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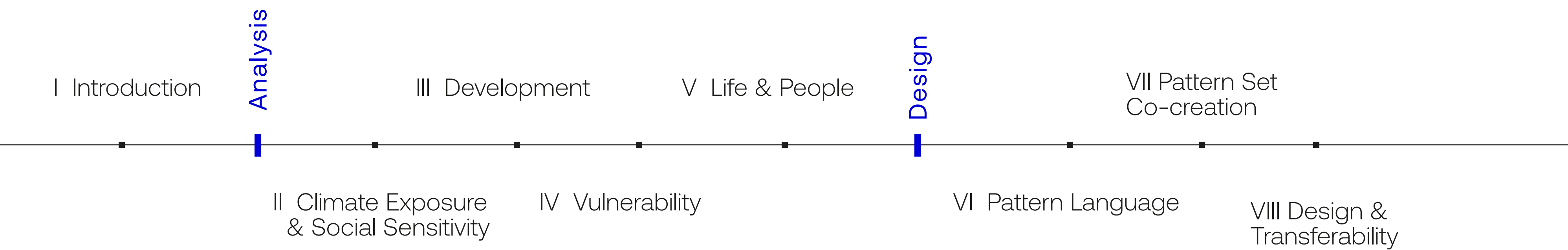
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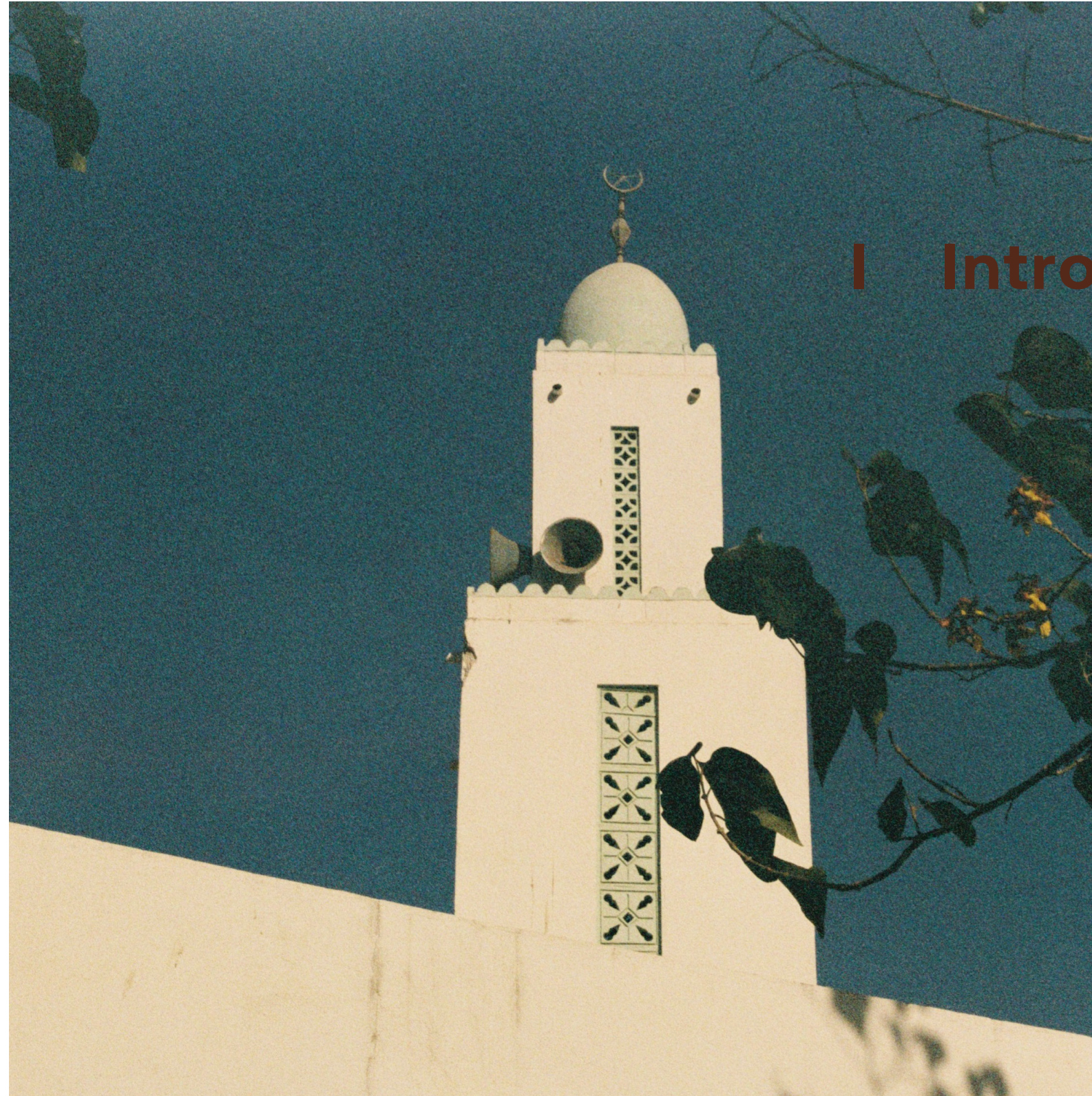


*Yallah**

a path to climate resilience and spatial justice in Nouakchott

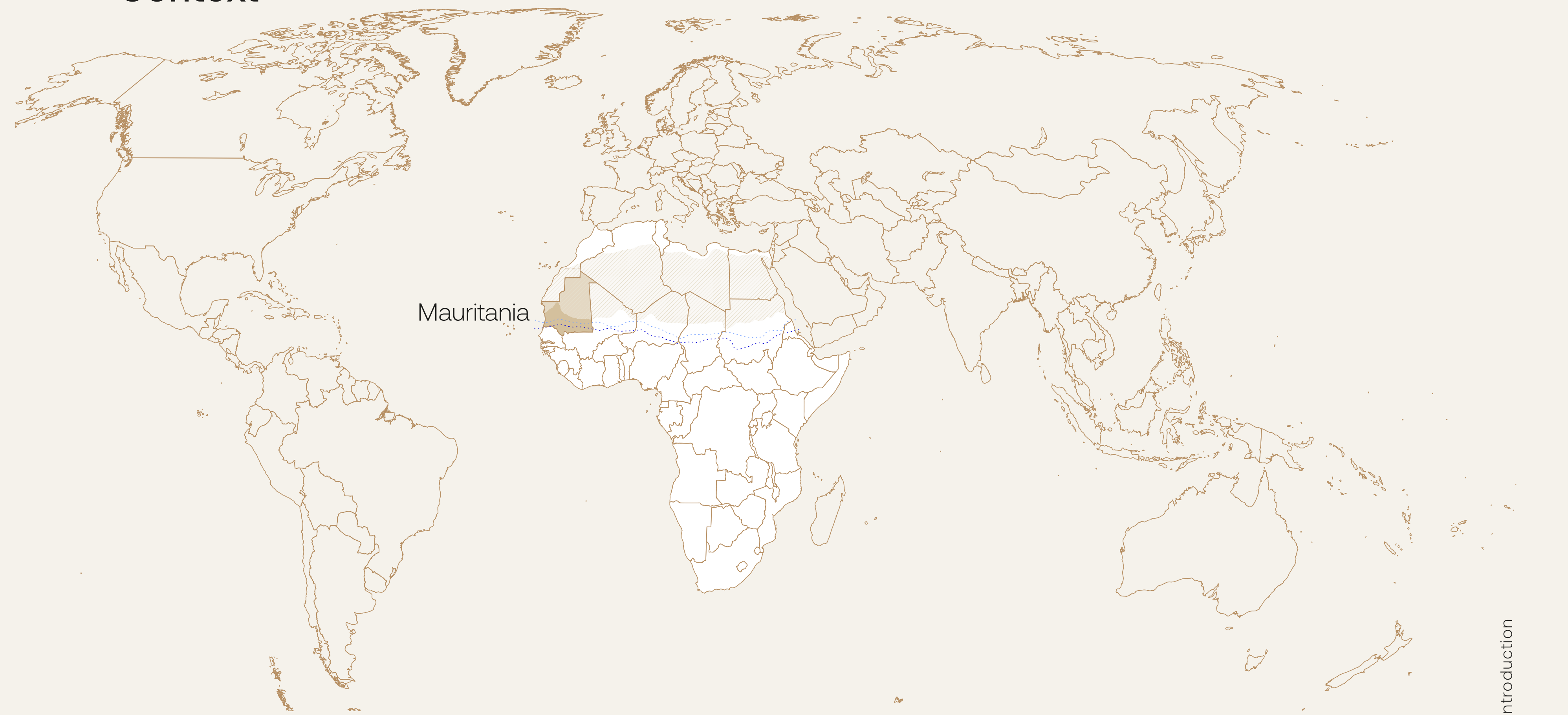
Content





I Introduction

Context



Mauritania



© Michael Wahl



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II Climate Exposure & Social Sensitivity

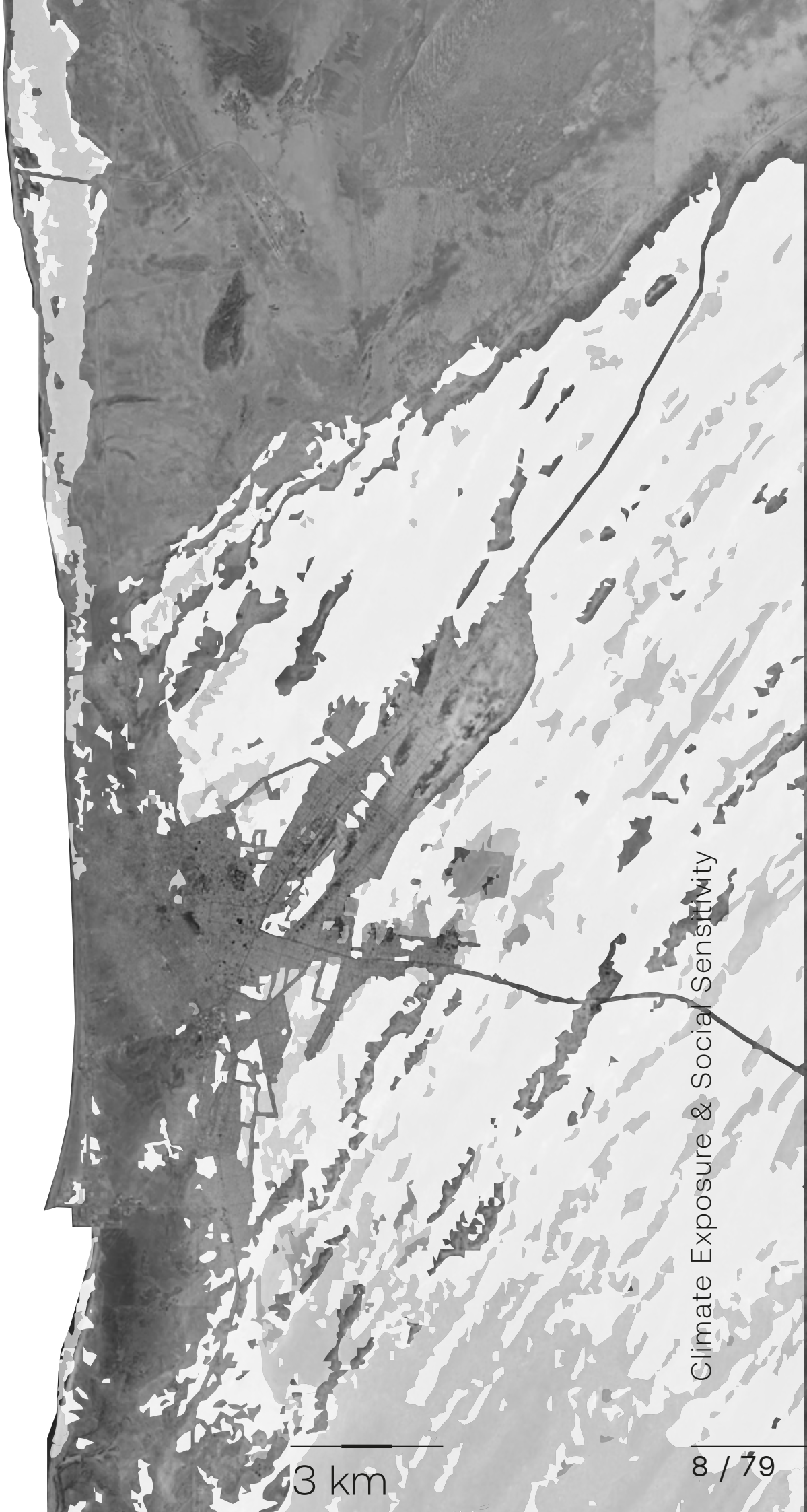


Desert



Desertified area

- Very severely desertified
- Severely desertified



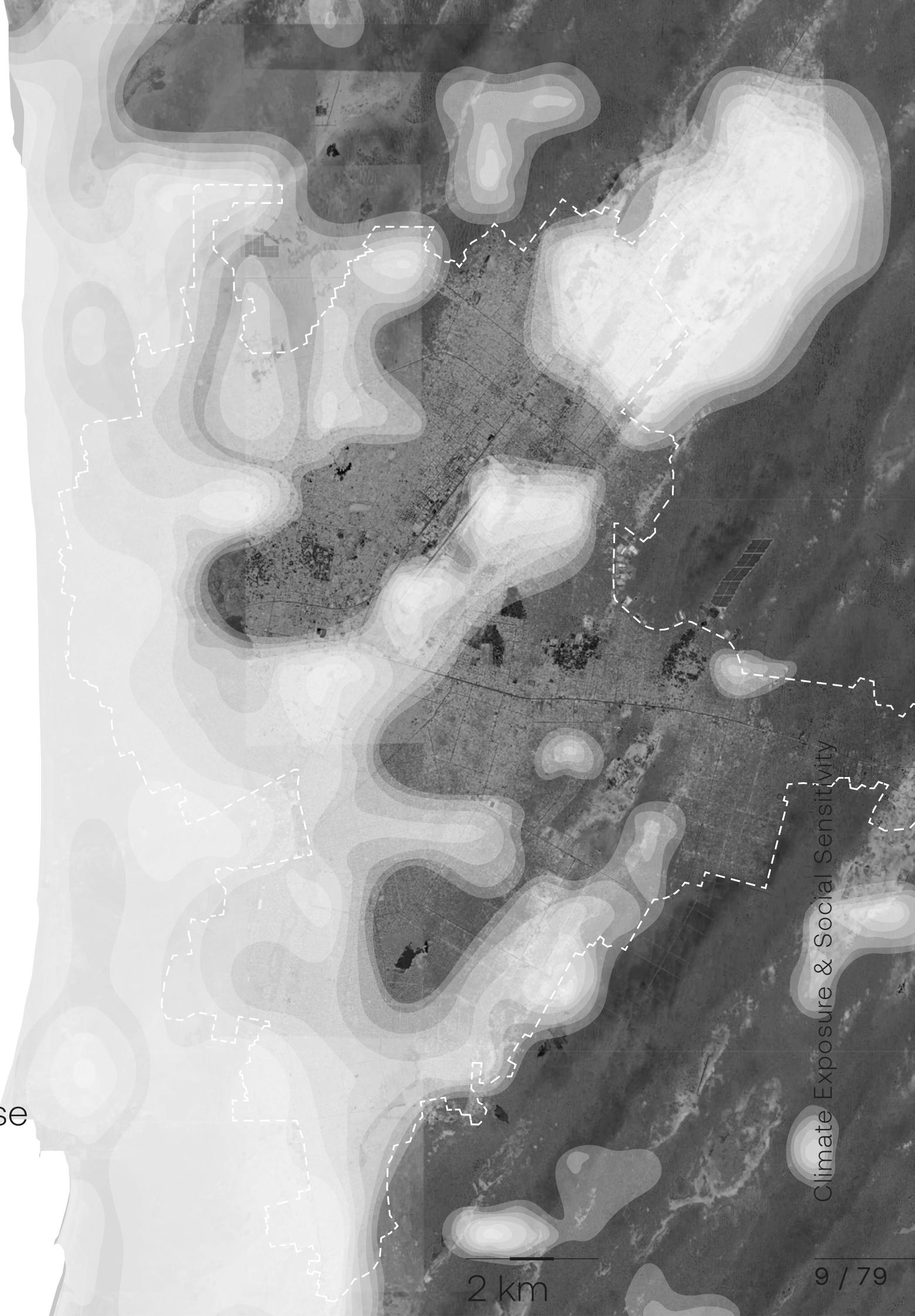
3 km

Water



3 m sea level rise

- Water
- City Outline

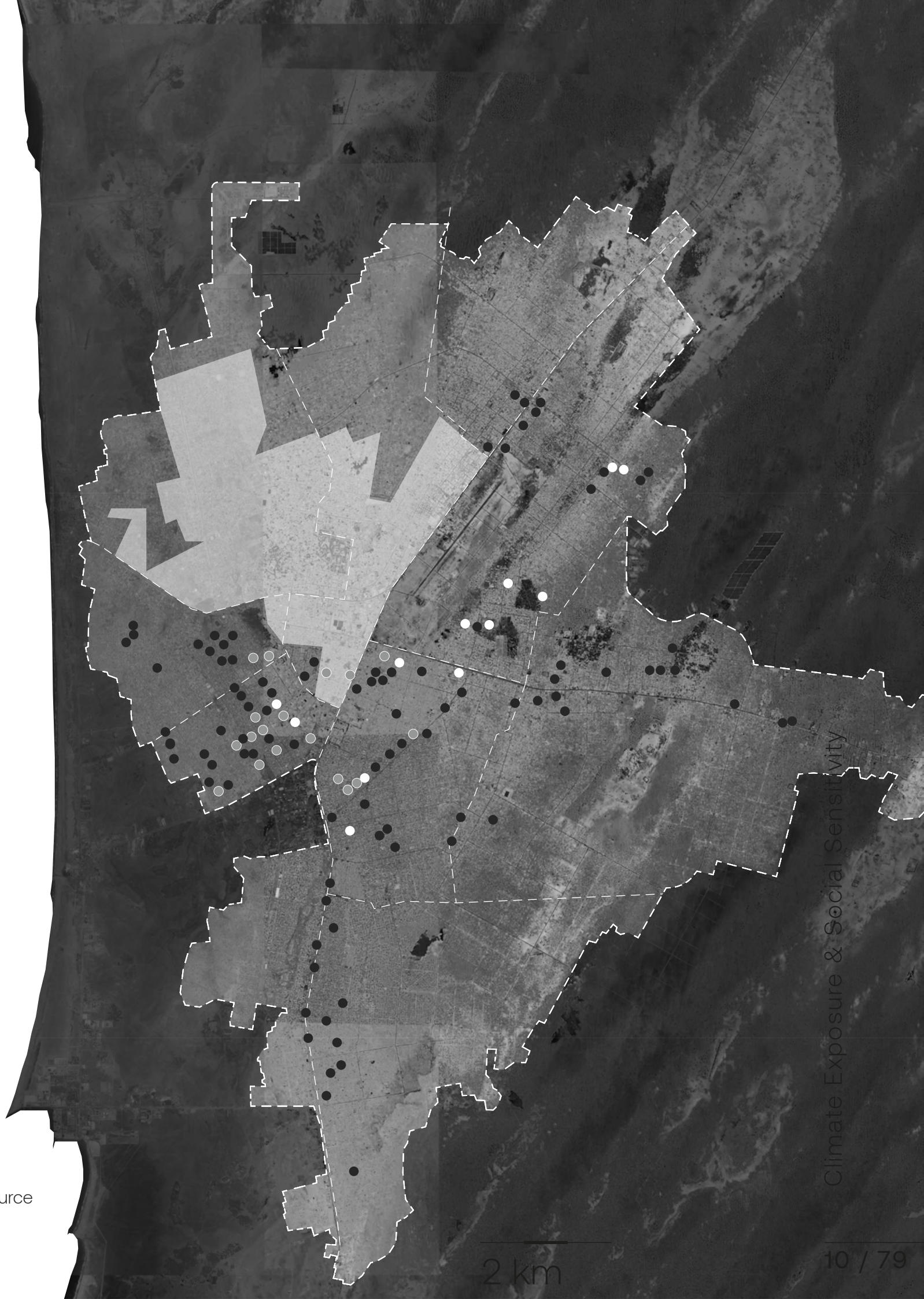


Poverty



Water Access

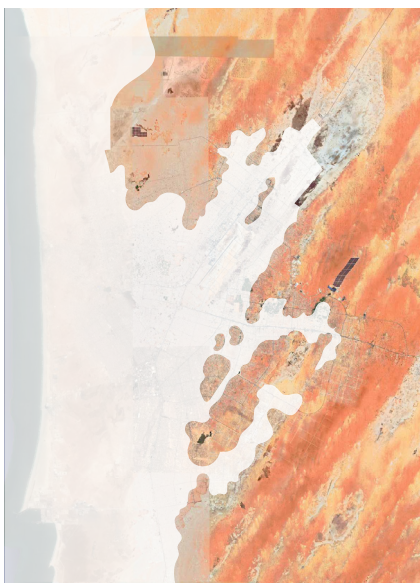
- Water taps
- Clean water source
- Contaminated water source



Conclusion



Water



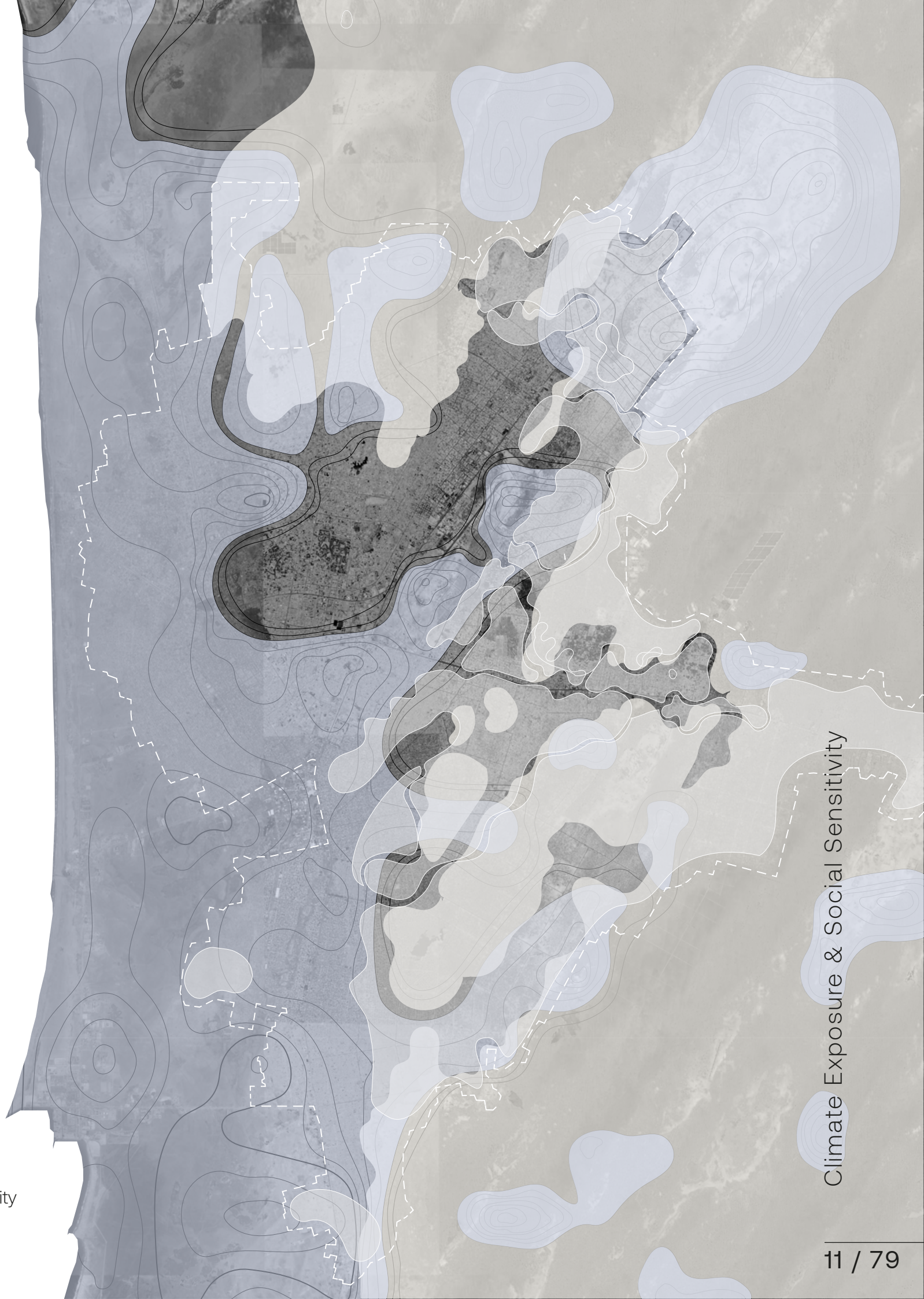
Desert



Poverty

Overlay

- Water exposure
- Desert exposure
- Poverty - Social Sensitivity



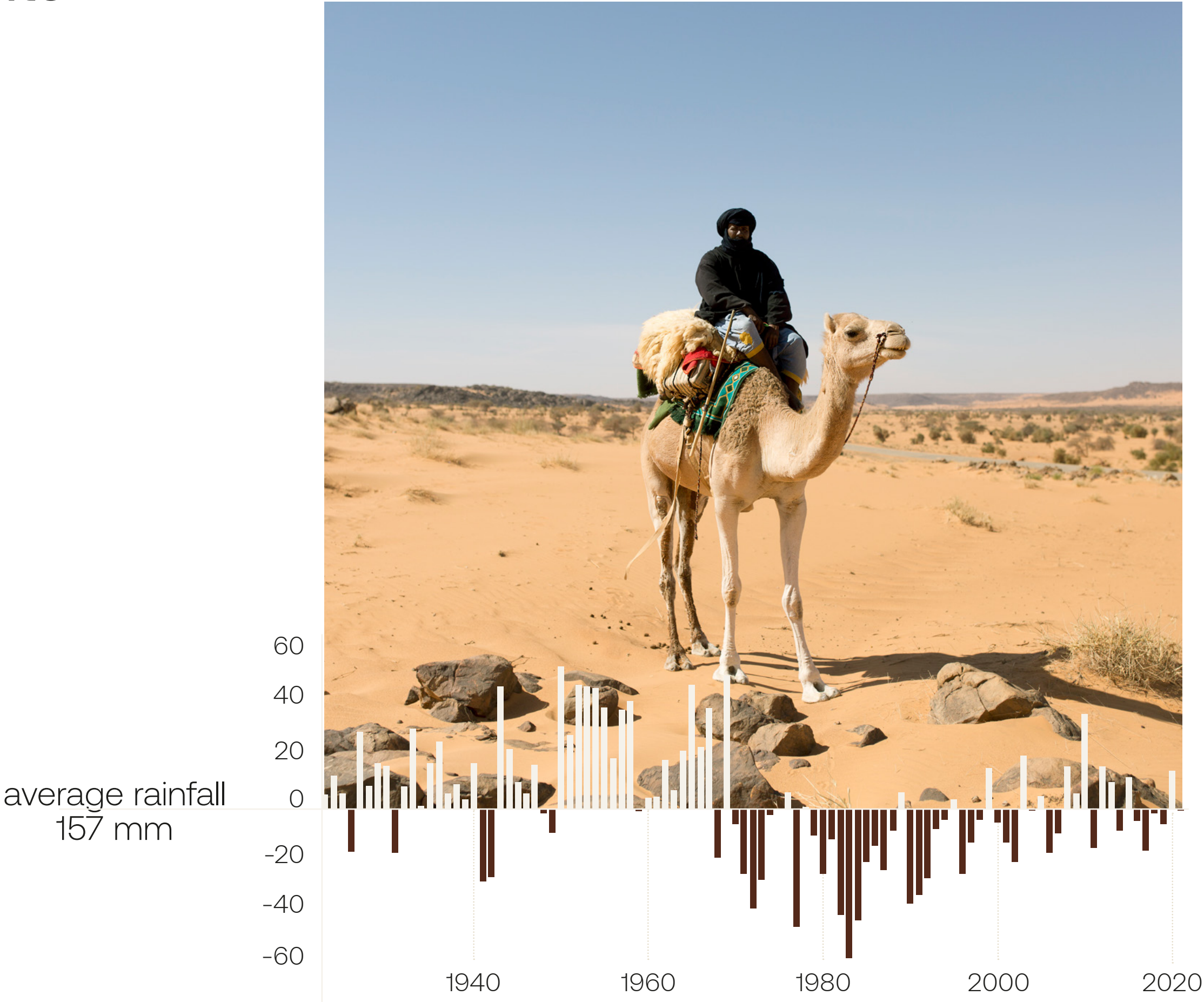
III Development



Nomadic Lifestyle

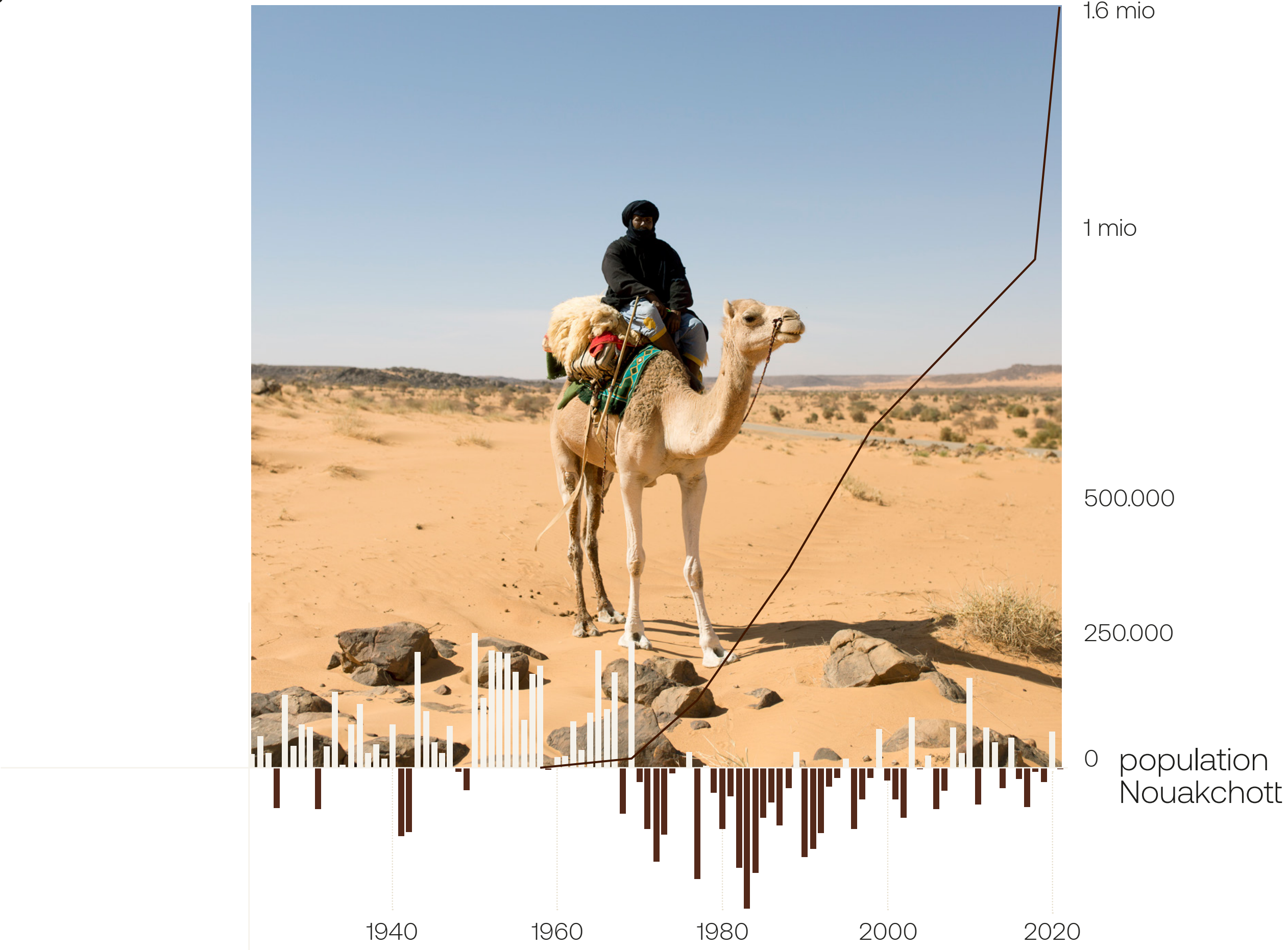


Droughts



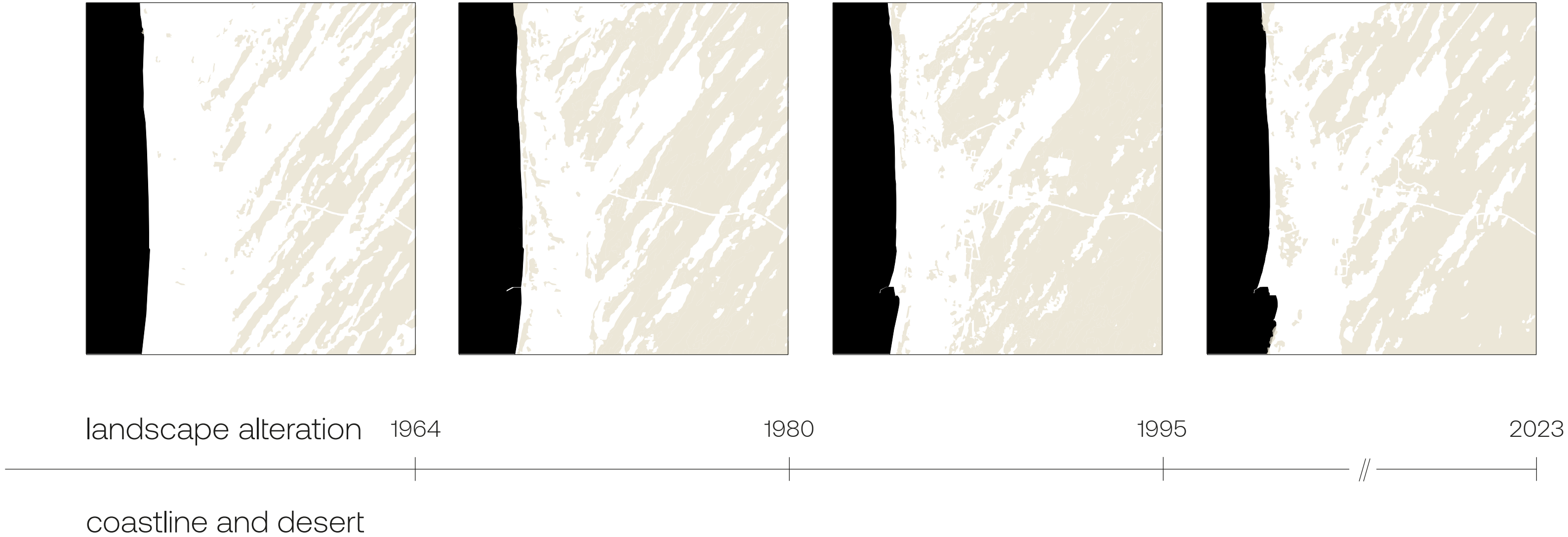
© Correlation of precipitation anomalies and population growth (based on worldbank, 2023)

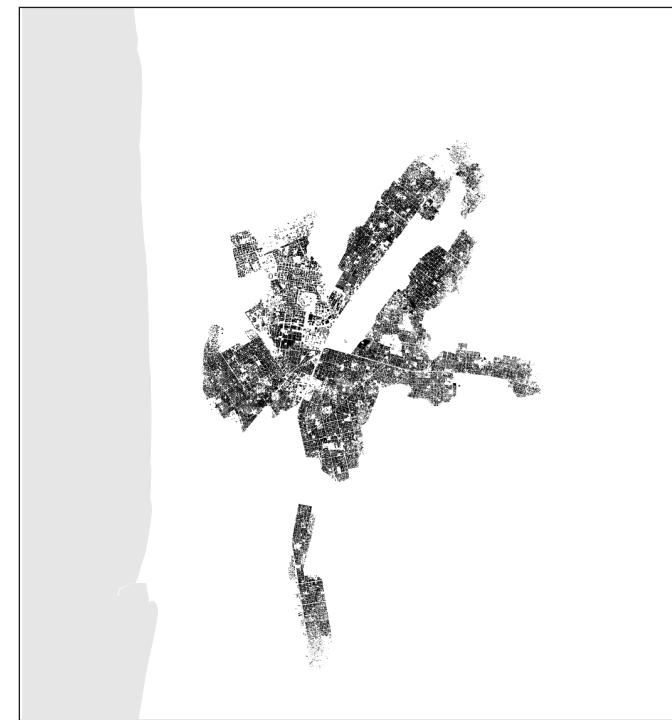
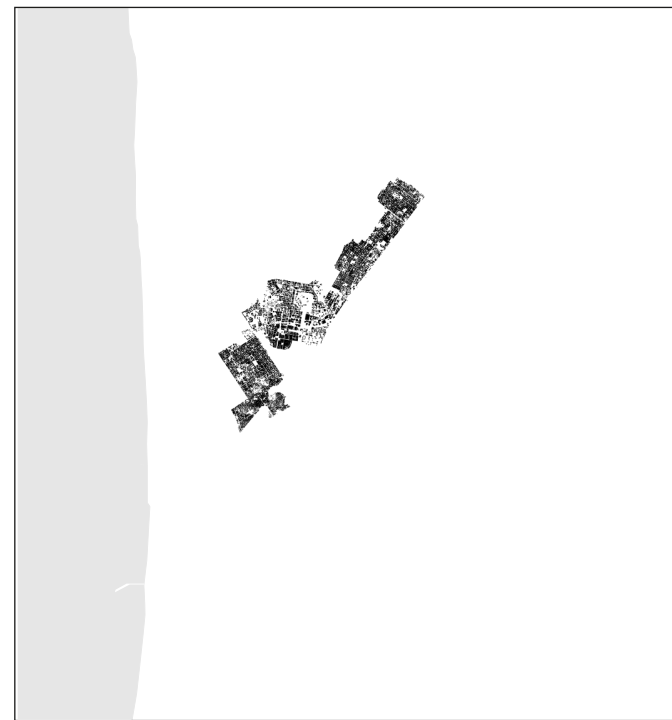
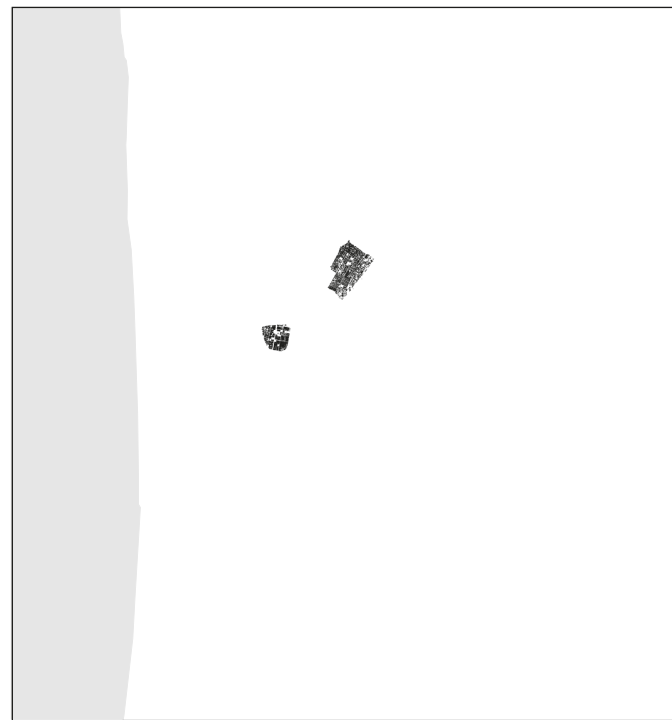
Droughts



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

Development





urban fabric

1964

1980

1995

2024

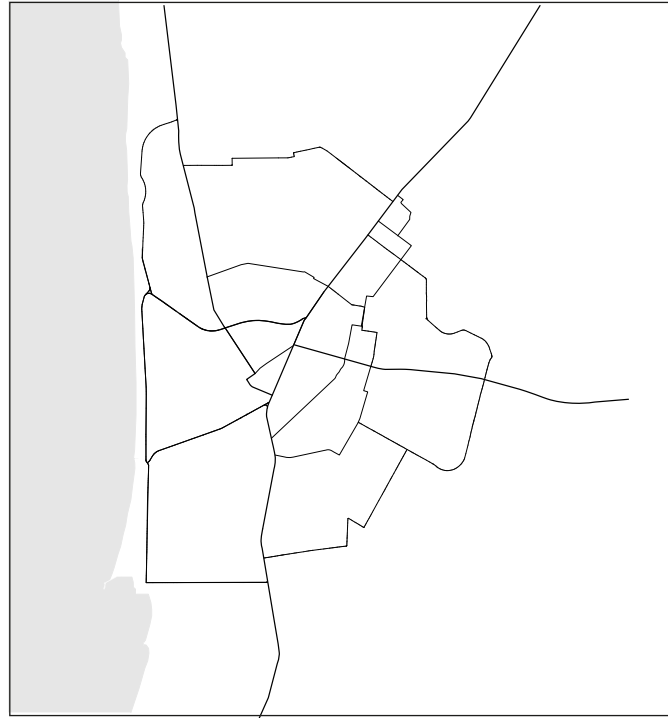
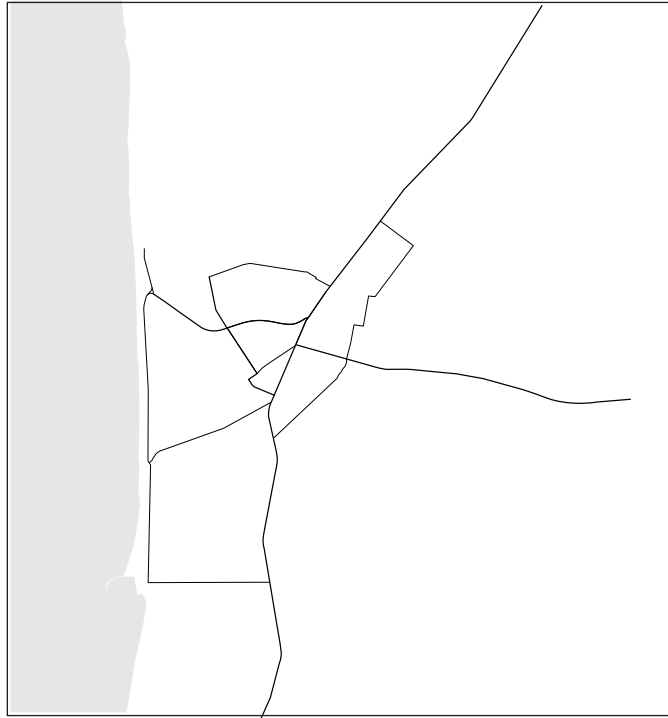
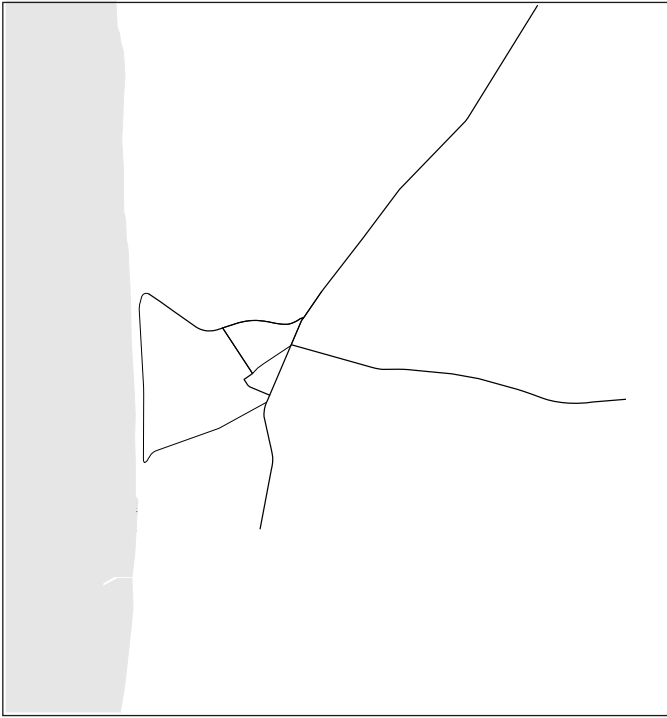
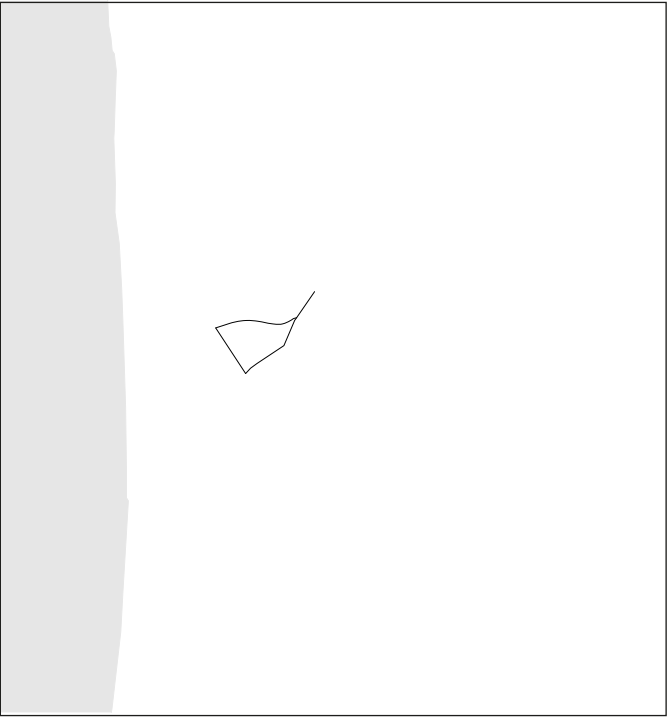
population

2.000

140.000

670.000

1.6 mio



infrastructure

1964

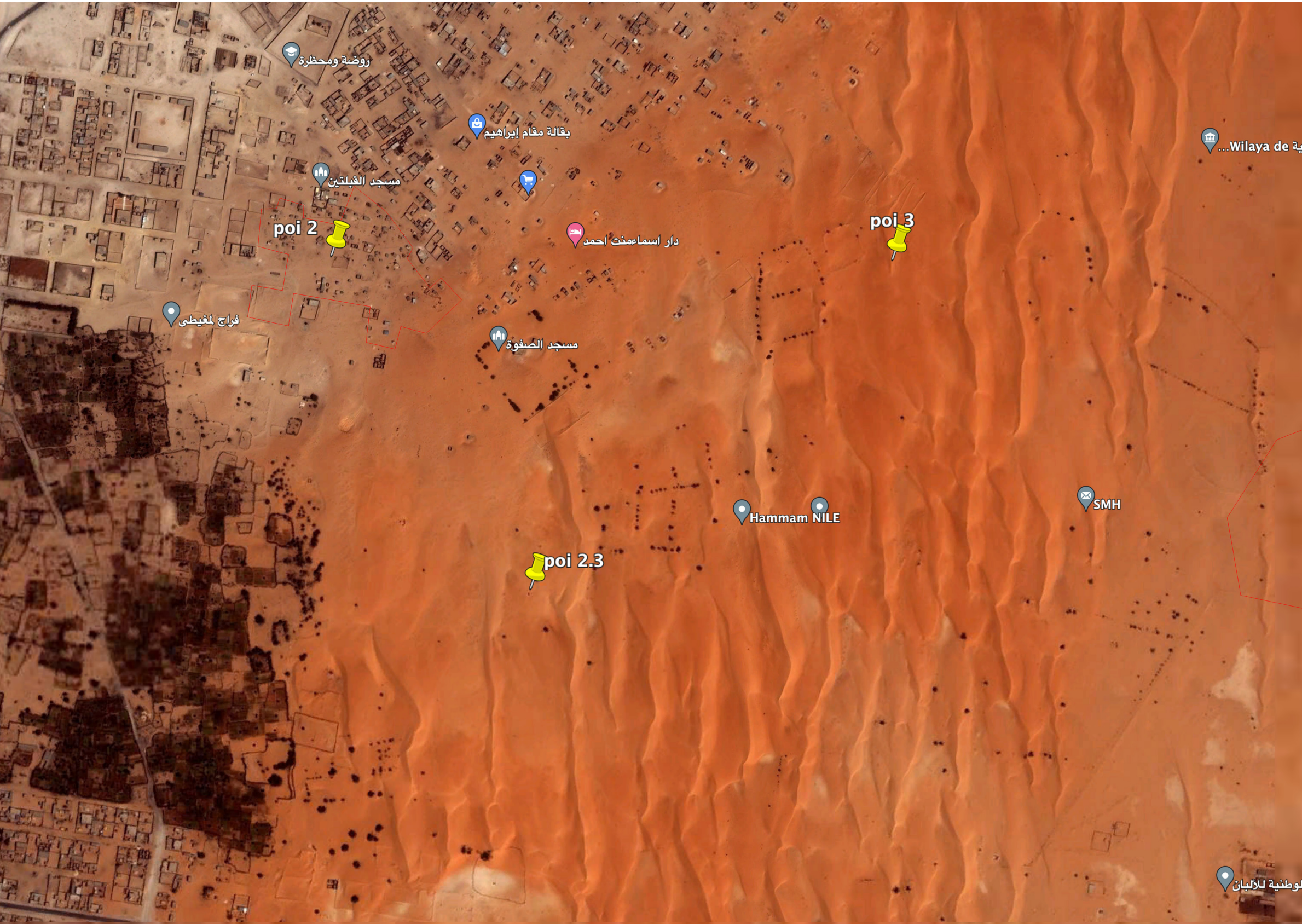
1980

1995

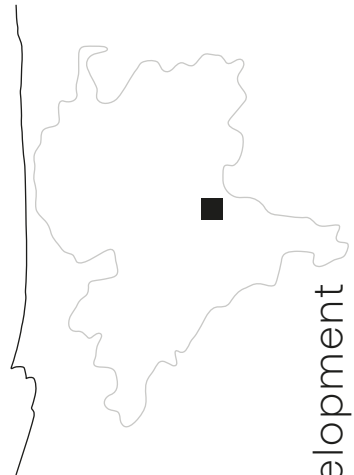
2023

//

Disruption

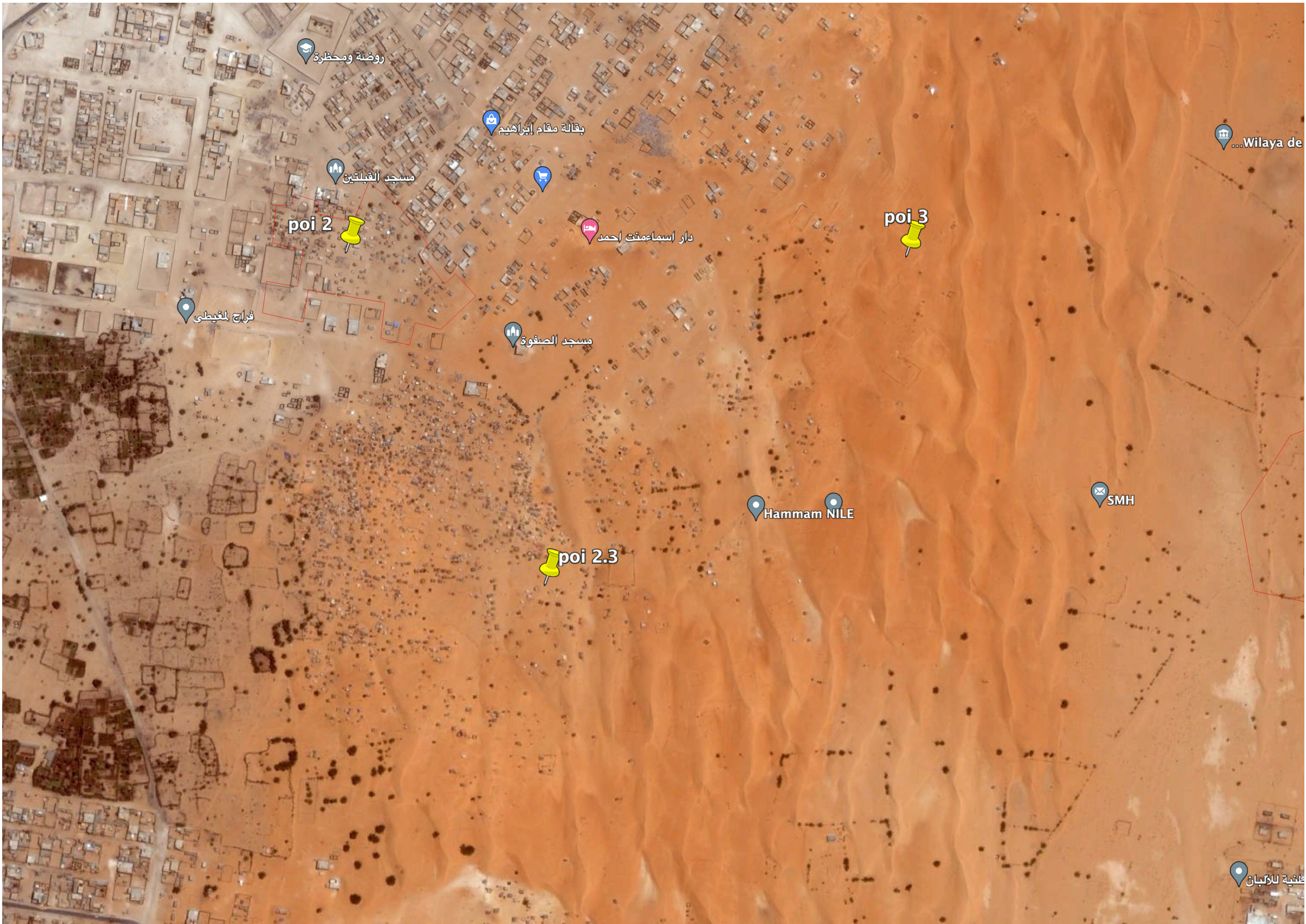


2005

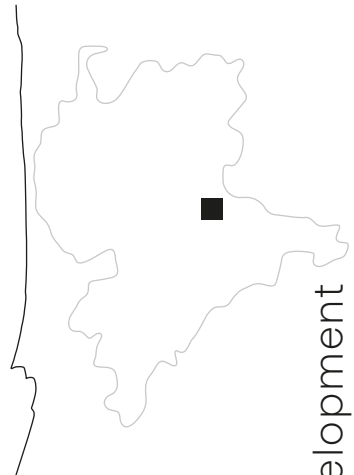


Development

Disruption

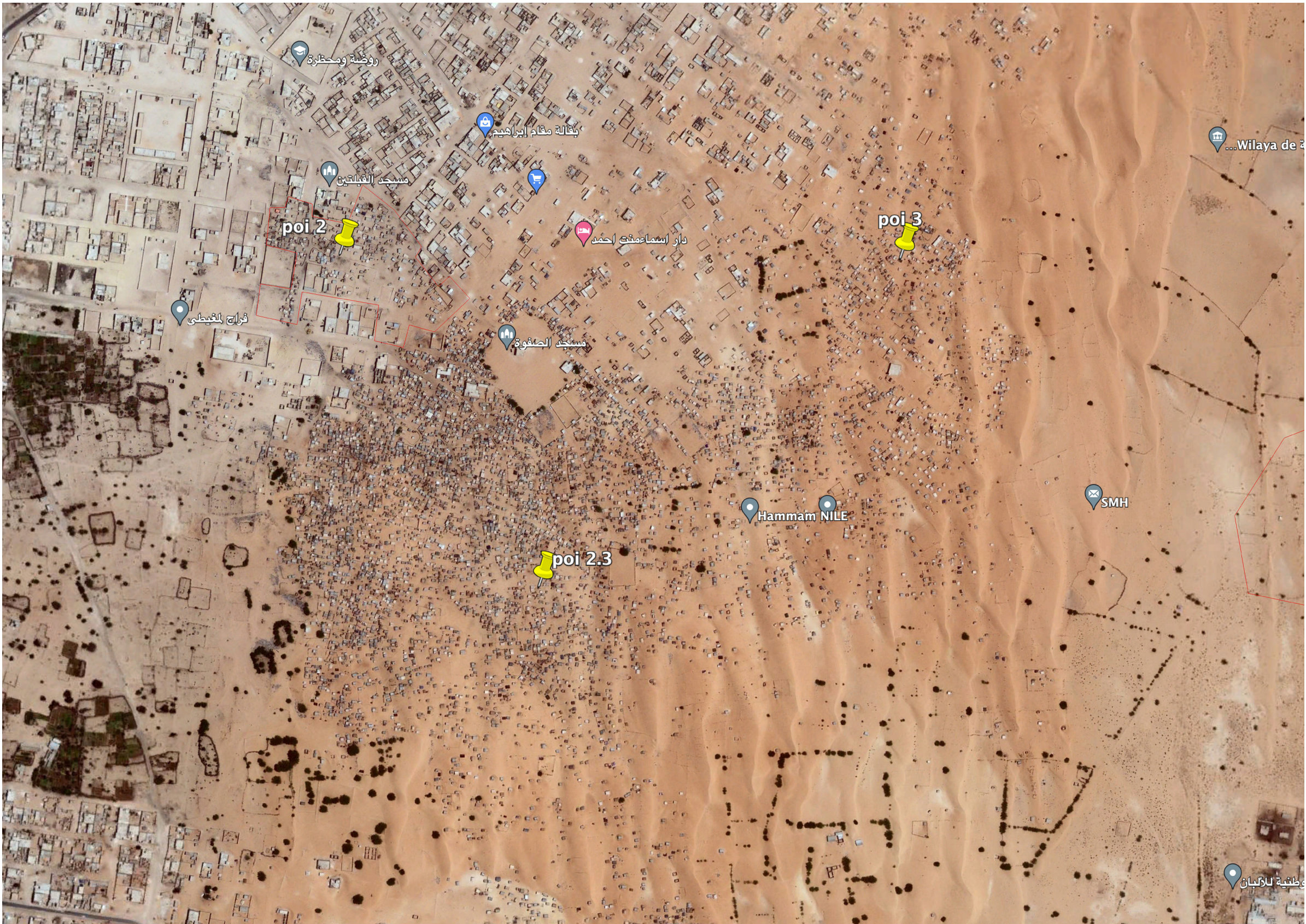


2008

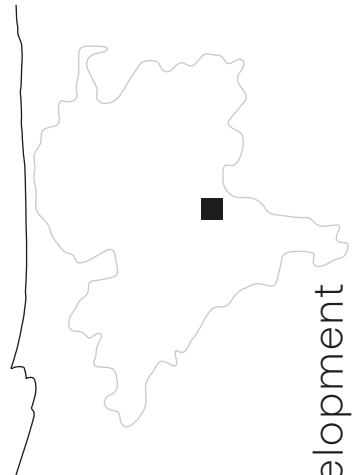


Development

Disruption

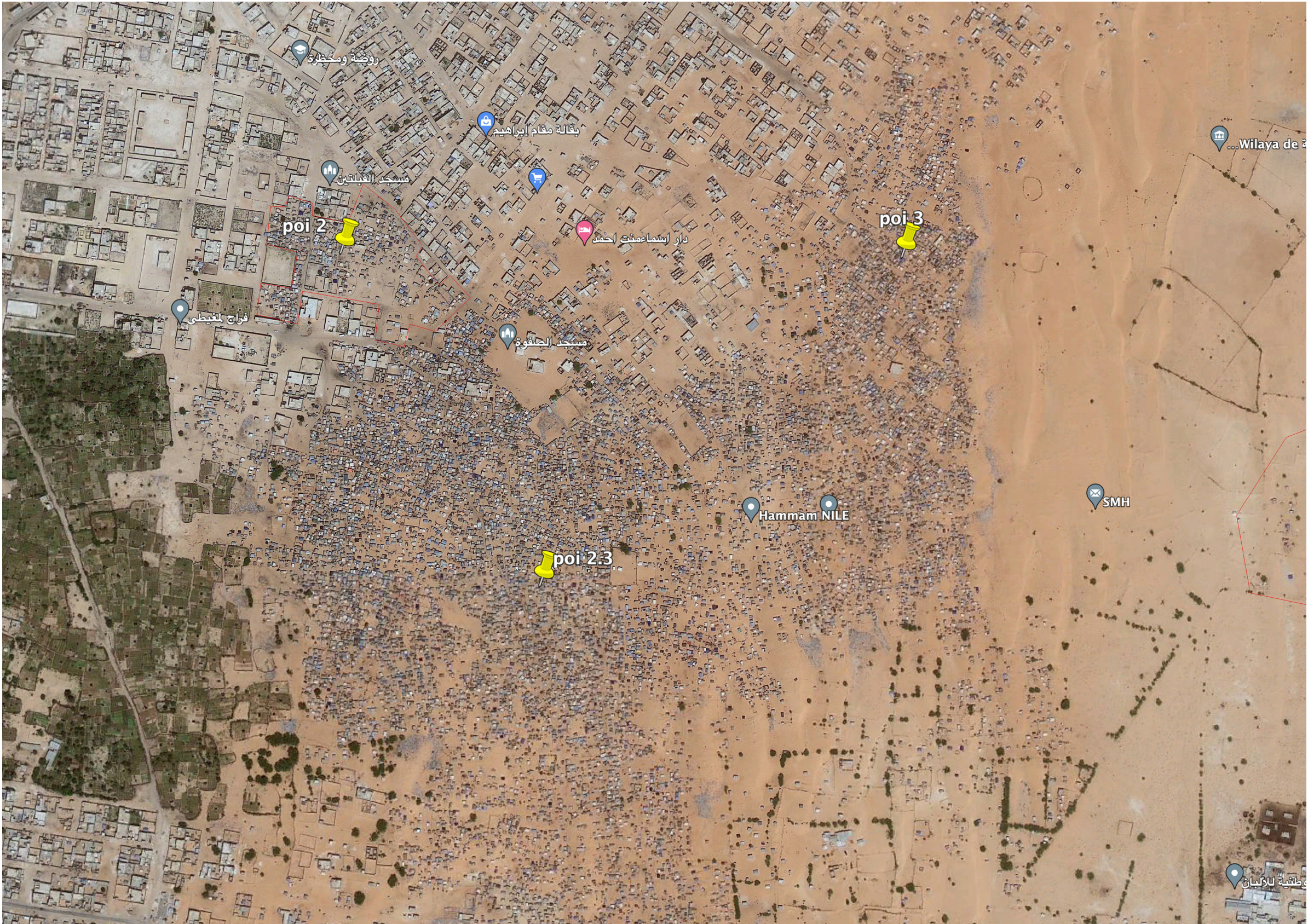


2010

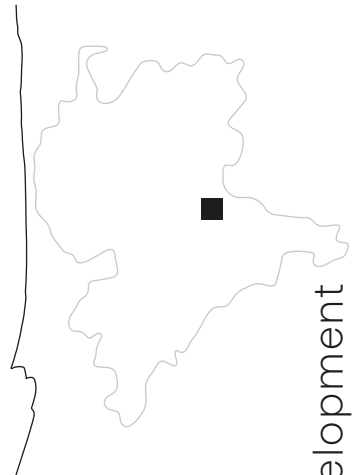


Development

Disruption



2012 November

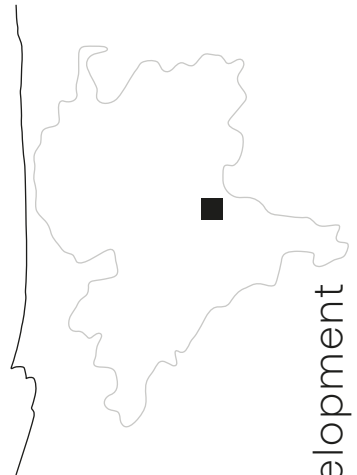


Development

Disruption

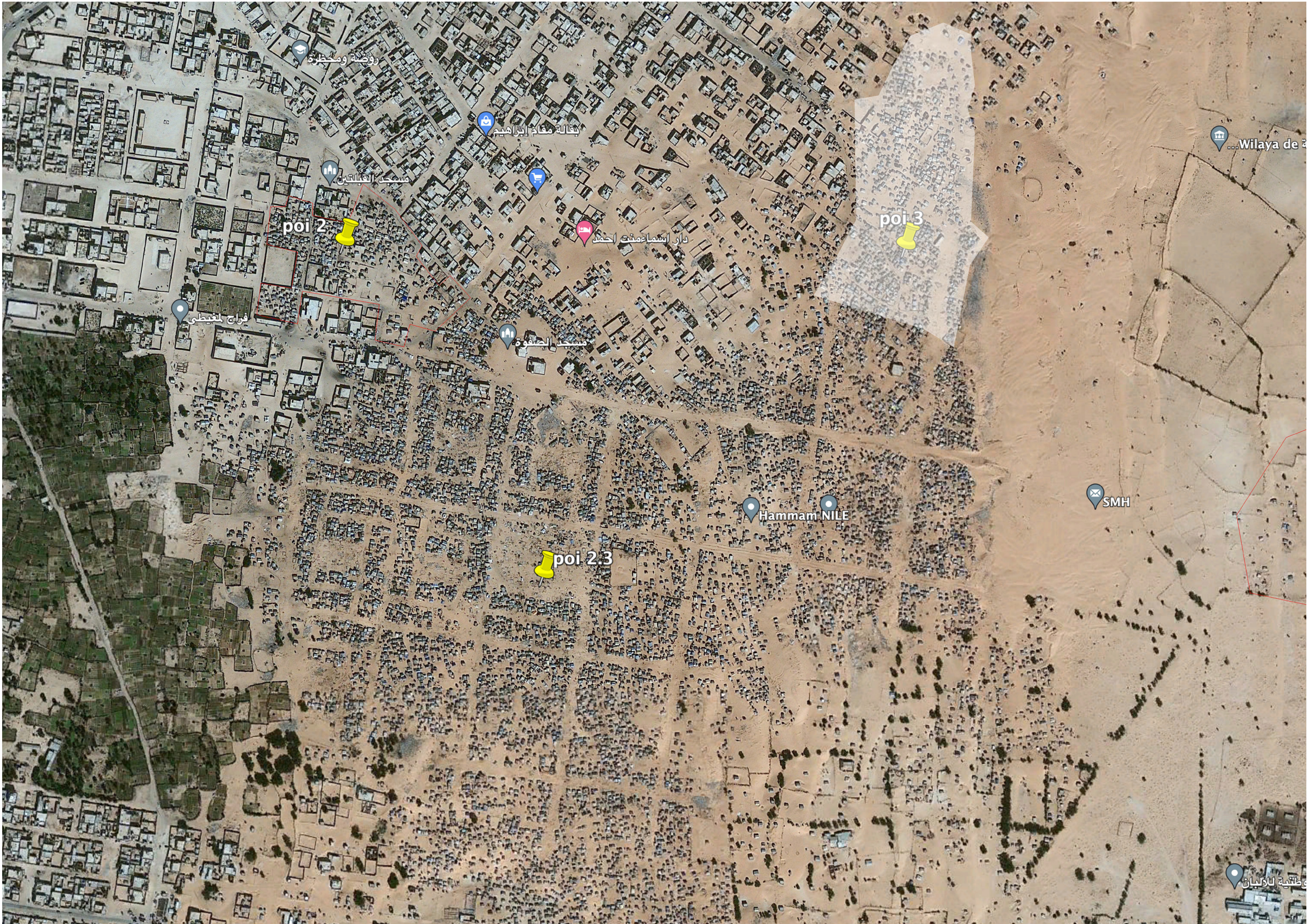


2012 December

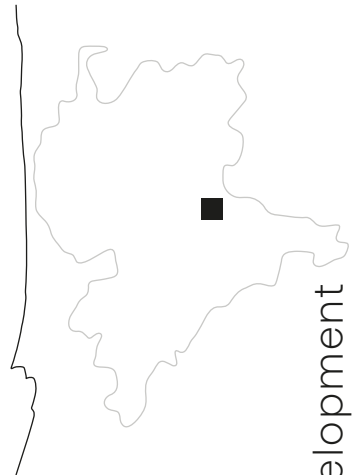


Development

Disruption



2012 December

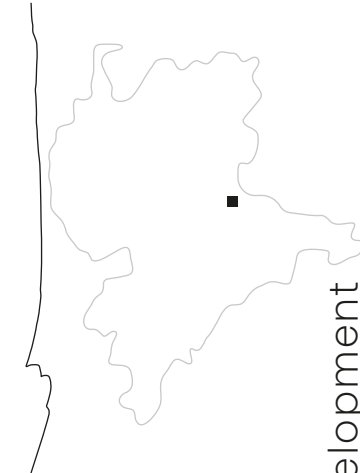


Development

Persistence

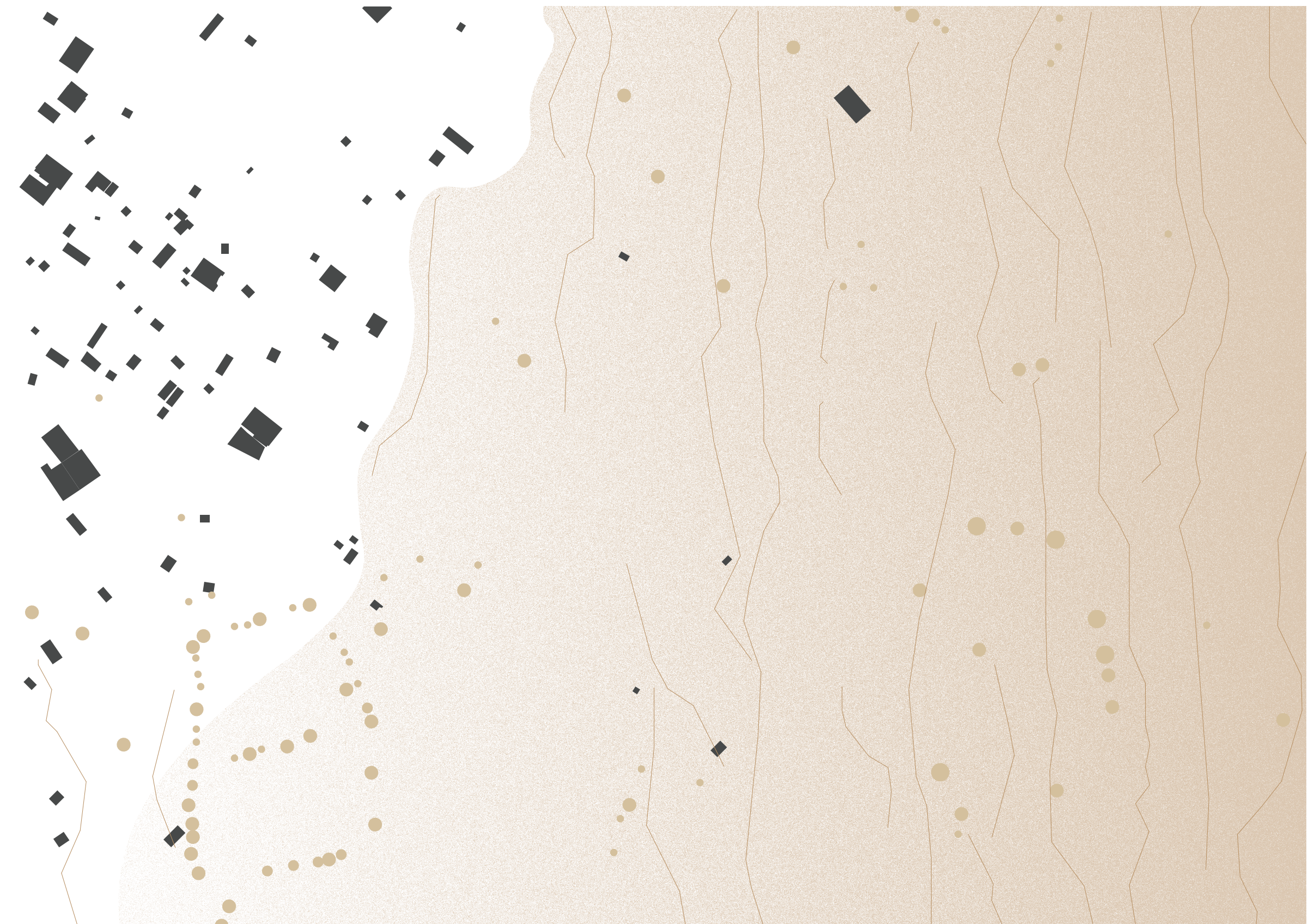


2002

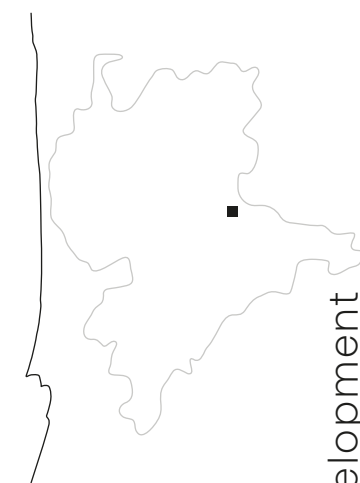


Development

Persistence

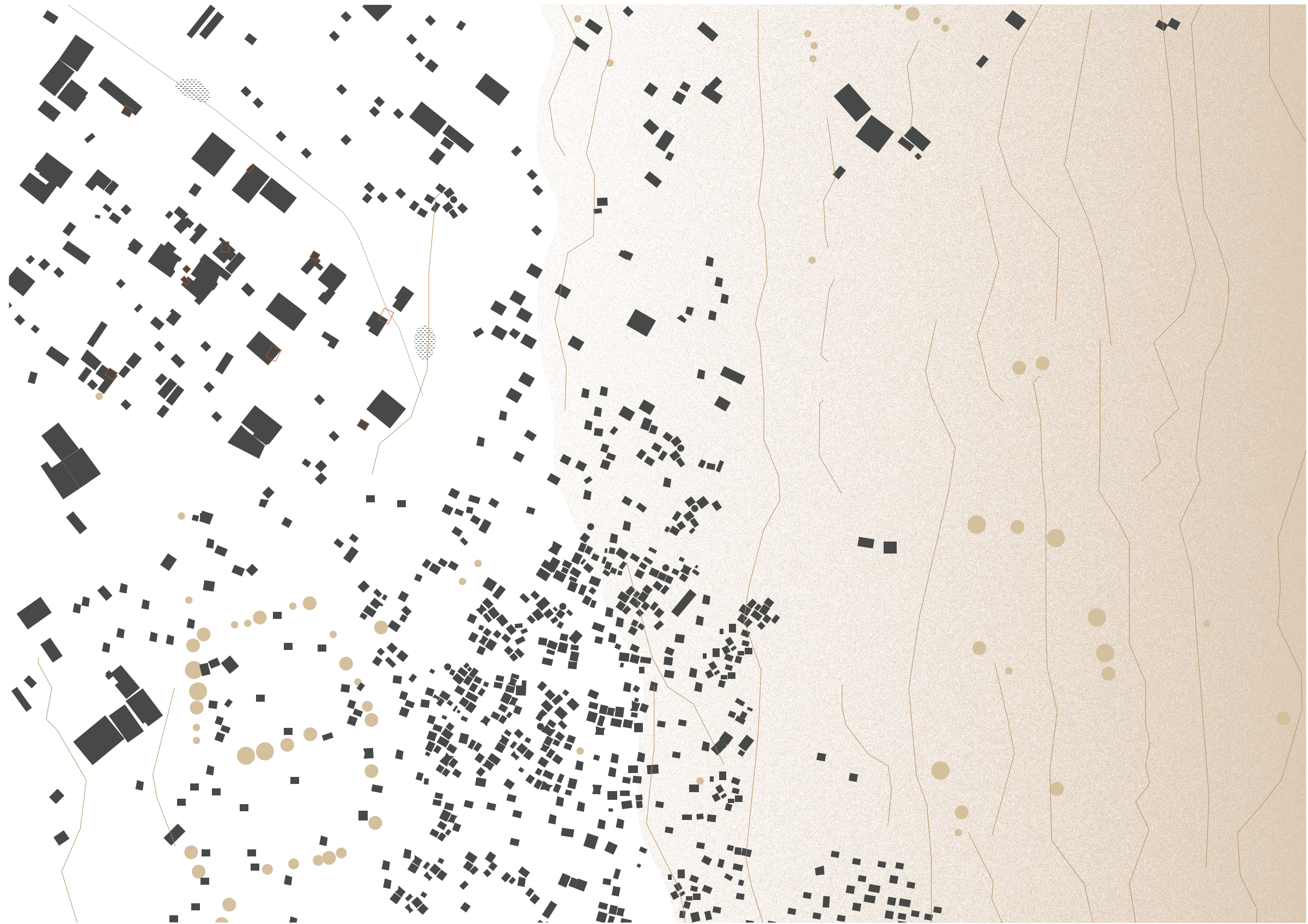


2008

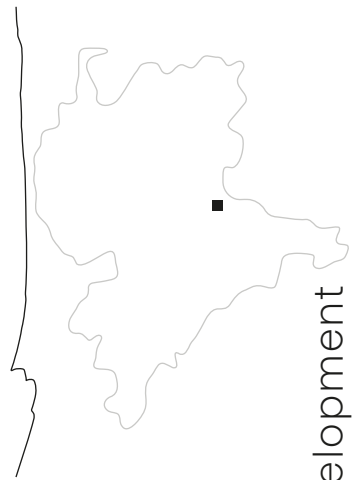


Development

Persistence



2010

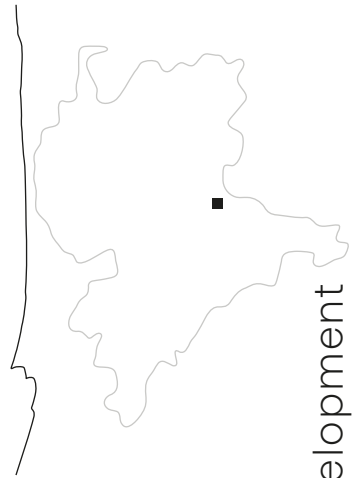


Development

Persistence

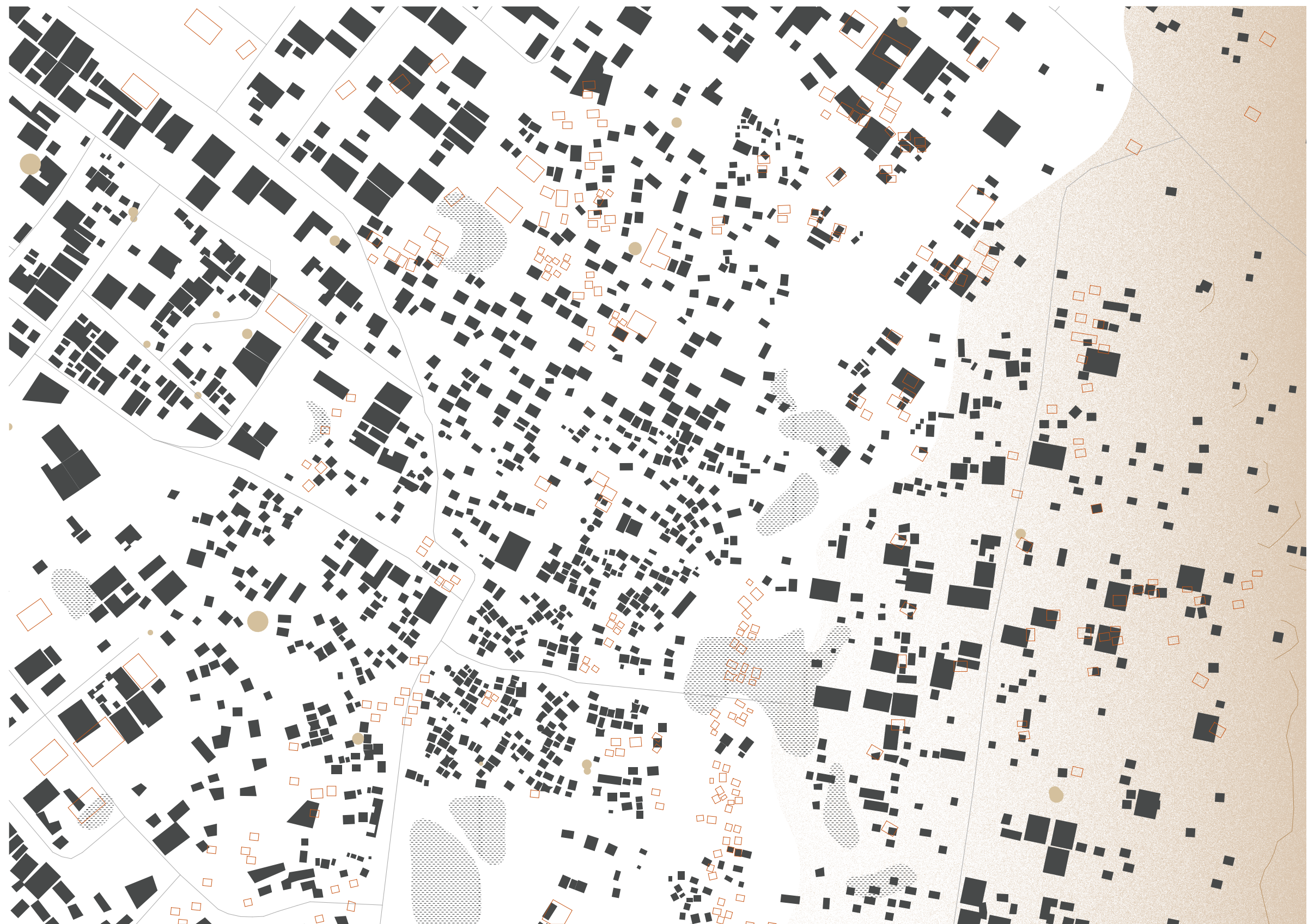


2013



Development

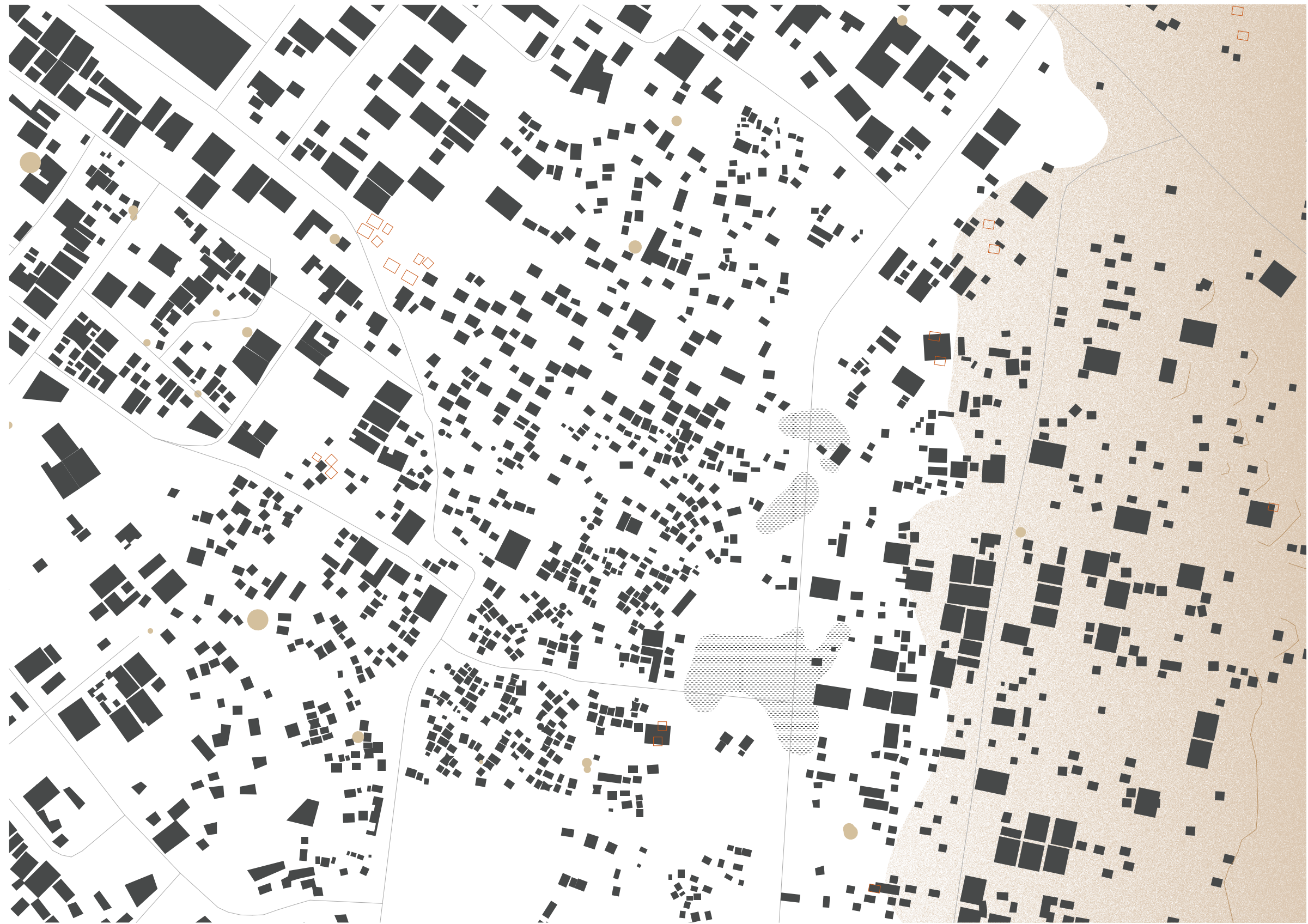
Persistence



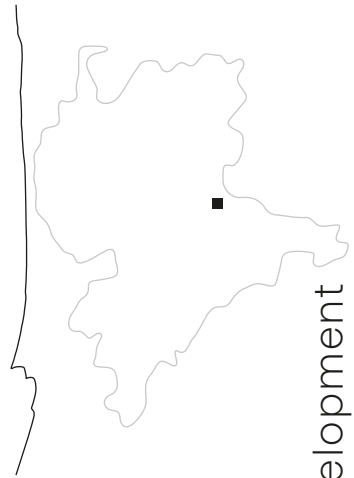
2016

Development

Persistence



2020

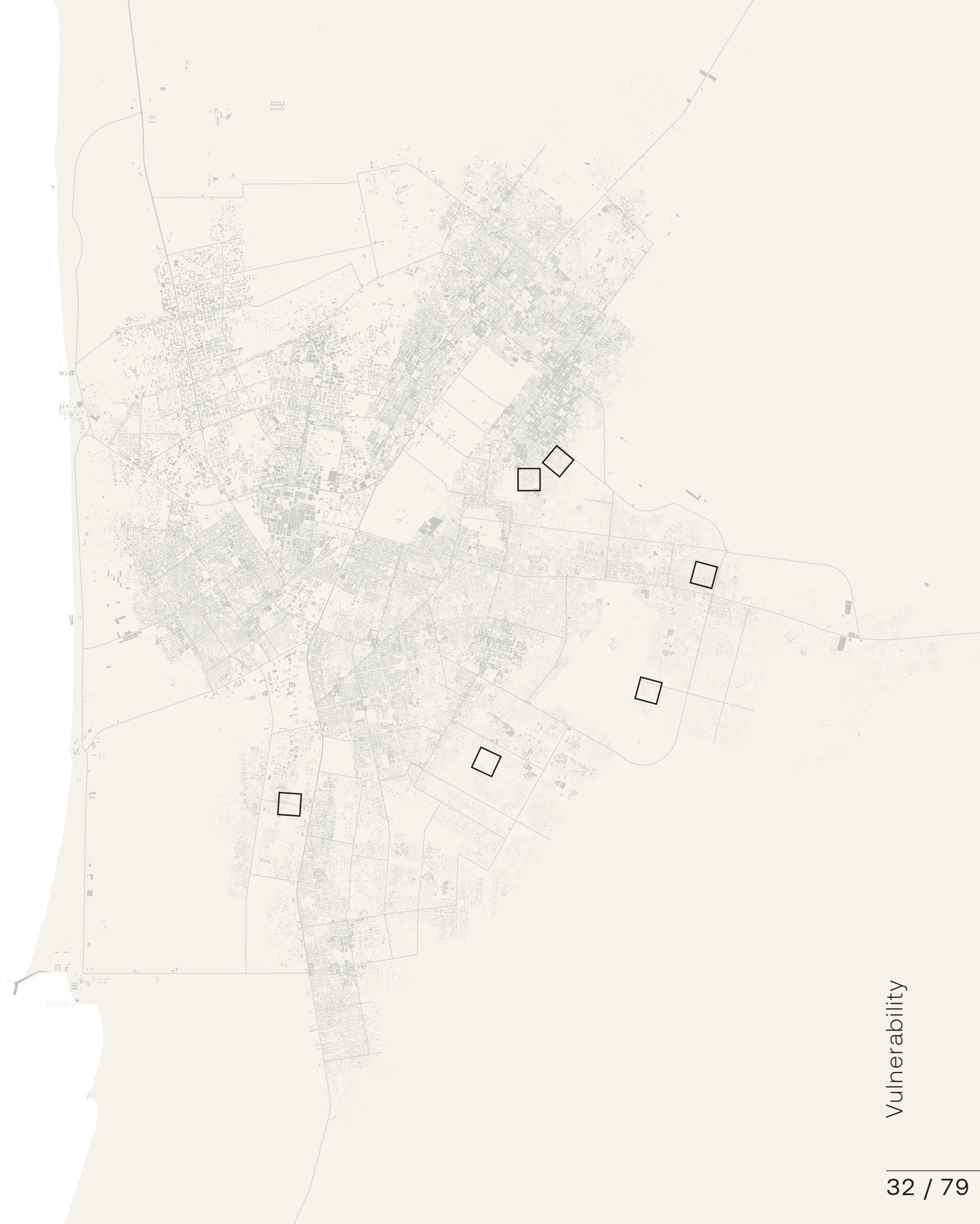


Development



IV Vulnerability

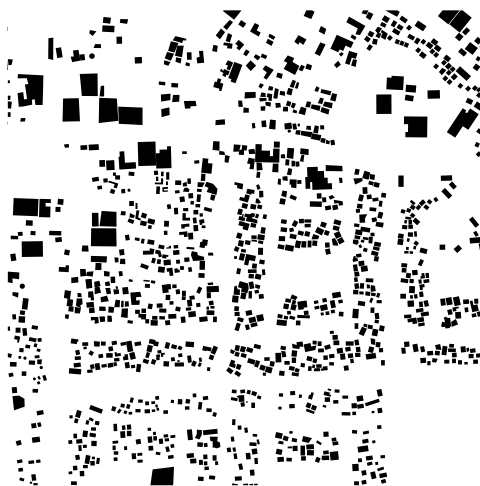
Typology



Typology



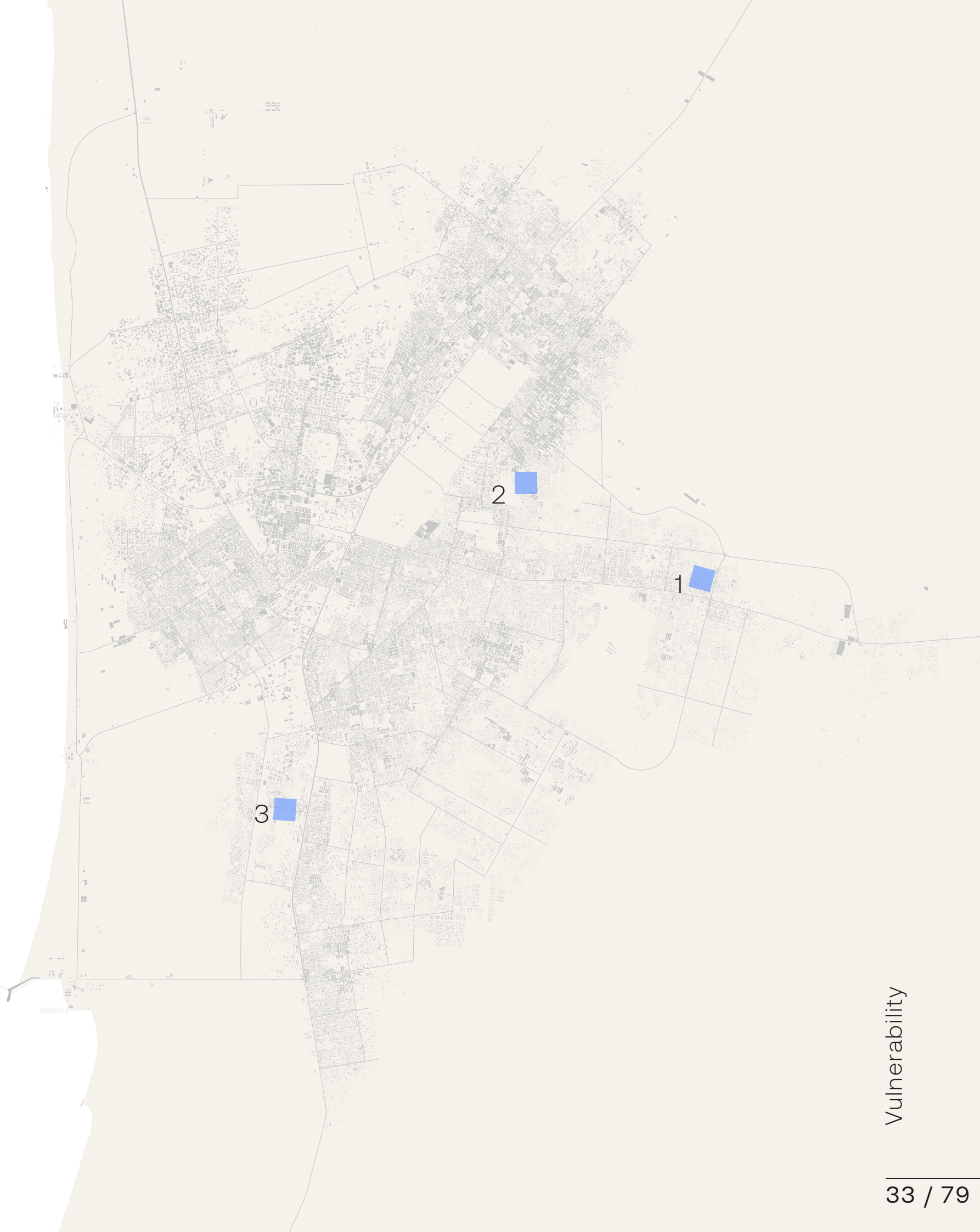
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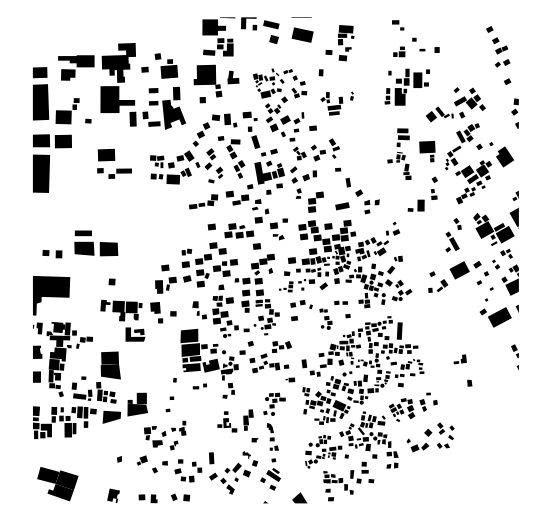
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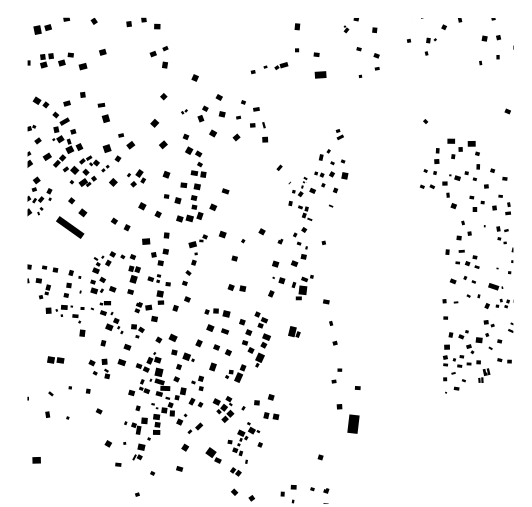
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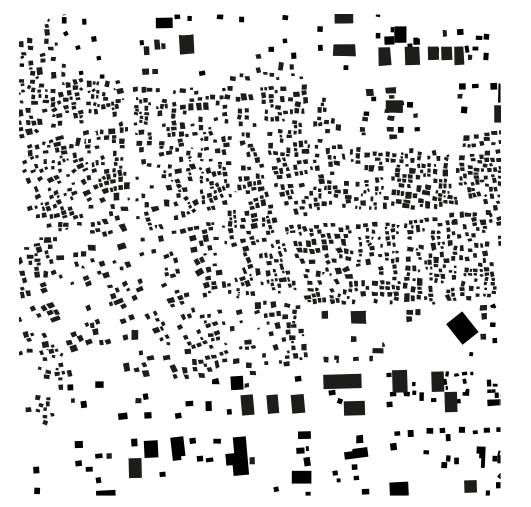
Typology



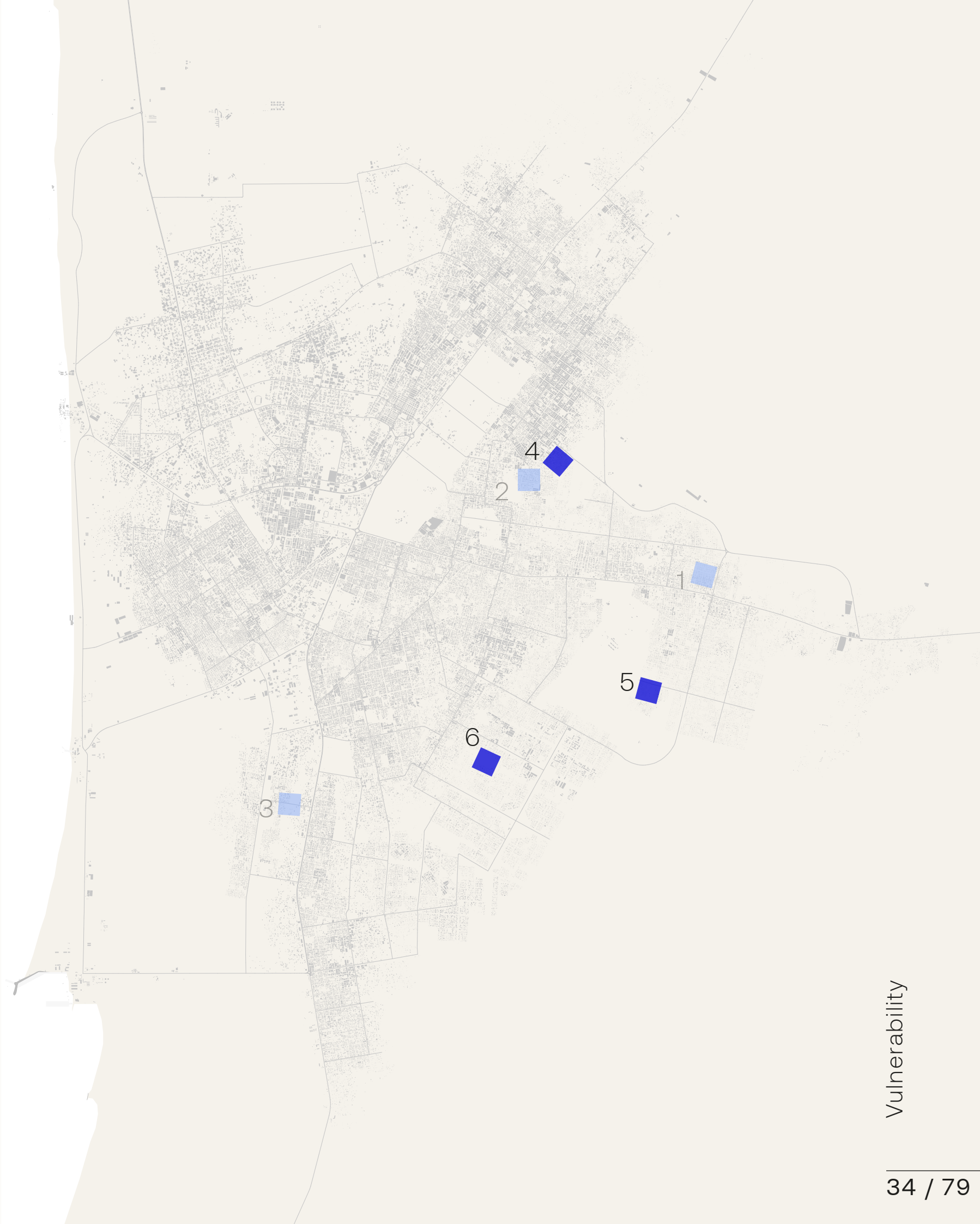
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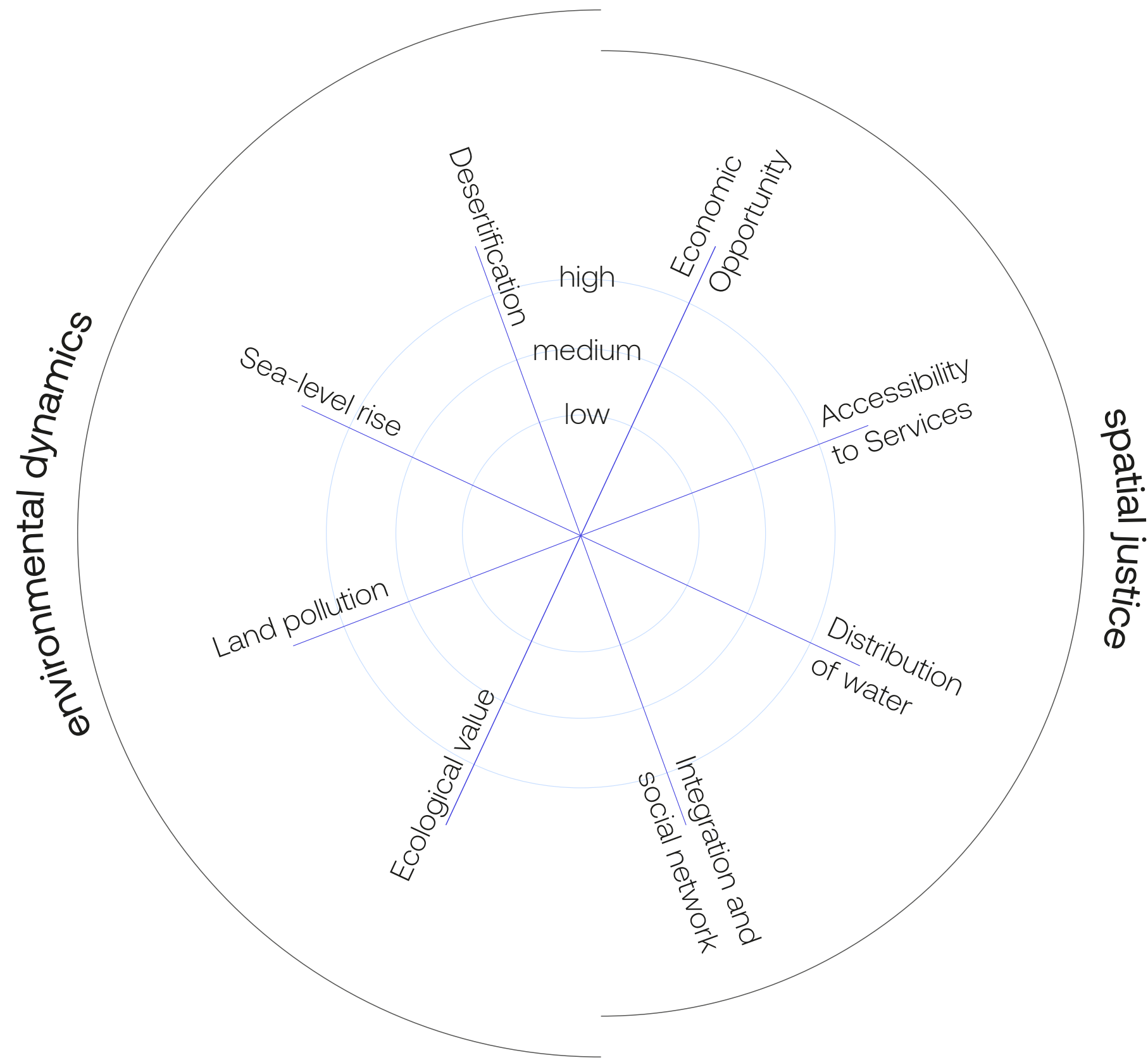
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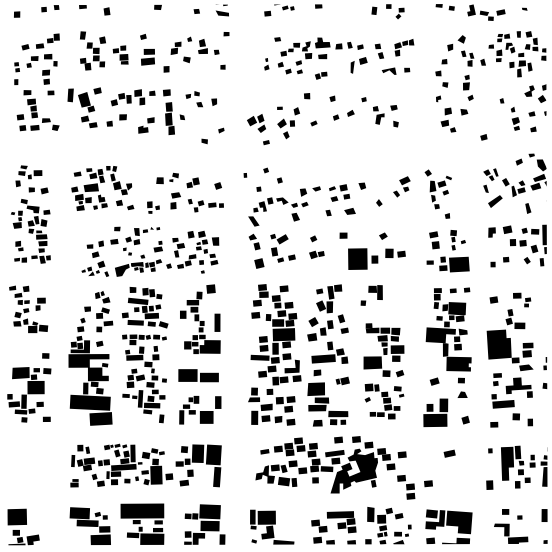
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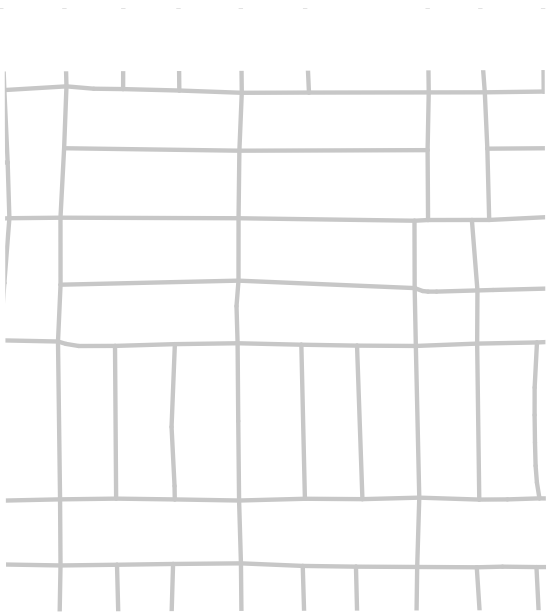
Assessment



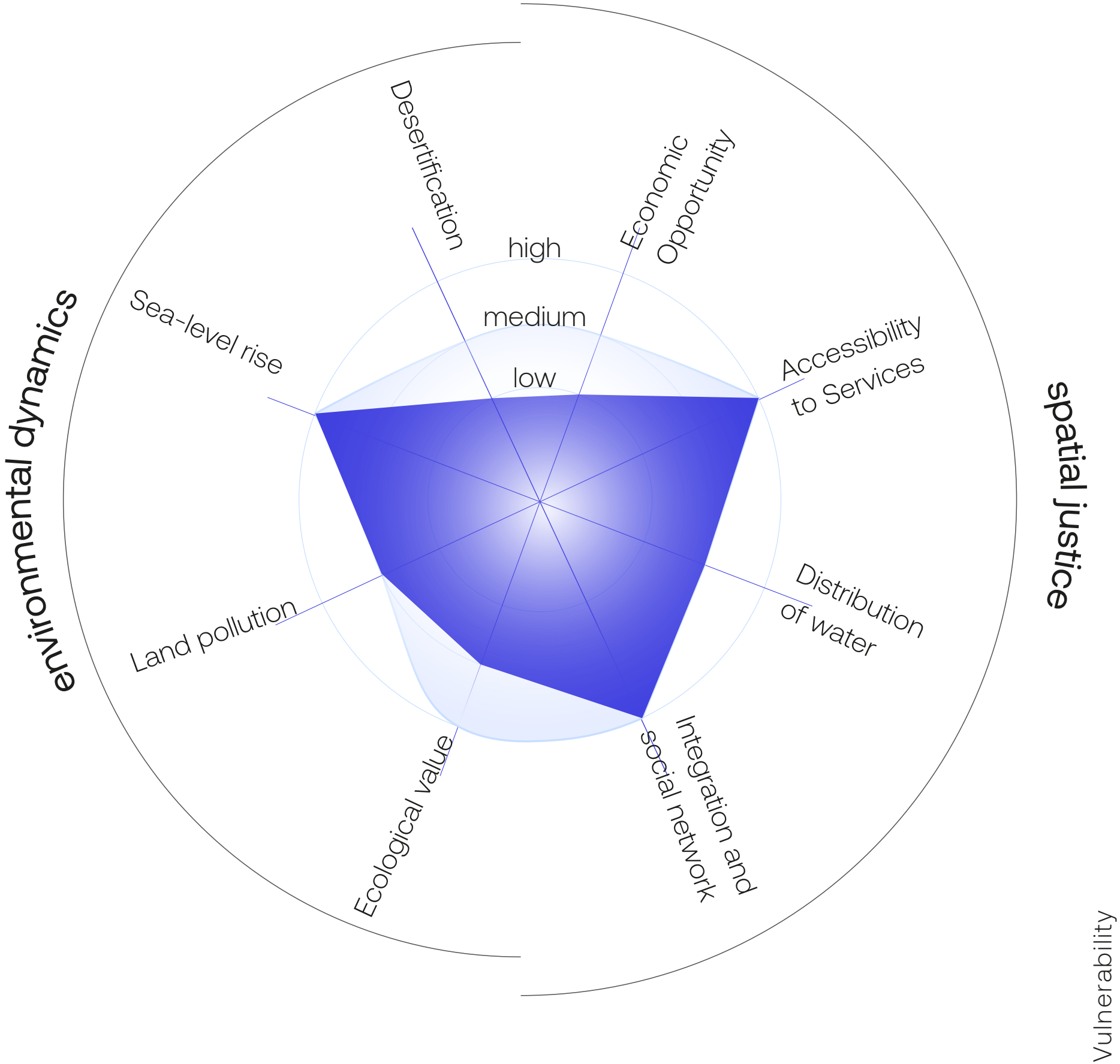
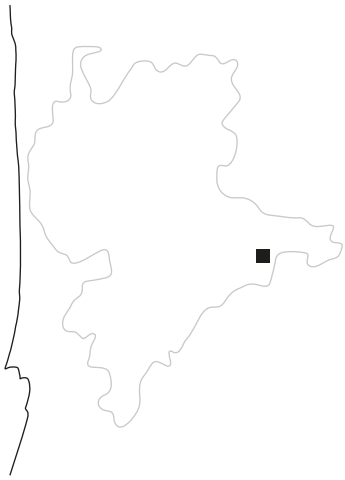
Assessment



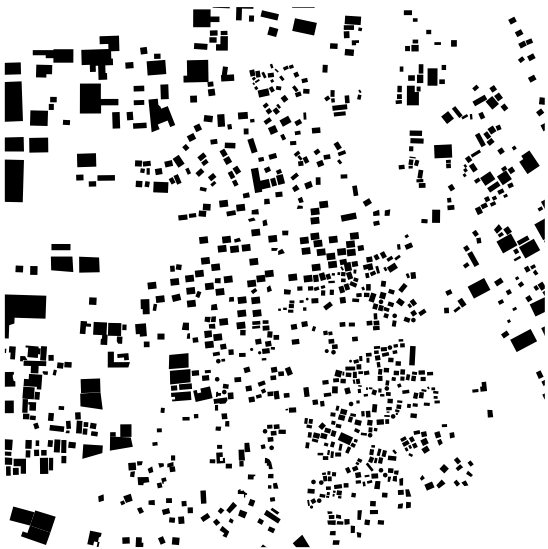
1



Problems:
Desertification
Economic Opportunity



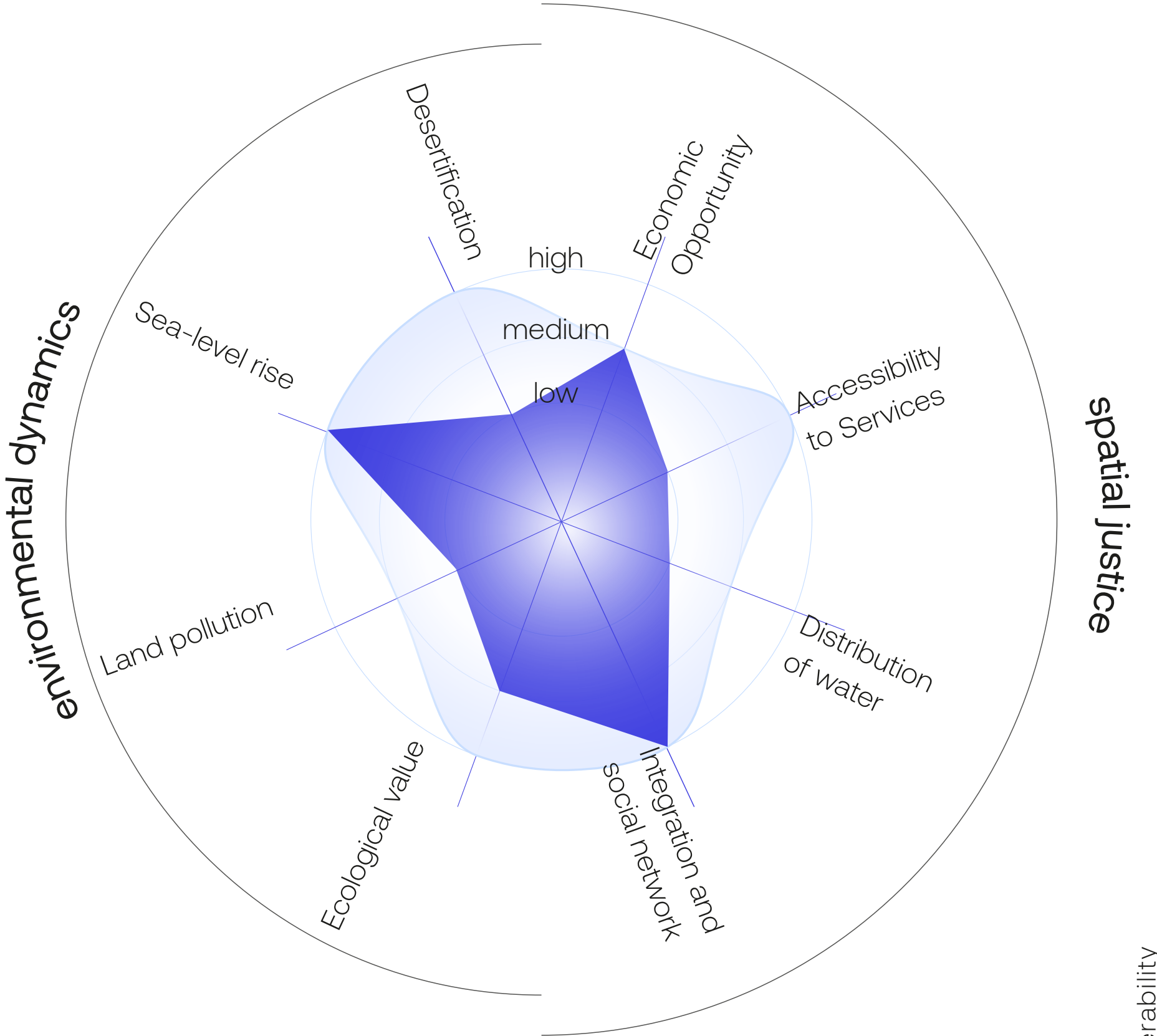
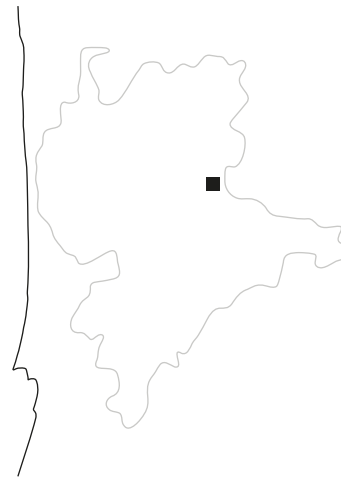
Assessment



4

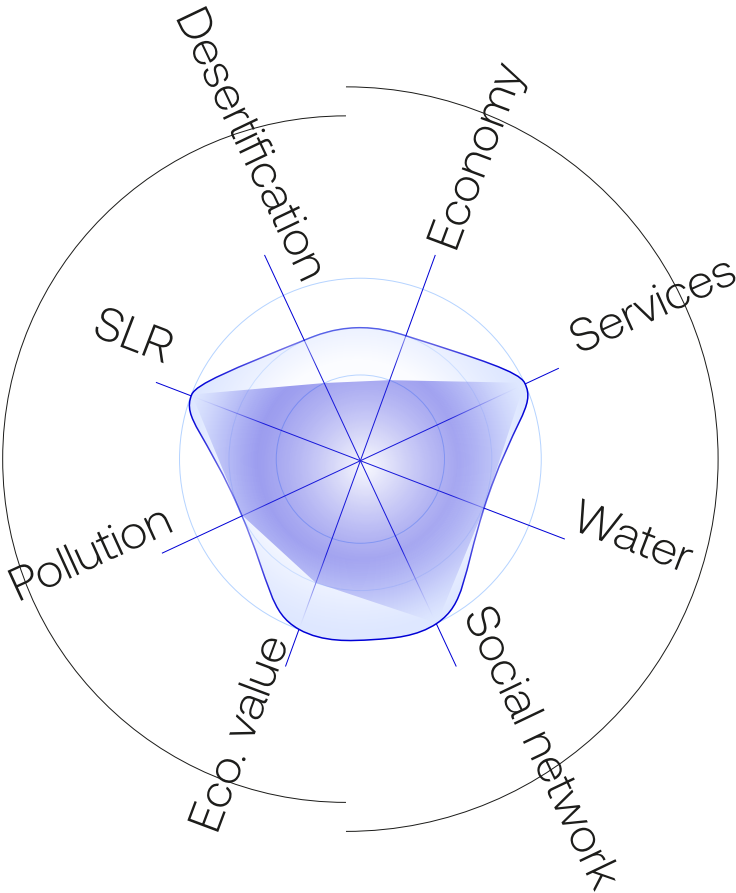
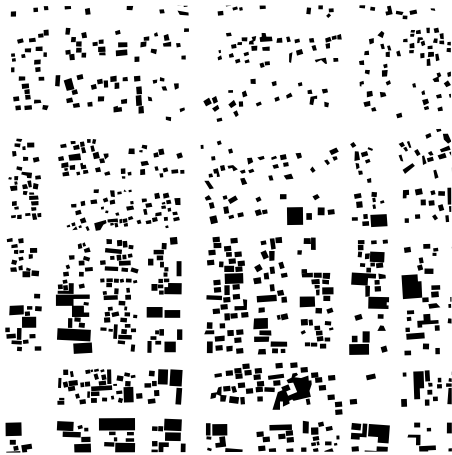


Problems:
Desertification
Pollution
Accessibility

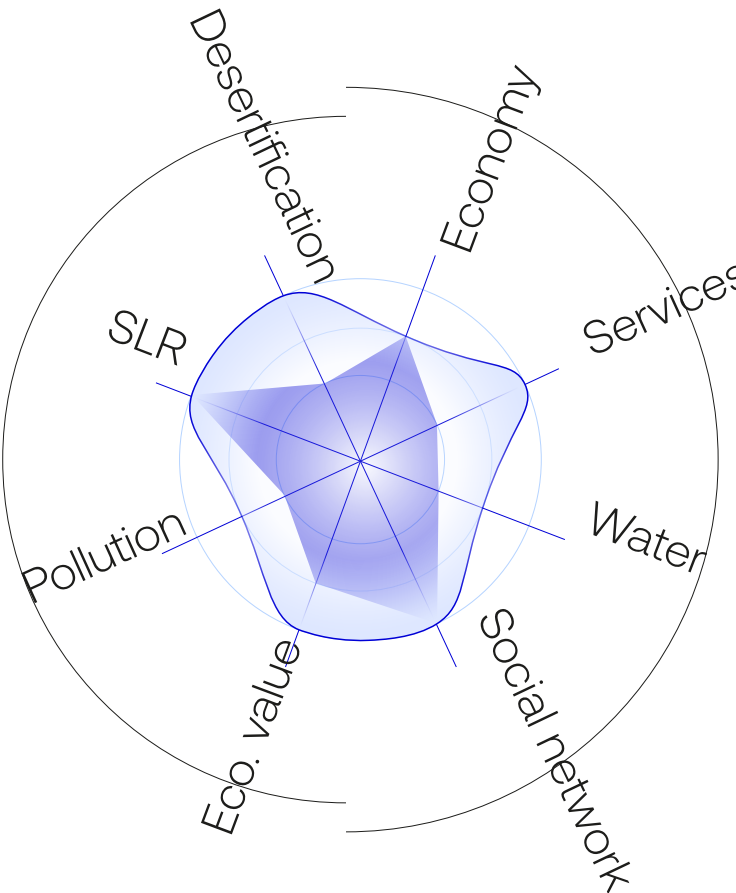
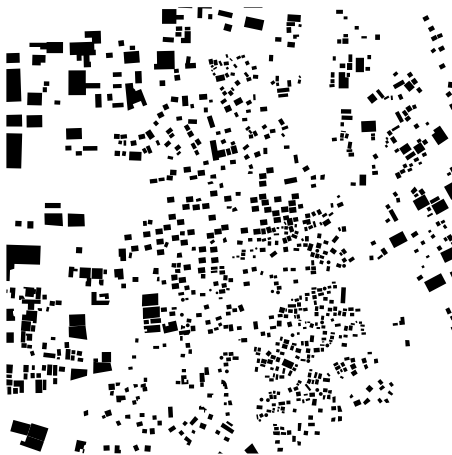


Potential

1

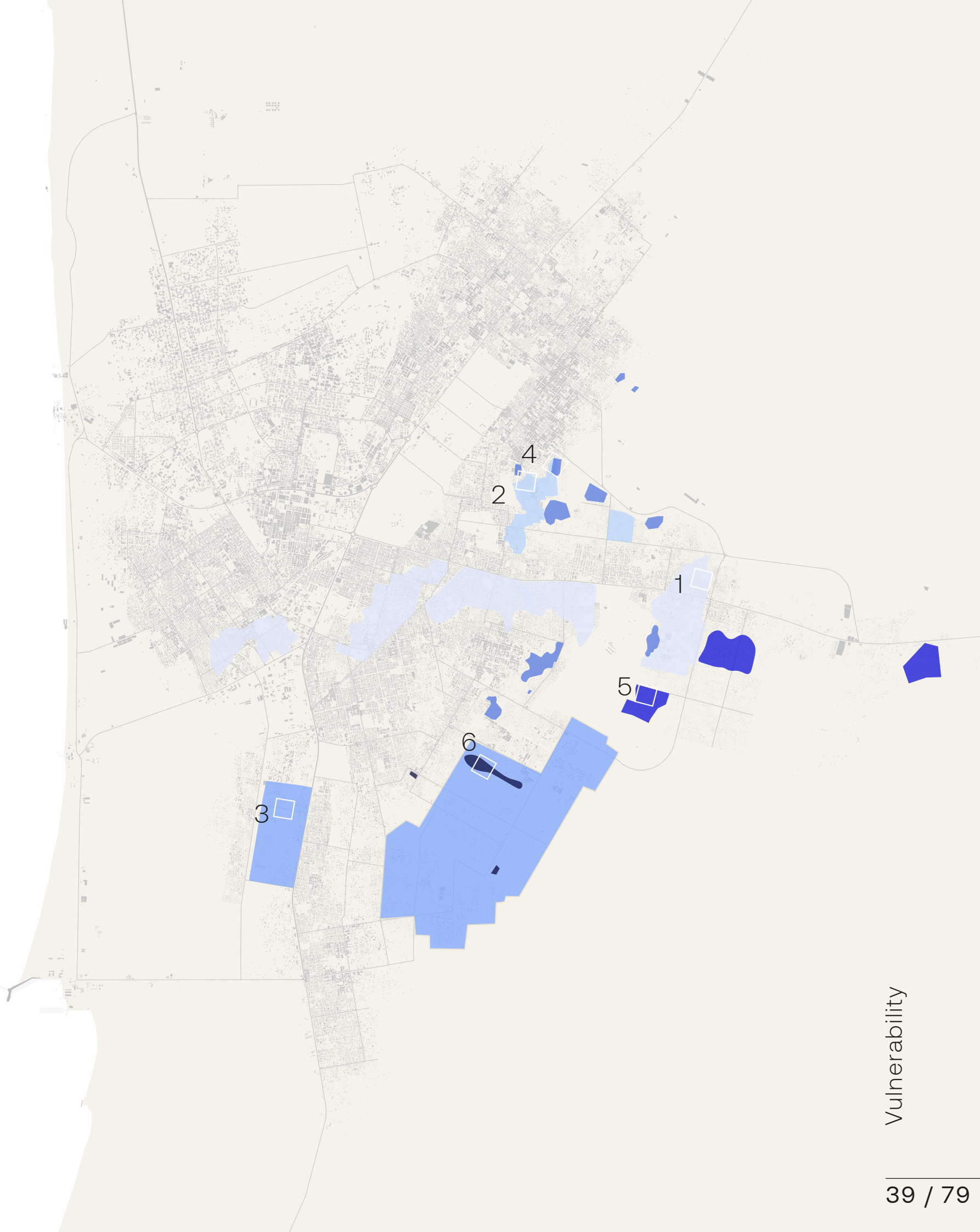
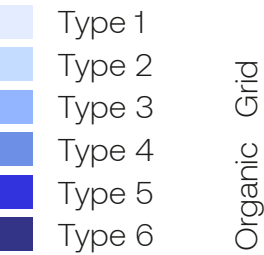


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Replication

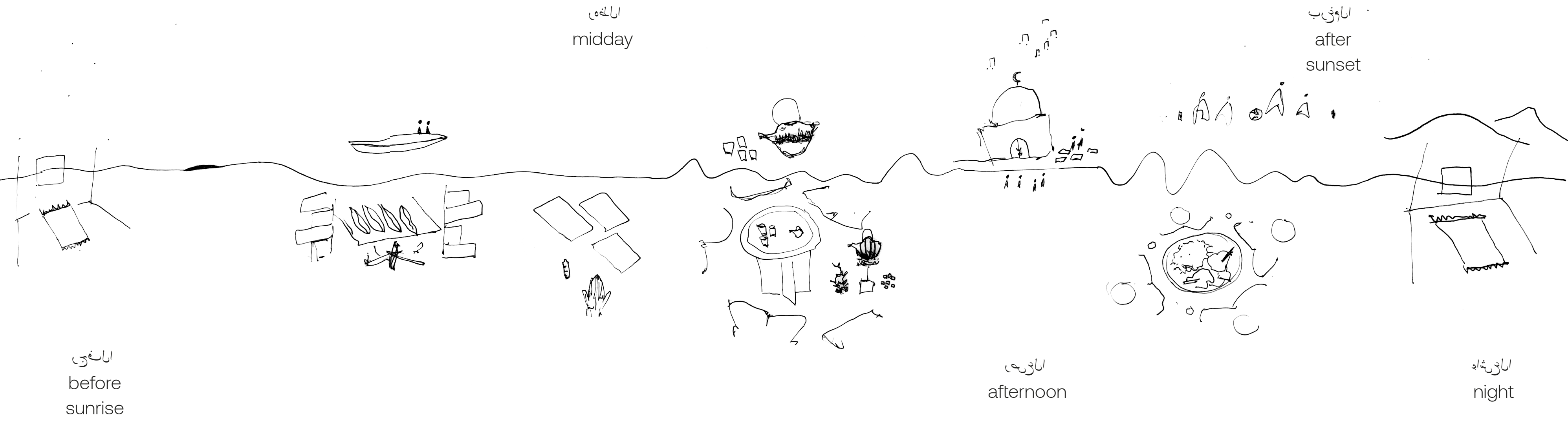
Replication of Types





V Life & people

Rhythm of Life



People

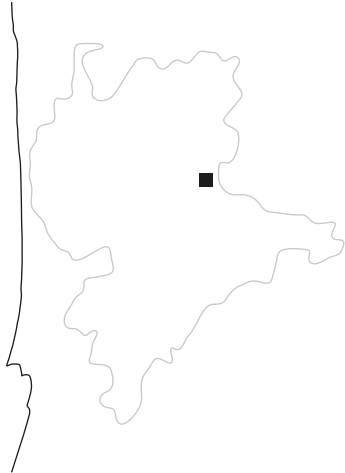


Life & people

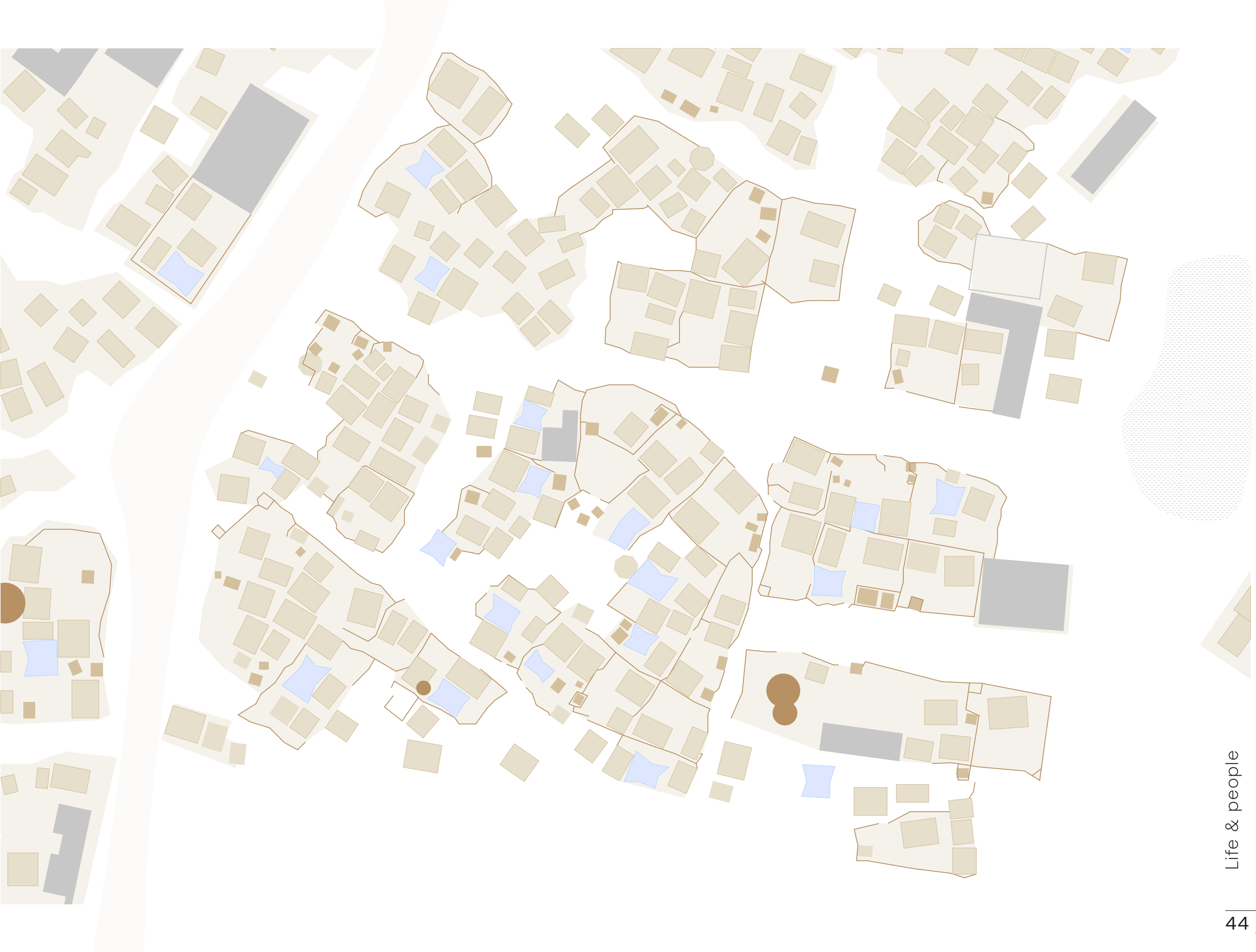
Stories



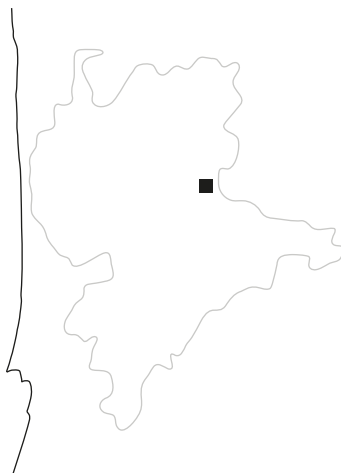
Space



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

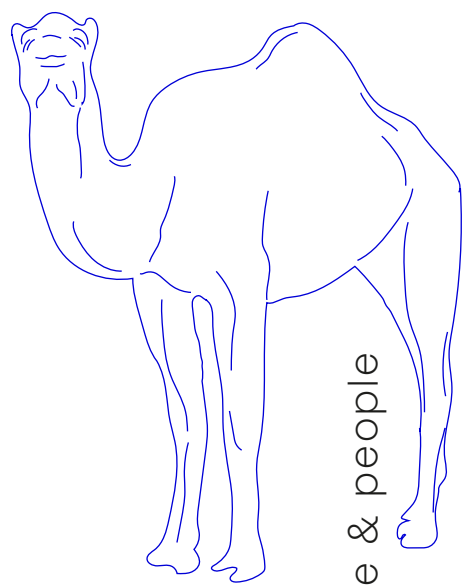
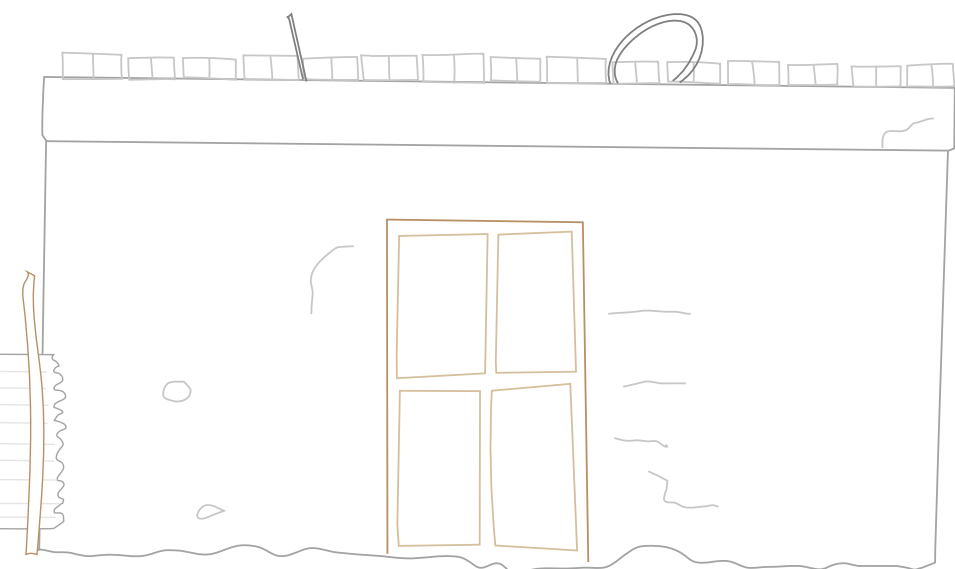
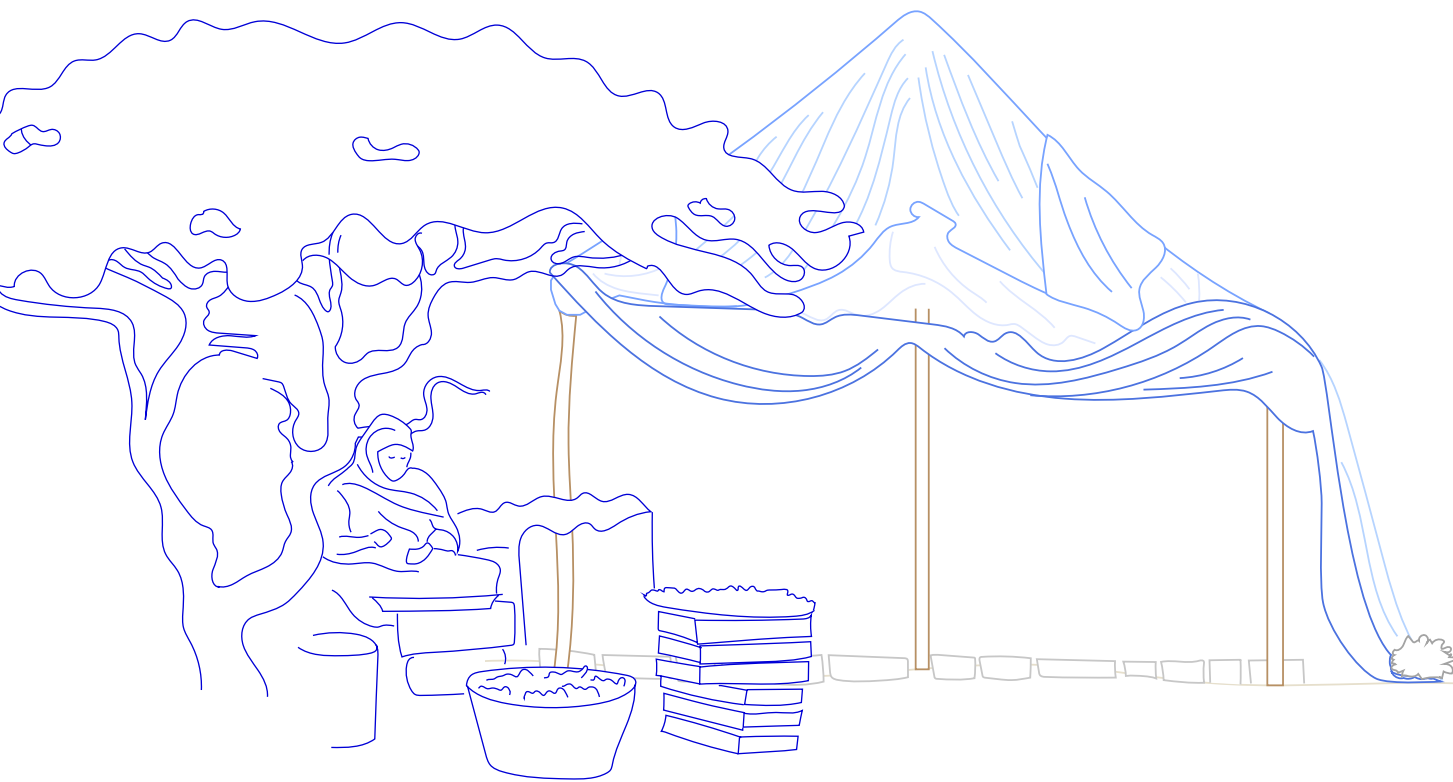
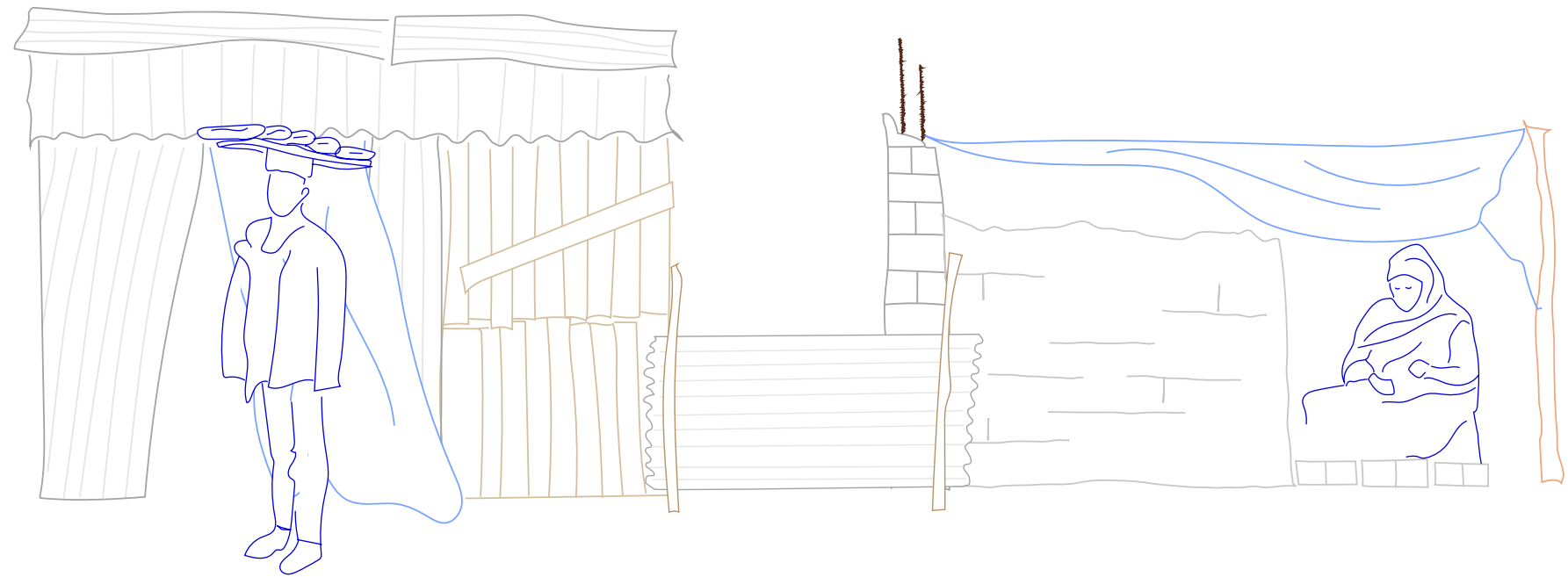
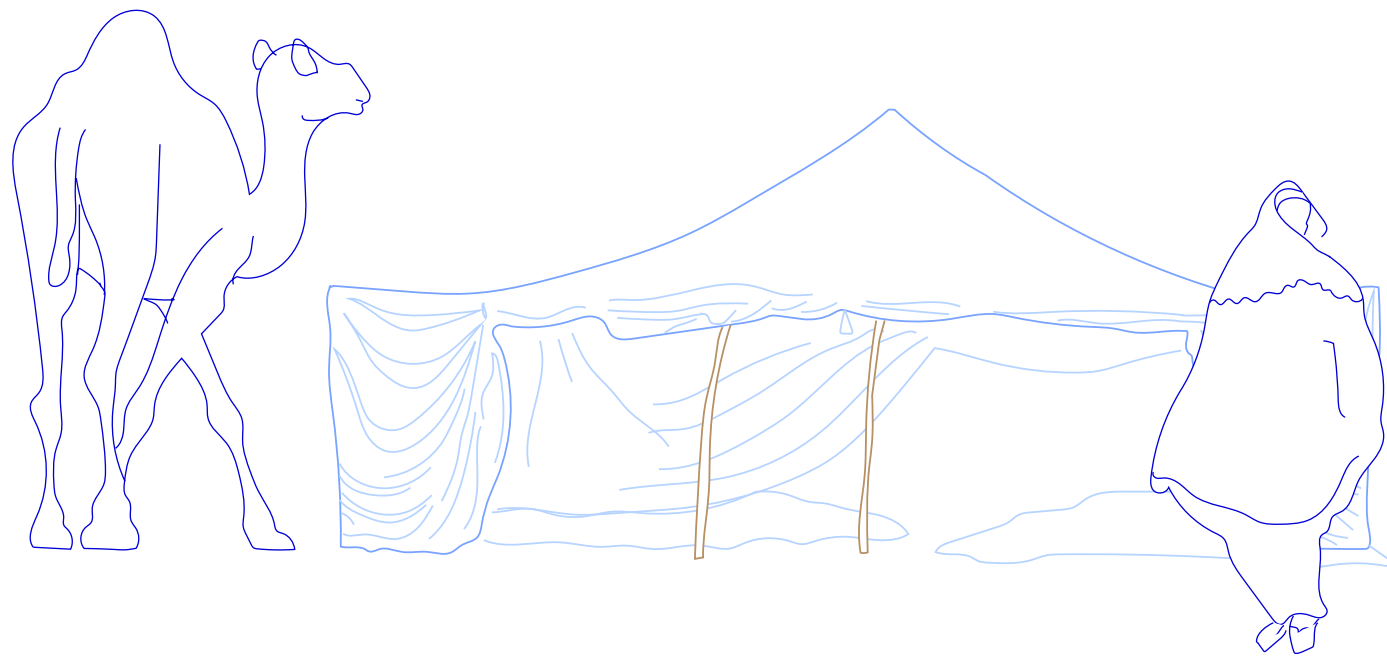


Activity



- Animals
- - - People
- Cars

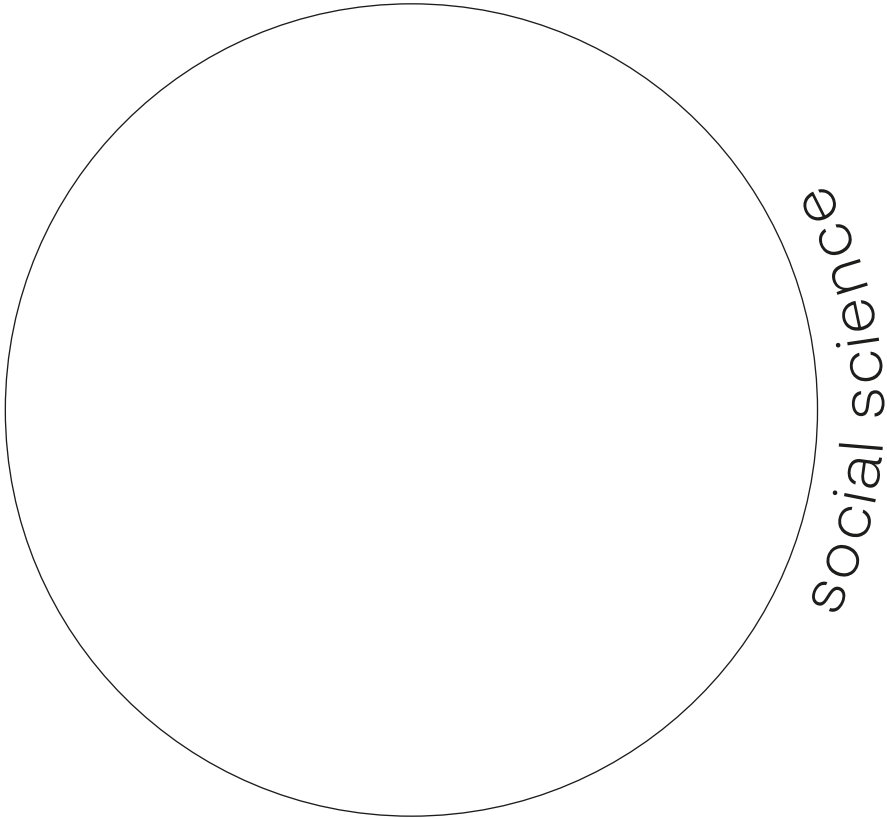
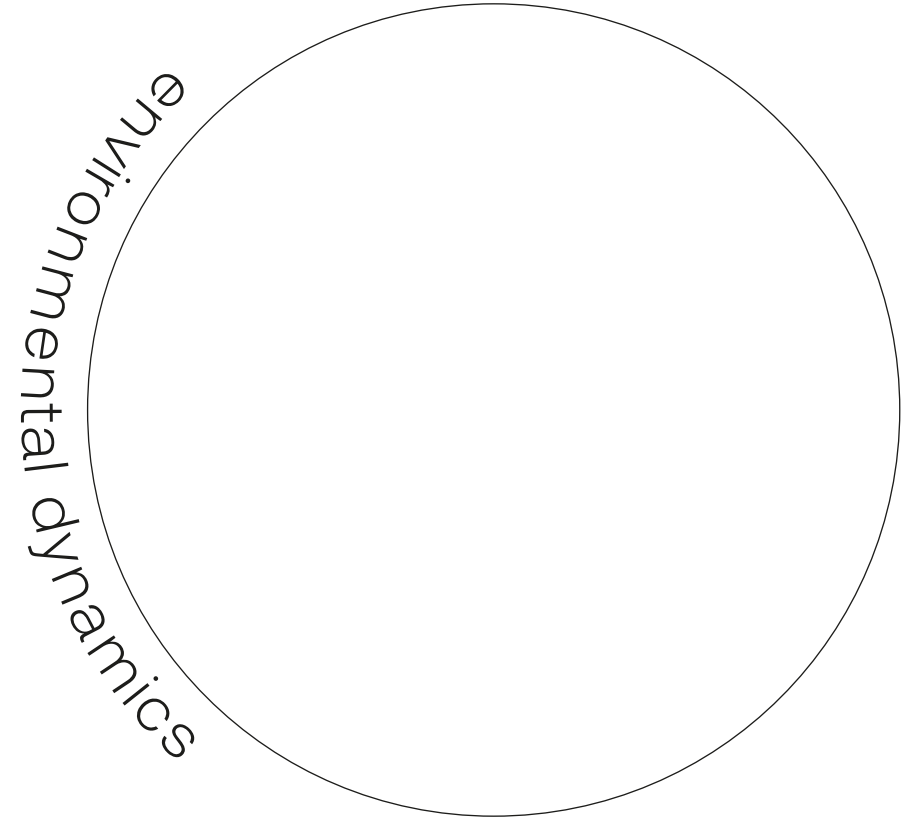




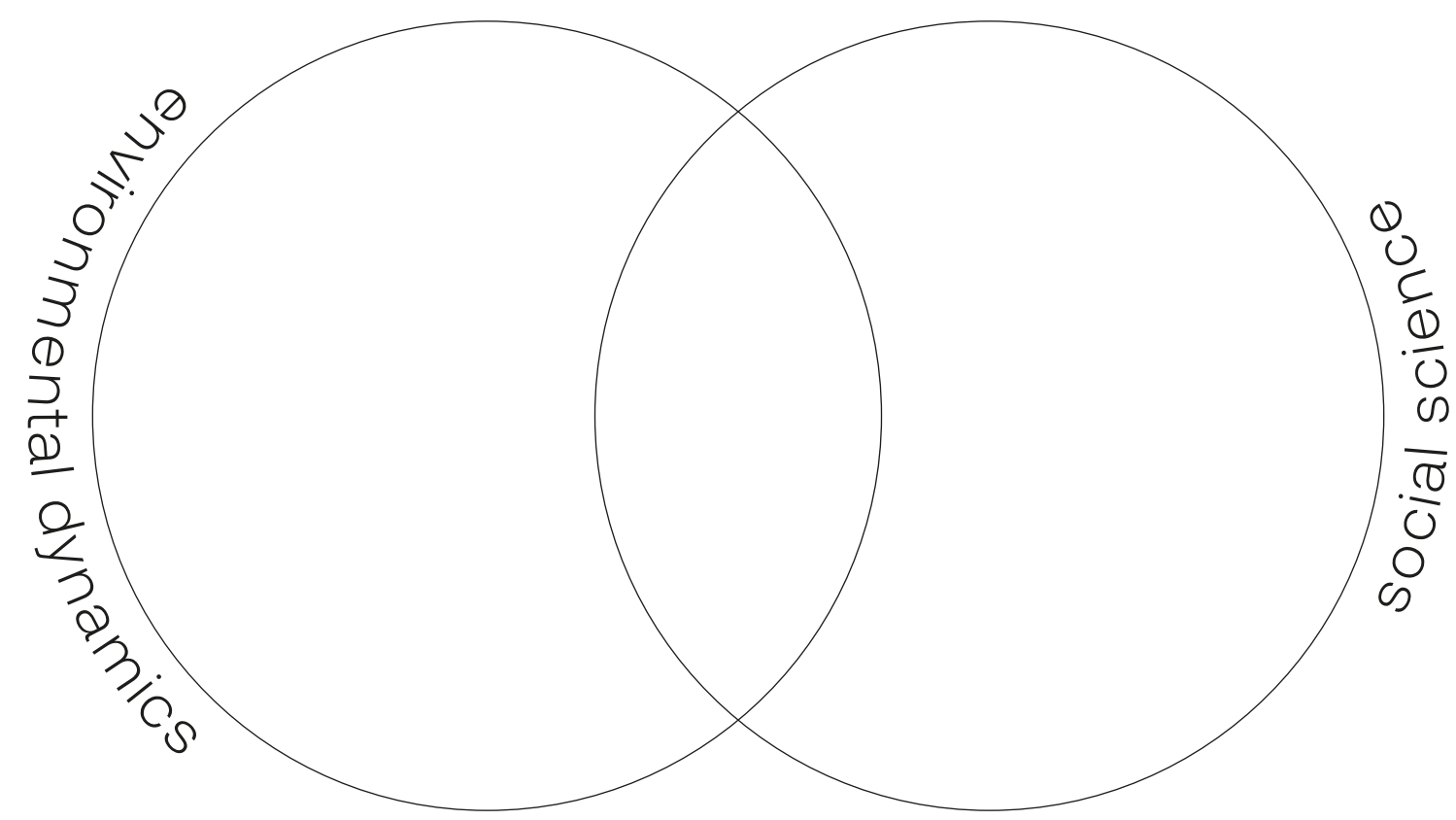


VI Design

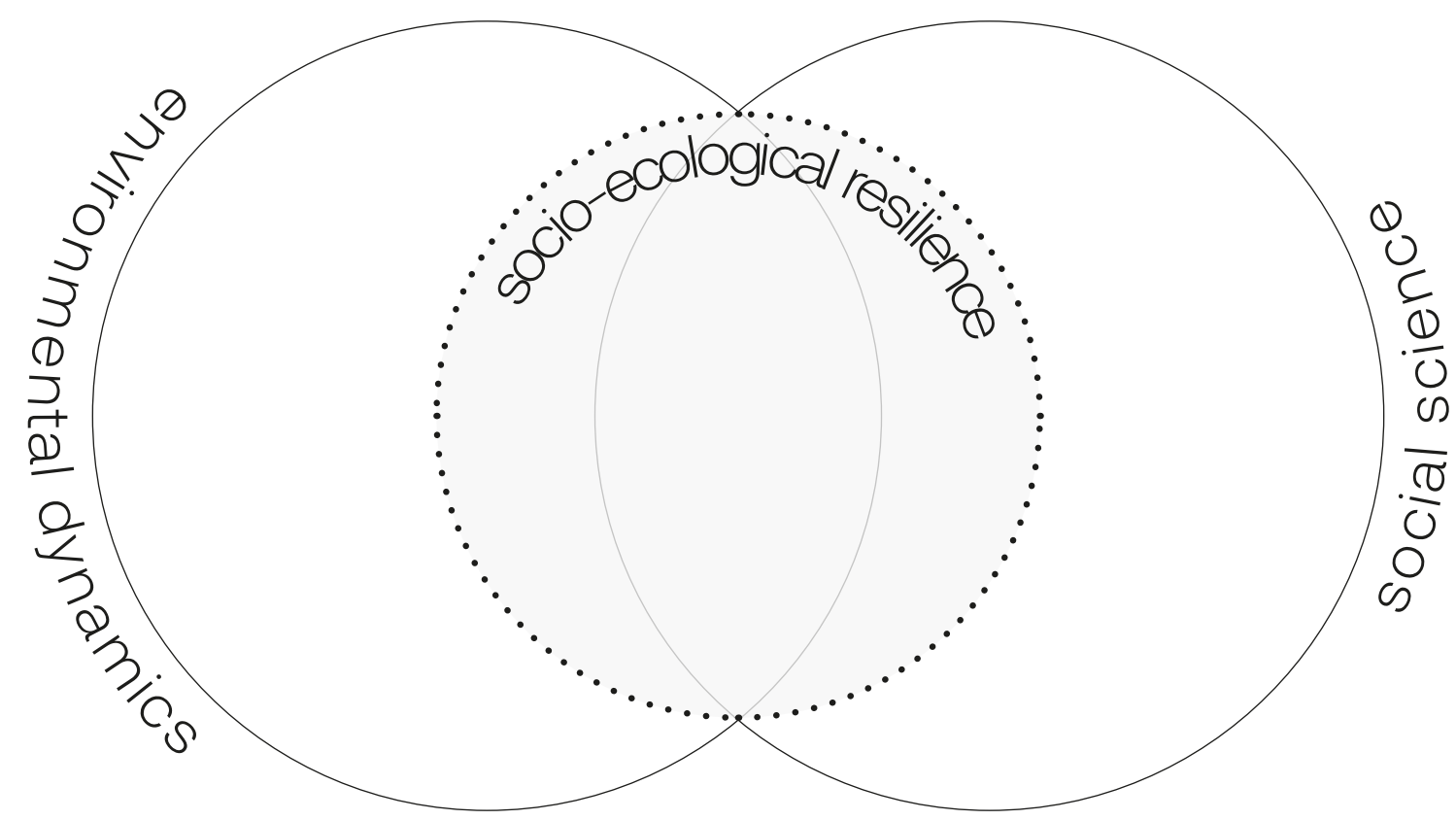
Conceptual framework



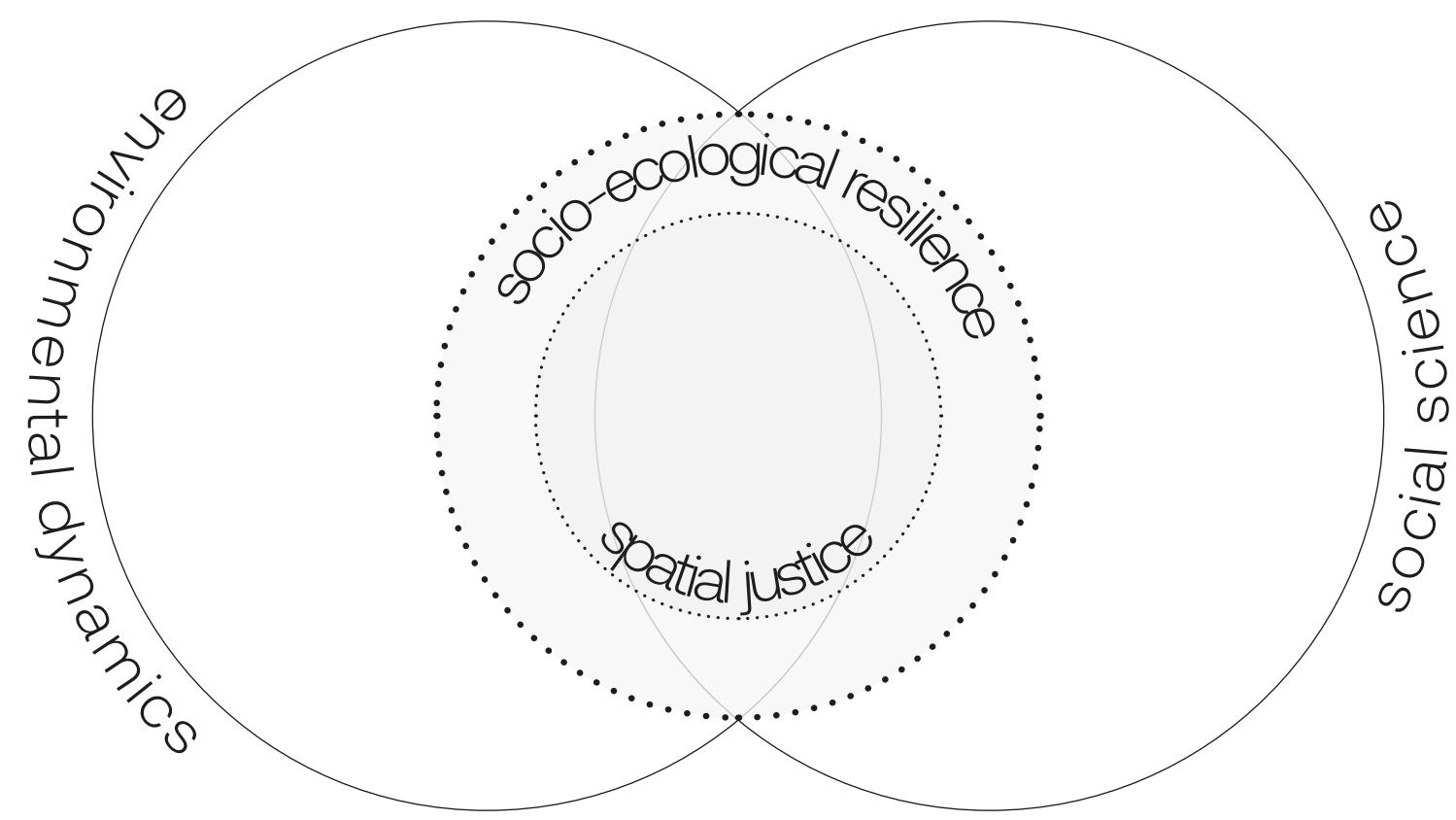
Conceptual framework



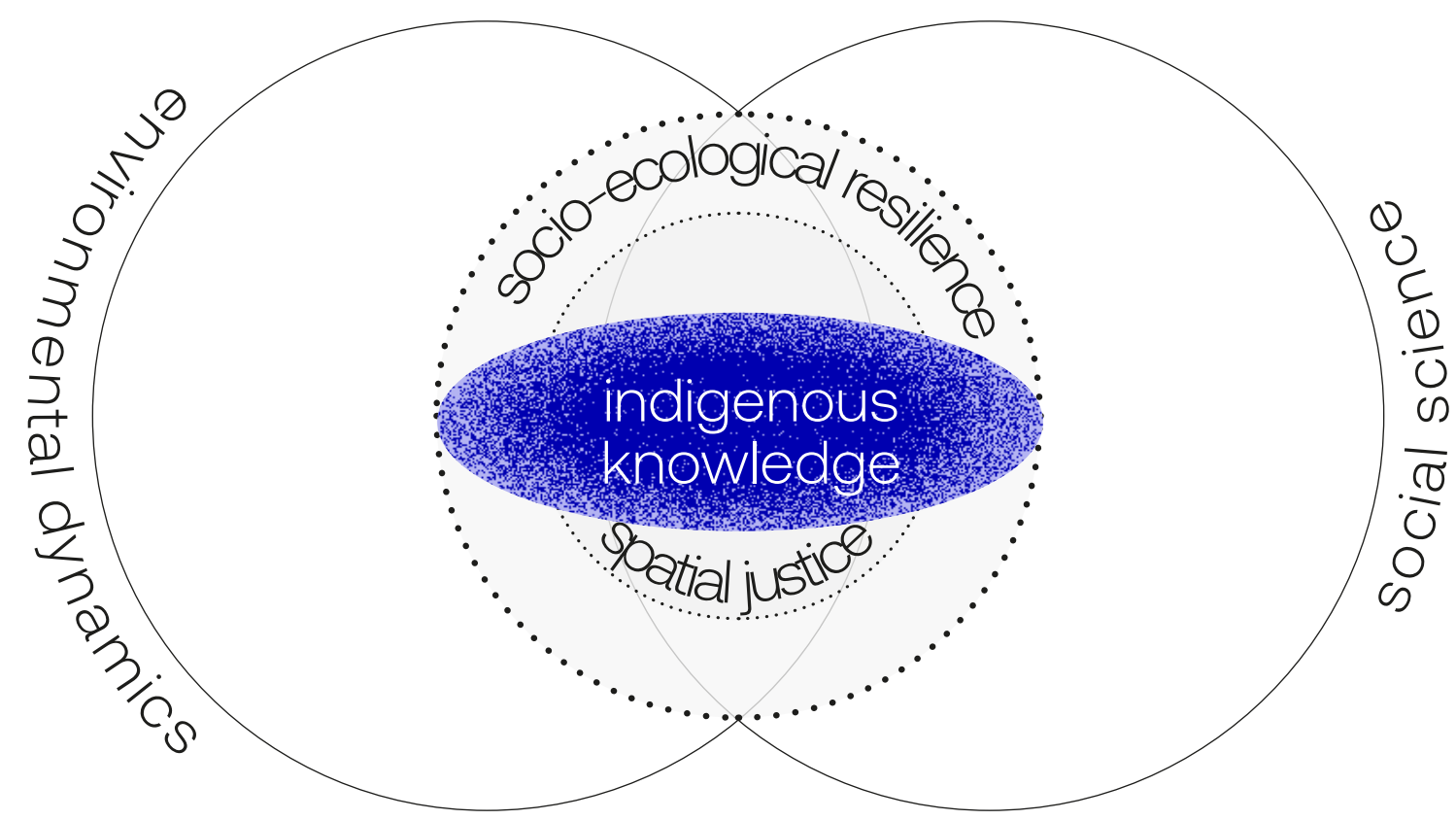
Conceptual framework



Conceptual framework



Conceptual framework



Pattern

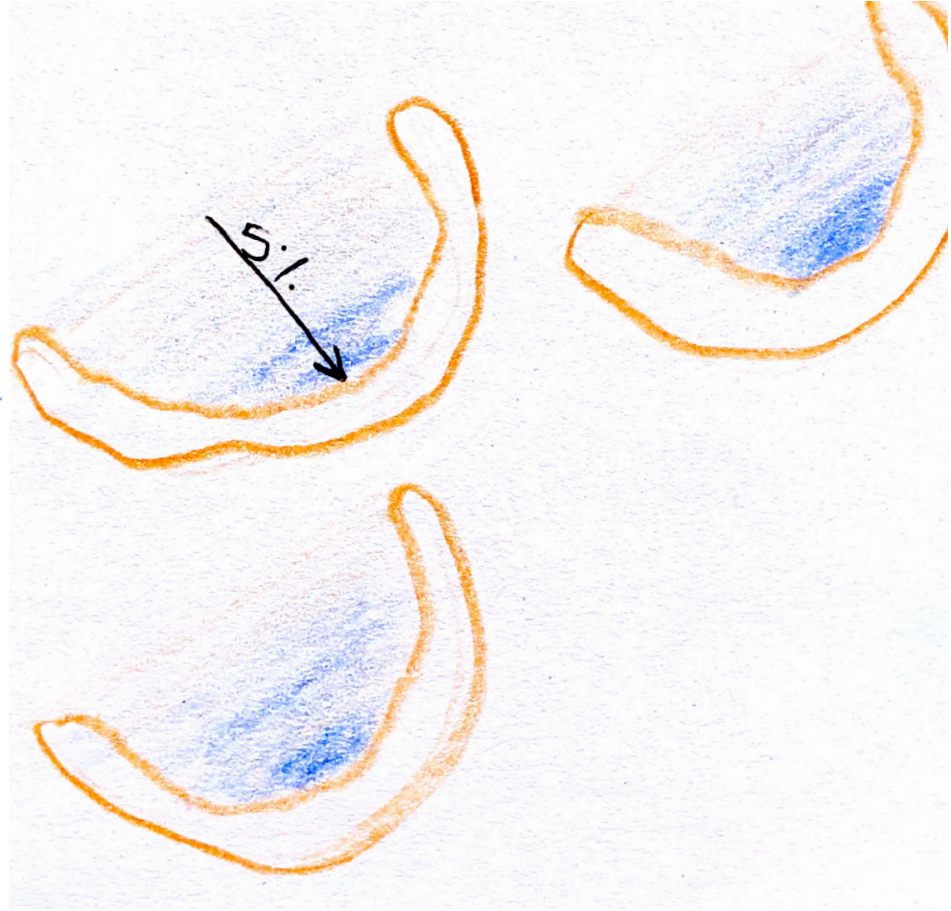
pattern identification

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




photo



scale

-  dwelling
-  block
-  neighborhood
-  city
-  region

governance

-  top down
-  bottom up
-  both



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

Native speciesEco 4



Using native and non invasive species will help the ecosystem restore and thrive in the future

pattern set: Community garden - Desert fight - Green education - Living with water

Salt marshesSLR 1



Areas threatened by SLR and groundwater flooding should be transformed into spaces for nature adapting to life with water.

pattern set: Altered landscape - Living with water

Dune fixationDesert 4



To prevent dangerous drifting sand dunes we need to protect and recover fixed dunes through practices

pattern set: Desert fight

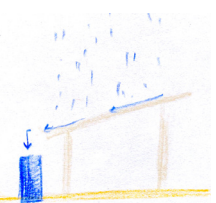
KhaimaIntegration 4



Communal spaces where people can meet and gather improves the social network and sense of belonging

pattern set: Unite people through space - Sense of home

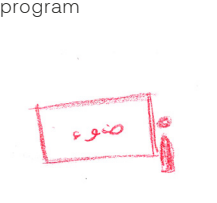
Collecting waterWater 1



Collecting rain water can save resources and help families become more self-sufficient

pattern set: Community garden - Desert fight - Green education - Water for all - Home upgrade

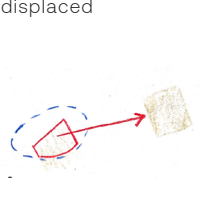
Education programAccess 3



Supporting education on all levels financially through the government will make it more accessible to all people

pattern set: Good public - Fair energy - Uncertainty


Space for displacedCentral 1



When people are displaced for any reason, space has to be found near by to house them

pattern set: Altered landscape - Living with water

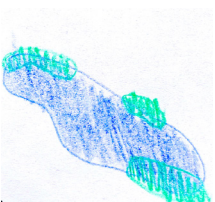
Companion plantingEco 3



Companion planting is a method inter-planting species that support and benefit each other

pattern set: Community garden - Green education

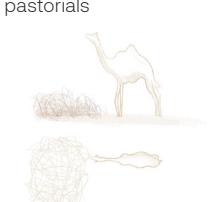
WetlandsSLR 2



Wetlands add to the adaptive capacity of a place and conserve biodiversity.

pattern set: Altered landscape - Living with water


Sensible pastoralistsDesert 3



In this fragile ecosystem, using indigenous pastoral practices creates a fusion between human and ecosystem, nurturing the landscape

pattern set:

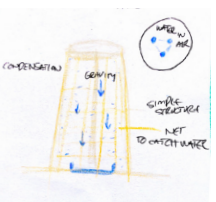
Support public functionsIntegration 2



Supporting existing public infrastructure to improve their capacity will improve accessibility

pattern set: Good public - Unite people through space - Sense of home


Fog collectionWater 3



This practice collects water through the humidity in the air, taking advantage of condensation and gravity

pattern set: Water for all - Unite people through space

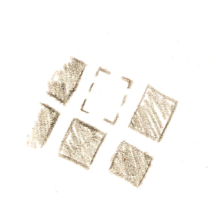
Education on ecologyAccess 4



Education on ecological practices will improve peoples use with the ecosystem, and include residents in process of transformation

pattern set: Green education

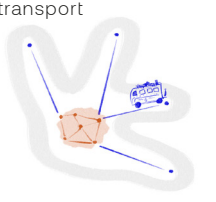
Reuse porosityCentral 4



Porosity within a city are spaces of future transformation. The goal is to find new purpose for these spaces, reusing the existing

pattern set: Healthy neighborhood - Fair energy - Uncertainty

(In)formal public transportCenter 7



Supporting and expanding the existing public transport especially into the cities outskirts to be more consistent

pattern set:

Waffle gardensEco 2



This indigenous practice of the Zuni used in dry landscapes captures, stores and re-directs water in communal agriculture

pattern set: Community garden

Recycling is cool!Pollution 1



Separating waste and recycling plastic can improve the quality of the neighborhood and prevent further land pollution

pattern set: Healthy neighborhood


Wetland agricultureSLR 3



Wetlands can benefit surrounding community when they include agriculture that can sustain people

pattern set: Living with water

MudhifSLR 6



The mudhif is an indigenous practice, using reed to build floating islands and mesmerizing architecture in wet landscapes.

pattern set:

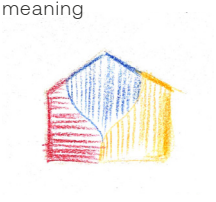
Green beltDesert 2



Green spaces and living fences surrounding the city will protect and reduce shifting dunes

pattern set: Desert fight

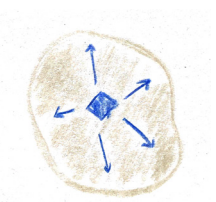
Shelter with meaningIntegration 3



Painting facades in informal settlements has proven to improve peoples feeling of belonging and reduce stigmatization

pattern set: Unite people through space - Sense of home - Home upgrade


Centralized waterWater 4



Having centralized points for water around the city makes it more accessible for vulnerable communities

pattern set: Water for all

Solar supportAccess 1



Supporting the investment in solar energy will increase accessibility and help the economy

pattern set: Home upgrade - Fair energy

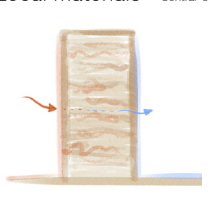
Local economyCentral 2



Shifting the economic center from one space to more divided, multiple centers will increase accessibility and fair distribution

pattern set: Healthy neighborhood - Uncertainty

Local materialsCentral 5



Using local material and building techniques such as clay bricks and rammed earth improves room temperatures, sense of home and the local economy

pattern set:

Zai PitEco 1



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

pattern set: Desert fight - Green education

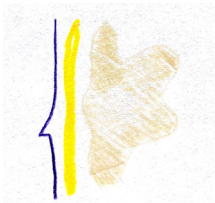
Waste managementPollution 2



Waste has to be managed on different scales, including support by the government on a city scale

pattern set: Healthy neighborhood

Dune protectionSLR 4



Restoring and protecting the coastal dune landscape is necessary to protect the city against rising sea levels

pattern set: Altered landscape - Fair energy

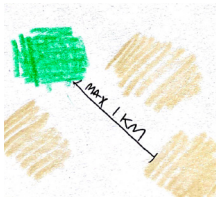
Built on stiltsSLR 5



Settlements in flooded areas can be adapted to living with the water by building on stilts

pattern set: Living with water

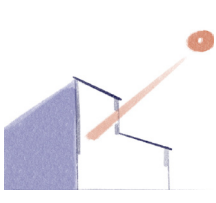
Green spacesDesert 1



Greenery adds to the ecological value of a place and protects vulnerable communities against the forces of the desert.

pattern set: Community garden

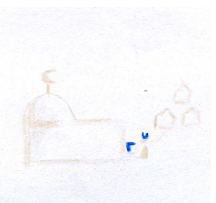
Shaded houseIntegration 5



Creating a new housing typology sensible to its context and location to provide housing for displaced while creating shade in open

pattern set:

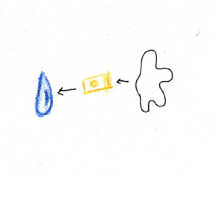
Public waterWater 2



Using public buildings connected to the cities water network as distribution centers for the neighborhood

pattern set: Good public - Water for all

Fair water priceWater 5



Policies regulating water prices will close the price gap between water from taps and water transported with trucks

pattern set: Water for all


Public bathroomsAccess 2



Free public bathrooms will improve the sanitary situation in neighborhood with no water network

pattern set: Good public - Unite people through space

Urban unplanIntegration 1



Supporting informality where it proves to be valuable

pattern set: Uncertainty

Water economyCenter 6



Aquaculture and processes to win salt create new economic opportunities in flood prone areas.

pattern set:

Ecological value

Land pollution

Sea-level rise

Desertification

Integration & social network

Distribution of water

Accessibility to Services

Economic Opportunity

Pattern sets

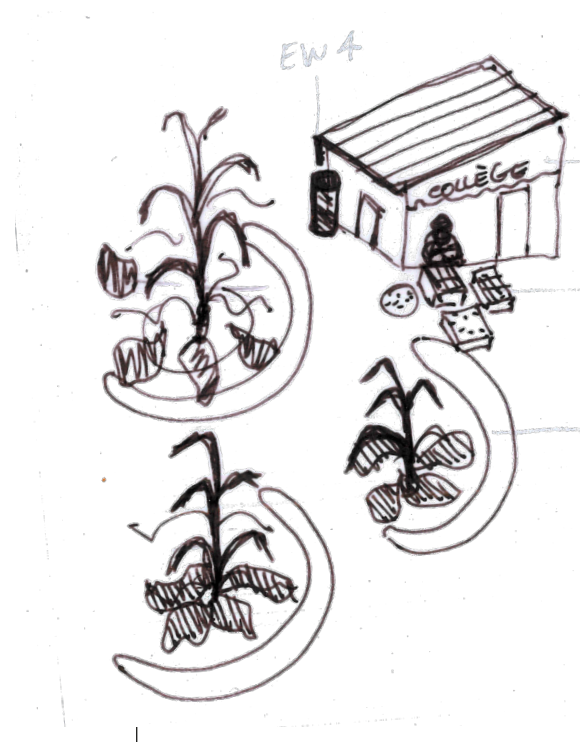
Title

Visual

Explanation & Implimentation

Assessment

Green education



W 1 Collecting water

E 1 Zai pit

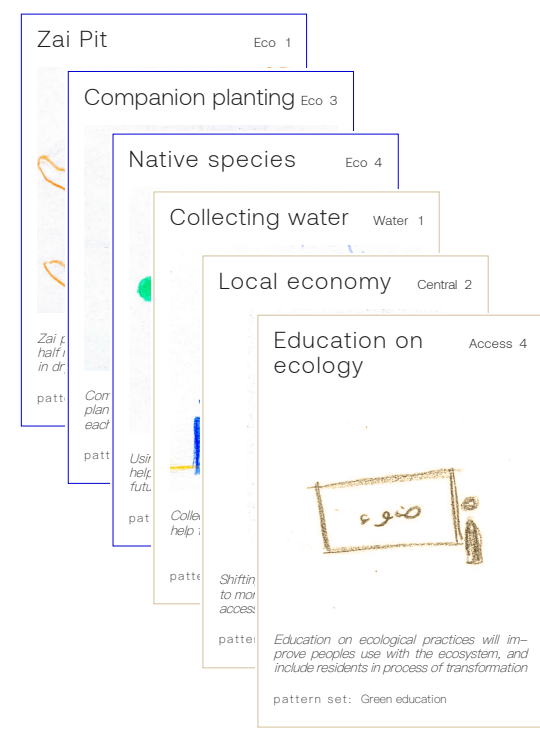
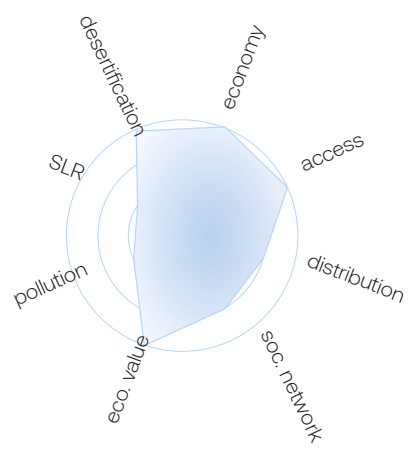
C 2 Local economy

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.



Scale & Governance

Patterns

Create a Pattern Set

Task

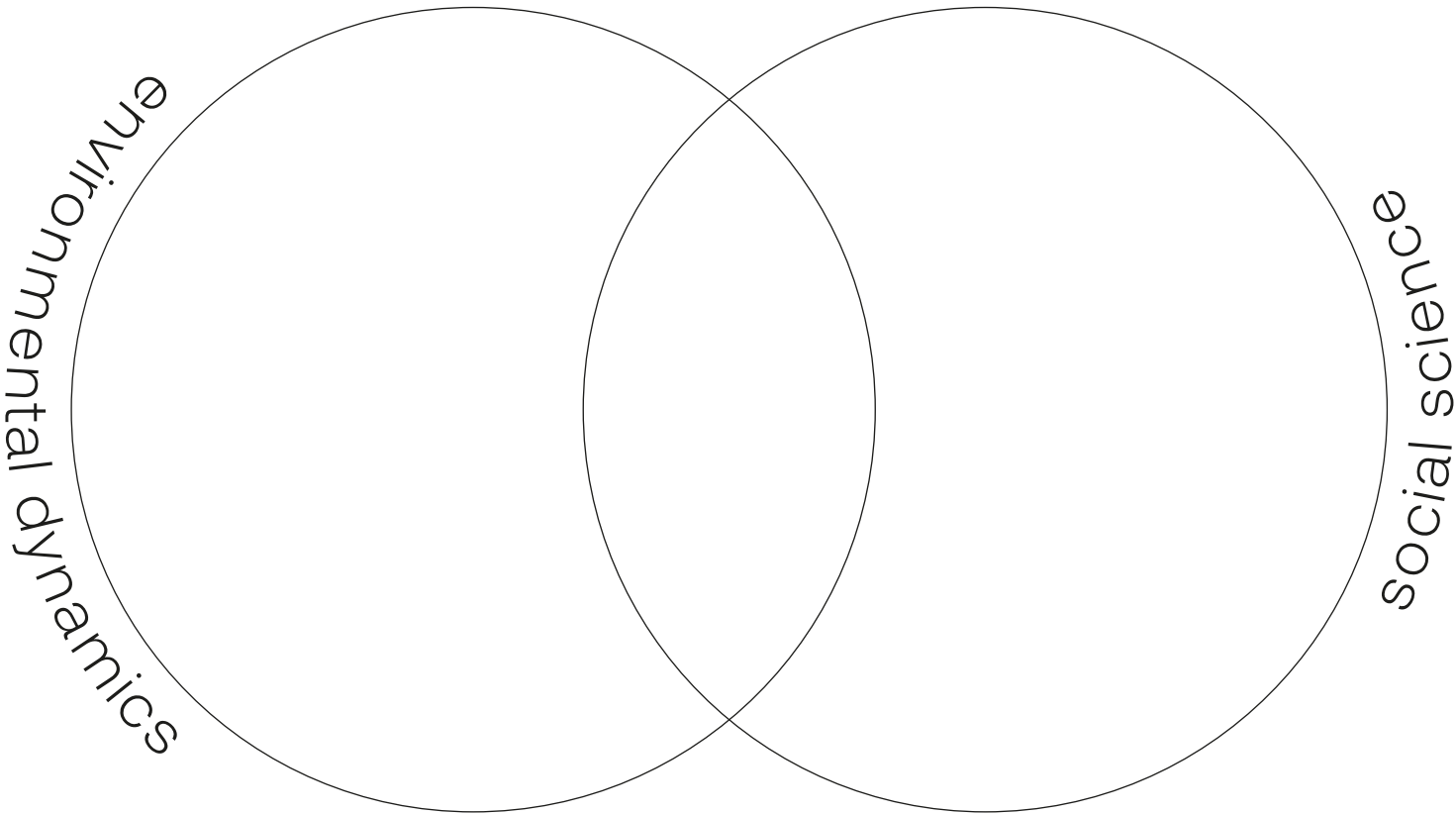
Using the Patterns in front of you create a meaningful Pattern Set, tackling specific urgencies.

Rules

- 1. Sets are made of **at least three patterns**
- 2. Sets need patterns from **both fields**, social and ecological

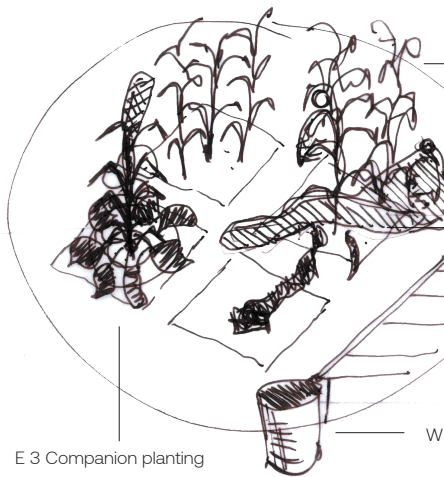
Aim

The aim is to connect environmental and social aspects.

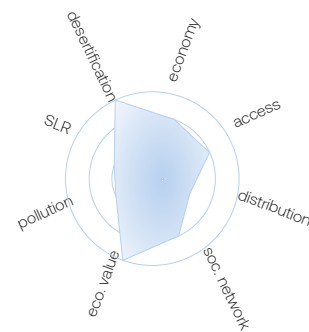


Ecological pattern sets

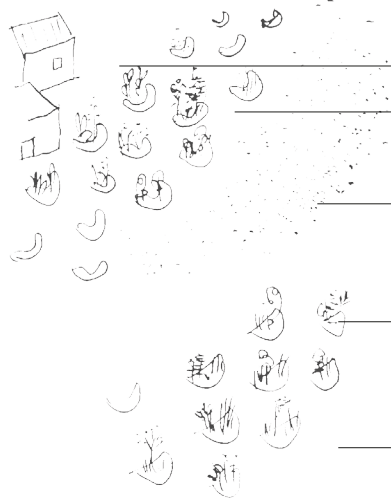
Community garden



The community garden combines indigenous knowledge of planting in desert landscapes with a focus on native species to form a symbiosis with the ecosystem. A focus lays on the locality and the users experience. In the Zuni culture, waffle gardens were community gardens led by women, ensuring food security in areas with [limited] water and degraded soil. The sunken waffle gardens are dug into the ground, offering protection to groundwater and keeping temperatures low. In addition, a layer of manure and gravel trap moisture in the soil and reduce water runoff (Watson & Davis, 2020). Using plant species that residents are familiar with, such as acacia nilotica, mentha, and moringa stenopetala will utilize people's existing knowledge. These gardens are best placed in secluded, cool spots within the neighborhood. They can also be developed bottom-up, provided that the technical know-how is shared.



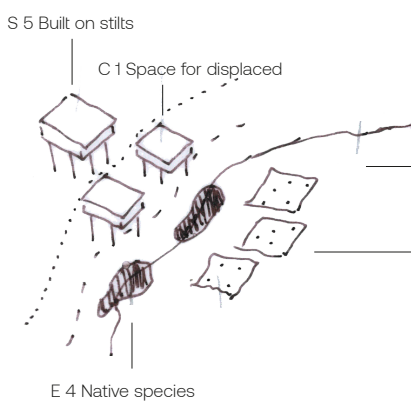
Desert fight



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).



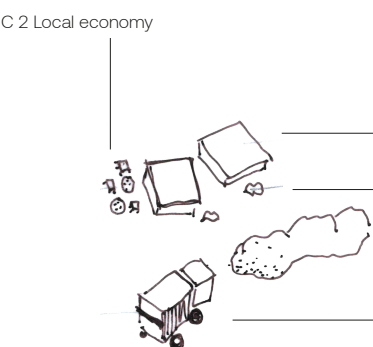
Living with water



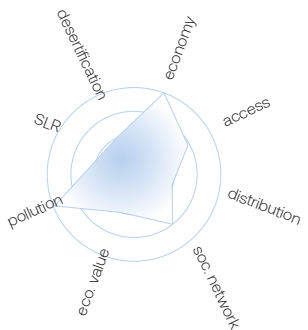
Much of the current territory is being confronted with issues of flooding and ground-water seepage, resulting in many people being displaced from the flooded areas. This pattern set arises from the urgency of dealing with this issue, but instead of trying to fight against it, it proposes to live along 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.



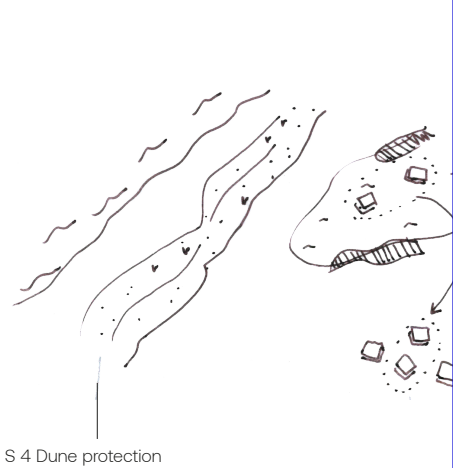
Healthy neighborhood



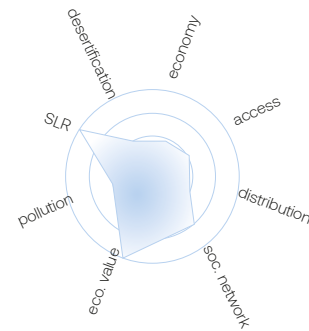
The current waste management system is lacking, with existing landfills being overcrowded creating serious health issues for the residents. This pattern set addresses this widespread issue of pollution by creating employment opportunities through it. By addressing the issue of waste management in the neighborhood scale throughout the city, the volume of trash that reaches the landfills would be reduced – making it easier to sort and recycle. This can be achieved by educating people on recycling practices and providing the necessary infrastructure. Moreover, job opportunities could emerge through the recycled materials, either in the form of new construction materials or crafts.



Altered landscape

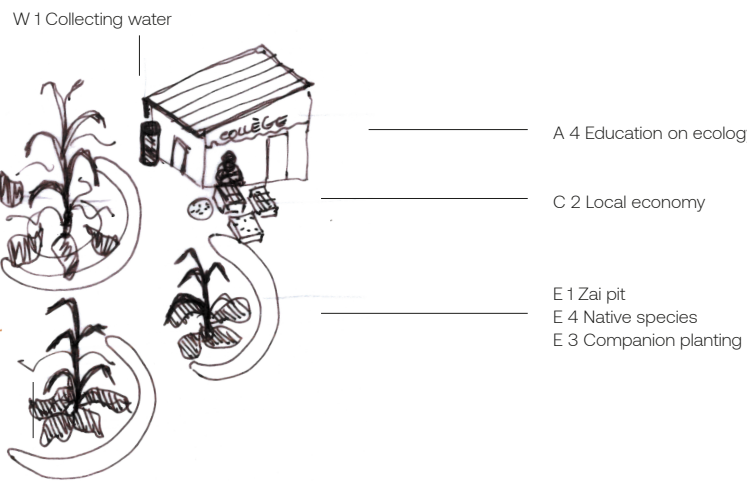


The alteration of Nouakchott's landscape is inevitable. Addressing the single physical barrier between the city and the Atlantic Ocean, this pattern set focuses on the protection of the narrow dune strip. This requires consideration of both human and non-human agents – both the residents of the affected 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.

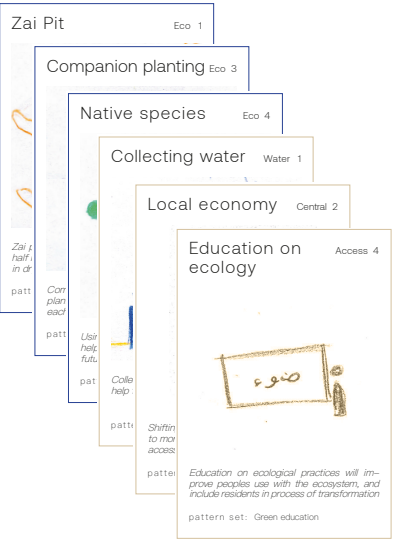
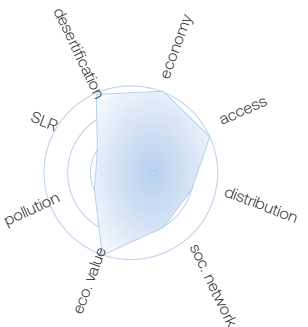


Green education

neighborhood to city scale → both

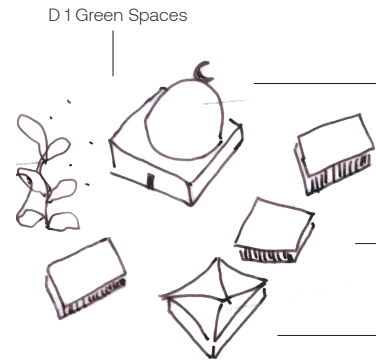


Protection against desertification requires large-scale cooperation at a transnational level; however, such efforts need to be grounded to local actions and education. Hubs of knowledge sharing should be present in close proximity to the Zai Pit landscapes, where people can get educated on the indigenous 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.



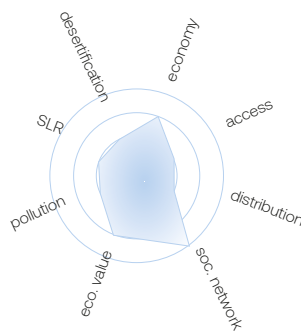
Social pattern sets

Sense of home

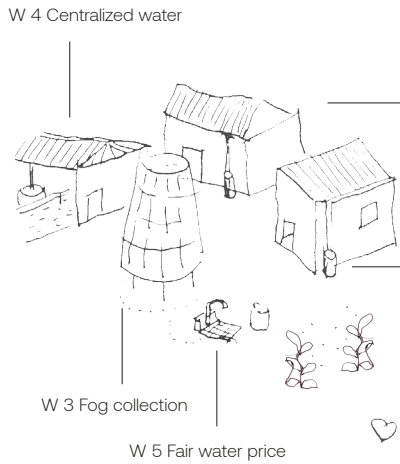


A sense of home is a vital part in creating and maintaining a social network, especially in times of strife. This pattern set is geared towards the urban block and neighborhood scales, focusing on people's perception and use of public space. Many examples have shown that small and inexpensive interventions, 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.

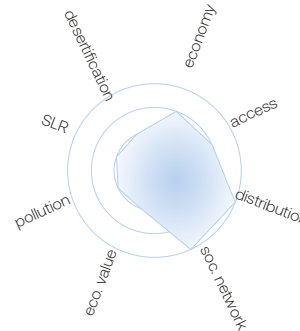
By supporting local public functions, such as schools or mosques, and with the integration of more communal spaces throughout the neighborhood in the form of the traditional Khaimas, the local community can be strengthened.



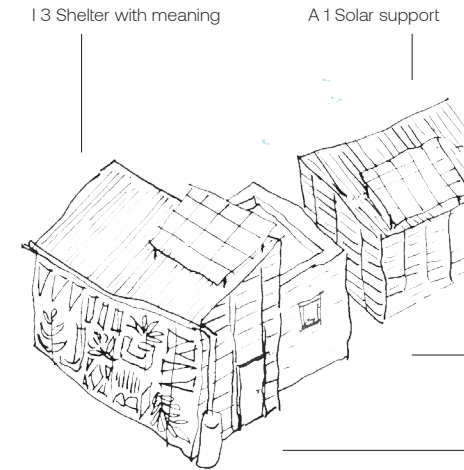
Water for all



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.



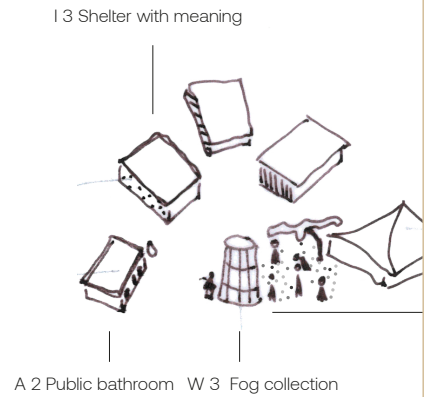
Home upgrade



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



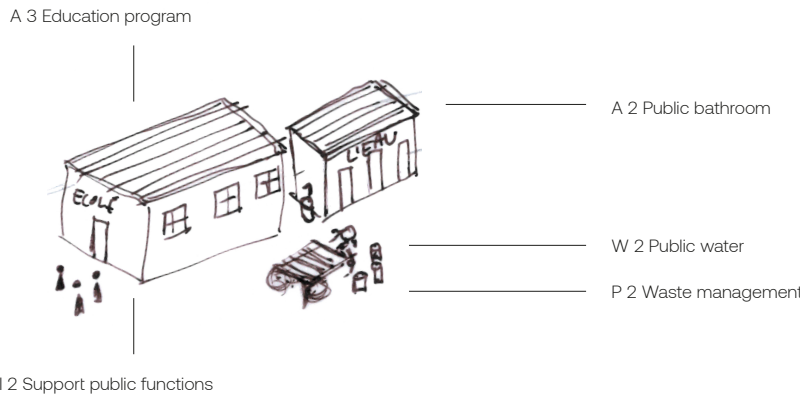
Unite people through space



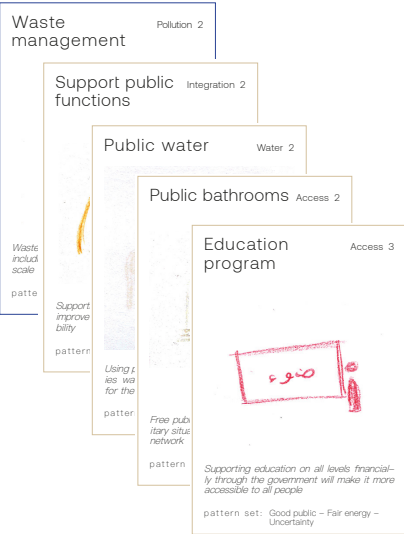
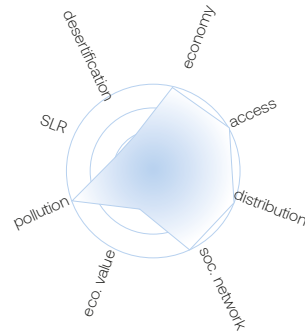
This pattern sets advocates for creating community spaces throughout the neighborhoods of Nouakchott, in order to aid in both urban and social cohesion. This can be achieved through the intensification of public services, like local water collection and distribution through the fog towers, access to public toilets, access to shade and public gathering through the Khaimas, and access to public green. These nodes of unity should be placed at suitable locations, like courtyards, public squares or other existing open spaces throughout the city, ensuring accessibility for all residents.



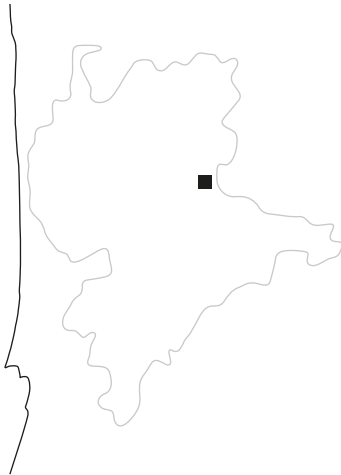
Good public



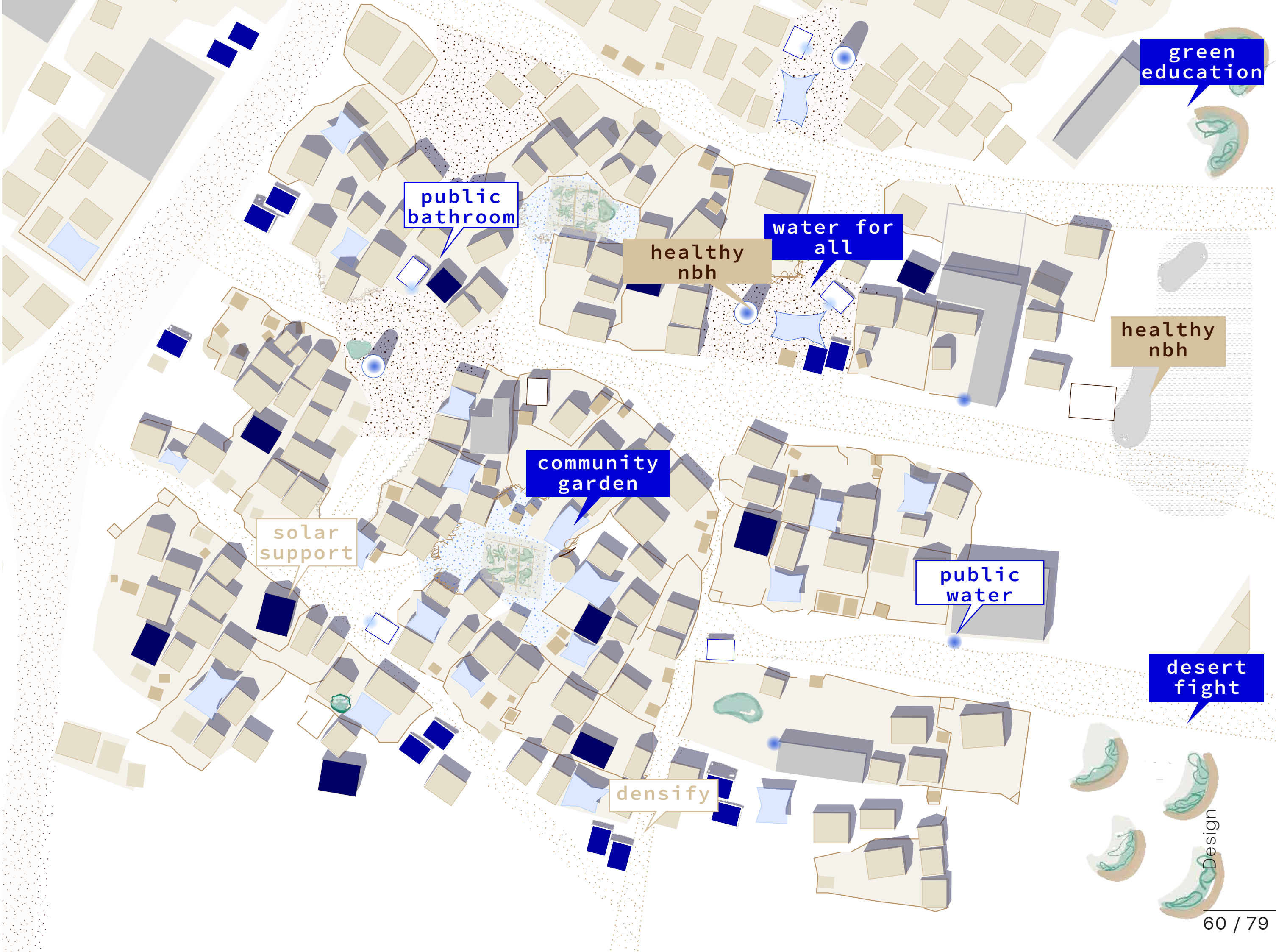
Access to public services is limited, especially at the outskirts of the city. This pattern set operates at the scale of the building and its immediate surroundings and emphasizes the importance of providing such access for all residents. This is not done through costly new construction, but by supporting 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.

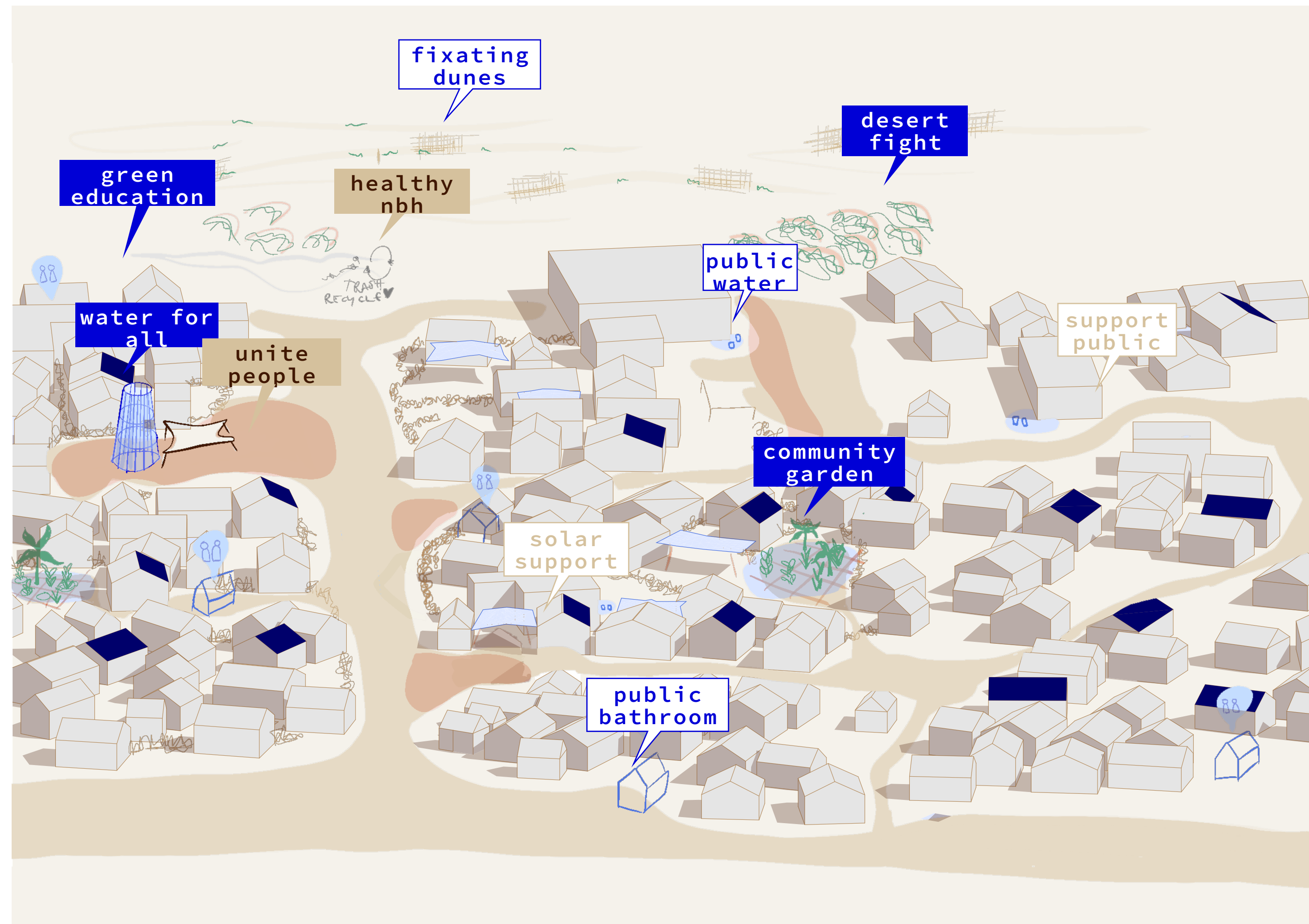


Upscaling

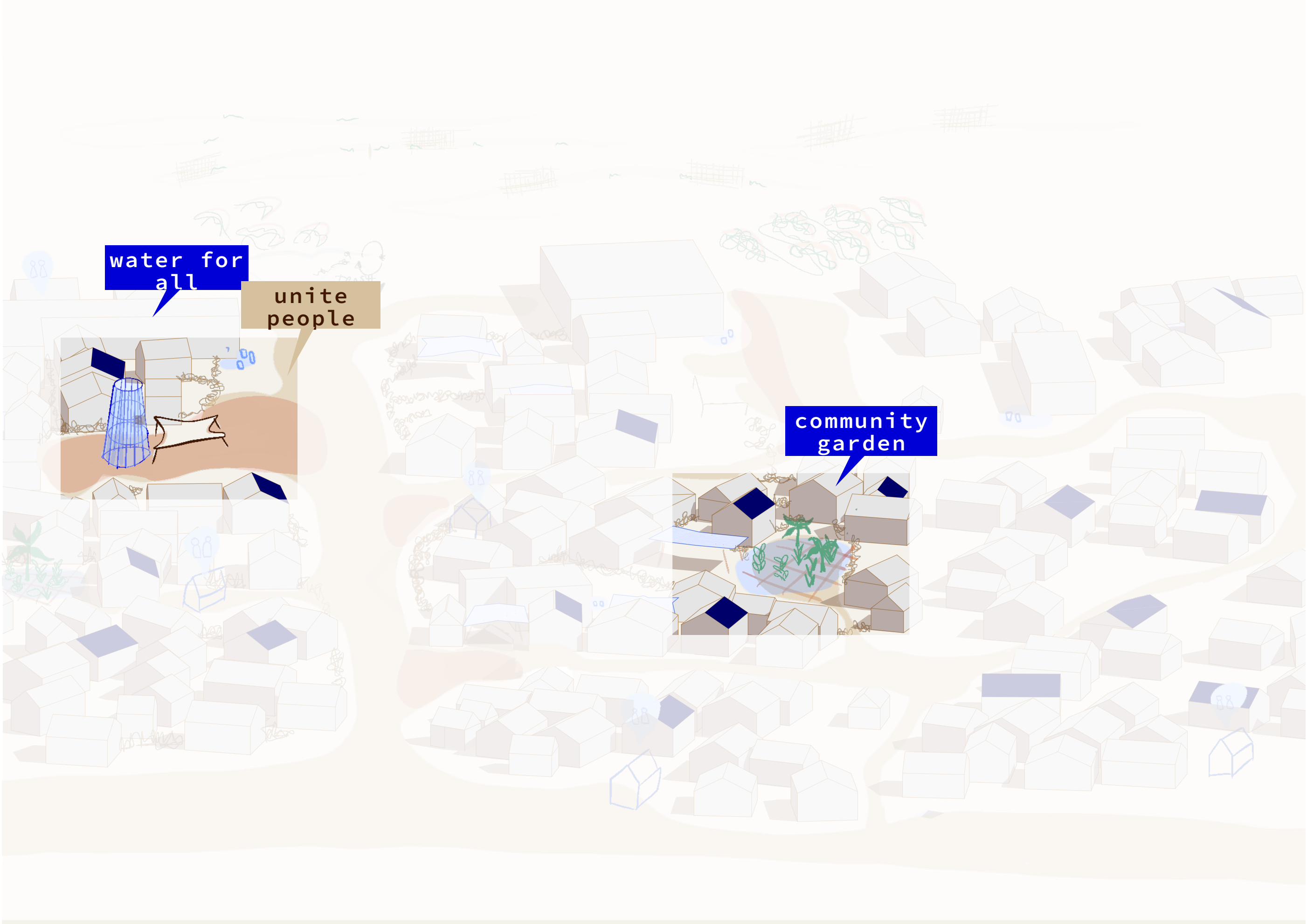


Green Safety

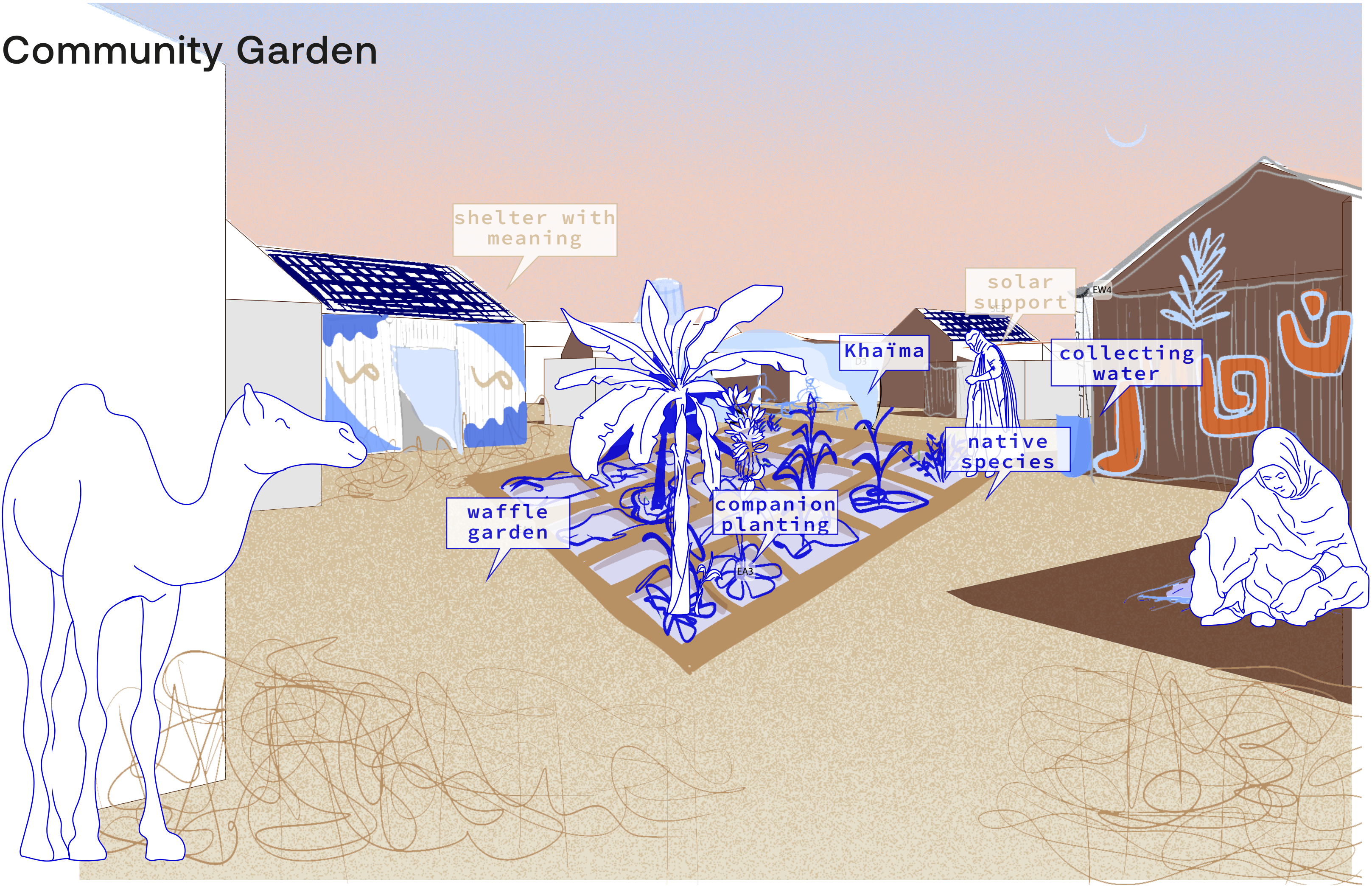




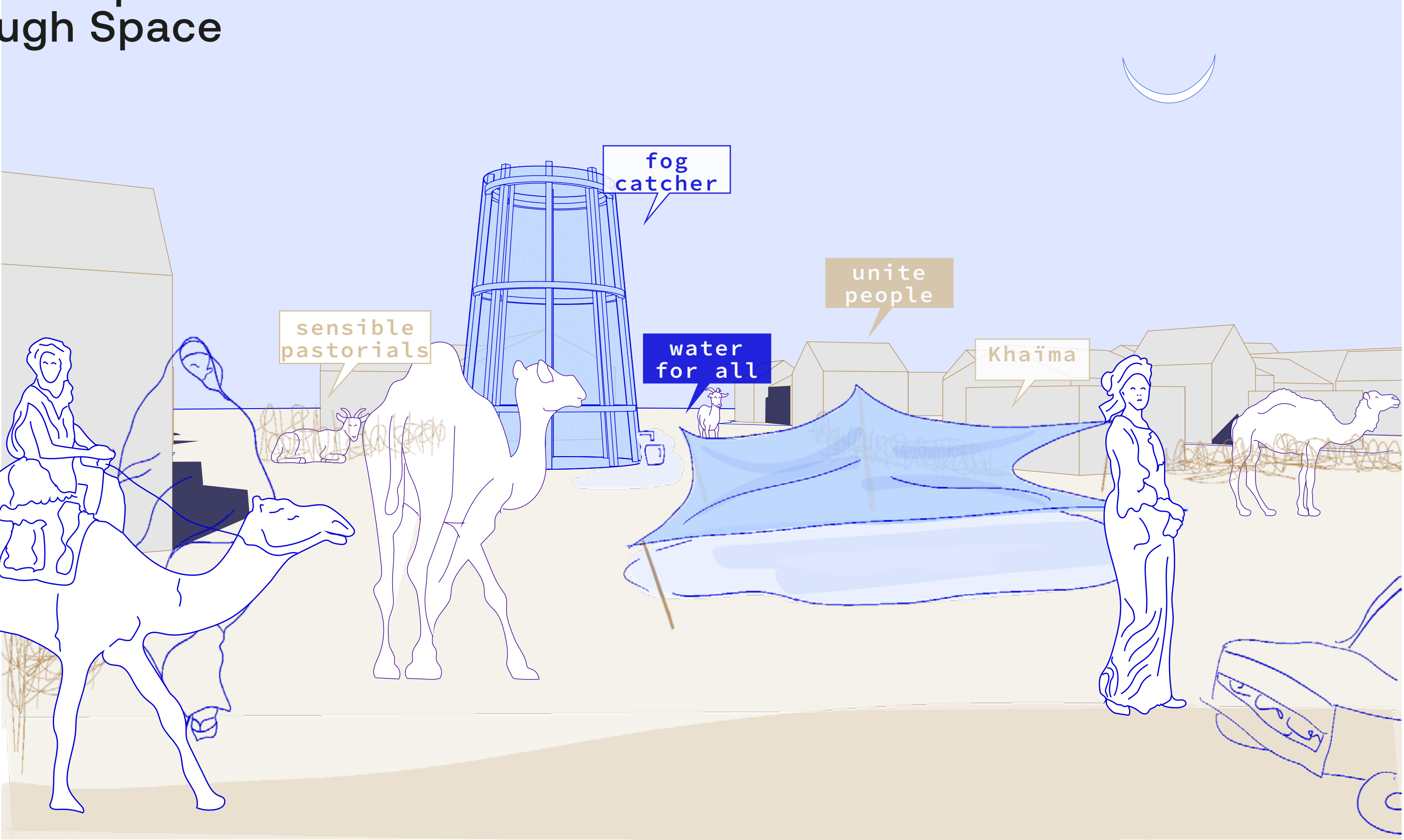
Focus



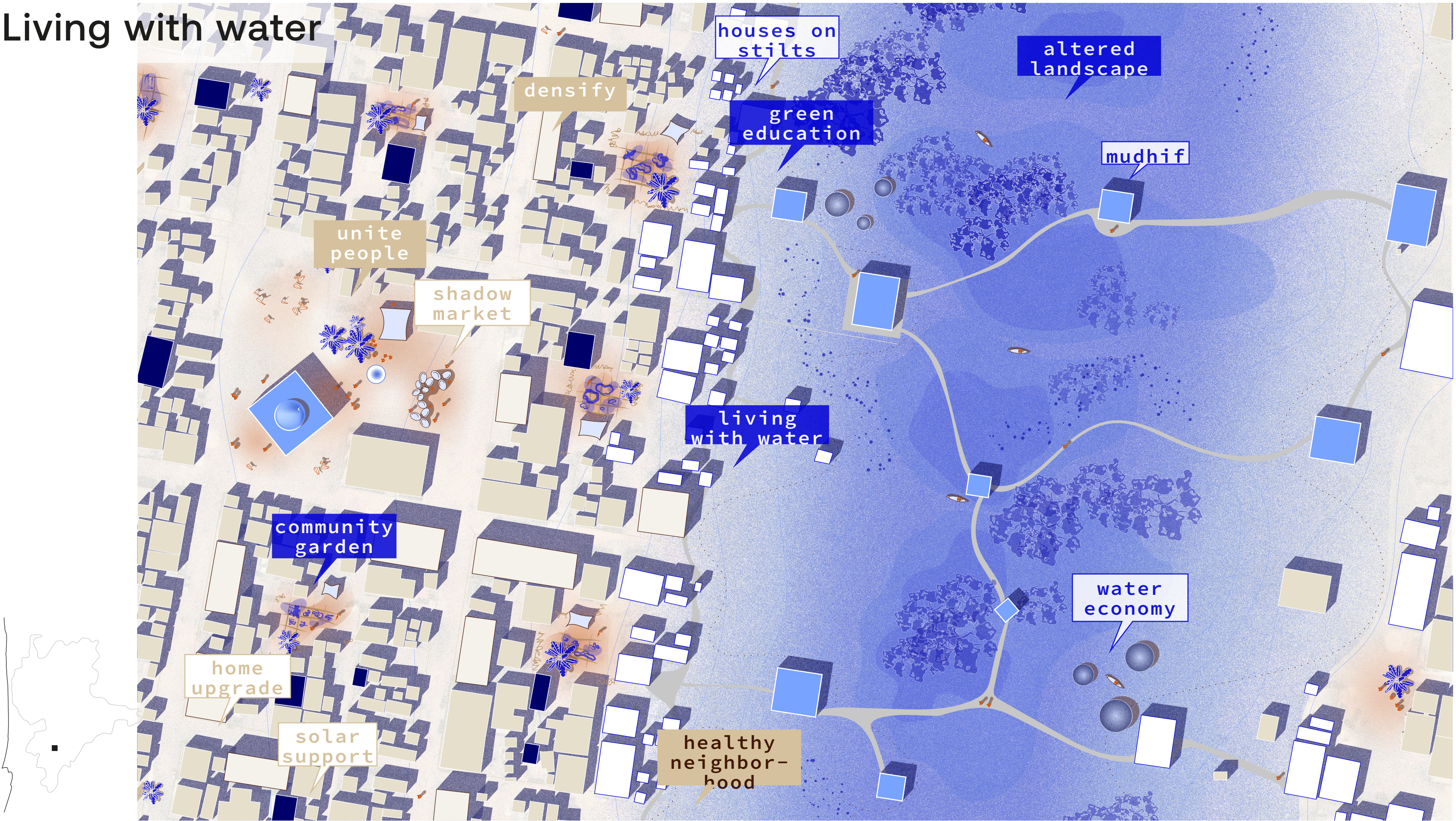
Community Garden



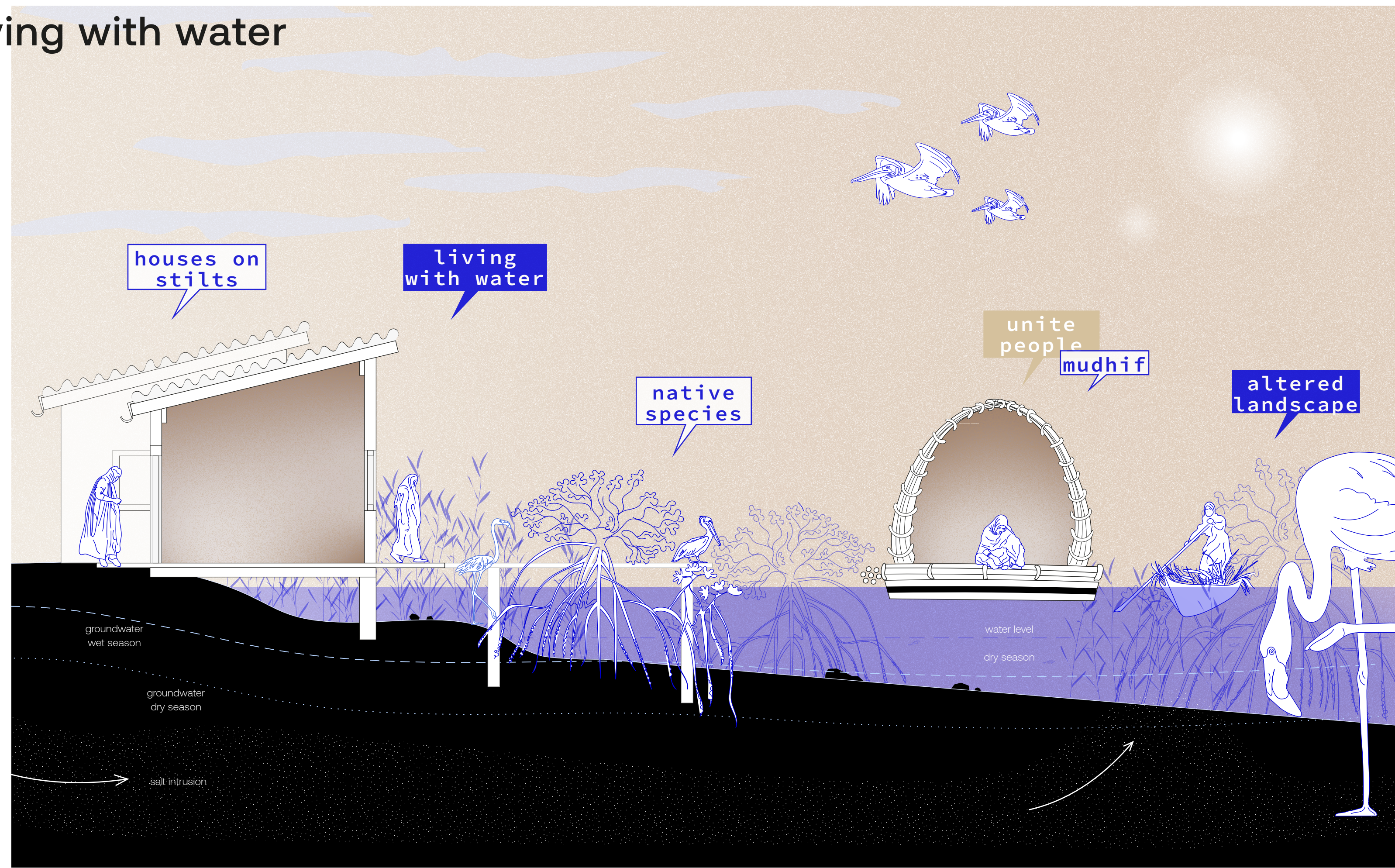
Unite People through Space



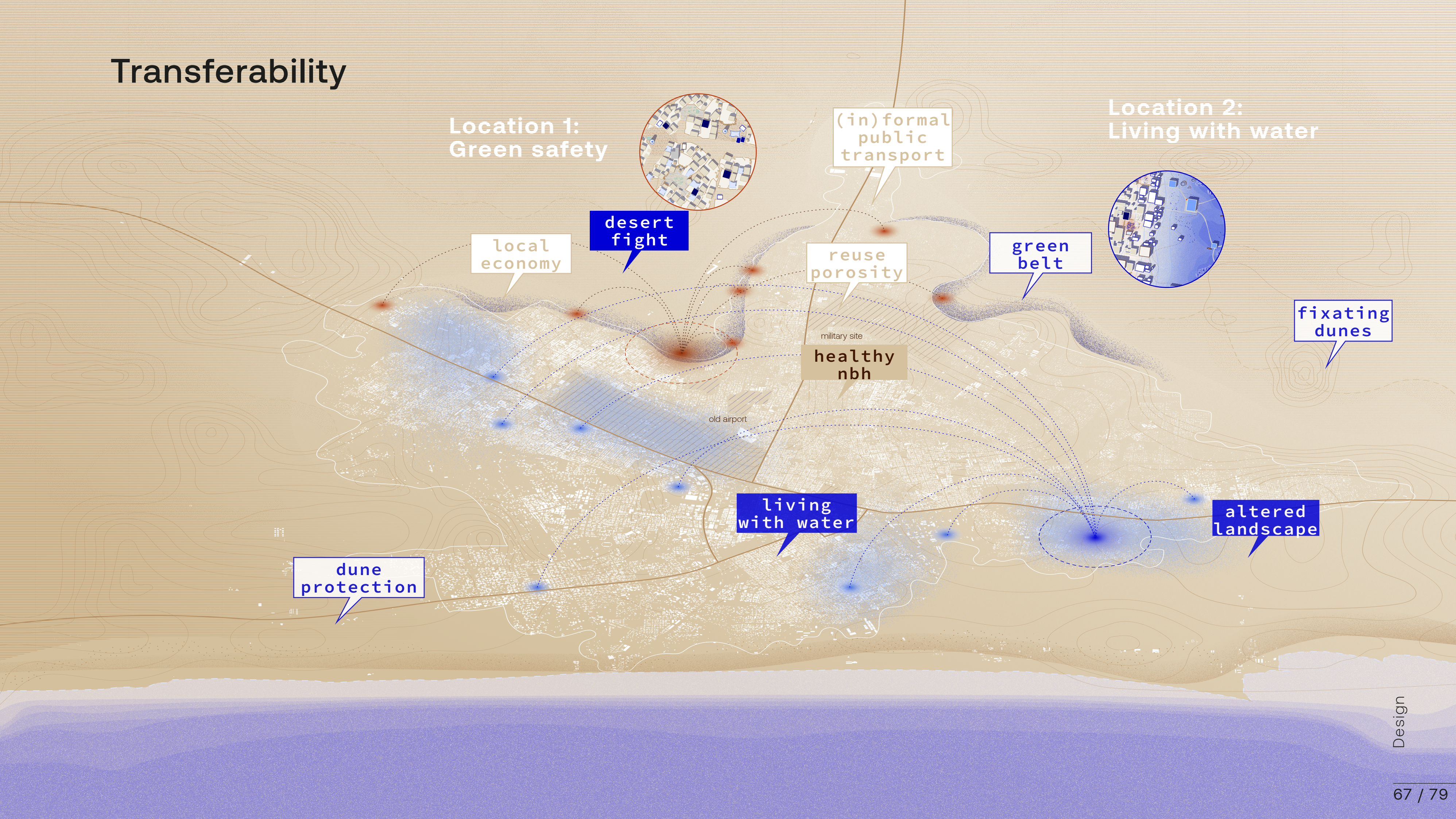
Living with water



Living with water



Transferability

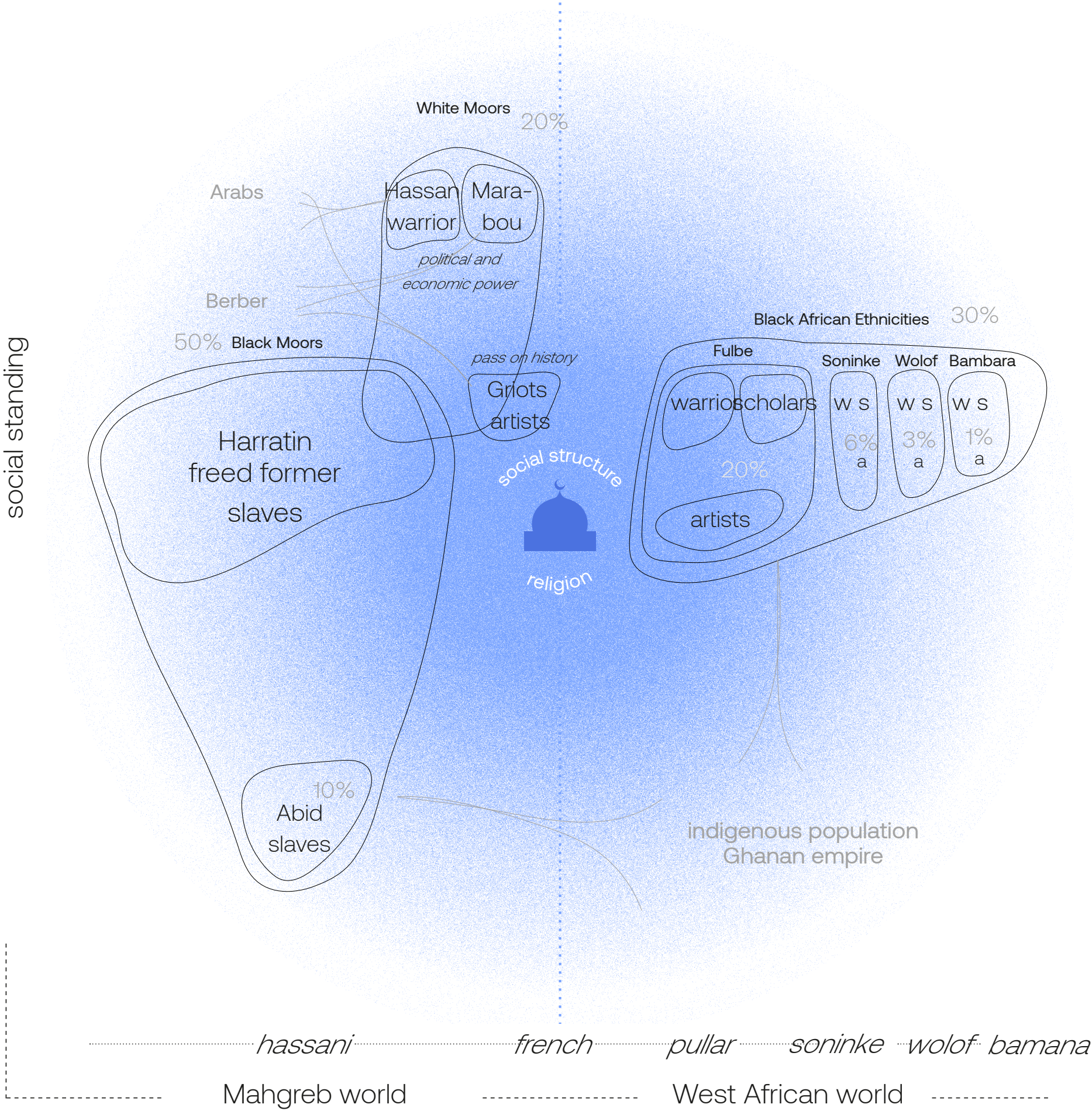


thank you for listening!

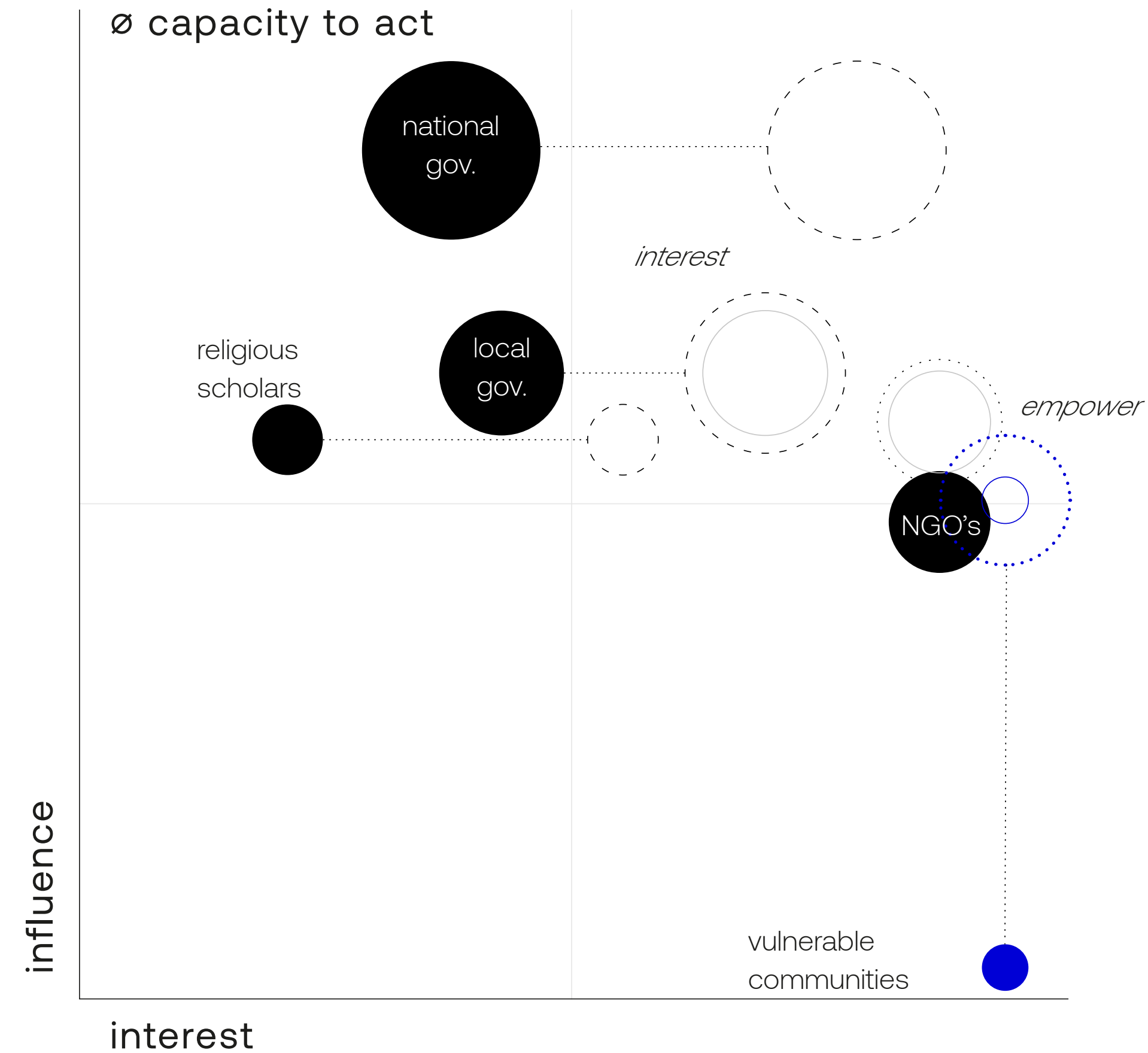


VII Appendix

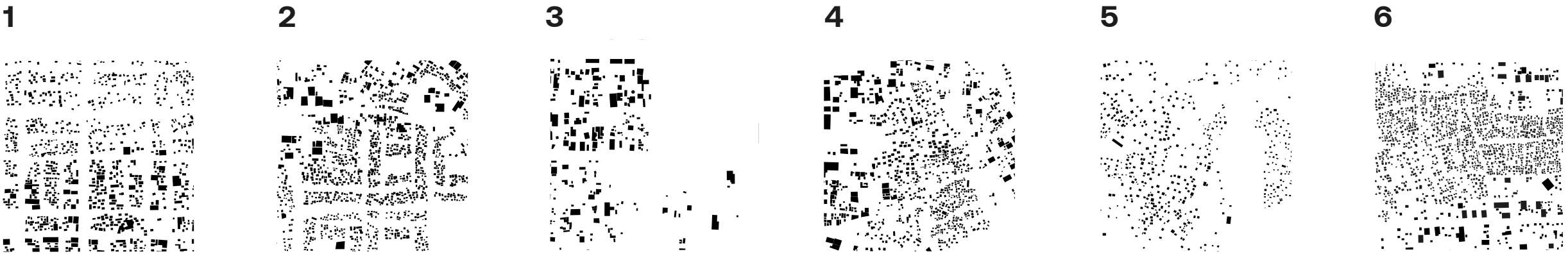
Social Structure



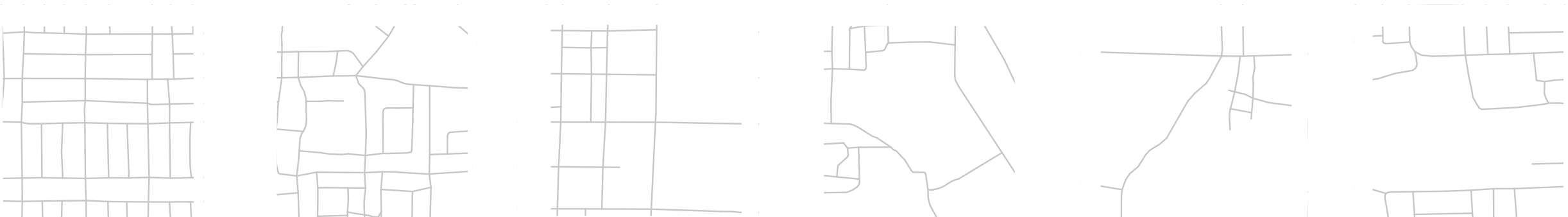
Governance



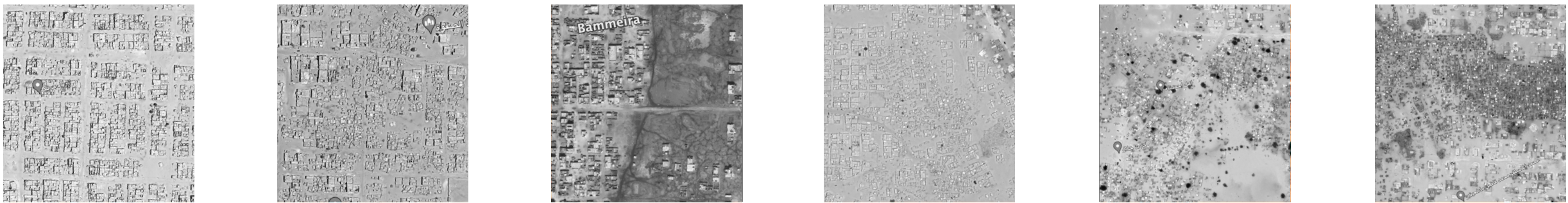
Urban fabric



Street Hierarchy



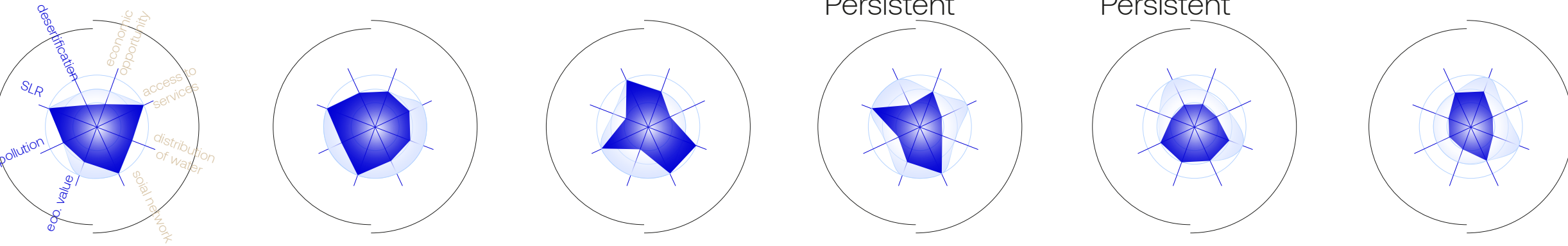
Satellite



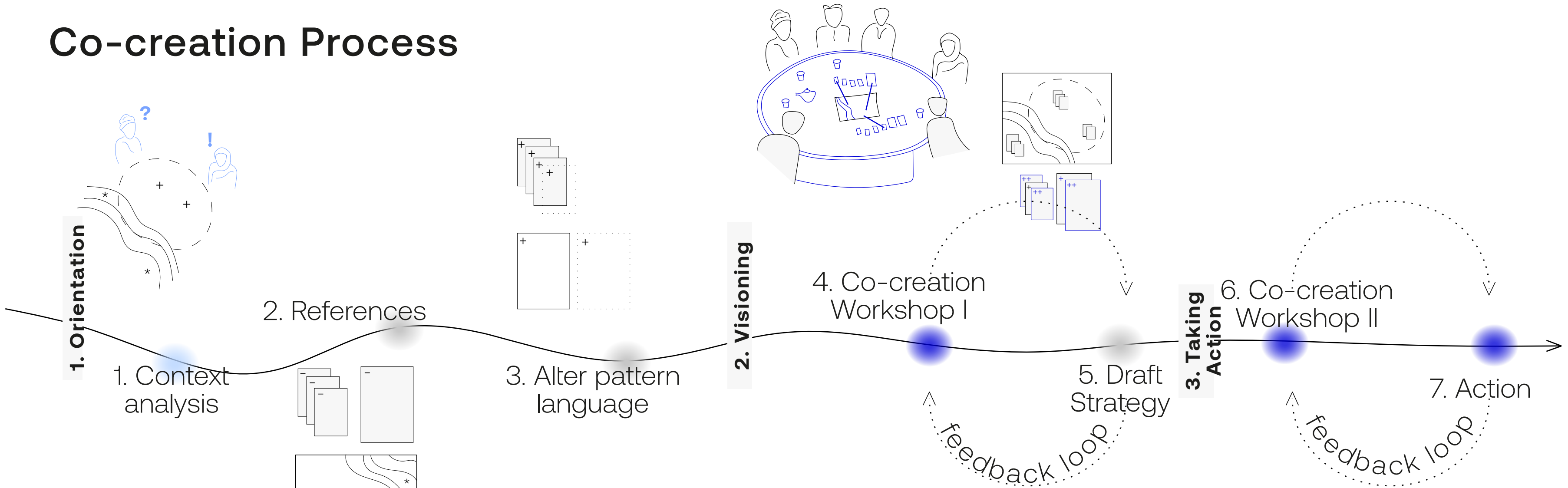
Morphology of urban fabric
Order of (surrounding) grid
Grid scale
Density
Age
Dynamics

1	2	3	4	5	6
Grid	Grid	Grid	Organic	Organic	Organic
Regular	Irregular	Irregular	Surrounding	Surrounding	Surrounding regular
Small	Large	Large	irregular	irregular	Small
High	High	Low	High	Low	High
2005	2008	2006 / 2007	2010	2012	2014
Formalized 2012	Formalized 2012	Persistent	Persistent	Persistent	Demolished 2023

Assessment and Potential



Co-creation Process



Phase 1: Orientation

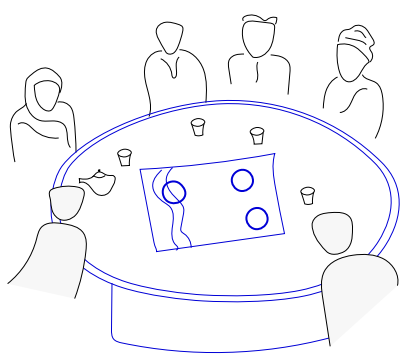
1. Context analysis
assess environmental exposure, social sensitivity and existing adaptive capacity
2. References
refer to similarities in design examples
3. Alter pattern language.
Alter patterns and pattern sets to fit the local context

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?

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

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

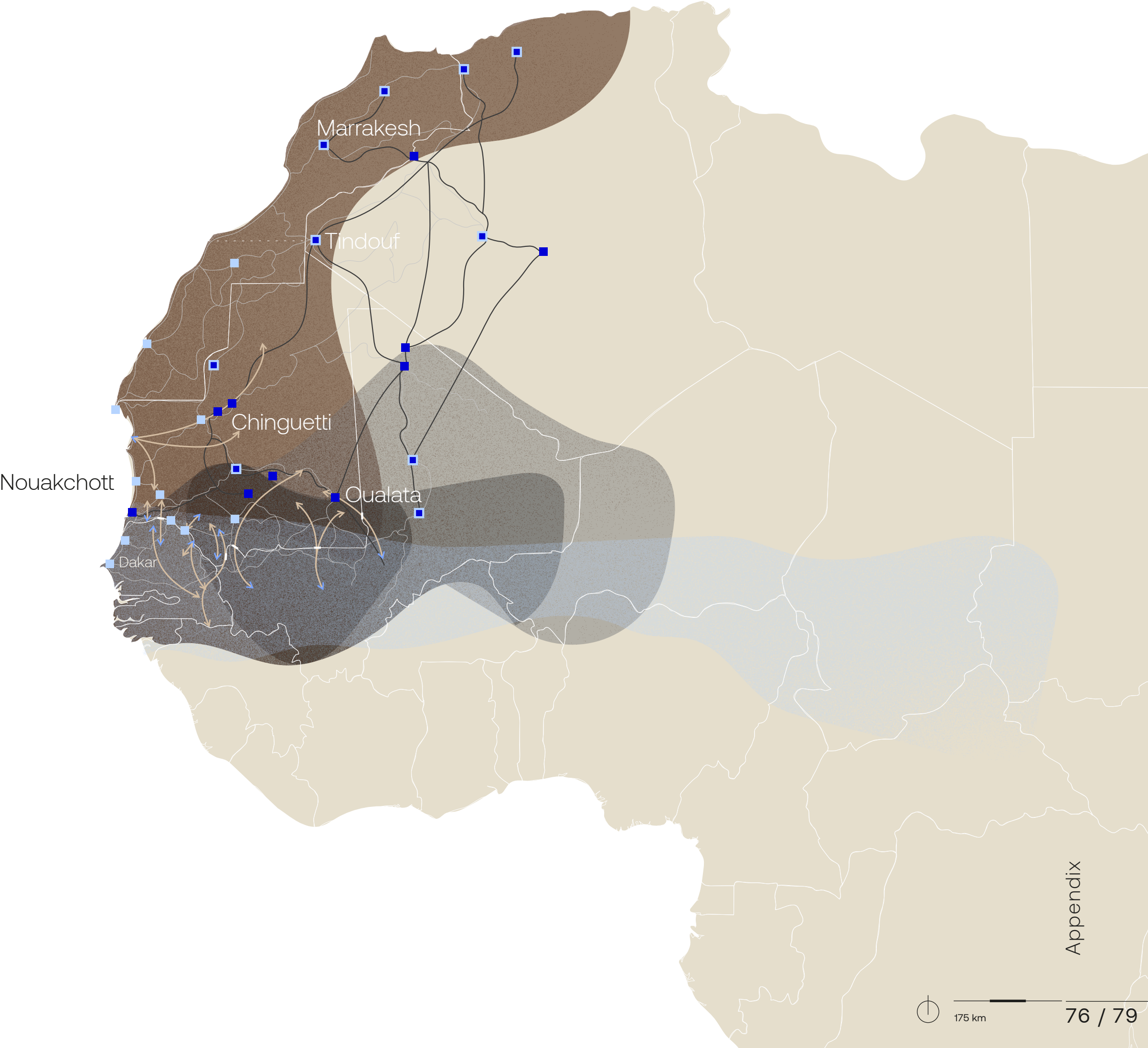
5. How can indigenous practices and technological solutions inform the design of an adaptive pattern language?

- Analytical research question
- Theoretical research question
- Design assignment

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
<div>1. What makes Nouakchott particularly vulnerable to present and future impacts of climate change?</div>	(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
<div>2. How has Nouakchott grown and persisted over time in its vulnerable geographical context?</div> <div>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?</div>	(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 , infrastructure and landscape on a metropolitan scale. (3) Diachronic maps identifying persistent and transformative patterns on a neighborhood scale.
<div>3. What spatial injustices, especially in vulnerable communities, arise in Nouakchott?</div>	(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
<div>4. What can we learn from the cultural identity and historic context of Mauritania?</div>	(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 Mauritaniens through identity portraits. (2) Map of spatial implications and activity on a neighborhood to architectural scale.
<div>5. How can indigenous practices and technological solutions inform the design of an adaptive pattern language?</div>	(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.

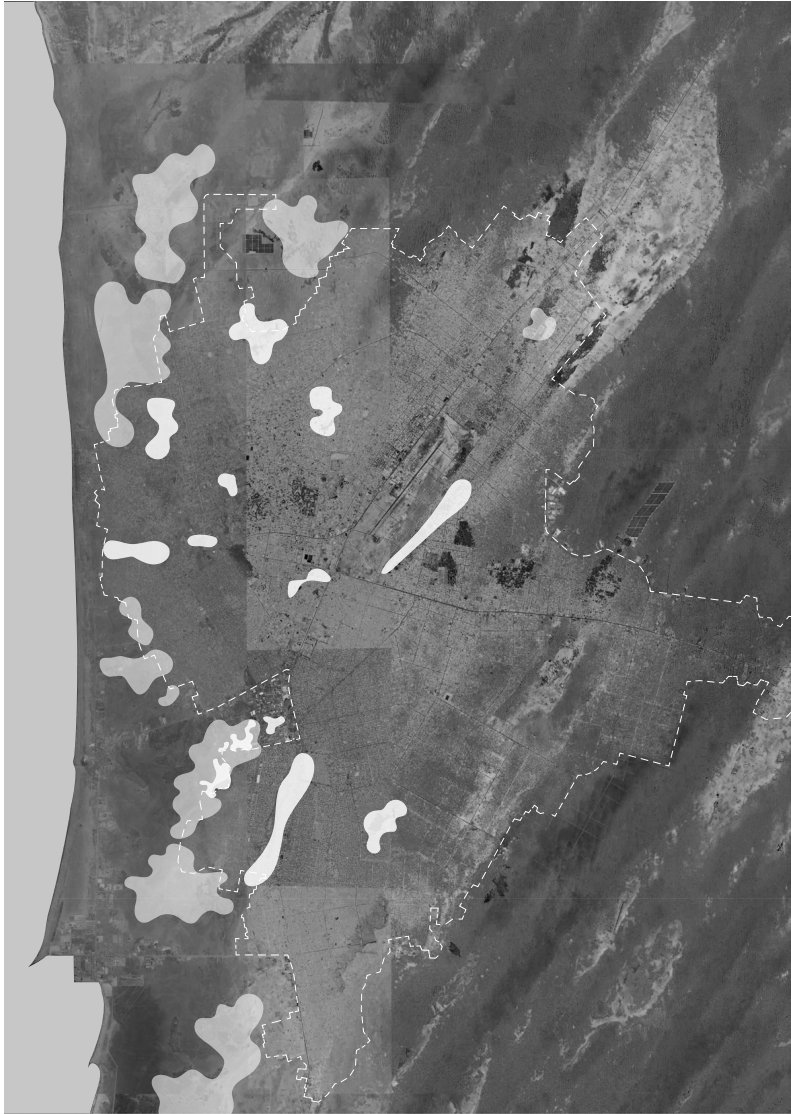
History



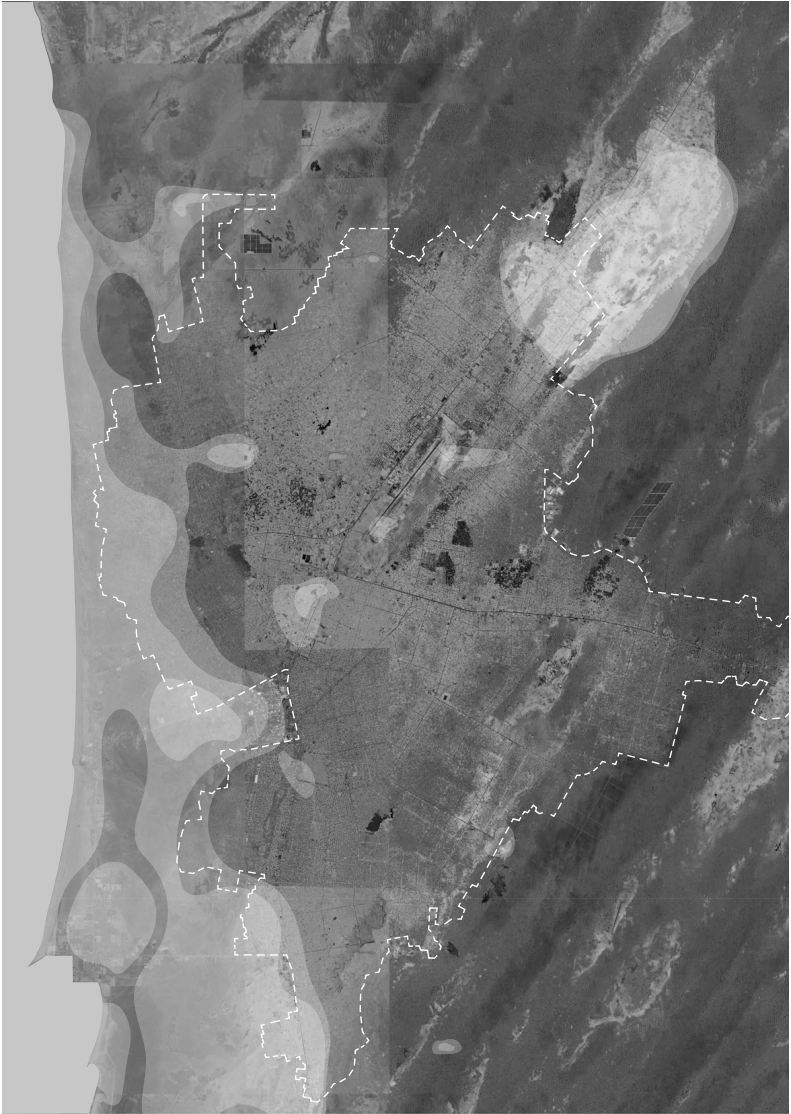
Indigenous and postcolonial territory

- 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

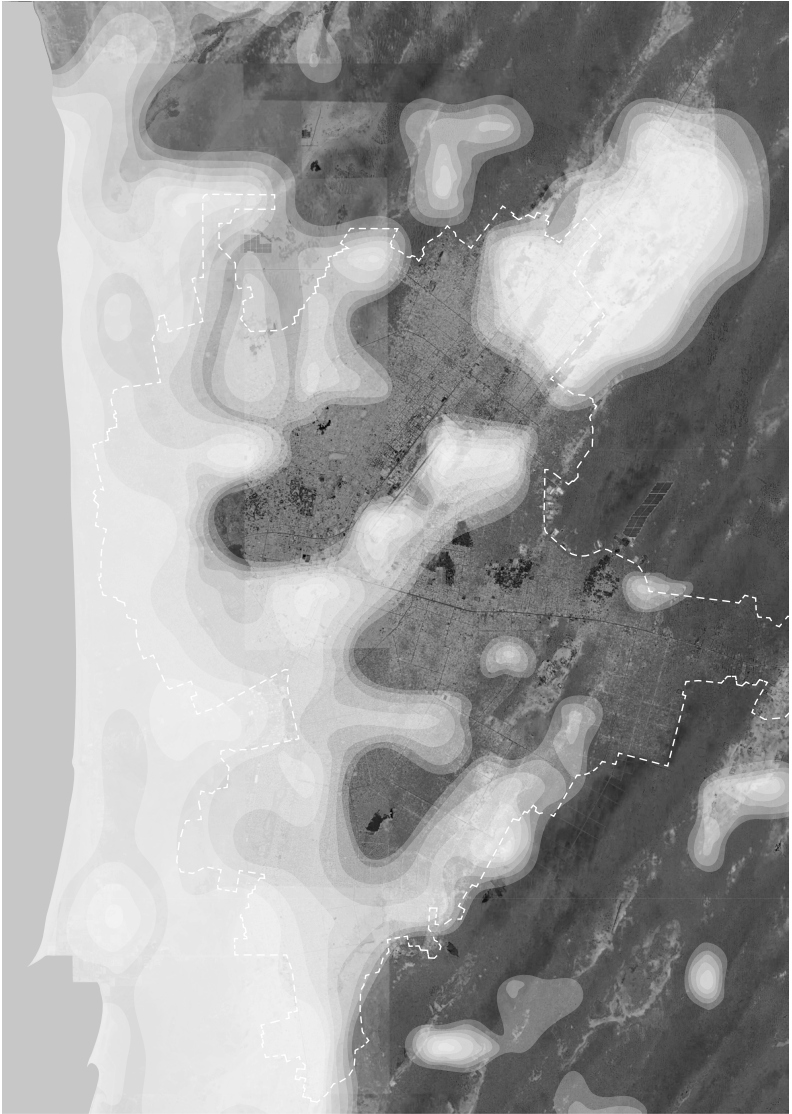
Water



Flooded today

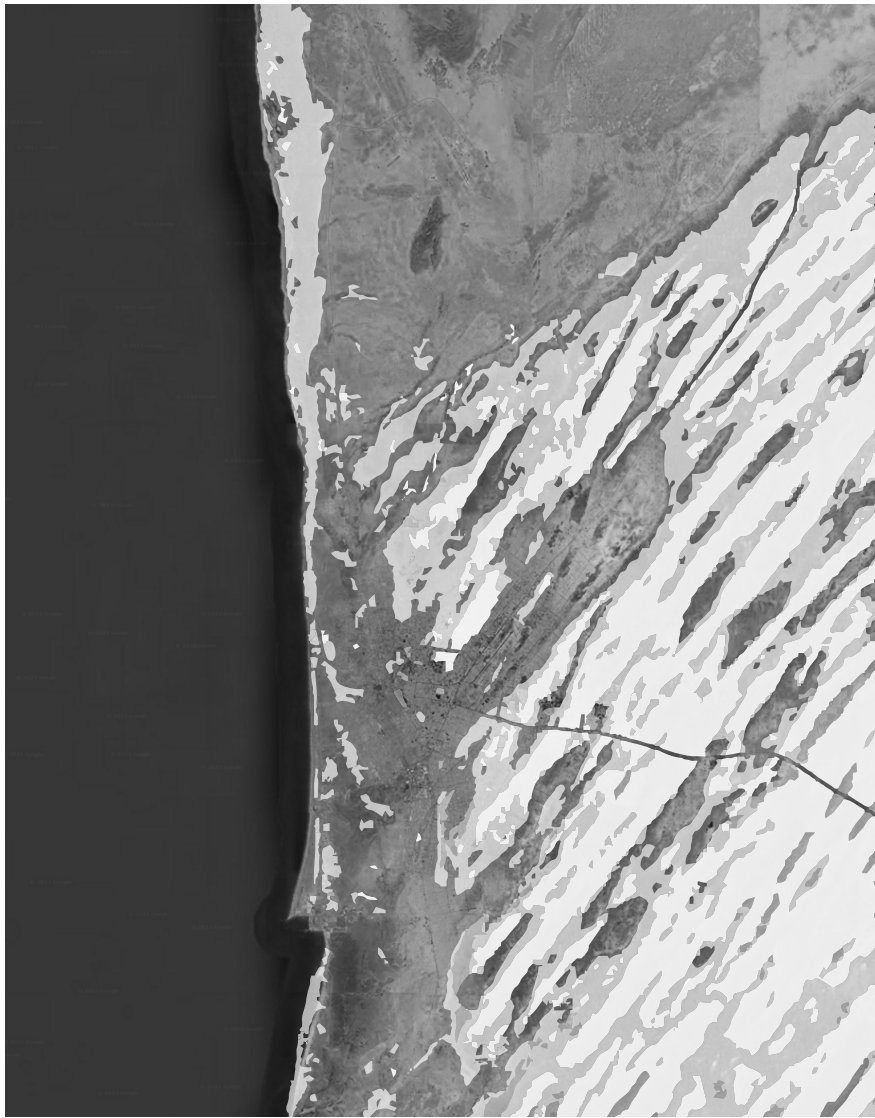


2 meter



3 meter

Desert



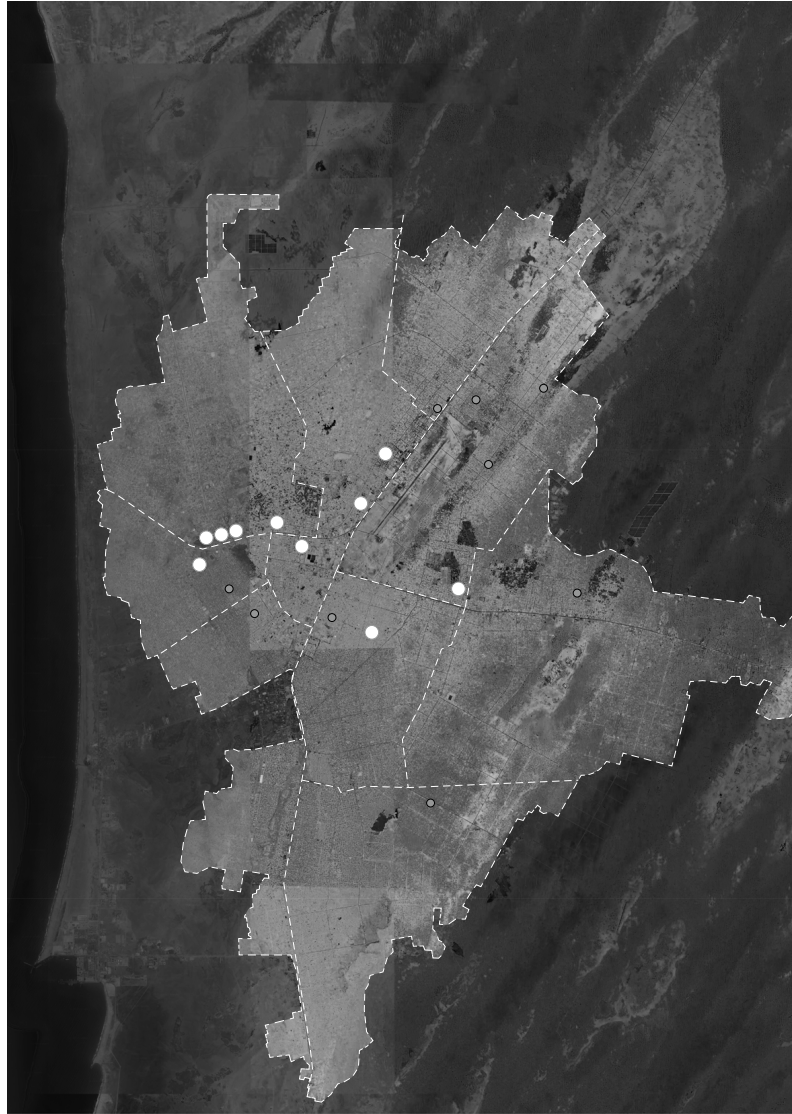
1985



2000

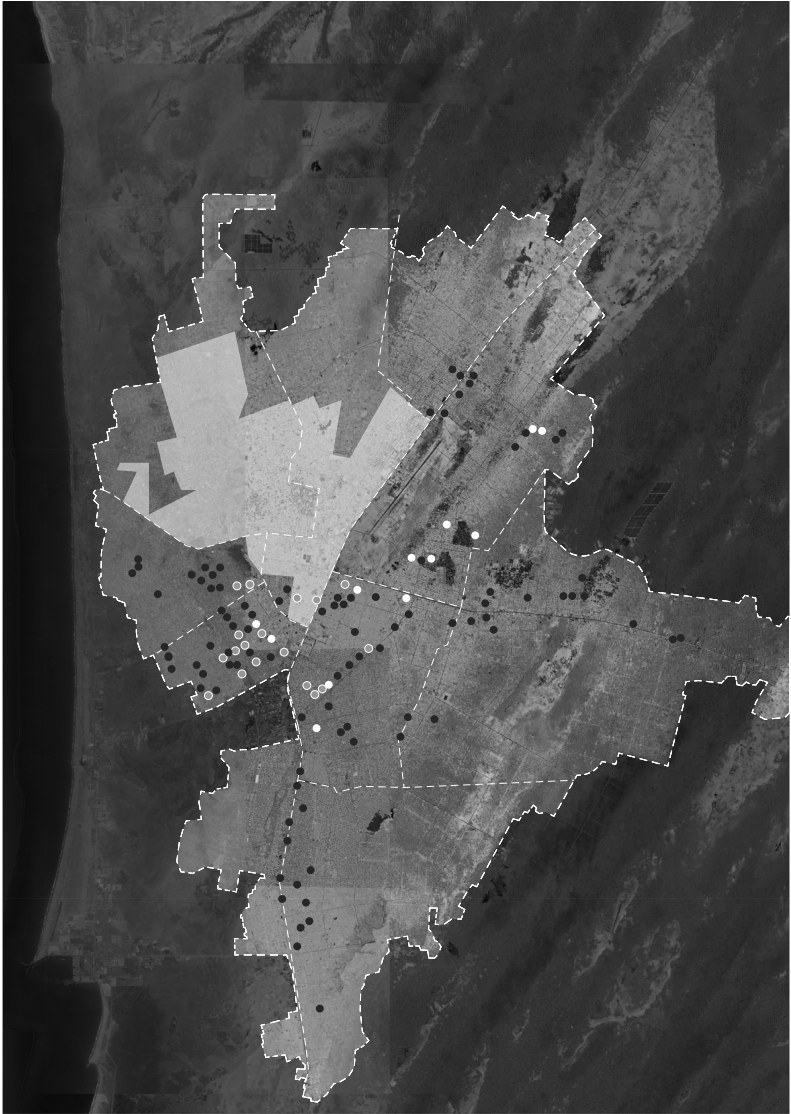
3 km

Human



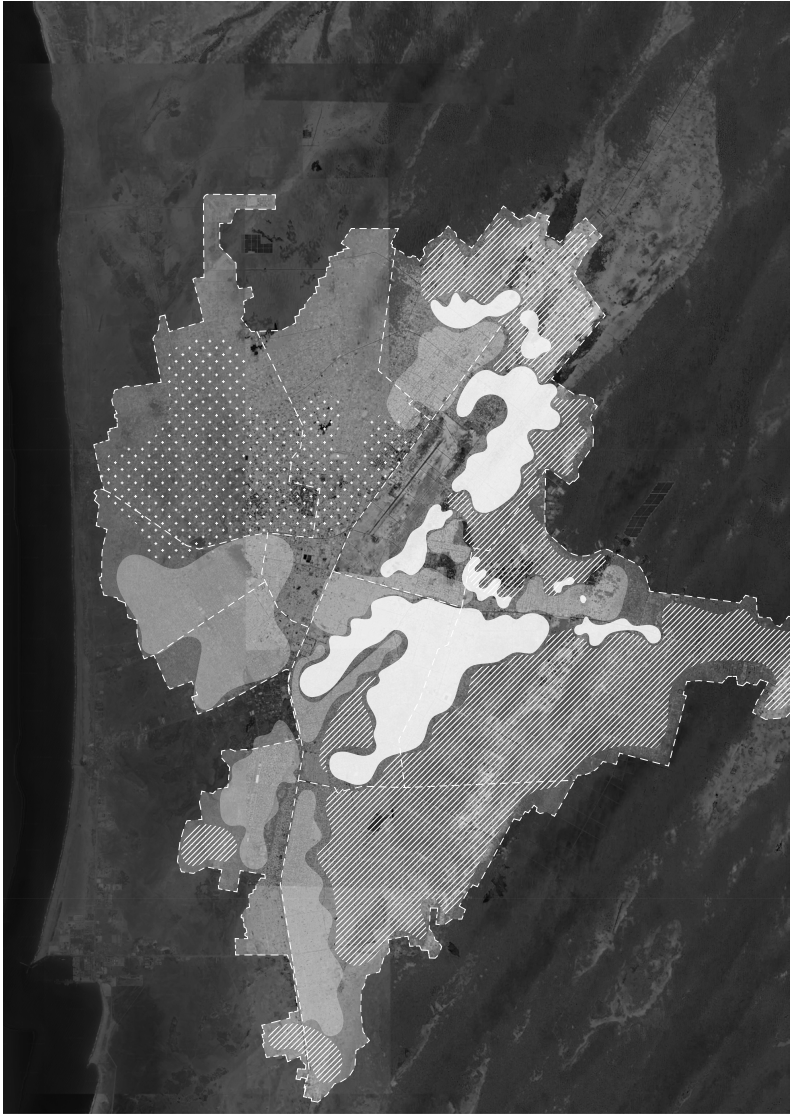
Health Care

○ Hospital



Water accessibility

● Home or public tap
● Clean Portable water
● Highly contaminated water



Housing quality

2 km