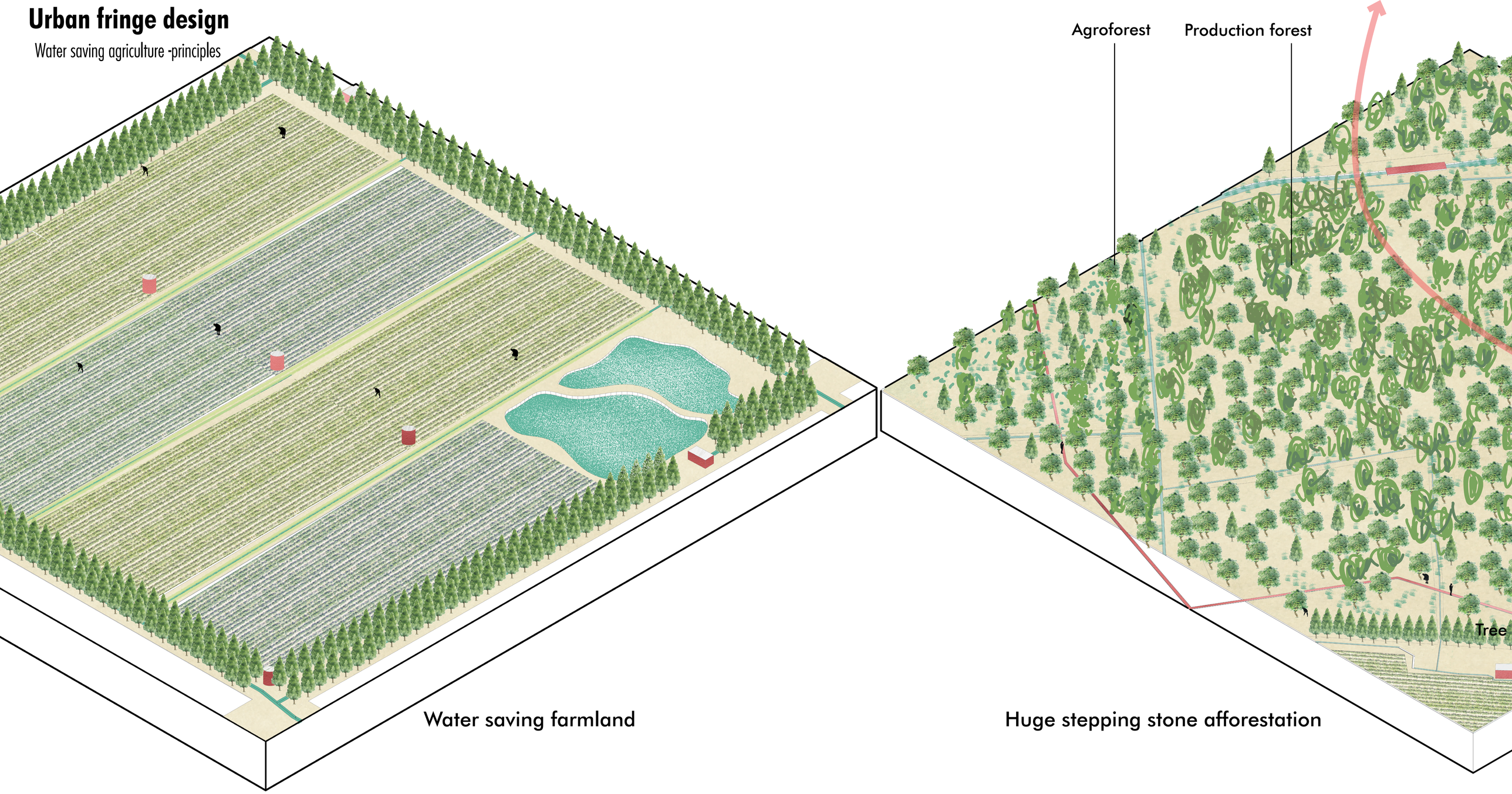
Urban fringe design

Zoom in - Water saving agriculture and forest struction



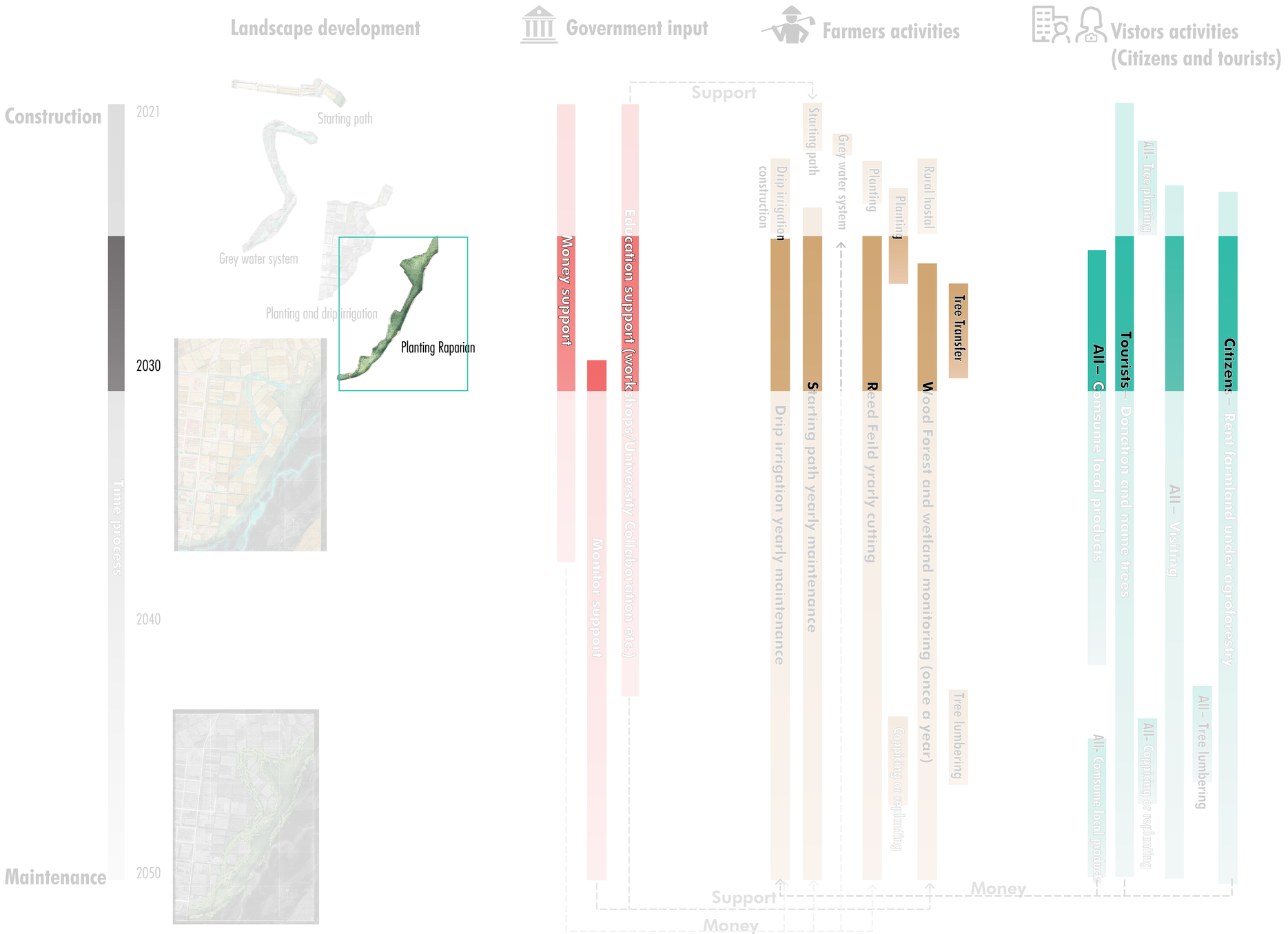
Urban fringe design

Water saving agriculture -principles



Urban fringe design

Zoom in - detailed design forest planting



Urban fringe design

Zoom in - detailed design forest planting



Planted Forest in human's views



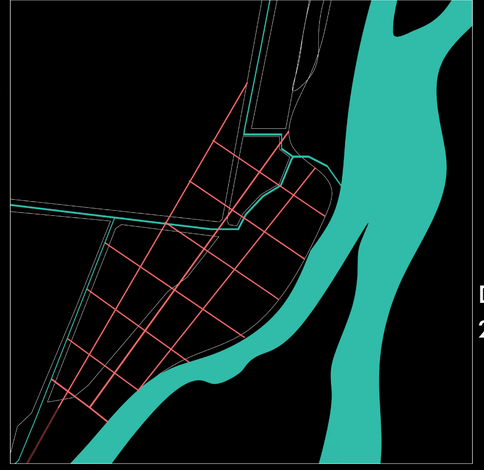
Forest in animals' views

Detailed design- River landscape

Current situation



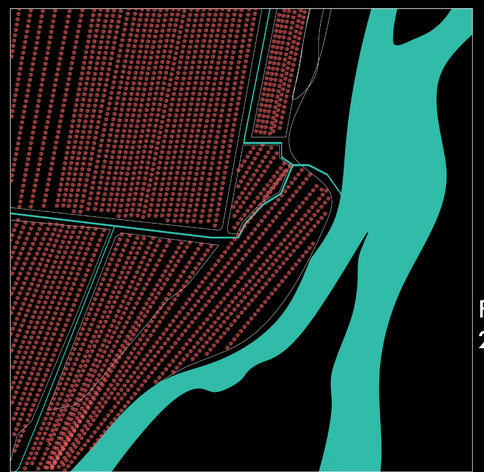
Future intervention



Digging for soft river bank
2027



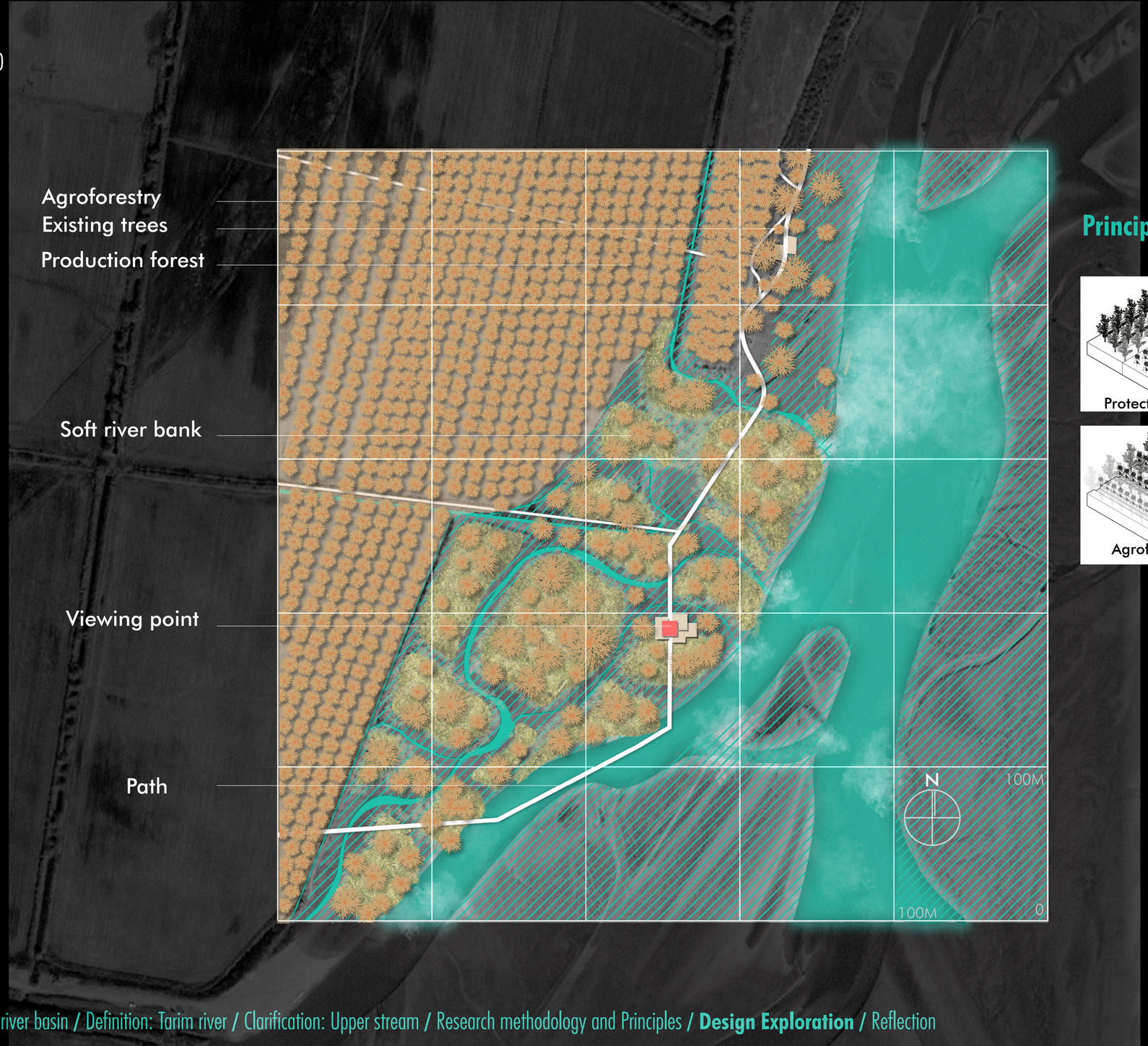
Path construction
2027



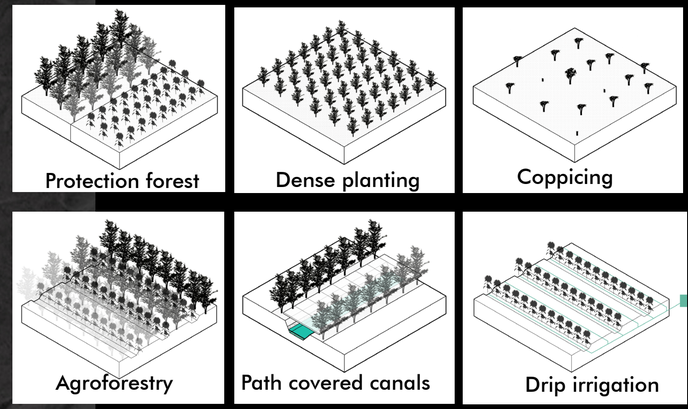
Planting
2028

Detailed design

Possible future plan after 2050

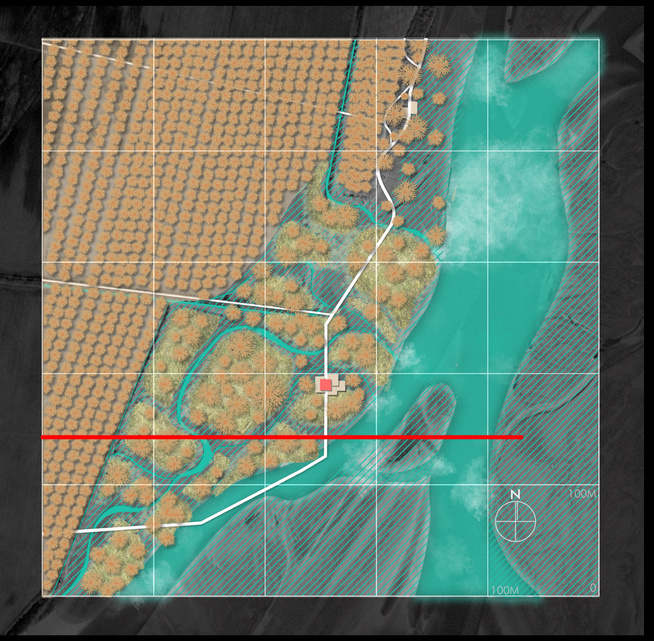


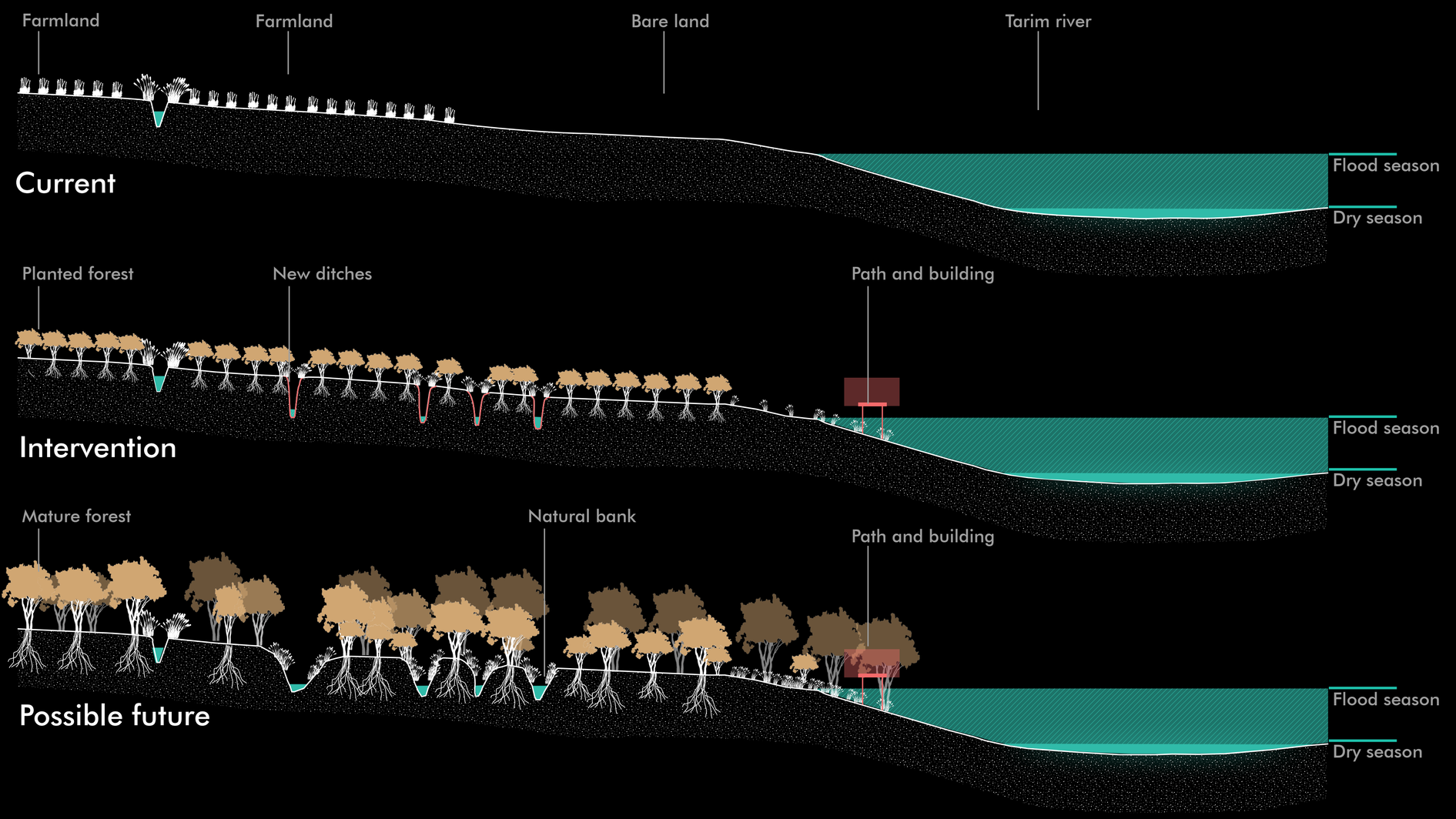
Principles Applied



Detailed design

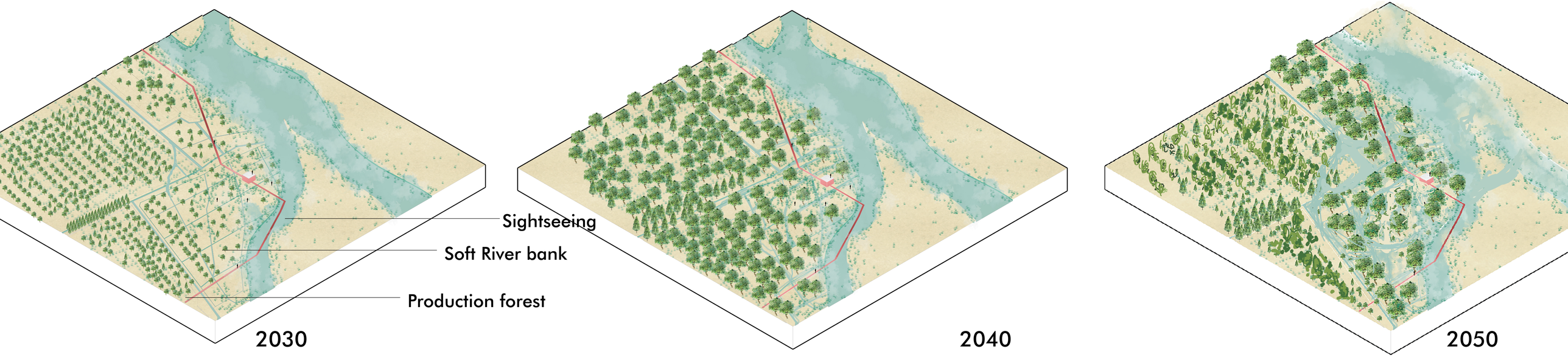
Transcription





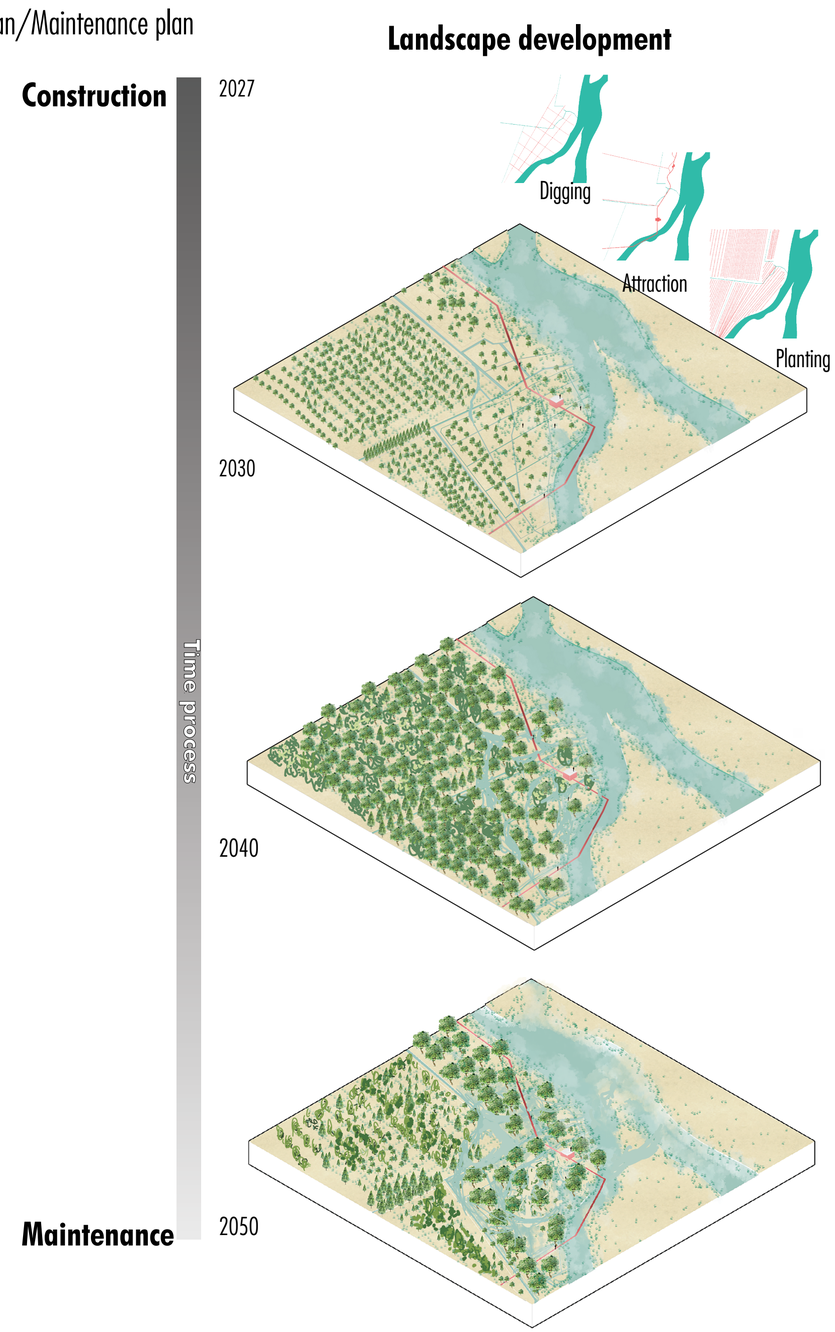
Detailed design

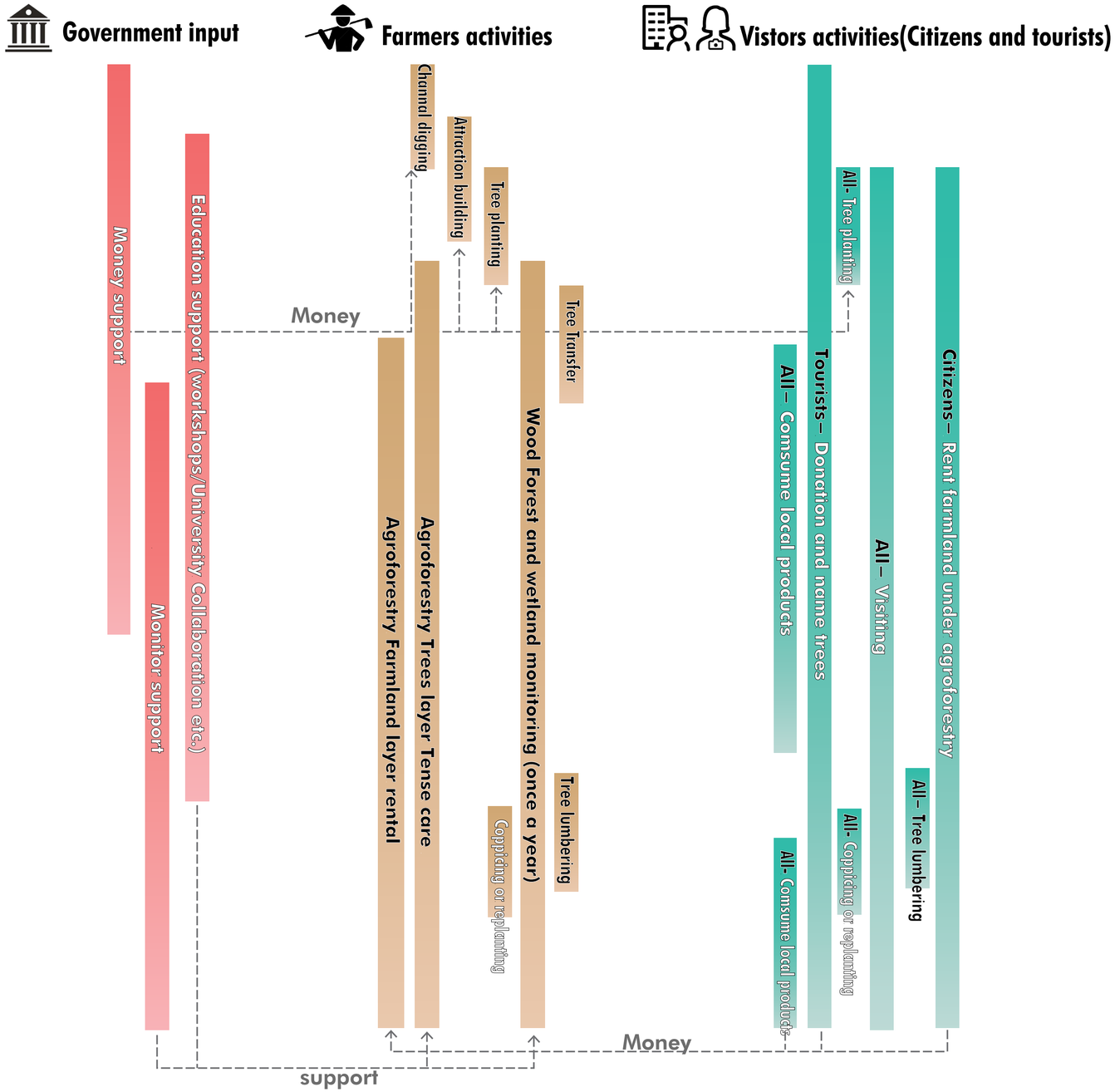
Transformation



Detailed design

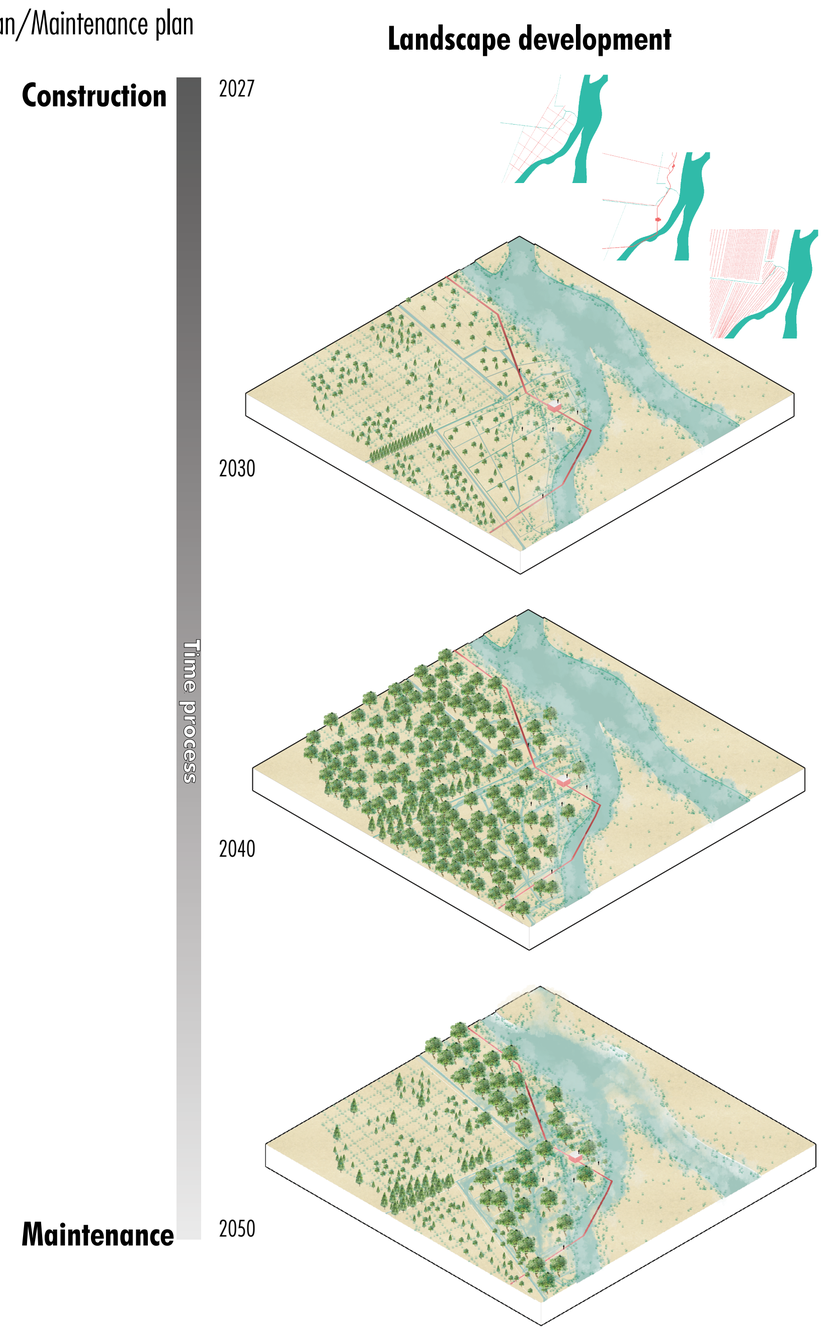
Transformation plan/Maintenance plan

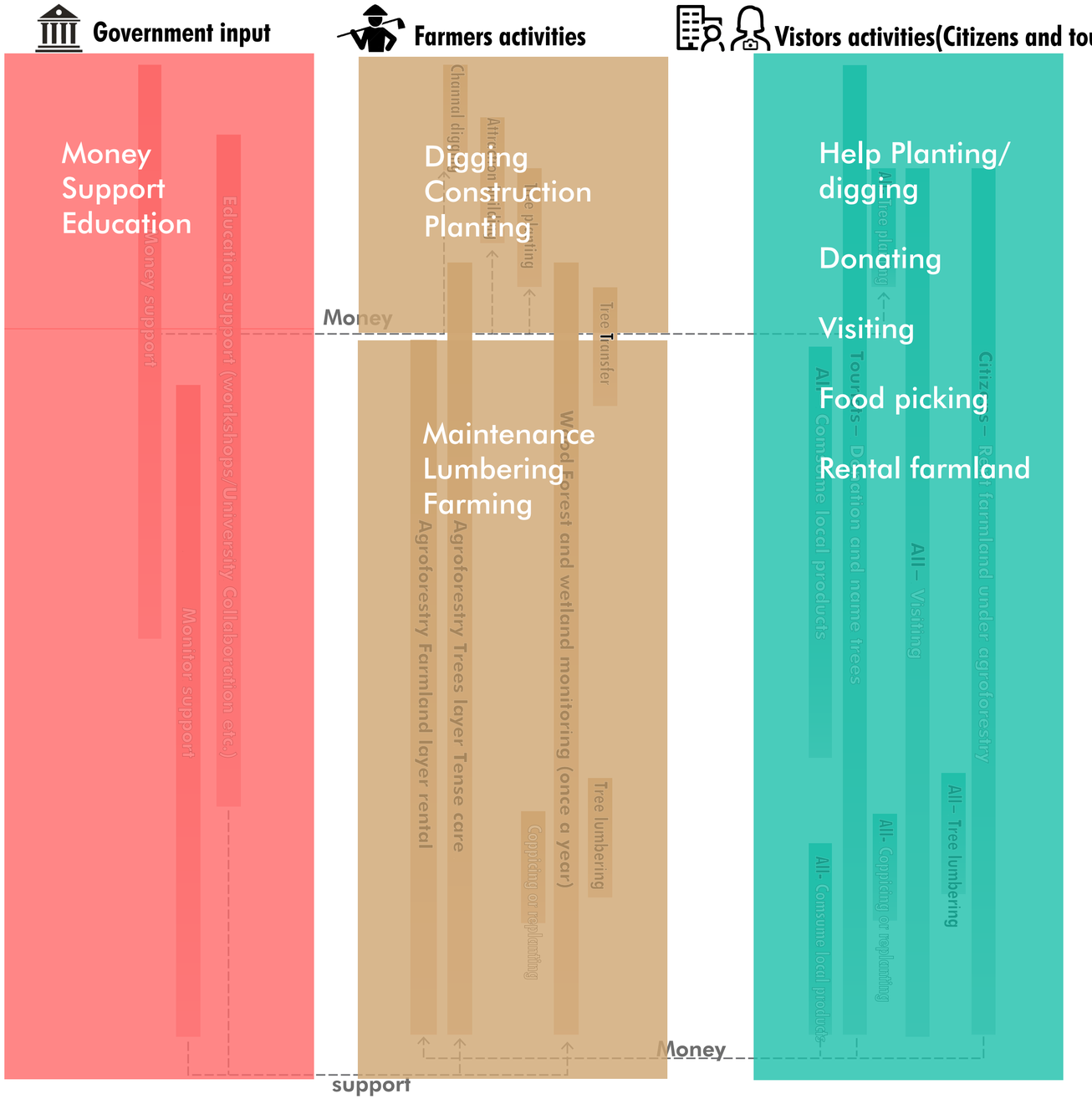




Detailed design

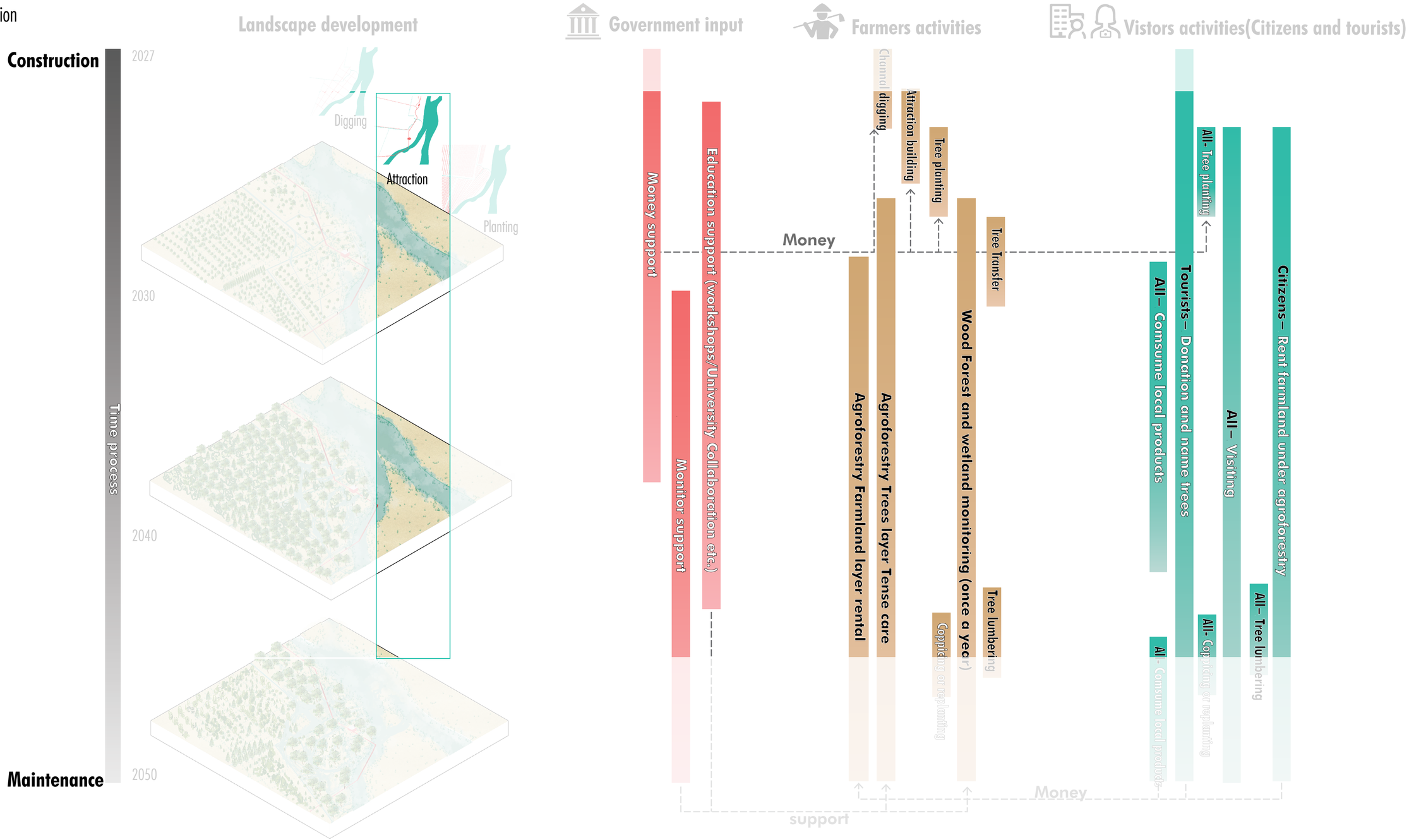
Transformation plan/Maintenance plan





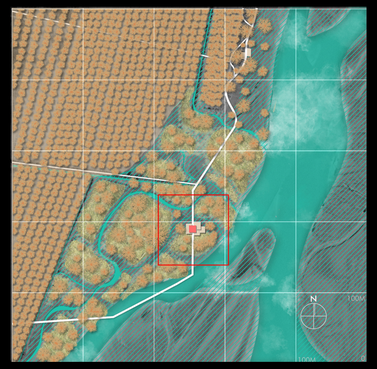
Detailed design

Zoomed in - Attraction

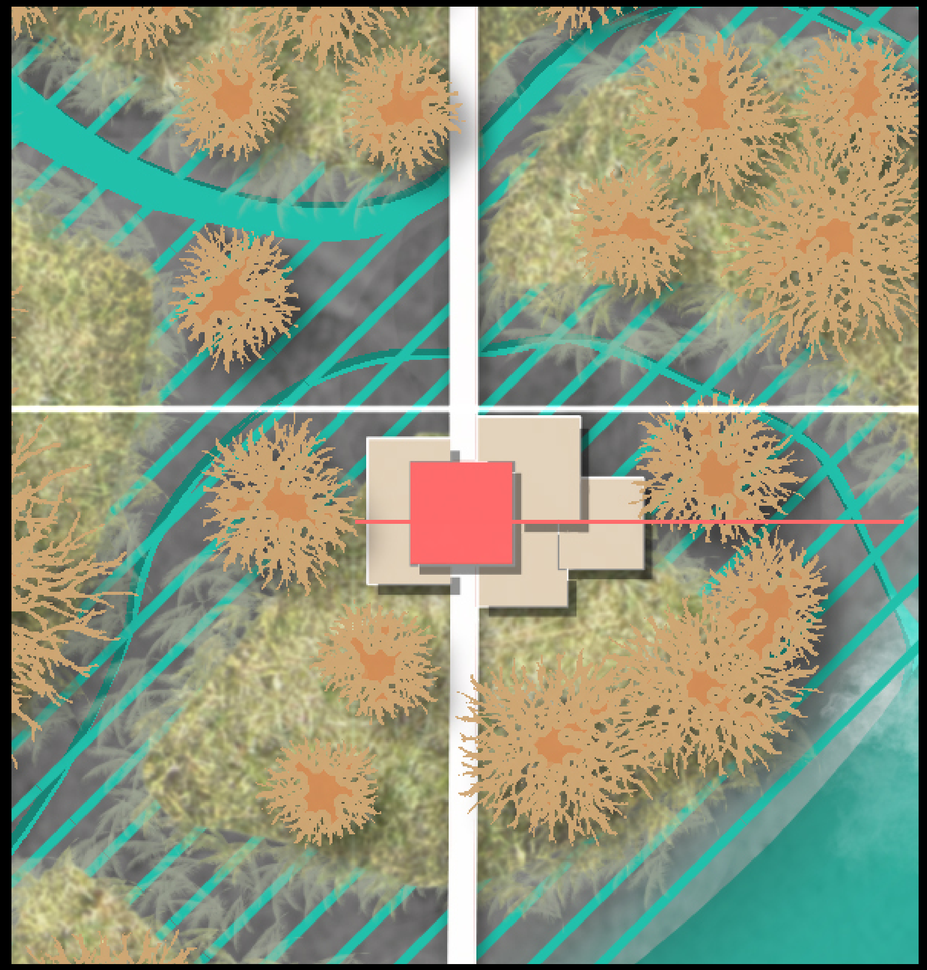


Detailed design

Zoomed in - Attraction in 2050



Zoomed in plan



Section



Detailed design

Zoom in - River landscape atmosphere change in 4 seasons after construction and human action

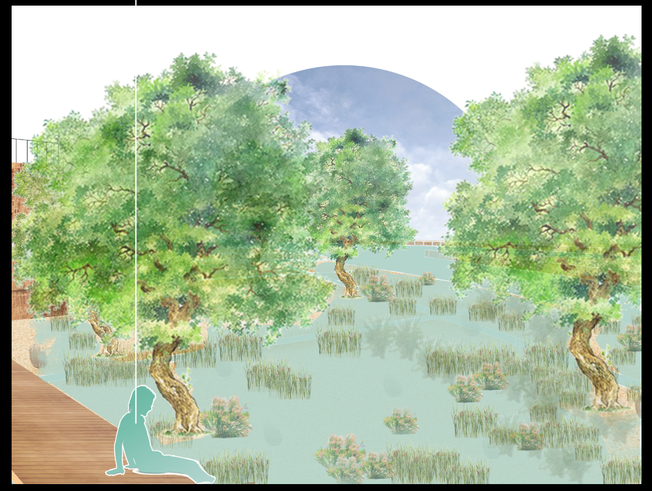
Visitors- Visiting

Farmers- Health check



Spring

Visitors- play water

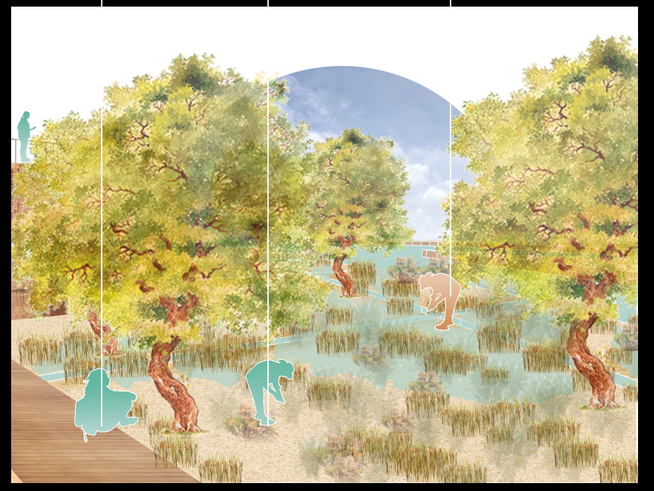


Summer

Visitors- visiting

Visitors- Help trimming

Farmers- Health check



Fall



Winter

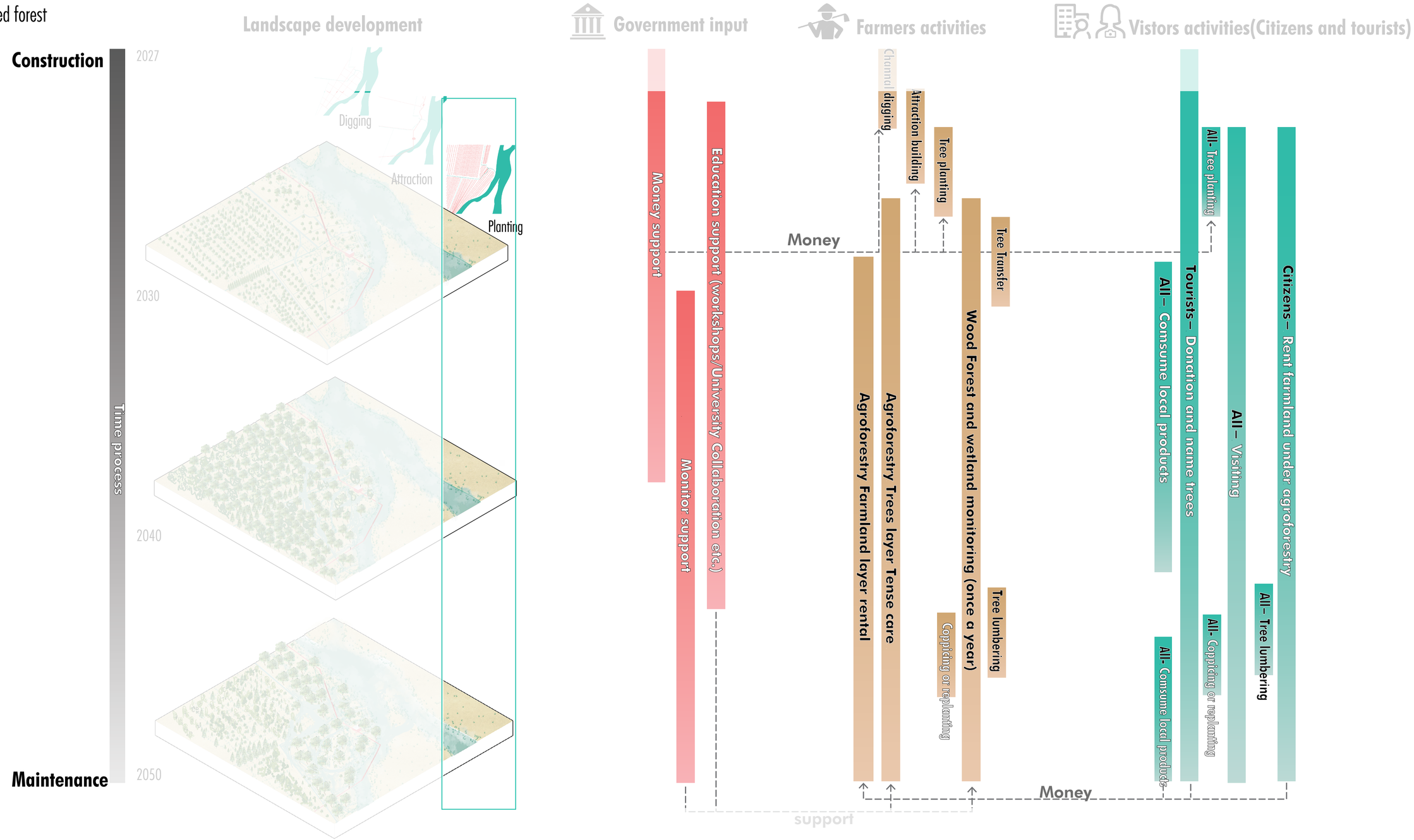
Detailed design

Zoomed in - attraction perspective



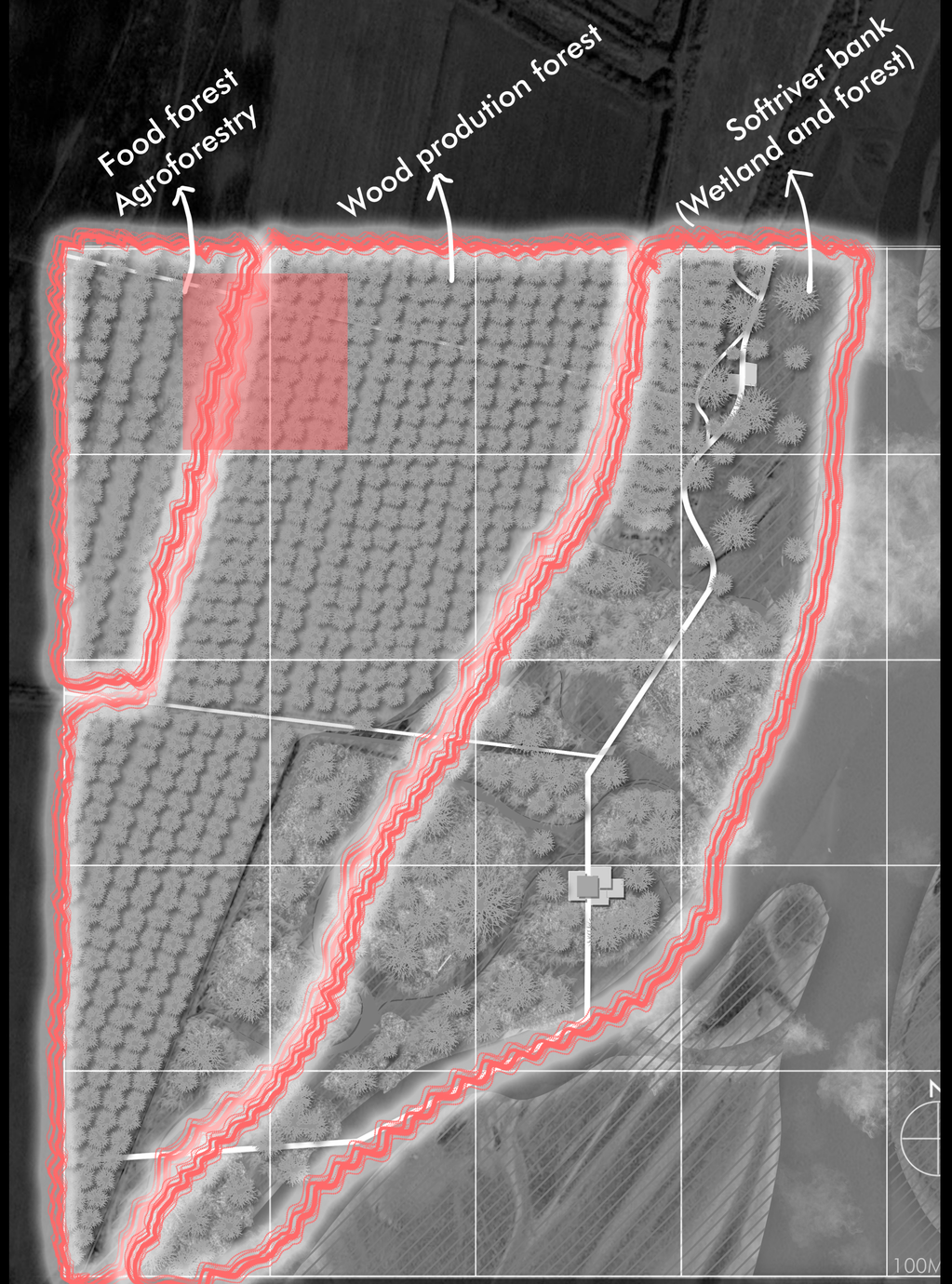
Detailed design

Zoomed in - Planted forest



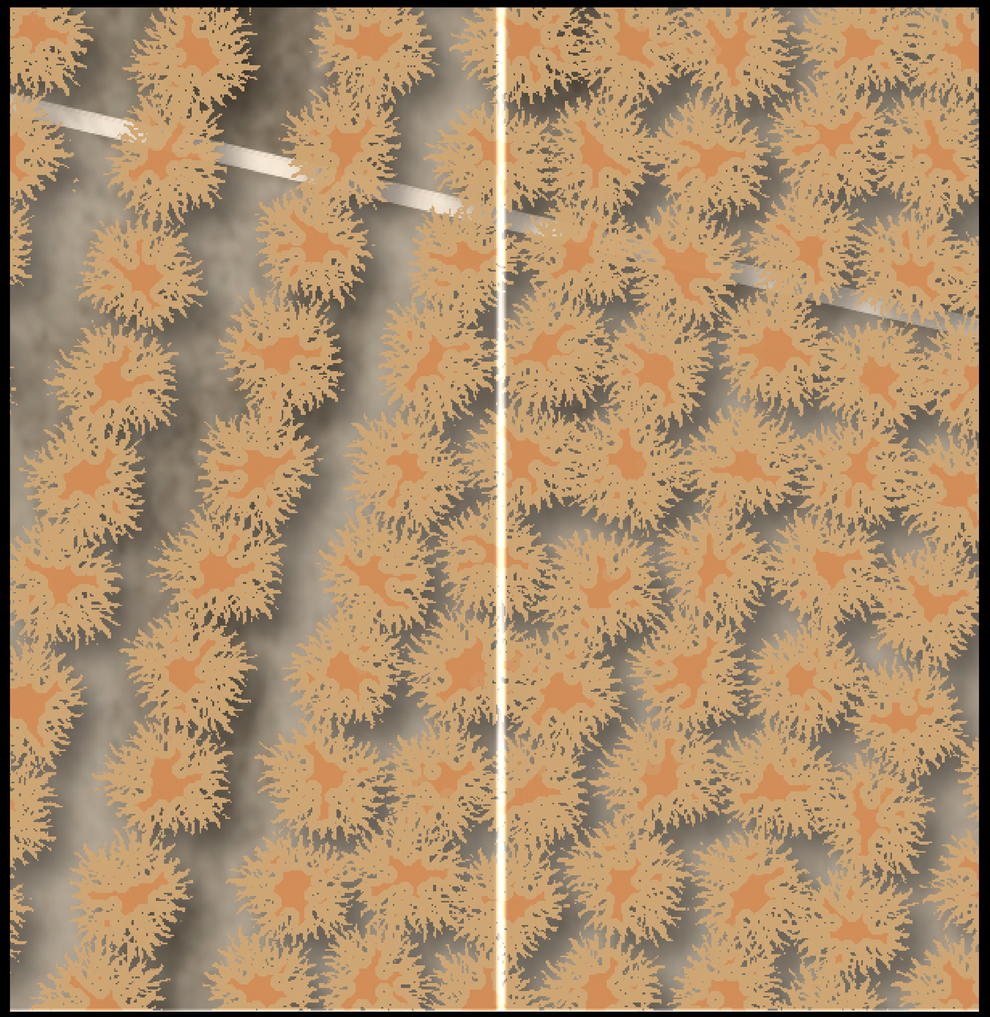
Detailed design

Zoomed in - forest structure



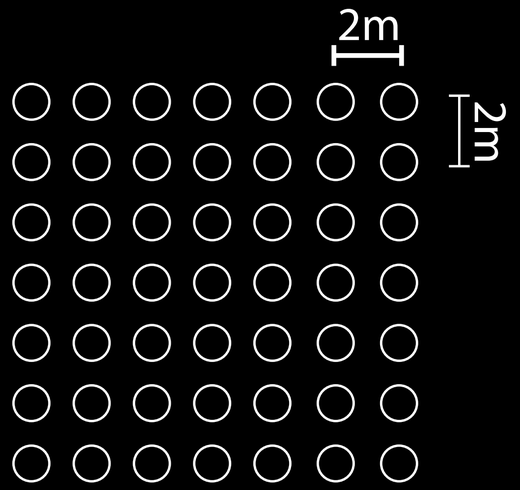
Detailed design

Zoom in - forest plan



Detailed design

Zoom in - planting schema



Production

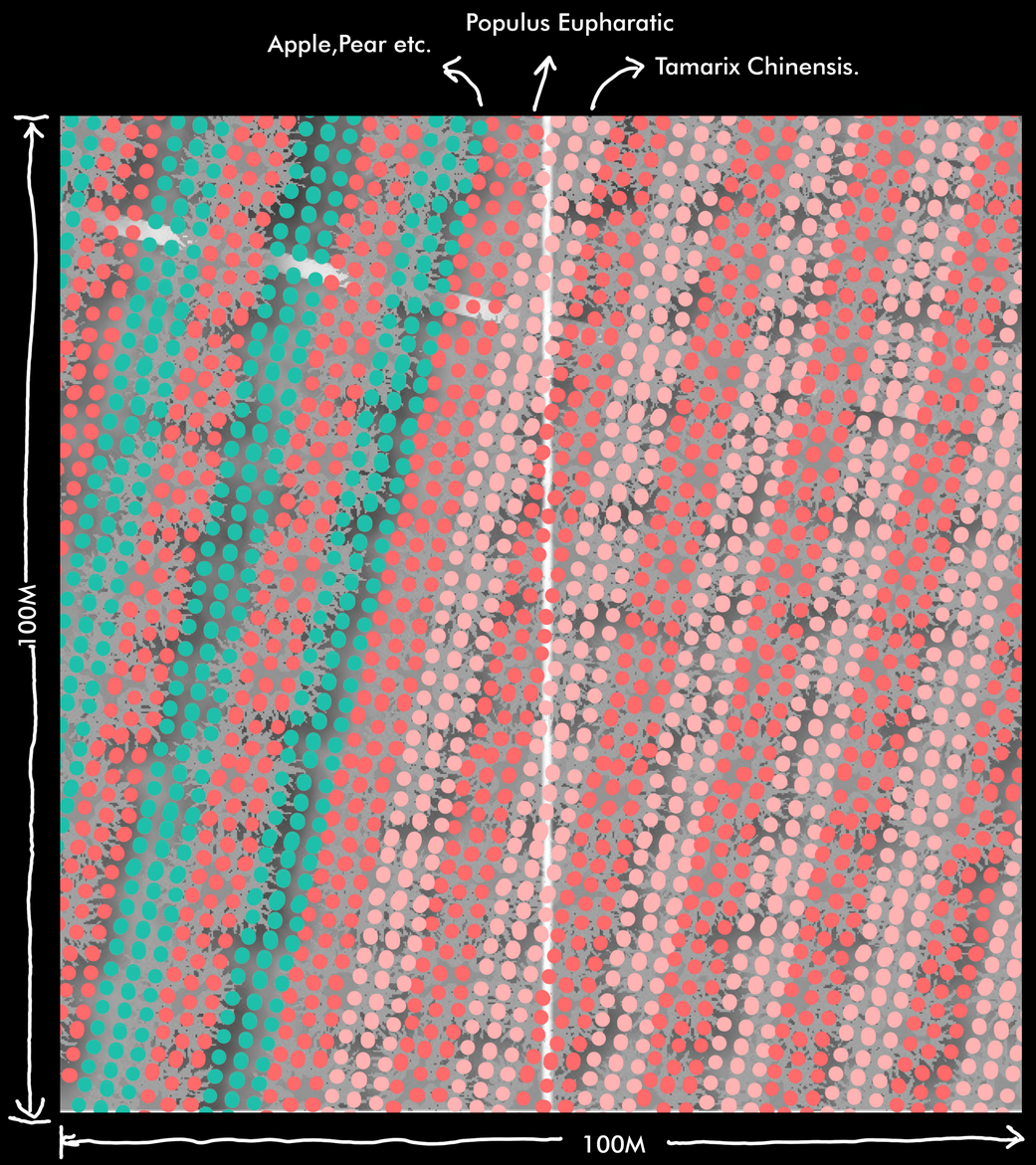
Wood production forest



Timbe for construction and paper making

Agroforestry

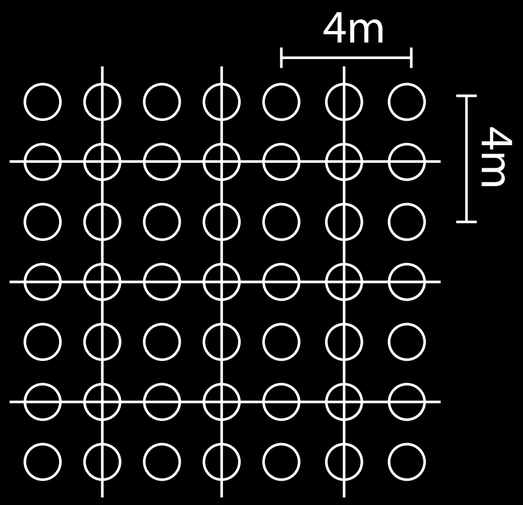


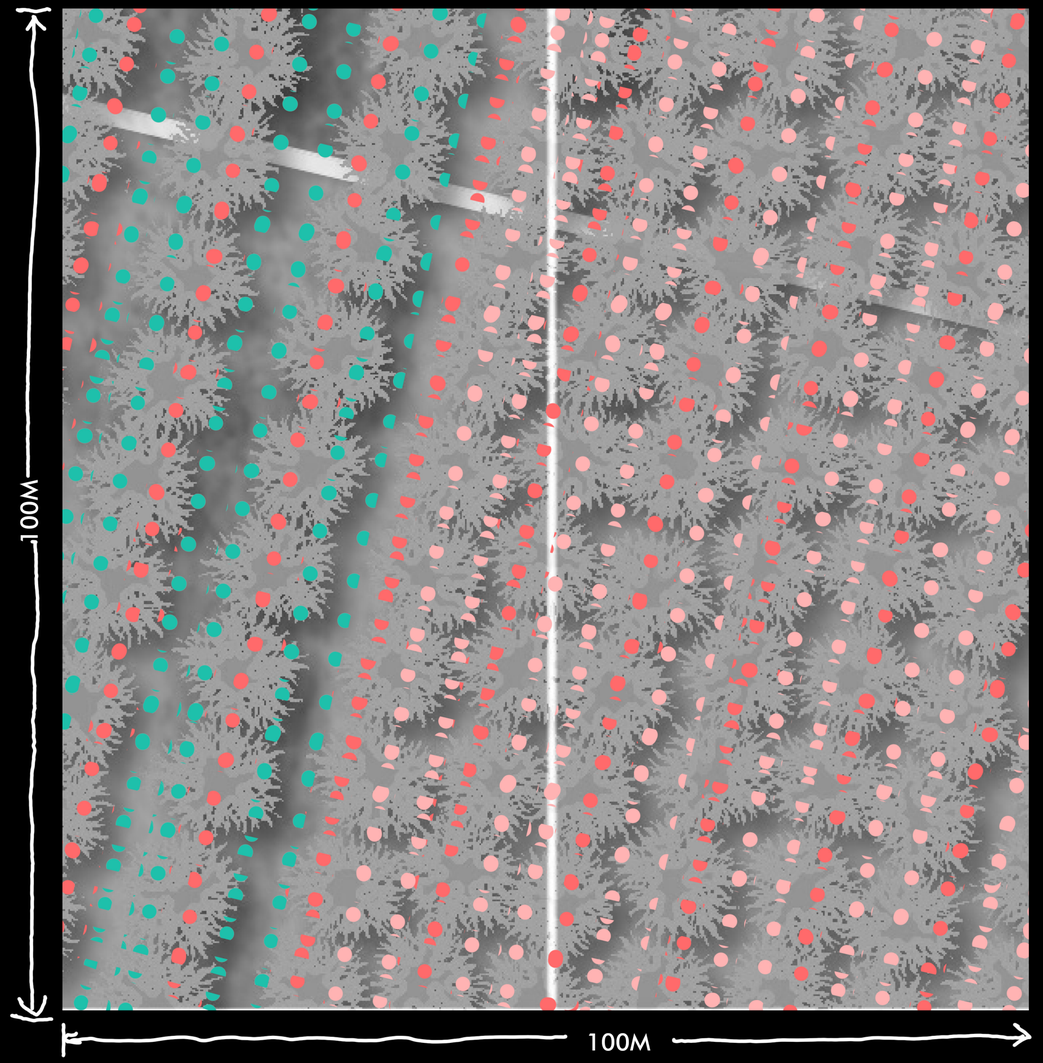


Planting /seeding

Detailed design

Zoom in - planting schema

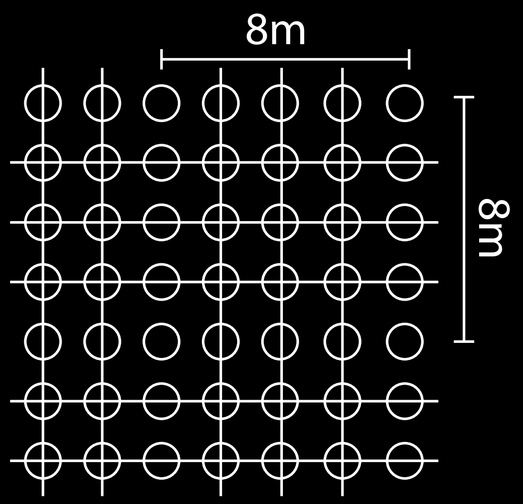


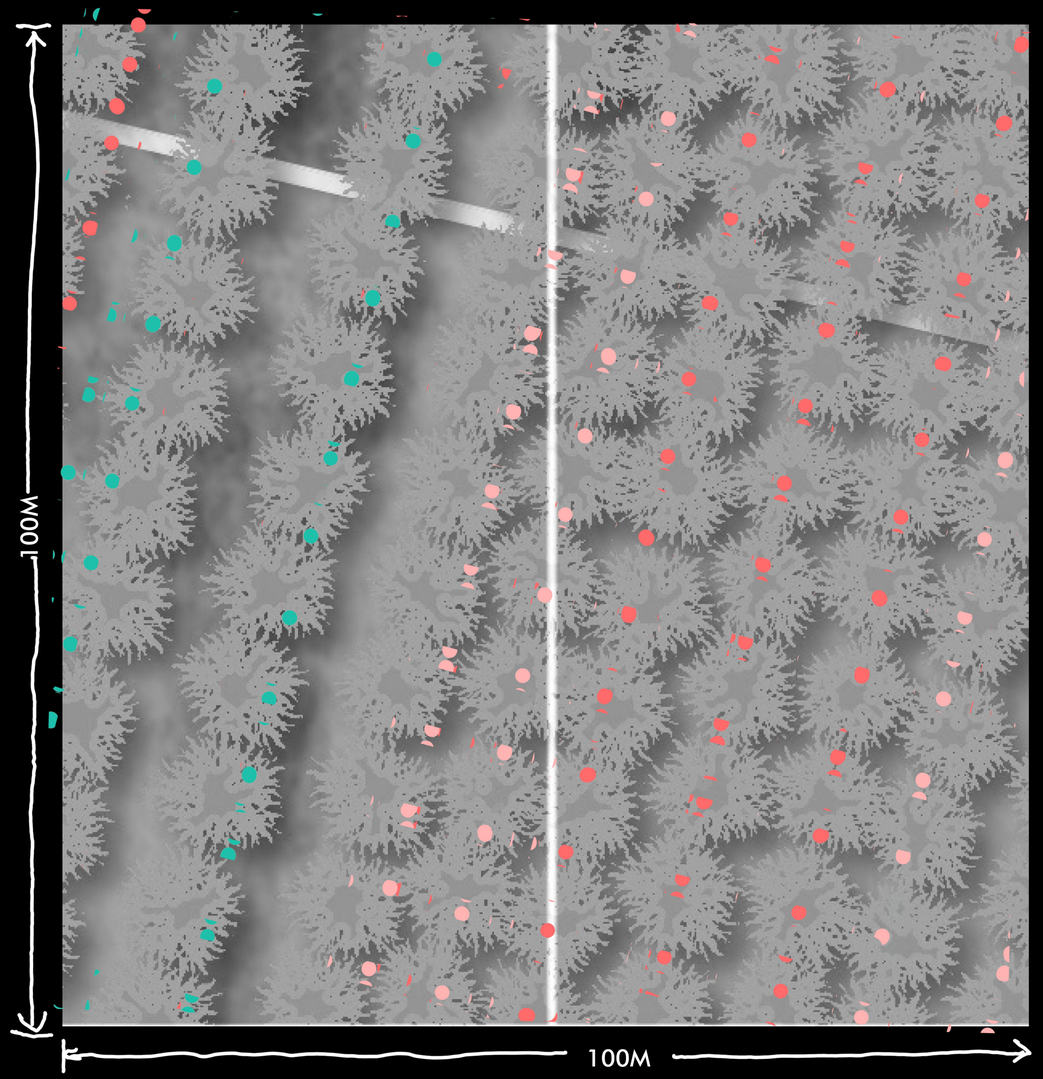


First time cutting/Transporting

Detailed design

Zoom in - planting schema





Second time cutting/ Transporting

Detailed design

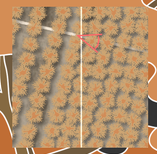
Zoomed in - atmosphere and activities during transformation



Seeding 2028 ***Growing 2030*** ***Mature 2043*** ***Lumbering and coppicing 2045*** ***Mature again after 2050***

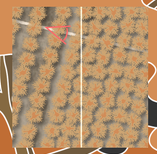
Detailed design

Zoom in - Production forest perspective



Detailed design

Zoom in - Agroforestry perspective



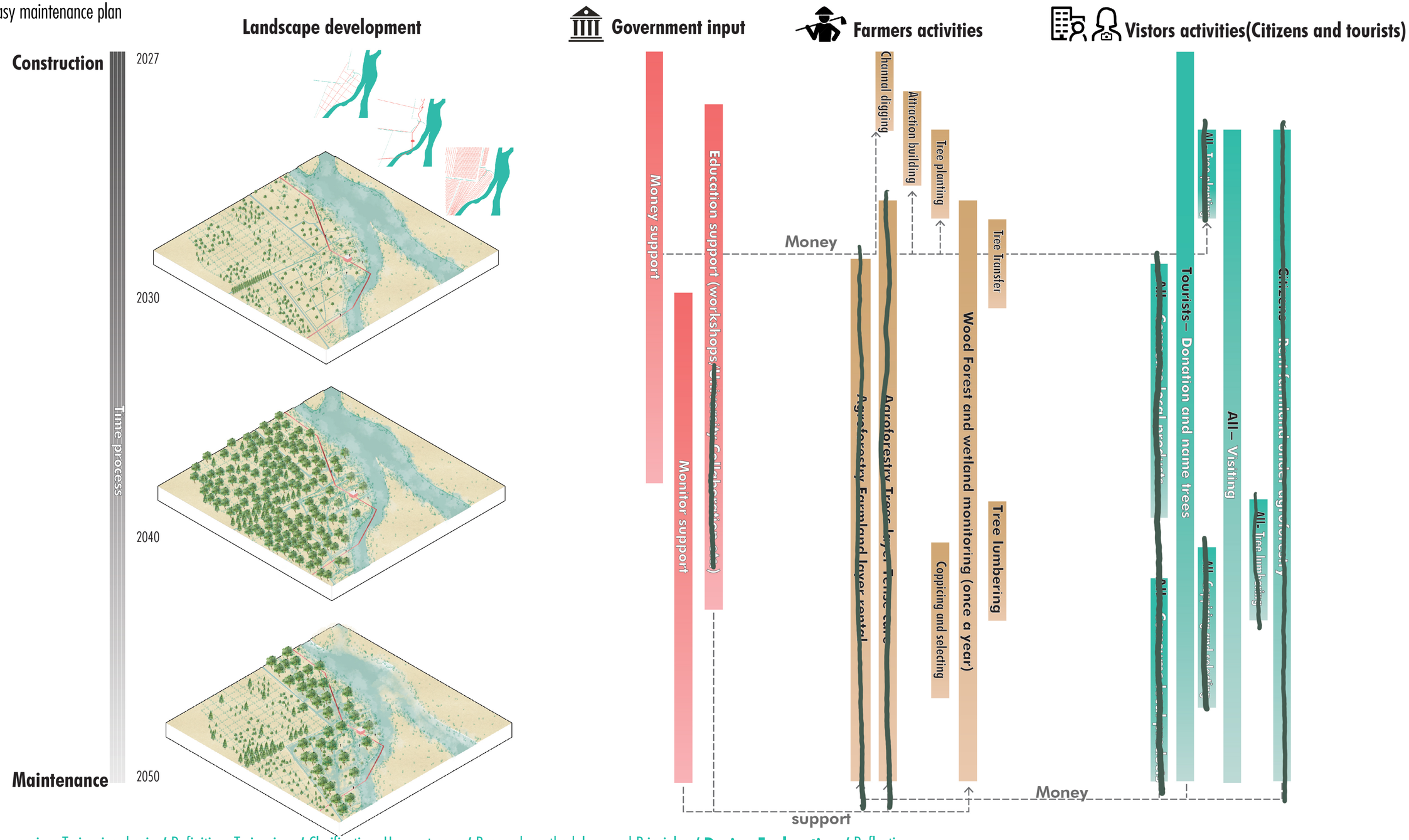
Detailed design

Discussion- less people participants

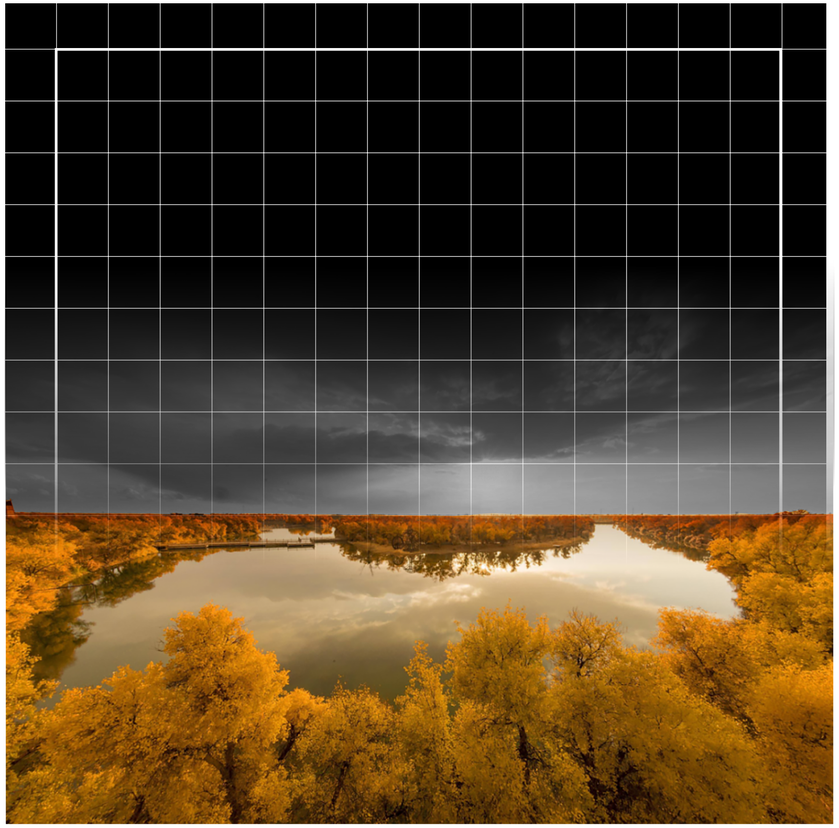


Detailed design

Discussion - Easy maintenance plan

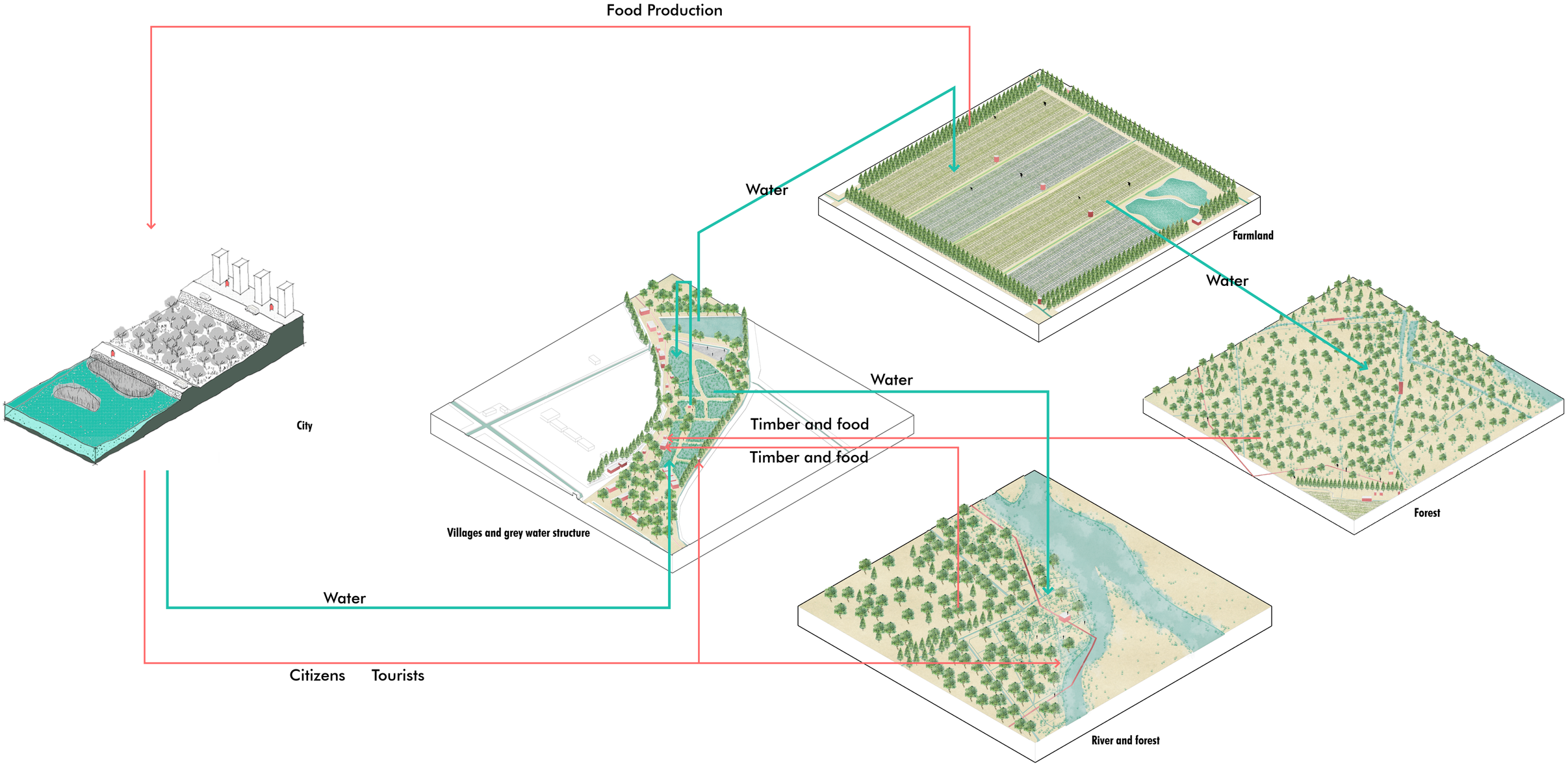


Conclusion and reflection



Conclusion

New circularity



Reflection

How to improve **water infrastructure and water efficient**?

Problem field

- Water scarcity
  - Over population
  - Farmland increase
  - Ecology decrease
  - Future trend
- Unsustainable livelihood
  (Farming environment)
  (Single baned product)
  - Vulnerable circularity
  - Potential influence of pro-duction
  - Global market ban

Principles

- Water saving design
- Afforestation
- New Circularity

Scenario, method and concept

Saving 50% agriculture water

Combined Approach



Products

- Government
- Farmers
- Tourists and city citizens

(L) Upper stream

(M) Urban fringe
Urban- farmalnd-river path
Whole urban fringe zone

(S) River landscape

Reflection

How to form a **sustainable farming environment**?

Problem field

Water scarcity

- Over population
- Farmland increase
- Ecology decrease
- Future trend

Unsustainable livelihood
(Farming environment)
(Single baned product)

- Vulnerable circularity
- Potential influence of pro-duction
- Global market ban

Principles

- Water saving design
- Afforestation
- New Circularity

Scenario, method and concept

Saving 50% agriculture water

Combined Approach



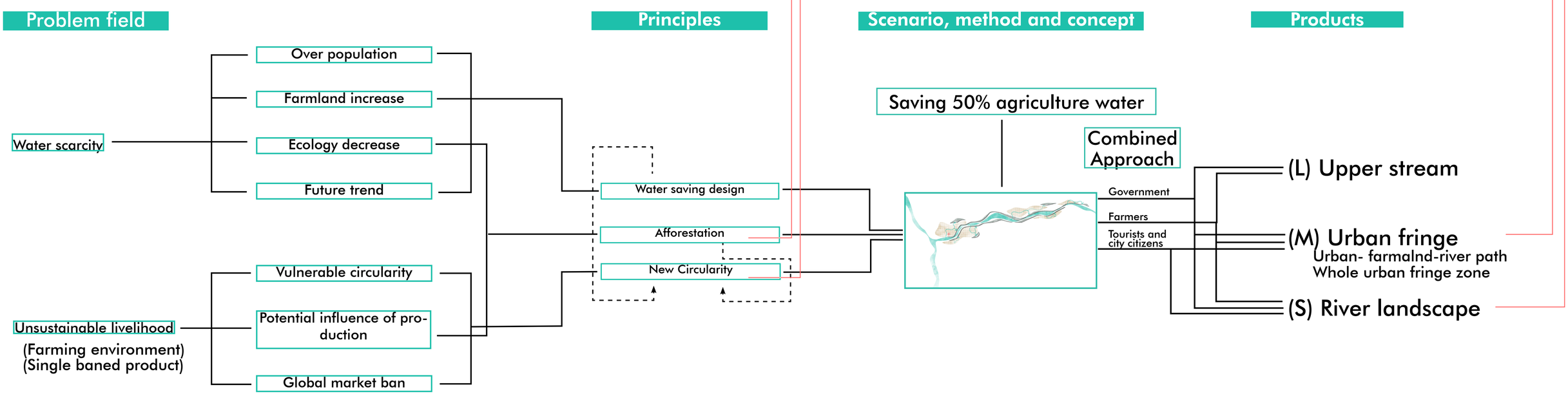
Products

Government
Farmers
Tourists and city citizens

- (L) Upper stream
- (M) Urban fringe
  Urban- farmalnd-river path
  Whole urban fringe zone
- (S) River landscape

Reflection

How to form a establish a **sustainable circular living** way for farmers?



Reflection

The relationship between research and design- Research by design
Limitation of the project- Hard predict future, More focus on afforestation, participation, economic consideration
Ethical issues and dilemmas- human and nature, Urbanization or afforestation or river space, people's willing and designers' ambitions.


Thank you!