Wanda Wahl-Mertes
5865921
Delft University of Technology
Faculty of Architecture and the Built Environment
Master of Science Architecture, Urbanism, and Building Sciences
Department of Urbanism

يلا

*Yallah**

a path to climate resilience and spatial justice in Nouakchott

Content

I Introduction

Analysis

II Climate Exposure & Social Sensitivity

III Development

IV Vulnerability

V Life & People

Design

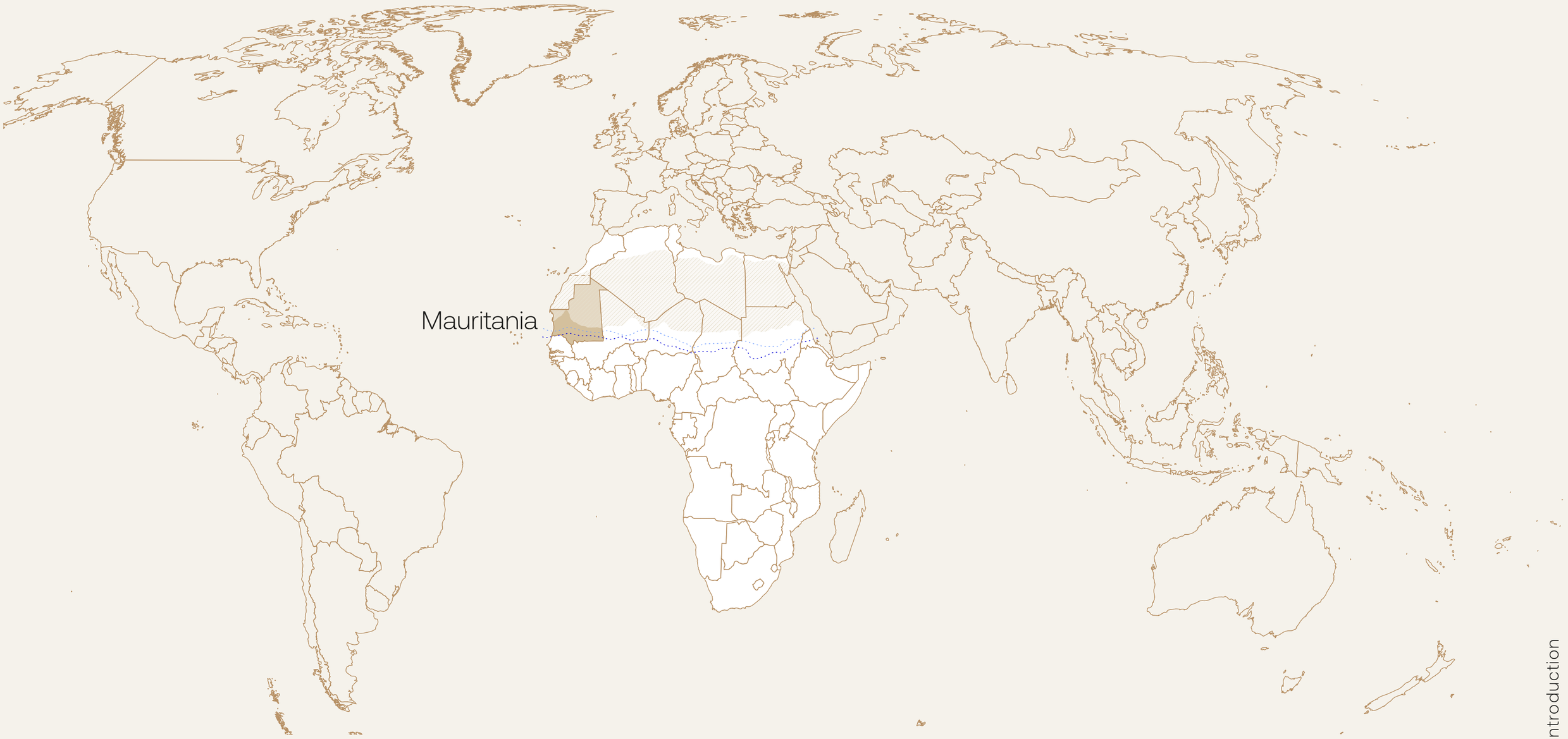
VI Pattern Language

VII Pattern Set Co-creation

VIII Design & Transferability

I Introduction

Context



© Michael Wahl

© Ivona Mirkovic 2023

II Climate Exposure & Social Sensitivity

Desert

Desertified area

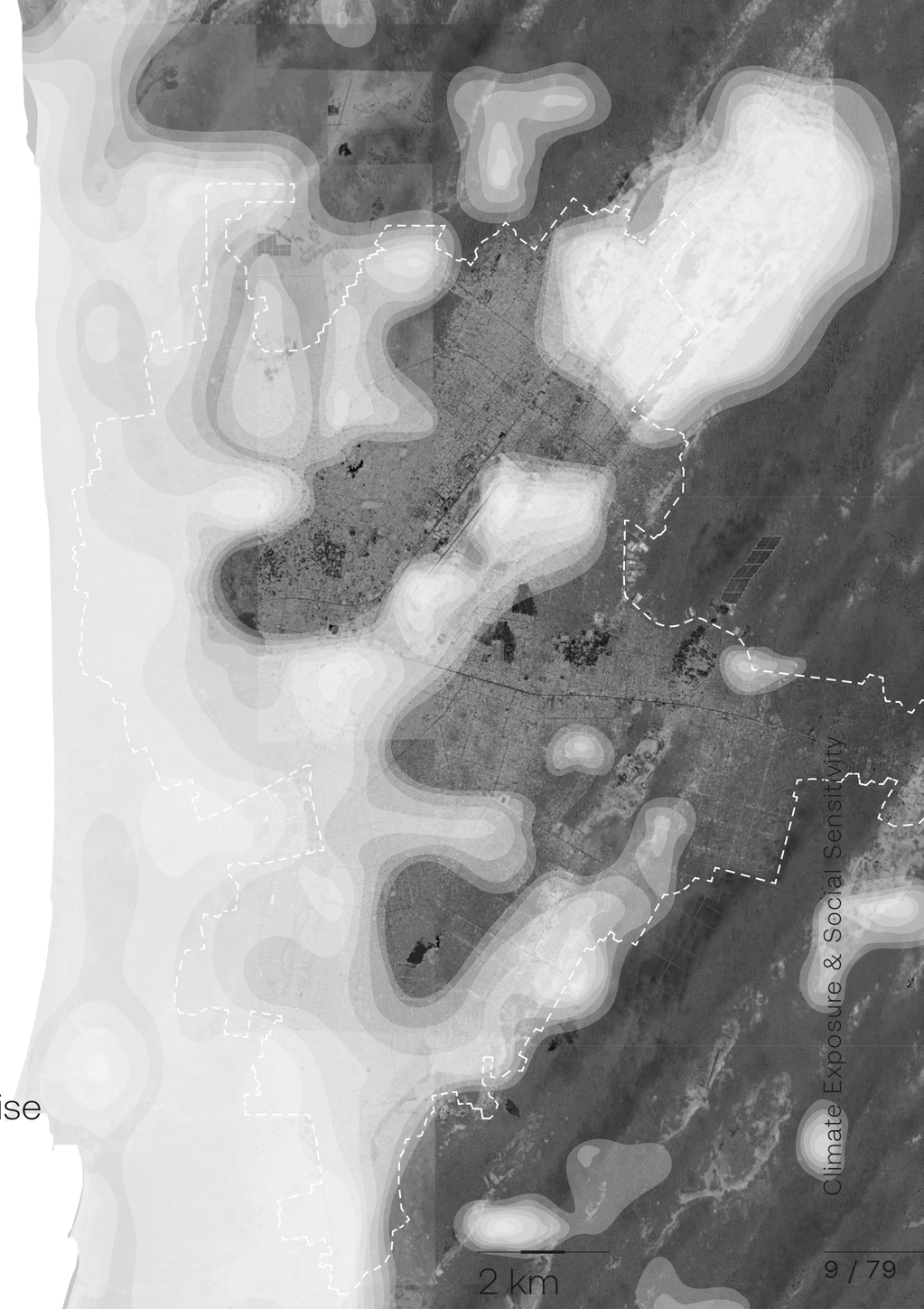
Very severely desertified

Severely desertified

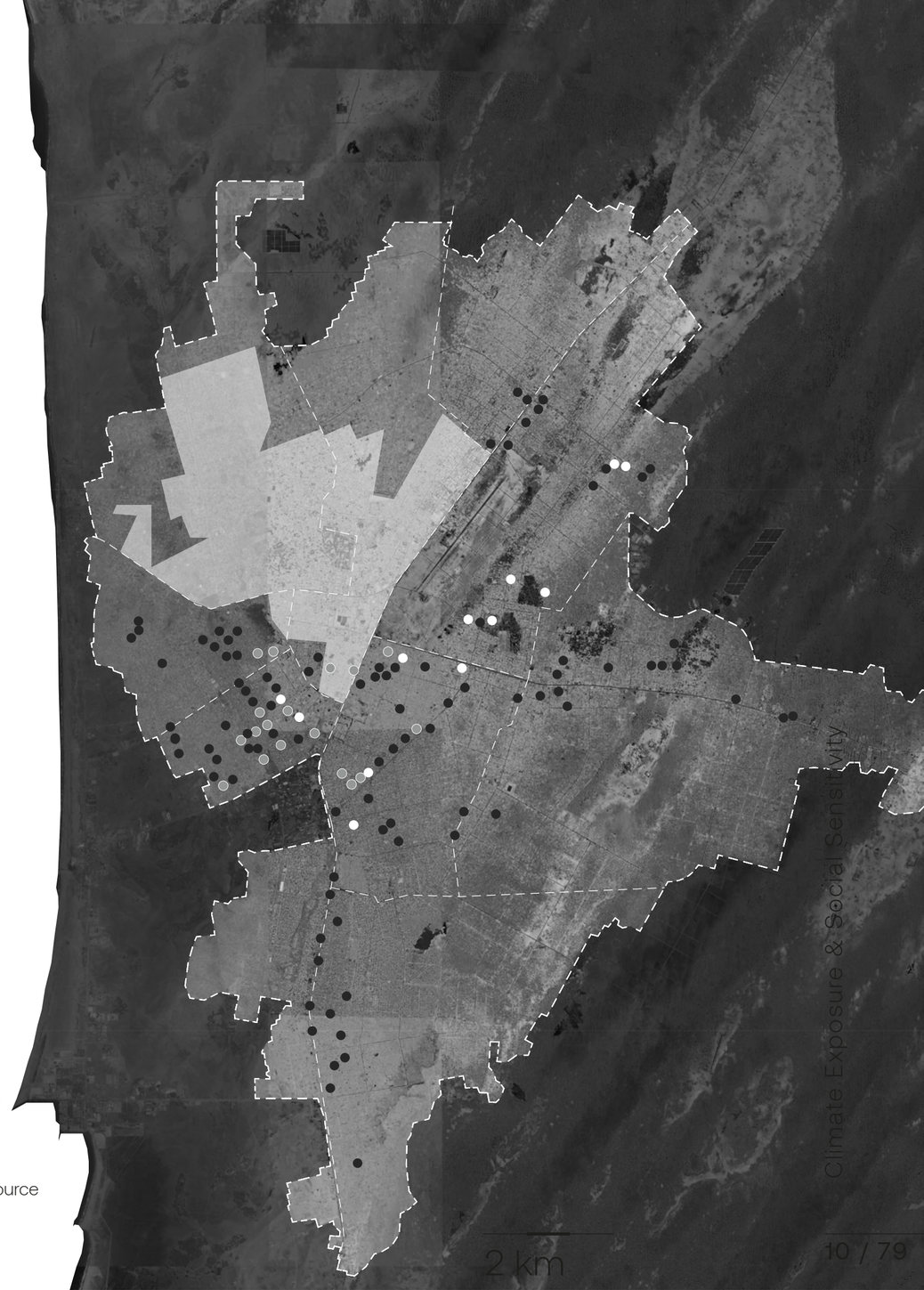
Climate Exposure & Social Sensitivity

3 km

Water

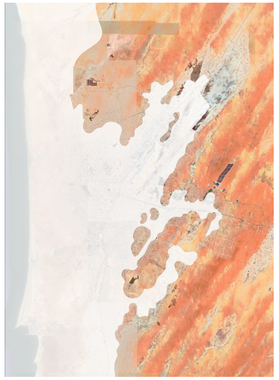

3 m sea level rise
Water
City Outline
Climate Exposure & Social Sensitivity
2 km

Poverty


Water Access
Water taps
Clean water source
Contaminated water source
Climate Exposure & Social Sensitivity
2 km

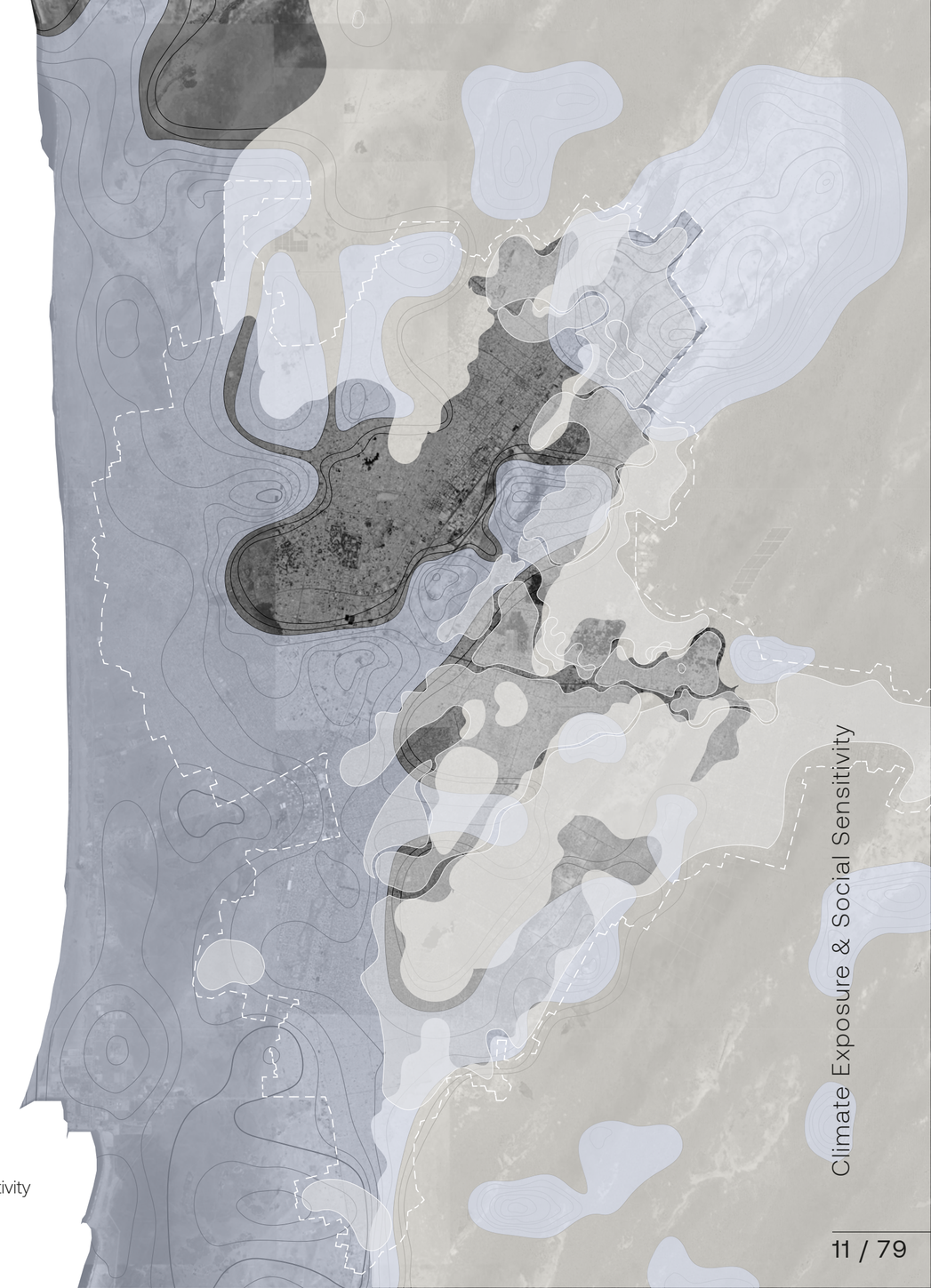
Conclusion

Water



Desert

Poverty



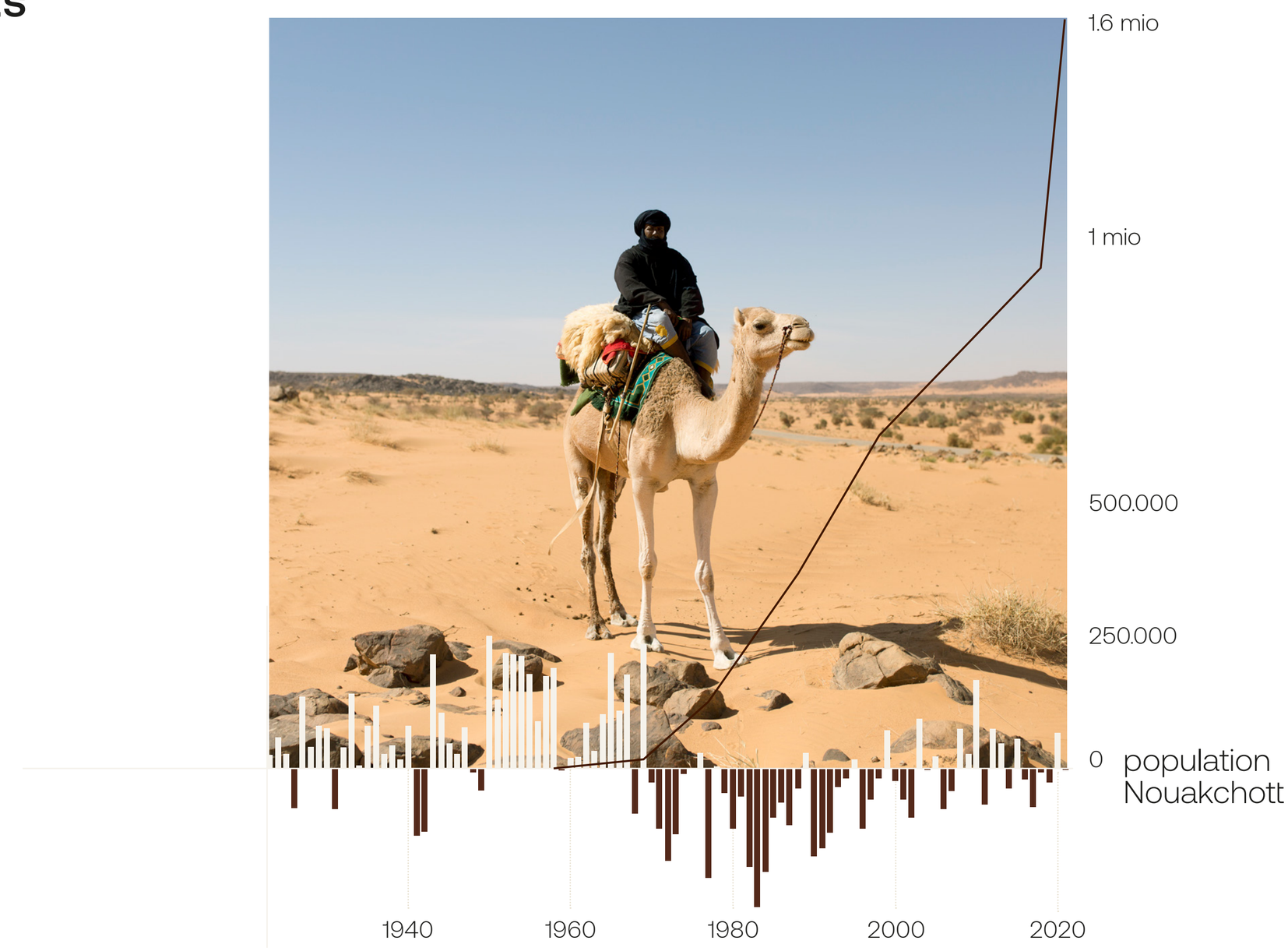
III Development

Nomadic Lifestyle

Droughts

© Correlation of precipitation anomalies and population growth (based on worldbank, 2023)

Droughts



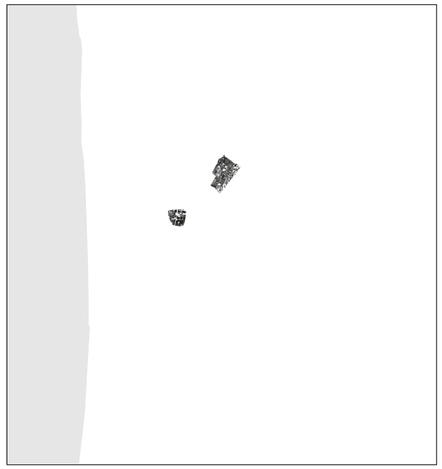
© Correlation of precipitation anomalies and population growth (based on worldbank, 2023)

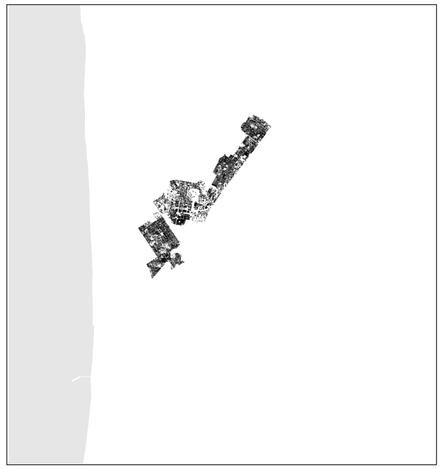
Development

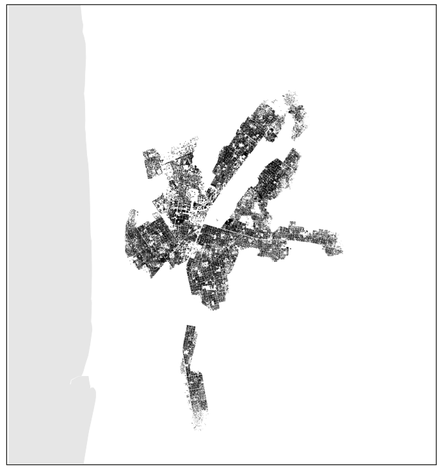
landscape alteration

1964 — 1980 — 1995 — // — 2023

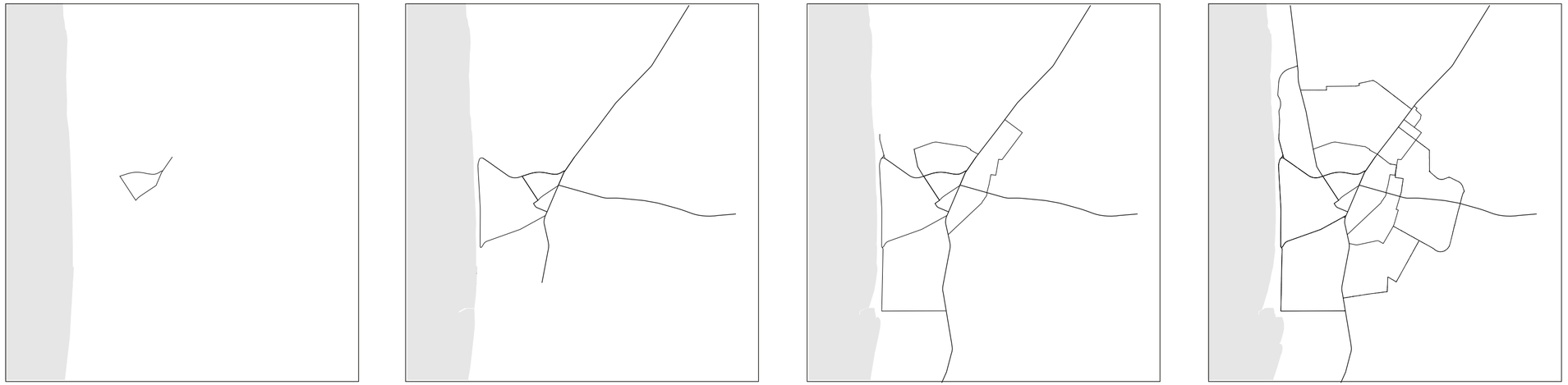
coastline and desert







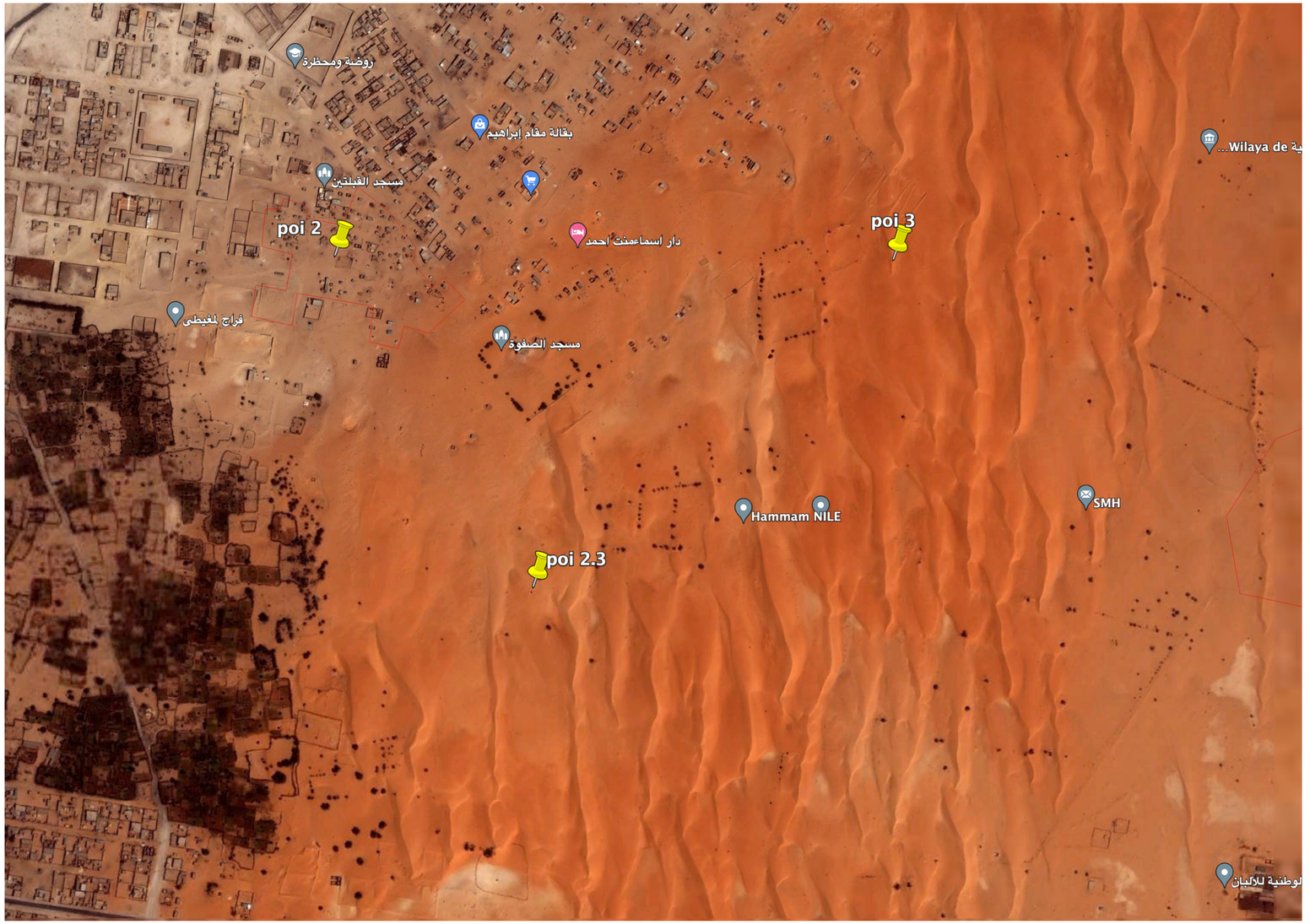
	1964	1980	1995	//	2024
urban fabric					
population	2.000	140.000	670.000		1.6 mio



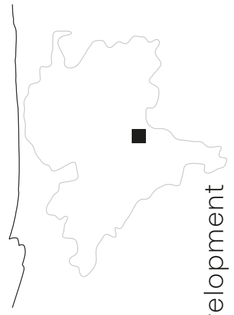
infastructure

1964 1980 1995 2023

Disruption

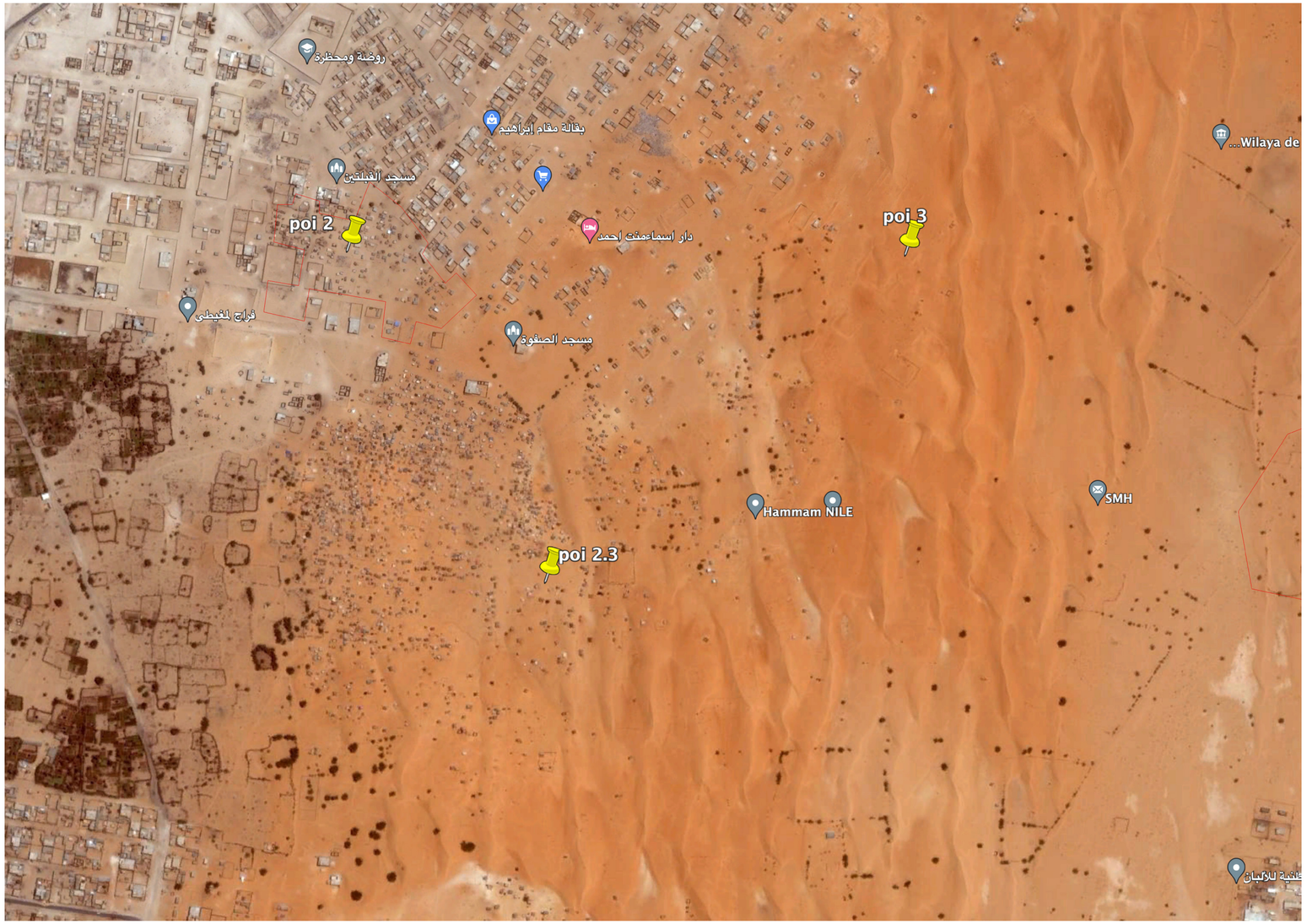


2005

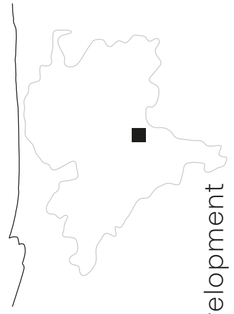


Development

Disruption

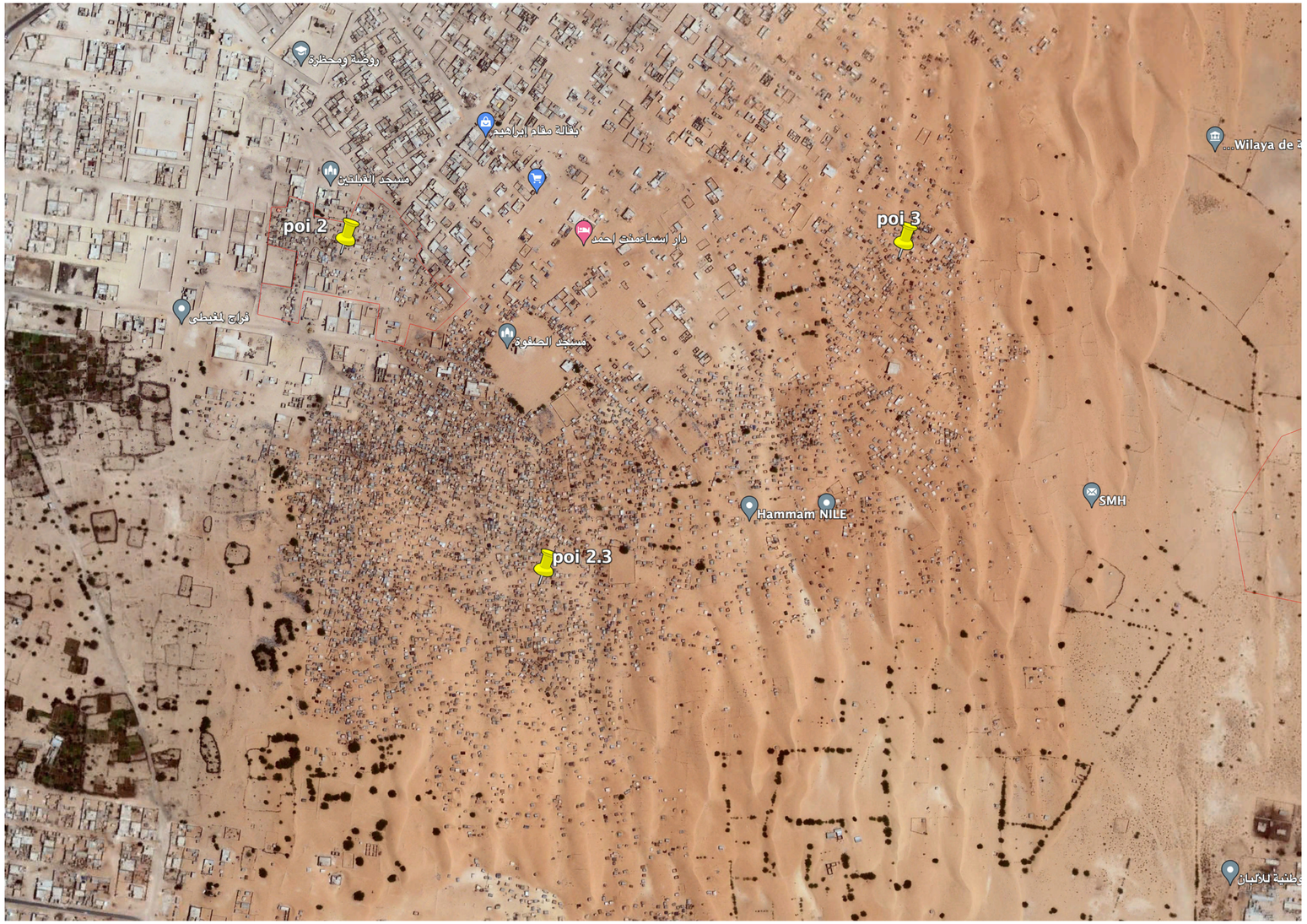


2008

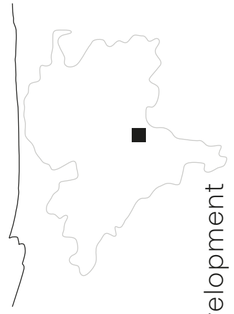


Development

Disruption

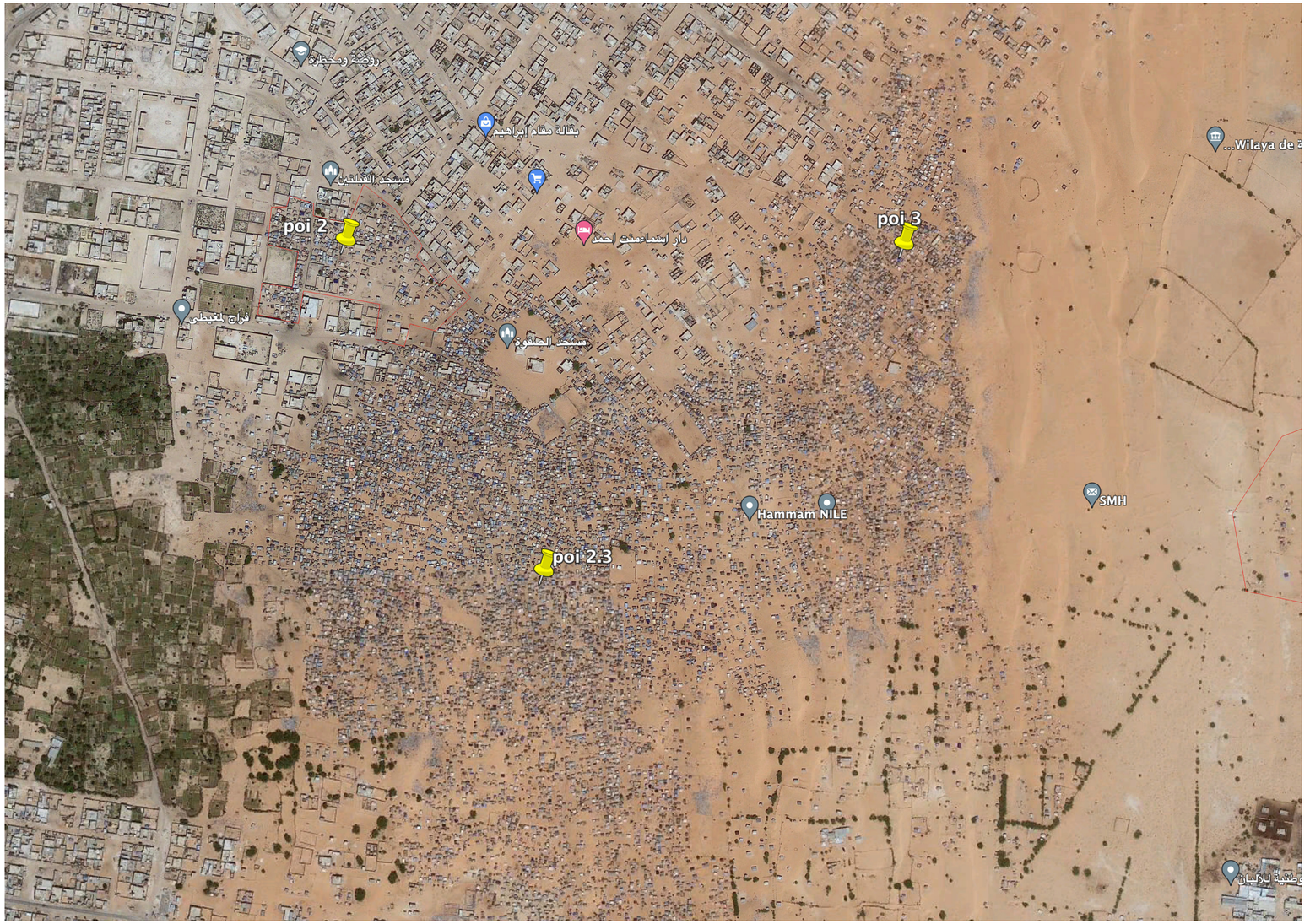


2010

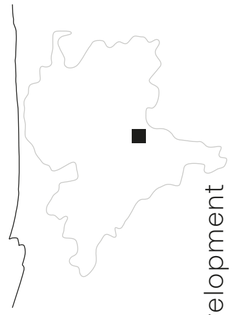


Development

Disruption



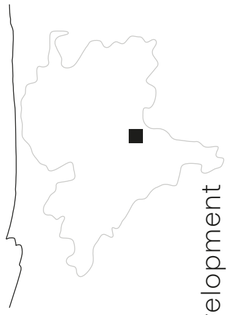
2012 November



Development

Disruption

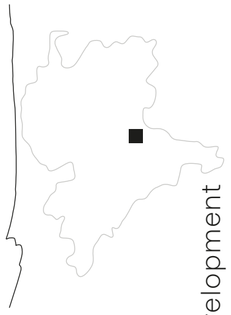
2012 December



Development

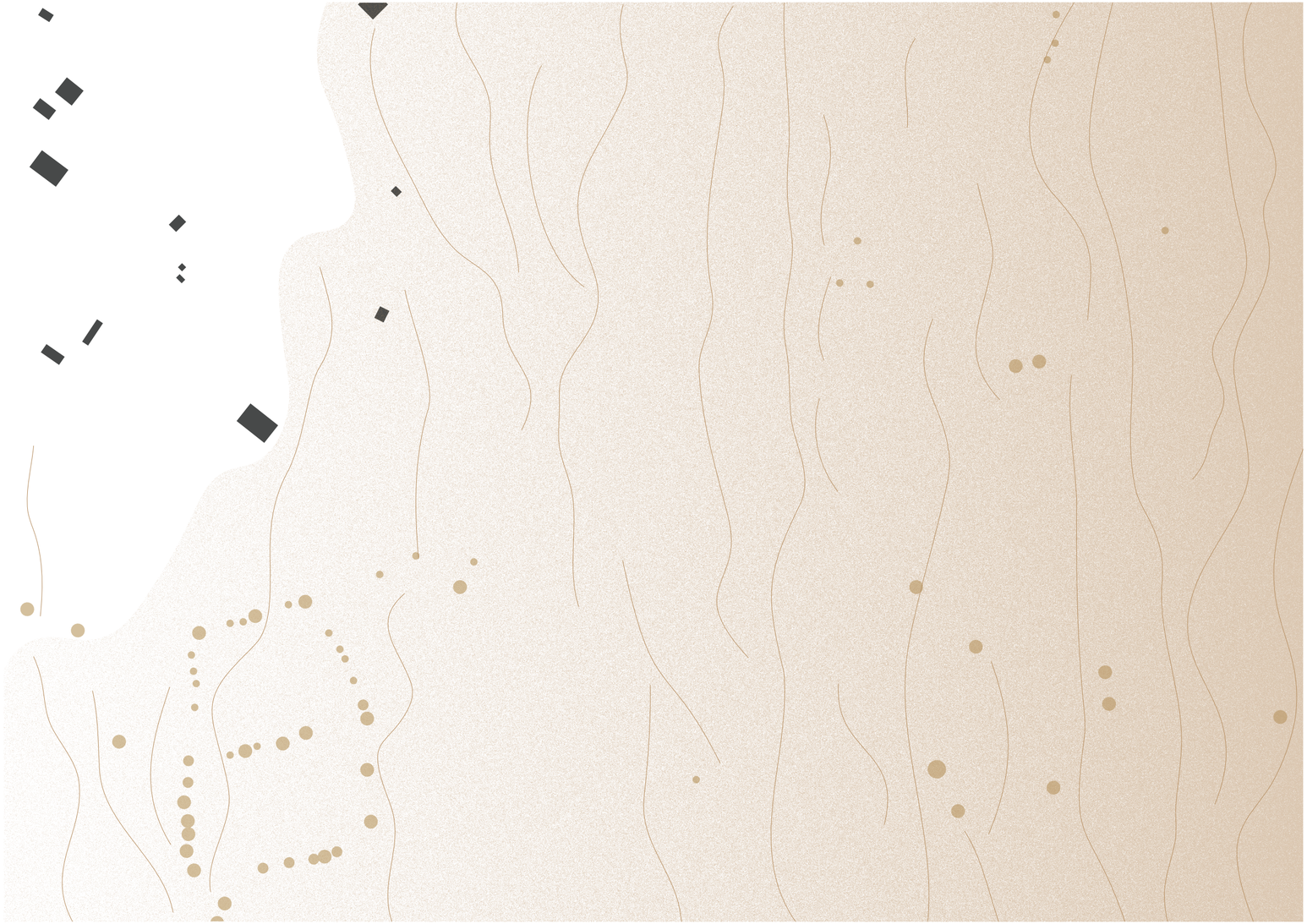
Disruption

2012 December

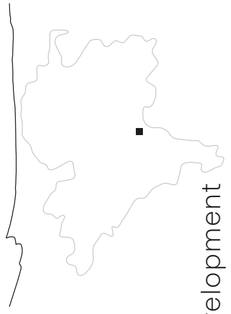


Development

Persistence

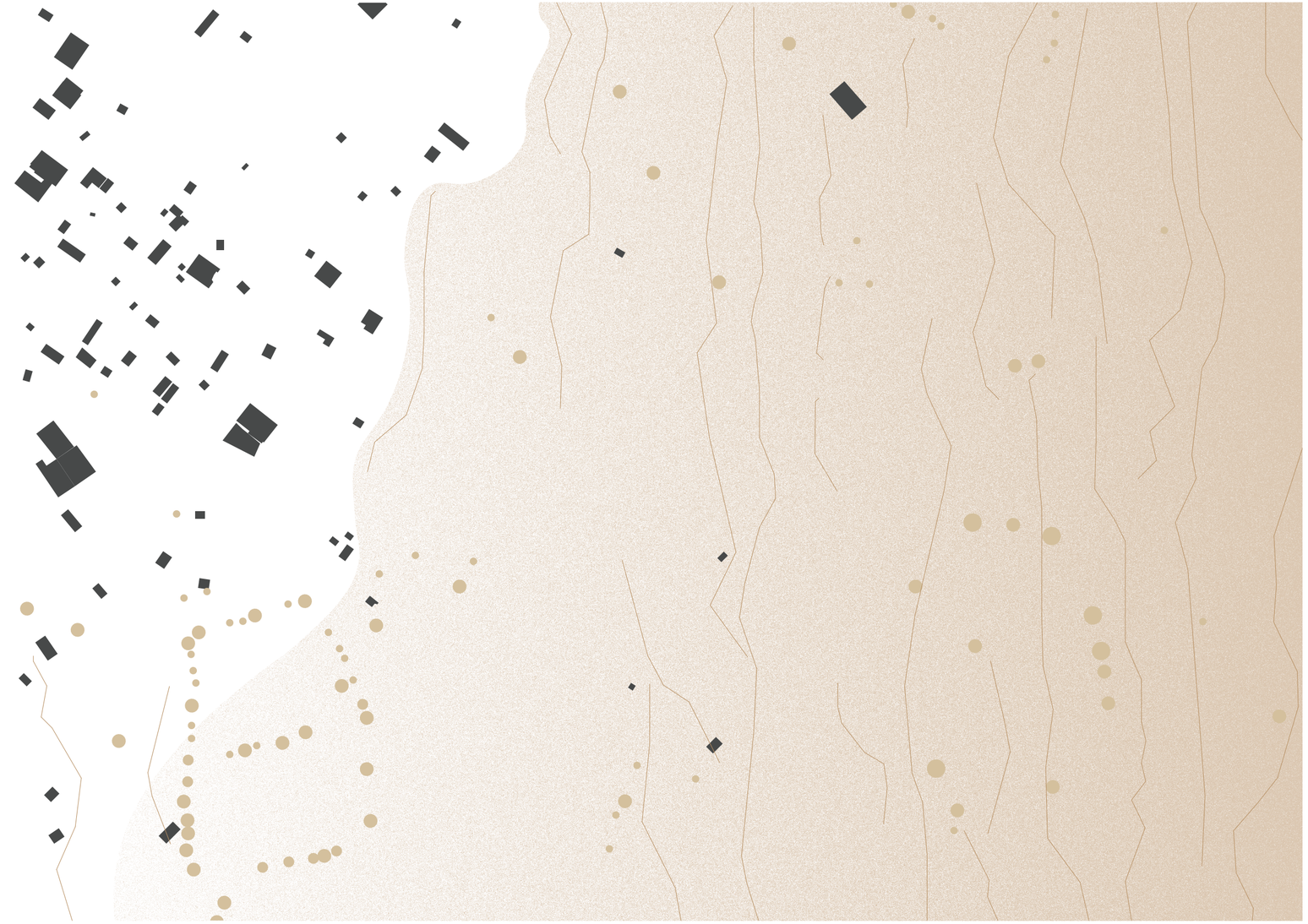


2002

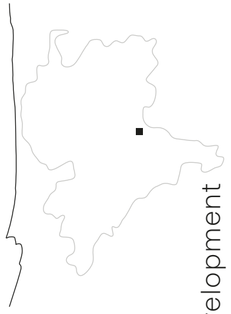


Development

Persistence

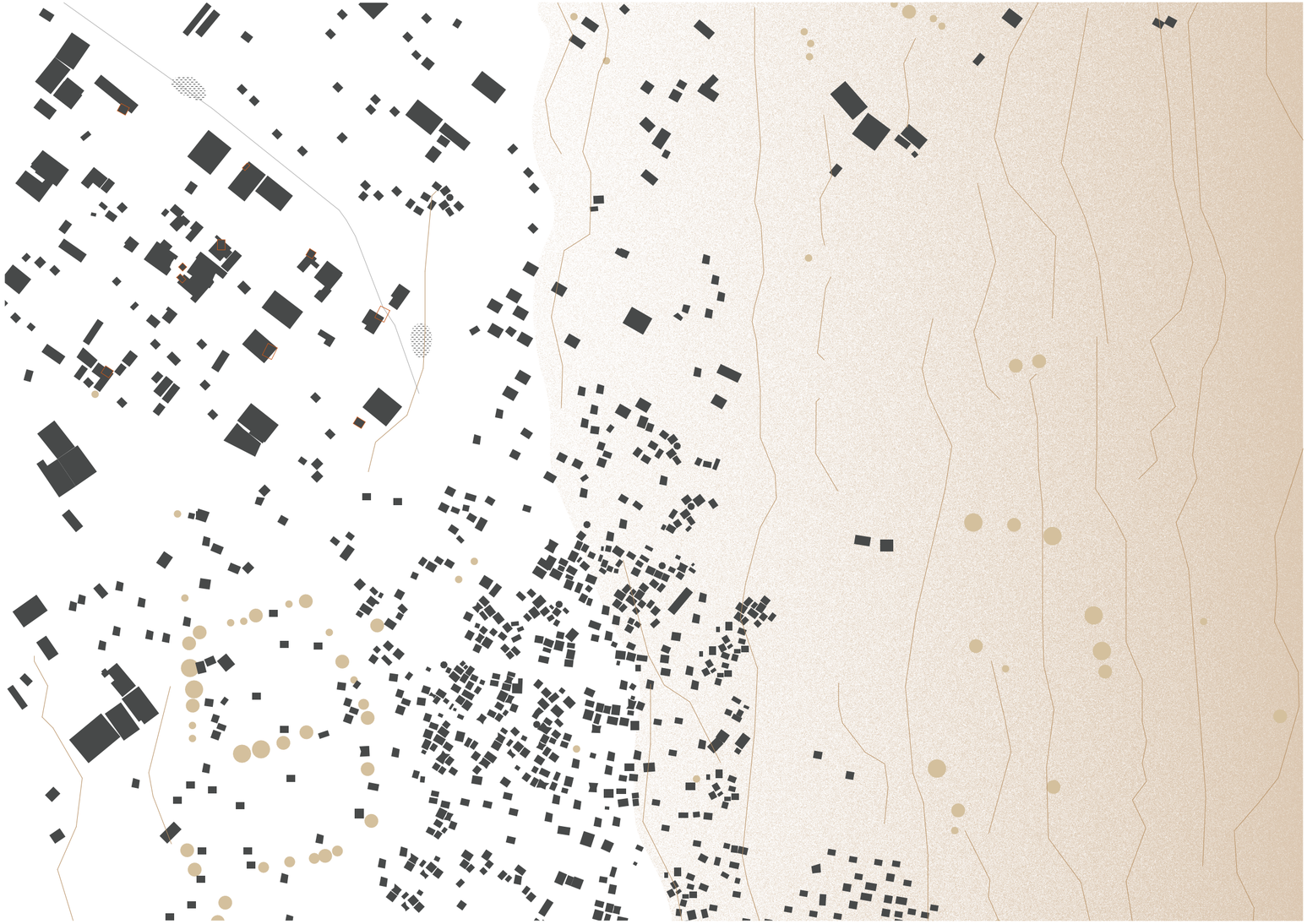


2008

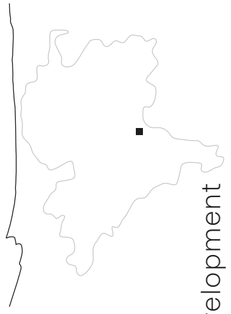


Development

Persistence



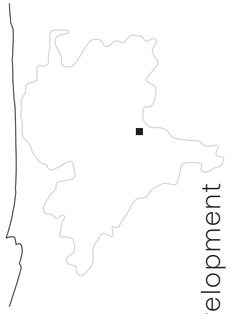
2010



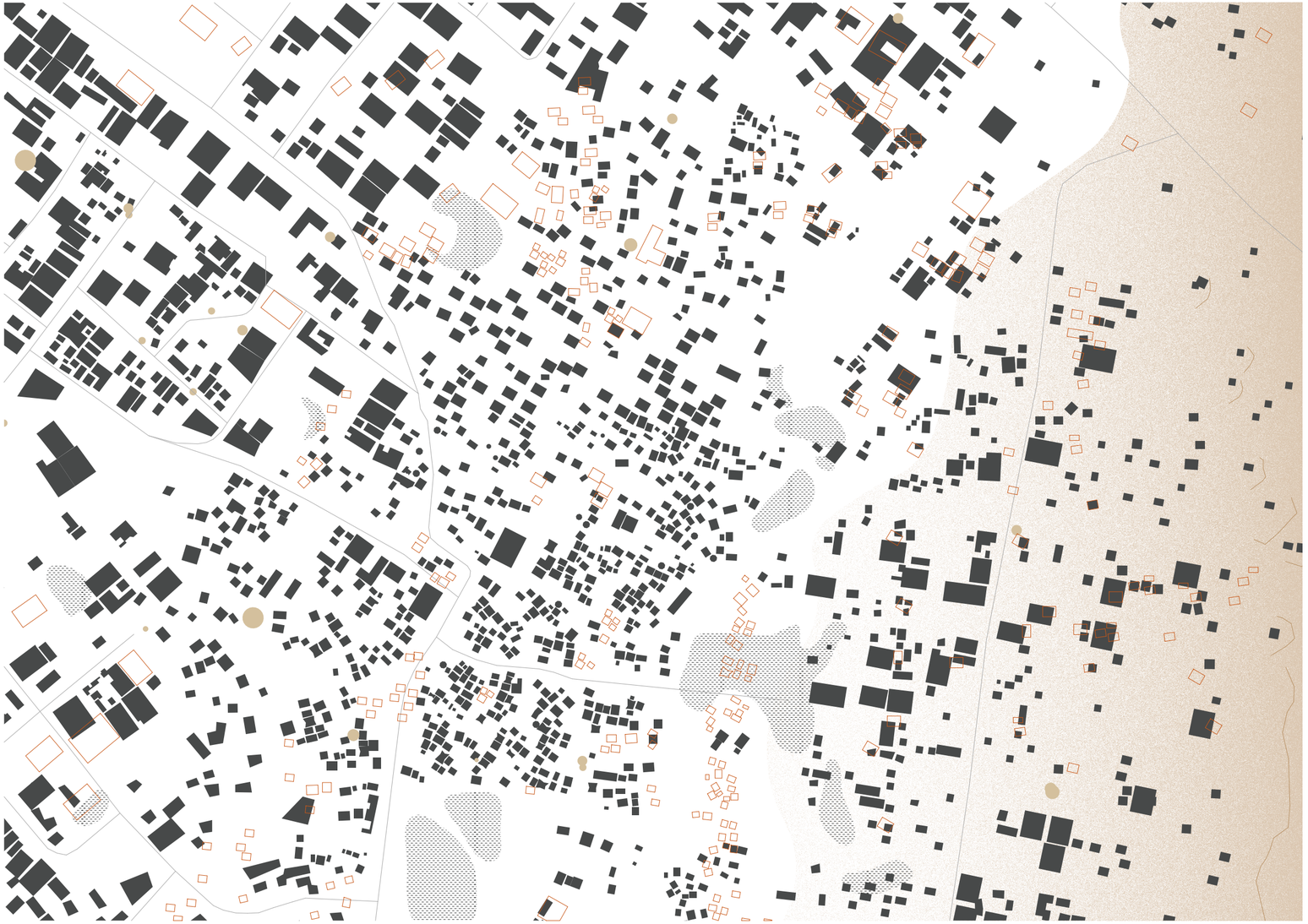
Development

Persistence

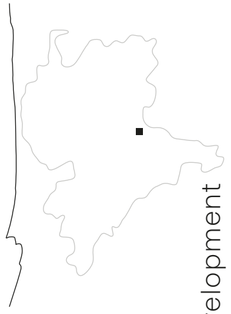
2013



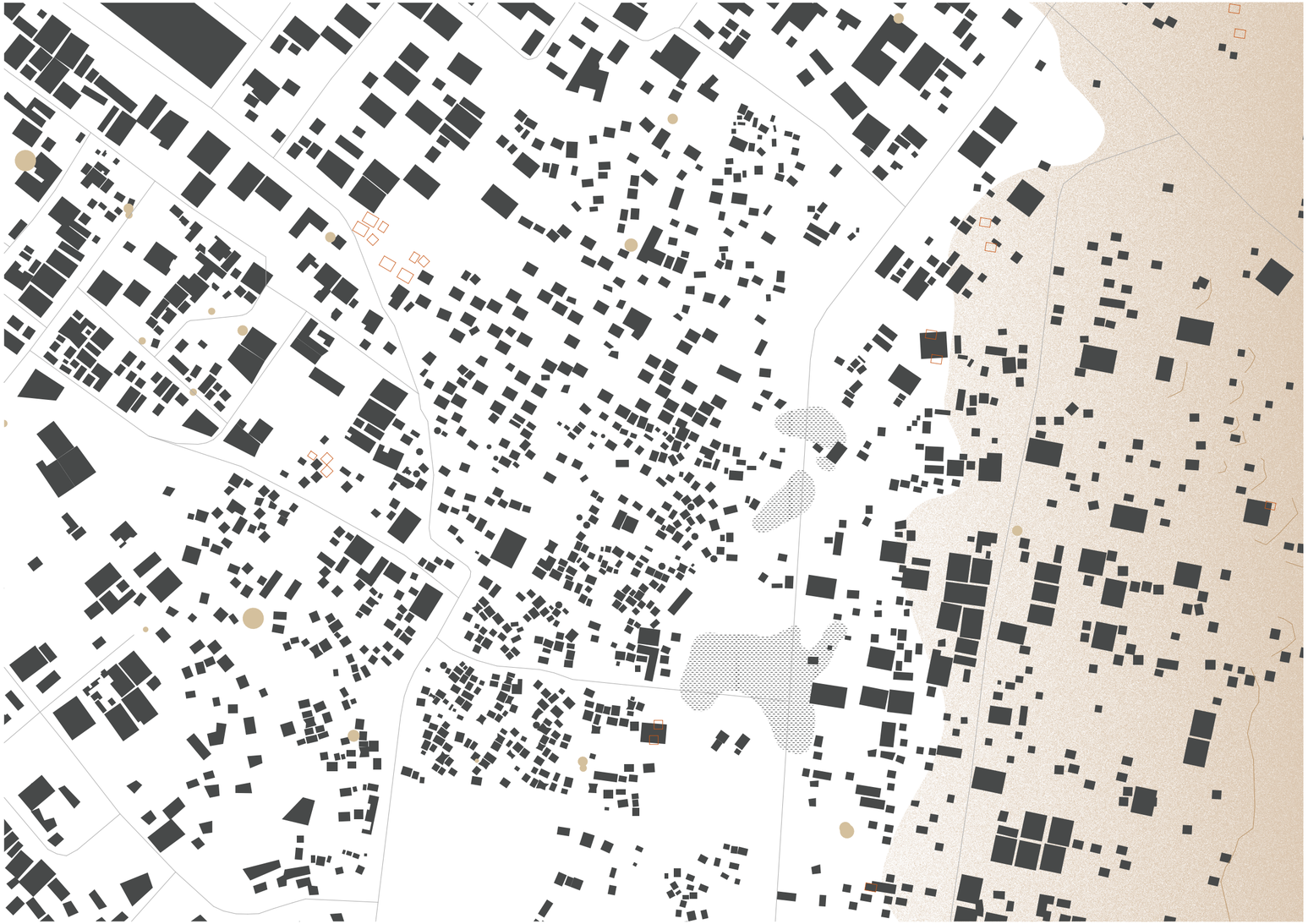
Persistence



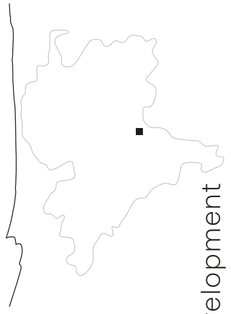
2016



Persistence

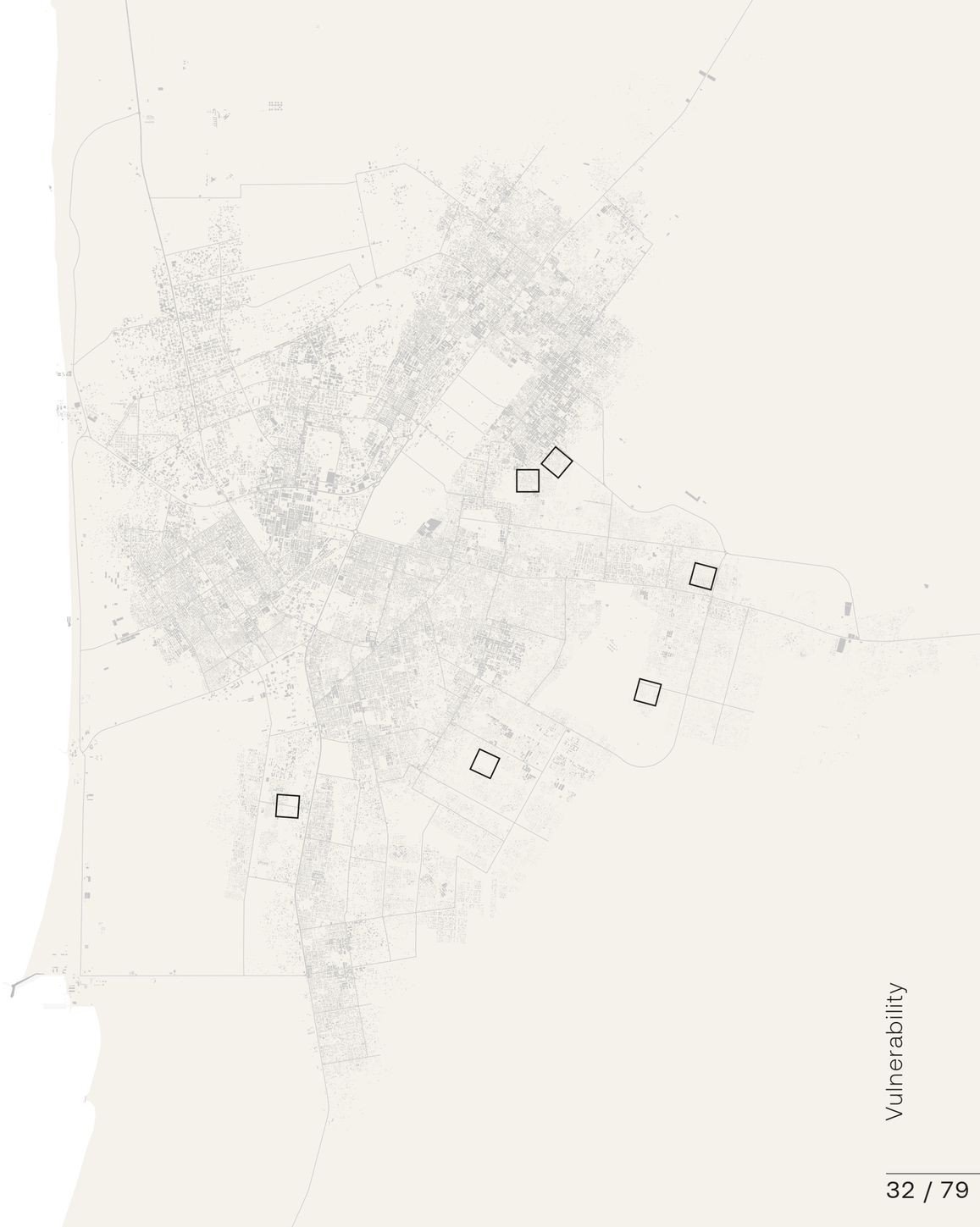


2020



IV Vulnerability

Typology

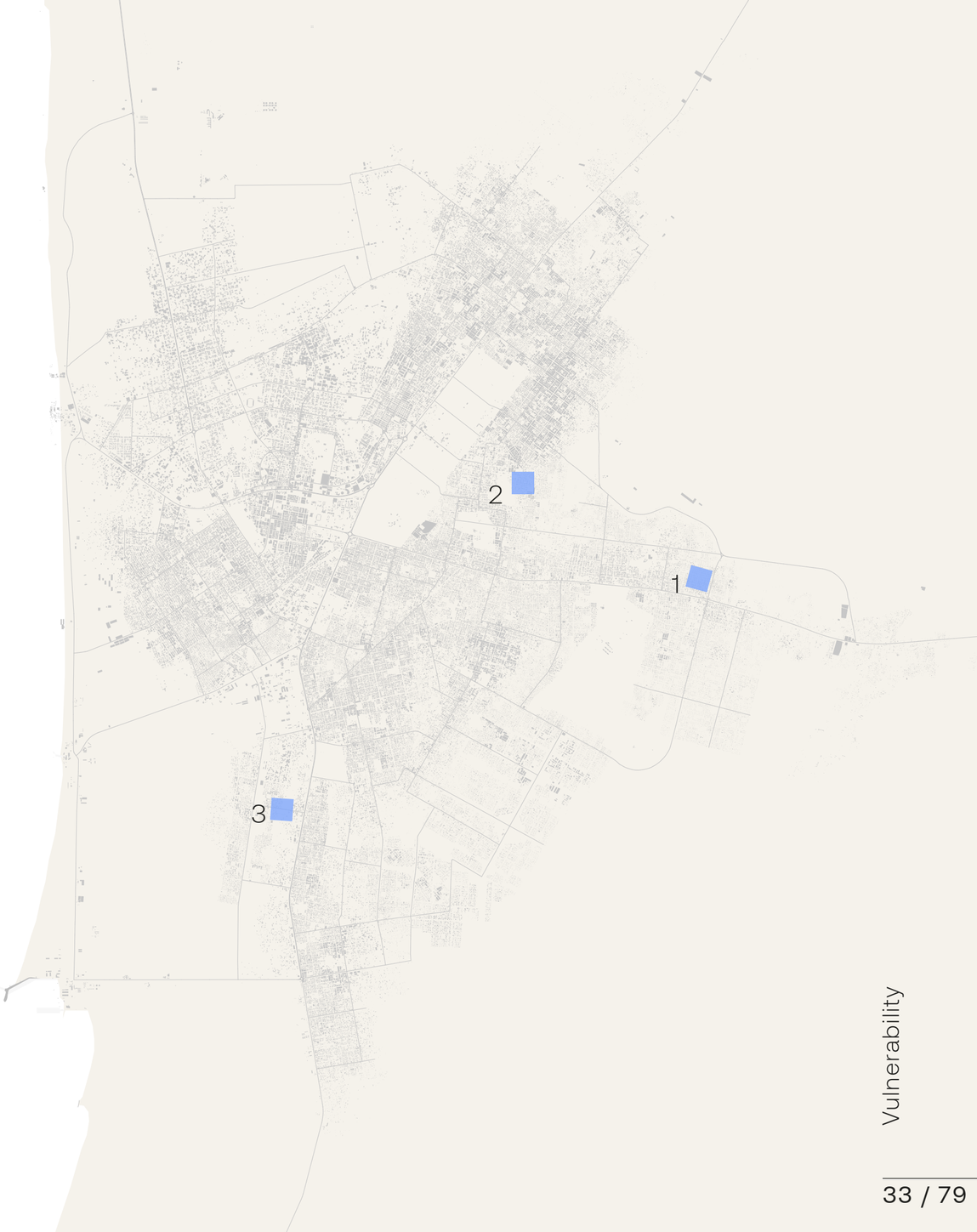


Typology

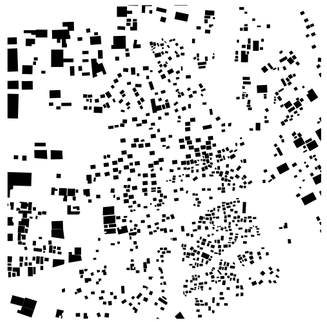
1

2

3

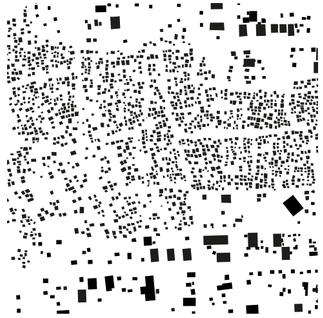


Typology

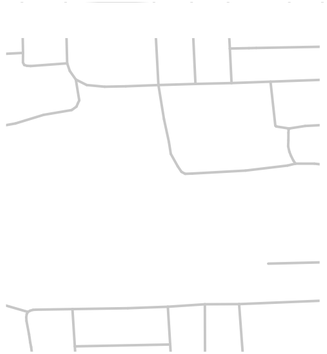


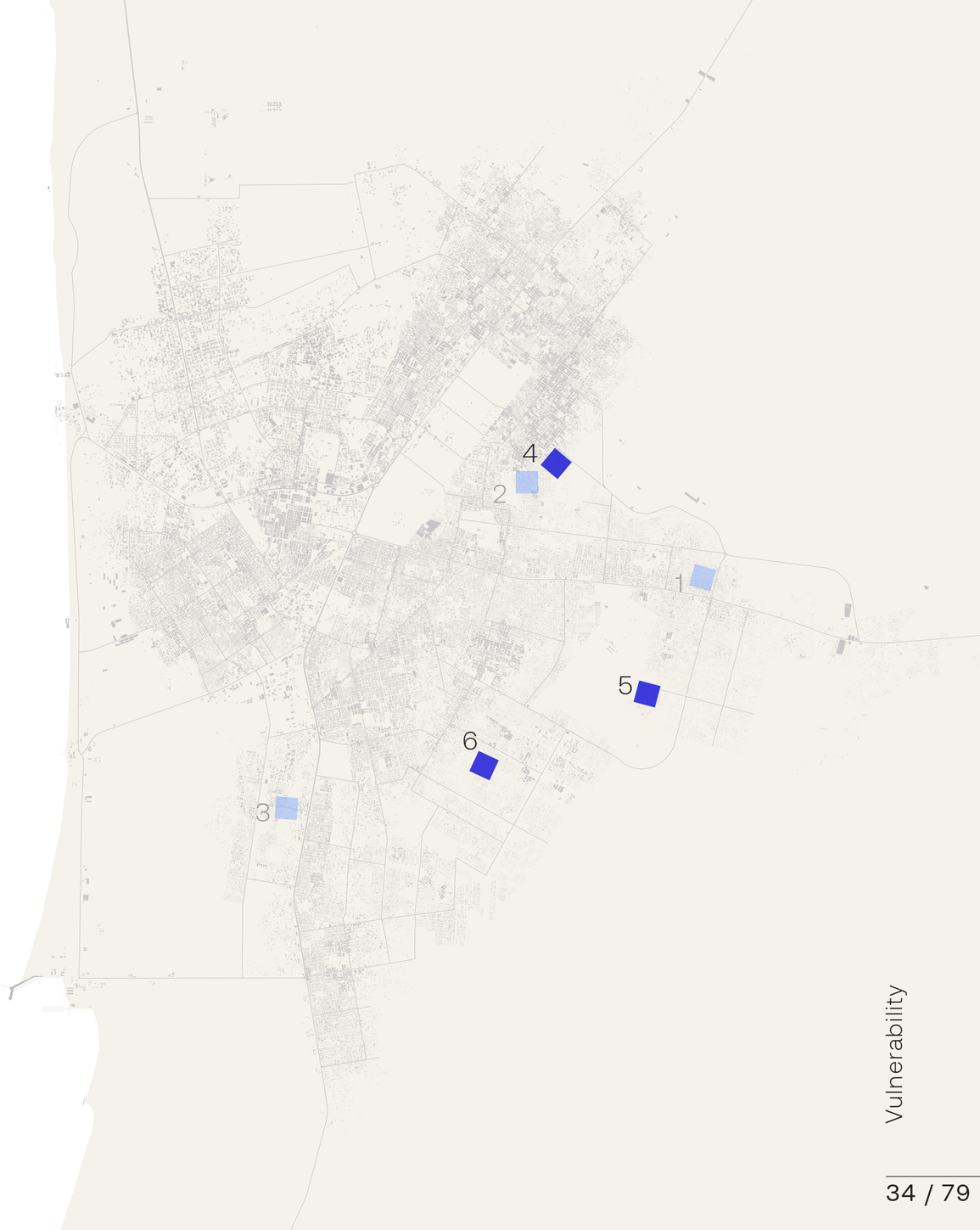
4

5



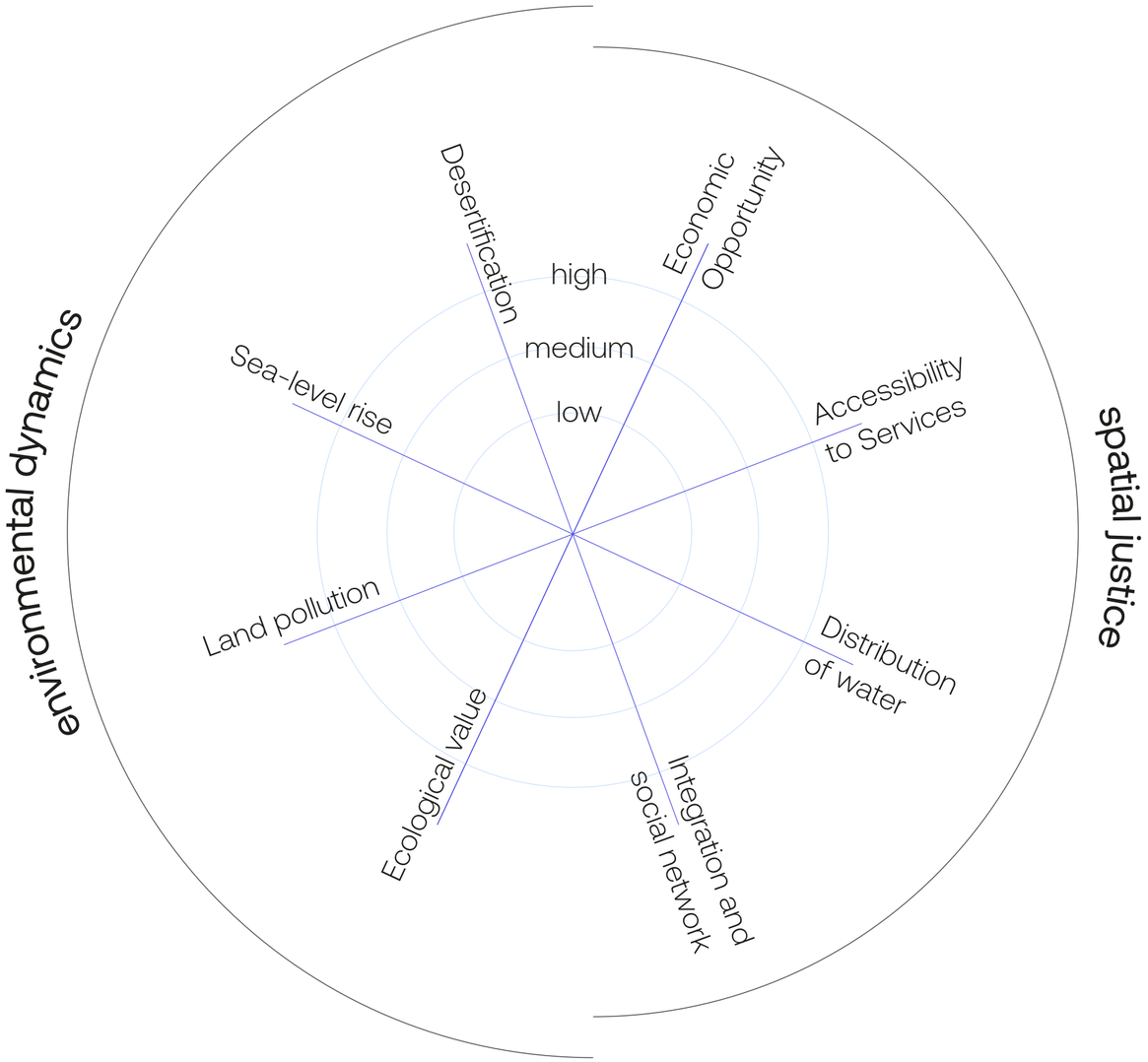
6



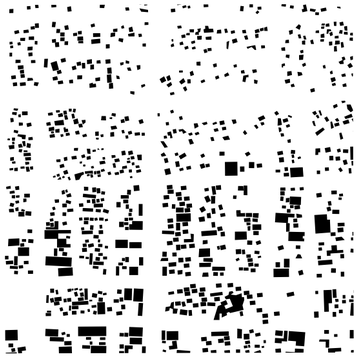


Vulnerability

Assessment


environmental dynamics
spatial justice
high
medium
low
Desertification
Economic Opportunity
Sea-level rise
Accessibility to Services
Land pollution
Distribution of water
Ecological value
Integration and social network

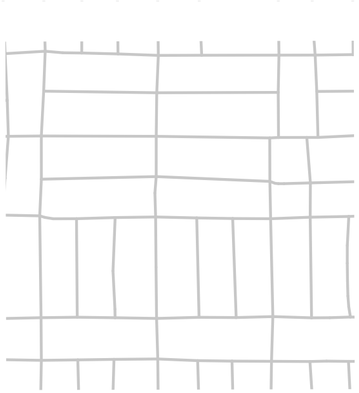
Assessment

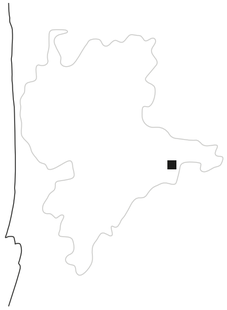


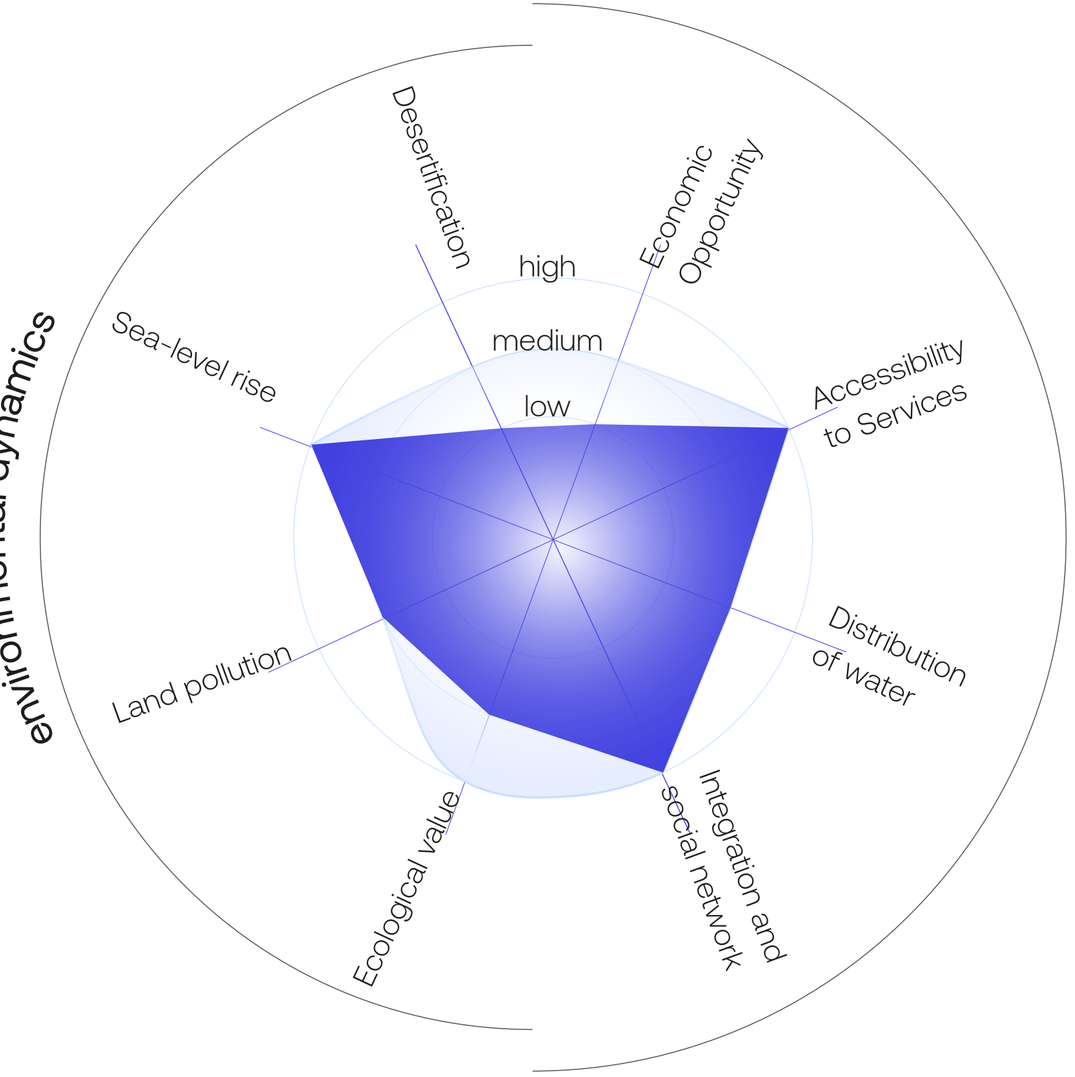
Problems:

Desertification
Economic Opportunity

1

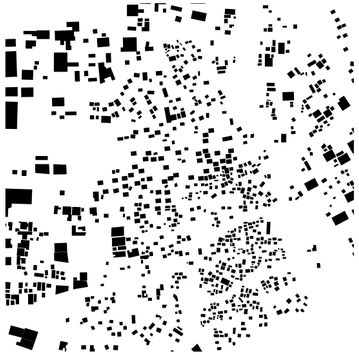






Vulnerability

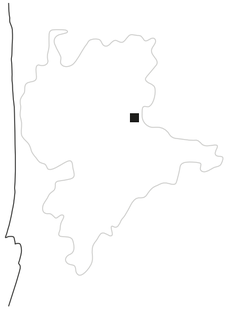
Assessment

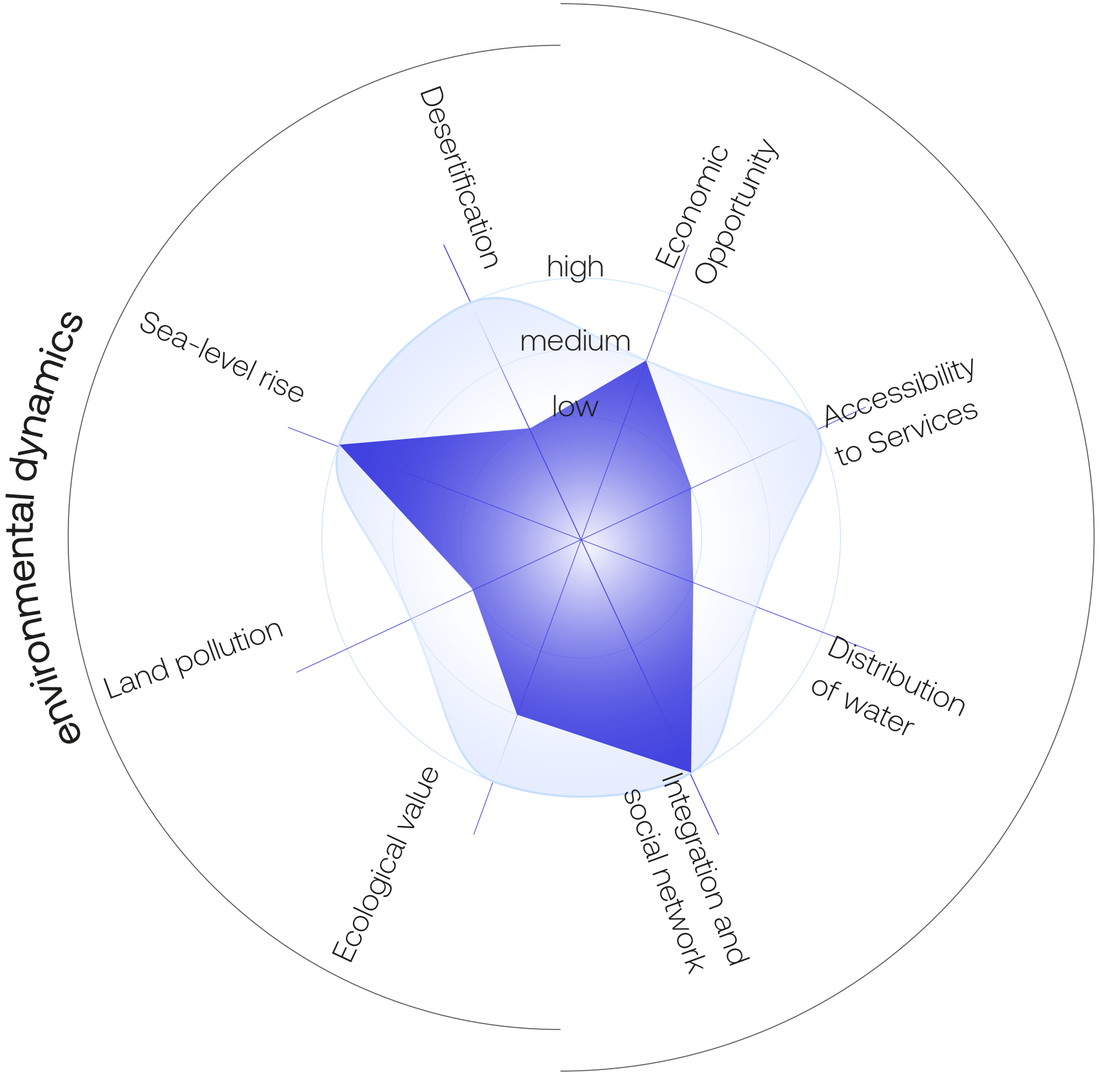


Problems:

Desertification
Pollution
Accessibility

4

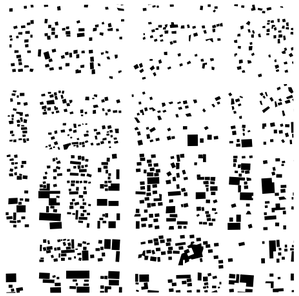


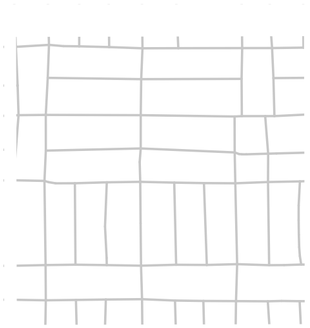


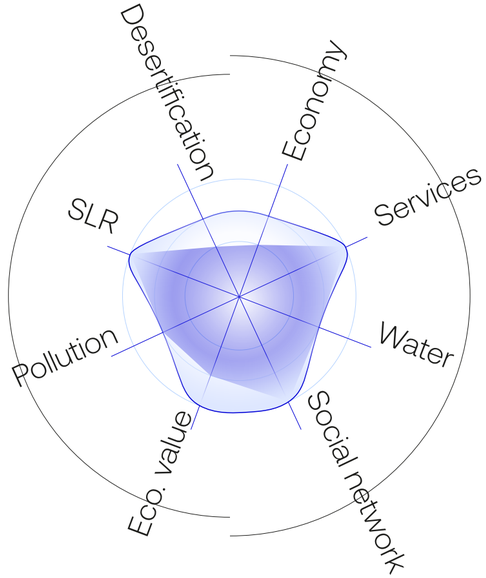
Vulnerability

Potential

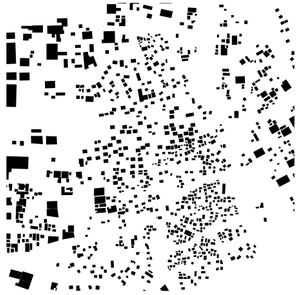
1

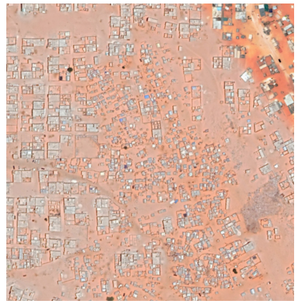


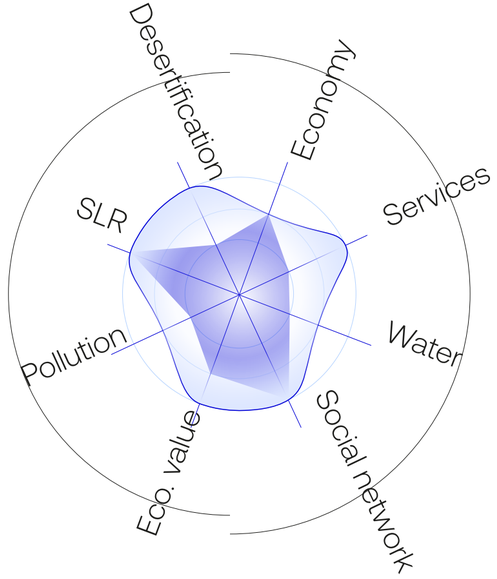




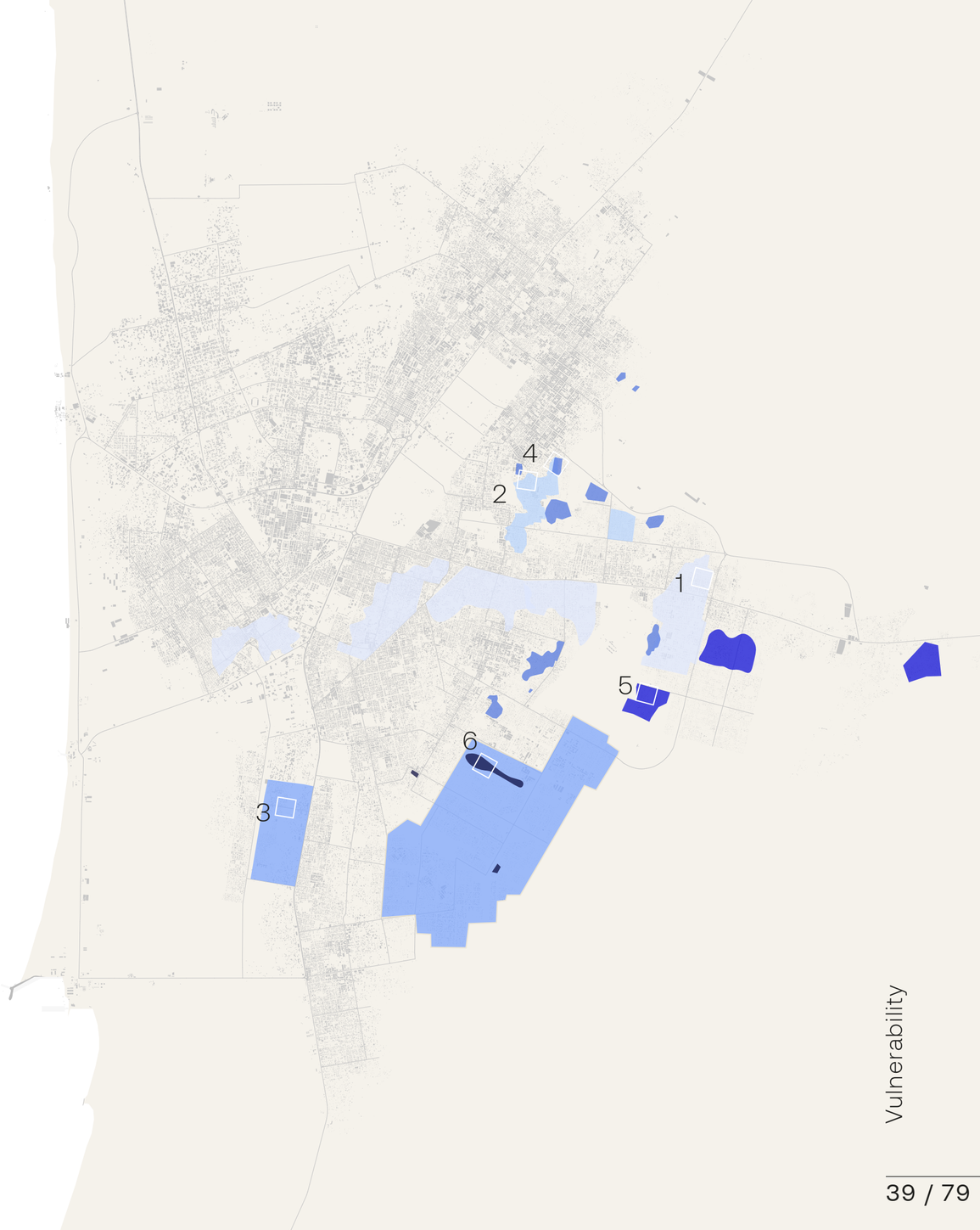
4







Replication

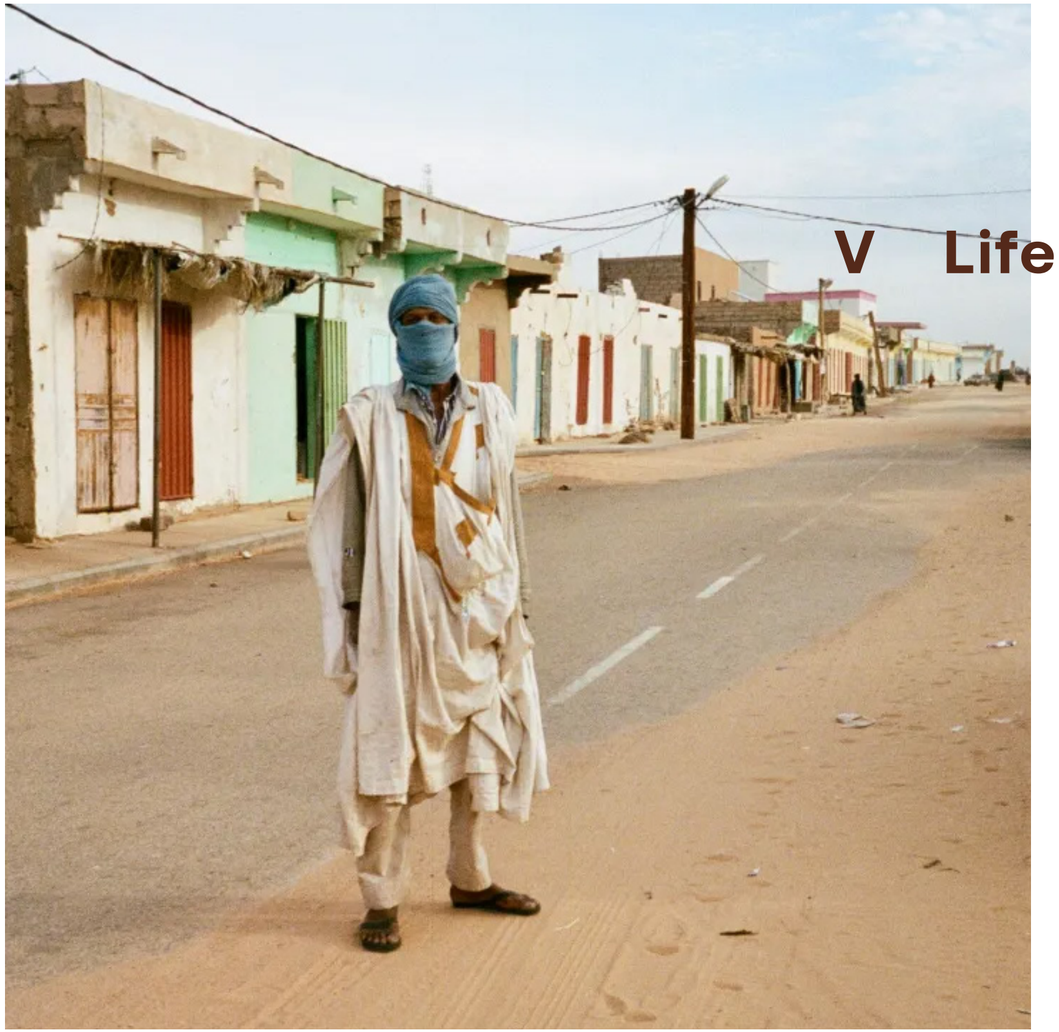


Replication of Types

- Type 1
- Type 2
- Type 3
- Type 4
- Type 5
- Type 6

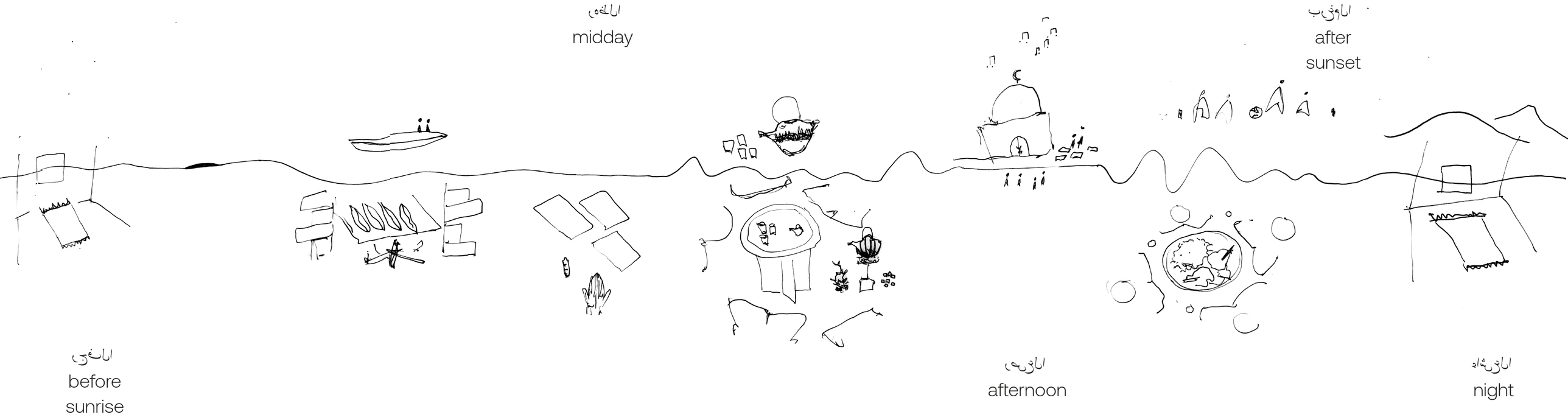
Organic Grid

Vulnerability



V Life & people

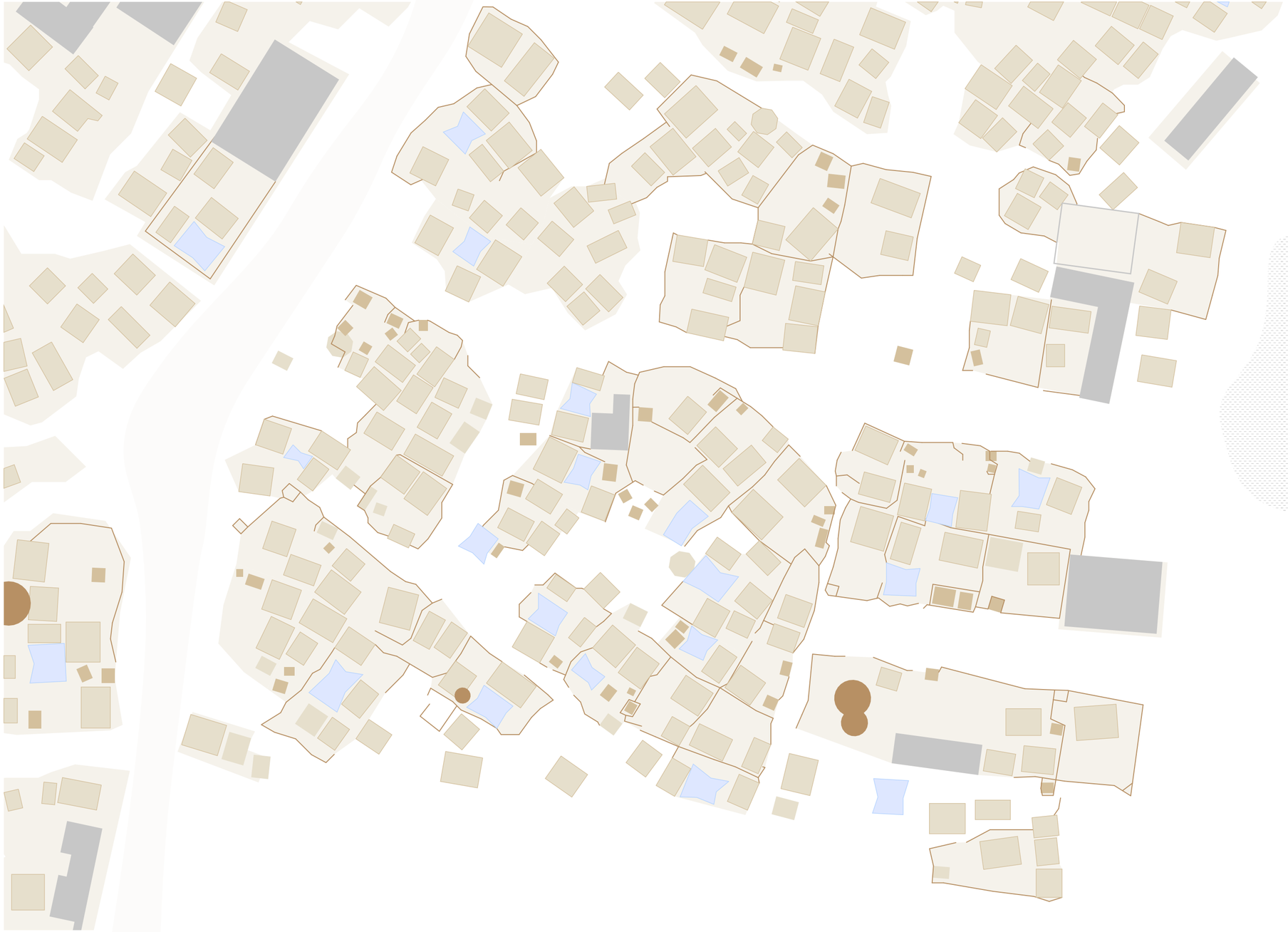
Rhythm of Life



People

Stories

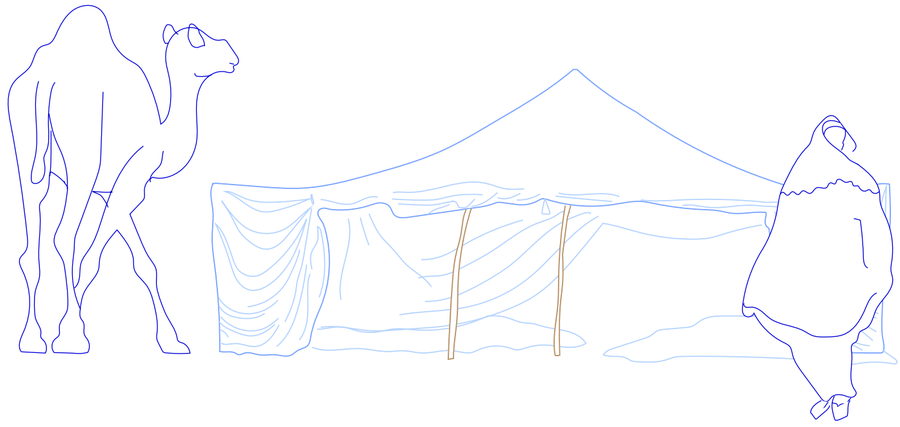
Space

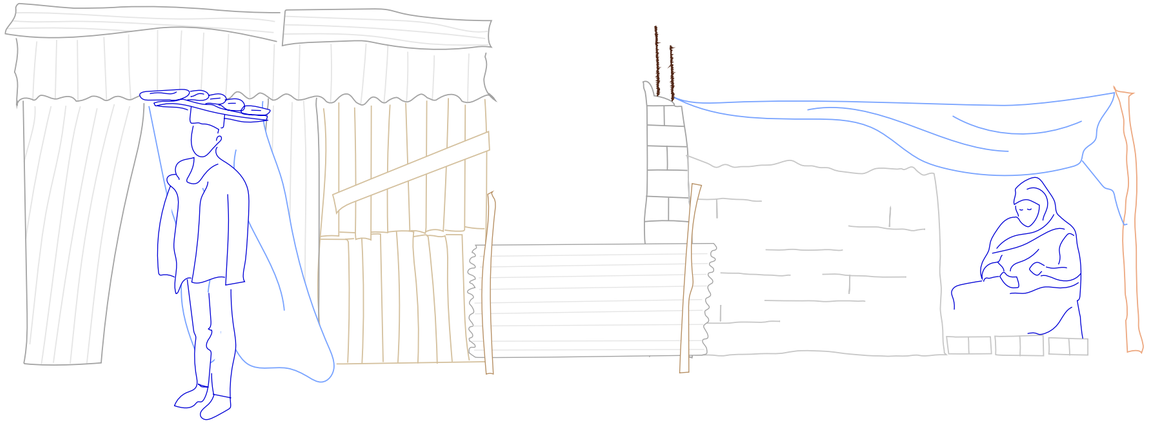


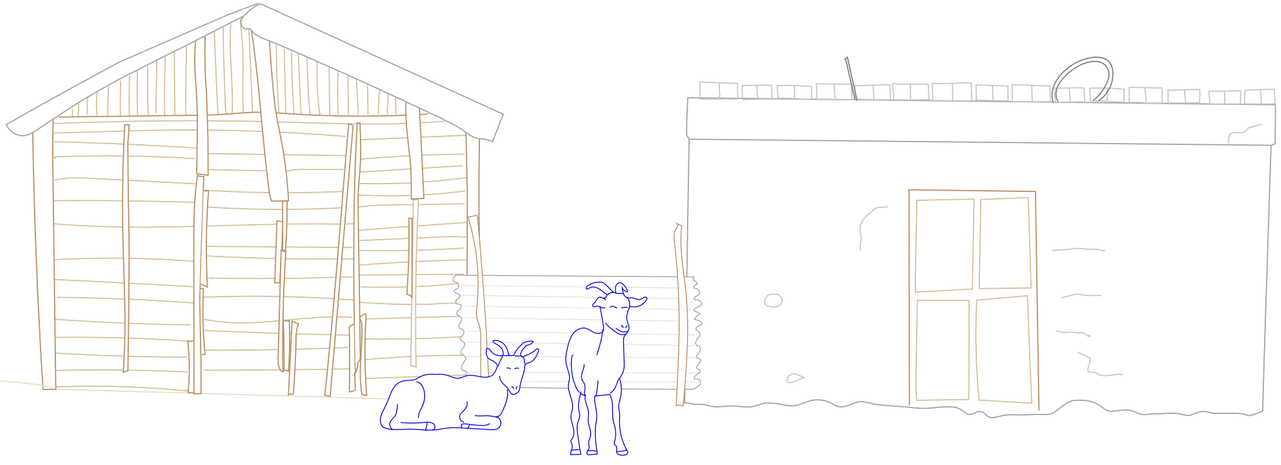
- Tents or covers
- Wood & metal dwellings
- small sheds
- dwellings (70% certain)
- Concrete buildings
- Concrete walls

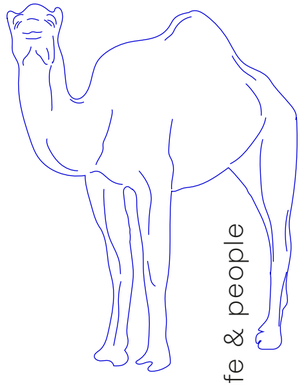
Activity

Animals
People
Cars



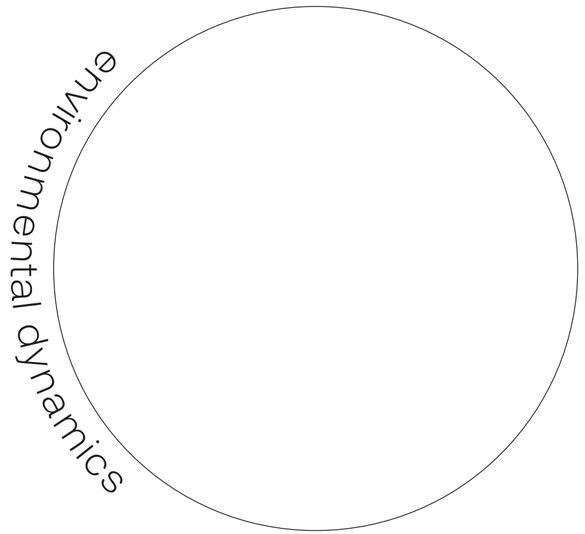


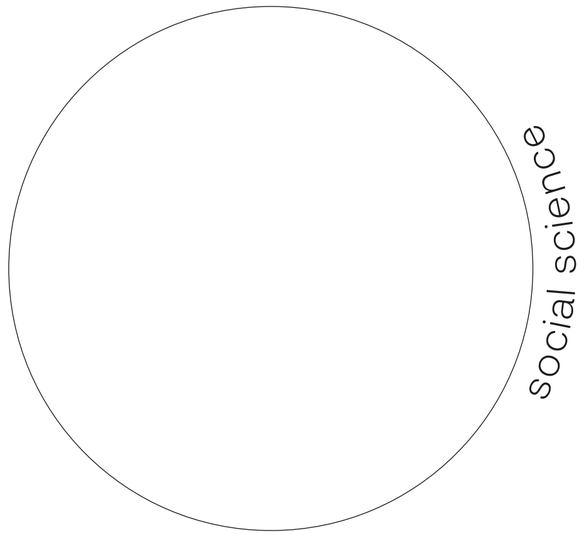




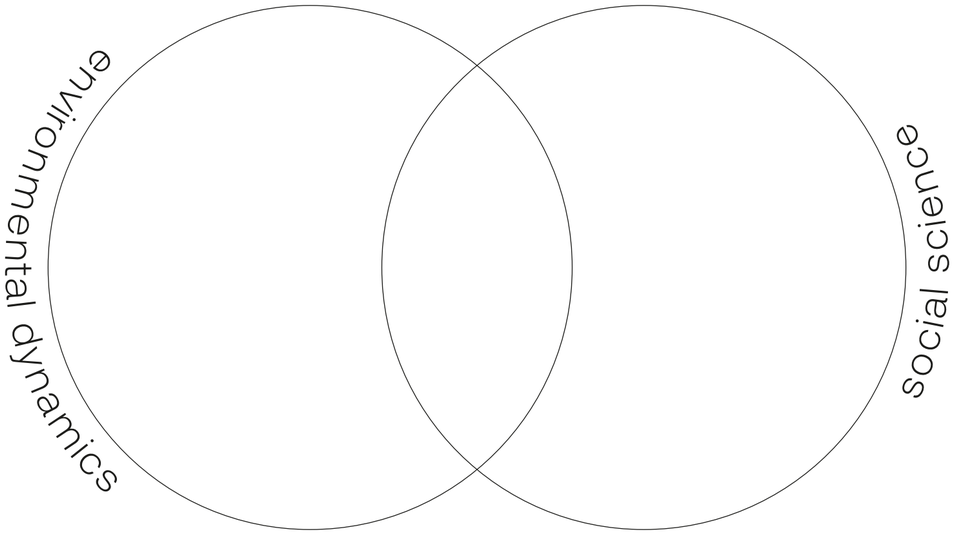
VI Design

Conceptual framework

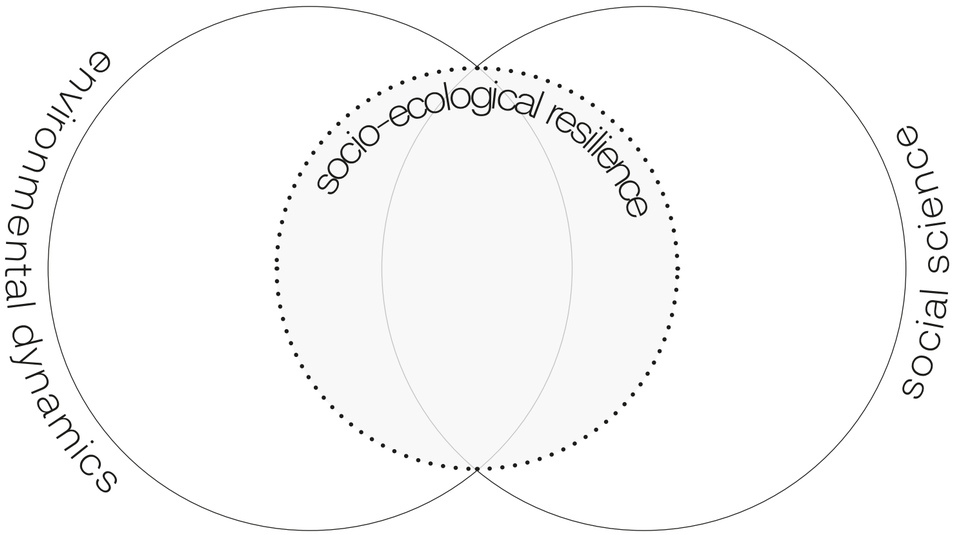




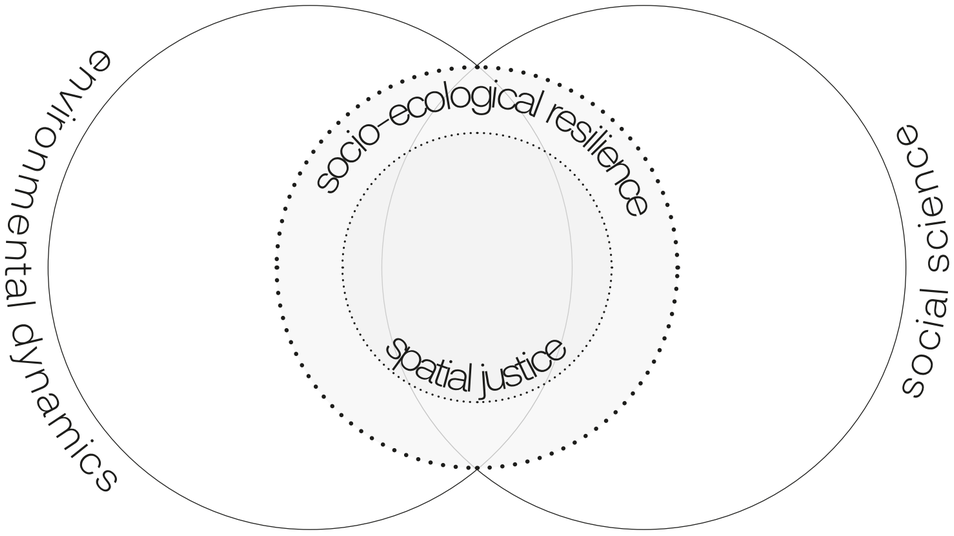
Conceptual framework



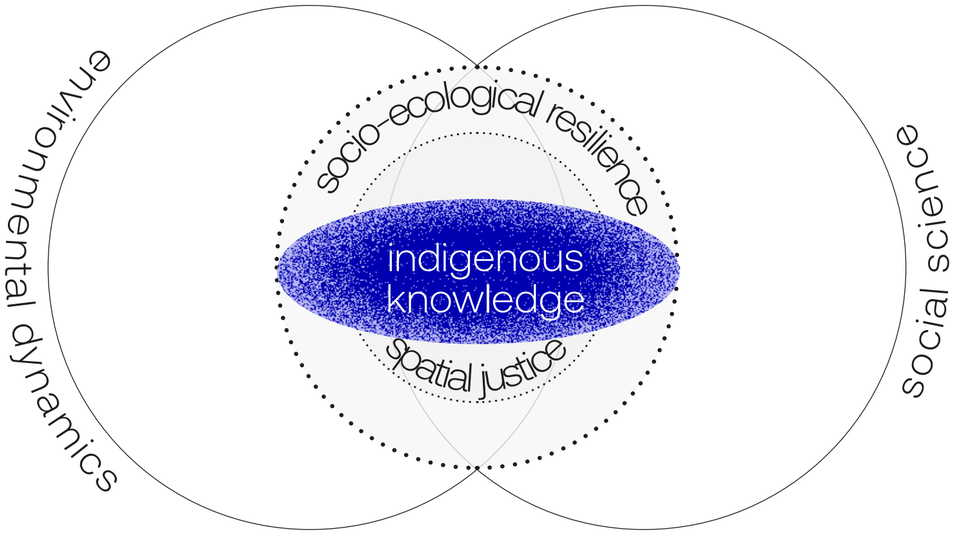
Conceptual framework



Conceptual framework



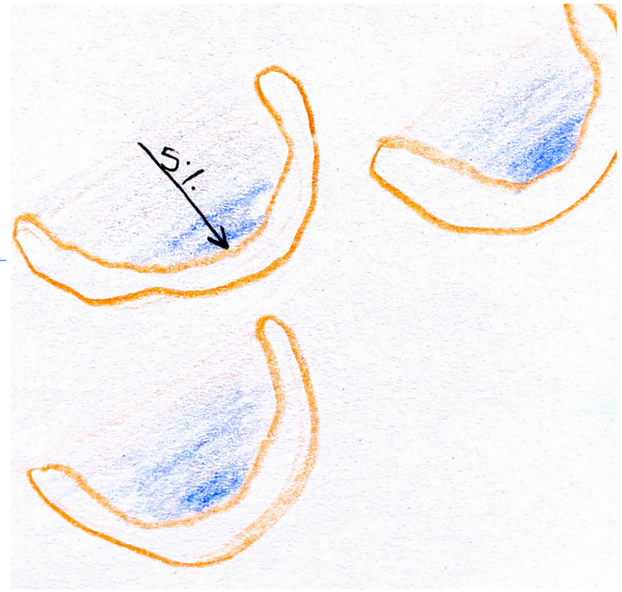
Conceptual framework



Pattern

pattern identification

Title — Zai Pit — Eco 1



Visual

Hypothesis — *Zai pits are an indigenous practice digging half moon shaped pits to recover soil quality in dry areas.*

Set — pattern set: Desert fight – Green education

scale

- dwelling
- block
- neighborhood
- city
- region

governance

- top down
- bottom up
- both

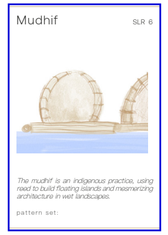
photo

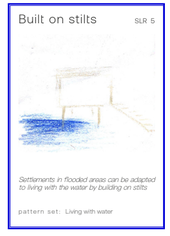
This practices is used in dry land–scapes with little water resources. The half moon shape catches and preserves rain water, regenerating the soil.
Pitfall: It needs human maintenance and possibly water

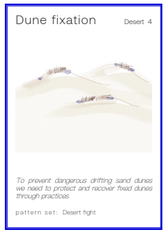
implementation & pitfall

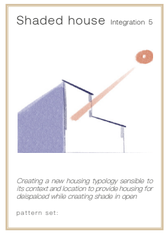
environmental

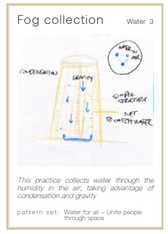
social

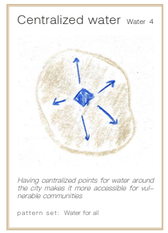


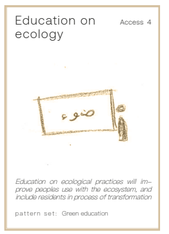


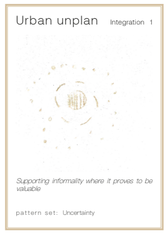


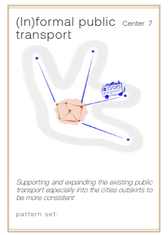


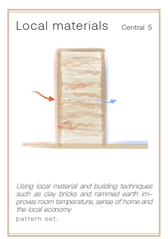












Ecological value

Land pollution

Sea-level rise

Desertification

Integration & social network

Distribution of water

Accessibility to Services

Economic Opportunity

Pattern sets

Title

Visual

Explanation & Implimentation

Assessment

Green education

W 1 Collecting water

E 1 Zai pit

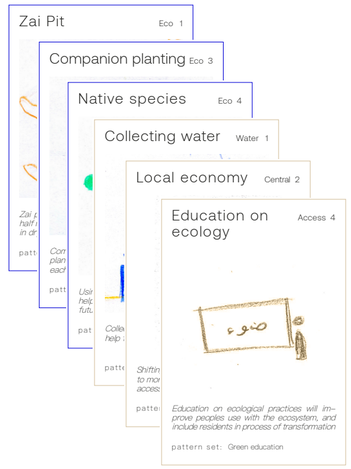
C 2 Local economy

A 4 Education on ecology

E 4 Native species

E 3 Companion planting

Protection against desertification requires large-scale cooperation at a transnational level; however, such efforts need to be grounded to local actions and education. Hubs of knowledge sharing should be present in close proximity to the Zai Pit landscapes, where people can get educated on the indigenous practices of caring for the land. They can also facilitate research and experimentation in a larger network of knowledge sharing throughout the Sub-Saharan region. This approach can also lead to creating a new economy around the green structures.



Patterns

Scale & Governance

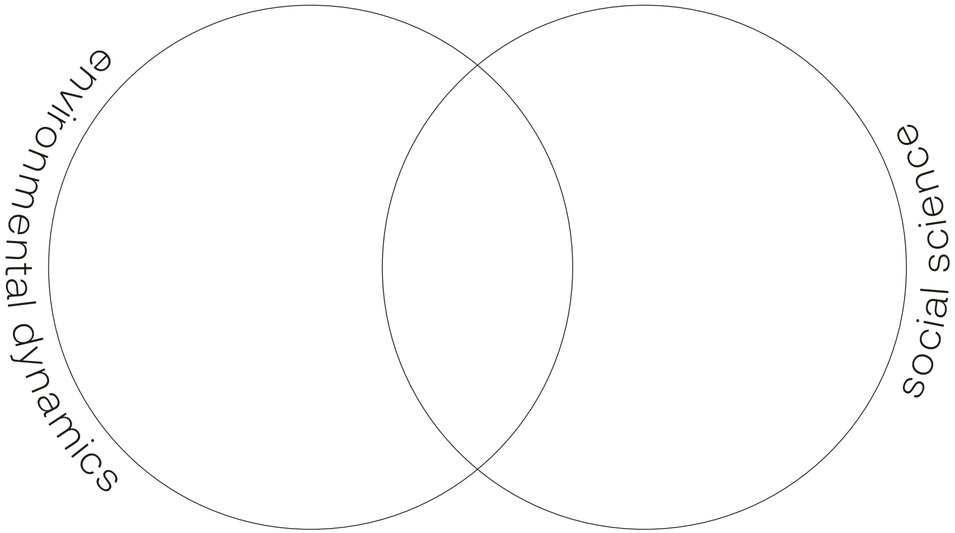
Create a Pattern Set

Task

Using the Patterns in front of you
create a meaningful Pattern Set, tackling
specific urgencies.

Aim

The aim is to connect environmental and
social aspects.



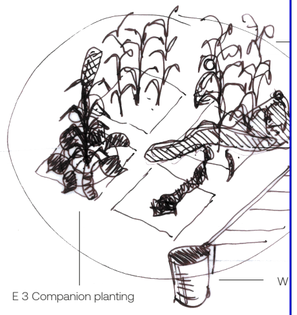
Rules

1. Sets are made of **at least three patterns**

2. Sets need patterns from **both fields**,
social and ecological

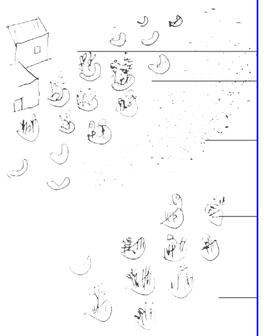
Ecological pattern sets

Community garden



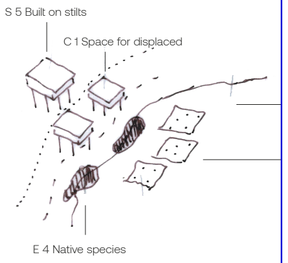
The community garden combines indigenous knowledg
planting in desert landscapes with a focus on native spec
form a symbiosis with the ecosystem. A focus lays on th
ticality and the users experience. In the Zuni culture, wat
dens were community gardens led by women, ensuring
in areas with [limited] water and degraded soil. The sunk
of the waffle gardens are dug into the ground, offering
ty to groundwater and keeping temperatures low. In ad
layer of manure and gravel trap moisture in the soil and
water runoff (Watson & Davis, 2020). Using plant spec
residents are familiar with, such as acacia niliotica, ment
gifolia, moringa stenopetala will utilize people's existing
edge. These gardens are best placed in secluded, c
like spots within the neighborhood. They can also be dev
bottom-up, provided that the technical know-how is sha

Desert fight



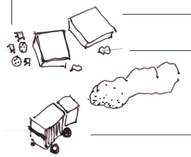
Desert fight is a strategic set of patterns formed to adapt the landscape to current and future challenges. Interacting with both the neighborhood scale and the city scale, it requires a somewhat higher level of organization and governance. This set utilizes the Zai Pit, a half-moon shape dug into the ground to capture rainwater and reduce run-off. This practice is already in use at the Green Wall Project, which operates on the scale of the entire continent to fight against desertification. Combining this practice with the planting of native plants and structures that can collect rainwater, this could provide relief for the city against the encroaching desert, as well as provide more employment opportunities for people in the outskirts of the city (FAO & MEDD, 2014: pp 111-115).

Living with water



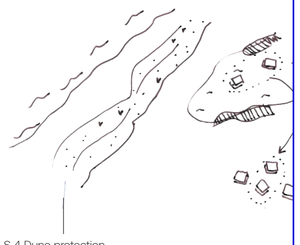
Much of the current territory is being confronted with issues of flooding and ground-water seepage, resulting in many people being displaced from the flooded areas. This pattern set arises from the urgency of dealing with this issue, but instead of trying to fight against it, it proposes to live along with the water. New housing types that utilize construction on stilts can be embraced to provide space for the displaced, but could also be expanded in the future, making new water-based neighborhoods. Caring for this emergent landscape through careful maintenance, planting of native plants that aid in water filtration, are important aspects to ensure a healthy environment for residents, as well as employment opportunities.

Healthy neighborhood



The current waste management system is lacking, wit
existing landfills being overcrowded creating seriou
health issues for the residents. This pattern set ad
dresses this widespread issue of pollution by creatin
employment opportunities through it. By addressing th
issue of waste management in the neighborhood scal
throughout the city, the volume of trash that reaches th
landfills would be reduced – making it easier to sho
and recycle. This can be achieved by educating peopl
on recycling practices and providing the necessary in
frastructure. Moreover, job opportunities could emerg
through the recycled materials, either in the form of ne
construction materials or crafts.

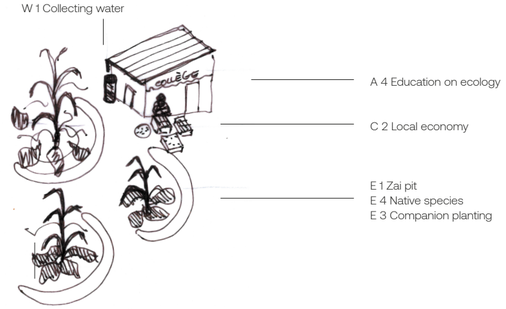
Altered landscape



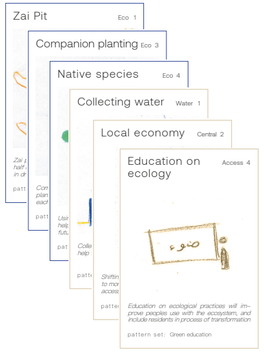
The alteration of Nouakchott's landscape is inevitable. Addressing the single physical barrier between the city and the Atlantic Ocean, this pattern set focuses on the protection of the narrow dune strip. This requires consideration of both human and non-human agents – both the residents of the affected areas of corrosion but also the animal and plant ecosystems. Apart from restoration work of the dunes through groundworks and policies, the government needs to anticipate the formation of new salt marshes and wetlands, and take early action. This includes providing suitable space for the people that need to relocate, as well as thinking of new ways of living with water.

Green education

neighborhood to city scale → both



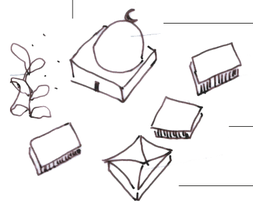
Protection against desertification requires large-scale cooperation at a transnational level; however, such efforts need to be grounded to local actions and education. Hubs of knowledge sharing should be present in close proximity to the Zai Pit landscapes, where people can get educated on the indigenous practices of caring for the land. They can also facilitate research and experimentation in a larger network of knowledge sharing throughout the Sub-Saharan region. This approach can also lead to creating a new economy around the green structures.



Social pattern sets

Sense of home

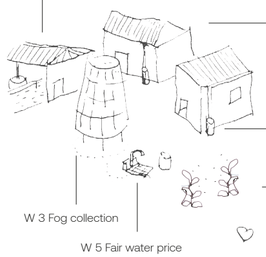
D 1 Green Spaces



A sense of home is a vital part in creating and maintaining a social network, especially in times of strife. This pattern set is geared towards the urban block and neighborhood scales, focusing on people's perception and use of public space. Many examples have shown that small and inexpensive interventions, like coloring the facades of buildings can provide a sense of identity to a neighborhood, as well as dismantle stigmatization and thus make residents feel more connected. It is also an act of repair towards the existing buildings, that if it is done with the assistance of a public institution may create better relations between residents and local government.
By supporting local public functions, such as schools or mosques, and with the integration of more communal spaces throughout the neighborhood in the form of the traditional Khaimas, the local community can be strengthened.

Water for all

W 4 Centralized water



W 3 Fog collection

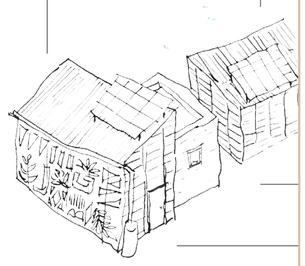
W 5 Fair water price

Water is the most precious resource for Nouakchott's residents, as it is both expensive and scarce – thus it is a necessity that it becomes a public good rather than a luxury. This pattern set establishes several principles for water use, in order to develop better availability and fair distribution. Most importantly, water prices need to be regulated in the form of policies from the government. Currently, water is far too expensive for people that are not connected to the central water network, however, such infrastructure can be costly and its construction very slow. In order to provide faster availability to water for all members of a neighborhood, this pattern set suggests the distribution through public functions. Making use of biophilic design principles, a fog collector in the form of a tower uses condensation and gravity, making water out of air. Each tower is easy to construct and lightweight, while it can also act as a local landmark.

Home upgrade

I 3 Shelter with meaning

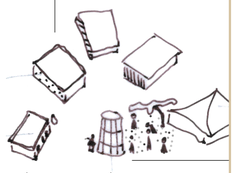
A 1 Solar support



This pattern set is aimed towards the adaptation of the individual home towards energy and water sufficiency, as the majority of buildings at the outskirts of the city lack basic infrastructure. This can easily be done by solar panels at the rooftops of existing houses, as well as by constructing systems of rainwater collection – making use of recycled local materials. Neighbor and local community relations should be considered here, resulting in small-scale communities that share resources. Upgrading the facades of houses with simple paint can inspire a sense of belonging and community

Unite people through spac

I 3 Shelter with meaning



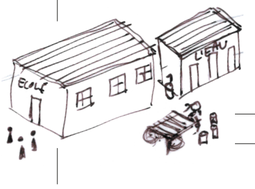
A 2 Public bathroom W 3 Fog collection

This pattern sets advocates for creating communit
spaces throughout the neighborhoods of Nouakchott, i
order to aid in both urban and social cohesion. This ca
be achieved through the intensification of public se
vices, like local water collection and distribution throug
the fog towers, access to public toilets, access to shad
and public gathering through the Khaimas, and acces
to public green. These nodes of unity should be place
at suitable locations, like courtyards, public squares o
other existing open spaces throughout the city, ensurin
accessibility for all residents.

Good public

□ ○ block to neighborhood scale ↓ top down

A 3 Education program



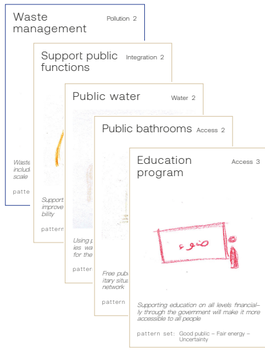
A 2 Public bathroom

W 2 Public water

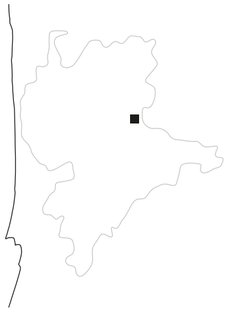
P 2 Waste management

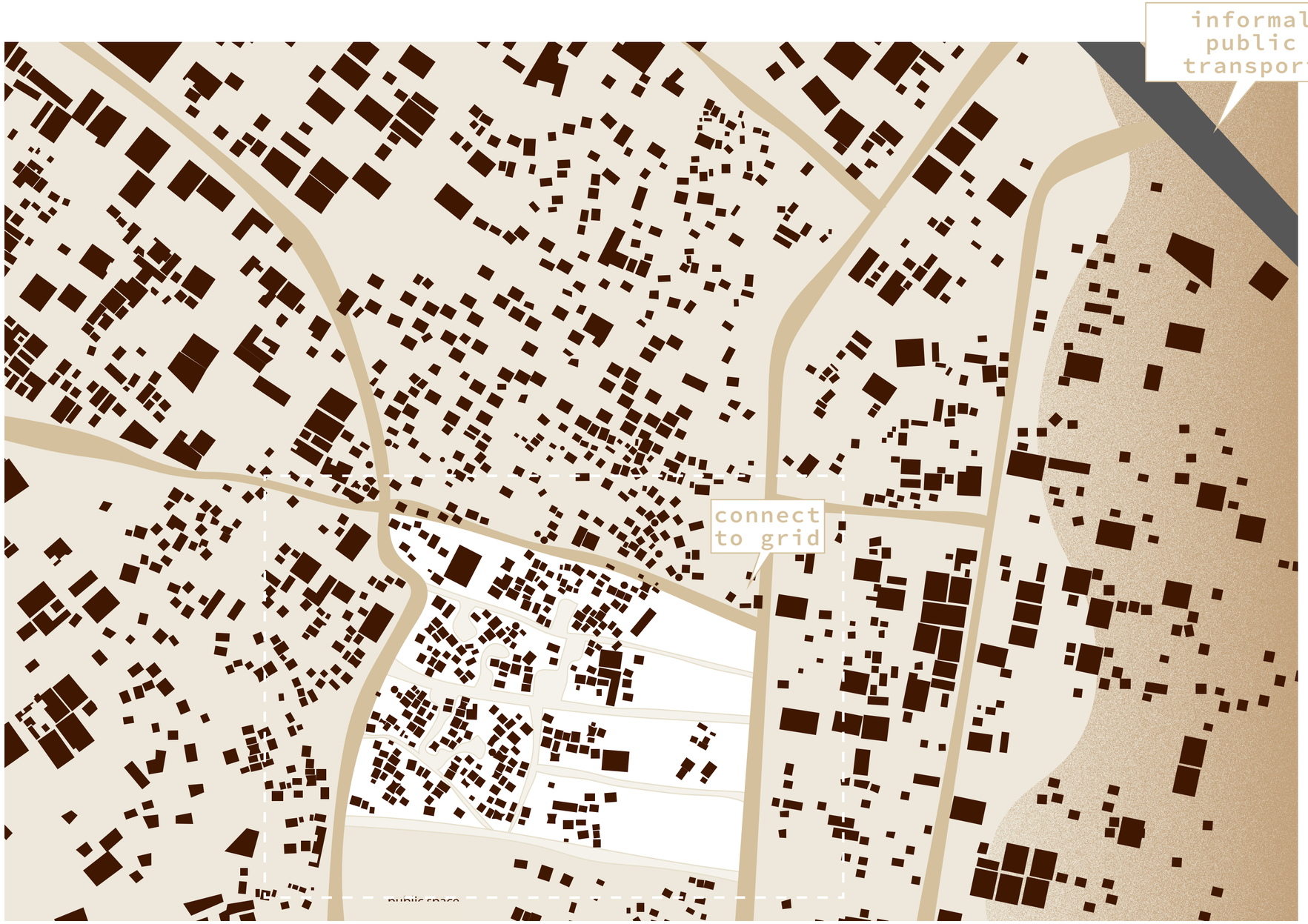
I 2 Support public functions

Access to public services is limited, especially at the outskirts of the city. This pattern set operates at the scale of the building and its immediate surroundings and emphasizes the importance of providing such access for all residents. This is not done through costly new construction, but by supporting existing public functions like schools and mosques to provide water and bathrooms to neighbors. Emphasizing education at the core of these public program nodes, with the combination of providing access to drinking water and public bathrooms, strengthens the existing community ties that naturally develop around places of public services, instead of seeking to create new ones elsewhere.

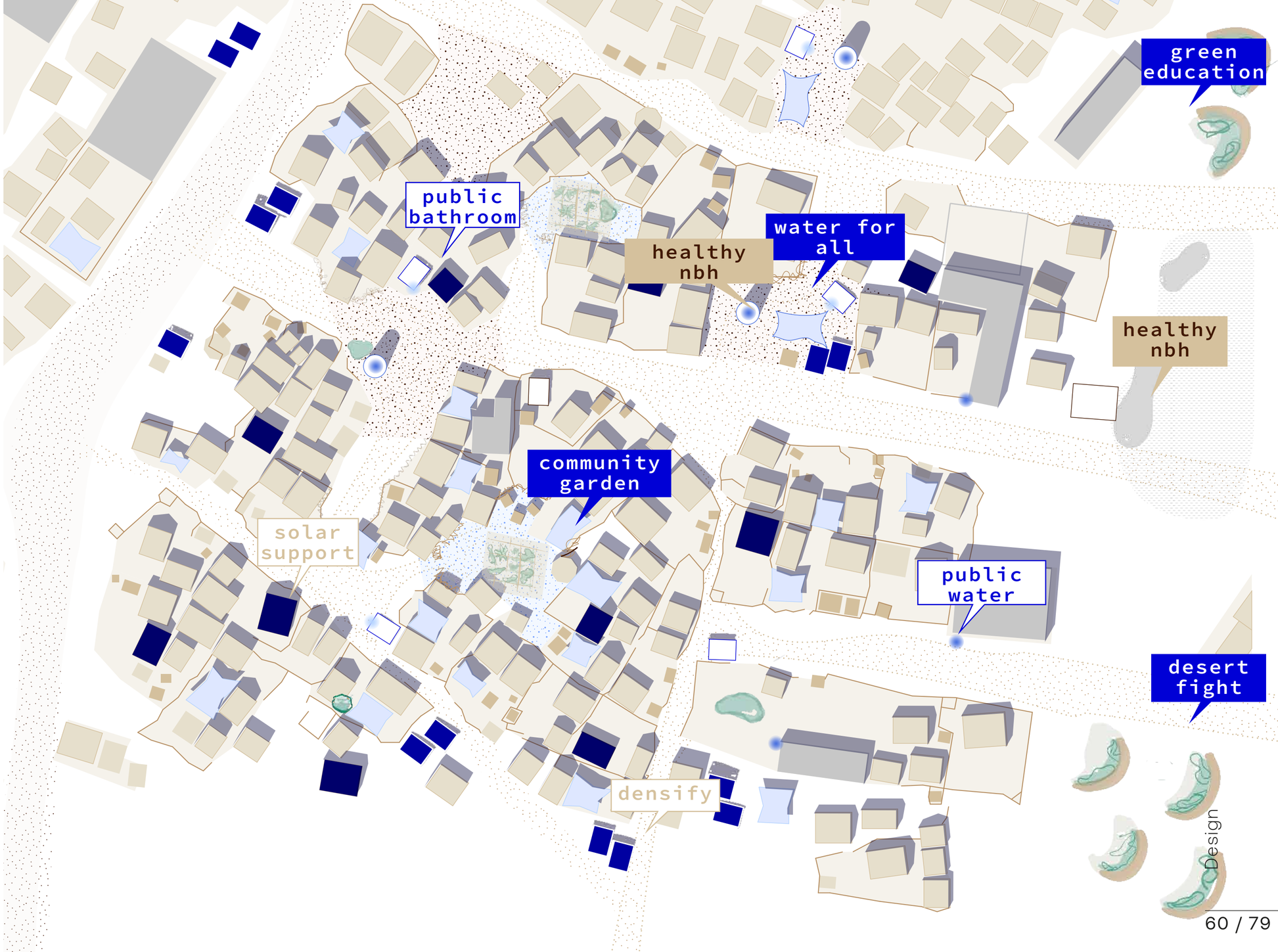


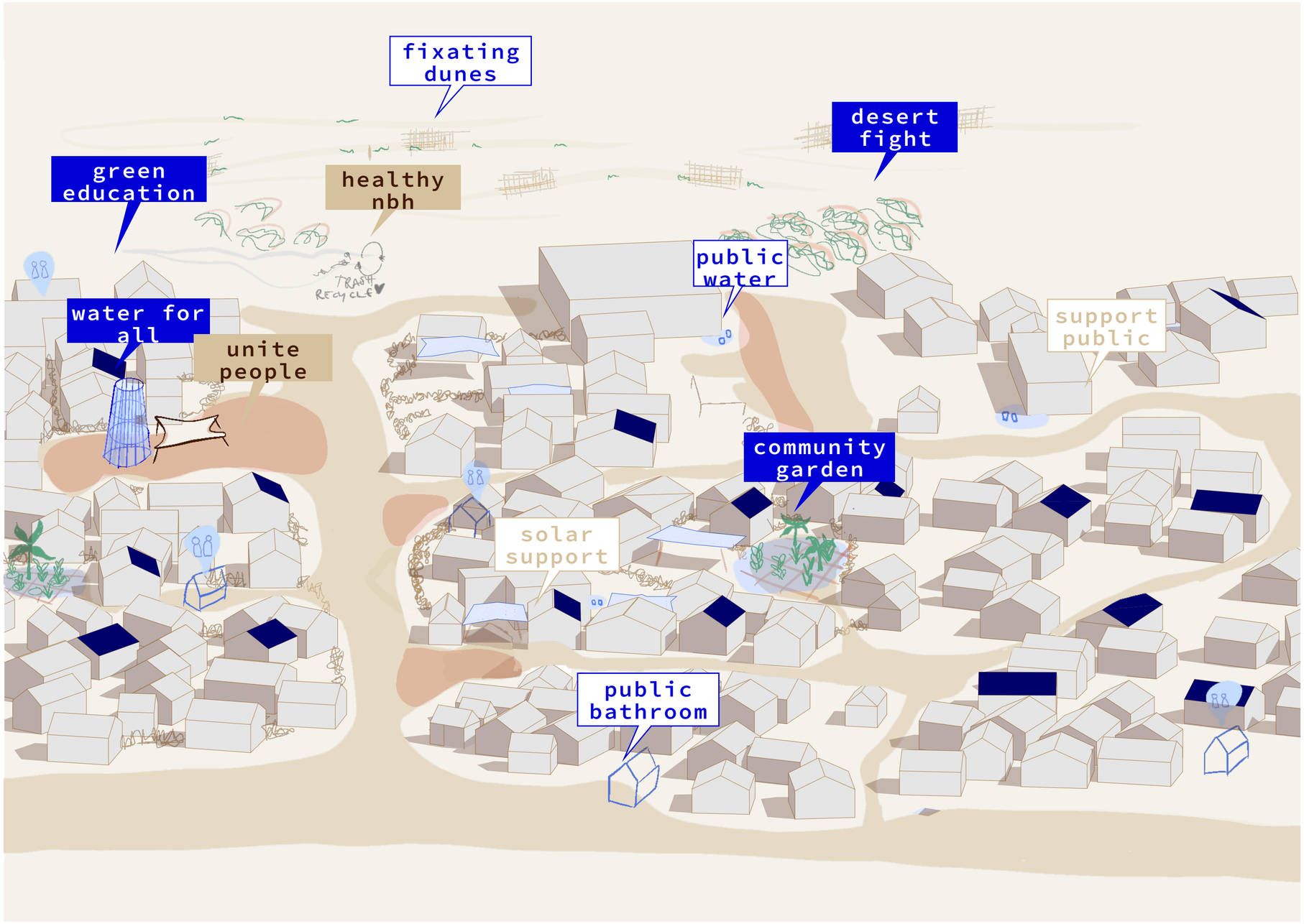
Upscaling



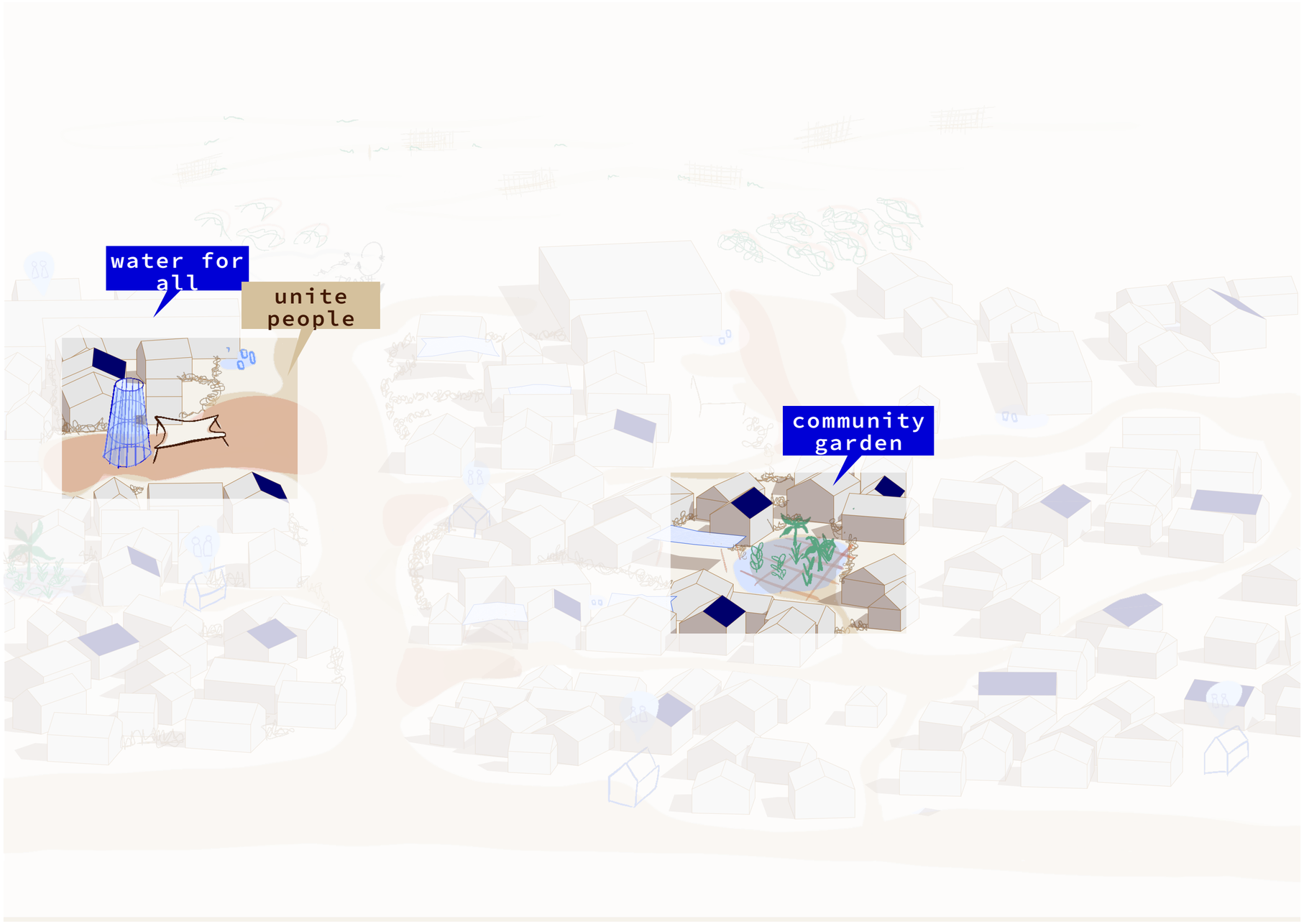


Green Safety

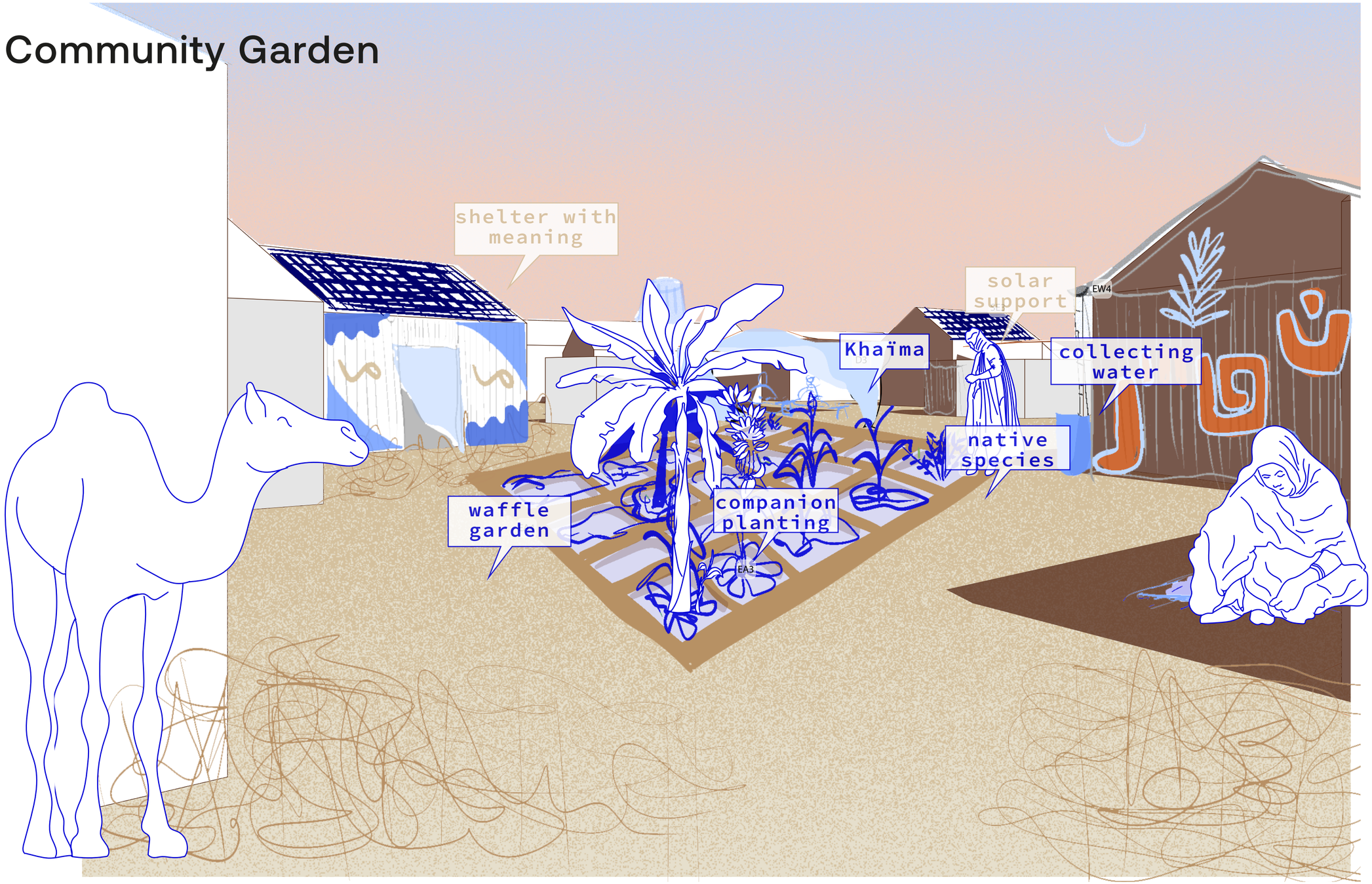



fixating dunes
desert fight
green education
healthy nbh
public water
water for all
unite people
support public
community garden
solar support
public bathroom

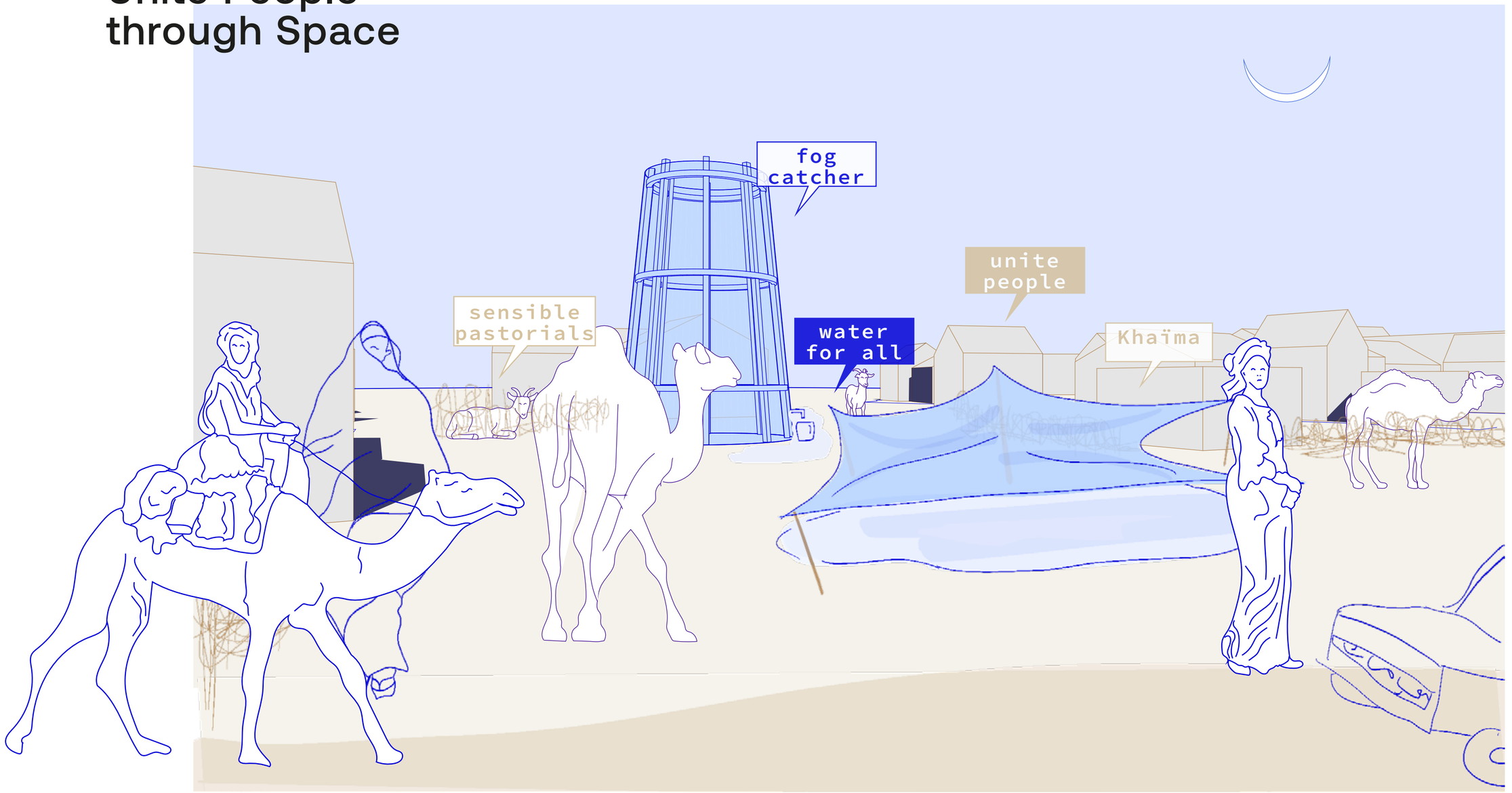
Focus



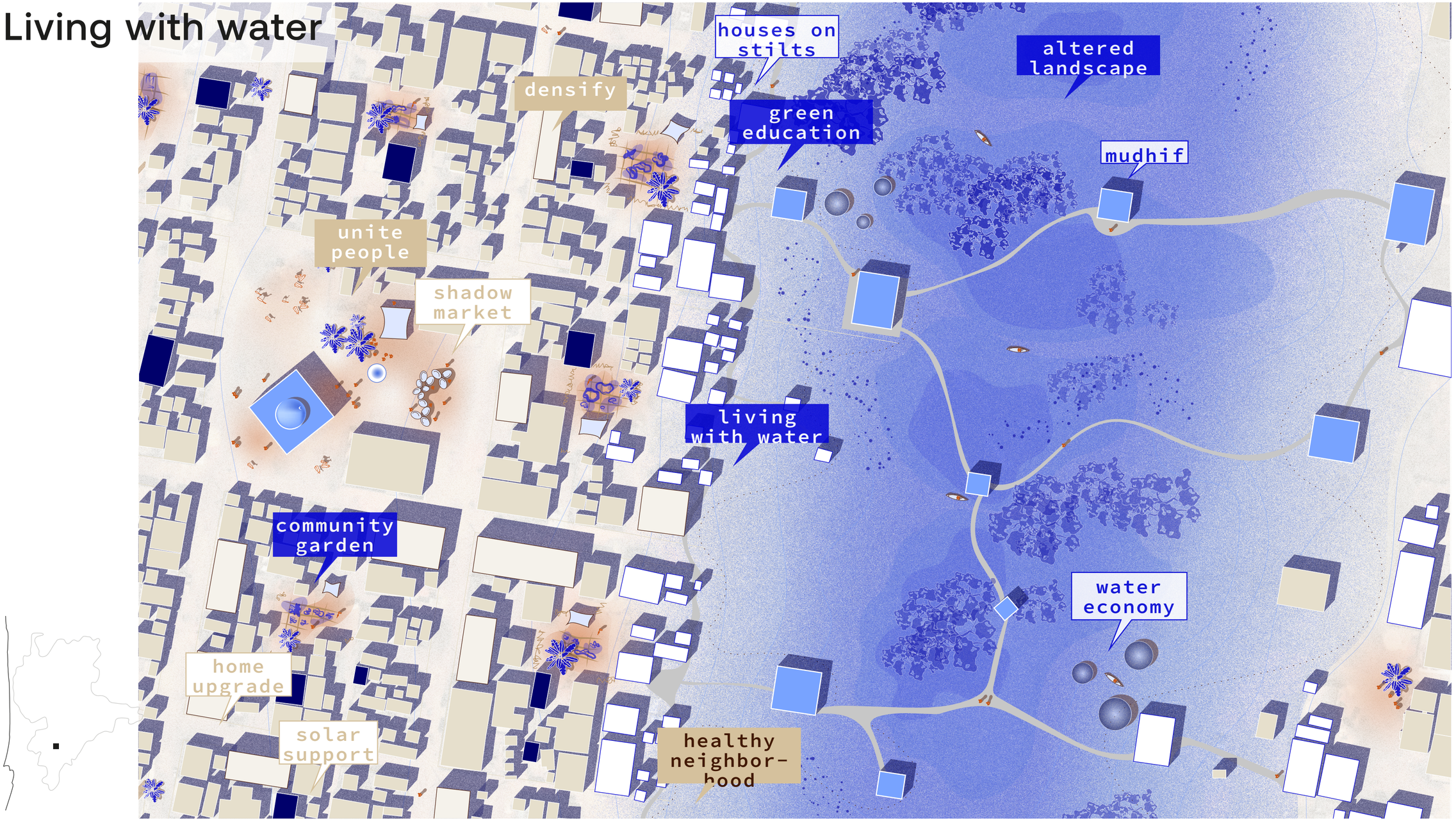
Community Garden



Unite People through Space

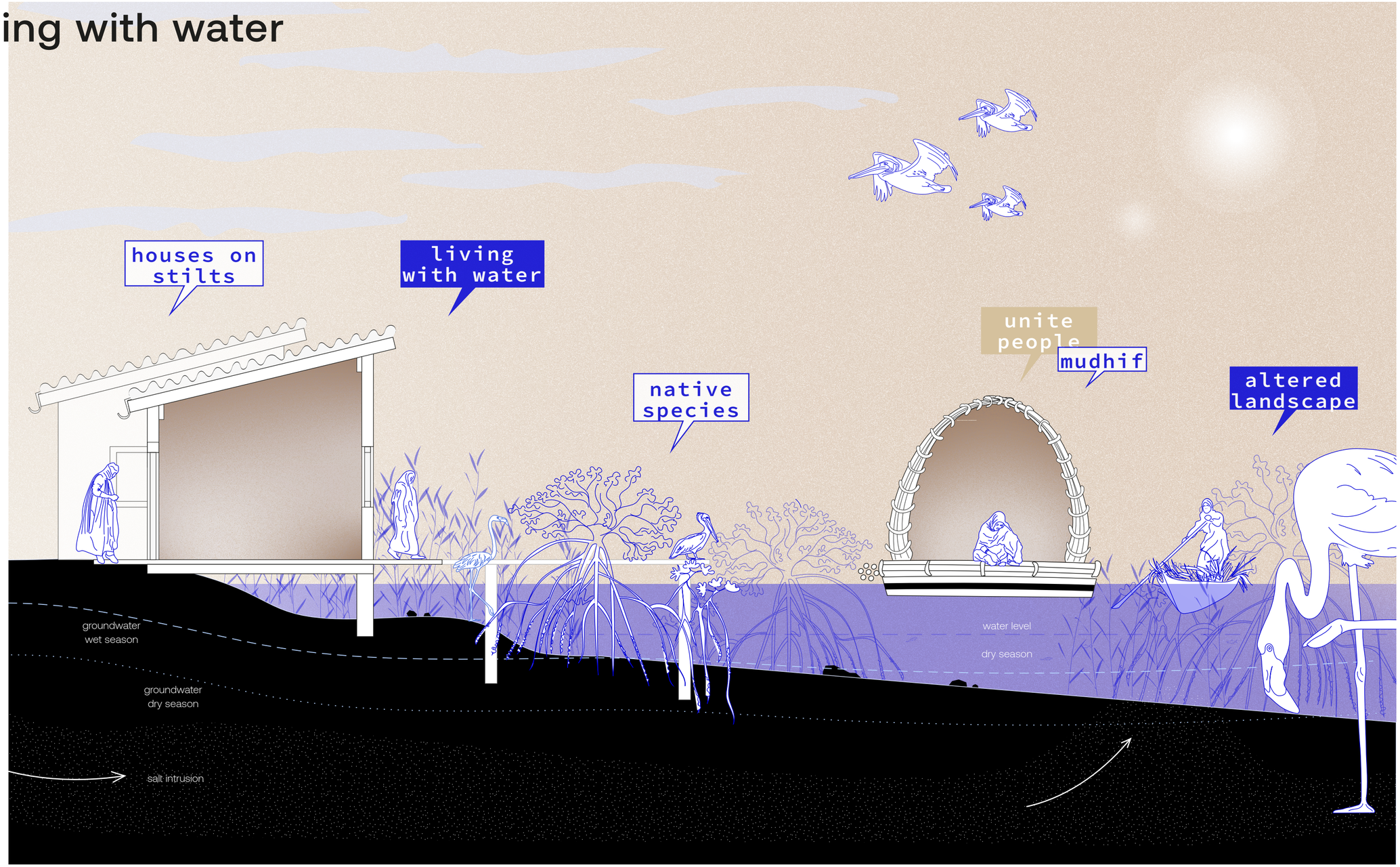


Living with water

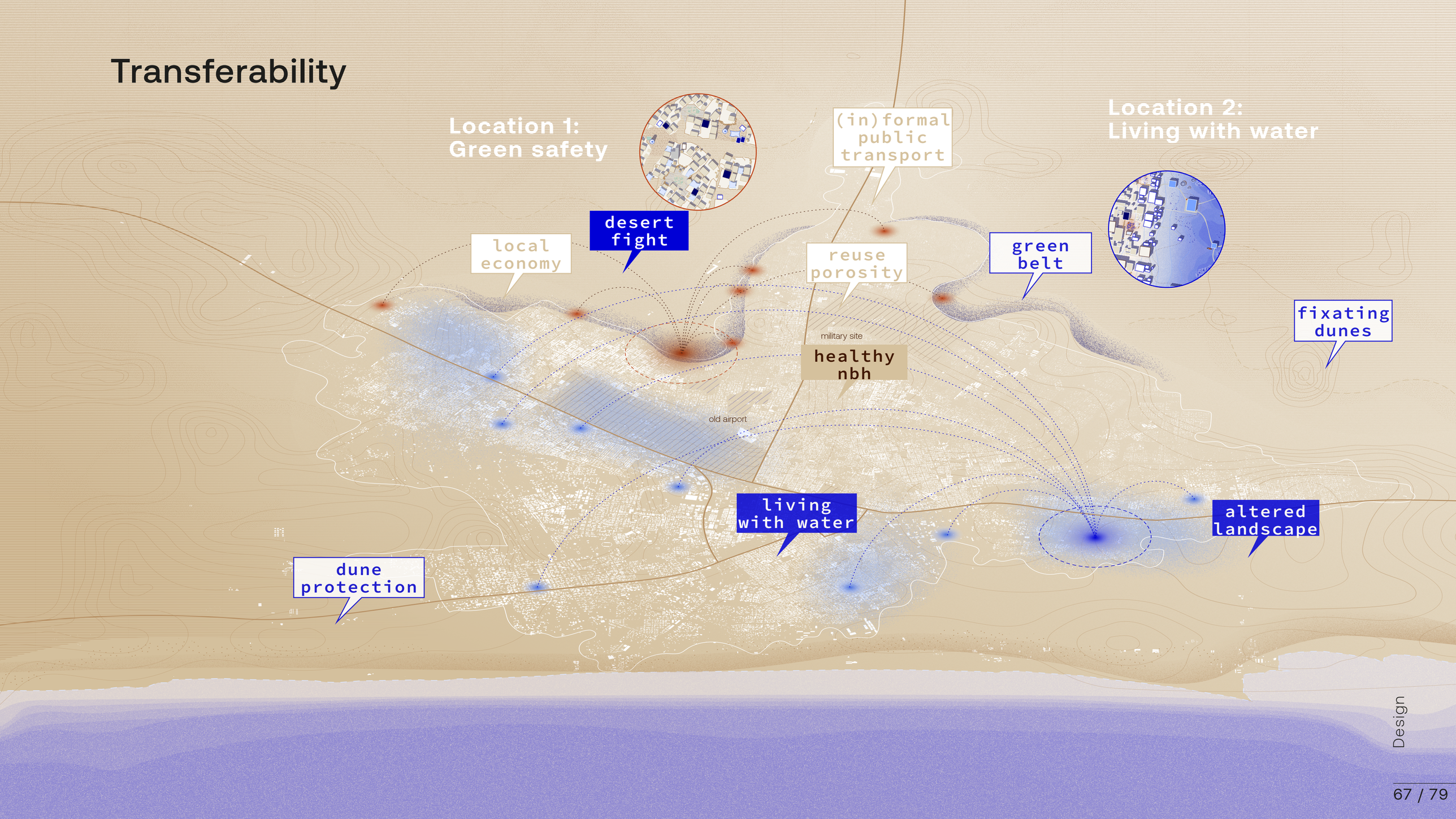


Design

Living with water



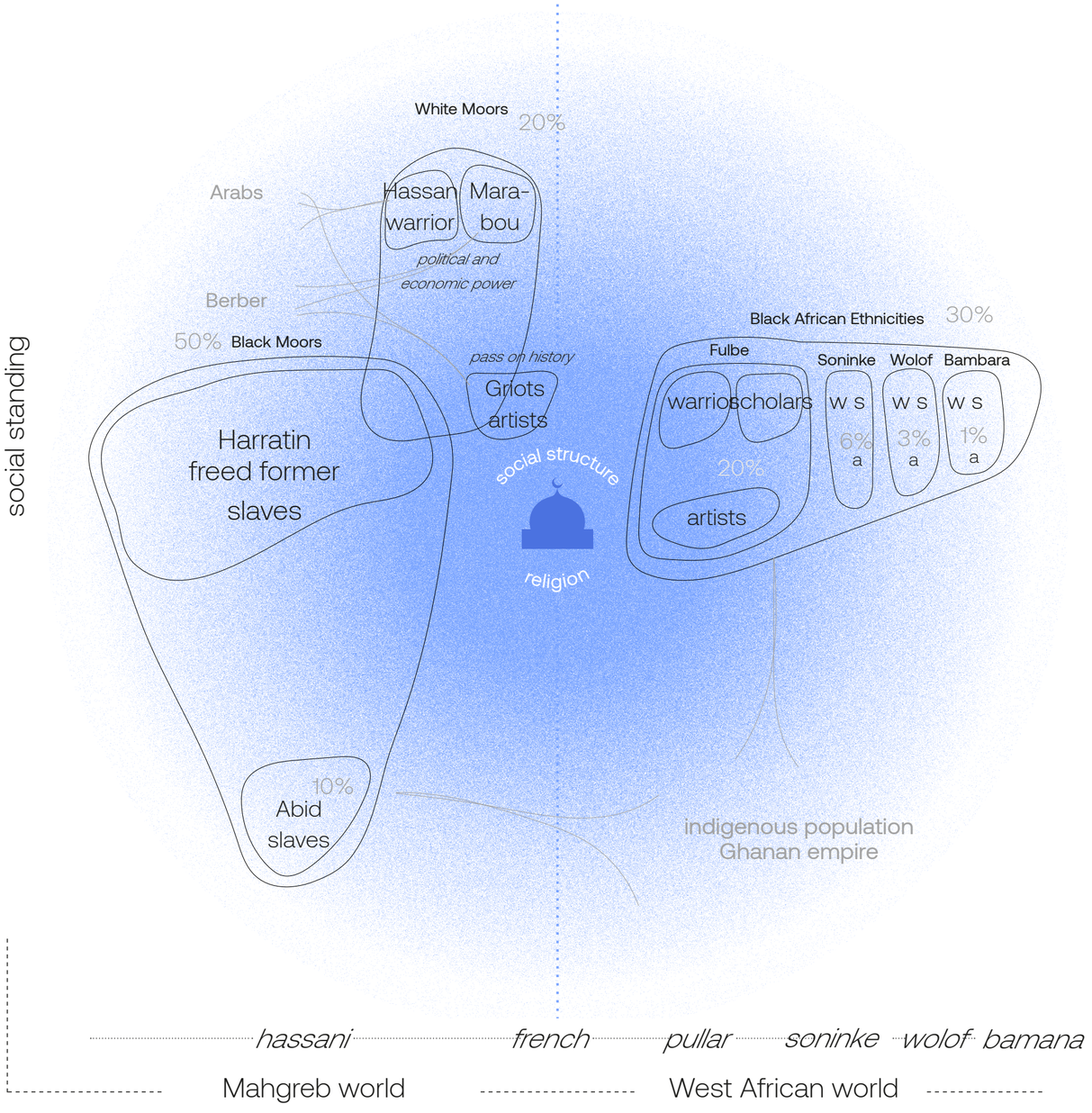
Transferability



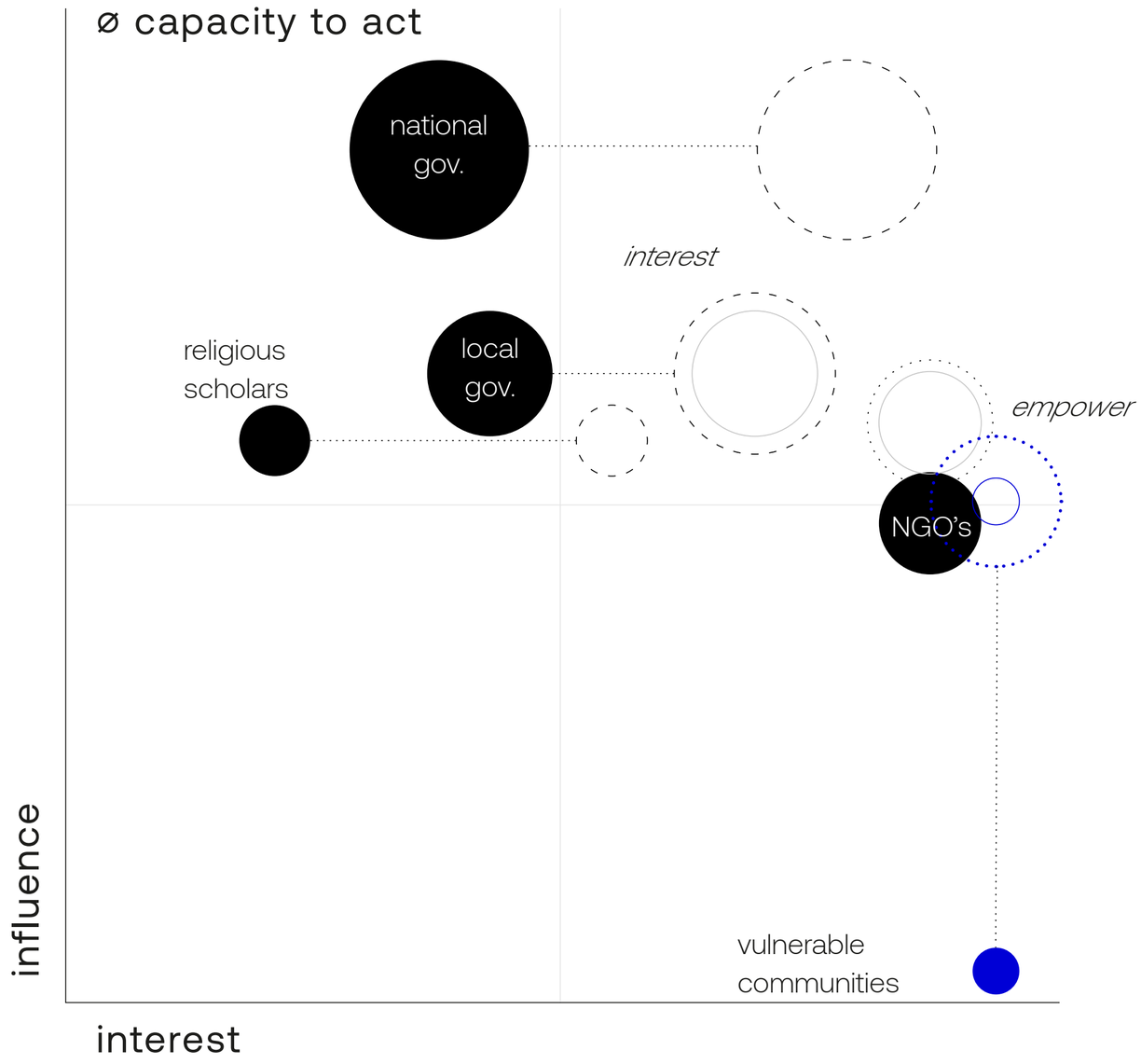
thank you for listening!

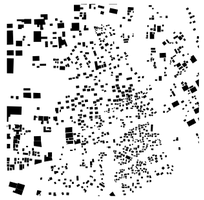
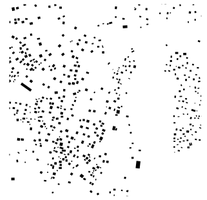
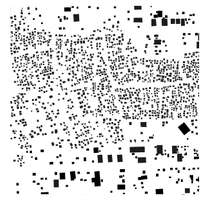
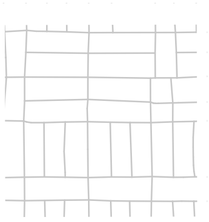
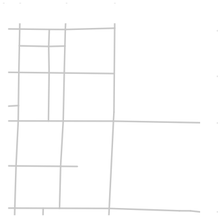
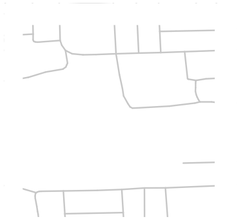
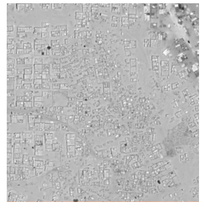
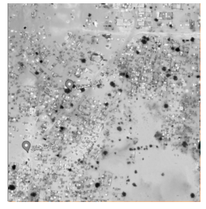
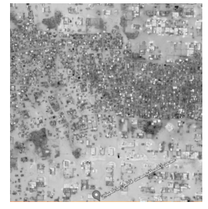
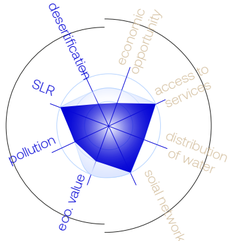
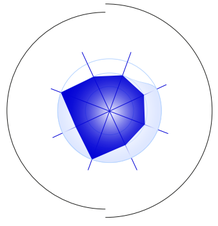
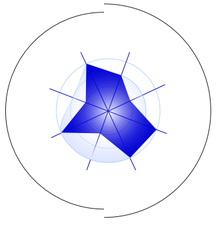
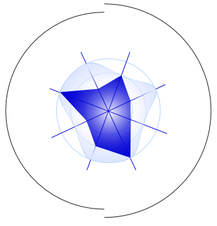
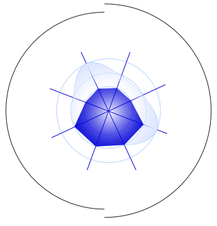
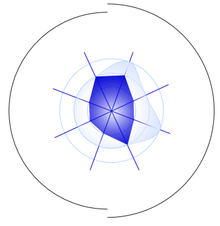
VII Appendix

Social Structure

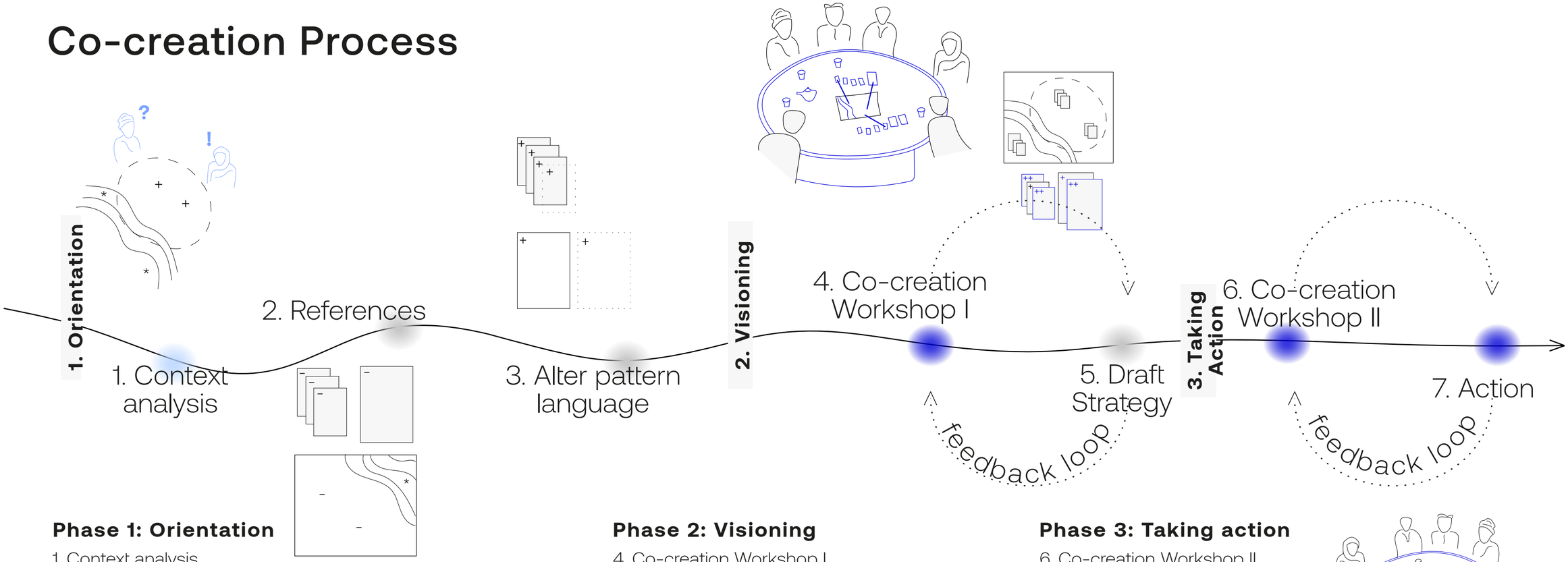


Governance


ø capacity to act
national gov.
interest
religious scholars
local gov.
empower
NGO's
vulnerable communities
influence
interest

	1	2	3	4	5	6
Urban fabric						
Street Hierarchy						
Satellite						
Morphology of urban fabric	Grid	Grid	Grid	Organic Surrounding irregular	Organic Surrounding irregular	Organic Surrounding regular
Order of (surrounding) grid	Regular	Irregular	Irregular			
Grid scale	Small	Large	Large			Small
Density	High	High	Low	High	Low	High
Age	2005	2008	2006 / 2007	2010	2012	2014
Dynamics	Formalized 2012	Formalized 2012	Persistent	Persistent	Persistent	Demolished 2023
Assessment and Potential						

Co-creation Process



Phase 1: Orientation

1. Context analysis
assess environmental exposure, social sensitivity and existing adaptive capacity

2. References
refer to similarities in design examples

3. Alter pattern language.
Alter patterns and pattern sets to fit the local context

Phase 2: Visioning

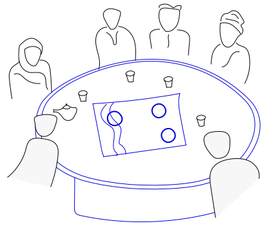
4. Co-creation Workshop I
community gives feedback and spatial insights on proposed pattern language

5. Draft Strategy
Patterns are adjusted, and a draft spatial design strategy is developed using local knowledge.

Phase 3: Taking action

6. Co-creation Workshop II
Presents design strategy and creates a space for feedback, discussions and alterations

7. revised strategy is presented. preparing residents for implementation, fostering engagement. The implementation phase includes learning indigenous practices from the community, as well as educational workshops.



Research Questions

4. What can we learn from the cultural identity and historic context of Mauritania?

1. What makes Nouakchott particularly vulnerable to present and future impacts of climate change?

How can context specific spatial interventions focused on climate urgencies contribute to urban and climate resilience, while improving spatial justice in Nouakchott?

3. What spatial injustices, especially in vulnerable communities, arise in Nouakchott?

2 How has Nouakchott grown and persisted over time in its vulnerable geographical context?

5. How can indigenous practices and technological solutions inform the design of an adaptive pattern language?

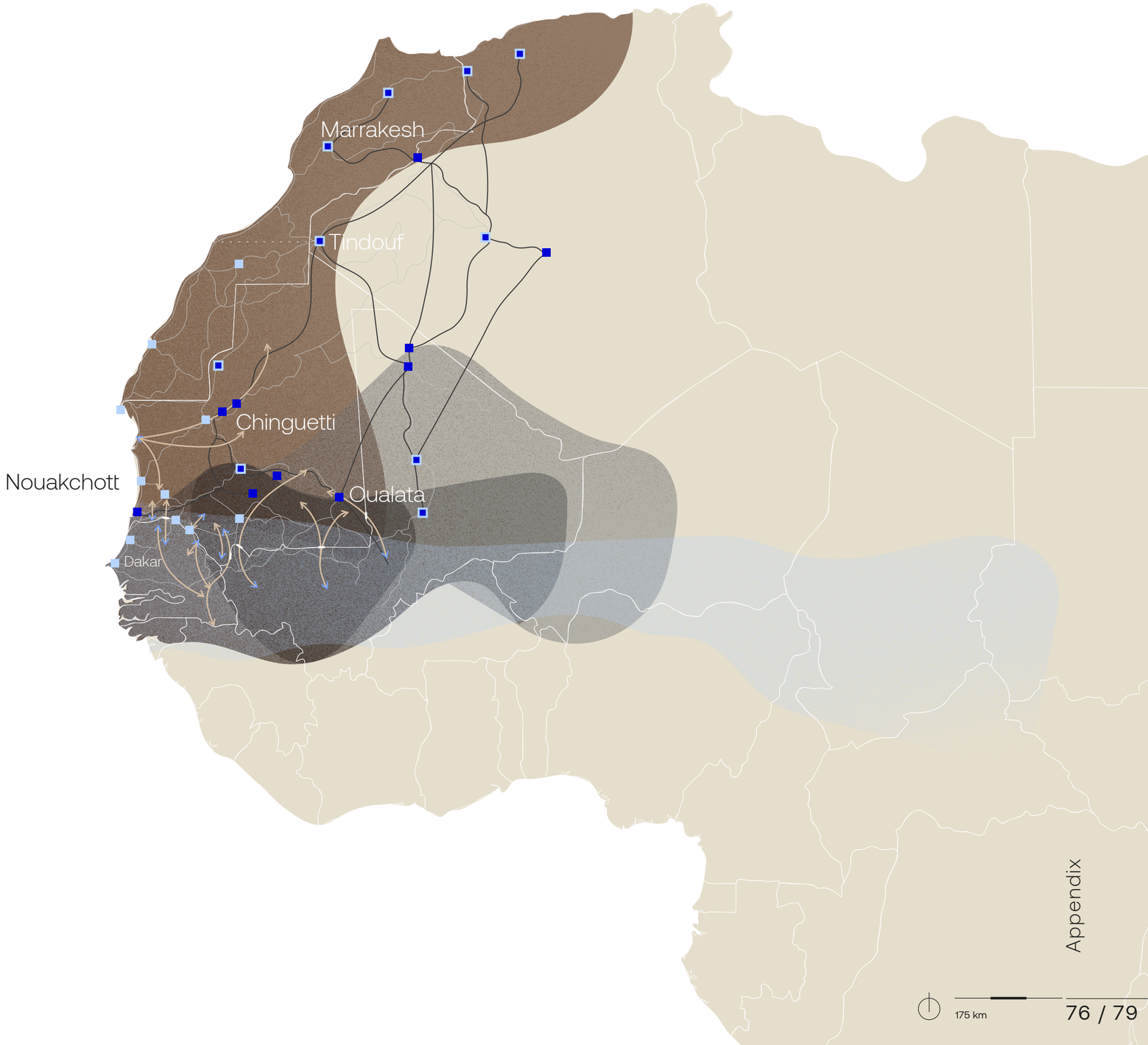
How can context specific (4.) spatial interventions focused on climate urgencies (1.) contribute to urban and climate resilience, (2.) while improving spatial justice (3.) in Nouakchott?

Sub-research question	Method	Acronym	Expected Outcome
1. What makes Nouakchott particularly vulnerable to present and future impacts of climate change?	(1) Morphological analysis, Research and statistical data analysis (2) Spatial Mapping with GIS	**MA** **SD** **SM**	**Maps projecting the spatial implications and landscape alterations caused by negative impacts of the climate crisis**
2. How has Nouakchott grown and persisted over time in its vulnerable geographical context? Why does Nouakchott experience this rapid growth? Where does this happen spatially on a city scale? What urban structures are persistent or transformed and how on a neighborhood scale?	(1) Literature review and statistical data analysis (2) Morphological analysis, Spatial Mapping, Diachronic analysis (3) Data comparison and transformation, Spatial Mapping, Critical cartography	**LR SD** **MA SM** **DA** **DT SM** **CC**	**(1) Identifying drivers for urbanization dynamics. (2) Diachronic maps of urbanization , infastructure and landscape on a metropolitan scale. (3) Diachronic maps identifying persistent and transformative patterns on a neighborhood scale.**
3. What spatial injustices, especially in vulnerable communities, arise in Nouakchott?	(1) Literature review (2) Spatial Mapping (3) Research and statistical data analysis, Vulnerability assessment	**LR** **SD** **SM** **VS**	**An atlas on identifying and assessing vulnerability. (1) Summary of reviewed literature to identify the relation of vulnerability and scale. (2) A typology of urban patterns representative throughout the city, and map of their replication. (3) An assessment criteria and evaluation for spatial and social vulnerability, used on the identified typology**
4. What can we learn from the cultural identity and historic context of Mauritania?	(1) Site research through text, video, photography, Morphological analysis, Literature review (2) Research through exploration and design, statistical data analysis, Spatial Mapping,	**SR** **MA** **LR** **XD** **SD** **SM**	**(1) Identifying aspects of the culture, tradition and indigenous resilience in the daily life of Mauritanians through identity portraits. (2) Map of spatial implications and activity on a neighborhood to architectural scale.**
5. How can indigenous practices and technological solutions inform the design of an adaptive pattern language?	(1) Literature review, Case study analysis, Pattern language method, (2) Research through exploration and design	**LR** **CS PL** **XD**	**Pattern booklet with spatial interventions through all scales. Designing the process and use of patterns through pattern sets. Lastly verifying their transferability, adaptive qualities, and limitations of patterns by mapping transformative implications.**

= Approach
Research approach

Analytical research question
Theoretical research question
Design assignment

History



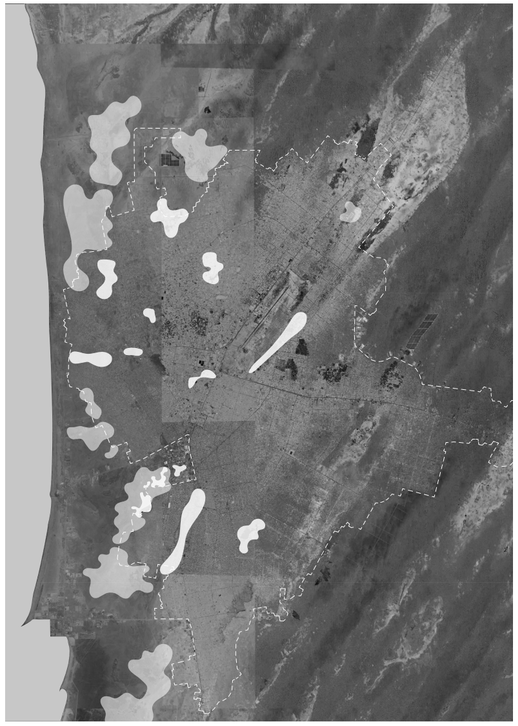
Indigenous and postcolonial territory

- Shonghay Empire 15-16th century
- Mali Empire 9-14th
- Ghana Empire 4-10th
- Almoravid Empire 12-13th
- Ancient city or oasis
- Precolonial route
- Seasonal movement (dry & wet season)
- Present day borders
- Present day routes
- Border crossings
- Pastoral zone
- Present day cities

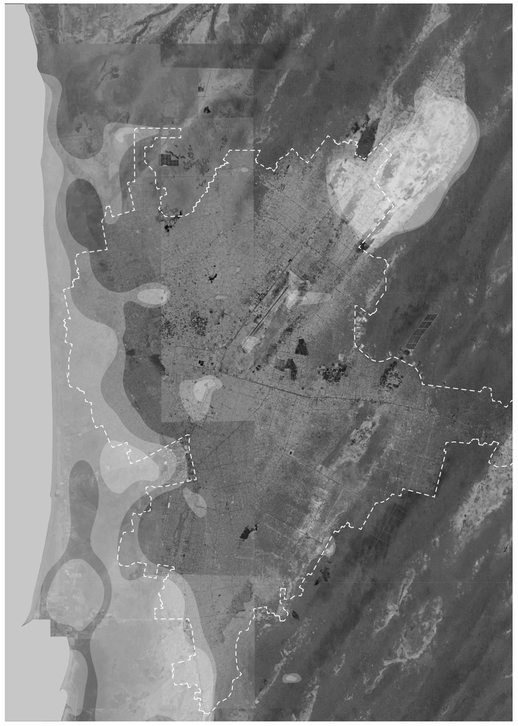
Appendix

175 km

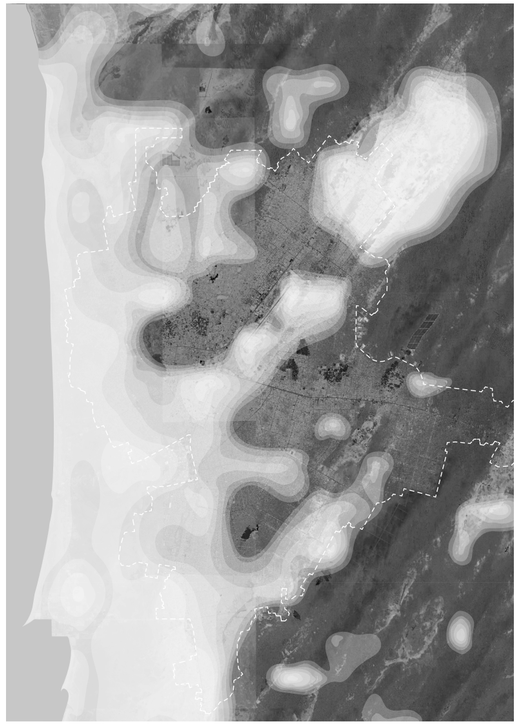
Water



Flooded today



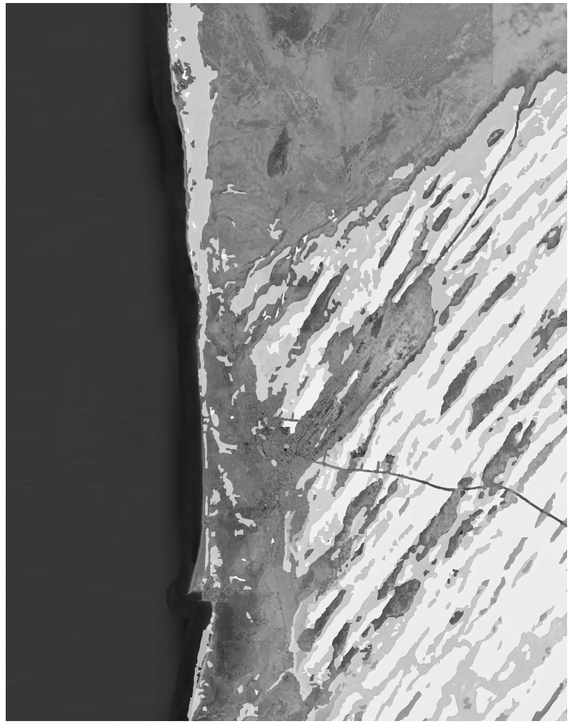
2 meter



3 meter

2 km

Desert

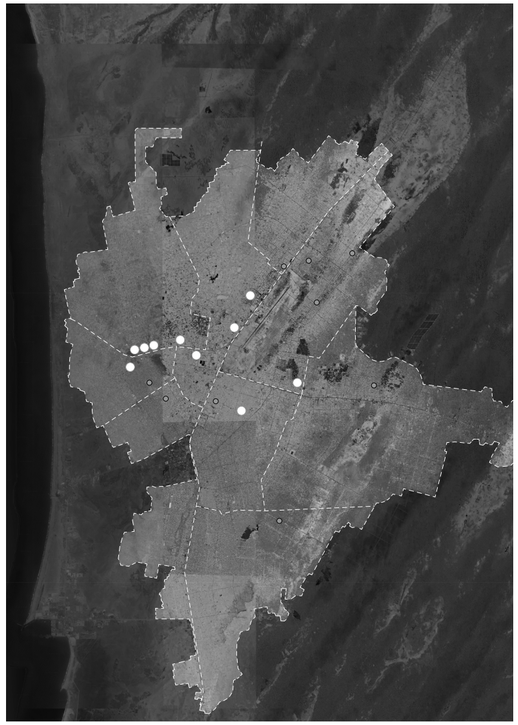


1985

2000

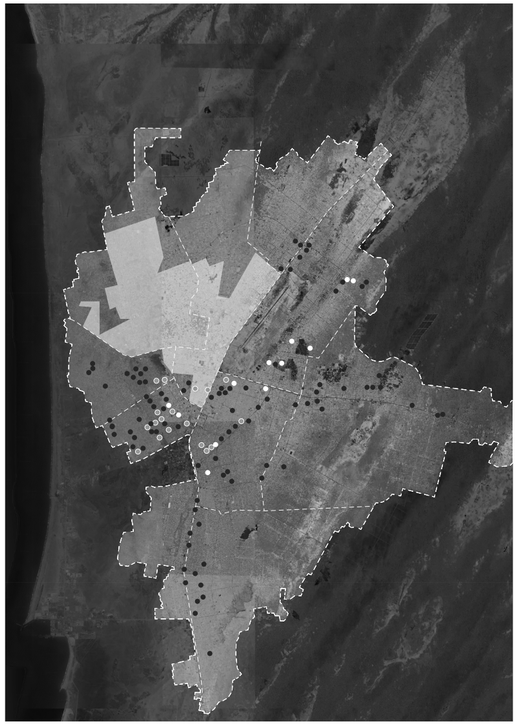
3 km

Human



Health Care

Hospital

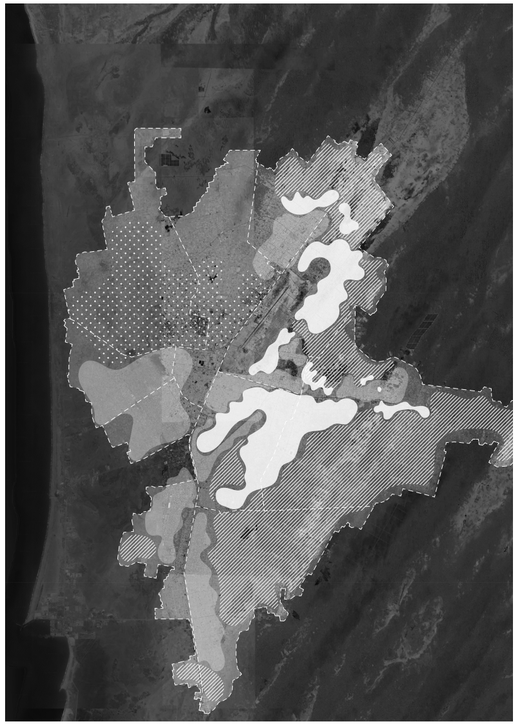


Water accessibility

Home or public tab

Clean Portable water

Highly contaminated water



Housing quality

2 km