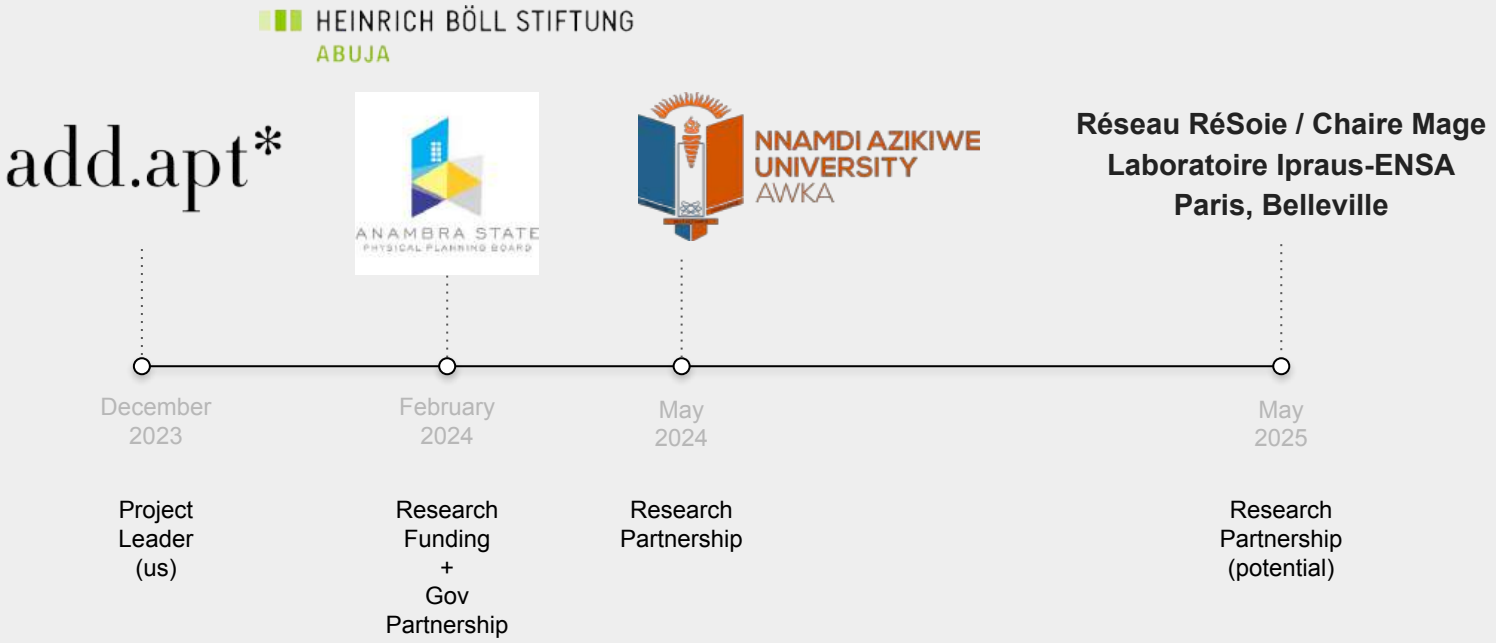
Anambra Flood-Resilient Architecture

The development of flood risk management in Nzam, Anambra through architecture and environmental design

add.apt*

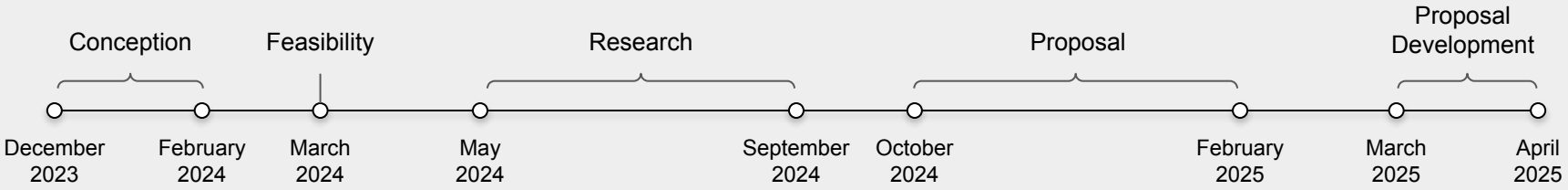
PROJECT PARTNERS



Project Statement

This project was developed to discover how architecture can transition from building for individual clients in isolated scenarios to building for communities with shared environments and challenges.

TIMELINE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Research
Proposal
Proposal Development
December 2023
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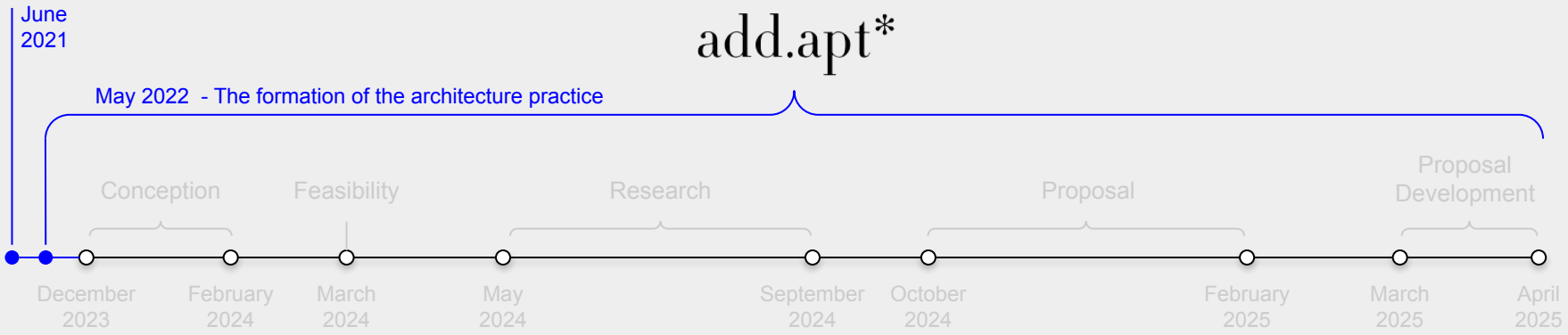
‘Water We Talking About’

Thesis Project - IaaC Barcelona



Background
Conception
Feasibility
Research
Proposal
Development

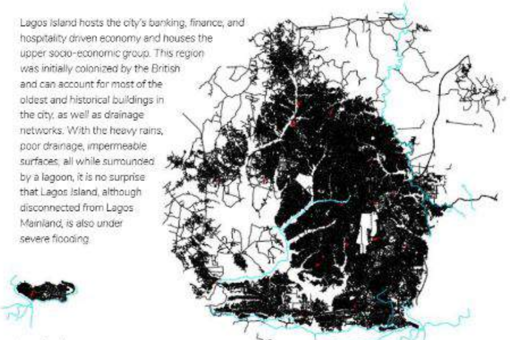
LAGOS STATE _

Looking at Lagos state, 3 locations were closely studied; Lagos Mainland, Lagos Island, and Lekki. These three locales are usually summed up as 'Lagos'. For this section the locales will be referred to by their individual names.

Lagos Mainland, which is located directly below Magboro, has a population of 14,368,000. It receives 2000mm of rainfall per year from flows through its elevation from north to south spanning from 71 to 0m above sea level. The Ogun River, Osun River, Aye waterway, Owo waterway, Yewa waterway, and Iju waterway all flow through Lagos mainland and outlet into the Lagos and Lekki Lagoon. This rapidly urbanized city with an economic focus on oil and commerce has expanded to a size of 3,577 square km, mostly composed of tightly packed buildings and impermeable surfaces. This environmental make-up coupled with a low elevation and high rainfall has created the perfect scenario for devastating flood events. With its extensive labyrinth of roadways comes it's even more extensive and complicated labyrinth drainage system which is mostly compared to open gutters.

Lagos Mainland has recently been experiencing a short burst of heavy rainfall leading to flash floods that rapidly inundated the region, resulting in the loss of lives and the damage of property, especially automobiles. The use of cars and generations in almost every household has contributed to the increase of CO2 in and around the city. This increase in CO2 is attributed to the short bursts of heavy rainfall. Lagos Island, which is surrounded by the Lagos Lagoon has also recorded unprecedented flood occurrences. This small island with a size of 8.7 square km, roughly twice the size of Mokoloki, has a population of 212,700, more than Iwo, which is 24x its size.

Lagos Island hosts the city's banking, finance, and hospitality driven economy and houses the upper socio-economic group. This region was initially colonized by the British and can account for most of the oldest and historical buildings in the city, as well as drainage networks. With the heavy rains, poor drainage, impermeable surfaces, all while surrounded by a lagoon, it is no surprise that Lagos Island, although disconnected from Lagos Mainland, is also under severe flooding.



lagos island

lagos mainland

Fig. 20: Google Earth - Lagos Mainland

Fig. 21: Google Earth - Lagos Mainland

Fig. 22: Google Earth - Lagos Island

DESIGNING FOR MICROCATCHMENTS : RELIEF STRATEGY MAP _

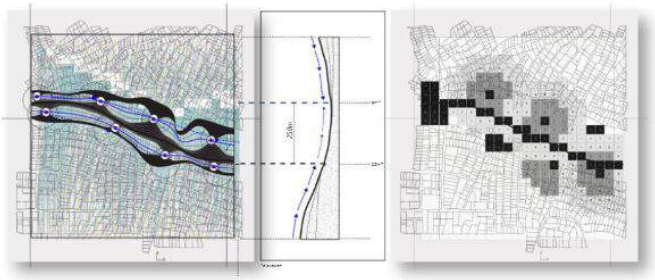
The system of bunds offers many design variations that can adhere to the distributive guidelines of the zones. Each zone is meant to distribute and capture the runoff water at different rates. While distribution is achieved through the geometric formation of the bund, retention is achieved through vegetation and ground cover. As previously discussed, the floodplain's hydrological process is just a series of water in which water flows through various mediums. The percolation rate is the amount of time it takes for water to pass through earth substances such as soil, clay, and rock formations. This rate can be controlled through various ground covers.

Vegetation also increases percolation as well as provides another avenue for water to travel, this is through the root system of the plant and eventually through evapotranspiration. As the water flows through each zone, it can pass through ground covers and vegetation that moves from a rapid absorption and percolation rate to a more gradual rate as it reaches the center of the zone, the retention point.

Another layer was added to the micro-catchment strategy mapping by plotting vegetation and groundcover types. Three plant types were indicated for the strategic use of their uptake rate. As the runoff reaches each retention point, grassy vegetation and low shrubs that sit on porous soil covered with coarse pebbles are able to absorb the first incoming surface runoff; this ground cover typically has a percolation rate of 15-18 liters of water per day. As the water moves through the stone, it is met with high level shrubs and low level trees. These sit on sandy clay and or sandy clay loam which has a decreased percolation rate than the previous environment; this ground cover typically has a percolation rate of 6.5-10 liters of water per day. Finally, as the soil reaches the central retention point, it is met with woody vegetation that sits on clay with small sand or gravel; this ground cover typically has a percolation rate of 3-4 liters of water per day.

This strategy uses the frontlines of the retention zone to receive as much water as possible before passing the remainder runoff towards the center. The center is meant to slowly receive the first liters of runoff which will come at a gradual pace. At the point where it is eventually inundated with water, these conditions will not do as much damage to woody vegetation as it can to shrubs. Overwhelming a small plant's roots with water can cause it to die; however, larger plants are able to withstand flooding events. To represent this strategy on the map, a gradient of gray was used to indicate the ground cover; light grey being high percolation rates to dark grey being low percolation rates. The numbers 1-3 were used to indicate the vegetation type; 1 being grassy and 3 being woody vegetation.

Fig. 75: Microcatchment strategy map



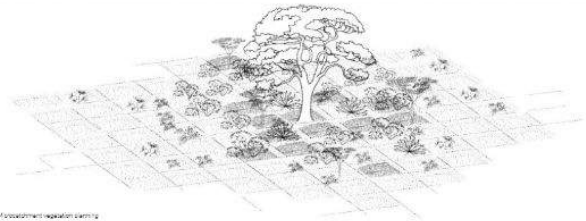
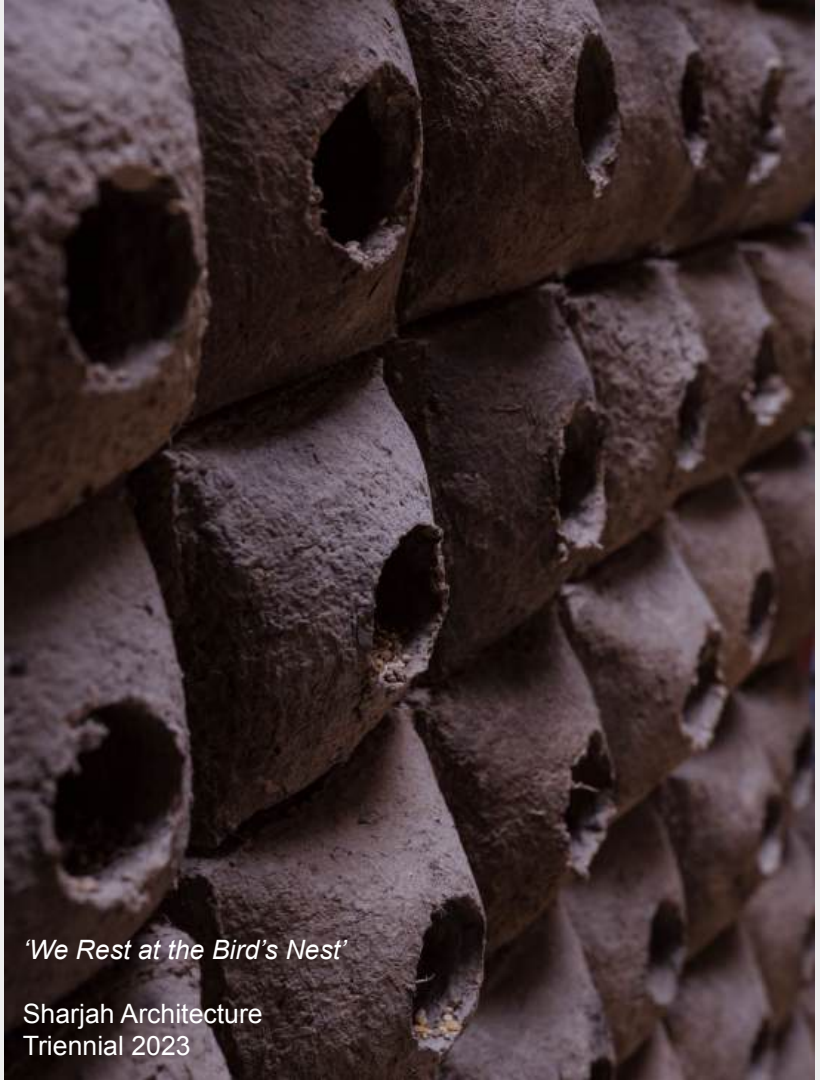


Fig. 76: Microcatchment vegetation planning

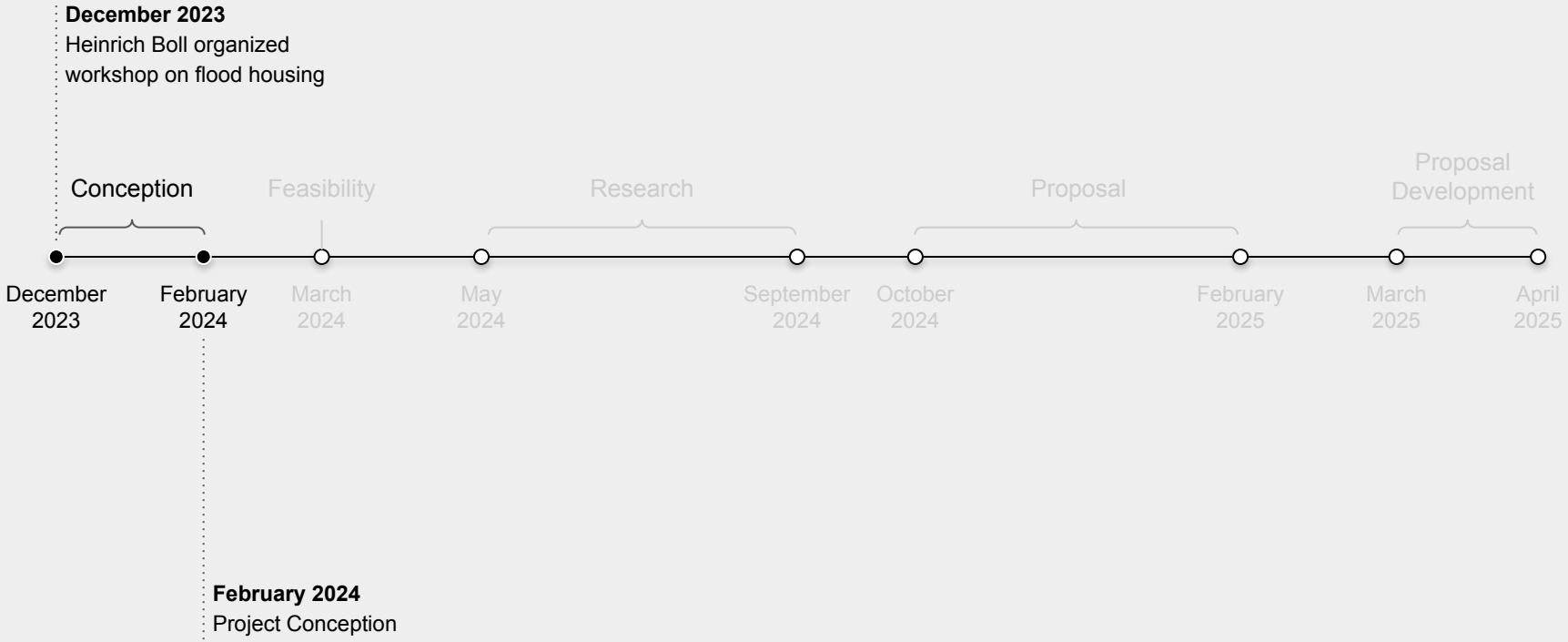


'We Rest at the Bird's Nest'

Sharjah Architecture
Triennial 2023

‘We Rest at the Bird’s Nest’

Sharjah Architecture
Triennial 2023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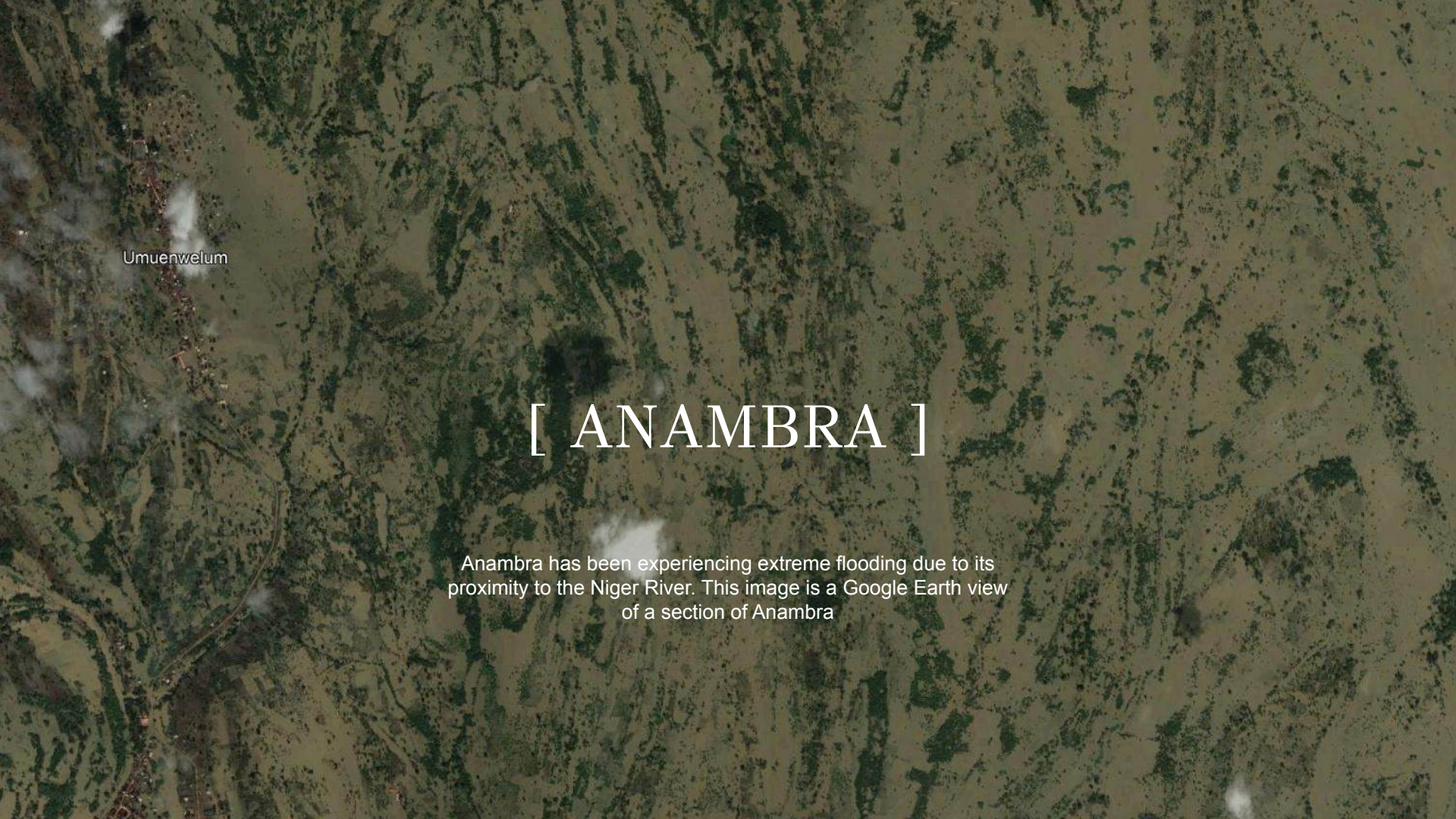


[ANAMBRA]

Anambra has been experiencing extreme flooding due to its proximity to the Niger River. This image is a Google Earth view of a section of Anambra

LAGDO DAM RELEASE

The flooding of 2012 and 2022 were both caused by heavy rainfall and climate change as well as the release of water from the Lagdo Dam in neighboring Cameroon.

2012 FLOOD

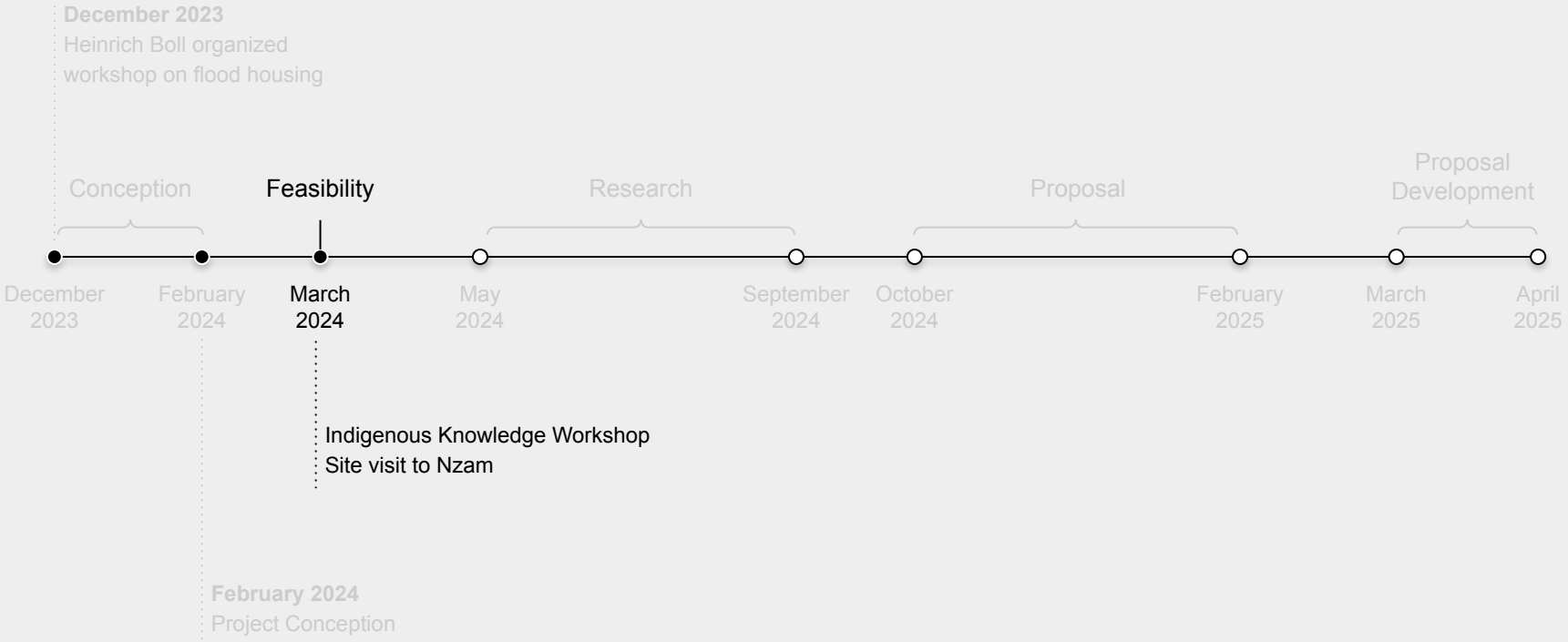
- In 2012, Nigeria experienced its worst floods in decades.
- 365 lives lost
- 2.5million people displaced
- 30 of Nigeria's 36 states were affected by the flood
- Over 20,000 buildings affected
- (NEMA, 2015)

It affected 57 communities in 8 local government areas, damaging 117,148 Farms and agro-based industries, 79 water and sanitary facilities, 325 schools, 122 health facilities and about 20,000 houses and damages totally about 30 billion naira (Emmanuel, Ojinnaka, Baywood, & Gift, 2012).

2022 FLOOD

- More intense than the 2012 floods
- 3 million families saw their houses damaged or destroyed
- 64% of households were affected by the floods in 2022

It was obvious that major flooding in Anambra had become recurrent, the main question was why are the impacts of flooding recurrent?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[THE WORKSHOP]

A workshop was created to investigate in the locals knew any indigenous ways of dealing with flooding.

WORKSHOP STRUCTURE

Through presentations and group work, the workshop aims to answer the following:

1. ***How did indigenous architecture display people's understanding of their environment?***

2. ***How do we translate our understanding of the environment back into architecture [and urban planning]?***

3. ***How does urban planning inform the local community on how to build on the environment?***

WORKSHOP AIM & OBJECTIVES

Aim:

1. To explore indigenous flood risk mitigation strategies and encourage innovative, contextual solutions in and around the floodways
2. To encourage ecological restoration and environmental preservation as part of local government infrastructure plan
3. To reinforce a network between the vulnerable communities, local professionals and local government bodies in order to create a feedback loop between problems and solutions

Objectives

1. Identify historical and traditional conditions of living in floodplains and floodways - workshop in partnership with the local community and professionals
2. Identify indigenous resources, traditional construction methods and building materials that can be integrated in urban flood mitigation strategies - field work in coordination with the local communities
3. Propose innovative, contextual architectural applications and urban flood mitigation interventions - with local and regional professionals

Anambra Indigenous Architecture

PROBLEM	KNOWLEDGE	SOLUTION
Heavy rainfall and wall sensitivity to water	Hydrophobic property of palm, surface runoff	Tall pitched roof using water resistant fronds
Heat trapped in homes, need for security	Windflow through landscape, communal forms	Open ventilation, rain catchment courtyard
Constant expansion of family and buildings	Soil capacity and vegetation availability	Malleable clay walls reinforced with bamboo

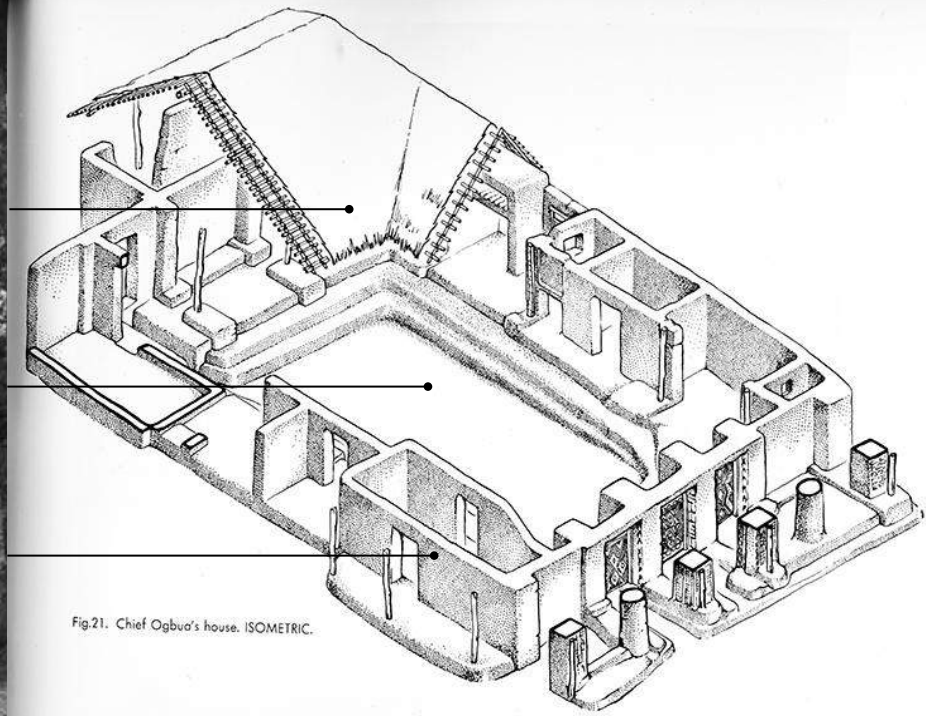


Fig.21. Chief Ogbua's house. ISOMETRIC.

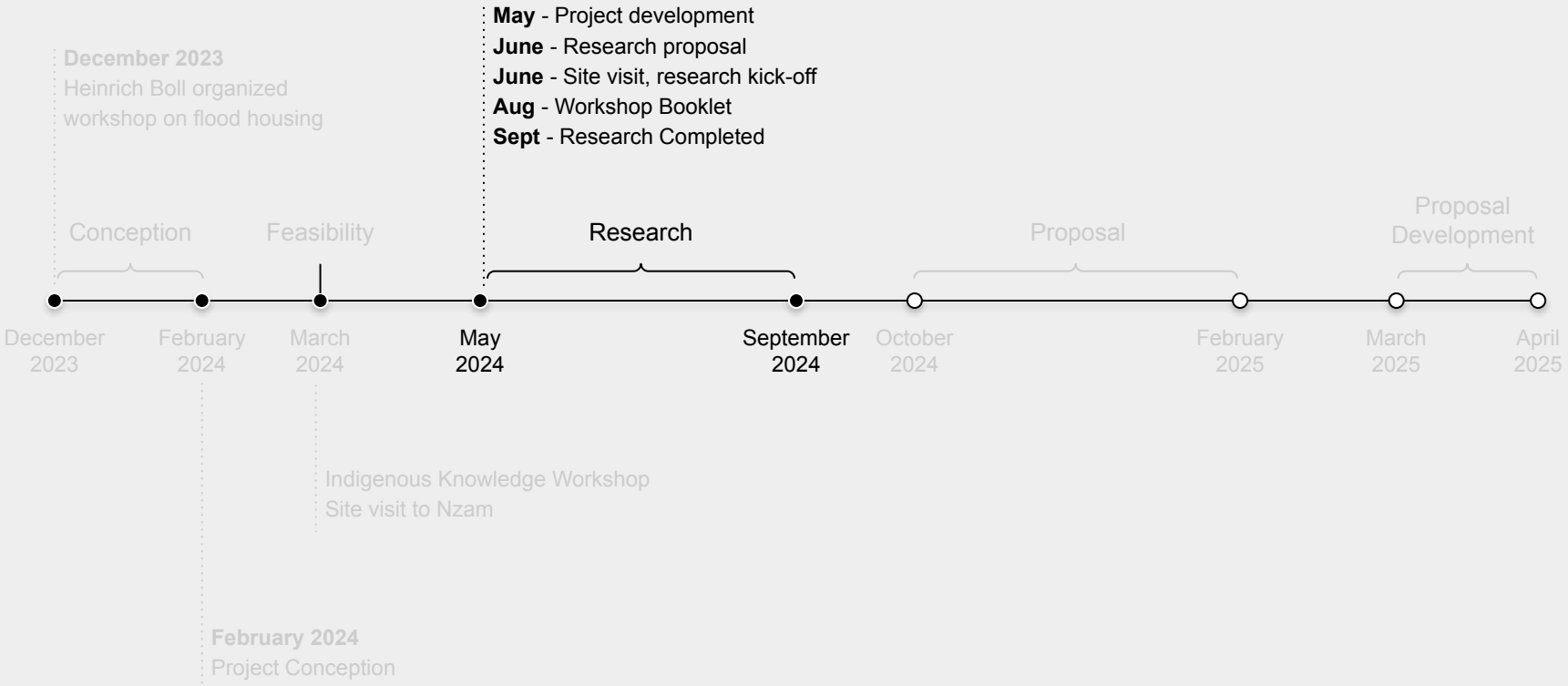
NZAM

[a lowland community]

We visited Nzam to see the first hand effects of the flooding on lowland communities.


Ogodo
Ibokye
Population
238,400
Illah Waterside
1.5km
Nzam
Nzam
Oda
Ogu-Ozella
Ugu-Ozalla
Illah
Nmiata
Umuoba
Ugumoeke
DELTA

Indigenous flood mitigation was absent, the environment was transforming, and people were adapting to an uncertain future.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RESEARCH BRIEF

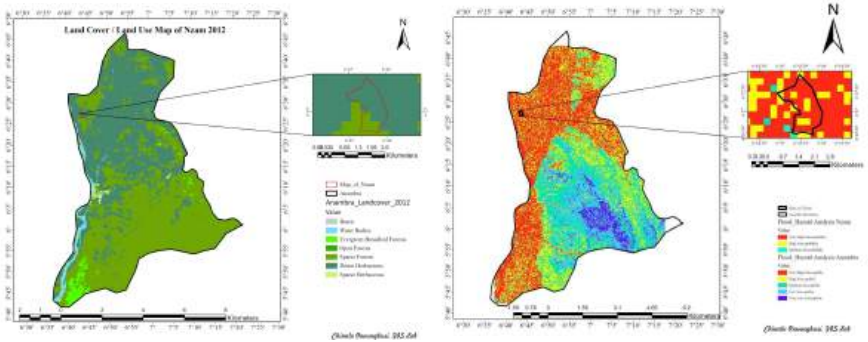
The research is divided into the four categories below towards developing flood risk mitigative architecture. Each section will be delegated to a team member(s), in order to create focused and in-depth findings.

1. Water - investigate current water sources and the hydrological conditions of the environment

2. Land/Soil - map the geological and vegetative features, conduct soil tests

3. Architecture - categorize the current building methods and architecture according to flood resilience

4. Urban - map the community growth and impacts, predict growth pattern and future demands



STUDIES CONDUCTED

1. Geological, Climate - [Dr. Samuel + Chinalu]
    - Topography, slope, rock type
    - Soil geotechnical analysis - chinalu to contact department
    - Precipitation - rainfall intensity, volume (nimet)
2. Environmental assessment - [Chinalu]
    - Vegetation loss
    - Soil pollution - need a lab
    - Biodiversity loss
    - Map existing wetland regulations and preservation
3. Hydrological [Dr. Samuel]
    - Rainfall infiltration rate
    - River flow
    - Surface water runoff volume and speed
    - Flood inundation time and extent of coverage
4. Urbanization study - land use, urbanization patterns, flood evacuation and community access - [Dr. Onyinyechi]
    - Political and traditional stakeholders relevant for decision making
5. Existing building assessment and building techniques - [Addapt]
6. Food and water resource analysis, economic sustainability analysis [Dr. Onyinyechi + Addapt]

RESEARCH CONCLUSION

The following are the major findings from the research:

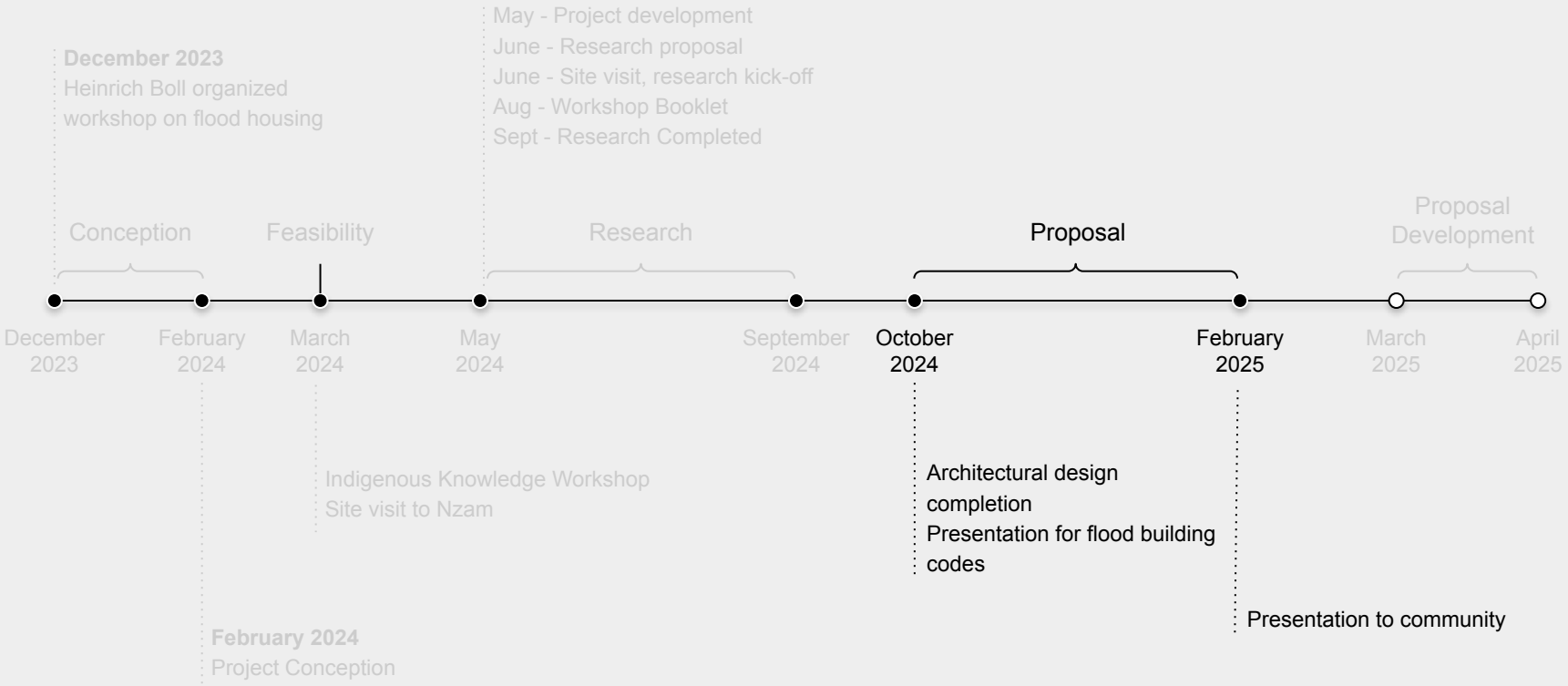
1. There is no communication between towns regarding development of solutions or collaborative techniques to cope with the flooding
2. The community currently settled in Nzam is a new generation that has never dealt with severe flooding and have build inadequate structures for the environment
3. The flooding has lead to the destruction of farmland to the point where farmers are no longer practicing commercial farming
4. The acquisition of farmland around Nzam, has lead to the inability of the environment's ability to retain excess water
5. The flooding events has lead to the contamination of water resources

Flood resilience in Nzam is the fortification of their agricultural practices

community sustainability

as well as the revitalization of the environment's functions

environmental sustainability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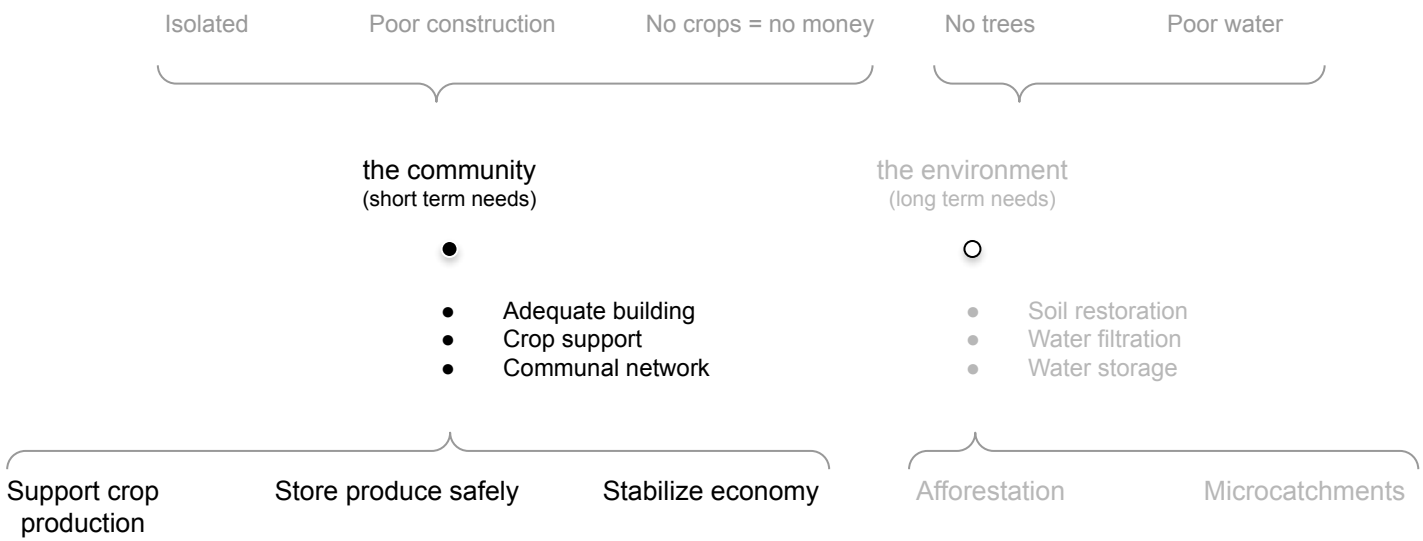
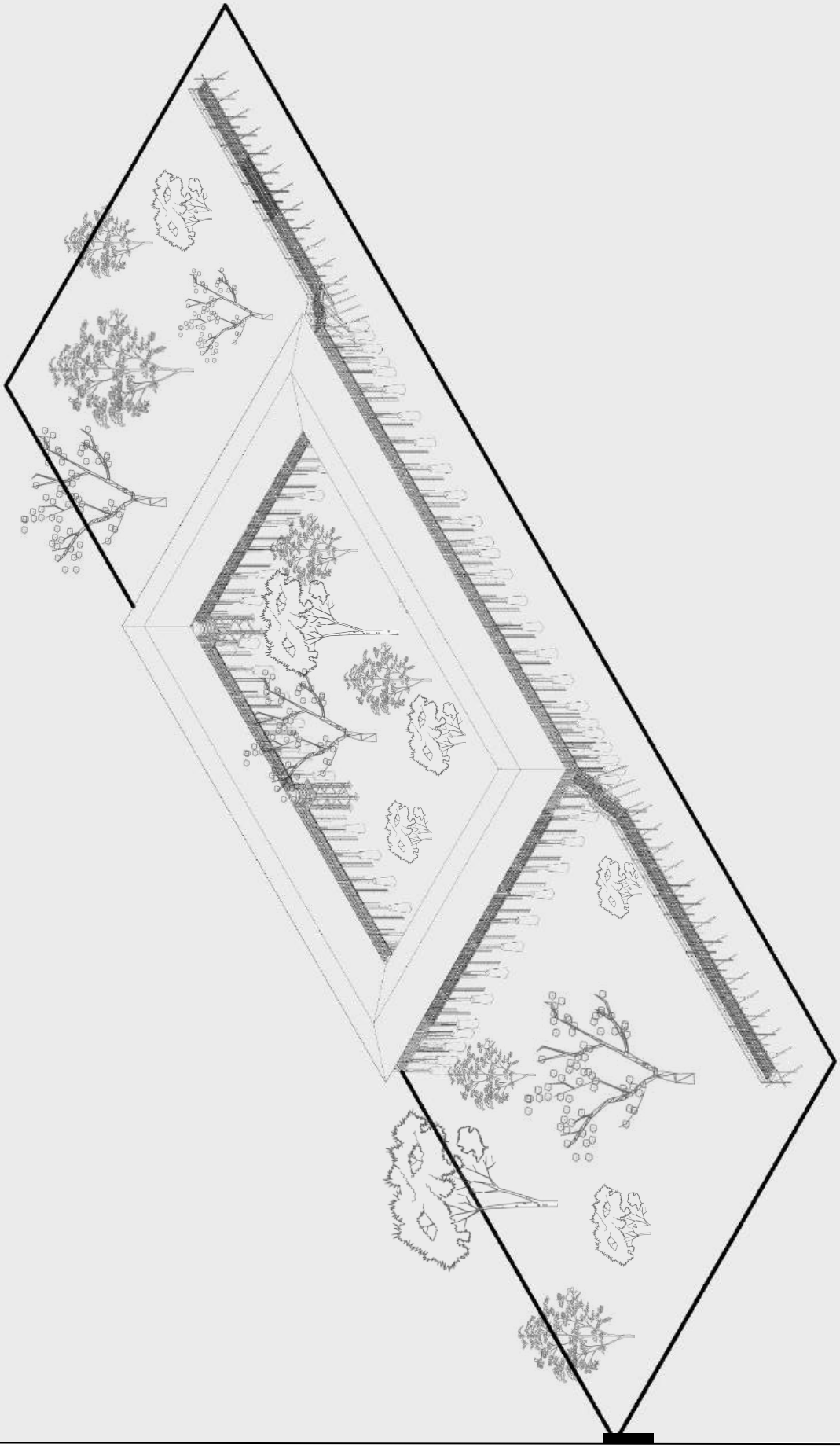
Presentation to community

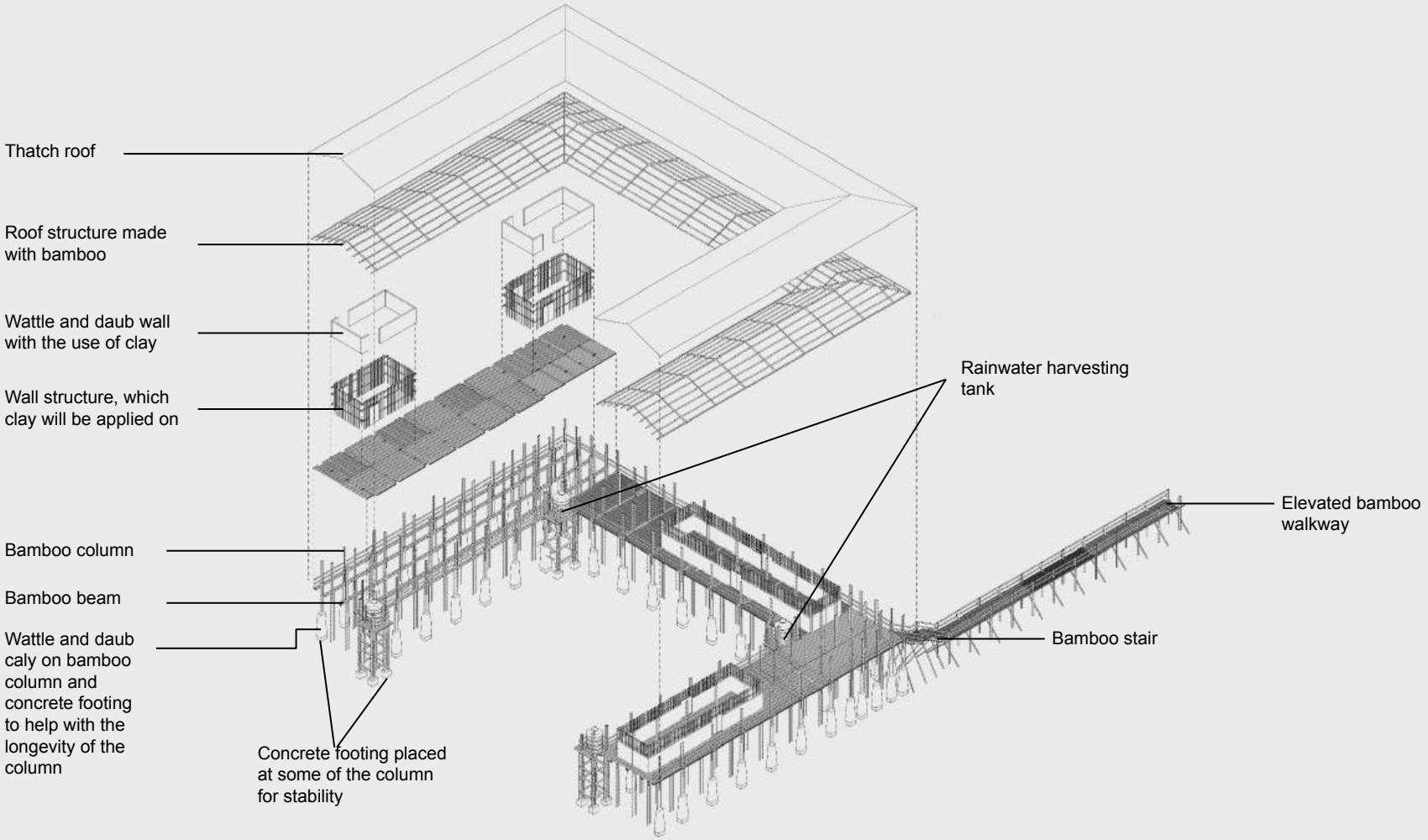


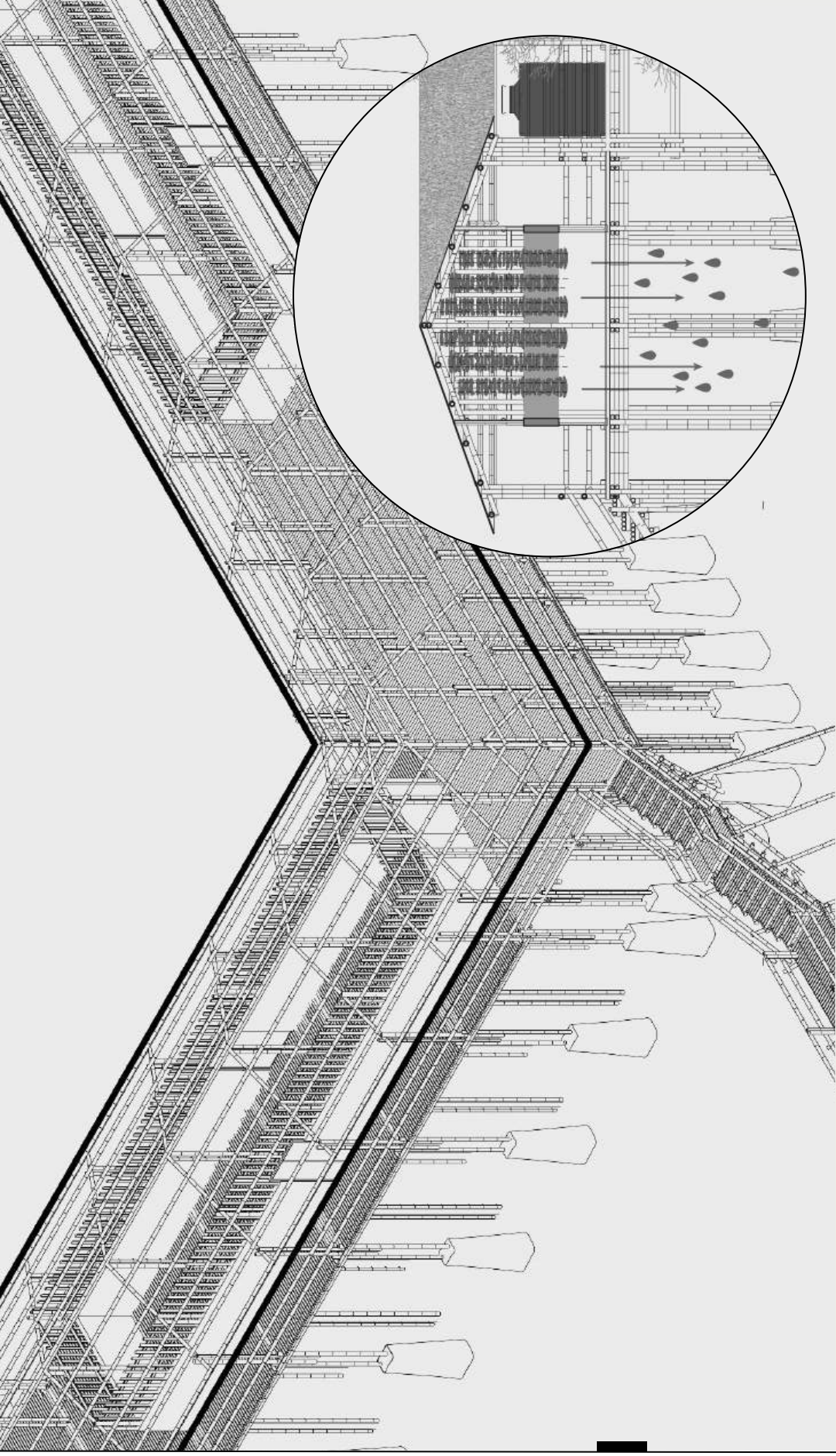
Communal irrigation & crop storage

PROJECT PROPOSAL

Communal irrigation & crop storage




Thatch roof
Roof structure made with bamboo
Wattle and daub wall with the use of clay
Wall structure, which clay will be applied on
Rainwater harvesting tank
Elevated bamboo walkway
Bamboo column
Bamboo beam
Wattle and daub caly on bamboo column and concrete footing to help with the longevity of the column
Bamboo stair
Concrete footing placed at some of the column for stability



COMMUNITY FEEDBACK

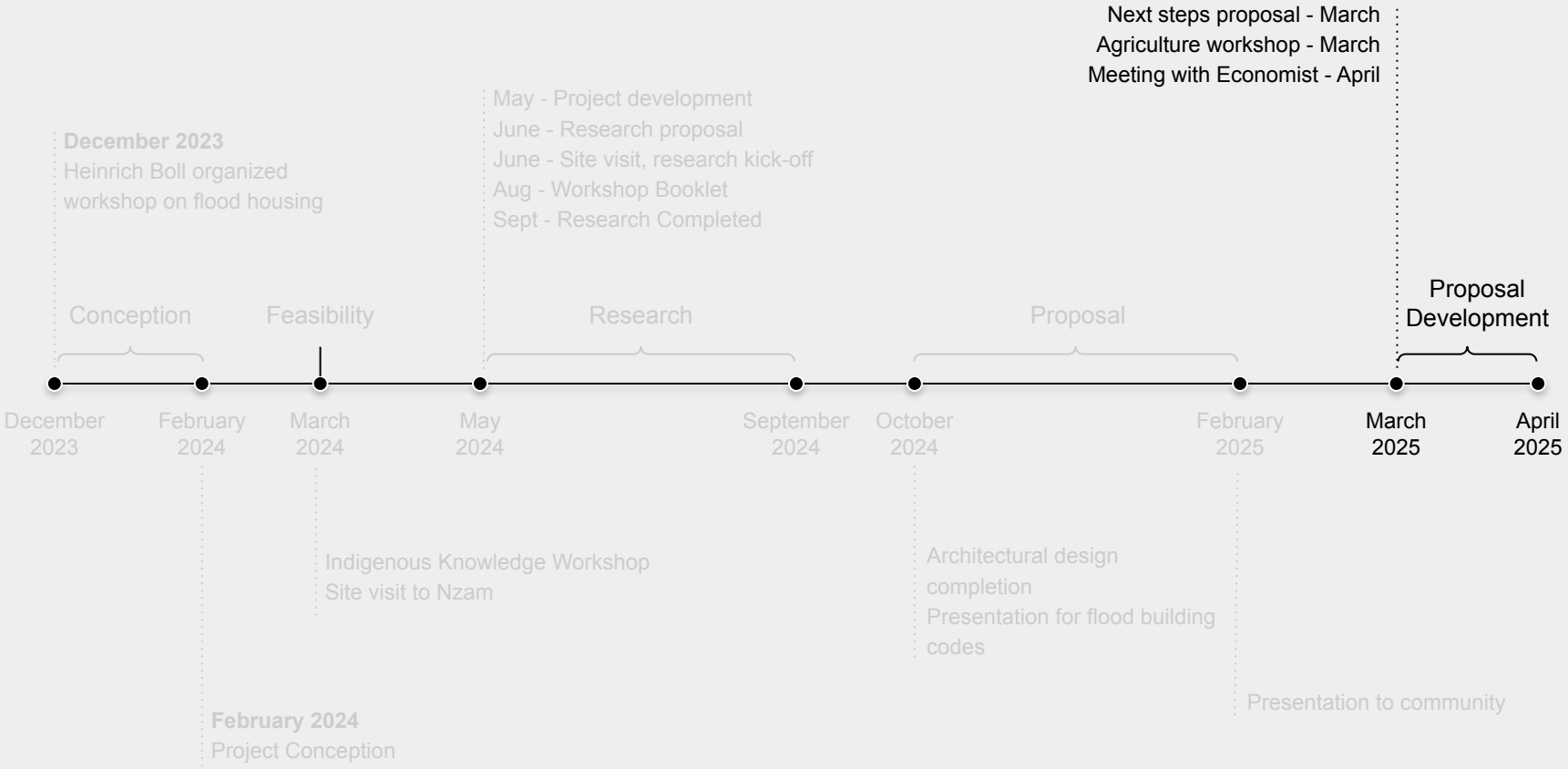
We visited Nzam to present our design and received the following feedback from the farmers:

1. They did not like the idea of having to replace the bamboo and thatch and found the **materials inadequate**

2. They did not like the idea of sharing a crop storage system because of **past experience with theft**

3. They were very **focused on irrigation** rather than the storage system because they need to produce before they can store

This led us to realize that the application of our proposal was much more important than the proposal itself.


Next steps proposal - March
Agriculture workshop - March
Meeting with Economist - April
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Where are we now?

MAJOR CHALLENGES

1. Research limitations - We understand the depth of the project, but we do not have the capacity to tackle all of it
2. Funding - We need to prototype and test our ideas in order to make stronger cases, but we don't have the funding to do any physical explorations
3. Partnerships - We need to create partnership with the identified stakeholders, but they are very limited in supporting us without funding
4. Pace - If we do not physically engage the community, we risk losing their attention and support

NEXT STEPS

We're currently developing a scalable project towards serving the short-term goals while we map out the long-term goals

1. Identify partnerships that key into each phase of the project's development
2. Develop the proposal to a prototypical level that can serve as a call for partnership in other regions facing and solving similar challenges
3. Search for funding