

# MAA-BARA: CATALYZING CHANGE IN NIGERIA'S NIGER DELTA

by  
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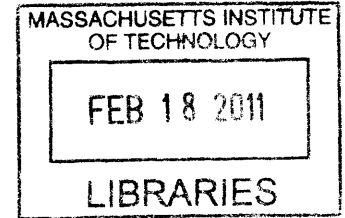
SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE  
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARCHITECTURE  
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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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Submitted to the Department of Architecture on January 18, 2011  
in Partial Fulfillment for the requirements for the degree of Master of Architecture

## ABSTRACT

Can architecture catalyze economic growth? This thesis serves as a design contribution to the war against poverty by proving that small-scale architectural interventions can propagate large-scale economic growth. It demonstrates how by 'rethinking relationships'- which is the essence of design thinking- synergistic innovations are created, capable of unleashing economic growth of pandemic proportions.

Case in point: Nigeria's Niger Delta, home of the nation's oil wealth, and paradoxically home of the nation's poorest citizenry. Where over 85% of the populace are without access to safe water and an average of 13 million barrels of crude oil annually spill to contaminate the soil and water. Obviously, this is no *architectural* problem. Through the *Maa-Bara* (translated: *Water-Farm*, from Ogoni language) which is a careful splicing of aquaculture technologies, local building technologies and capacity-focused development strategies with design thinking, innovation of great economic potential is born.

**Thesis Supervisor:** Shun Kanda  
**Title:** Senior Lecturer of Architecture

**Thesis Supervisor:** James Wescoat  
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**OGHENERUNO**

With local fishermen at Bodo  
Fishing Settlement, July 2010

**DEDICATION**

I dedicate this thesis to my brothers  
and sisters of the Niger Delta. Your  
resilience, optimism and beauty in spite  
of hardship is an inspiration.

*And because we can speak -and design- for  
ourselves...*

# ACKNOWLEDGEMENTS

---

In Nigeria, we say, “it takes a village to raise a child.” Like the proverbial child, this thesis was nurtured and guided by several hands and mouths. Primarily, by God’s hands have I made it this far. I appreciate You coordinating the symphony of events that helped realize this dream.

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### **BIOGRAPHICAL NOTE**

Ogheneruno Okiomah was born in the US to a Nigerian couple, who was studying at Oklahoma State University. At age eight, she moved with her family to Nigeria where she spent her formative years, only to return to the U.S. for college at age 18. She has retained a rapacious interest in issues of identity/hybridity, indigenous technology, social justice and rural agriculture.

She belongs to the Isoko ethnolinguistic group of the Niger Delta peoples.

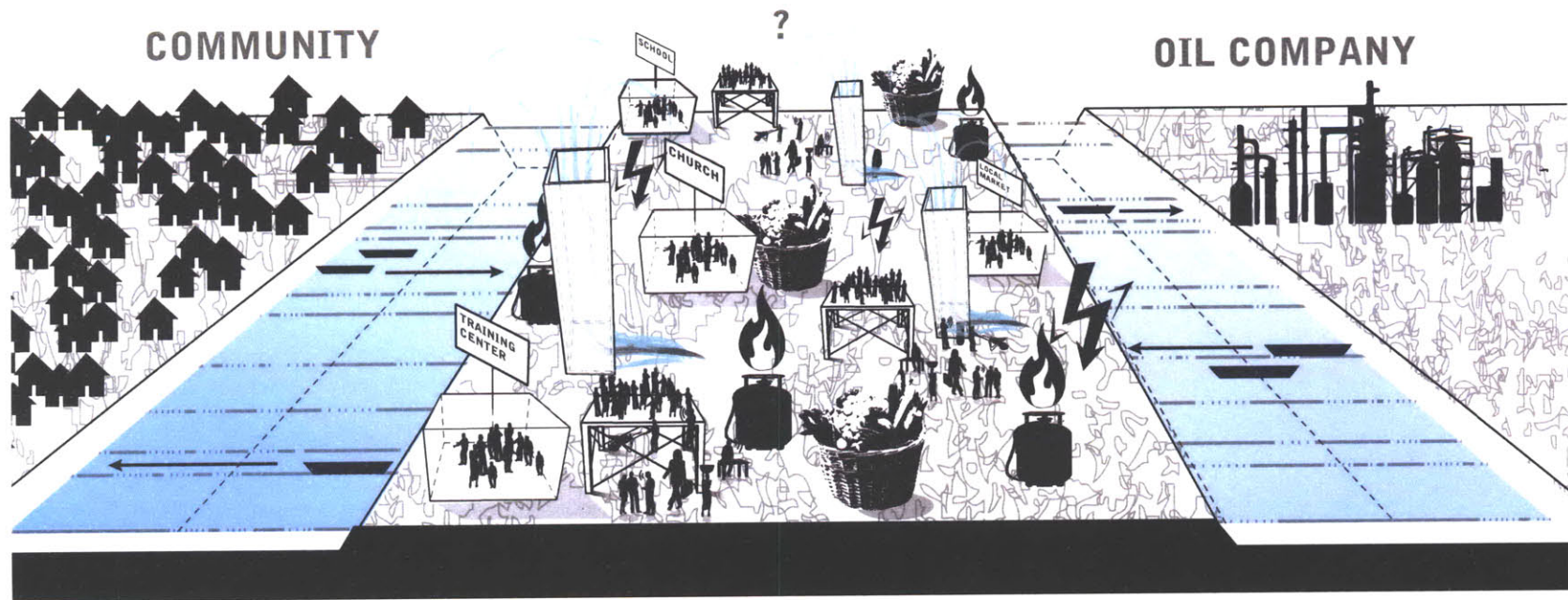




# Maa|Bara

## CATALYZING CHANGE IN NIGERIA'S NIGER DELTA

Ogheneruno Okiomah







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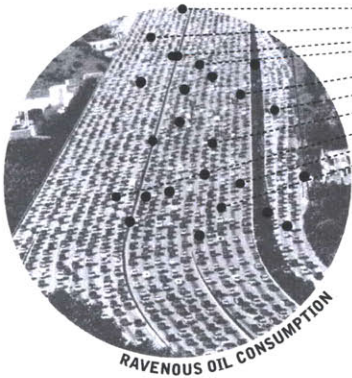


# **CONTEXT**

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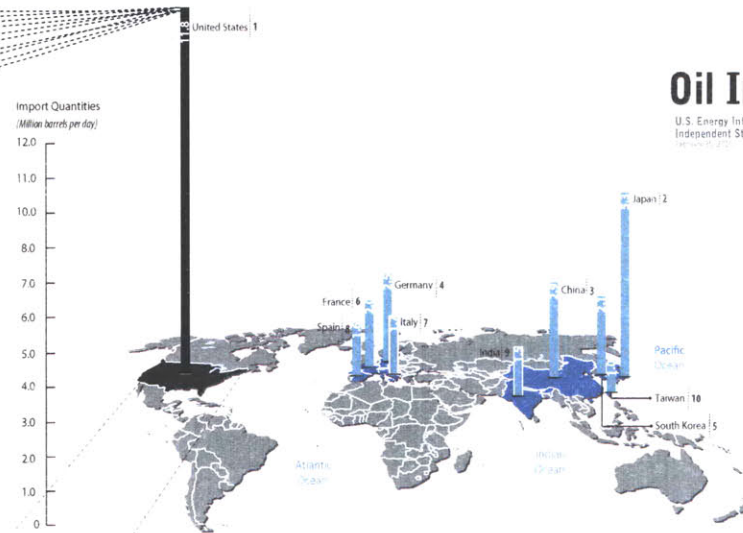
**1. GLOBAL CONTEXT**

**2. SITE SELECTION**

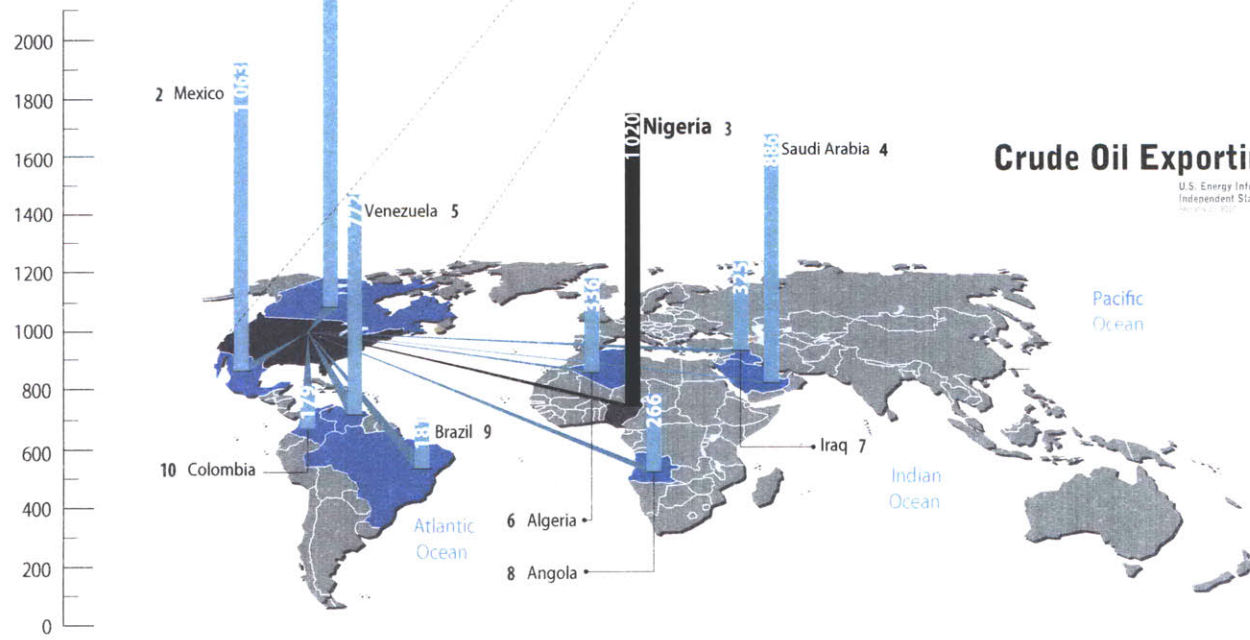


## Oil Importing Nations Top 10

U.S. Energy Information Administration  
Independent Statistics & Analysis  
February 2010



Export Quantities Dec 2009  
(Thousand barrels per day)



# CONTEXT

---

*... I call petroleum 'the devil's excrement'. It brings trouble, waste, corruption... Our public services are falling apart... And debt we shall have for years. We are drowning in the devil's excrement"*

*Juan Pablo Perez Alfonso*

## GLOBAL CONTEXT

Everyday Nigeria exports 2.5 million barrels of oil (Rewane, xi) with 40% carted off to the U.S. (Kashi, 48) dubbing Nigeria the 3rd largest exporter to the US – after Canada and Mexico. Oil revenues account for 90% of the nation's economic wealth (Rewane, xii) amounting to \$600 billion since the oil industry's inception in 1958 (Howden 2009). This thriving oil industry is located in the Niger Delta where 7 million of 12 million live under \$1 a day (UNDP 1999) and 85% are without access to safe water (UNDP 2006).

Major ethnolinguistic groups include Ijaw, Ogoni, Isoko, Urhobo and Itsekiri. Poverty amidst plenty, the Niger Delta peoples are paradoxically the poorest in the nation with GNP per capita below the estimated national average of \$200 per year (Ojatorotu, 31).

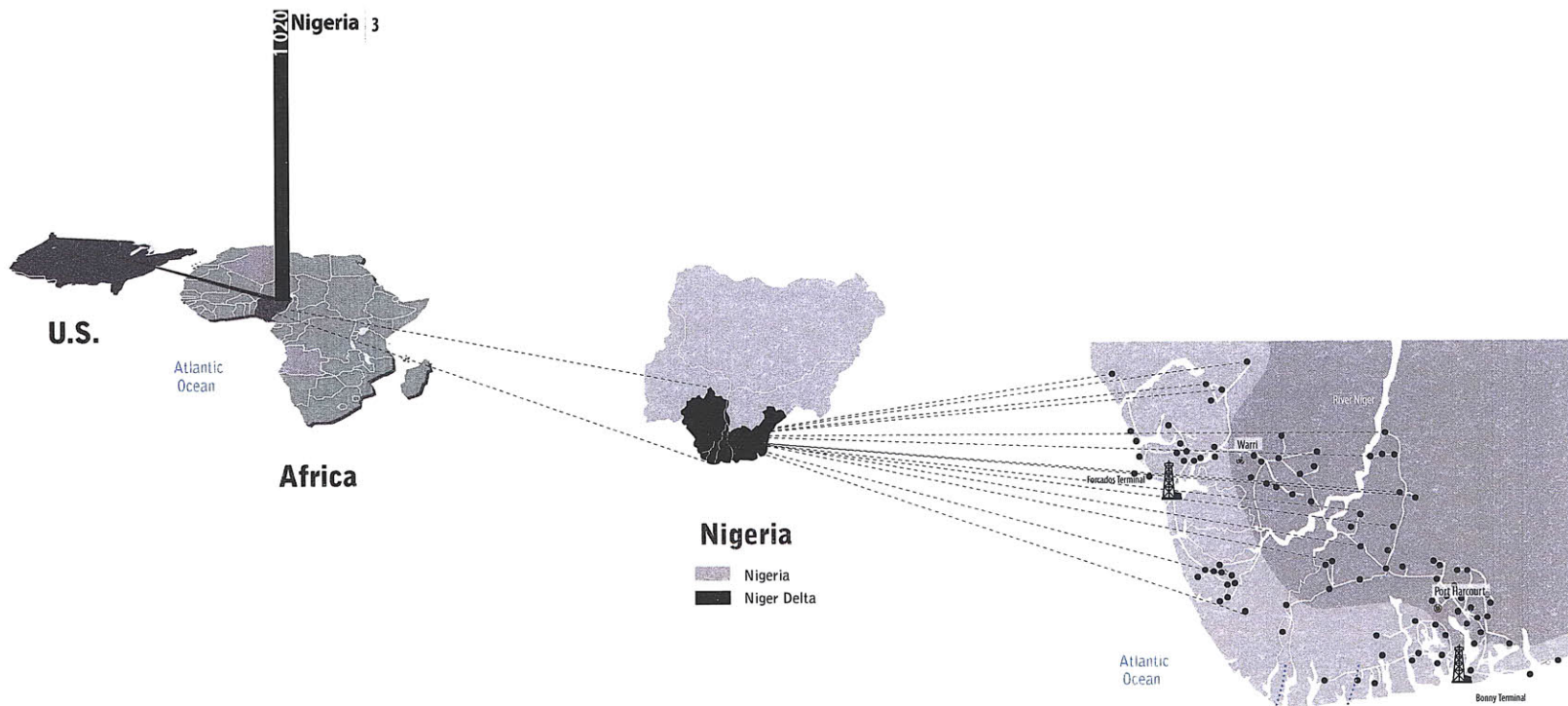
## Economic Crisis:

Nigeria was an agrarian economy after independence in 1960 with 85% of foreign exchange earnings from agricultural products. By 1970, the oil industry eclipsed the agricultural sector causing a pandemic lack of economic diversity which the nation has yet to recover from (Ojatorotu, 29).

The Nigerian government has not helped the situation in the Niger Delta, rather has enacted policies that facilitate divesting the people of their resources without due compensation. Legislation such as the 1969 Petroleum Act and 1978 Land Use Act are a few of the legal instruments by which the government has usurped ownership of the region's resources without just compensation to the people (Ojatorotu, 4).

## Environmental Crisis:

In the Niger Delta, the major oil exploration and production activities are owned by Shell Petroleum, ExxonMobil, Chevron, Texaco, Agip and Elf. These transnational corporations are major culprits of the degradation to the natural environment. This thesis will not enumerate all the environmental issues, but highlights oil spillages



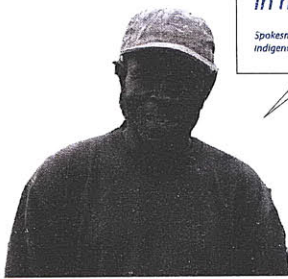
*"Indigenes are being fed toxins  
in their water, food, air and soul"*

Spokesman for Indigenous Peoples Group in Papua New Guinea against mining; "Global Struggles of Indigenous Peoples," Independent Film, 2001



*"Everything begins with the Earth.  
Extraction is the foundation of all industry.  
Indigenous Peoples still live in extraction!"*

Spokesman for Chippewa Indigenous Peoples Group against mining; "Global Struggles of Indigenous Peoples," Independent Film, 2001



*"Who wants to be a beggar  
in his own land?"*

Spokesman for Dene Nation; "Global Struggles of Indigenous Peoples," Independent Film, 2001



*"We are the land, the land is us,  
We are the water, the water is us"*

Spokesman for Indigenous Peoples Group in Philippines against mining; "Global Struggles of Indigenous Peoples," Independent Film, 2001



because of the widespread effects on the natural environment and its major threat to the resuscitation of local agricultural activities. The Niger Delta wetlands are the largest in Africa and 3rd largest in the world. The Niger Delta basin of Nigeria is the 5th largest in the world, 2nd to only the Nile basin in Africa (Rewane, xiii). These ecosystems are home to a wide variety of flora and fauna whose existence is threatened.

**Spillage Quantity:**

“13 million barrels of oil have been spilt in the Delta- equivalent to 1 Exxon Valdez disaster every year for 40 years,” divulged Daniel Howden of *The Independent*. He explained the causes are out-of-date and

faulty equipment on the part of the oil companies, while the oil companies claim local vandalism is vastly responsible.

**Spillage Frequency:**

Conservative oil-industry estimators concur with findings of 7,000 oil spills occurring from 1970 to 2000- averaging more than one every day. “The real figure might be twice or three times that number,” suggests Michael Watts in *Curse of the Black Gold: 50 years of oil in the Niger Delta*. Howden added, “Nigeria’s own watchdog reports that there are 2,000 current spills.”

Alas, the situation is dire, the crisis is real, urgent responses are of the essence.

canoeing is the main transport medium, children learn from the age of 5



water festival enacted on the riverways and streams



Major ethnolinguistic groups



fish masquerades; celebrated water ceremony

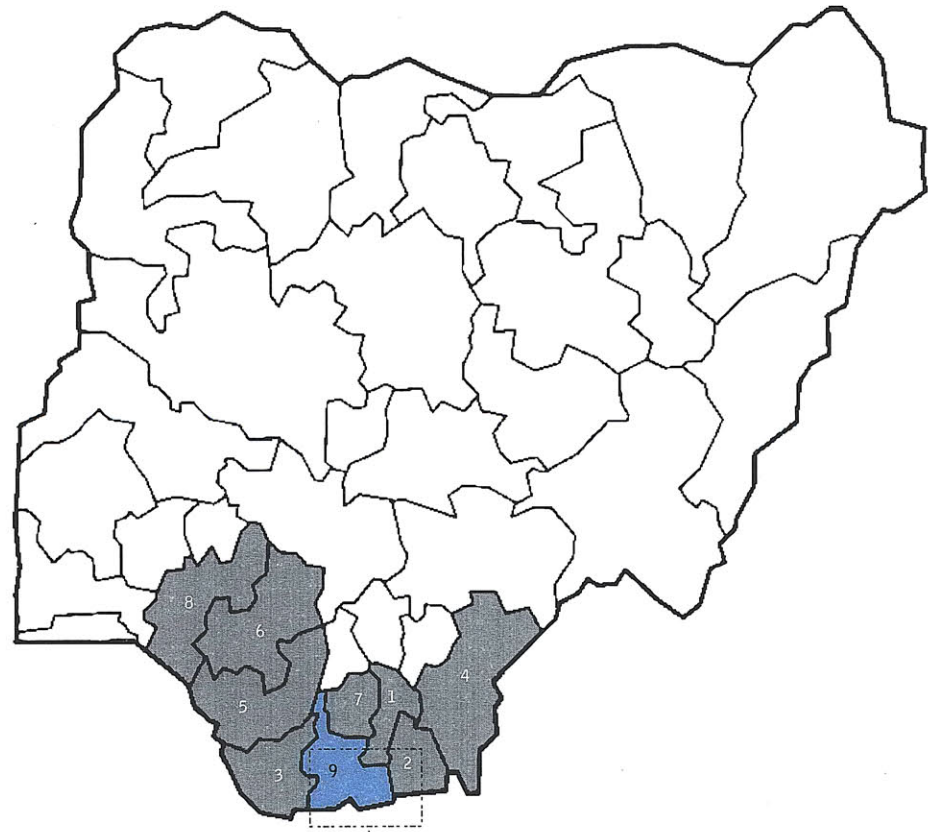


local craft; a canoe hat worn during water festivals



local craft; a wooden shark carving

Images courtesy: Anderson, Martha, et al. *Ways of the rivers: Arts and environment of the Niger Delta*



Niger Delta States:  
1. Abia State, 2. Akwa Ibom State,  
3. Bayelsa State, 4. Cross River State, 5. Delta  
State, 6. Edo State 7. Imo State, 8. Ondo State,  
and 9. Rivers State

Research Site:  
**Rivers State**



# CONTEXT

---

*"... Is it not an irony that those who live on top of wealth should be the poorest people in the nation?"*

*-school teacher: Sam Badilo Bako*

## SITE SELECTION

The major stakeholders; the communities and the oil corporations, both have a pervasive presence on the Niger Delta landscape. Unfortunately, this coexistence has yet to prove mutually beneficial. The intent of the thesis is to realize sustainable interdependent linkages. However, to establish *links*, one must first have *points*.

Maps pin-pointing local communities and the oil company flowstations (explained later) were overlain to illustrate their physical proximities and ascertain the replicability of any eventual result. Several potential sites were identified, albeit, the prototypical nature of the project permits that site specificity remain a non-issue.

Bodo Town near Port Harcourt is the representational site selected because:

## 1. Community Location:

Bodo of Ogoniland experienced a spill in August 2009 caused by a pipeline leak. Daniel Howden for *The Independent*.

reported,

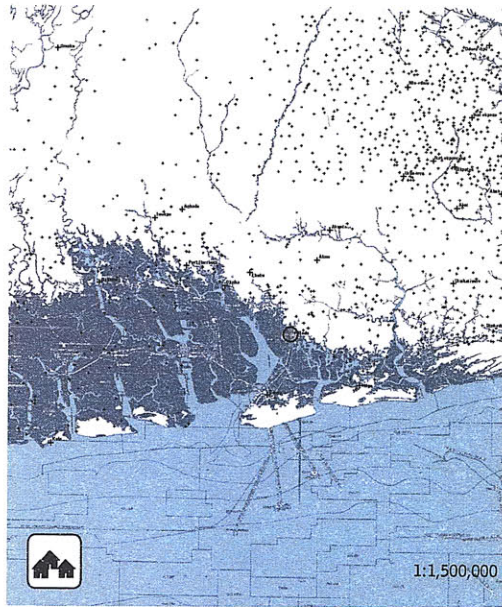
*"Oil poured into the swamp covering the area in a thick slick and killing fish. Local people's access to food and water was devastated (...) Emergency help (...) of 50 bags of rice, 50 bags of beans, 50 bags of garri, 50 cartons of sugar and 50 cartons of dry peak milk was rejected as 'insulting and provocative' by the community,"* expressed Howden.

## 2. Community-Relations Partner:

Enterprise for Development International (EfDI- formerly TechnoServe) served as a partner in field research. The reputable non-profit organization has developed a positive rapport with local communities and has a regional office in Port Harcourt. *(Research funds were provided through the MIT Schlossman Travel Grant.)*

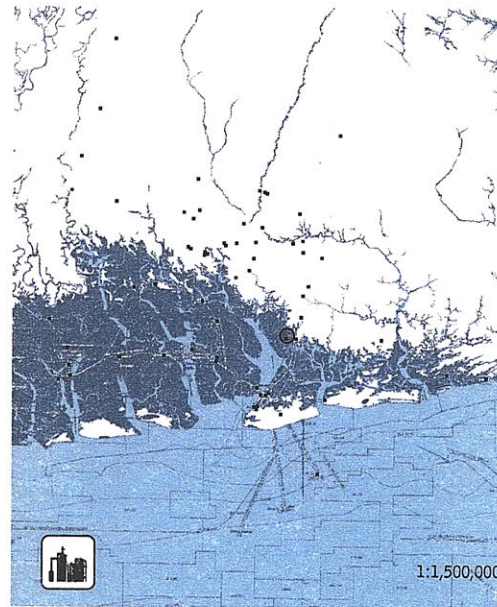
## 3. Oil Company Location:

Shell Petroleum Development Corporation (SPDC) has a major office in Port Harcourt.



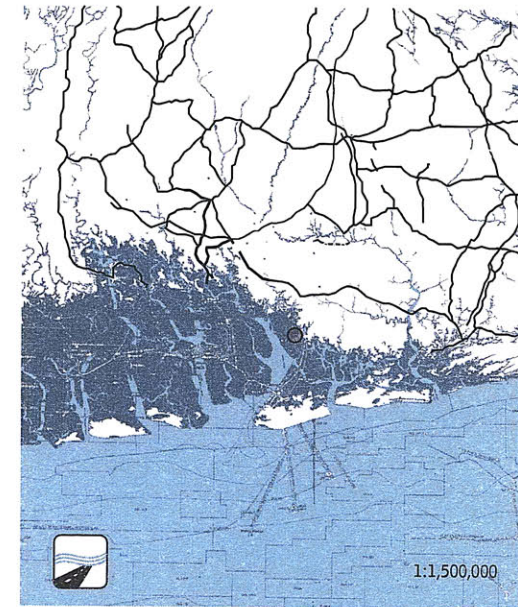
**Communities:**

The map above shows a vast number of communities with major communities highlighted. Bodo, the selected community, has an estimated population of 10, 000 people. *Figure generated from counting houses from satellite image.*



**Oil Corporation Infrastructure:**

The network of flowstations canvassing the landscape are only of Shell Petroleum Development Corporation. Facilities for Chevron, ExxonMobil, Total or Agip are yet to be requested and overlain. The assumption is more communities will fall within range of “Potential Sites,” once all oil infrastructure is collected and mapped accordingly.



**Transport Networks:**

Waterways and roadways are the major transport modes. Successful markets thrive along the roadways because of the added vehicular clientele. Transporting produce to major city centers like Port Harcourt and Warri is an important factor for consideration. Water transport by canoe is more prevalent in the southern marshlands. Inexpensive and produced locally, they are the pervasive transport mode.



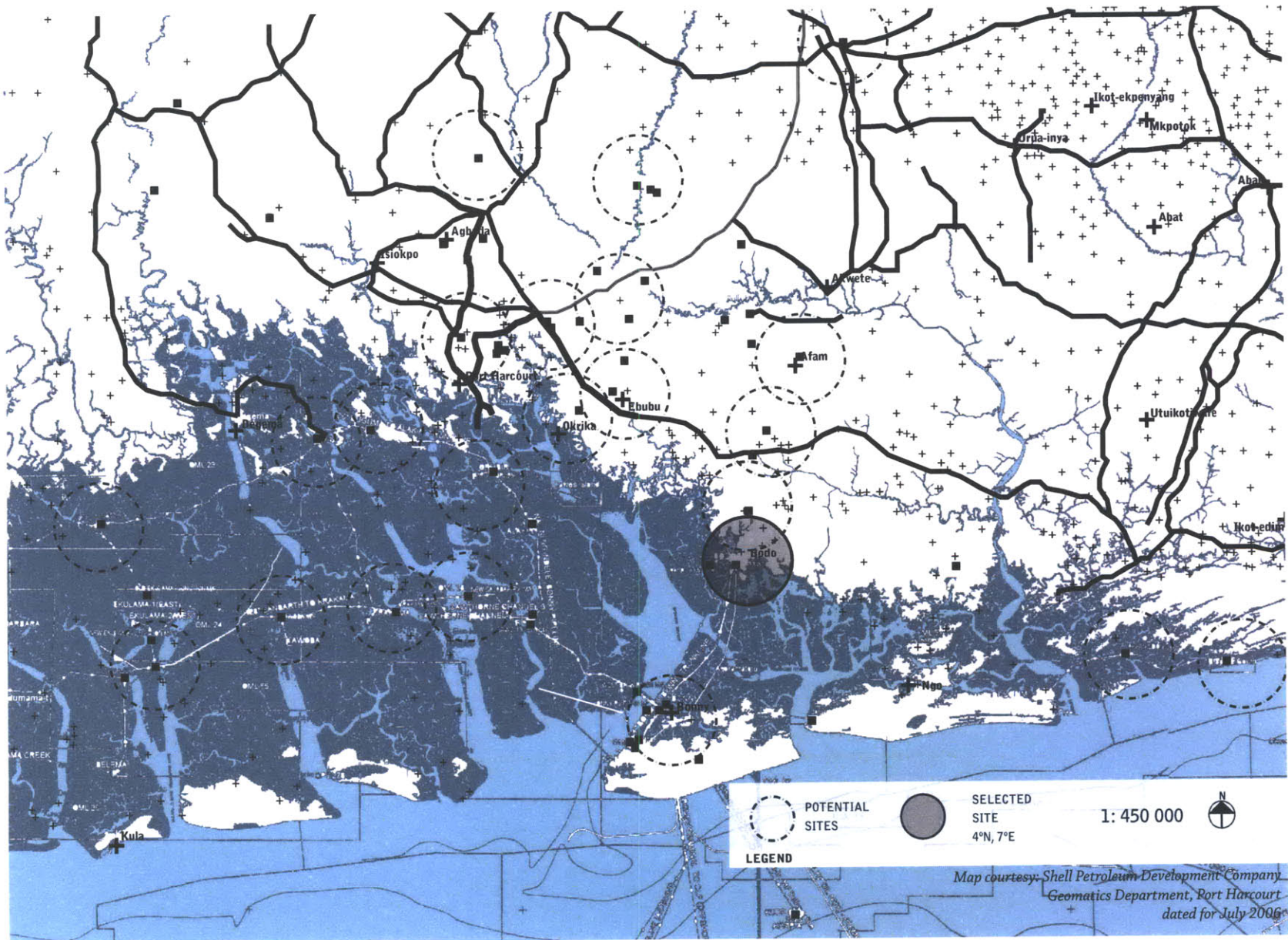






Image from Bodo Fishing Settlement, 2010

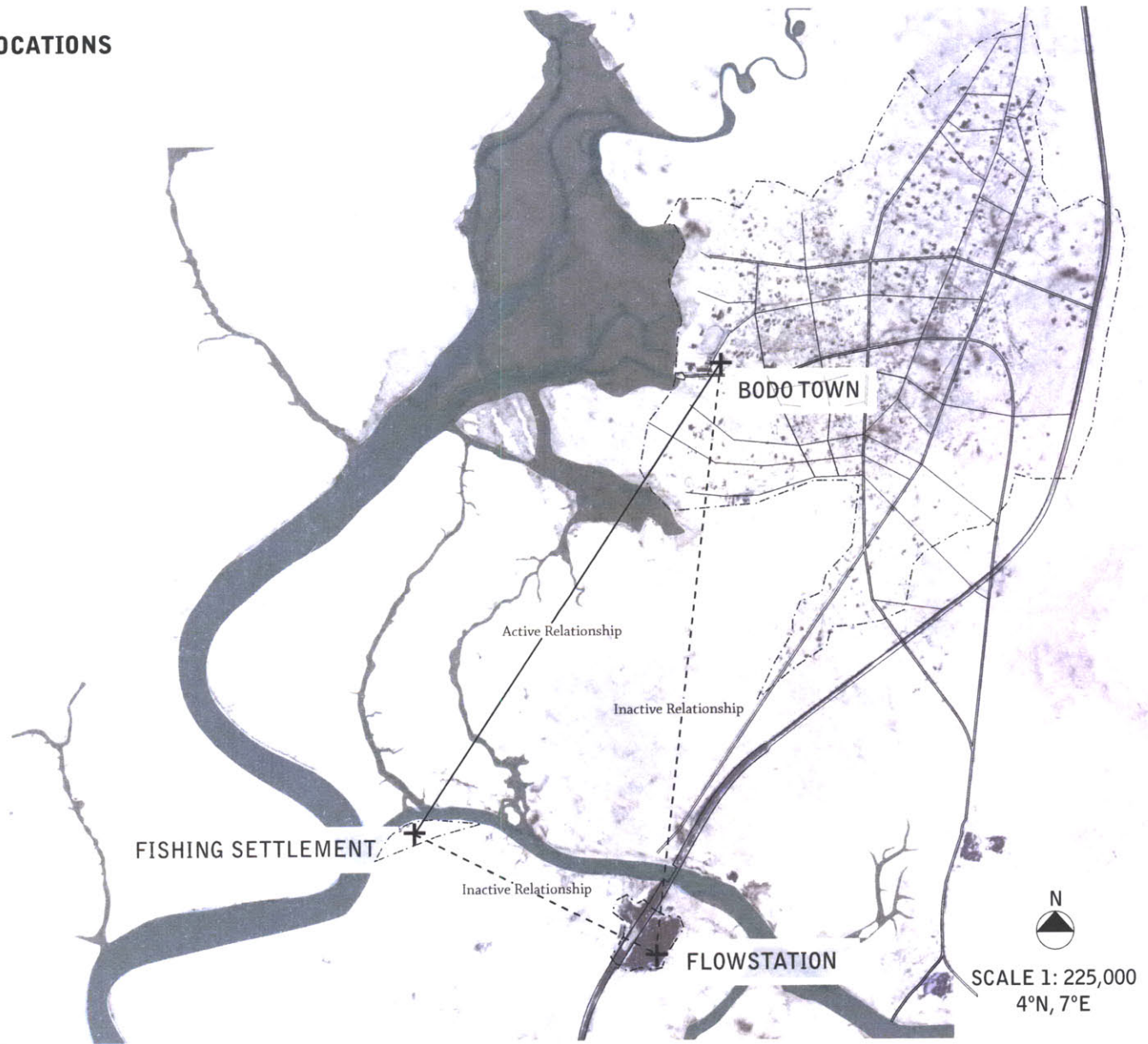
## SITE CONDITIONS

During field research, I learned about a resilient sub-community of Bodo Town-fishermen and their families seasonally set-up dwellings a few kilometers away in a Fishing Settlement. Commonly referred to as *Fishing Camp*, the site is inhabited for six months- the *good fishing season* (February to July) when fishermen attest to better yields. This transhumance phenomenon, of seasonal movement for agricultural gain, offers a welcomed “Intermediary Scale” between the major stakeholders of Bodo community and the Oil company.

The adjacent map identifies the inter-relationships and spatial adjacencies at work. The goal is to spark active economic interdependencies with mutual benefits.

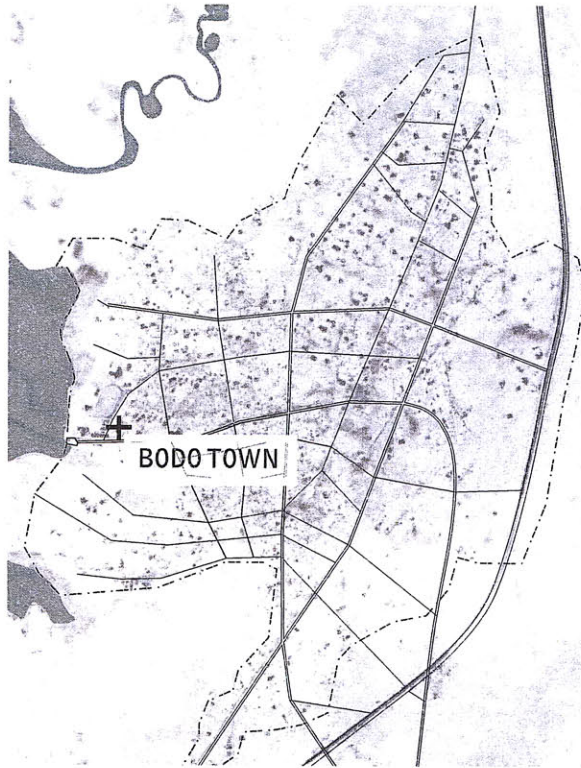
A catalogue of the varied site conditions; vegetation, population, etc. for each characteristic location is subsequently charted.

**STAKEHOLDER LOCATIONS**



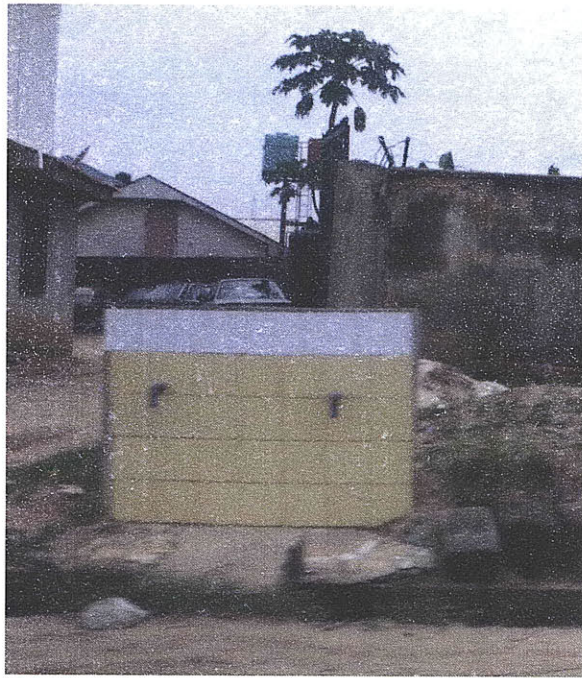


SCALE CATEGORY 01:



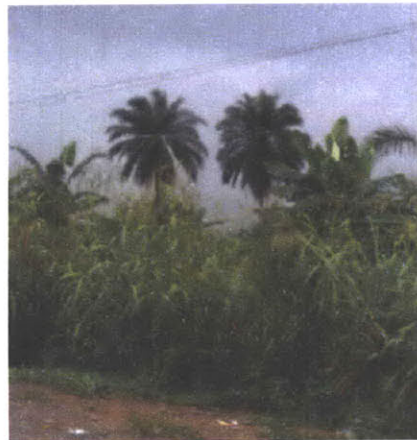
**NIGER DELTA COMMUNITY**  
10,000 PEOPLE approx.

x 10



**Water Infrastructure**  
Wells locally known as “bore holes” can be randomly located along the roadsides. These are owned by nearby residences and those withdrawing water typically pay a fee.





### **Vegetation**

Lush rainforest vegetation forms a dense canopy over the muddy clay soil. Oil palm, plantain and banana trees are widespread and tall grasses form the secondary canopy.



### **Employment**

The roadside market though sporadic is extensive. It consists primarily of women and their children while produce sold is plantain, tilapia fish, catfish, corn and periwinkles. They would greatly benefit from a roadside market with child-care amenities.



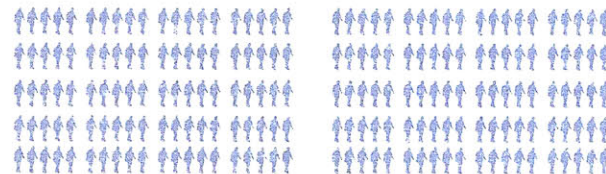
### **Housing**

Most residences are constructed with wood members, however a growing majority have adopted concrete structures or hybrids with a concrete core and wooden extensions.

**SCALE CATEGORY 02:**



**PROPOSED SITE**  
200 PEOPLE approx.



**Water Infrastructure**

The locals ferry **drinking water** from the nearby town. Though the river is covered with a sheen of oil, bathing and clothes laundering are still sourced by **river water**.





### Vegetation

Red mangroves *rhizophora mangle* cover the **intertidal** landscape and protect the coast from **erosion**. Propped up by its roots, this hardy plant struggles to thrive in spite of incessant oil spillage and firewood harvesting.



### Employment

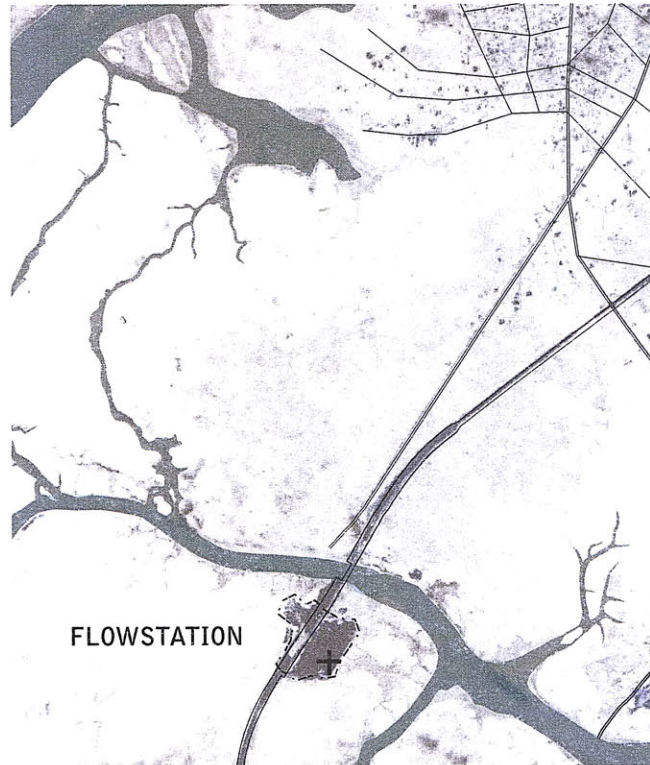
Fishermen primarily catch **fish**, however crabs and periwinkles diversify their income. Their women typically handle **drying** with firewood and **selling** the produce to roadside markets near the town, on a daily/weekly scheduled commute.



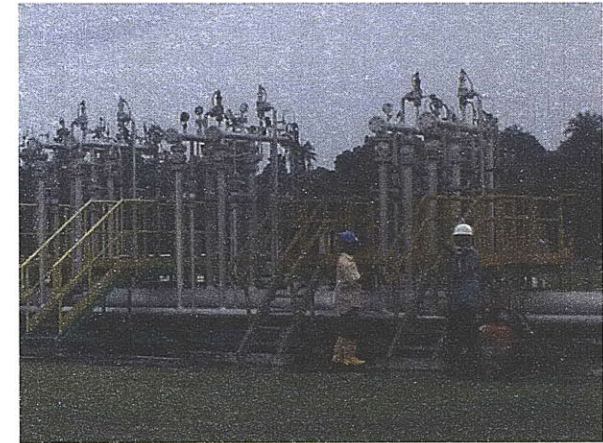
### Housing

Temporary housing is designed and constructed by the fishermen and their families. Housing is communal and sourced with wood and raffia from the towns where such vegetation is pervasive.

**SCALE CATEGORY 03:**



**OIL COMPANY**  
20 PEOPLE approx.



*Images courtesy: Presentation by Engr. Iwo George P.S.*

**Oil Infrastructure**

A typical flowstation is where piped crude oil is separated from water and gas. It is constantly powered by the gas generated. Shown are the Separator and the Arrival Manifold.

### **Conclusions:**

- The Niger Delta is in a crisis- economically and environmentally.
  - Key stakeholders are the communities and the oil companies that must cohabitate the land.
  - The agricultural industry, a major employer in such rural community is threatened by oil spillage activity.
  - Oil company equipment and activities have negative effects on the environment and the local agrarian economy.
- Government is slow to regulate or stop the effects of the oil companies.
- Oil companies might improve their activities (update equipment, curb spillages, remediate the environment and compensate the locals), but this is highly unlikely.
  - This crisis has been the norm for over 50 years. The locals can not continue to *hold their breath*, waiting for top-down change.
  - There is need for innovations that will allow the local communities to thrive in spite of pollution.



# PROPOSAL

---

**1. DESIGN PHILOSOPHY**

**2. NEW RECIPROCITY MODEL**

**3. PRODUCTION IN POLLUTION**

**4. SUSTAINABLE NUTRIENT CYCLE**

**5. RESEARCH PRECEDENTS**





# PROPOSAL

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*"Through the act of building... marginalized people can come back into the community and reassert their role, their position, their political right."*

*-Sergio Palleroni*

## DESIGN PHILOSOPHY

This thesis proudly endorses a design philosophy that focuses on the people. By designing for the people, with the people and fostering designs by the people sustained economic benefits will result. It also ensures that the people have a vested interest in a project's success.

### Design for the People:

On November 4, 2010, architect Bryan Bell gave a lecture entitled *Expanding Design Through Activism* where he explained, "Currently the design profession is tapping into only 2% of its potential." He believes the full potential lies with:

1. Design serving greater masses
2. Design addressing larger issues
- 3.. Design engaging a greater scope of roles.

Designers have a skill unlike any other profession, "we see things that aren't there and we are equipped to realize those visions," extolled Bell. Designers could use their "super abilities" to bring about positive change. If the demand is great, there is also profit to be made. His lecture concluded with the admonitions, "Find a segment of society that is not being addressed by the market and address it. *-A call to ingenuity.*

Over 35 years before the admonitions of Bryan Bell, African architect Hassan Fathy professed that architects were also culturally integral to societal development. In *Architecture for the Poor*, he attested that designers were specially equipped to redirect the attention of the common man towards the hidden jewels in his own culture. (Fathy, 43). He dubbed the designer- *authoritarian critic*, (one who) "shows what is admirable in local forms, and goes so far as to use them himself..., (the people) look on their own products with pride. What was formerly ignored or even despised becomes suddenly something to boast about...knowingly" (Fathy, 43).







### **Design of the People:**

The local *forms* Fathy mentioned are also known as local *crafts*. *Craft*, must be explained lest it be misconstrued as playful children's artwork. I resort to the definition furnished by architect and critic Scott Francisco, in *The Way We Do Thing Around Here*, "craft ...(is) a powerful descriptor of values associated with historic construction culture- values that survive."(8) Though I agree with the author, I also believe craft is dynamic, acting -more so- as an active pacesetter of cultural values and less as a passive descriptor. Because craft is an ongoing construct of a people, its progress reflects the progress of a people.

Indian architect and theorist Prem Chandavarkar author of *Crafting the Public Realm* shared similar sentiments. Francisco outlines Chandavarkar's perspective thus;

1. Craft is practiced by a community.
2. All ideas belong to the entire community; if any single crafts-person comes up with a new idea then that innovation serves to extend the visual language of the entire community.
3. The crafts-person does not seek to be compensated for the value of his/her ideas, and only claims compensation for the cost of time and materials. The business model is not linked to any claim to compensation derived from intellectual property rights. It is based on the cost of a service provided, where the commercial valuation of the

service is not linked to the idea on which it is based.

4. Each innovation does not seek to start from scratch. Innovation is based on building upon what the community has already produced. The craft develops in a gradual, incremental "bazaar" mode rather than (...), grand-design "cathedral" mode.
5. Judgement regarding quality is based on peer review.
6. Community development is valued above personal glorification.
7. Every contribution to a craft is judged on two counts—the utility it contributes to the immediate task at hand and the extent to which it contributes to the development of a symbolic language that is useful to the community at large (Francisco, 9). *underlining is mine.*

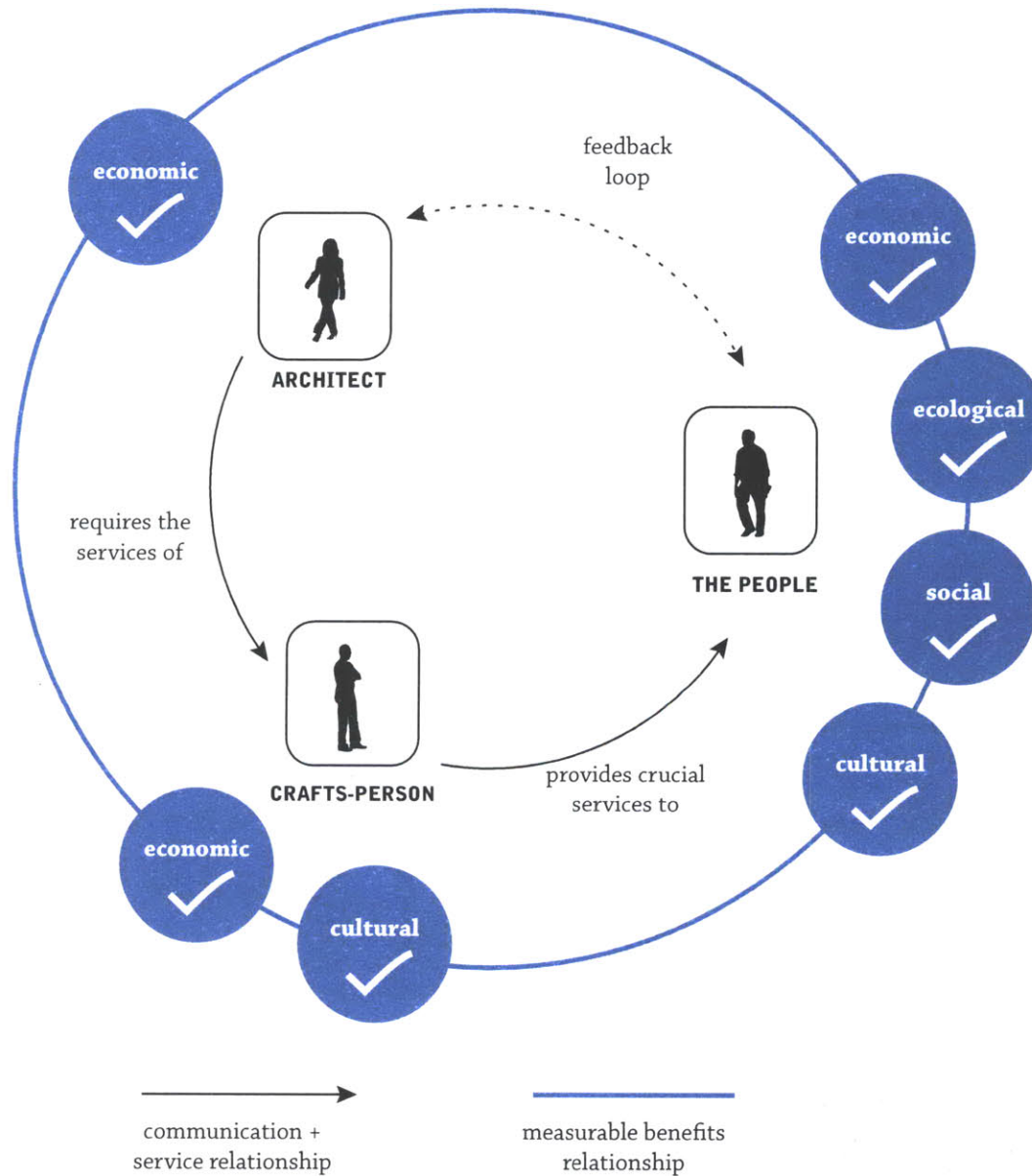
### **Design by the People:**

Crafts embody the identity of a society. The crafts-person, therefore, is the crucible of local culture and a potential pacesetter of innovation. Why then are crafts-people still counted among the poor? Their value is yet to be linked with the life blood of the society.

For any product to attract higher economic value within a society, it must prove itself functionally invaluable to that society. Once such indispensability is established, the crafts-person is rescued from cultural obsolescence and economically liberated from penury.







**Proposed Sustainable Framework:**

Here in lies the quadruple bottom line; Architects designing for people, with designs only attainable through collaborations with local crafts-people, spurs economic activity for designers and crafts-people as well as a resurgence of cultural identity and local pride. If the architect’s design intrinsically improves the quality of life (social) of the local recipient and works without environmental damage (ecological)- then we have a win, win, win... win!

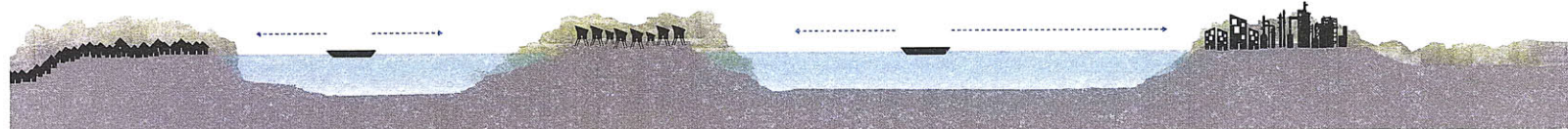
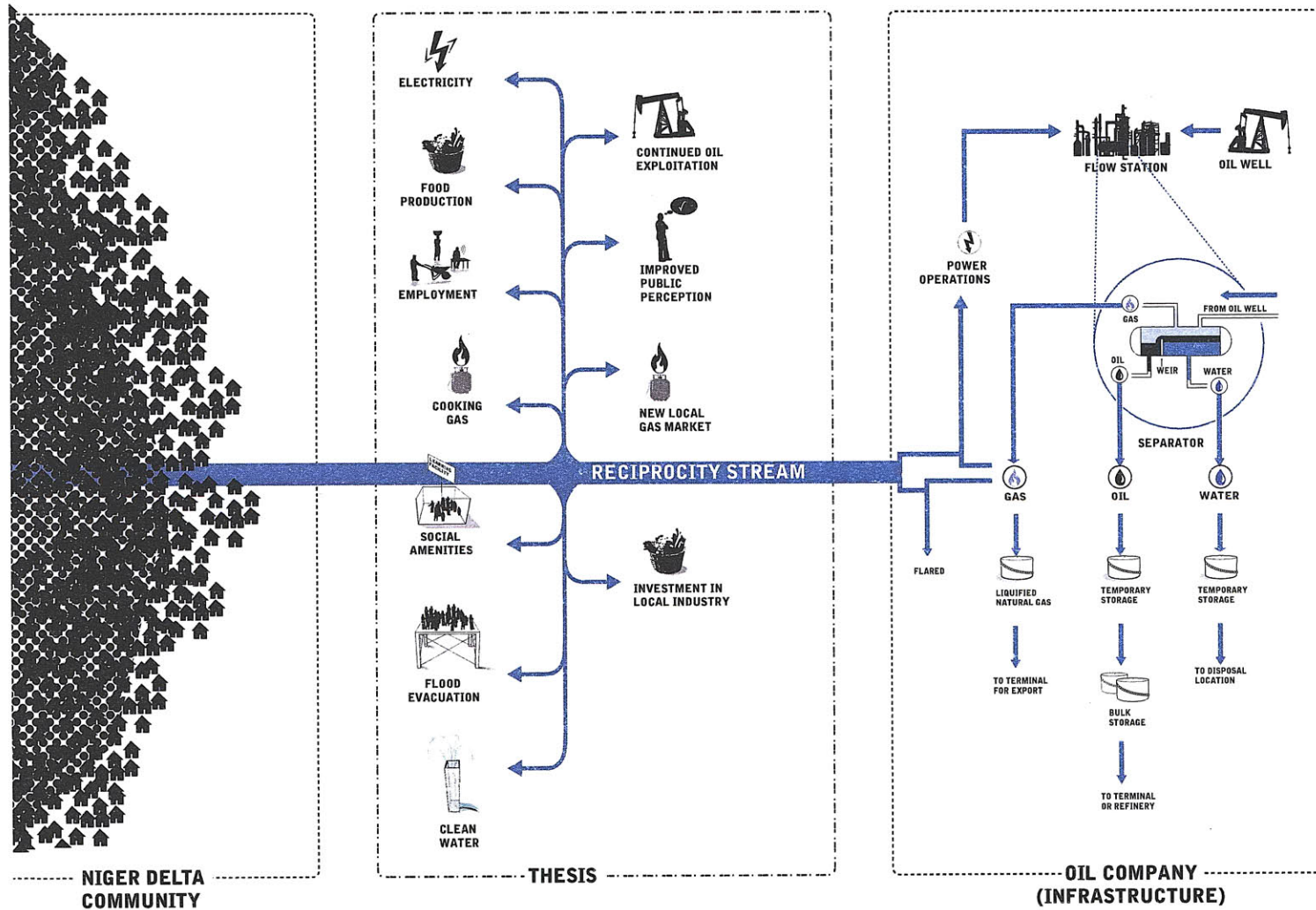
*Added bonuses:*

1. Incentive for further innovation among crafts-people and designers.
2. Palpable blow towards knocking-out poverty. Total knock out (TKO) is now conceivable!

Fathy envisioned this synergistic relationship in 1973 saying, “Thus the village craftsman is stimulated to use and develop the traditional local forms, simply because he sees them respected by a real architect, while (...) the client, is once more in a position to understand and appreciate the craftsman’s work...” (Fathy, 43)

Fathy’s dream was idyllic. Without the sustainable economic component- explored in this thesis, his idea remained just that- a dream.

# RECIPROCITY MODEL DIAGRAM



RECIPROCITY MODEL SECTION



# PROPOSAL

---

*"Africa will not overcome its poverty unless we develop skilled individuals who can wrench themselves (...) and their communities out of the cycles of poverty that drag each succeeding generations deeper and deeper into the quagmires of dependency."*

*Achimut Dangor*

## NEW RECIPROCITY MODEL

The reciprocity model lays the foundation for synergistic inter-relationships that turn conflict into cooperation, energy into food.

Let's recap:

- The purpose of this thesis is to rethink the existing relationships of major stakeholders in the Niger Delta: the Community and the Oil company.
- A representational site in Bodo Town, indicative of stakeholder adjacencies pervasive in the region, was selected.
- The design philosophy which focuses on the inherent capacity of existing crafts and the designer relationship with crafts-people has been expatiated.

The "New Reciprocity Model" scales up the design philosophy of expanding upon

inherent capacities. Existing assets and skills are identified at the stakeholder level and fused around common goals.

I carried out separate stakeholder meetings with key decision makers of both factions during the Research trip to the Niger Delta in July 2010. Shared goals and objectives were tabled and concessions were made on both sides. Viewing only the positives and highly likely possibilities, the final assets are as follows:

### COMMUNITY:

#### 1. Manpower:

They have wealth of numbers, a large populace eager and ready to work -*workforce*.

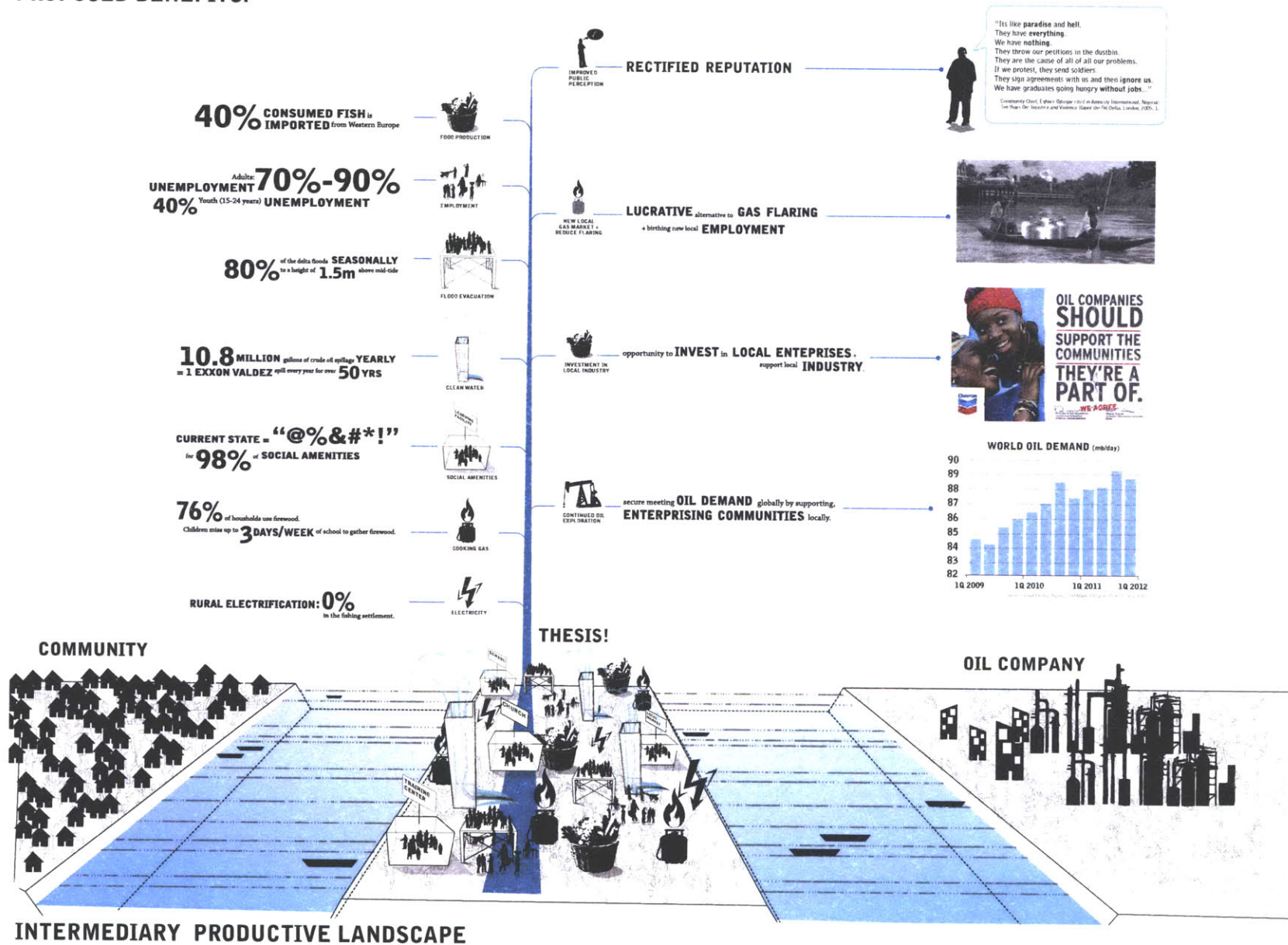
#### 2. Expertise:

Most of the locals are from an agrarian background and practice small scale fishing or farming already. Additional training may be required - *human capital*.

#### 3. Under-utilized land:

The swampy marshlands are a difficult terrain for habitation or cultivation. Some land remain largely unused-*workspace*.

**PROPOSED BENEFITS:**



#### **4. Prolific canoe-craftsmen:**

The proliferation of canoes showcases a highly skilled and dexterous set of craftsmen- *home grown technology*.

#### **OIL COMPANY:**

##### **1. Extra electricity:**

They generate enough power to sustain operations within a flowstation. Upgrading their generators to supply power to a portion of the adjacent community is a welcomed possibility-*rural electrification*.

##### **2. Local gas supplier:**

*Flaring*, the burning of extra gas derived from oil extraction, has been banned. Several communities still witness flaring activities. Containing the gas in pressurized canisters and selling to the local economy is not impossible- particularly as the crude oil is *sweet*, meaning the sulphur content is less than 0.5% and can be used for domestic cooking purposes-*reduced firewood deforestation*.

##### **3. Local gas employer:**

Economic over dependence on oil translates into a vast number of the population eager to be employed by the oil sector without the necessary skills or training. As a local gas provider, the oil companies who likewise wish to employ locally- now can. Ferrying the canistered gas, collecting empty canisters and even re-charge depots and staffing will provide gainful

employment to a subset of the populace with minimal training, stations, and can be gainful employ a subset -*expanded local employment base*.

#### **PROPOSED BENEFITS:**

##### **To the community:**

- Provides entrepreneurial employment that grows over time empowering people to control and expand productivity.
- Increased local food production and ensures healthier fish are consumed from clean water sources.
- An alternative agricultural foundation- instead of the oil contaminated ground,
- Flood evacuation to higher ground while ensuring the sustenance of aquaponics production.
- Planned temporary shelter for fishermen/ farmers and their families.
- Provides building blocks aggregated to form community amenities. 3 Maa-Bara living spaces assembled in succession = 1 Learning center or Fish processing site.

##### **To the Oil Company:**

- Provide oil companies with a better reputation, to the community and global economy.





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# OIL COMPANIES SHOULD SUPPORT THE COMMUNITIES THEY'RE A PART OF.

*Michel Kazatchkine* **WE AGREE.** *Rhonda Zygocki*

**Professor Michel Kazatchkine**  
*Executive Director, The Global Fund to Fight AIDS, Tuberculosis and Malaria*

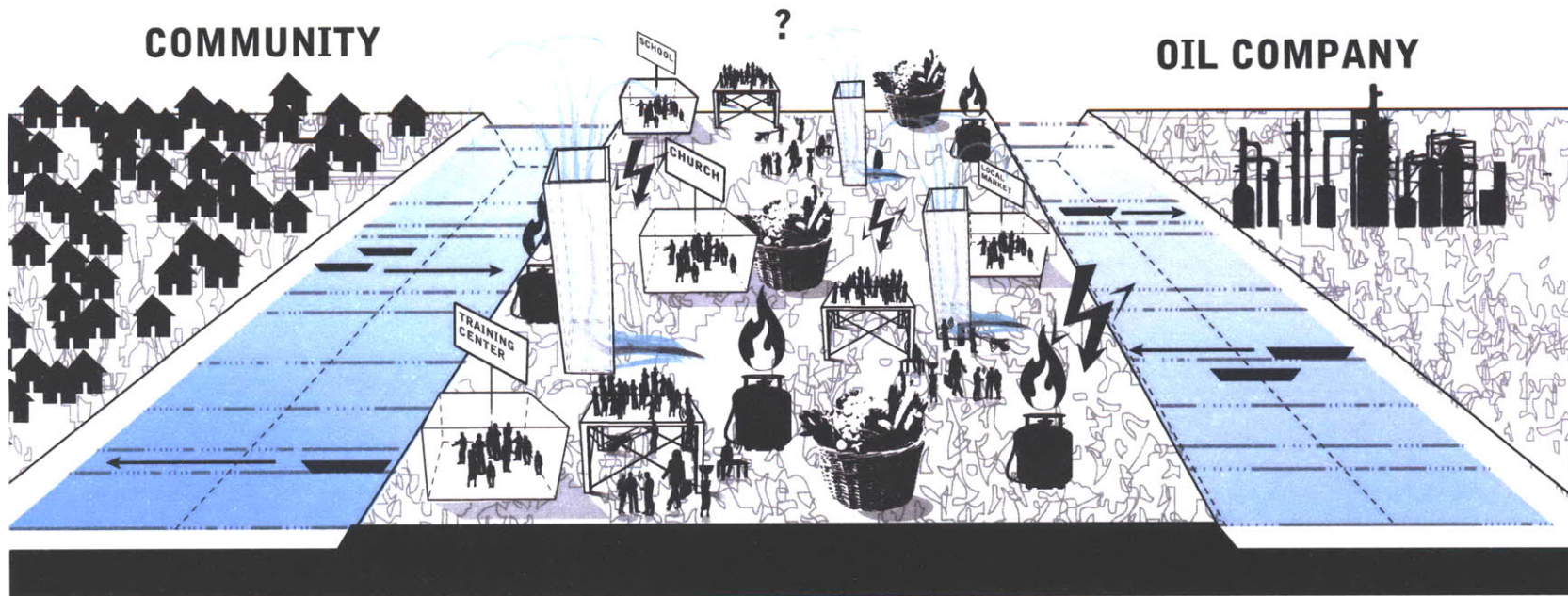
**Rhonda Zygocki**  
*Vice President, Policy, Government & Public Affairs*  
Chevron



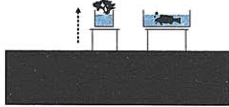

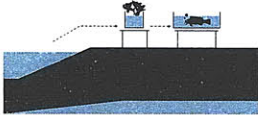
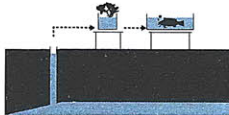





- Opens a new market for local gas sales and distribution
- Allows them to “get involved” putting money where their mouth is, without having to maintain the investment.
- Enjoy less vandalism and conflict as they continue oil exploration and production.

**SYSTEMS RESEARCH:**

The following pages showcase relevant technologies and methods used for sustainable fish farming and hydroponics (aquaponics), local crafts.



PROBLEM ?	POOR SOLUTION ✗	DESIGN STRATEGY !	THESIS SOLUTION ✓
 <p><b>Oil Contaminated Land:</b> It percolates into the soil with attendant damage to surface water reservoirs. High occurrence of tree mortality, deformed growth, chlorosis and complete extinction of seaweeds like water lettuce, are the result.</p>		<p><b>Hydroponics;</b> grow plants in a soiless solution above the ground</p>	
 <p><b>Oil Contaminated Water:</b> The constant de-oxygenation results in asphyxiation of plankton, extinction of catfish and other native fish species, near extinction of crocodile and manatee populations, deformation of fish eggs, low hatching rate and tainted wild catch.</p>		<p><b>Dig Wells;</b> grow fish with water naturally cleaned at the aquifer.</p>	
 <p><b>Flood Re-contamination:</b> Contamination in the water is redeposited on the land during floods. It is this seasonal inundation that hinders several agrarian pursuits.</p>		<p><b>Floating Agriculture;</b> grow fish and veggies in water-tight troughs, capable of buoying above the water during floods.</p>	

## PRODUCTION IN POLLUTION

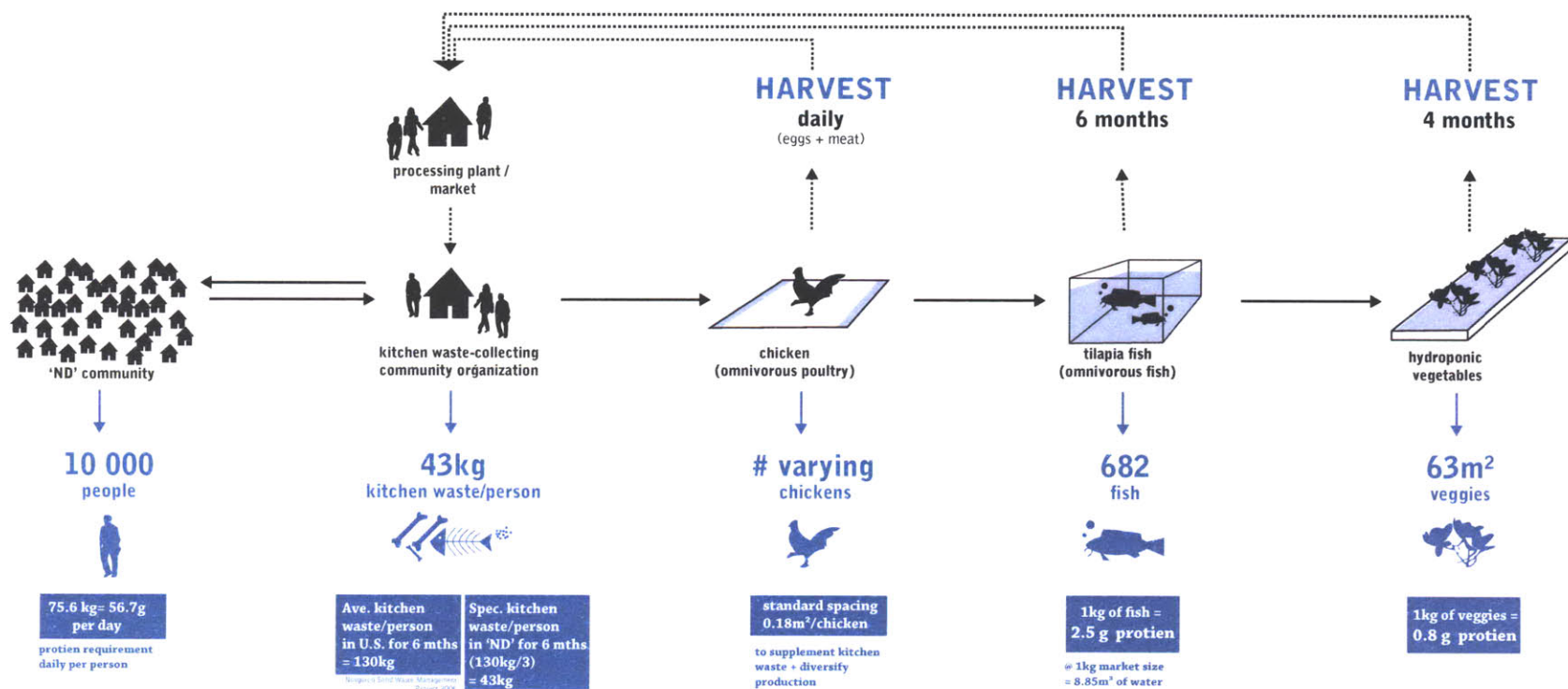
### Resilience Strategies:

Generations have gone by waiting for contamination remediation by oil companies. It is a costly herculean feat at best. The Maa-Bara will consider contamination as a the norm and work around it.

Initial schemes intended for each Maa-Bara to serve as mini-purifier (*shown on pgs 84-85*); channeling contaminate water into the

system, purifying, utilizing then expelling the water at a higher quality. "*Cleaning the Niger Delta waters one Maa-Bara at a time*". The contaminants proved to require more sophisticated treatment than mere "filtration beds" of gravel, sand and silt.

The final design scheme uses aquaponics (hydroponics and aquaculture), bore-hole wells to the aquifer and floating architecture of reverse-canoe construction techniques- *keeping water in, not out*.



### SUSTAINABLE NUTRIENT CYCLE Innovative Aquaponics:

The community produces an additional asset- kitchen waste. This output serves as input to fuel a new cycle of nutrients and profit. (explained in pgs 72-75)

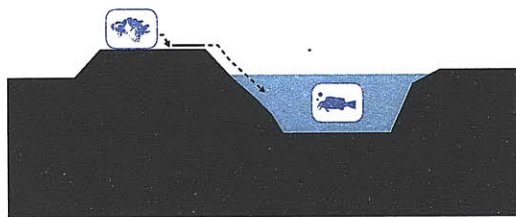
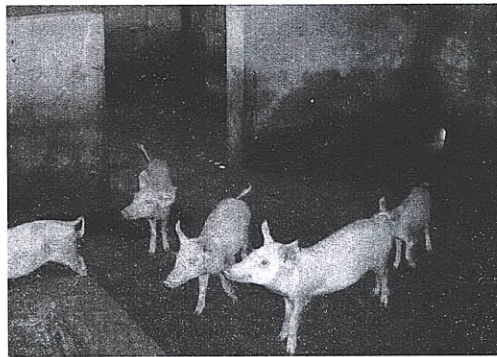
Kitchen waste generated (yam, plantain peels and animal bones etc. ) is collected and ground up by an community group/ business enterprise, using electricity provided by the oil company. This pelleted

waste serves as feed for tilapia and chickens. The chicken waste is mixed as additional feed for tilapia. Tilapia effluent; solids, nitrogenous and phosphorus waste- serve as manure and nutrients for the plants. This bio-filtration via hydroponics ensures water quality is suitable for re-circulation.

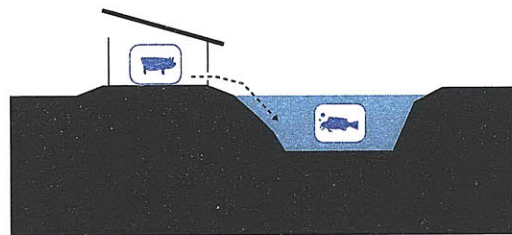
A Produce Processing Space for smoking/ drying fish, slaughtering chicken and bundling vegetables will add animal waste to the kitchen waste- all pelleted as feed.



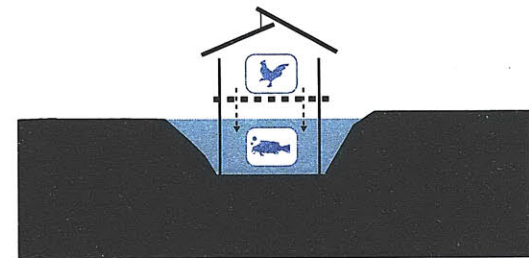
# AQUACULTURE (SMALL SCALE) AFRICAN REGIONAL AQUACULTURE CENTER (ARAC), PORT HARCOURT



**VEGGIES | FISH**



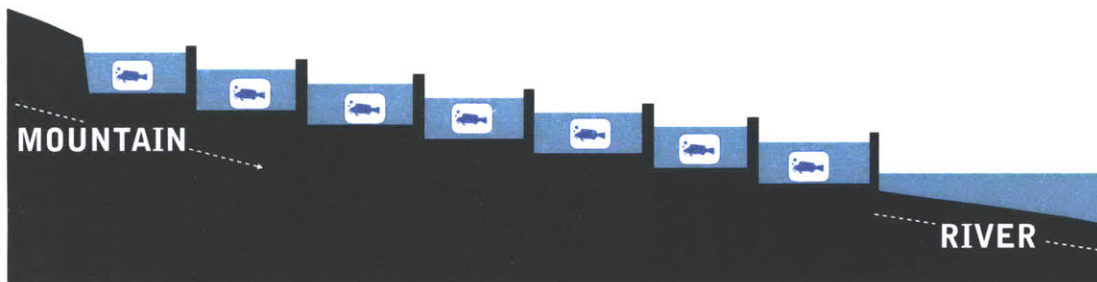
**PIGS | FISH**



**CHICKENS | FISH**



## AQUACULTURE (LARGE SCALE) IRIGAWA FISHERIES, JAPAN



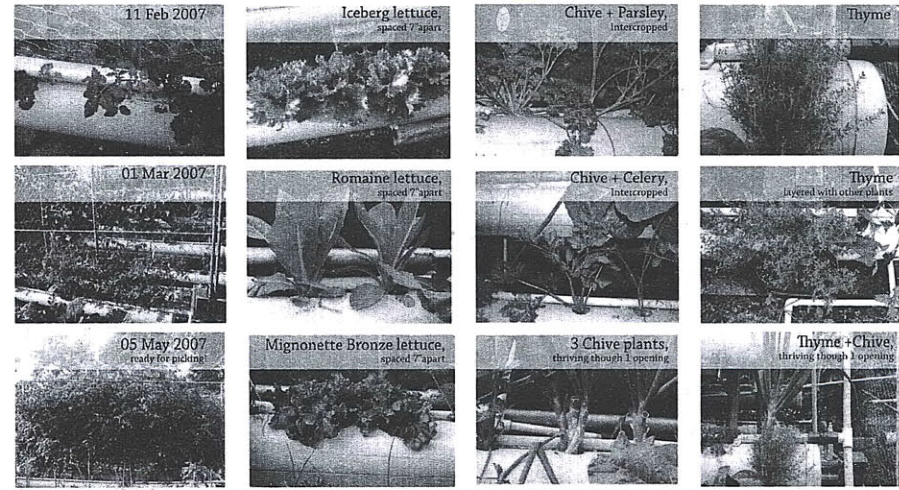
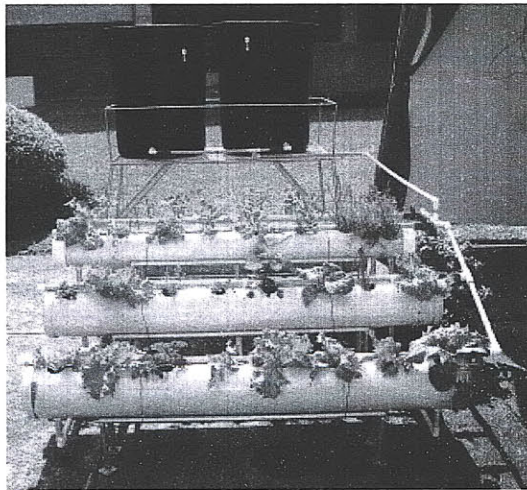
**AGGREGATED  
TROUGHS**

**GRAVITY DRIVEN WATER  
RE-CIRCULATORY SYSTEM**

### **Conclusions:**

- Tilapia will eat anything if it is in pelleted, ground-up form.
- Crops can serve as fish feed, but will catch a higher price if sold as food for people.
- Pigs will require a more robust structure for housing than chickens. Eventual scheme will not include pigs.
- Direct release of chicken waste as feed seems efficient, however, there is no opportunity to inspect chicken waste if sick poultry occurs.
- Aggregating troughs allows for maximized water usage. Earthwork may be required to achieve gravity flow effects.

# HYDROPONICS (SMALL SCALE) EZY GROW HYDROPONICS, TRINIDAD

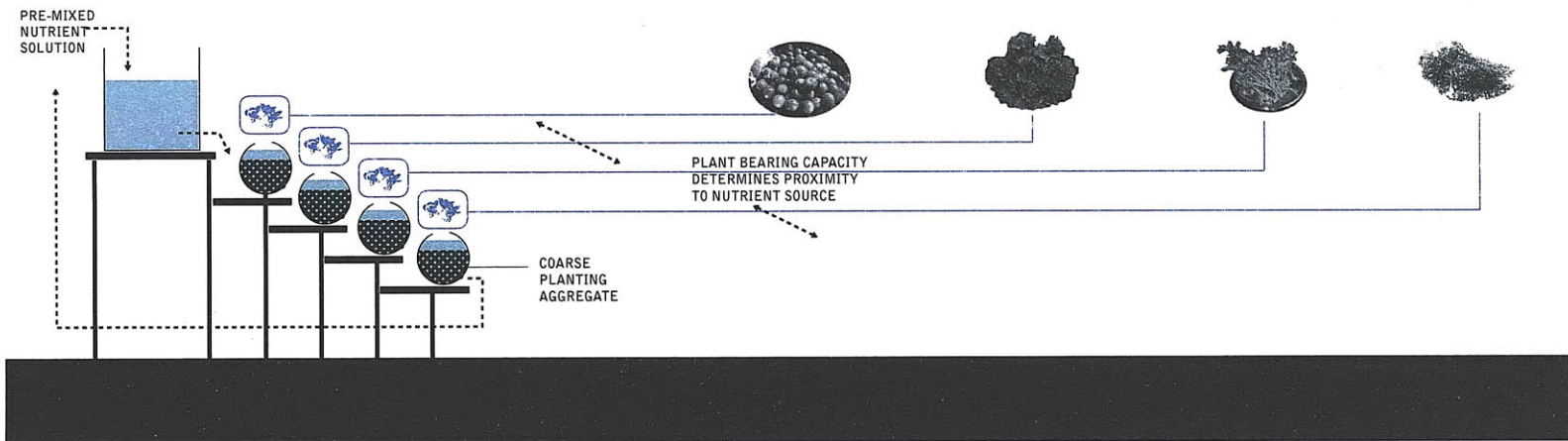


CHERRY TOMATOES

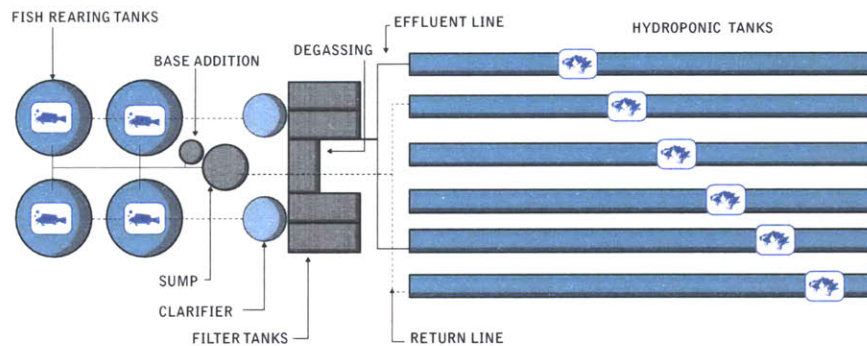
LETTUCE

CHIVE

THYME



# AQUAPONICS (LARGE SCALE) UNV. OF THE VIRGIN ISLANDS



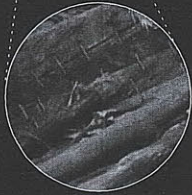
<b>TOTAL VOLUME</b> (4) 7.8 m <sup>3</sup> = 31.2 m <sup>3</sup>	<b>TOTAL FISH PRODUCTION</b> = 2 400 fish/ 6 months	<b>TOTAL AREA</b> (6) 37m <sup>2</sup> = 222 m <sup>2</sup>	<b>TOTAL VEGGIES PRODUCTION</b> = 6 400 lbs/ 6 months
---	--	--	--

### Conclusions:

- Gravity-driven system, reduces the need for extensive plumbing and pumping.
- Planting beds should be arranged type-specific such that fruit bearing plants like tomatoes are at the top and no-fruiting plants like thyme, at the bottom.
- For easy duplication and construction, the fish tanks should be modelled after the local canoe. Floated to the site, it will be filled with water and maintained as a canoe.

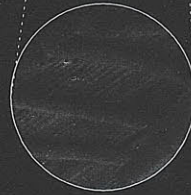


## LOCAL CRAFTS + TECHNOLOGIES:



### Canoe Crafting

Prolific canoe craftsmen are key to this economy with each family owning at least one canoe. Their technique for joinery and waterproofing can be adapted to serve in the construction of the Maa-Bara” Systems.



### Roof Thatching

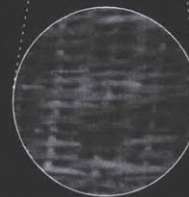
With its constant rainfall, roofing is crucial to living in the delta. The extensive use of rafia palm in thatching the roofs existing due their abundance near northernly in Bodo town and its environs. Considered in the housing for the poultry.





### Lumber Joinery

Proficient carpenters dwell on site. Lumber can be sourced from Bodo Town encouraging local industry. While carpenters can be employed to execute the major joinery tasks, the average fisherman can handle the bulk of other tasks.



### Mat-wall Weaving

Lightweight rafia walls provide shelter against the harsh winds. Sunlight filters through the translucent rafia fronds with different intensities, sculpting a unique interior experience that changes throughout the course of a day.



## MEMOIRS OF THE RIVER

Historically, industrial economies have been carried out through a corresponding means of water navigation. *"From Slaveships to Oil Tankers,"* by Ugo Nwokeji further describes this commodification of the Niger Delta region. In this trajectory, each vessel is a foreign construction- a harbinger of extraction. The fishing canoe, however, is of local construction methods and a symbol of local ingenuity and pride. This thesis has identified it as the basis for transport and the inspiration for building construction. It will serve as the fluid conduit for this new agrarian industry.





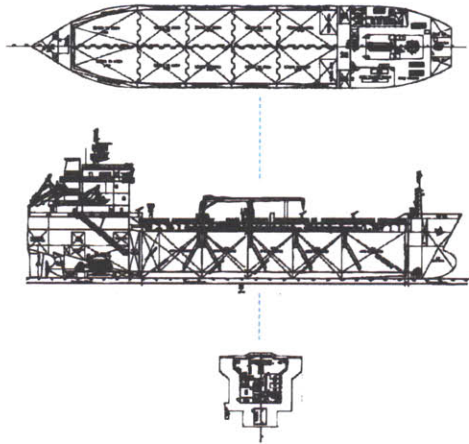
**pre 1700  
agricultural  
industry**

canoe



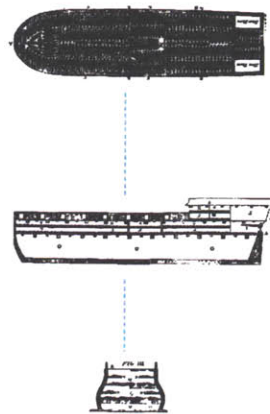
**1780 - 1891  
transatlantic  
slavetrade**

slaveship



**1986 - 2011-?  
petroleum  
industry**

oil tanker



**2011-?  
agricultural  
industry**

canoe







# DESIGN

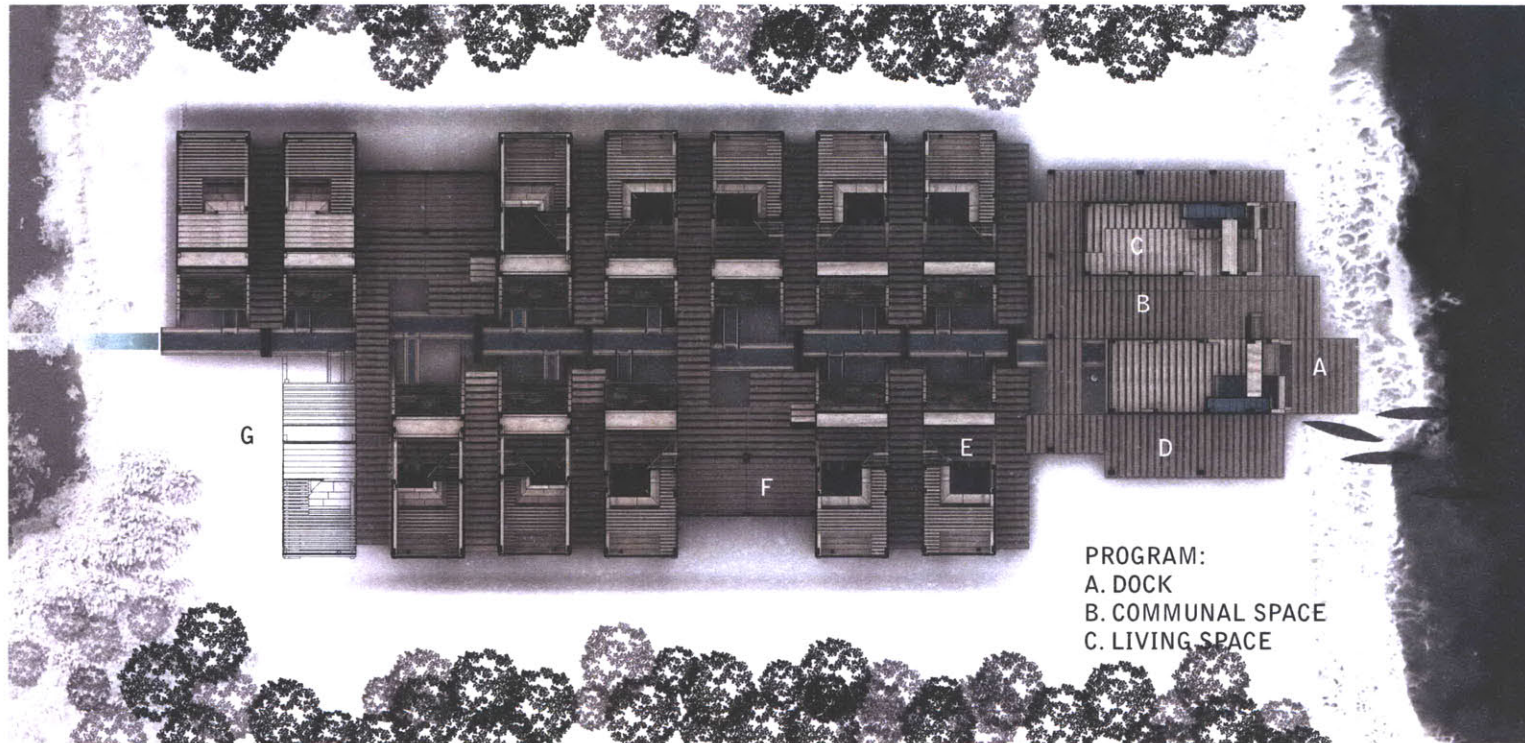
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**1. INTENT ARCHITECTURALIZED**

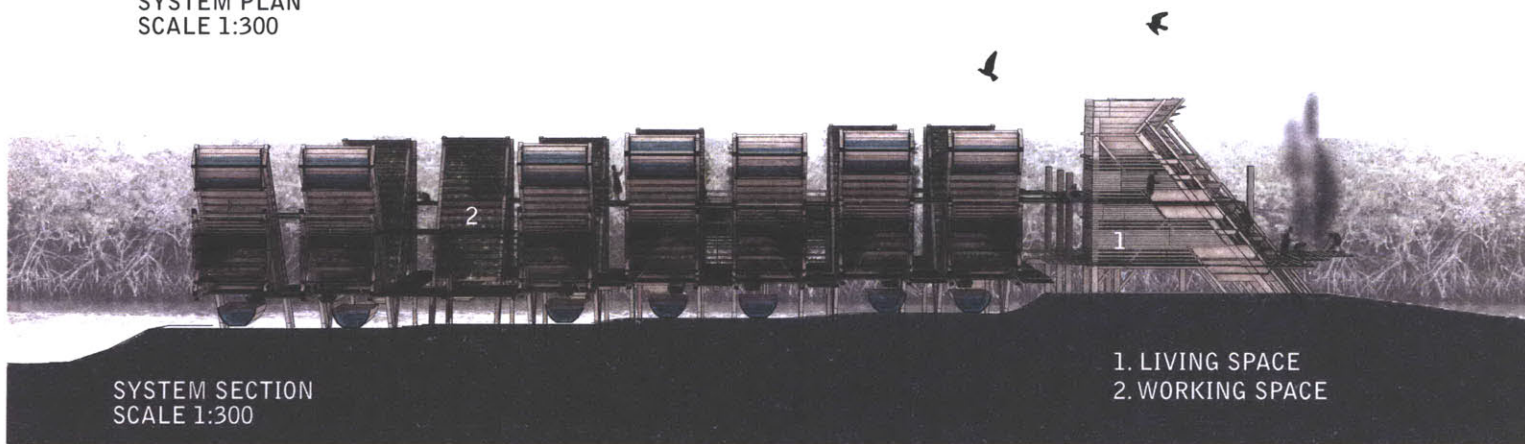
**2. DESIGN MODELS**

**3. ECONOMIC VIABILITY**

**4. SCALING-UP!**



SYSTEM PLAN  
 SCALE 1:300



SYSTEM SECTION  
 SCALE 1:300

# DESIGN

---

*“You must start right from the beginning, letting your new buildings grow from the daily lives of the people who will live in them, shaping the houses to the measures of the people’s songs”*

*Hassan Fathy*

## INTENT ARCHITECTURALIZED

### Design Parameters:

The design imperative was to

1. Create labor-intensive economic wealth-generators,
2. Easily assembled by local crafts-people
3. For a populace with an agricultural skill set (farming and fishing)
4. To be powered with electricity from the oil companies,
5. While maximizing the gas locally distributed
6. All amidst an ever-pervasive backdrop of oil contamination.

In a nutshell, that explains the Maa-Bara, translated “Water-farm,” from Ogoni language. Its realization required multi-disciplinary investigations to realize the inter-disciplinary goal. It embodies the

stakeholders’ mutual intentions, siting on the landscape previously used for only transhumance fishing operations.

Void of embellishment, spacial calisthenics or the aesthetic hedonism that *architecture* is recently known for, it strives for functional efficiency.

The Maa-Bara gracefully balances a plethora of design parameters, and emerges from the landscape with utilitarian simplicity.

## MAA-BARA PROTOTYPES:

### Working space:

Outfitted to optimize fish and crop production, this structure starts out individually and rapidly grows across the river levee.

### Living space:

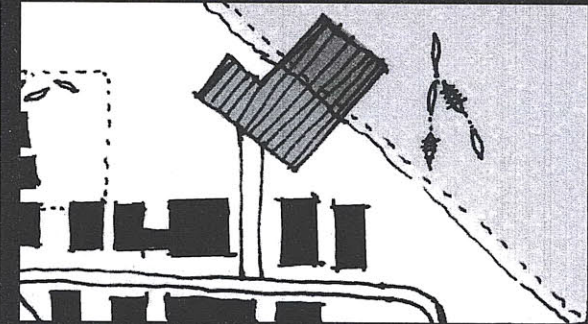
Equipped to support improved communal living conditions adjacent to the “*Work Space*.” It grows along the river levee and is designed to optimize rainwater capture for domestic activities. It also provides the platform for smoking/drying fish.



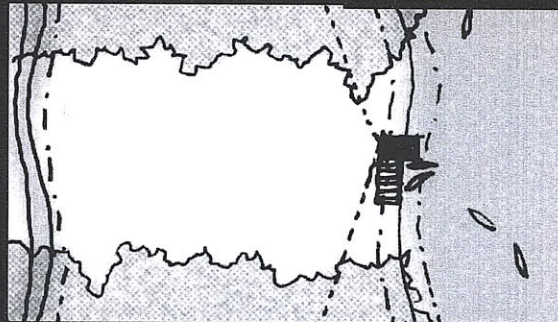
**INCREMENTAL GROWTH  
PIECE-MEAL APPROACH**



**01: COMPONENTS CRAFTED**



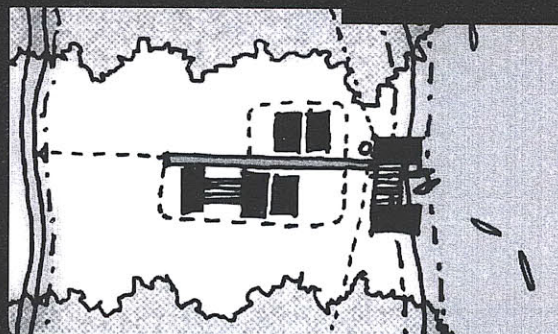
**02: WATER-RIVER TRANSPORT**



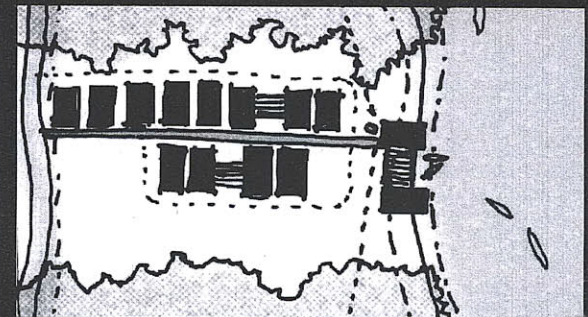
**06: ELECTRICITY CONNECTED**



**07: WATER WELL DRILLED**



**11: ADDITIONAL HOUSING +  
STORAGE**



**12: ADDITIONAL STRUCTURES**

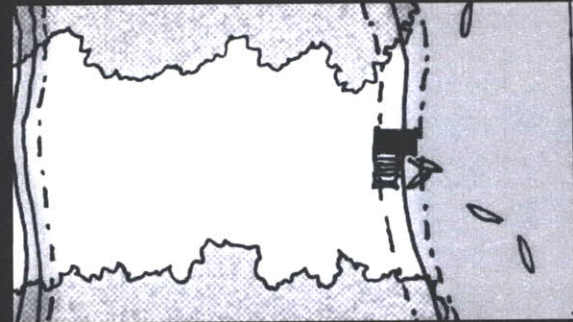




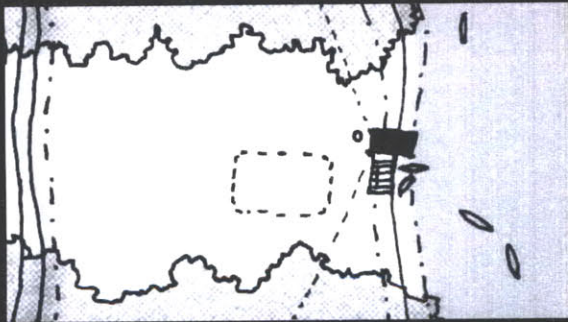
03: WATER-TIGHT TEST TO SITE



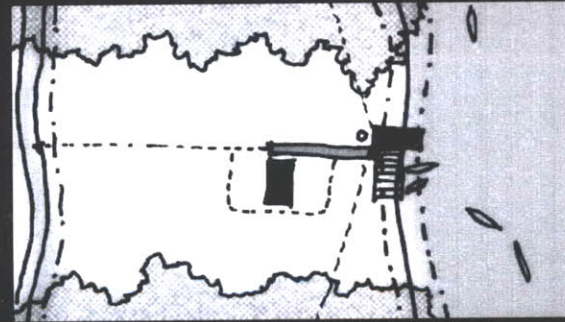
04: NATURAL SANDBAR LOCATED



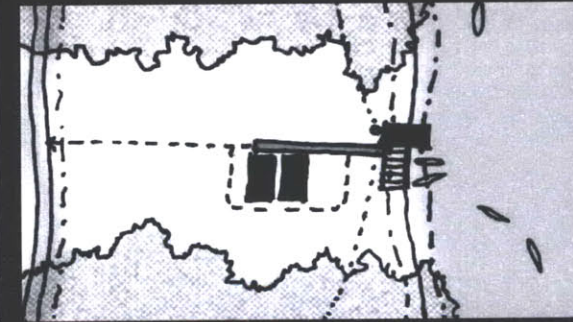
05: HOUSING ERECTED



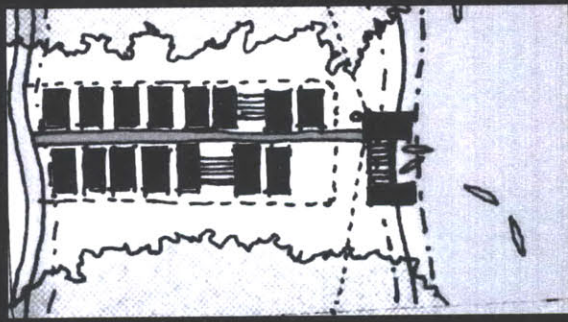
08: EARTH DISPLACED



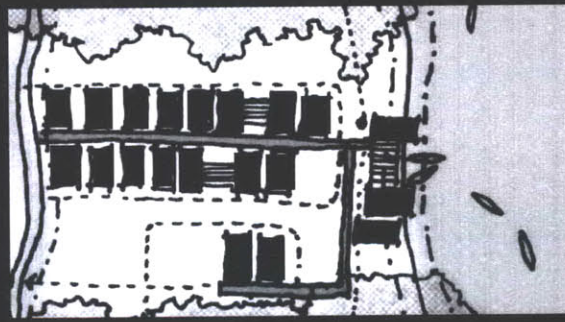
09: "MABARA #1" CONSTRUCTED



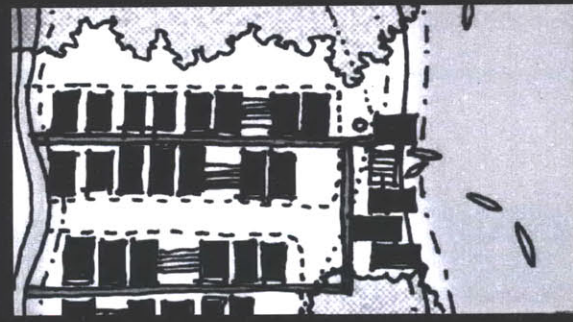
10: "MABARA #2" CONSTRUCTED



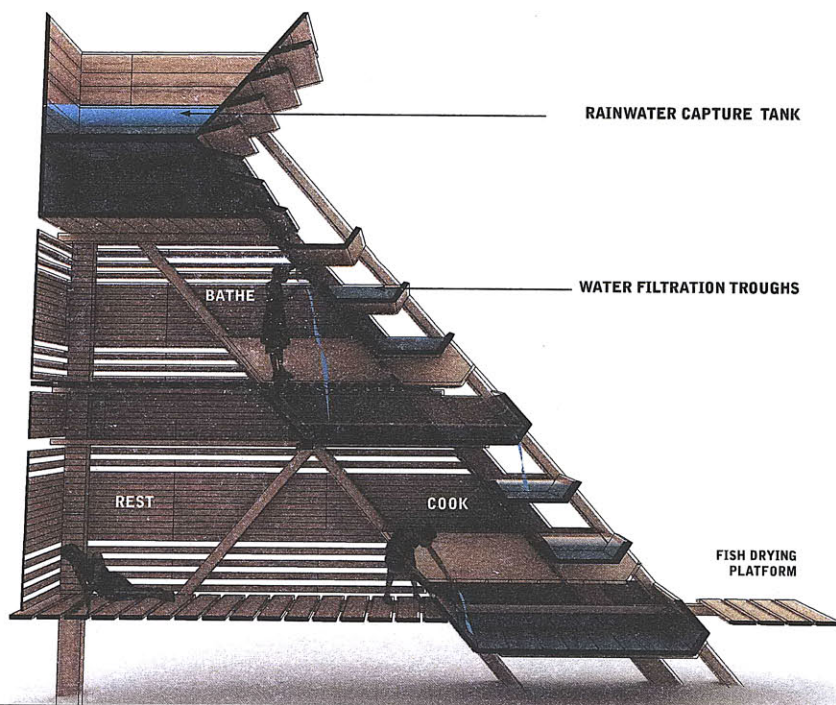
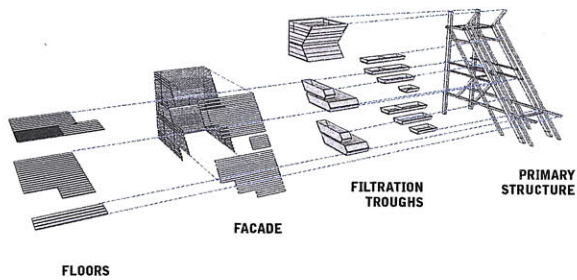
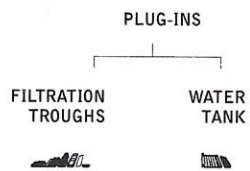
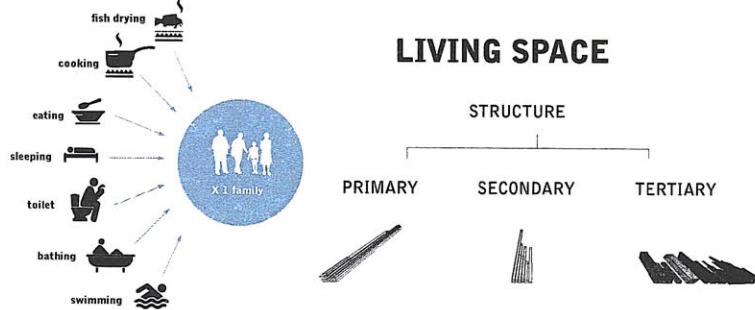
13: LEVEE CAPACITY OPTIMIZED



14: ADJACENT PLOT AQUIRED +  
ADDITIONAL HOUSING



15: NEW SITE SOUGHT FOR FURTHER  
EXPANSION



EXPLODED AXONOMETRIC OF COMPONENTS

MAA BARA: LIVING SPACE

SCALE 1: 150



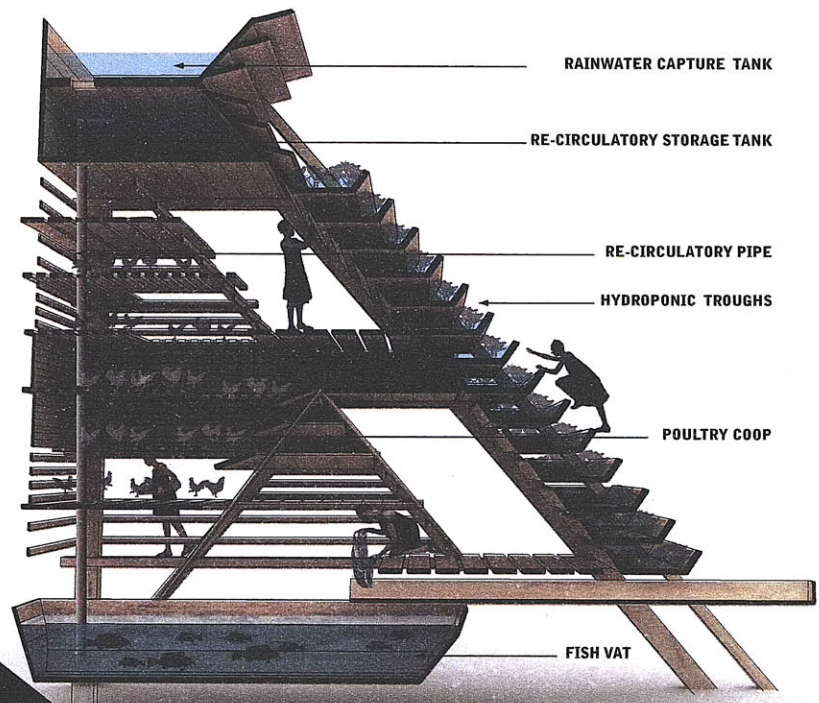
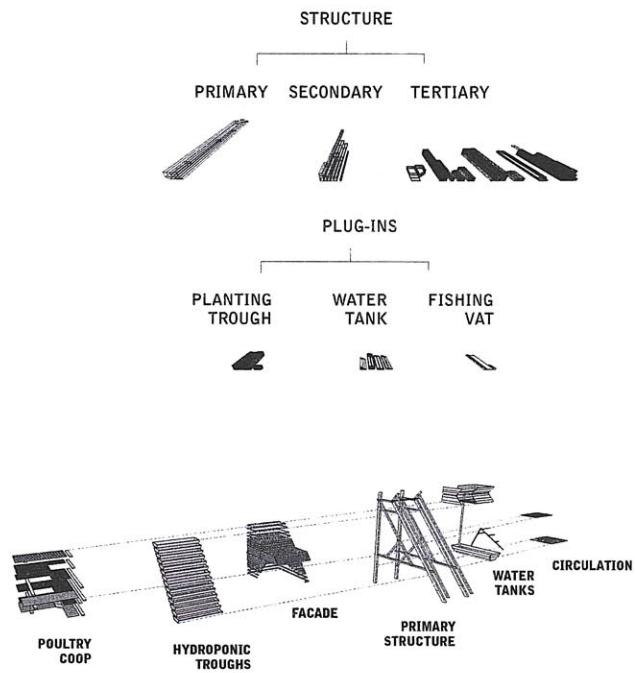
LIVING-SPACE VISION



Image compiled by: Maryam Eskandari



# WORKING SPACE



MAA BARA: WORKING SPACE

SCALE 1: 150

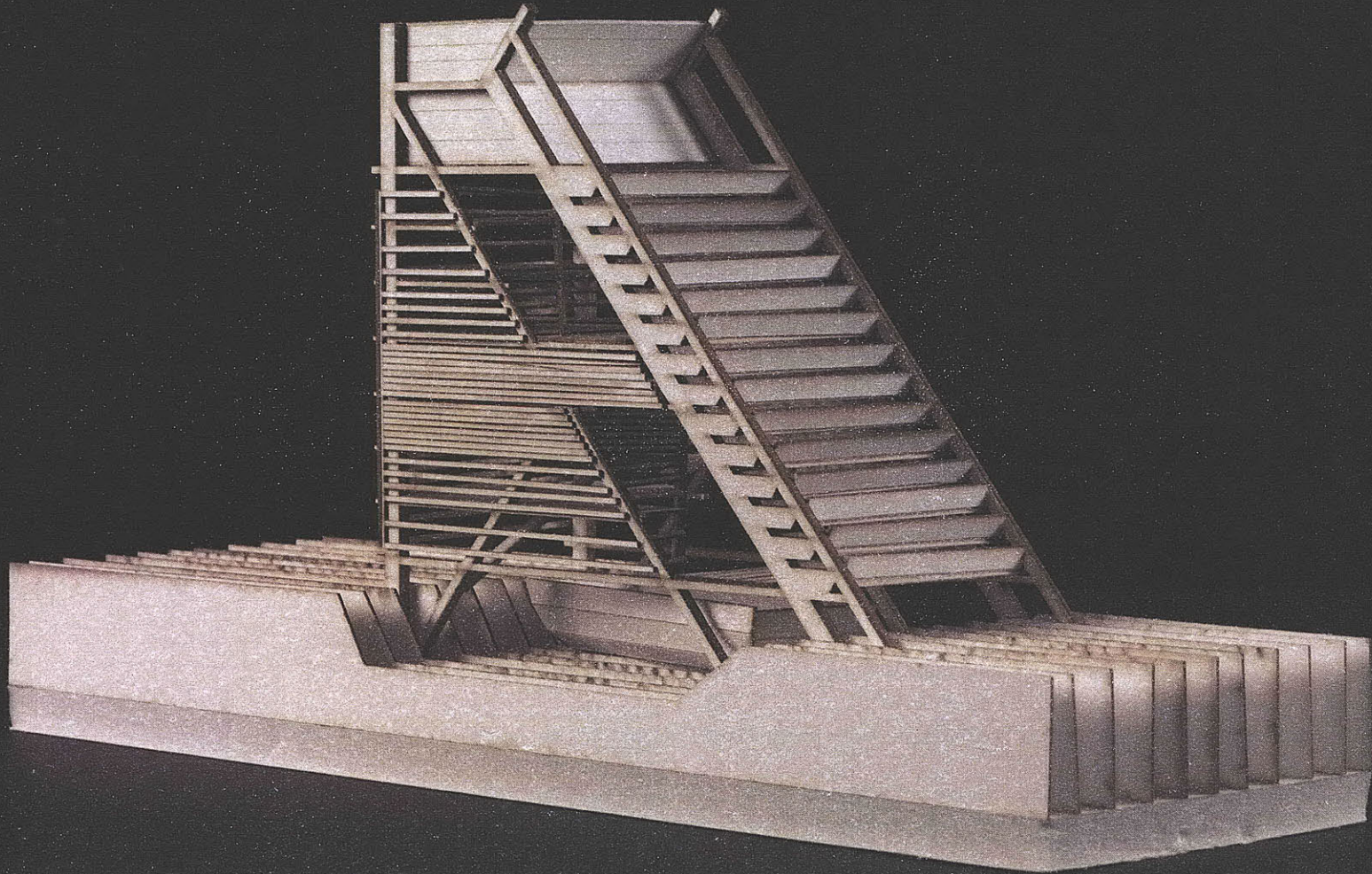
WORKING SPACE VISION



Image compiled by: Daniel Dacu

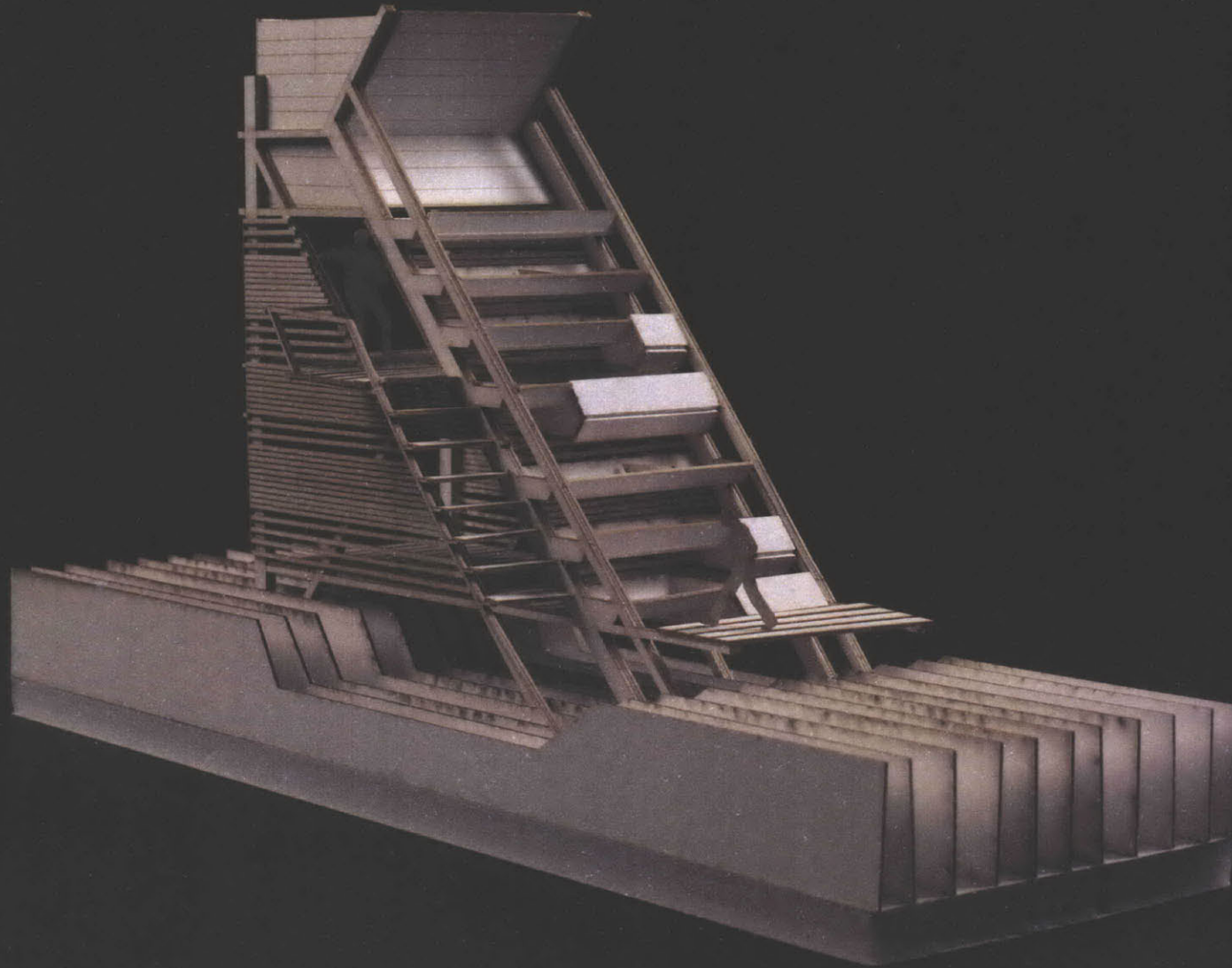


DESIGN MODELS



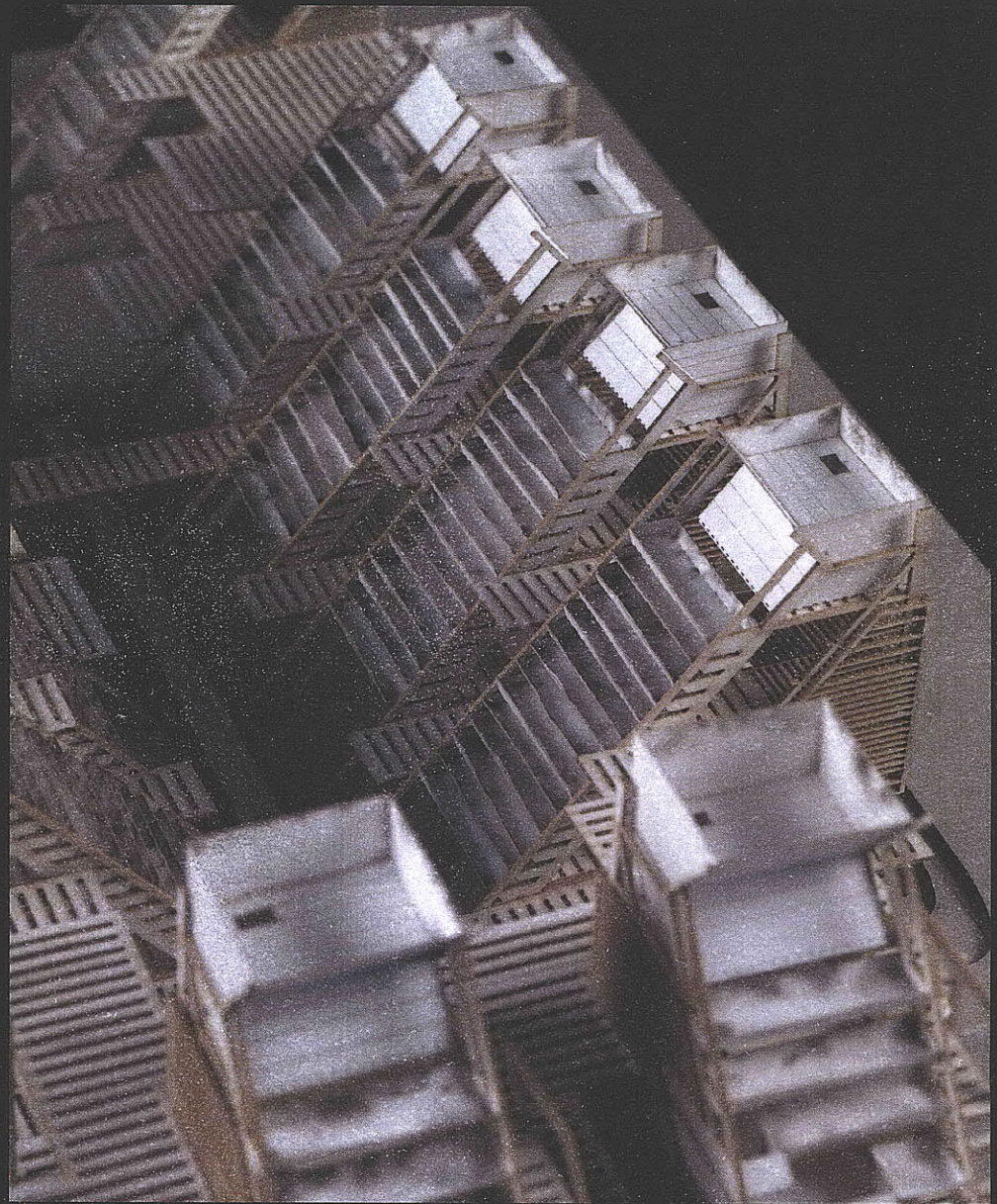
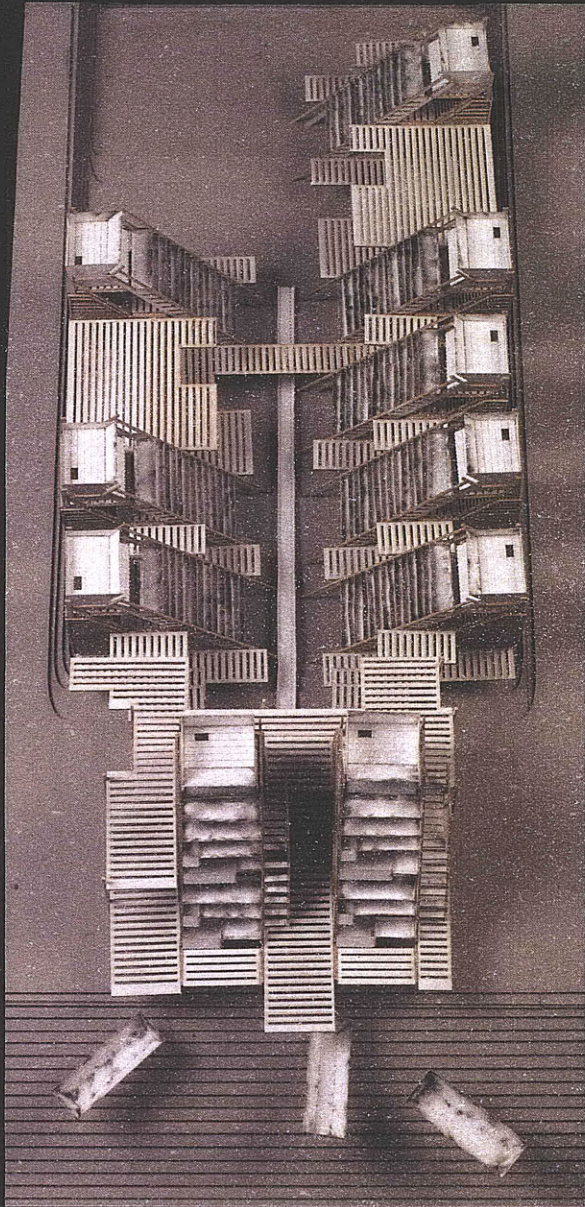
MAA-BARA WORKING SPACE





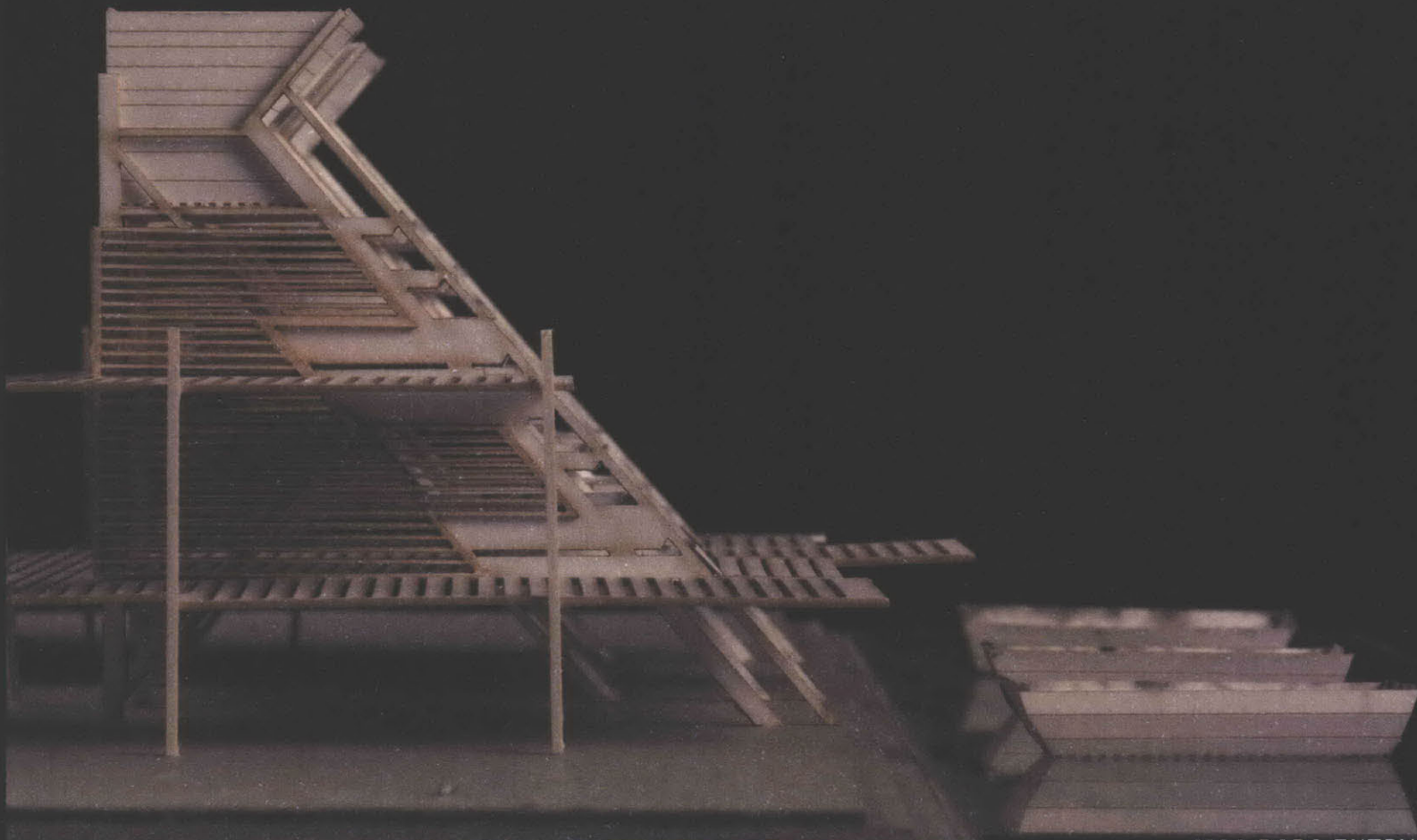
MAA-BARA LIVING SPACE





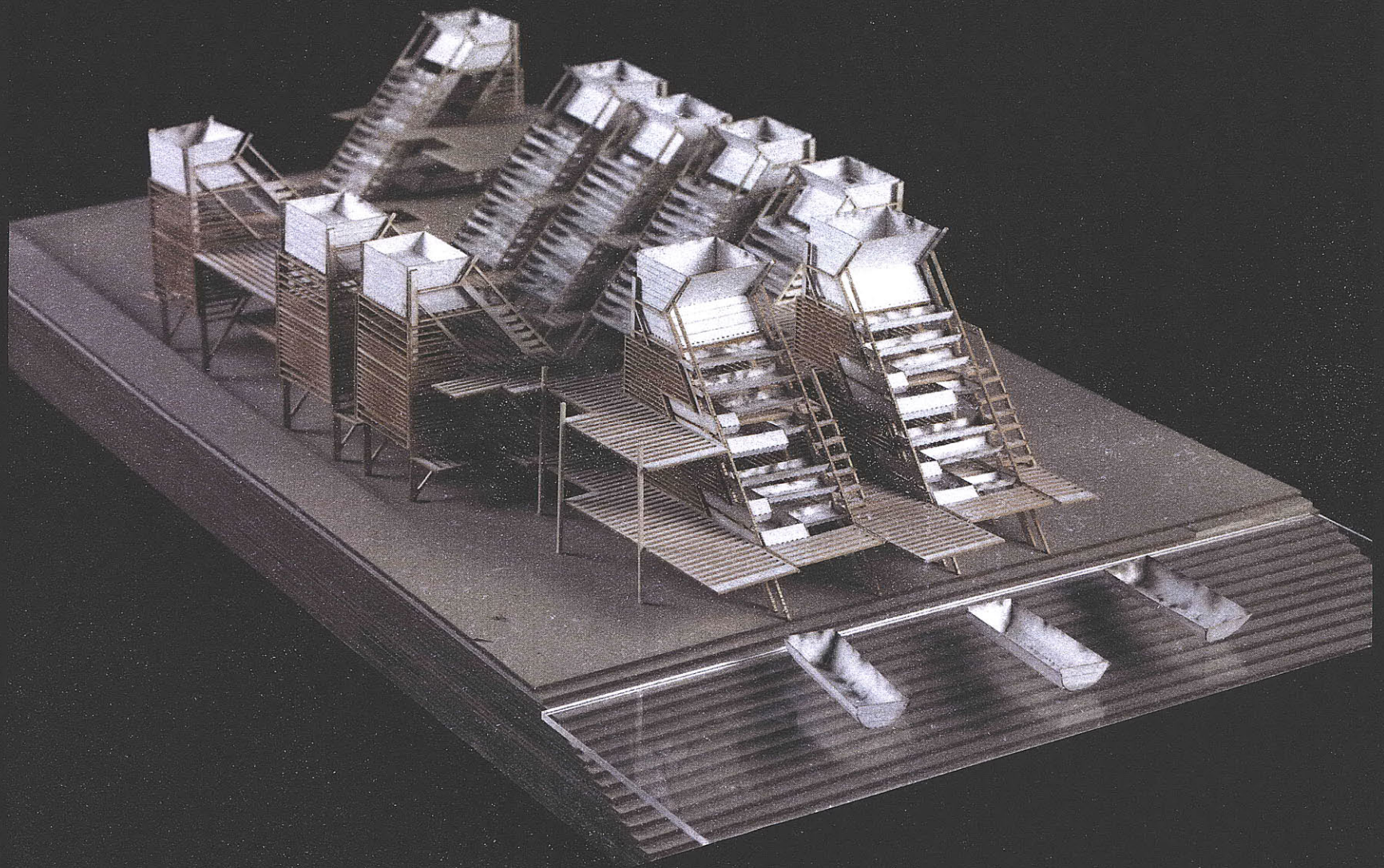
MAA-BARA AGGREGATED SYSTEM





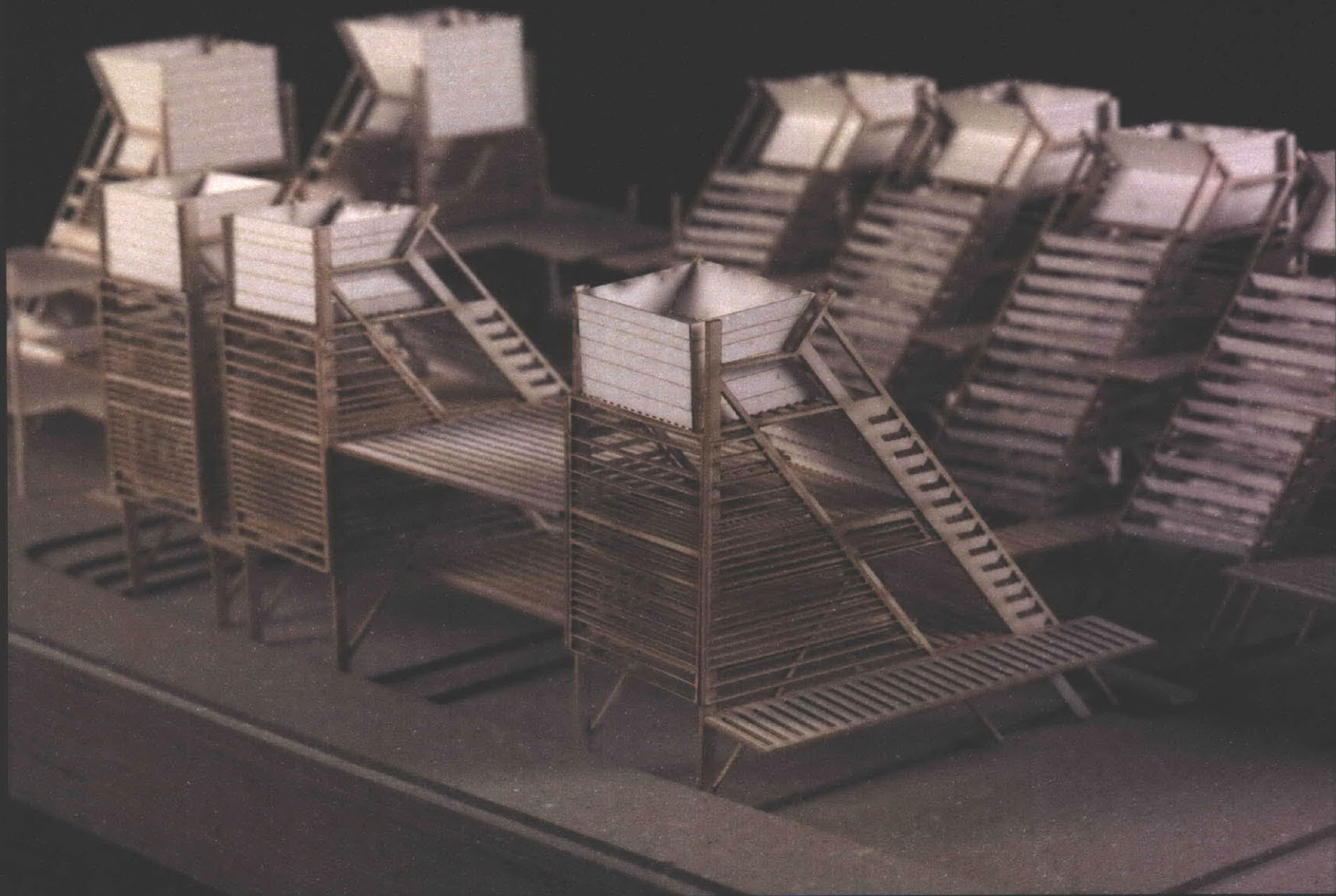
MAA-BARA ENTRY DOCK





MAA-BARA SYSTEM





MAA-BARA SYSTEM

Average UK household food waste= 120kg/ 6 months

Source: thefoodwewaste.org (2008)

**THESIS ASSUMPTION:**

Niger Delta household kitchen waste=

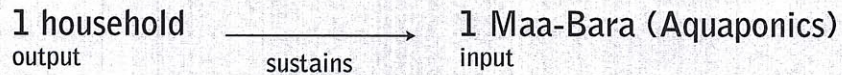
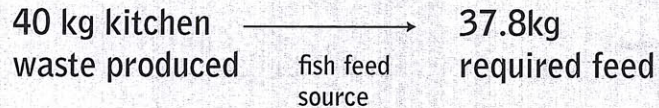
(1/3)UK household waste=

40 kg

**TILAPIA CAN FEED ON KITCHEN WASTE!**

"Omnivorous- tilapia will eat anything, if it is grounded."

Explained during field research with Dr. Deekae  
-Head of Fisheries Dept., RSUST Port Harcourt



**EVERY FAMILY CAN **ALREADY** SUPPORT A MAA-BARA!**

Remember:

Each Maa-Bara is sized to house poultry-tilapia also feed from chicken waste...

**POULTRY WASTE WILL SUPPLEMENT FISH FEED!**

For efficient scaling up, after initial structure, poultry coop will be sized to produce enough waste/ food to sustain fish.

*I might try it if it brings me money...*

actual response from fishermen, July 2010





# DESIGN

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*“Only a sack that is empty, like an empty stomach, cannot stand up on its own.”*

*- Aly Diallo*

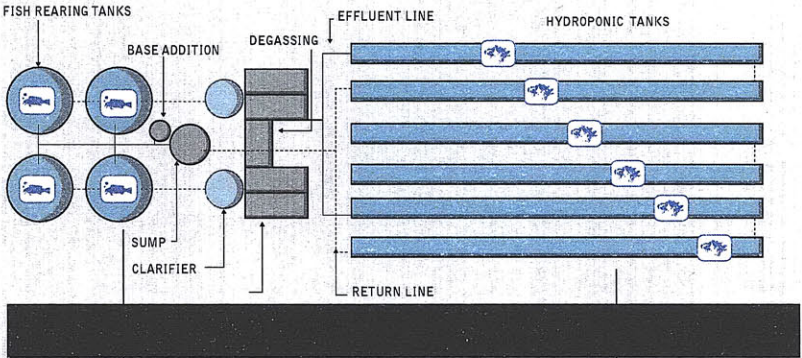
## **ECONOMIC VIABILITY**

Based off the University of The Virgin Islands (UVI) methods of operation and financial return, the Maa-Bara proves to be a wealth-generating infrastructure.

After 6 months, projected earnings from the construction of one is 341,000 Naira (\$3,410 approx.) and subsequent structures multiply financial gain. It seems highly unlikely that the owner of a Maa-Bara is counted among those “living under \$1 a day,” instead he/she becomes an employer of labor.

Operational and financial information are explained, but serve only as estimates, because when dealing with natural elements absolutes are foolhardy.

# UVI AQUAPONICS MODEL



design for  
 $31.2m (100) =$   
 $3,120 g$  of feed

**Fish food**

100 g/m<sup>2</sup> of plant area  
 (rule of thumb)

Mature fish weight=  
 0.5 kg

1 fish requires=  
 8.75 g

2,400 fish require=  
 21,000 g/day (approx.)

**Fish tank: Nile tilapia**

Volume = 31.2 m<sup>3</sup>

Fish stocking density=  
 77 fish/m<sup>3</sup>

Fish quantity=  
 2,400 fish/ 6 months  
 (approx.)

Fish financial returns=  
 \$12,018/ 6 months

**Hydroponic bed: basil + okra**

Area = 222 m<sup>2</sup>

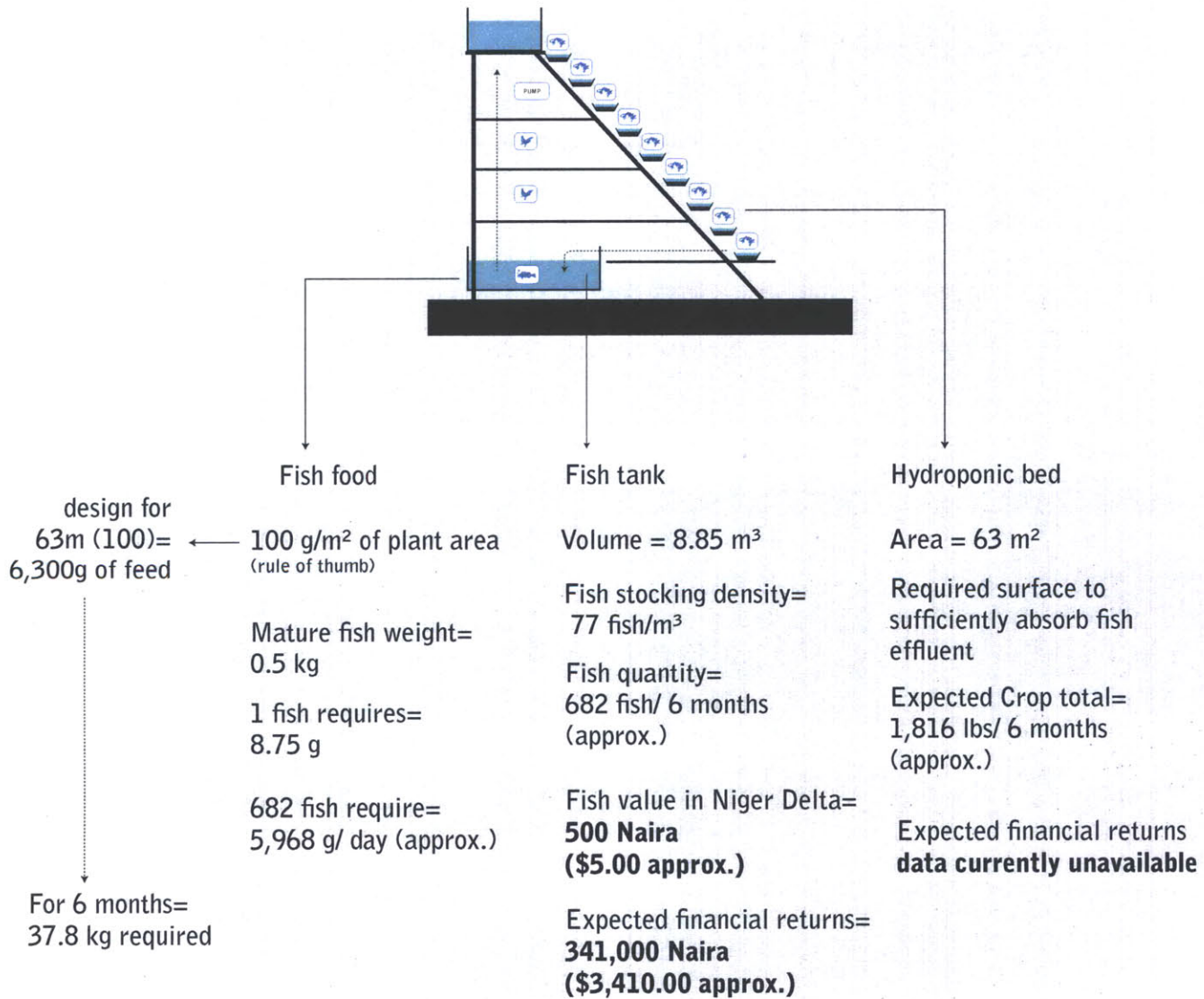
Required surface to  
 sufficiently absorb fish  
 effluent

Crop total=  
 6,400 lbs./ 6 months

Crop financial returns=  
 \$55,105/ 6 months

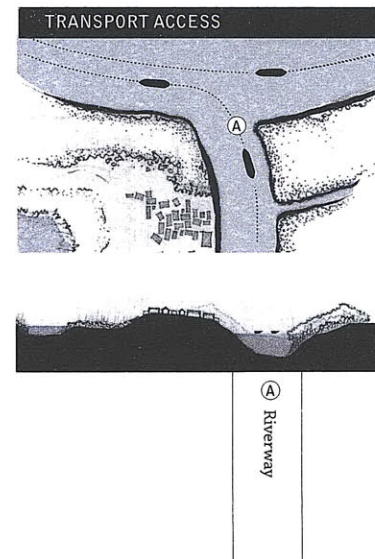
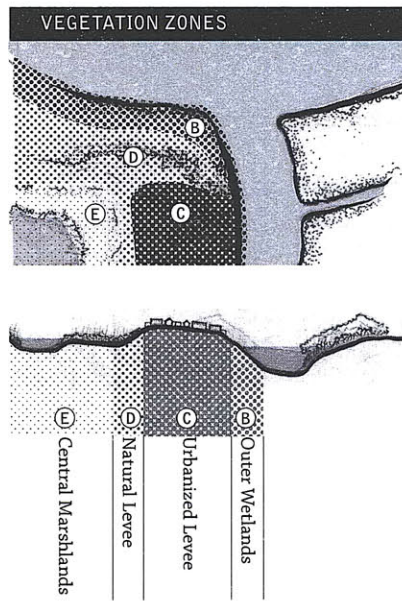
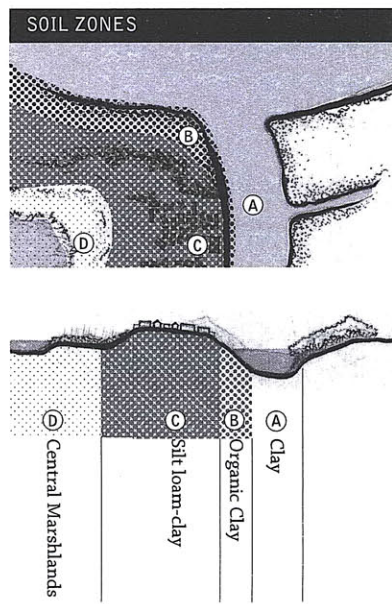
Source: "Aquaponics—Integration of Hydroponics with Aquaculture." ATTRA—  
 National Sustainable Agriculture Information Service- Publication (2006)

# MAA-BARA AQUAPONICS MODEL





**Deltaic Analysis:**



PLAN ANALYSIS

SECTION ANALYSIS

# DESIGN

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*“The priority for the great majority of my compatriots, and indeed for every human being, is to be healthy, to be able to eat one’s fill, to work and to sleep peacefully at home.”*

*Aly Diallo*

## **SCALING-UP!**

The ability of a system to gracefully cope with increased scope of workload while maintaining or even increasing performance level is scalability<sup>1</sup>.

The designer, Diego Parrilla once suggested a scalable architecture to be:

- 1) almost linear
- 2) cheap
- 3) based on clonable components
- 4) transparent to the user
- 5) transparent to the assembler
- 6) self-scaling
- 7) self-healing
- 8) self-balanced

The Maa-Bara is scalable. Strategically replicating the system required:

## **Deltaic Analysis:**

It is based on the existing layout of the fishing settlement. The local precedent ensures a sustainable siting within the deltaic landscape.

## **Settlement Scale Projections:**

Comparable to the original fishing settlement in scale, this works with prescribed zones to aid siting Maa-Bara systems. The configurations lay along the river for easy access by canoe. Additional social amenities; markets, learning centers, gas canister depots etc are also located as supporting infrastructure.

## **Regional Scale Projections:**

This scale encompasses the broader Niger Delta region and indicates locations with characteristics favorable for the implementation of the Settlement Scale layout.

*Note; at the Regional Scale roadways are included as the transport medium between stakeholders.*



## PRODUCTION ZONES

### PRODUCTIVE LEVEE ZONE

Typically mangrove covered, is most readily accessible by canoe. Sensitive placement of Maa Bara to coexist with mangroves for:

- Biodiversity maintenance
- Coastal protection

### CONVERSION (DEVELOPABLE) ZONE

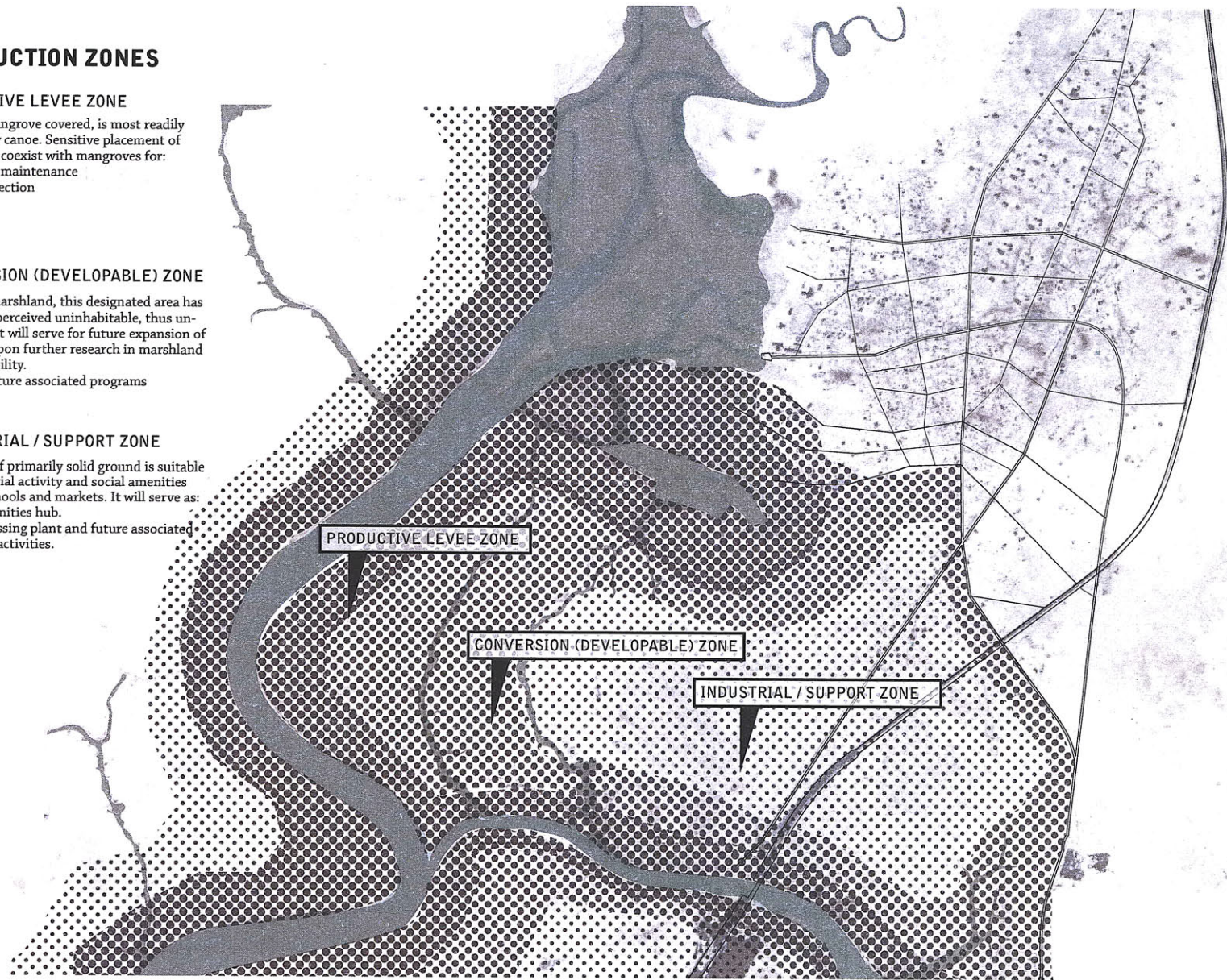
Primarily marshland, this designated area has since been perceived uninhabitable, thus unprofitable. It will serve for future expansion of Maa Bara upon further research in marshland constructability.

- Locating future associated programs

### INDUSTRIAL / SUPPORT ZONE

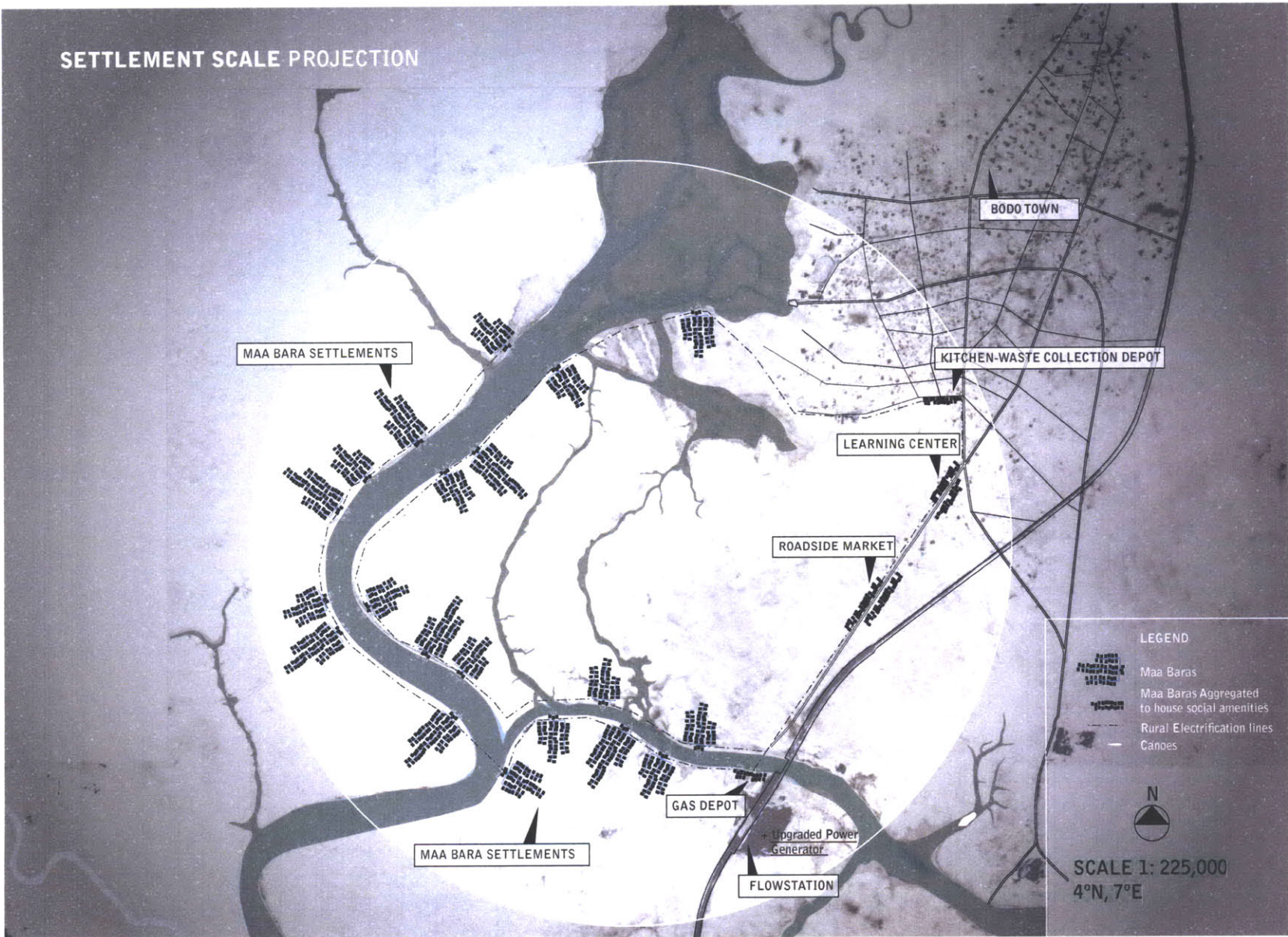
This area of primarily solid ground is suitable for industrial activity and social amenities such as schools and markets. It will serve as:

- Social amenities hub.
- Fish processing plant and future associated industrial activities.





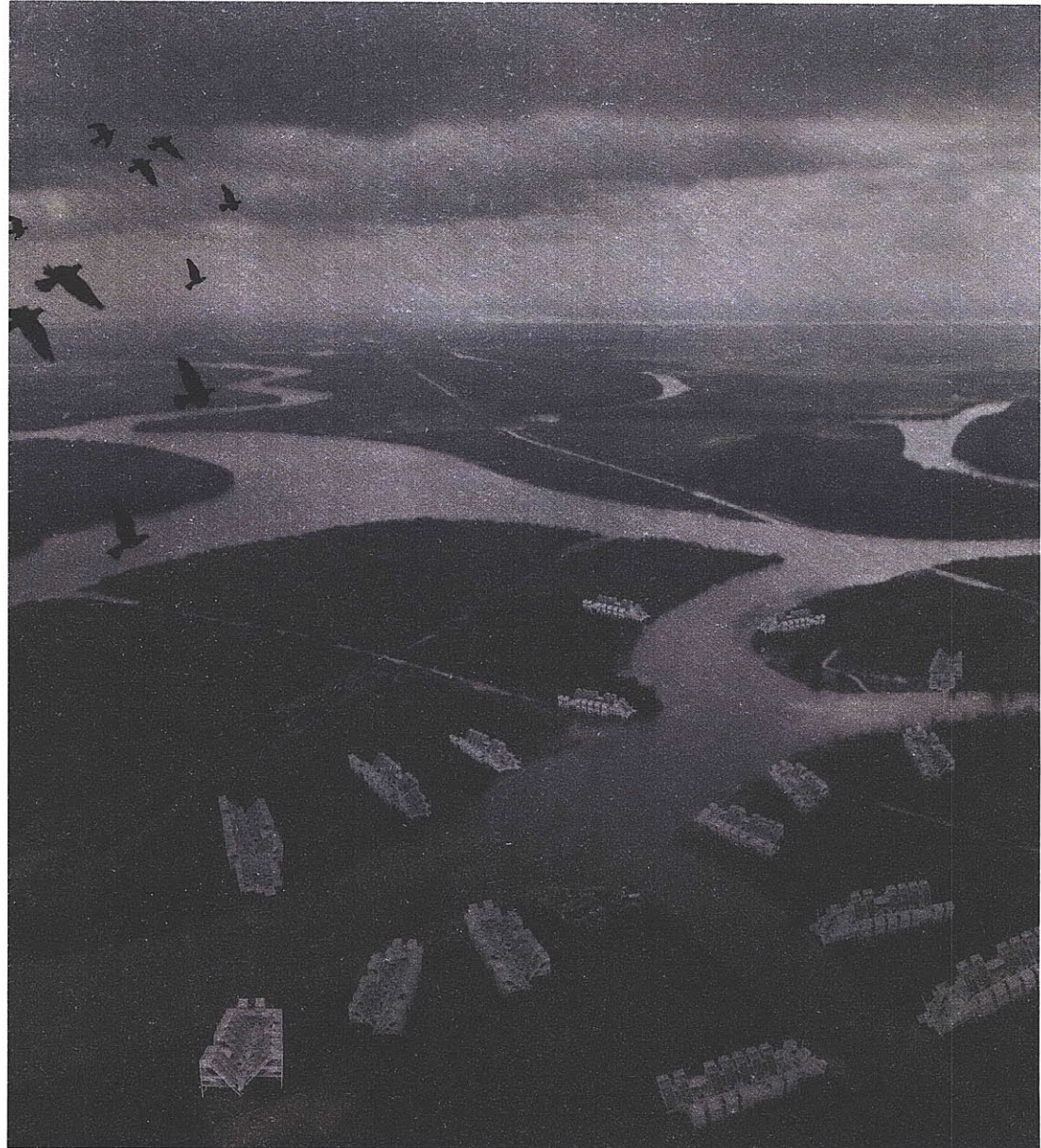
# SETTLEMENT SCALE PROJECTION





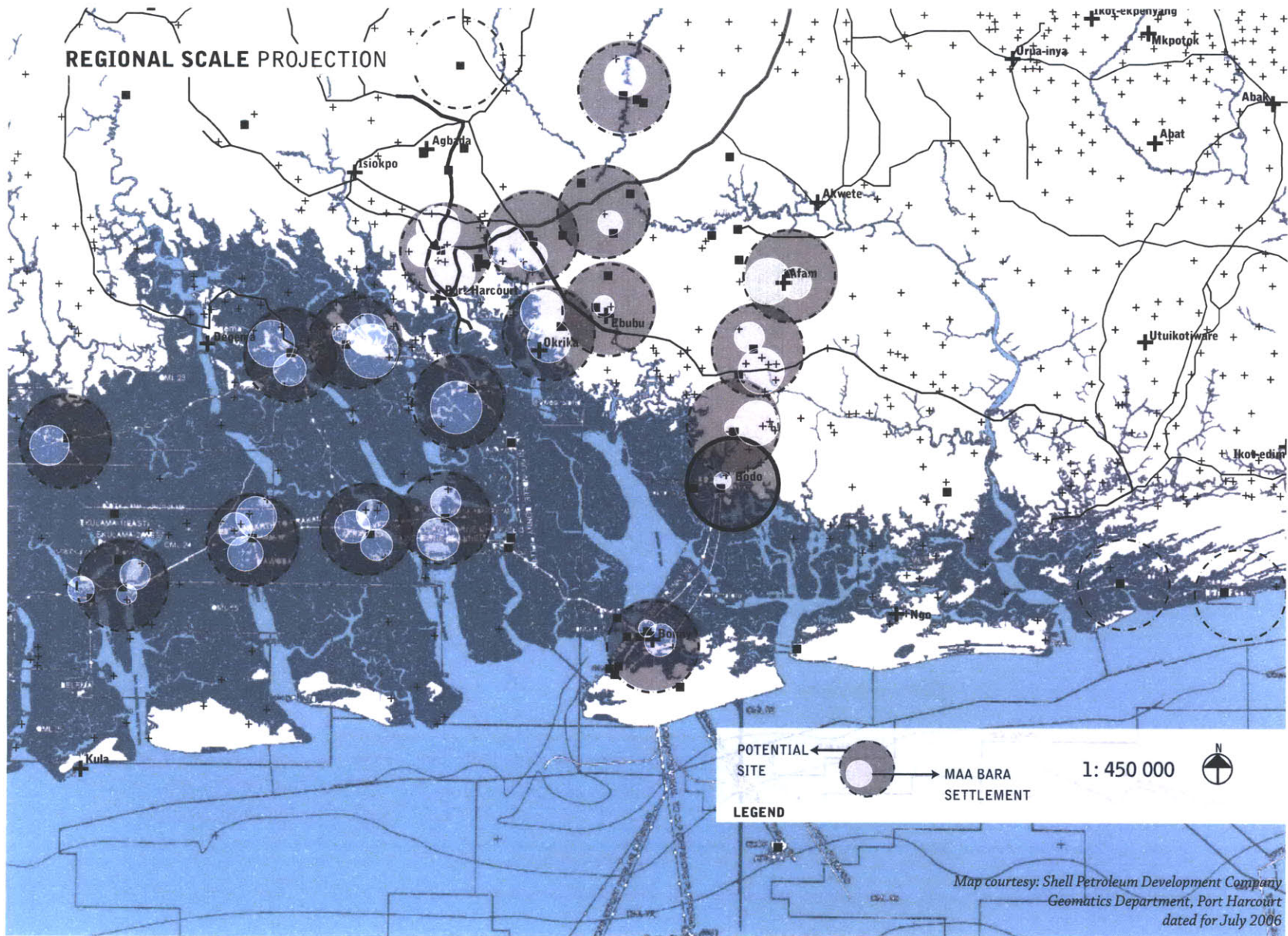
**Envisioned Deltaic Landscape:**

This pairing of Maa-Bara and mangroves helps to curb erosion. It will also foster a new local ecology around the footings where structure meets nature.



*Base image courtesy Ed Kashi's, "Curse of the Black Gold."*









# **ADDENDUM**

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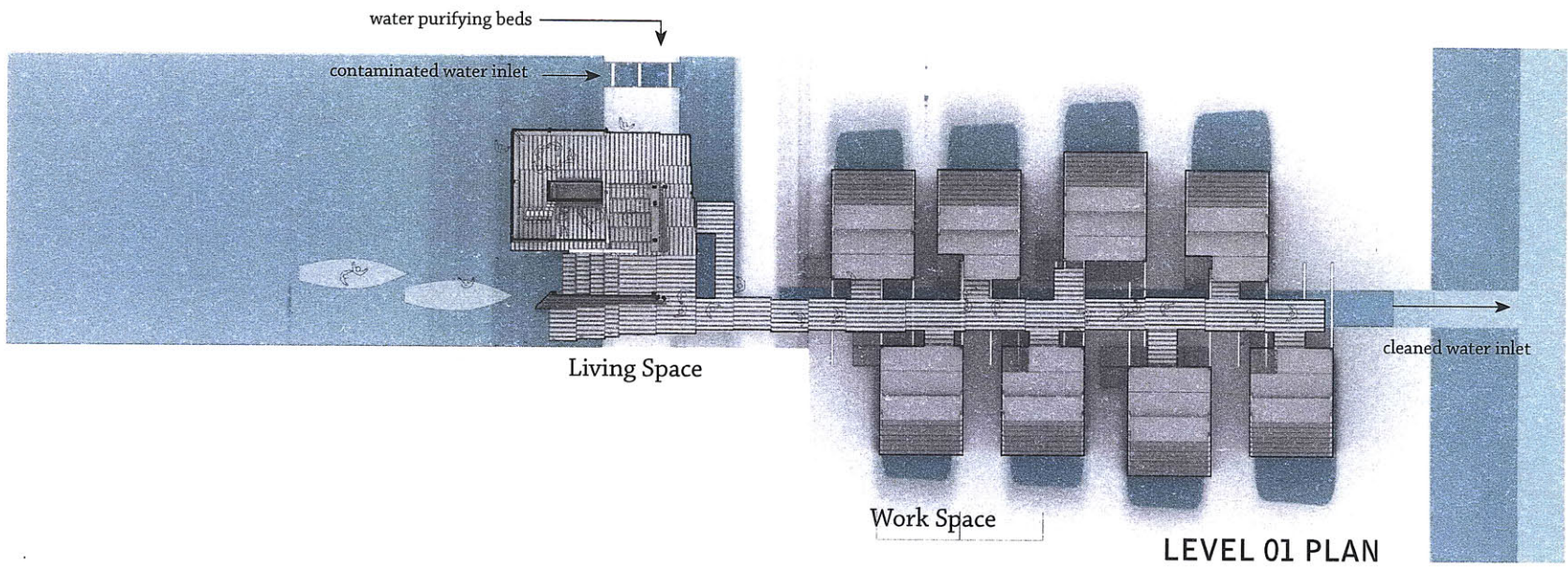
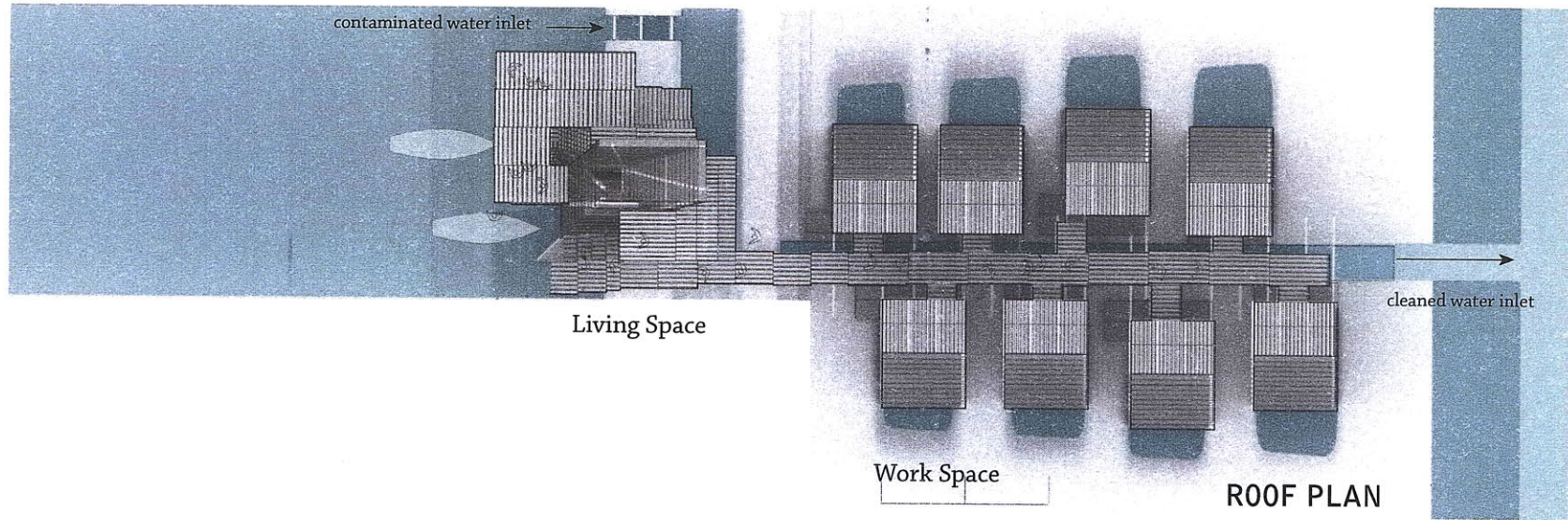
**1. PREVIOUS DESIGN SCHEME**

**2. PROCESS SKETCHES**

**3. RESEARCH-TRIP IMAGERY**

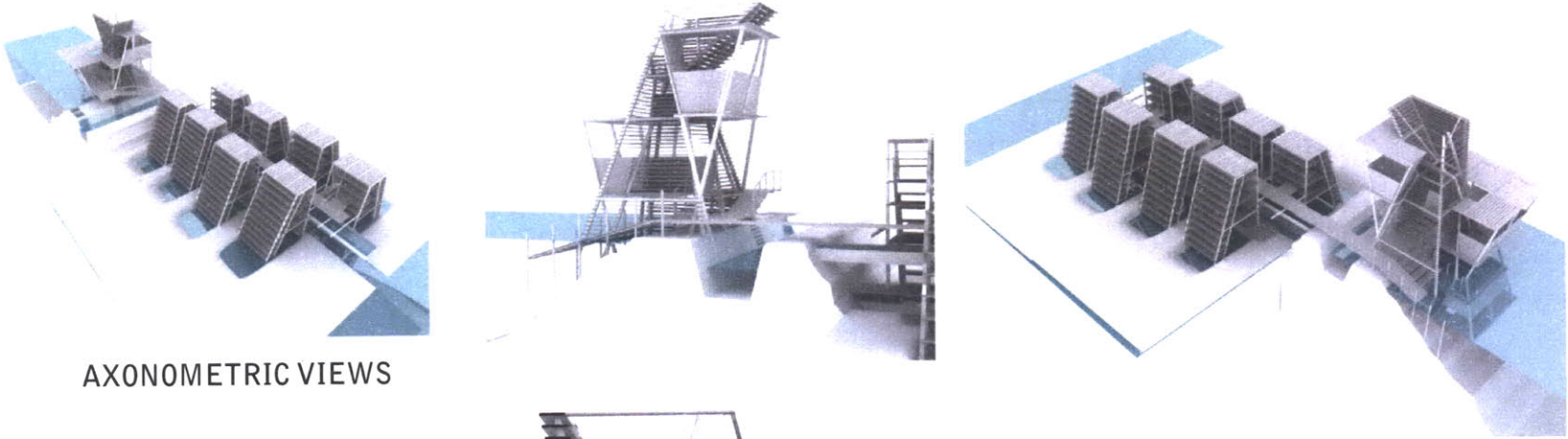
**4. BIBLIOGRAPHY**

**PREVIOUS DESIGN SCHEME (MID SEMESTER)**

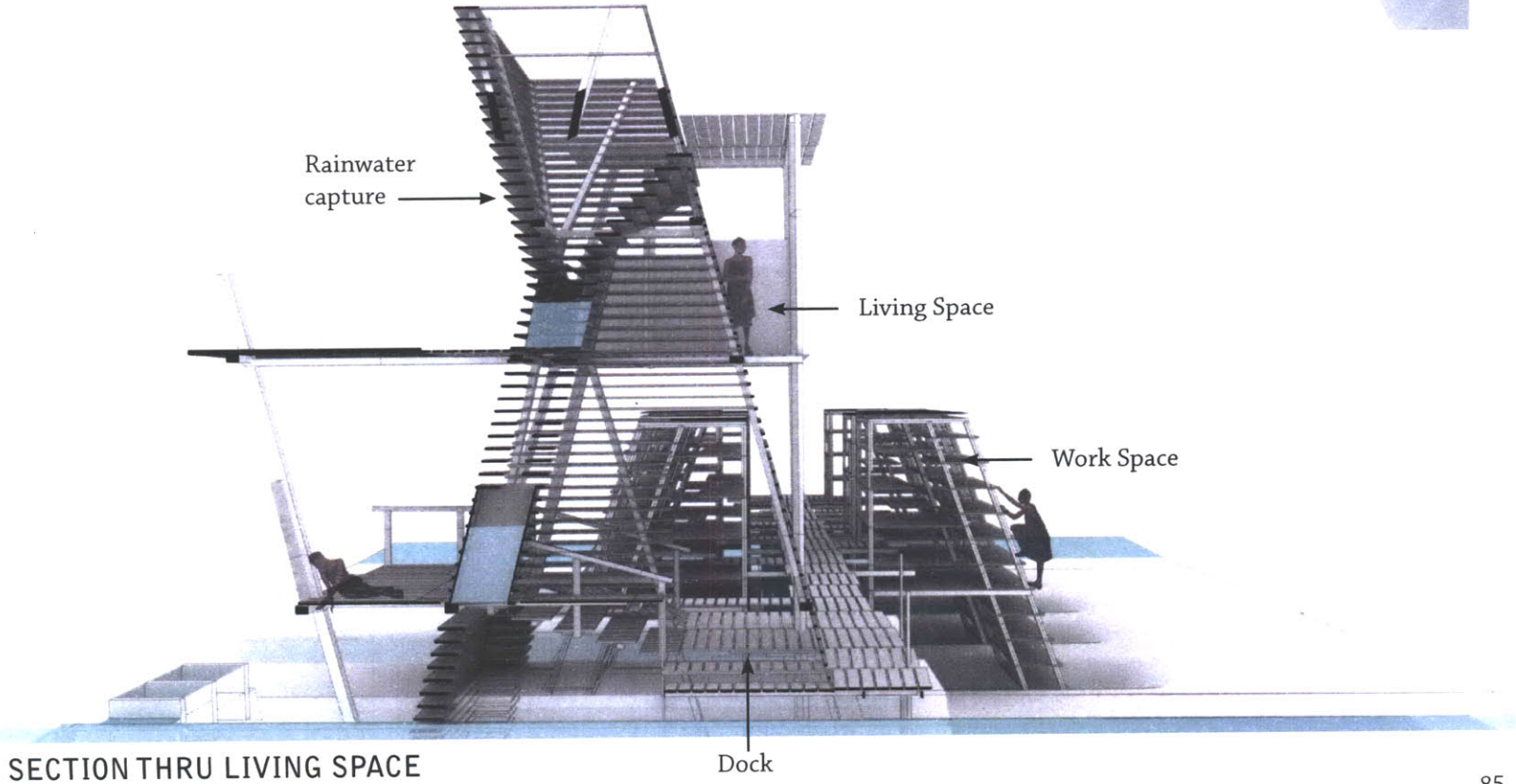




**PREVIOUS DESIGN SCHEME (MID SEMESTER)**



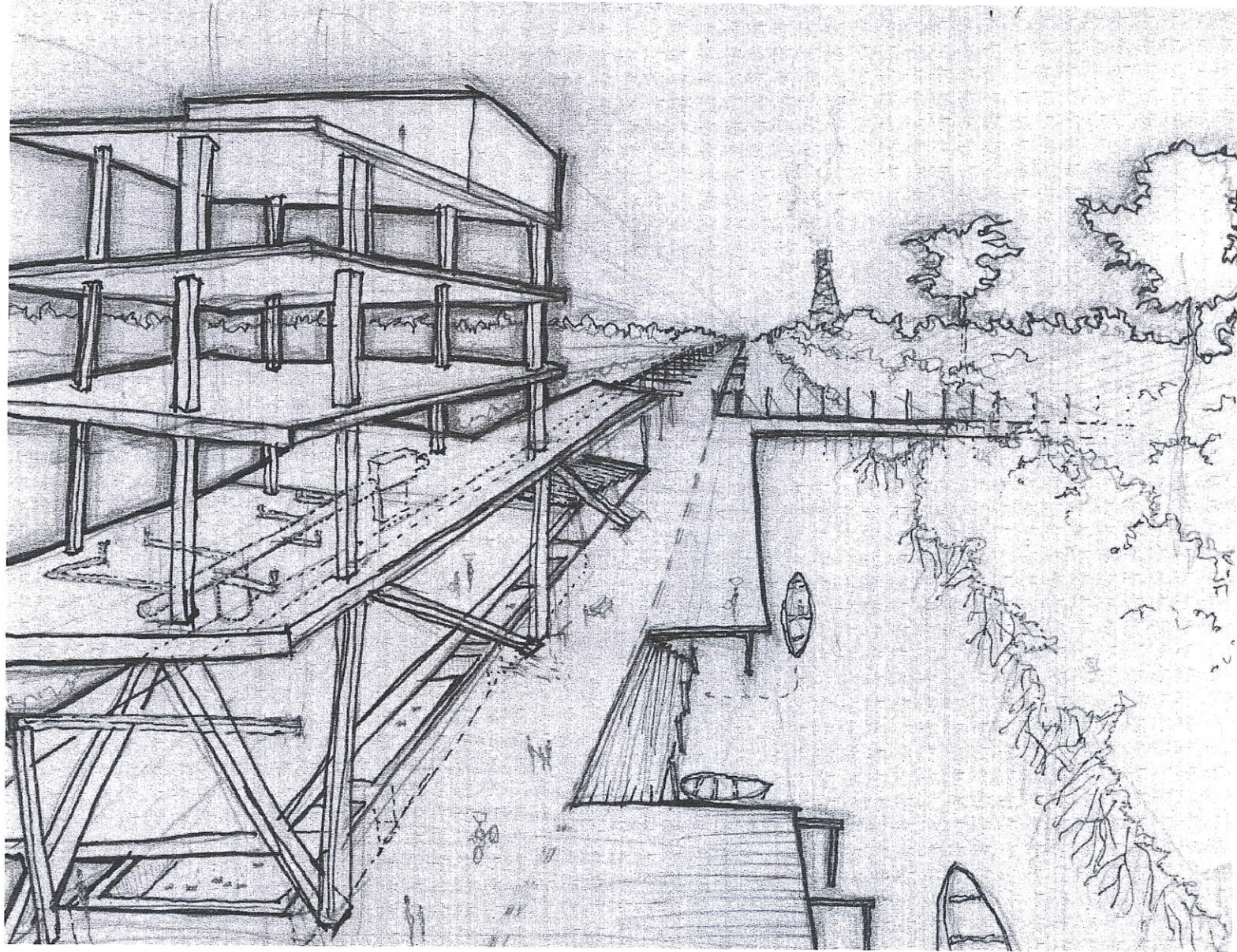
AXONOMETRIC VIEWS



SECTION THRU LIVING SPACE

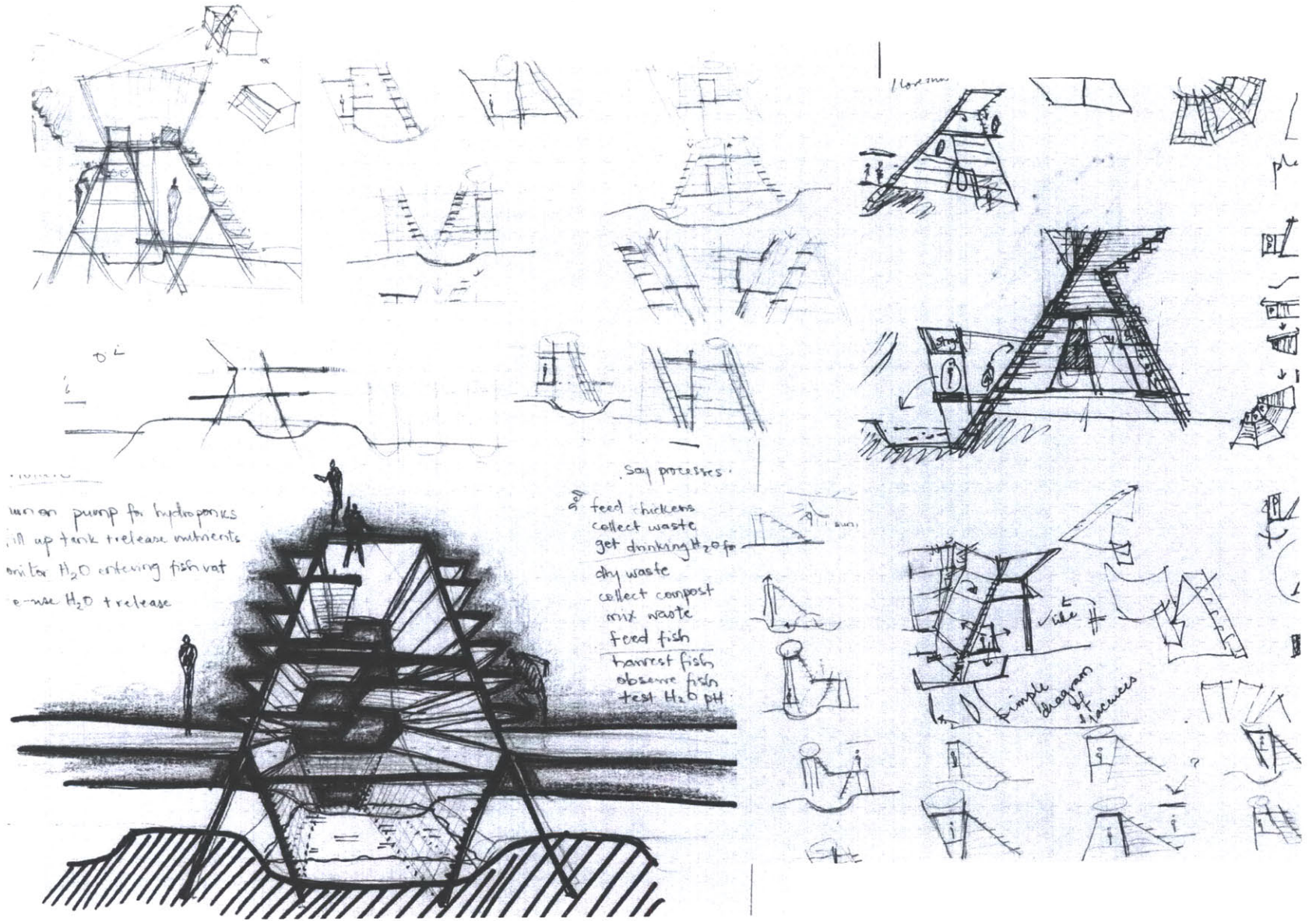


**INITIAL DESIGN SKETCH (CONCRETE MEGA-STRUCTURE IN THE DELTA?)**





**SUBSEQUENT SKETCHES (DESIGN DEVELOPMENT)**



irrigation pump for hydroponics  
 fill up tank & release nutrients  
 monitor H<sub>2</sub>O entering fish vat  
 re-use H<sub>2</sub>O & release

Soil processes:  
 feed chickens  
 collect waste  
 get drinking H<sub>2</sub>O for  
 dry waste  
 collect compost  
 mix waste  
 feed fish  
 harvest fish  
 observe fish  
 test H<sub>2</sub>O pH

Simple diagram of processes  
 side #



**RESEARCH-TRIP IMAGERY**





RESEARCH-TRIP IMAGERY







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All images and diagrams were taken/drawn by the author or property of the author unless otherwise noted.



**Final Presentation:**

Dec 13th, 2010 10:26 a.m. Thinking, "I can't believe its almost over. Thank You, God!"