Wasted Water:

Returning to the Fishpond Latrine Amidst Modernity, Pollution, and Stigma

by

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author's declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

abstract

Since 1990, Vietnam has made significant efforts to eradicate open defecation in rural areas[1]. With modernized systems and increasing severity of pollution within its rural provinces, local practices for managing human waste are also condemned as "backwards" and damaging to the environment and sanitary health. Labelled as "unhygienic", hanging latrines were subsequently banned as an attempt to raise rural standards. Without many alternative solutions for populations living in poverty with insufficient water supplies, this act is viewed as a contentious undertaking to modernize rural Vietnam. Around the same time, flood cycles were also increasingly exploited by high dike fields to meet needs for commercial agriculture. Enabled by Vietnam's "rice-first policy", monocrop rice production became dependent on chemical fertilizers, herbicides, and pesticides, severely polluting regional water sources. Former means of nutrient cycling are stigmatized as malpractice—while agriculture is seen as an economic necessity. The result is the displacement of nutrients at two ends: in fields where imported artificial fertilizers replace natural soils, and in households where using human waste is stigmatized and thus cannot be safely integrated into local agricultural systems. Compromised and deemed unsafe for local household usage, open water becomes a threat, continually detaching users from their reliance on the landscape.

1 WHO/UNICEF. *Joint Monitoring Programme for Water Supply and Sanitation*, 2017.

abstract

Set in An Giang province—an anthropogenic delta landscape shaped by its dominant agricultural practices—this thesis uses the premise of a fishpond latrine to challenge the threats of modernity, pollution, and stigma. Based on reflections in Ivan Illich's *H2O and the Waters of Forgetfulness*, modern technological advancement combined with sanitation have erased water's role as a vessel for memory and culture.[2] Sanitation is challenged for reducing water to H2O, a substance concealed within pipes to wash away our waste—resulting in perceptions of water as a polarized substance—strictly being either pure or impure in nature. Mary Douglas' theory from *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* complements the views on water's polarization —where dirt is defined as matter out of place, posing risks and fear resulting in stigma on certain actions and cultures.[3]

Based on these theories, the proposal uses the fishpond latrine, a vernacular structure that directly ties household sanitation to the delta's landscape, as a scalable framework that reinforces nutrient recycling, the connection between water and waste, and the bridging of land uses and household spaces together. Through this framework, a new landscape is proposed where flows are exposed through the restoration of streams and wetlands, and reducing pollution within a newly diversified field through natural cycles and integrated agricultural land use. At a household scale, a spectrum of water cascades through new sanitary spaces, destigmatizing the local practices of economic reuse of resource and conservation. Three settlement and land use typologies for dry, wet, and flood conditions are proposed at multiple scales. With agricultural land use ranging from gardens, orchards, and fields to livestock, aquaculture, and wetlands, these typologies employ adaptive design strategies for household amenities and structures, including the different latrines, for changing land conditions. Countering the efforts to wipe out its existence, the latrine is not removed from the system, but wholly integrated within the larger cycles occurring within the region.

2 Illich, Ivan. *H2O and the Waters of Forgetfulness*. London, New York: Marion Boyars, 1986.

3 Douglas, Mary. *Purity and Danger : An Analysis of Concept of Pollution and Taboo.* Douglas, Mary, 1921-2007. Works. Selections. 2003 ; v. 2. London ; New York: Routledge, 2003.

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Source: Satellite Image from Google Earth. Google earth V 7.3.2.5491 (December 30, 2015). An Giang, Vietnam. DigitalGlobe 2015. Accessed October, 2017. http://www.earth.google.com

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Diagram by author.

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Source: Satellite Image from Google Earth. Google earth V 7.3.2.5491 (December 30, 2015). An Giang, Vietnam. 10°37'34.20"N, 105° 3'19.87"E, Eye alt 100 kilometers.DigitalGlobe 2015. Accessed October, 2017. http://www.earth.google.com

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Source: Satellite Image from Google Earth. Google earth V 7.3.2.5491 (December 30, 2015). An Giang, Vietnam. 10°37'34.20"N, 105° 3'19.87"E, Eye alt 100 kilometers.DigitalGlobe 2015. Accessed October, 2017. http://www.earth.google.com

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Proposed Settlement: Water Flows
Drawing by author.

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Proposed Settlement: Water Flows
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Proposed Settlement: Type B Structures
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Proposed Settlement: Type B
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254 *figure* 3.80
Proposed Settlement: Type B Structures
Drawing by author.

256 *figure* 3.81
Proposed Settlement: Type B Structures
Drawing by author.

257 *figure* 3.82
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Drawing by author.

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Drawing by author.

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Rendering by author.

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Rendering by author.

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Collection of hanging latrines in An Giang.
Photos by Truong-Tuan-Thanh-Tran, 2018.

abbreviations

CAD	Canadian Dollar (conversion at 1 CAD = 17445.68 VND)
CPH	Centre for Preventive Health (Can Tho)
CTU	Can Tho University
GDP	Gross Domestic Product
IAAS	Integrated Agriculture-Aquaculture Systems
MOH	Ministry of Health
NGO	Non-Governmental Organizations
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
USD	United States Dollar (conversion at 1 USD = 23195.50 VND)
VAC	Vuon (Garden), Ao (Pond), Chuong (Livestock)
VAC-R	Vuon (Garden), Ao (Pond), Chuong (Livestock), Ruong (Field)
VIP	Ventilated Improved Latrine
VND	Vietnamese Dong (conversion at 1 VND = 0.000043 USD)
WASH	Water and Sanitation for Health
WHO	World Health Organization

translations

cầu	bridge
cầu tiêu	latrine
cầu cá	fishpond latrine
đổi mới	reform/renovation (*đổi mới* refers to economic reform in Vietnam in 1986)
nhà	house
nước	water
ao	pond
chuồng	livestock
ruộng	field
vườn	garden
đông-xuân	spring
hè-thu	autumn
thu-đông	winter



figure 0.1
Mother washing son's face by the latrine.
Photo by Andrea Bruce, 2017.

mother & child by the latrine



Mother and Child by the Latrine

In the August 2017 issue of *National Geographic*, an article was released concerning open defecation and its relation to millions of deaths and stunted lives. The author addressed how the "problem isn't just a lack of toilets—it's a lack of toilets that people want to use." Vietnam, included in the data presented, was mentioned as one of the countries that "has nearly eradicated open-defecation" from 1990 to 2015. Included in the article is a controversial photo, taken in An Giang province and published along with this caption:

"**VIETNAM -** *In the southern village of Vinh Xuyen, Pham Thi Lan washes her son with pond water beside the family latrine, which drops nutrients into their fish farm. Recycling feces this way is an old practice that's better than open defecation and can be done safely—but separating waste from drinking and bathing water is imperative."*

Photo by Andrea Bruce.[1]

1 Royte, Elizabeth. 2017. "Nearly a Billion People Still Defecate Outdoors. Here's Why." *National Geographic*. Accessed September 07, 2017. http://www.nationalgeographic.com/magazine/2017/08/toilet-defecate-outdoors-stunting-sanitation/

Open Defecation
The human practice of defecating outside in the open environment, rather than into a toilet. This is due to cultural practices or lack of access to a toilet.

Toilet/Latrine
A piece of hardware used for safe the collection or disposal of human urine and feces—with or without flushing.

Unhygienic Latrine
A "basic" toilet that does not meet sanitation standards in modern times due to unsafe handling and disposal of waste. This toilet may include pit latrines, hanging latrines, bucket toilets, etc.

Although published mainly for a Western audience, the image *(figure 0.1)* was circulated around social media and viewed by many Vietnamese who pointed out the caption's mistaken interpretation.[2] Users from all over the country commented about their own experiences of visiting rural villages in Vietnam, depicting how rainwater was collected into barrels and scooped into coloured plastic containers for household usage. Contrary to the caption, the woman in the National Geographic photo most likely brought clean water from inside her home to wash her son's face, however the caption implied that she was using water from directly beneath the latrine. This photograph—and the polarized interpretations of what it means—reflects an important gap of knowledge between two cultures of what is considered to be a "developed" and "developing" nation. The gap perpetuates assumptions and poses the risk of enforcing differing views around cleanliness and sanitation.

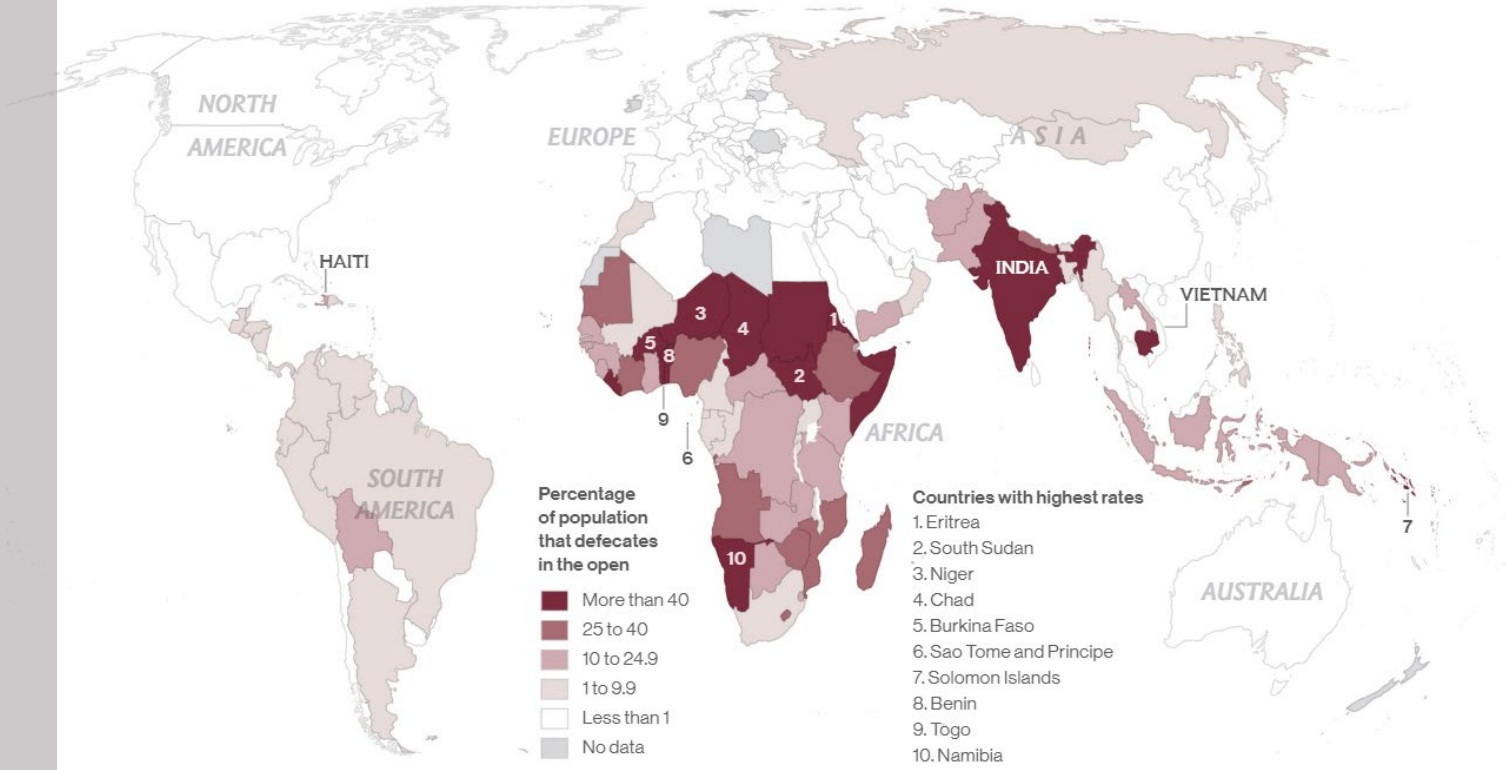
As a first-generation Vietnamese-Canadian, my reflections on this article were limited by my context of being raised in a suburb in Canada. Access to clean water here is plentiful with intensive infrastructural developments transporting water supply and sewage. This context formed my own interpretation of these practices, but I was also conflicted: I was raised to not trust drinking water from all sources unless it was properly filtered and packaged, and any water we had "used" was consider unclean and was sent down the drain. My family's concern comes from their own experience living in a country with high rates of waterborne diseases on downstream populations. Seeing this photo, I questioned and challenged my own thoughts and lifestyle. How contextual is sanitation? Can it be damaging in contexts with embedded practices and lifestyles?

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2 Mai V Pham's Facebook post, accessed October 10, 2017. https://www.facebook.com/maivupham/posts/10156597711986110

CLEANING UP AN UNSANITARY WORLD

The percentage of people defecating in the open air declined worldwide from 1990 to 2015, with the most dramatic reductions in some of the least developed countries. Yet nearly 950 million people still practice this public health hazard—a challenge augmented by population growth.



MAKING GAINS

Vietnam has nearly eradicated open defecation. UN statistics based on toilet construction show India has made progress too—but some experts dispute the extent, arguing in part that many of the latrines that have been built go unused.

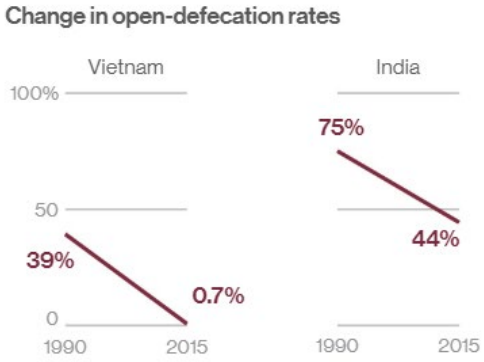


figure 0.2
Infographic on National Geographic's article on open defecation.

Infographic by Jason Treat and Matthew W. Chwastyk, NGM Staff; Kelsey Nowakowski
Sources: WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation; Sangita Vyas, Research Institute for Compassionate Economics

"Cleaning Up an Unsanitary World"

This article poses another question on the stigma attributed to developing countries due to disease and practices of open defecation. The infographic is titled "Cleaning Up a Sanitary World" *(figure 0.2)* and Vietnam was applauded for making great strides in almost eliminating open defecation within a mere quarter century. I questioned whether it is possible to wipe out a practice that has been practiced for centuries within several decades. Even with hanging latrines—the article implies they are still not hygienic enough to achieve modern standards. Modern technology has altered our lifestyles and concepts of daily life at unimaginable rates—but can it erase our relationship to our earth and water entirely?

Vinh Xuyen Village, June 2018

Almost one year after National Geographic's publication, I met a woman who knew Pham Thi Lan and had witnessed the photograph being taken. Through some investigation, I was able to find the exact house that photo was taken at, and spoke with some of the residents in the village. The woman and other villagers at first thought I was a filmmaker. Eventually I learned that the location of the photo is a common place for tourism, and the filming of Vietnamese and international films and documentaries due to its trench filled with blooming water lilies. Despite its popularity, the villagers I met with have not seen any of the movies or articles published of the location. When I mentioned how the National Geographic photo was captioned, the woman was quick to deny the incident, and insisted no one living there would ever think of washing their face with the water from the trench.

She continued to explain how the photographer had asked the mother and child to stand there, with the cup filled with water that was taken from inside the home. Although the photograph was staged, it was apparent she was not aware of the implications of the photo, or why it was taken and where it would be published. During our discussion, I later learned that the household, like others in the village of Vinh Xuyen, has had access to a centralized piped water supplies for several years now since the construction of the raised road twenty years ago. Hanging latrines are still scattered behind the houses, and are shared occasionally by villagers who lack funds and circumstances to install toilets in their houses. Many of these houses are built to meet the height of the road to prevent dust and dirt from coming into the house, making the installation of a modern toilet difficult. Even with a porcelain toilet fixture, the waste is either emptied directly into the trench through an opening or via a pipe.

Based on how the photograph is framed, villagers in An Giang, such as the mother in the photo, are inherently viewed by the developed world as uneducated and are condemned for their "unhealthy" habits. I was motivated to investigate the concept of sanitation and its dismissive notions in this village. This thesis challenges the narratives posed by the photograph and explores the hanging latrine and the pond as opportunities to better support the villagers through the lessons learned from it, as opposed to hindering their ways of life through stigmatizing local practices.

"Có thể người đi làm ruộng về dùng nước để rửa chân. Không ai dùng để rửa mặt dâu!"

"It may be used by the rice field workers to wash their feet after a long day of work, but never for our faces!".[1]

Woman from Vinh Xuyen Village, An Giang Province
June, 2018

1 Anonymous interview with villager. June 17th, 2018.



figure 0.3
Early mapping of the "*matters of concern*" through thesis themes.
Model by author.

"Water throughout history has been perceived as the stuff which radiates purity:
H_2O *is the new stuff on whose purification human survival now depends.*

"**H_2O** *and water have become opposites:*
H_2O *is the social creation of modern times, a resource that is scarce and calls for technical management."*

H_2O and the Waters of Forgetfulness (1985).
Ivan Illich

Introduction

Vernacular wastewater systems—where human waste is recycled in proximity to the home—are at risk of being erased in the name of sanitary modern technologies. Due to an increase in human population and pollution, traditional practices around the world for managing waste are seen as obsolete because of their incapability of addressing social and environmental changes.

Within Mary Douglas' theory from *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* - dirt is defined as matter, out of place. Only when it is displaced does it pose a risk and create fear, and thus taboo and stigma on certain actions and cultures.[1] Risk is a framework that when prevented, results in control and boundaries to create order, minimizing ambiguity and the unknown. Within this thesis, purity and its fueling of order in society unravel. Control and boundaries are explored through modern technology, resulting in compromises for rural populations.

Detachment emerges as a problem in the communities that continuously rely on the landscape for their livelihoods. As displacement occurs at different levels,[2] rural villages are unable to maintain their former lifestyles, leaving them forced to adapt to new ways of living. Those that cannot adapt due to social, economical, or cultural reasons are left behind. As a result, rural areas are pushed towards new centralized approaches that require consistently functioning systems, such as pump stations and sewage infrastructure that require constant and expensive maintenance.

In Illich's *Tools for Conviviality*, he challenges modern systems and their reversal of the relationship between humans and their tools. As progress continues, humans are more often controlled by the tools that previously aided them because of their dependency on new technology and inability to survive without it.[3] Vietnam would have been incapable of achieving the United Nation's global milestone status for "country-wide implementation of modern sanitation"[4] without funding and loans from developed nations—a proposal welcomed without hesitation by the government. Despite this, water supply and sanitation funding have not been put where needed the most due to corruption and the desire to keep rural villages dependent on water supplier companies. Modern latrines have only been implemented in wealthy households; not only can they afford them, but they also have access to water sources that can sustain their use, replicating the distancing of input and outputs of a system.

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1 Douglas, Mary. *Purity and Danger : An Analysis of Concept of Pollution and Taboo.* Douglas, Mary, 1921-2007. Works. Selections. 2003 ; v. 2. London ; New York: Routledge, 2003.

2 Nixon, Rob. *Slow Violence and the Environmentalism of the Poor.* Cambridge, London: Harvard University Press, 2011, 17. In his book, Nixon describes displacement as "temporal, geographical, rhetorical, and technological". All of these contribute to violence on humans and the environment as populations are displaced from places familiar to them, now irretrievable through the removing of means, resources and culture.

3 Illich, Ivan. 1973. *Tools for Conviviality.* New York: Harper & Row.

4 Royte.

"Fishpond latrines have been the traditional solution in the south and they are the cheapest types of latrines but there has been a ban on the use of such latrines.

However, there is not yet an alternative solution."

Ministry of Construction and Ministry of Agriculture and Rural Development (2000). National Rural Clean Water Supply and Sanitation Strategy up to year 2020. Socialist Republic of Vietnam

Since its widespread execution, there has been doubt whether these sanitation measures are in fact alleviating poverty and the assumed "educational improvements" can be critically observed as the contentious undertaking to modernize all of Vietnam.[5]

Vietnam's shift towards modern systems disregards the symbolic qualities that water carries with it. The ever-expanding systems of distancing and concealment are failing to address the rural village conditions and their reliance on government provided infrastructure are constantly being exploited for modern means. This new reliance is ineffective for regions that lack the capacity and cultural willingness to purchase access to piped systems and new modern toilets. As stated by the government itself in a strategic plan:

"Fishpond latrines have been the traditional solution in the south and they are the cheapest types of latrines but there has been a ban on the use of such latrines. However, there is not yet an alternative solution." [6]

There is an awareness within the country posed by the government's contradictions of enforcing bans and acknowledging the capability of a population to respond to them. Between the desire to protect public health through improved sanitation, as well as the desire to improve socio-economic conditions for those living in poverty, the government acknowledges that there are those who also have little choice other than to continue using these types of latrines. Despite this, modern toilets are promoted, and homeowners caught with hanging latrines are asked by officials to remove them and discontinue the practice.

5 Reis, N., and P. P. Mollinga. "Water Supply or 'Beautiful Latrines'? Microcredit for Rural Water Supply and Sanitation in the Mekong Delta, Vietnam." *ASEAS – Austrian Journal of South-East Asian Studies* 5, no. 1 (2012, 18.

6 Ministry of Construction and Ministry of Agriculture and Rural Development (2000). *National Rural Clean Water Supply and Sanitation Strategy up to year 2020*. Socialist Republic of Vietnam, Hanoi: Ministry of Construction and Ministry of Agriculture and Rural Development.

Methodology

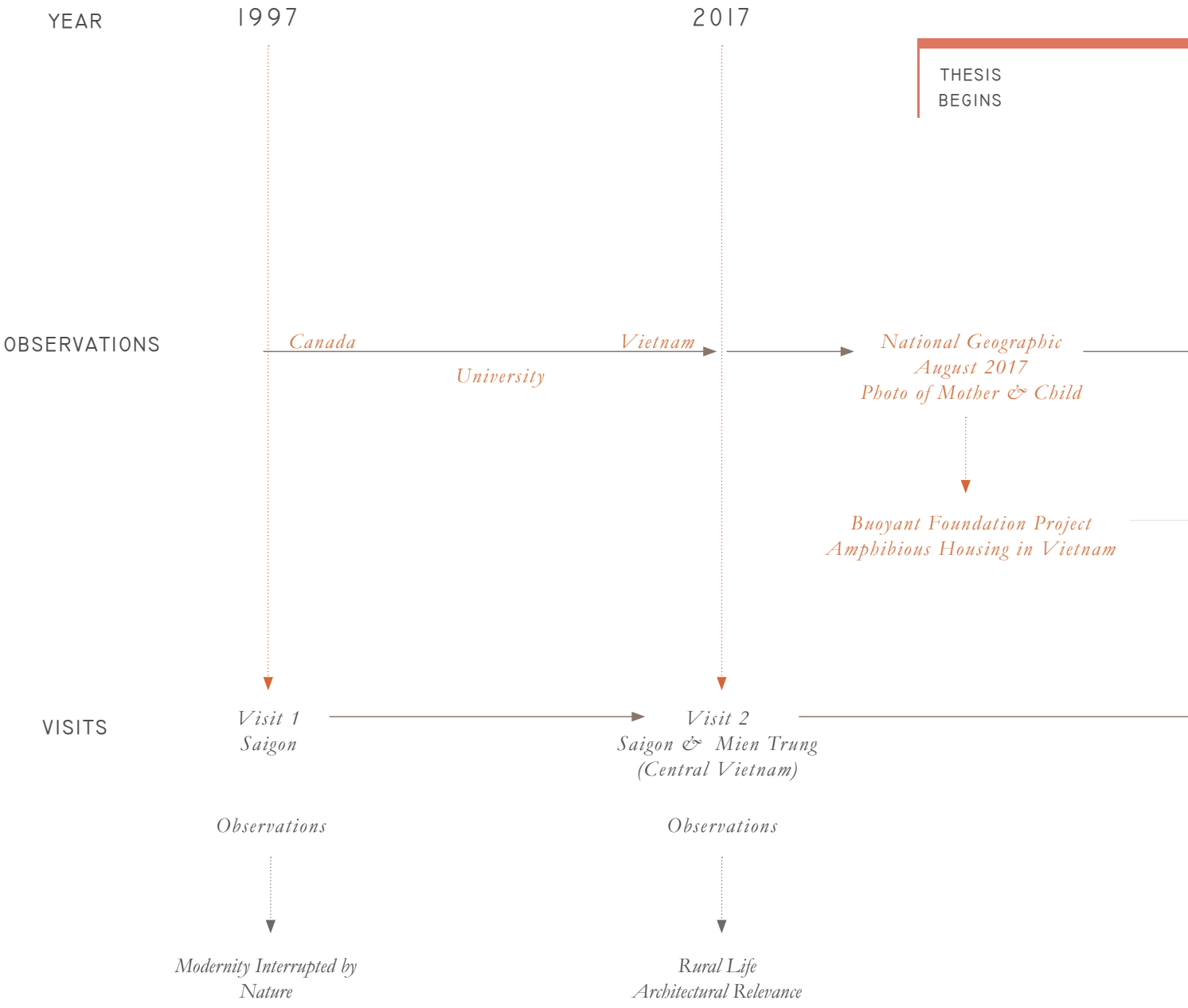
Within my lifetime, I have visited Vietnam only three times. The first time was as an toddler in 1997 on a family trip with my mother and grandma. The most resounding memories of this visit was the feeling of the environment around me. Although we stayed in Saigon, a highly urbanized area, the dust rising from the streets and the constant procession of ants on the exposed kitchen walls of our home were *đậm đà* (vivid) memories of nature intruding on our attempts at modern life. My second visit was two decades later, in 2017 to work at an architectural office as I returned to Saigon again. The uncomforting climate and organized chaos of the streets felt no different than my previous visit. This visit informed me of the actions of working at *Không gian nhiệt đới* (Tropical Space), a small office that specialized in sustainable low-cost and low-energy designs for homes that adapted to climate conditions of humidity, rain and sun - a way of bringing rural life back into the urban context. With my coworkers, I was also able to travel to regions of central Vietnam during this trip where I saw, felt, smelt, and tasted rural life for the first time.

These experiences immediately changed my focuses and interests as an architectural designer to Vietnam, a country I found so rich and raw in comparison to my life brought up in Canada's plain suburbs. Canada was an overprotected life stripped of risk, and lost with it the vividity of nature I had witnessed elsewhere. In the time I returned to begin my graduate program at the university, where I already had a profound interest in architecture's relationship to infrastructure - specifically wastewater - and how it was so complicated but concealed in our daily lives.

The research methods used in this thesis consisted of a mixed-method approach through observations, interviews, and experiments through design *(figure 0.4)*. In August 2017, I was sent the photo from National Geographic's article, where the key to my entire thesis followed afterwards. Based on the photo's direction, I began with interest in hanging latrines in rural Vietnam's Mekong Delta as my initial literature review. I studied the homes in this region through my work with Dr. Elizabeth English developing amphibious housing typologies for flood-prone regions in An Giang and Long An province. Eventually, with flooding as a major force in the landscape, this thesis research expanded into massive scale that focused on pollution and its transmission through water, leading to the themes of wastewater, sanitation and agriculture as developed within the work. Wastewater was explored as a challenge, but also an opportunity for the country, leading me to plan my two months of fieldwork within An Giang to search for the location of the controversial photo within the village of Vinh Xuyen, to understand further the voices of the villagers in contrast to the tones set by the article.

My third visit allowed me to visit An Giang province's three major areas: Tri Ton, a town located between the seven mountains; Long Xuyen, a former province, now city along the Bassac river; and Chau Doc, the major city along the Vietnamese-Cambodian border. Throughout the province, I observed and documented household typologies and their means of adaptation to the current situations of waste and water with the existent pressures of modernity, pollution, and stigma. My most unexpected finding was the prevalent fear of pesticide usage, as opposed to limited sanitation as expressed by the local Vietnamese—both wealthy and poor. However, the province was so dependent on its water systems for daily use and agricultural production, that removing the risks by changing lifestyles was an impossible feat for those that could not afford it. Within my arrival in Vinh Xuyen, I interviewed three homes that resonated the themes of my thesis: the first was a father and daughter living on a flooded field within an informal settlement; the second was a home that moved from beside the road to the trench that was sprawled with hanging latrines; and the final household was the home where the fishpond latrine photo was taken.

Following the visit, I expanded my findings with further research of methods and approaches taken to improve the land use of the province and its agricultural pressures that contributed to the water contamination via chemicals and nutrient pollution. These led me to the three design strategies that could occur at multiple scales in order to counter the existing challenges posed within the photo. Each of these interviews exposed different opportunities where I could take my findings of current adaptations to the landscape as seen in each of the homes I documented. My final proposal explored suggestions from existing research that fought to support wastewater usage while also combining with my field research directions. Both of these methods were merged in order to seek better alternatives to banning a structure that has worked for generations.


YEAR
1997
2017
THESIS
BEGINS
OBSERVATIONS
Canada
University
Vietnam
National Geographic
August 2017
Photo of Mother & Child
Buoyant Foundation Project
Amphibious Housing in Vietnam
VISITS
Visit 1
Saigon
Visit 2
Saigon & Mien Trung
(Central Vietnam)
Observations
Observations
Modernity Interrupted by
Nature
Rural Life
Architectural Relevance

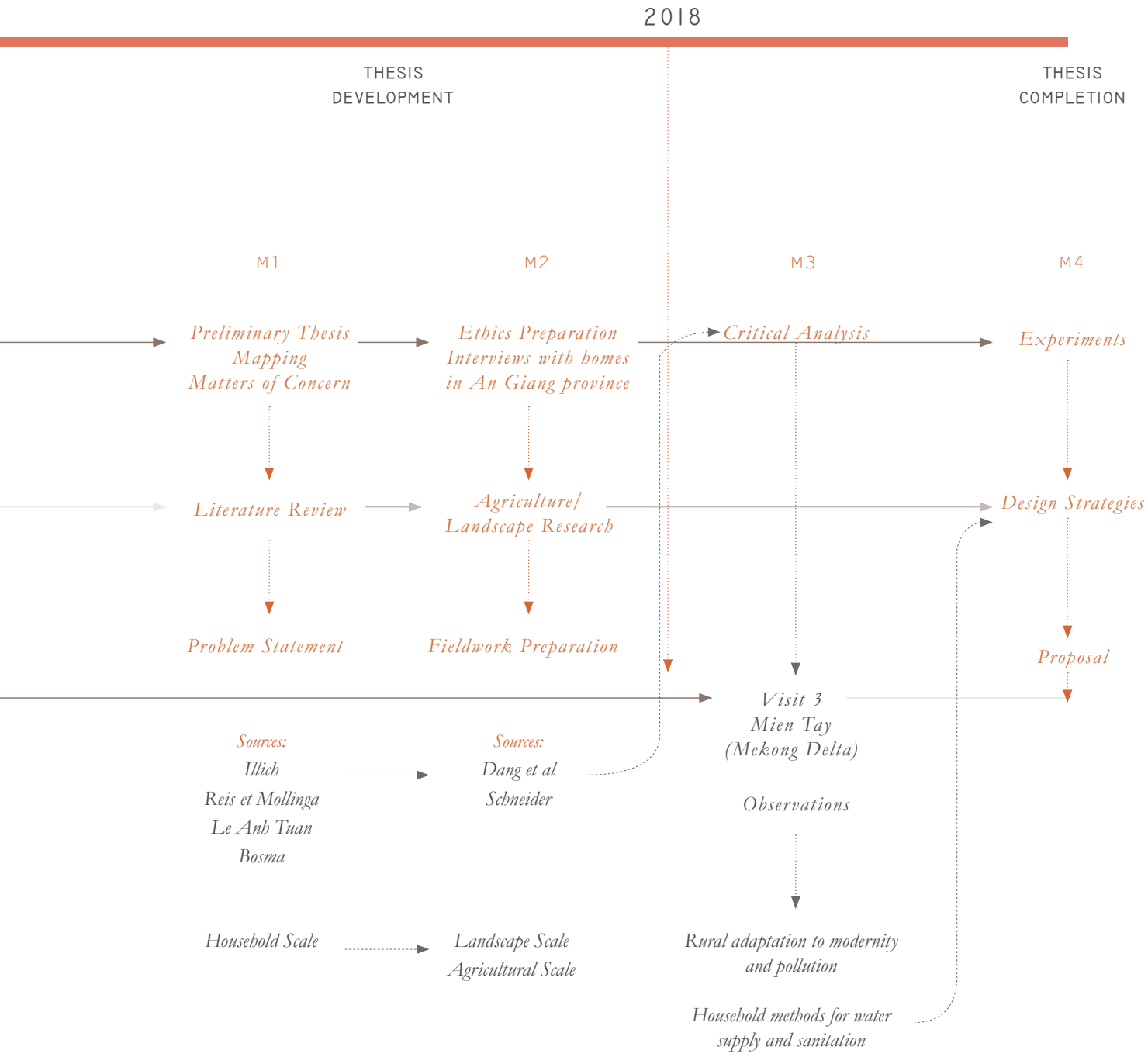


figure 0.4
Timeline diagram of research approach and methodology.
Diagram by author.

Through the framework of the hanging latrine, three categories will be used to inform the thesis and the proposal:

modernity, pollution, and stigma

of waste and water at multiple scales, ranging from the delta's landscape to the household pond. The following chapters will identify these themes and from them, propose design strategies that may counter them *(figure 0.5)*:

Part 1 begins with how the symbolic and physical construct of a pond relates to memory, matter, cycles, and the home. The latrine is explored as a bridge between land and water.

Part 2 addresses modernity, pollution, and stigma in detail through three different scales: the landscape, the agricultural field, and the household.

Part 2.1, Modernity addresses changes in the landscape of An Giang province through the industrialization of agriculture and how it has formed the delta's landscape today. It defines the phenomena of the construction of high dikes to resist flooding, and how it has brought benefits and drawbacks to the delta's ecological health and the socioeconomic health of the rural population. Within these changes are also new settlement typologies following canals and roads, which end up relying on surrounding water sources.
Part 2.2, Pollution addresses how commercialized agricultural practices have leaked pollutants through nutrients, fertilizers and pesticides from the field into the surrounding water systems. Nutrient management through traditional practices emerges as a way of reducing pollution.
Part 2.3, Stigma, combined with modern sanitary fixtures, have dismissed the spectrum of water—the value within the nuanced continuum of water within local practices. Practices to conserve water are ignored through the polarization between impurity and purity. Modern systems have concealed water, hiding with it the matter it carries.

Design strategies are proposed to counter each threat using *adaptive systems at the landscape*, *nutrient cycles for the agricultural field,* and the *spectrum of water at the household scale*.

Part 3 takes the framework of the latrine, combined with the design strategies from each chapter and integrates them to propose a new diversified landscape. Within this proposal are varying land use within fields, settlement typologies, and household structures, built to cycle waste and water at multiple scales.

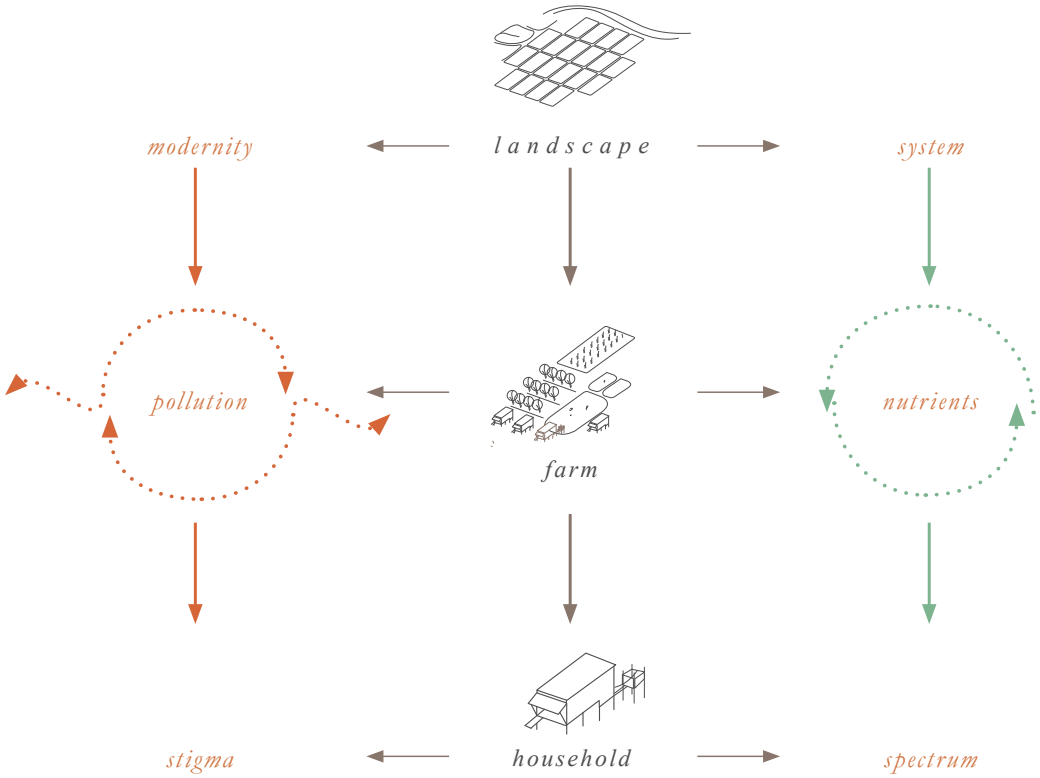


figure 0.5
Thesis negative & positive framework at different scales.
Diagram by author.

1.1 The Pond: Captured Memory

ta về ta tắm ao ta,
dù trong dù đục ao nhà vẫn hơn

I return to bathe in my own pond,
whether it is clear or murky, the pond at home is better.

-Vietnamese proverb

This traditional Vietnamese proverb that is passed down for generations depicts the country's rural ties to the household pond. The pond is understood as a metaphor for a place of familiarity, origin, and home that cannot be replaced. Ponds, which are natural occurrences, have been constructed artificially by humans to capture water for their own utility. It is a distinct entity of water, but is also intrinsically linked to its surroundings through the water cycle, where it constantly rises and falls from evaporation, precipitation, and accumulation. Inherently, actions evoked outside, and within the pond, flow through these links through actions of washing and waste cycling, resulting in a reciprocal effect on the water quality of a given environment.

During the construction of a home, the ground beneath the home is built-up from the extraction of soil from the field *(figure 1.1)*. This displaced soil forms a link between the raised ground and the pit adjacent to it. As rainfall occurs, the resultant cavity is filled with water and becomes a pond for household purposes and raising fish. In rural Vietnam, the self-sustaining household coexists with the pond for its daily waste and water cycles. The pond functions as a system to recycle nutrients and conserve excess water by collecting household scraps and wastewater from daily activities. Its adjacency to the home embraces and exposes the anthropogenic influences on water. Inevitably, as Shotwell addresses in *Against Purity*, it is a visible sign of human activity within a place, and its impurities are a result of it.[1]

1 Shotwell, Alexis. *Against Purity: Living Ethically in Compromised Times*. Minneapolis: University of Minnesota Press, 2016.

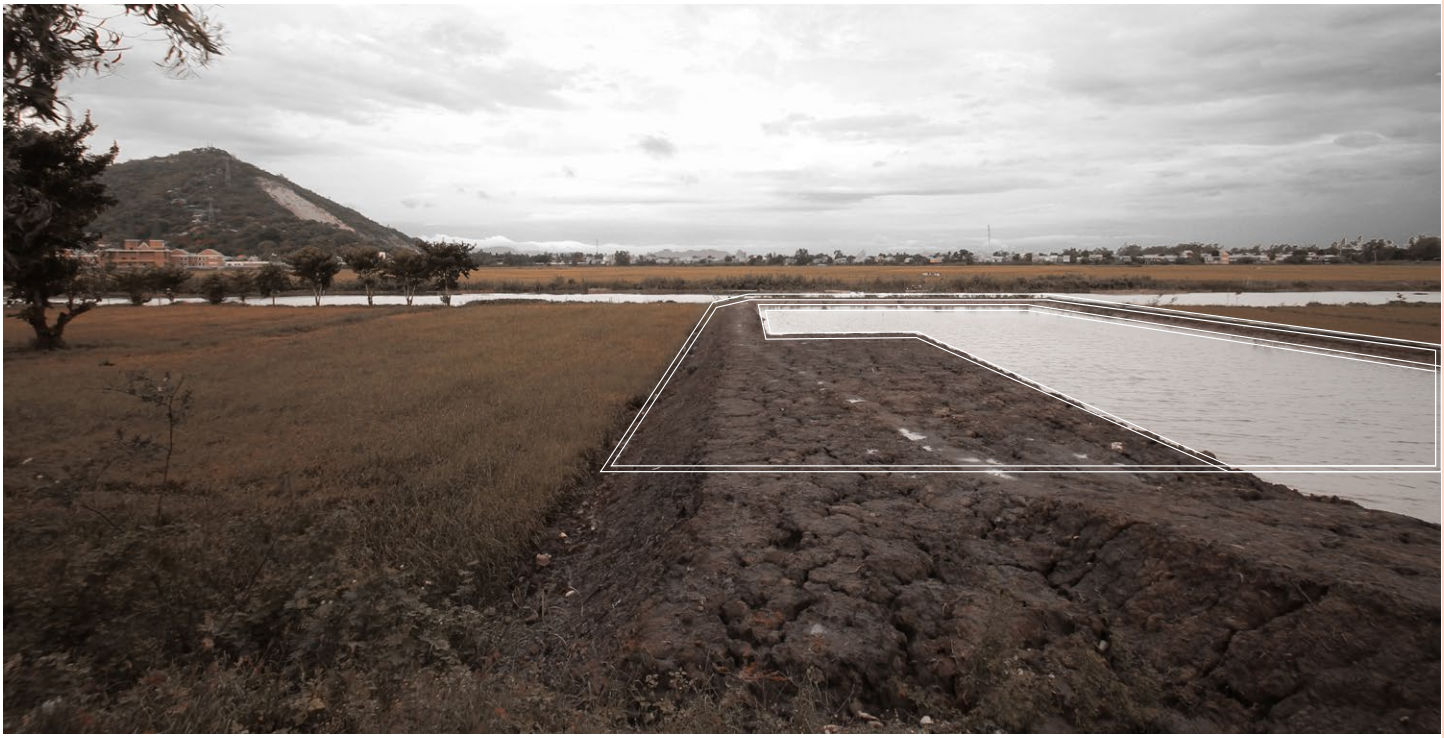


figure 1.1
Recently created home foundation and pond. Vinh Xuyen, An Giang.
Photo by author.

The act of pondering[1]—as depicted by Thoreau in *Walden*—is to reflect on one's own actions and thoughts.[2] As Illich describes from his metaphor of Mnemosyne—known as the well of memories in Greek mythology—still water can be seen as a reflection of time at a glance where memories are collected and stored. In contrast, rapid flows of water are seen as an acceleration or distortion of time that transports actions and outputs caught by its turbulence elsewhere.[3] The pond can be attributed as a mirror of rural domestic life in Vietnam where all memories are captured, allowing one to view and measure the depth of their own actions to the waters surrounding them.

1 Benner, Jeff A. "A Pound of Pondering by the Pond." The Culture of the Hebrew Language. Accessed January 09, 2019. http://www.ancient-hebrew.org/articles_ponder.html.
Benner describes how the term "pound" has two meanings in the English language—"weight" and "enclosure". The word "ponder" is assumed to be derived of the word "pound" in terms of "weight" in which one "gives weight to an idea or a thought". Possibly in relation, the term "pond" is derived from the word "pound" in terms of "enclosure" as a pond is enclosed by the banks built up around it. "Reflection" emerges as to reflect on a pond, which ties the two meanings of "pound" together.

2 Thoreau, Henry David. 1904. *Walden*. As he reflects on his life, Thoreau considers the water in the pond as sacred, as he bathes within it. Via the pond, Thoreau also studies nature as it surrounds him with seasonal changes reflected by the fluctuations within the pond.

3 Illich, Ivan. 1986. *H2O and the Waters of Forgetfulness*. London, New York: Marion Boyars.

1.2 The Fishpond Latrine

For generations, farmers in Vietnam have embraced the pond for its function to capture waste for household and agricultural benefits. In contrast to concealing or disposing of the waste, it is valued for its ability to feed into other cycles around the home, typically the pond. Due to the economic expenses for constantly purchasing external resources, farmers are careful in preserving limited supplies of water and nutrients on their land by reusing wastewater.[1]

A vernacular form of household fecal waste deposit is the hanging latrine, a simple structure hung over a body of water to aid with open defecation. Due to the vast networks of water and drainage systems, the bridge typology is commonly seen in the landscape in the form of monkey bridges[2] and latrines. The term *cầu cá* (fishpond latrine) in Vietnamese literally translates to "fish bridge". The latrine is typically located above a water body such as a pond, canal, ditch, or river, appearing singularly or in multiples. In the context where the latrine sits over a pond, it acts as a boundary between stages of human consumption, waste depositing, and nutrient recycling for production, closing the loop for the environment's nutrient cycle.[3]

Within the Mekong Delta, the fragile structures are constructed to seemingly blend with their surroundings *(figure 1.2)*. Typically, the structure is made of bamboo and branches found in the area, leaving a limited footprint on the landscape. The walls are constructed of scrap and recycled materials, making the latrine inexpensive to construct for any farmer. These materials can range from corrugated metal, tarps, cloths, grasses and wooden branches, and are built into panels to enclose the latrine. Usually camouflaged by leaves and trees for privacy, the latrines are hints of domestic life in the area, whether they were constructed for household use or for agricultural workers in the rice fields. Though these structures seem unstable and lack permanence, they are constructed to be easily dismantled or reconstructed by villagers in the event of seasonal changes and damage.[4]

1 Bunting, Stuart W. "Wastewater aquaculture: perpetuating vulnerability or opportunity to enhance poor livelihoods." *Aquatic Resources Culture and Development* 1, no. 1 (2004). doi:10.1079/ARC2004001, 21. Bunting describes how wastewater aquaculture provides poor communities with opportunities for additional income generation, employment and enhanced food security. Indirect benefits are gained through agro-ecosystems that support societal systems, as well as providing sanctuaries for biodiversity.

2 Monkey bridges are composed of branches of wood or bamboo to span across a canal, stream, trench, or ditch. Crossing them is usually an act done barefoot, and multiple people can cross it at one time. The act of crossing it is also a balancing act—giving it its name.

3 Le, Anh Tuan. "Thiết Kế Địn h Hình Các Mẫu Nhà Vệ Sinh Nông Thôn" [Toilet Design for Rural Areas]. Can Tho: Can Tho University, 2005, 54.

4 Le, Anh Tuan. "Cau Ca O Nong Thon Vietnam." Last modified April 15th, 2006. http://www.leanhtuan.com/OverhungToilet.html



figure 1.2
A hanging latrine in Vinh Xuyen village covered with foliage.
Photo by author, 2018.

Bà chằn lửa,
Sửa cầu tiêu,
Ba giờ chiều,
Đứt dây thiều,
Lọt cầu tiêu.

———

A hot-tempered lady,
Fixing the latrine,
Three o'clock in the afternoon,
Strings snapped,
Falling in the toilet.

Buffalo Boy Chant

Even within southern Vietnamese folk tales and literature, the fishpond latrine is commonly mentioned. In the past, the people living along the rivers and streams depended on the water for their livelihoods, and eventually constructed these bridges to navigate through the Delta region. The origins of the latrine started through the lifestyles of villagers who lived on boats and needed a means of discharging waste into the water. Following the adaptive model of the coastal regions, highland regions with scarce water conditions used composting toilets which promoted the growth of trees over time.[1]

In the past, the latrine was not stigmatized as a place of embarrassment and private enclosure, but was accepted more openly as a basic and natural function of daily life. In *H2O and the Waters of Forgetfulness*, Illich writes that since the intervention of contemporary sanitary routines and globalization, the social norm of using a toilet *(figure 1.3)* has become a private action, as well as an avoided topic that typically leads to social embarrassment and ridicule.[2] In the Mekong Delta, using the latrine for some villages would also be a communal activity where neighbours would enjoy a light conversation, or people passing by on the road would wave good morning as one did their business.

1 Ibid.
2 Illich. *H2O and the Waters of Forgetfulness.*



figure 1.3
A hanging latrine in Vinh Xuyen village shared by multiple households.
Photo by author, 2018.

1.3 Health Risks for Rural Areas

Today, the latrine faces the major challenge of health-risks associated with water-borne diseases. In 2012, the World Health Organization (WHO) together with UNICEF released the Vietnam Water and Sanitation Sector Assessment Report. Within their report the outstanding concerns and challenges of water and sanitation were analyzed within Vietnam's rural regions after the implementation of the National Target Programme on Water Supply and Sanitation in Phase 1 (1998-2005) and Phase 2 (2006-2011).[3] In 2008, the waterborne diseases diarrhea, dysentery, and bacillary dysentery were reported to be three out of ten diseases most prominently found in rural areas. These diseases have high rates of mortality resulting in limited development of socio-economy due to high health-risks.[4] With these risks, this program prioritized the development of rural water supply and sanitation for remote and poverty-stricken regions in the Mekong Delta by replacing the use of fishpond latrines with sanitary latrines. As the country moved towards Phase 3 (2011-2015) of the National Target Programme on Water Supply and Sanitation, 77% of rural households were reported to have latrines while only 55% had sanitary latrines.[5]

3 WHO/UNICEF. "Vietnam Water and Sanitation Sector Assessment Report: Year 2011," 2012, accessed September 25, 2018. 16. http://www.wpro.who.int/vietnam/topics/water_sanitation/watsan_sector_report_vietnam_2011.pdf

4 Ibid. 24

5 Ibid. 18

With regards to health concerns, 15.1% of households were found to be using surface water sources such as rivers, springs and ponds for drinking water and domestic water purposes with 30.4% of households using unsafe water sources. An Giang province was found to be the province with the highest rate of risks of polluted water sources at 54.1% of surveyed households. 30.1% of rural households in Vietnam utilize human excreta in agricultural production and in fish farming with limited composting to reduce the risks.[6] As water is flushed out to surrounding water bodies, this is identified as a significant contributor to the pollution of human excreta to the environment.[7] Although this technique is lower in risk than hanging latrines that deposit excreta directly into shared water-bodies, the changing of pond water is done too often by farmers, allowing little time for contaminants to naturally break down within food-chains.[8]

Although the latrine is significant to the region's vernacular forms and cultural values, it is challenged today for its limited functions, waterborne diseases and issues surrounding gender equity and the lack of development in rural areas. Due to these major changes, it has been rendered as obsolete within the modern context and times.

6 Ibid. 22

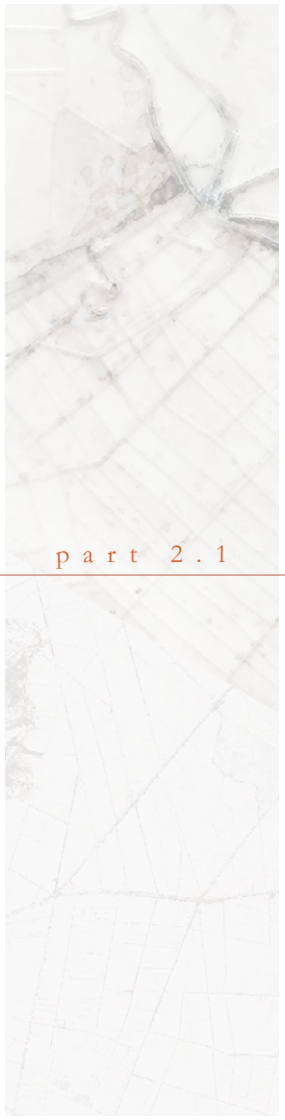
7 Bo Y tê (Ministry of Health, MoH). **Ve sinh môi trưng nông thôn Viet Nam. Nhà xuât bn Y hoc, 2007.**

8 Dang. Nhan K., Marc J.C. Verdegem, Nguyen T. Binh, Le T. Duong, Ana Milstein, and Johan A.J. Verreth. "Economic and nutrient discharge tradeoffs of excreta-fed aquaculture in the Mekong Delta, Vietnam." *Agriculture, Ecosystems, and Environment 124* (2008). doi.org/10.1016/j.agee.2007.10.005. 266-268

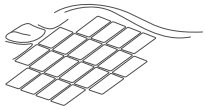


figure 1.4
A hanging latrine over a water lily trench. Vinh Xuyen, An Giang.
Photo by author, 2018.





part 2.1



modernity

controlling landscapes of water

This chapter focuses on modernity's role at the scale of the landscape, describing its origins, implications, and double-edged advancements in technologies and propositions today.

"It is (H_2O) an observed fluid that has lost the ability to mirror the water of dreams.

The city child has no opportunities to come in touch with living water.
Water can no more be observed; it can only be imagined,
by reflecting on an occasional drop or a humble puddle."

On the creation of the Town Lake in Dallas.
H2O and the Waters of Forgetfulness (1985).
Ivan Illich

2.1.1 The Mekong Delta: "Made" & "Unmade"

"Sống vì nước, chết vì nước."
"Live by water, die by water."

Huỳnh Sanh Thông
Vietnamese Scholar[1]

In 1820, *Trịnh Hoài Đức,* a Vietnamese scholar and poet identified Vietnam through the following quote: "the mountains are like the bones of the earth. Water is its blood."[2] If water, from its constant flow and circulation, can be attributed to a vital substance of the human body, then the Mekong Delta can be regarded as the heart of the country.

The Mekong Delta, an estuary of nine prominent water bodies located in southern Vietnam *(figure 2.1.1)*, is home to a culture that lives with water as its vital life-giving element. Its endless veins of water bodies—natural and manmade—provide passages for transportation, water for the people, and unique ecosystems of abundant biodiversity throughout the region.

Typically, there are two seasons in the Mekong Delta *(figure 2.1.4)*: the dry season lasting from November to May and the rainy season from June to October. Due to heavy rains and the low-lying regions of the delta, floodwaters from upstream from the Mekong flow and inundate the fields around September to November, depending on the climate and rainfall that year. The flooding transforms the landscape and lives of the Mekong's residents forcing those to adapt to its conditions or to prevent and control it. The desire to control the irrigation systems brought by the seasonal floods can be traced back to around 200 C.E.[3]

1 Huynh, Thong Sanh. 1991. "Live by Water, Die for Water (Sống vì nước, chết vì nước): Symbols and Metaphors of Vietnamese Culture" (unpublished manuscript), 3.
2 Kiernan, Ben. 2017. "Việt Nam: A History from Earliest Times to the Present." *The Asia-Pacific Journal* 15, no. 10.
3 Biggs, David. "Canals in the Mekong Delta: A Historical Overview from 200 C.E. to the Present." *Water Encyclopedia* (April 2005). doi:10.1002/047147844X.wh18.



figure 2.1.1
Map of Vietnam with the Mekong Delta.
Drawing by author.



figure 2.1.2
Traditional stilt-houses over the Bassac River. An Giang.
Photo by Elizabeth English, 2017.



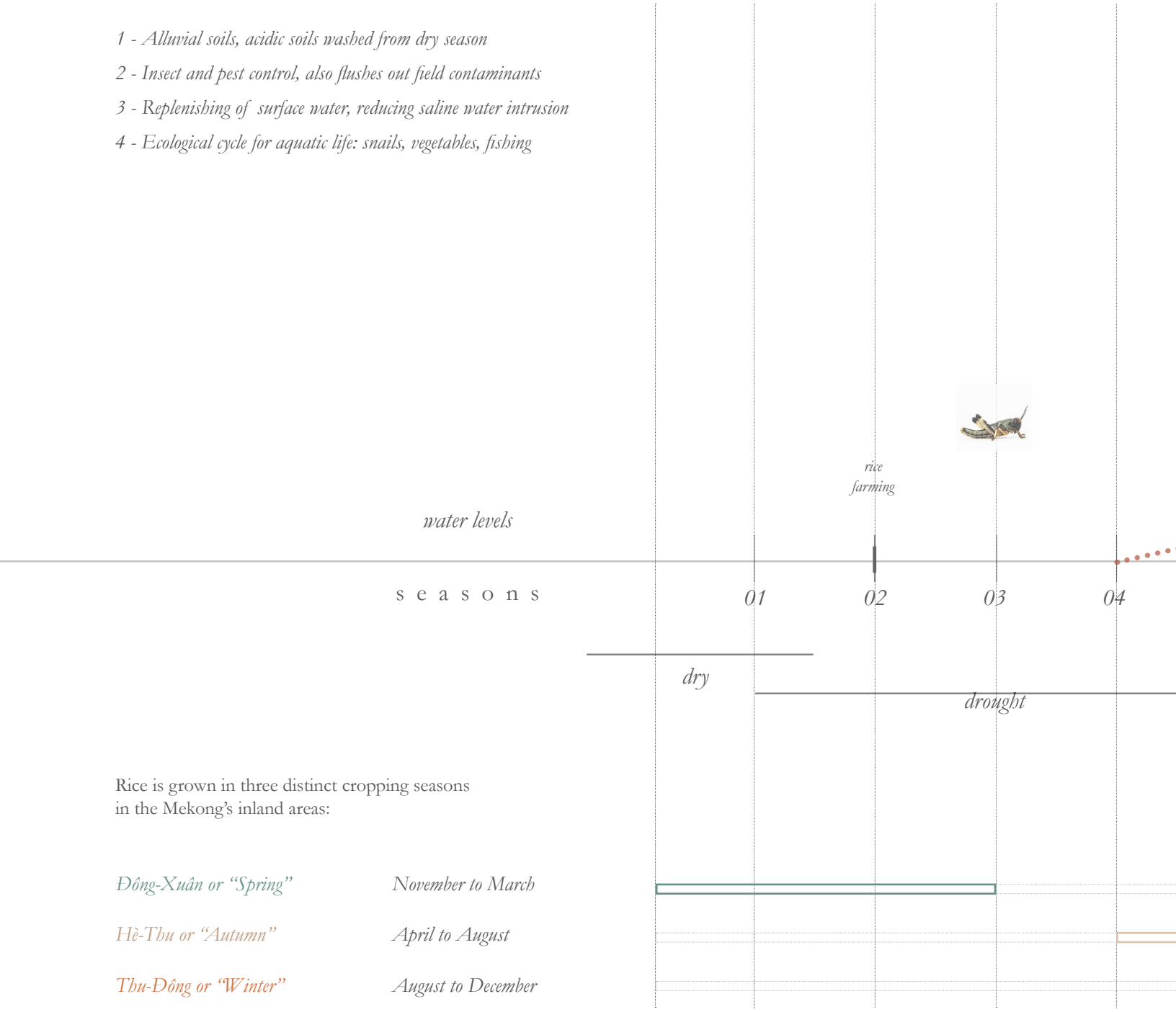
Benefits of Seasonal flooding:

1 - Alluvial soils, acidic soils washed from dry season

2 - Insect and pest control, also flushes out field contaminants

3 - Replenishing of surface water, reducing saline water intrusion

4 - Ecological cycle for aquatic life: snails, vegetables, fishing



Rice is grown in three distinct cropping seasons in the Mekong's inland areas:

Đông-Xuân or "Spring"	*November to March*
Hè-Thu or "Autumn"	*April to August*
Thu-Đông or "Winter"	*August to December*

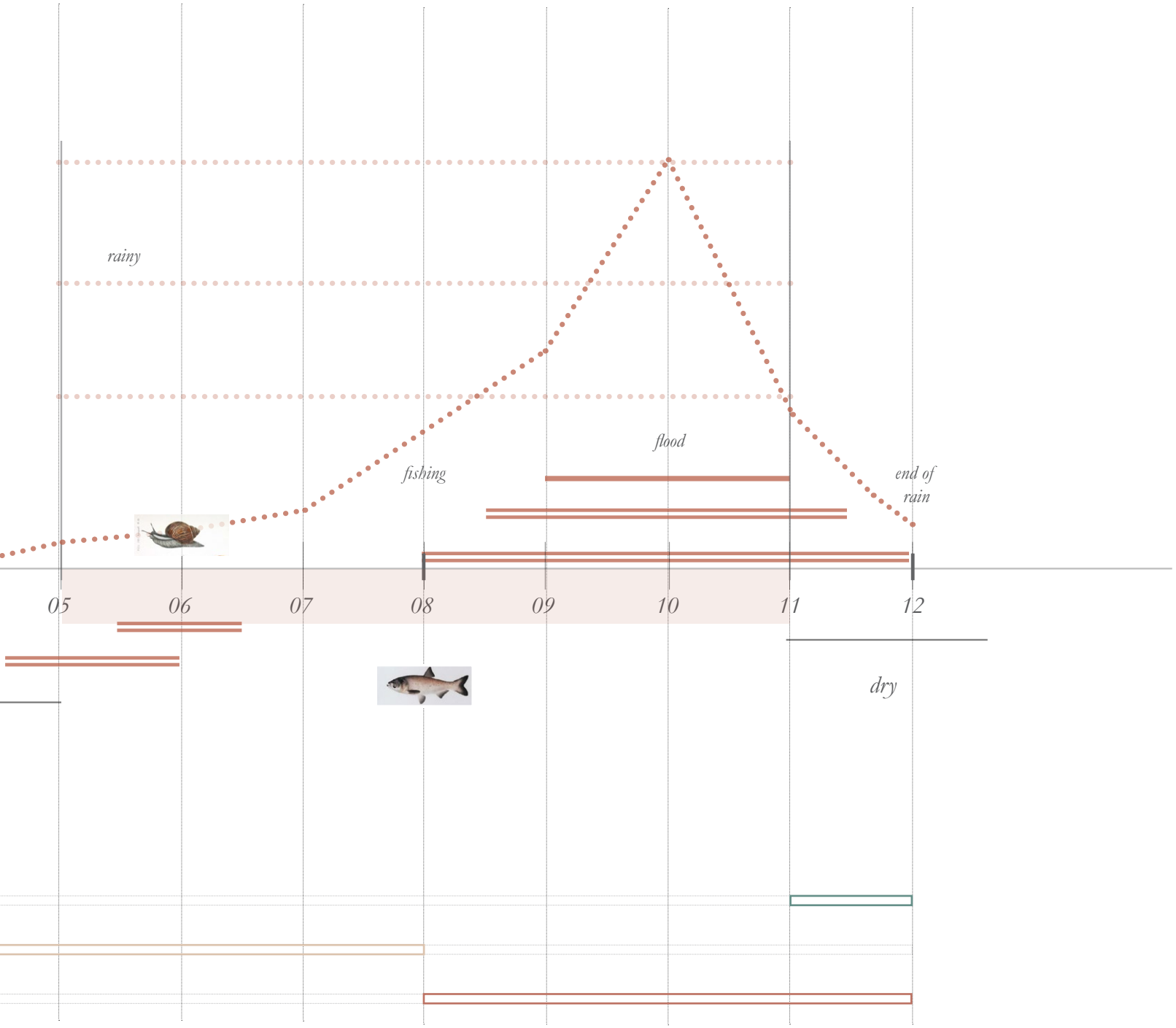
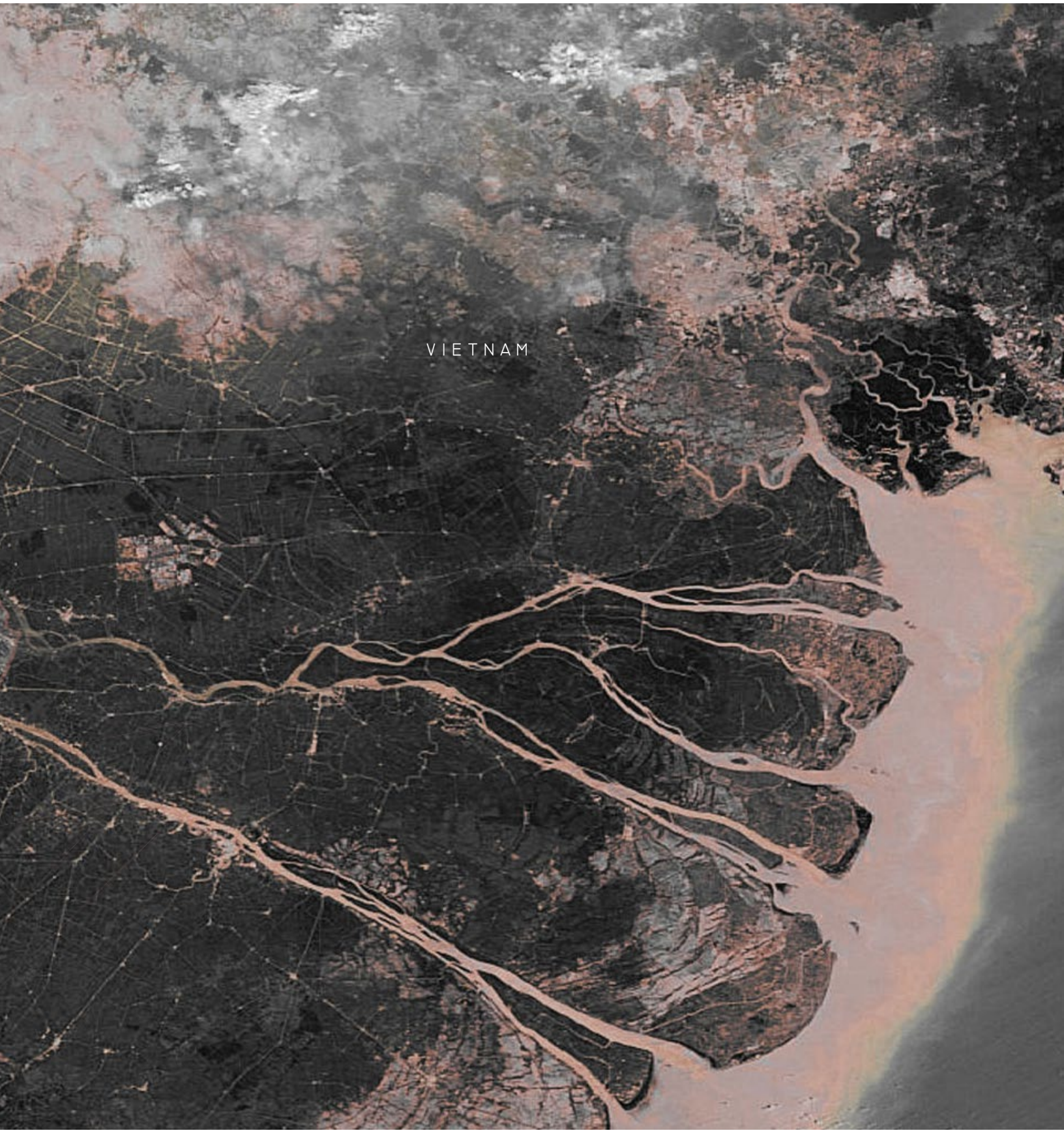


figure 2.1.3
Flooding calendar for the Mekong Delta. Water level changes are indicated.
Diagram by author.
Source: Nguyen et al, 2015. Mapping Rice Seasonality in the Mekong Delta with Multi-Year Envisat ASAR WSM Data.



figure 2.1.4
Envisat Satellite Imagery of the Mekong Delta taken on 06 February 2007.
Adapted by author.
Source: Image by ESA.


VIETNAM

Ancient canals were initially developed as passageways to travel between kingdoms and to promote trading *(figure 2.1.6)*. These trade routes were developed further in the 9th and 14th centuries as rice became a greater commodity, eventually until the French colonial conquest from 1858-1867 *(figure 2.1.14)*. By the 1900s, mechanical dredging technology allowed for the maintenance and development of major canals *(figure 2.1.16)*. Several of these projects linked densely populated areas and brought a major population increase from 500,000 to four million as labourers from the North travelled to the Delta to aid with construction.[4] These developments continued with both successes and failures due to natural disasters and diminished soil productivity until the Second Indochina War when Americans occupied the area and promoted the construction of infrastructural networks *(figure 2.1.19)*.[5] Due to tensions during the war, many projects were left incomplete, but were later continued under the *Đổi Mới* reform in 1986 *(figure 2.1.21)*.

Following Vietnam's post-war unification, the country began a phase of reconstruction with a single government now controlling all northern, central and southern regions of the country. Land reclamation and desalination processes for agriculture were developed further while "progress" in the Southern regions were seen as a necessity. Within the decade, the Mekong Delta's dry and wet seasons were controlled with a complex layer of canals and sluice gates. Natural streams are still apparent amongst the uniform grid of the delta's landscape, but many, like the ancient canals have been buried and dammed during the transformative processes.[6]

Today, the Mekong Delta is still considered the "rice bowl" of Southeast Asia for its numerous rice paddies and massive agricultural production. Despite the progression to modernity and globalization in the country's urban and peri-urban regions, the delta's provinces continue to be home to many poor rural areas that continue to employ themselves within what is stigmatized as a "backwards" agricultural economy.[7]

4 Ibid.
5 Ibid.
6 Sikor, Thomas O., and Dara O'Rourke. "Economic and Environmental Dynamics of Reform in Vietnam." *Asian Survey* 36, no. 6 (1996), 603.
7 To, Trung Nghia. "Vision of Vietnam's Water, Life, and Environment in the 21st Century." *National Water Visions in Southeast Asia*, 2001. 99.



figure 2.1.5
Man crossing a monkey bridge in the Mekong Delta.
Photo by Luc Forsyth. 2015.

PRE-1800S

100 B.C.E. - 550 C.E.
Fu Nan Period
An ancient canal linking Oc Eo to Ankor Borei was created when Oc Eo was a busy port of the Kingdom of Fu Nan.

figure 2.1.7
Map of Oc Eo and Angkor Borei.
Source: Wikimedia Commons



9th century - 14th century
Increased Angkor trading.

figure 2.1.8
Oc Eo Relics.
Source: www.vietnamnet.vn



11th century - 18th century
Nam tiến - Southward expansion of the territory of Vietnam from the Red River Delta changing frontier territory from the Champa Kingdom to the Vietnamese.

figure 2.1.9
Ancient Kingdom of Champa.
Source: University of Copenhagen



17th century
Rice trading increases due to population growth in the Red River Delta.

1800

figure 2.1.6
Timeline of canal construction within the Mekong Delta. [1/5]
Continued on next page.

1800s

1818
Vinh Te canal is dug by Thoai Ngoc Hau between Chau Doc and Ha Tien, linking the Bassac river to the sea.

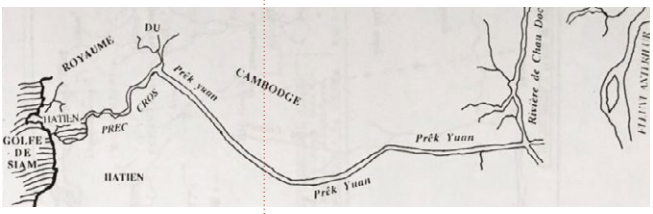


figure 2.1.11
Vinh Te Canal.
Source: www.voatiengviet.com

1816
Bao Dinh Canal - My Tho, Thoai Ha Canal - Long Xuyen - Rach Gia - Khmer Territory

1858-1867
French Colonial Conquest of Vietnam



figure 2.1.12
A French settler and his Vietnamese wife and servants.
Source: https://alphahistory.com/

1875-1879
Proposed French routes to Saigon increase transportation infrastructure of canals and railways.



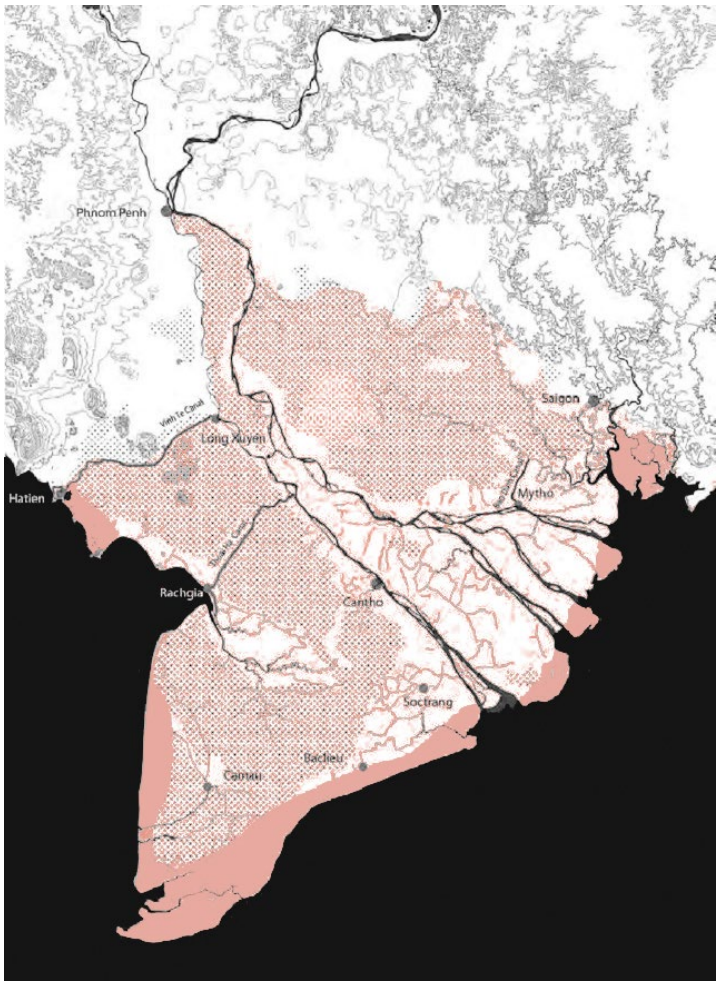
figure 2.1.13
Rubber Plantation, 1931.
Source: http://www.quanloi.org/

1890-1904
Dông Tháp Canals dug (Bac Liêu to Cà Mau, Rạch Giá to Hà Tiên)

1894-1945
Major Canals Dug - Bac Lieu - Ca Mau, Rach Gia - Ha Tien

1900

figure 2.1.10
Timeline of canal construction within the Mekong Delta. [2/5]
Continued on next page.



marshlands

water

figure 2.1.14
The Mekong delta in the 1800s: a wild marshland, with urban settlement on the natural levees of the riverbanks.
Adapted by author.
Source: Han Meyer, Built Environment: special issue on Delta Urbanism, 2017.

1900s-1930s

1904

1904
Xà No Canal.

1906
Lai Hiêu Canal
Bac Liêu to Cà Mau Canal
Ô Môn Canal

1908
Thôt Nôt Canal.

1914
Vinh Tê Canal is redredged.

1918
Quạn Lô–Phụng Hiệp Canal

1923
Ba Thê Canal

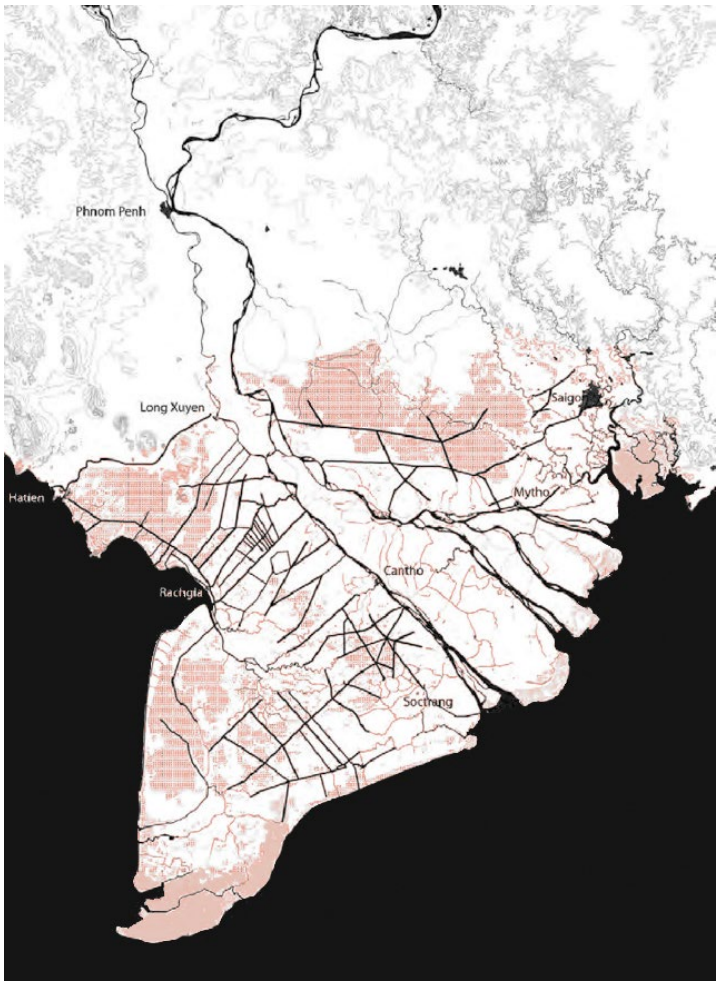
1928
Tri Tôn Canal

1930
Rạch Giá to Hà Tiên - Lower part of the Delta was least inhabited. Mechanical Dredging - Laborers from the North travelled south to work on canals. Population increased from 500,000 to 4 million

1931
World depression occurs with the reduction of agricultural crops.

1940

figure 2.1.15
Timeline of canal construction within the Mekong Delta. [3/5]
Continued on next page.



marshlands

water

The Mekong delta in 1900s: cultivating marshlands, with development of canal network during the French colonization.
Adapted by author.
Source: Han Meyer, Built Environment: special issue on Delta Urbanism, 2017.

1940s-2000s

1944

1944-1945
Military efforts combined with seasonal drought and delayed floods caused the famine "Nạn đói Ất Dậu" resulting in 400,000 - 2,000,000 estimated deaths.

figure 2.1.17
Buffalo in the flooded rice fields.
Source: Minh Nguyen-Vo, Buffalo Boy. Film still. 2004.



1945-1954
2nd Indochina War, Cai San Project in the South with the construction of the "transverse canals" 1-7, A-H Canals.

figure 2.1.18
Soldiers in the Water.
Source: Ut, Nick. Vietnam War 1970. Image, 1970. https://www.flickr.com/photos/13476480@N07/27523193686.



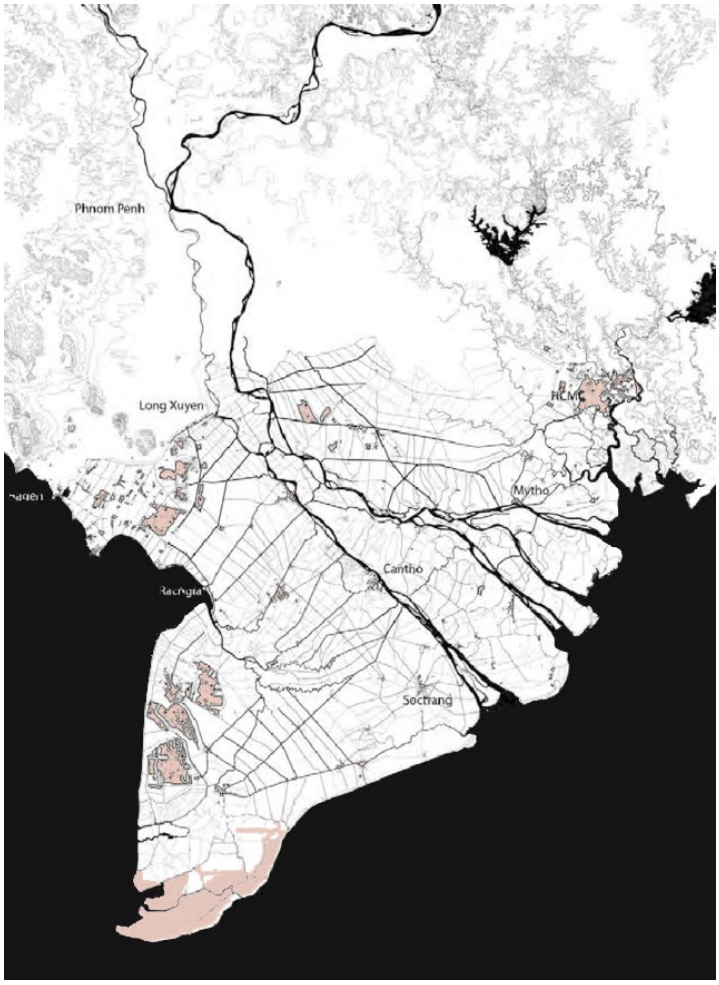
1970
American brought the onset of small-engine machinery with pumping engines for irrigation systems in the delta's rice fields.

figure 2.1.19
Dai Hoi Vi. Doi Moi Policy.
Source: http://en.nhandan.com.vn/



1984
Inauguration of Doi Moi policy

figure 2.1.16
Timeline of canal construction within the Mekong Delta. [4/5]
Continued on next page.



marshlands

water

The Mekong delta in 2000: the whole delta as a hydraulic system.
Adapted by author.
Source: Han Meyer, Built Environment: special issue on Delta Urbanism, 2017.

21ST CENTURY

2000

2000
Increased high dike construction.

1996-2001
My Thuan Bridge



figure 2.1.21
My Thuan Bridge
Source: Wikipedia

2005
Can Tho Bridge construction



figure 2.1.22
Can Tho Bridge.
Source: Pixabay

figure 2.1.20
Timeline of canal construction within the Mekong Delta. . [5/5]

2.1.2 An Giang Province

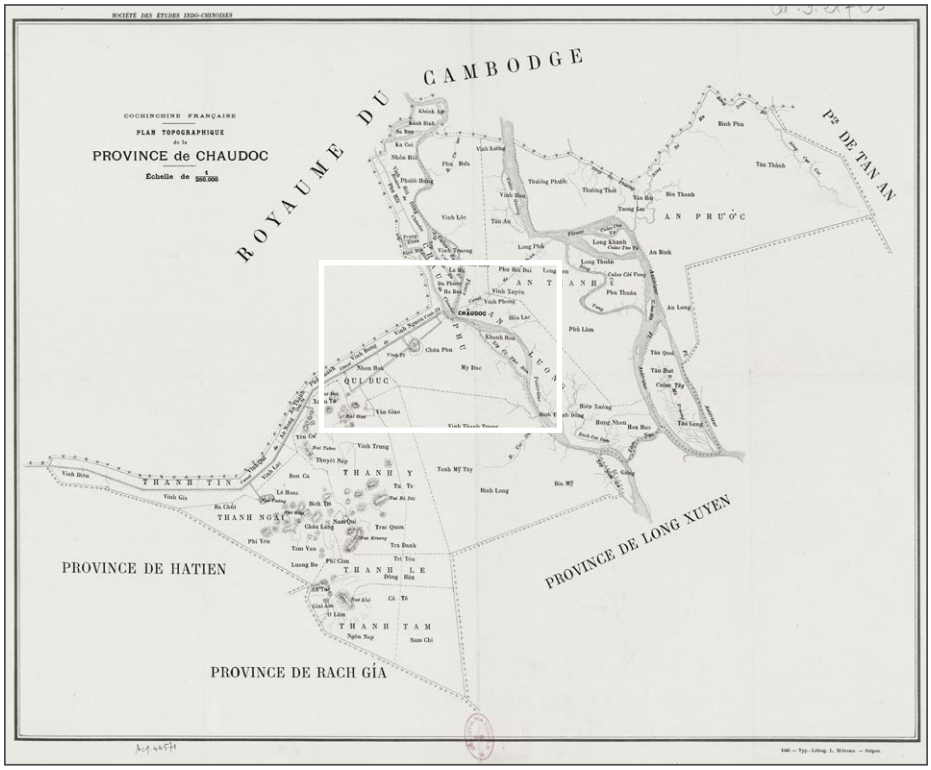
An Giang—a province in the Mekong Delta and home to over 2 million people—borders Cambodia and follows along the Bassac River. The province's adjacency to the delta at the freshwater sub plain known as the Long Xuyen Quadrangle makes it a relatively flat region with a vast hierarchy of drainage systems including rivers, streams, and canals flowing from larger rivers and its several prominent mountains *(figure 2.1.25)*. Due to its location and flood cycles, the province is heavily reliant on its agricultural and aquaculture production for its economy.

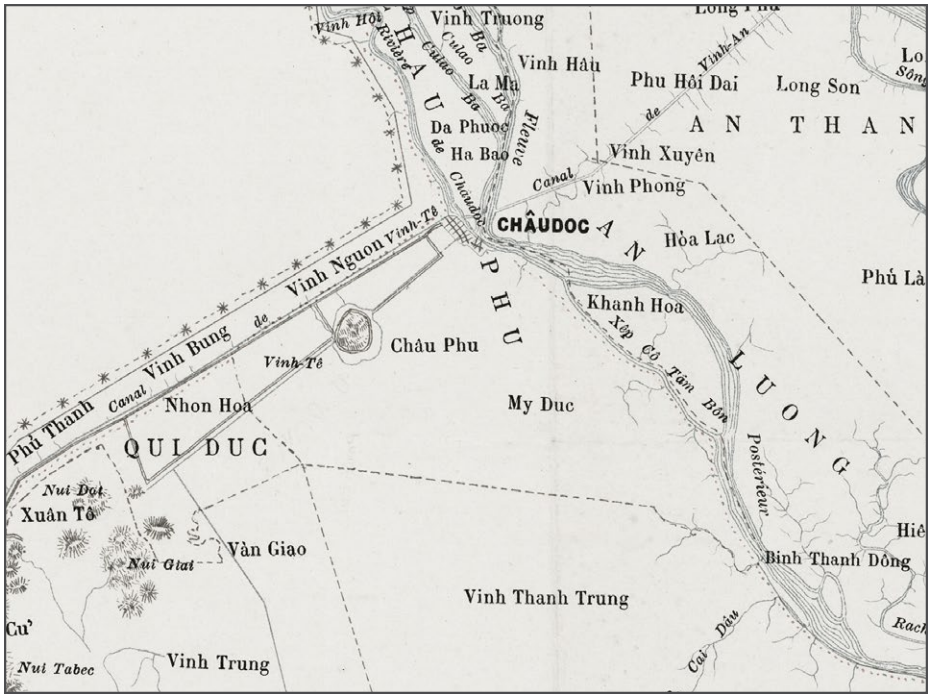
The province is currently facing ongoing challenges with water management at macro- and micro-scales for supply, sanitation, and wastewater management. However, vernacular systems of conserving water—such as the household pond—are reduced in their efficiency to manage contaminants in waste.[1] Around the same time, flood cycles are also increasingly exploited by high dike fields to meet needs for commercial agriculture *(figure 2.1.28)*. The side-effects of industry and modernization are a volatile disruption of natural systems in rural areas, limiting the potential of vernacular methodologies in a smaller, self-sustaining system. *(figure 2.1.26)*

The infrastructural networks of the province are a result of an intensive water-control system, contributing to its hybridization of natural and manmade waterways. As modernity continues to influence the region, thoughts of sewage systems where treatment is not dealt with via the household, but dependent on local government services increases detachment between rural populations and the landscape by removing the natural aspect of wastewater processes from household functions.[2] Modern and centralized sewage systems are not viable due to underdeveloped roadways and limited access to many rural households. In addition to this, homes in the region are constructed with a raised typology to avoid flooding and dust from the roads *(figure 2.1.27)*. Many informal waste management systems are located directly beneath homes due to the limited number of hygienic toilet typologies for raised homes.

1 Le, Anh Tuan. 2006. "Đề xuất các Giải pháp Công trình cho Cấp nước và Vệ sinh Nông thôn tỉnh An Giang" [Proposed Engineering Solutions on Water Supply and Rural Sanitation For An Giang Province]. Can Tho: Can Tho University, 2.

2 Schneider, Daniel, "Hybrid Nature Sewage Treatment and the Contradictions of the Industrial Ecosystem." *American Council of Learned Societies.* ACLS Humanities E-Book (Series). Cambridge, Mass.: MIT Press, 2011. Within his book, Schneider explores the history between society and nature in relation to the development of the wastewater treatment plant. He argues that wastewater treatment is an ecosystem itself, but dependent on the extent of human interventions. These industrial systems pose contradictions on how wastewater and excreta treatment done with natural processes is reverted to its former origins, not developed to a new form. An example he provides is of the development of a "Living Machine" used to treat blackwater using natural processes – which performs as a naturalization of industry today.





Map of Chau Doc produced by the French Colonialists in 1890.
Source: Ménard, L. "Chau Doc 1890." Digital image. Wikimedia Commons. April 24, 2014.



figure 2.1.23
View of rice fields and canal from Nui Sam. Vinh Xuyen, An Giang.
Photo by author, 2018.





figure 2.1.24
View of rice fields and canal from Nui Sam. Vinh Xuyen, An Giang.
Photo by author, 2018.



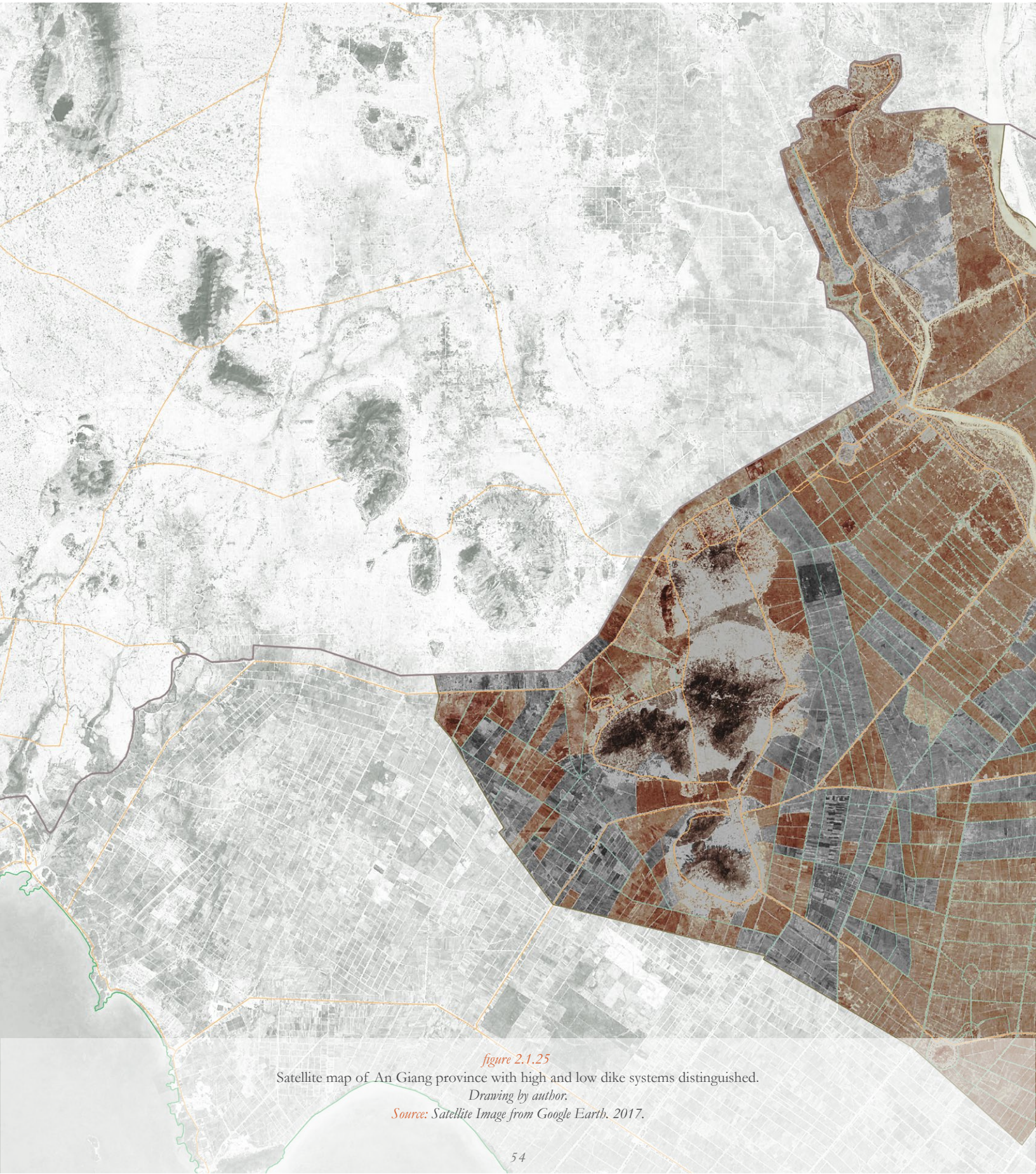


figure 2.1.25
Satellite map of An Giang province with high and low dike systems distinguished.
Drawing by author.
Source: Satellite Image from Google Earth. 2017.



high dikes

low dikes

border

national roads

secondary road

70% of the province has been constructed with high dikes, which do not allow flooding but increases its severity in low dike regions.

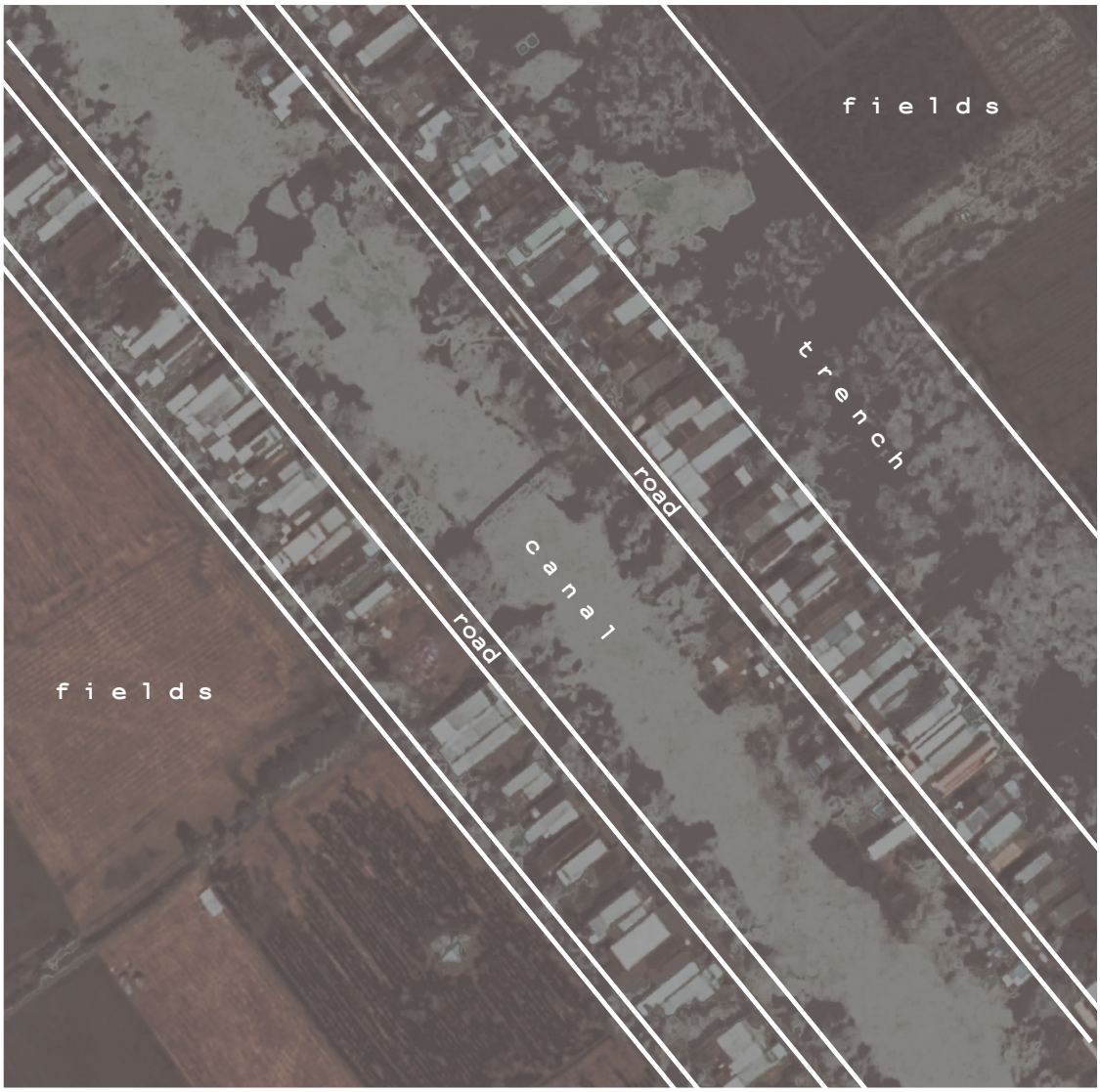
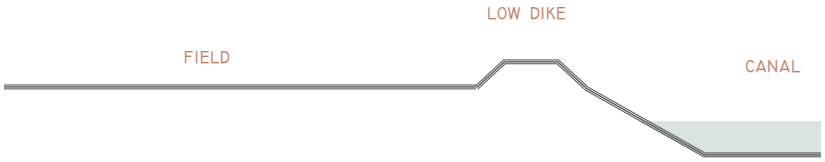
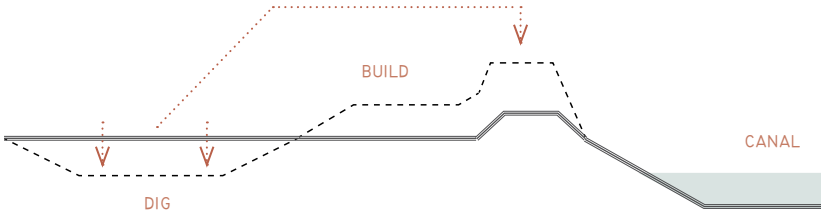


figure 2.1.26
Diagram of string-typology housing settlement along roads and canal.
Drawing by author.

01 *Field with low dike*



02 *Field soil removed to create higher road and foundations*



03 *Newly constructed high dike with homes*

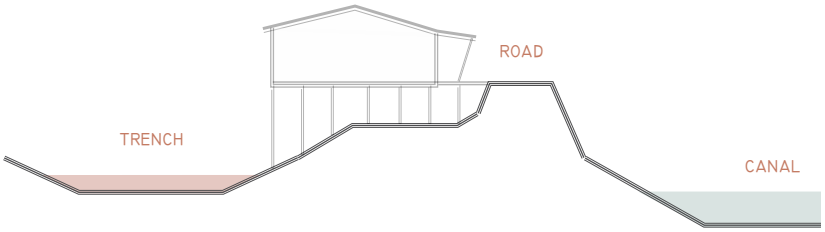


figure 2.1.27
Process of high dike and resultant trench construction.
Diagram by author.

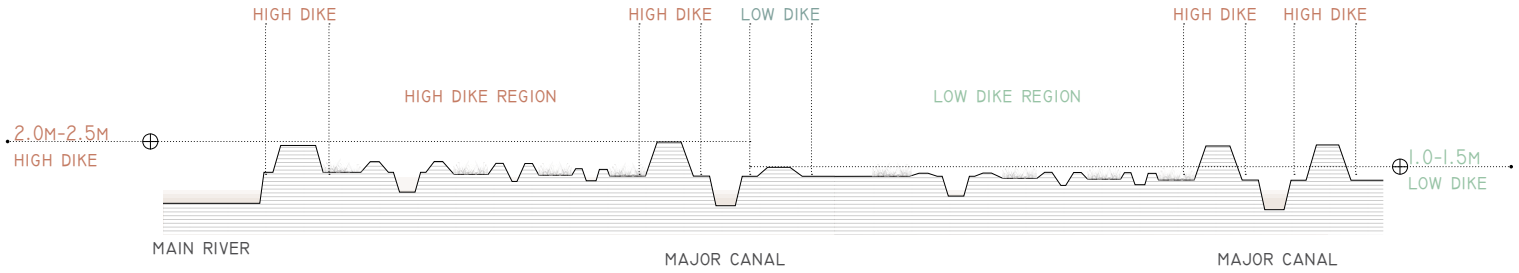


figure 2.1.28
Section of high dike and low dike conditions in the dry season.
Diagram by author.

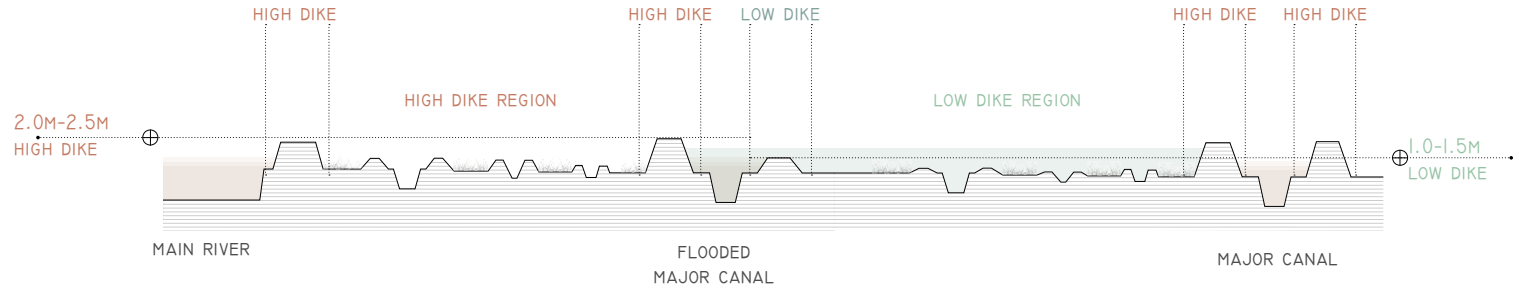


figure 2.1.29
Section of high dike and low dike conditions in the flood season.
Diagram by author.

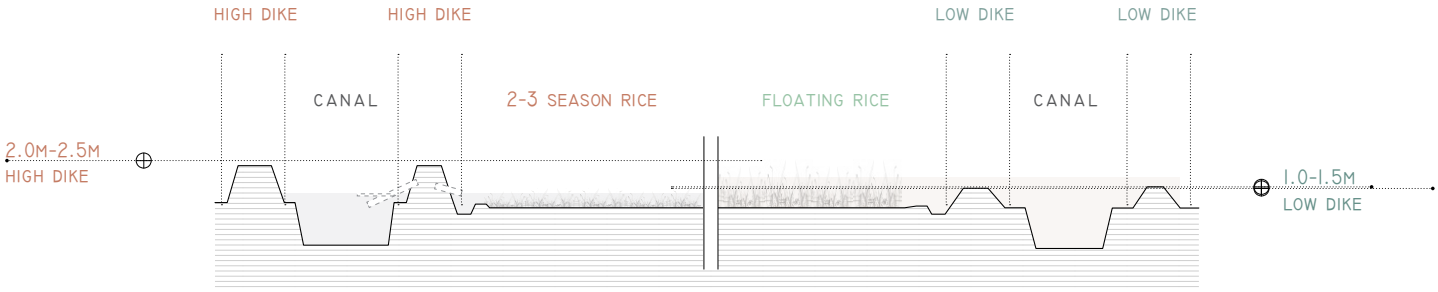


figure 2.1.30
Section of 2-3 season rice fields in controlled irrigation and flood conditions.
Diagram by author.

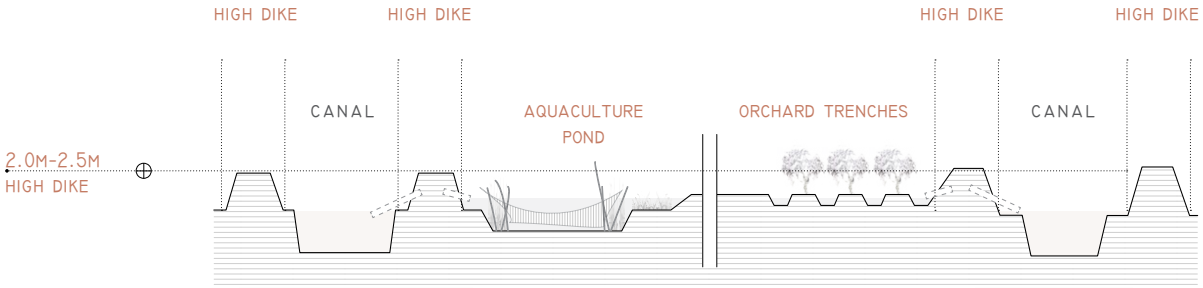


figure 2.1.31
Section of various land uses including forests, upland crops & aquaculture.
Diagram by author.

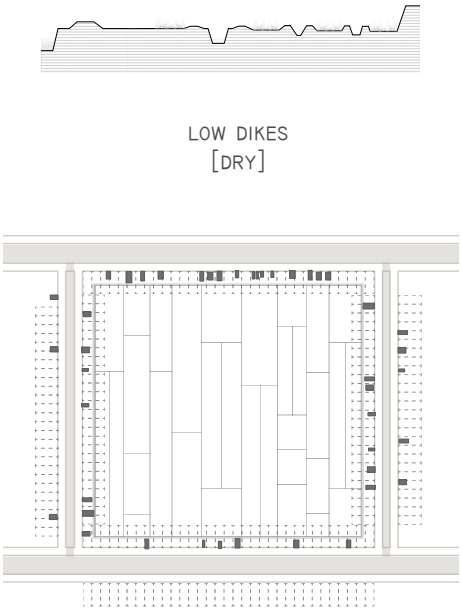


figure 2.1.32
Diagrams of low dike field in the dry season.
Diagram by author.

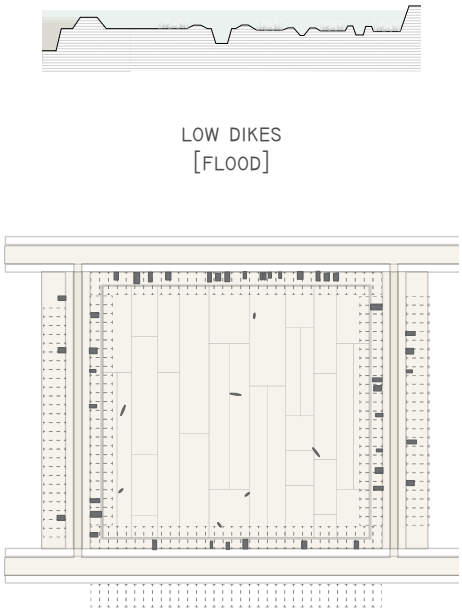


figure 2.1.33
Diagrams of low dike field in the flood season.
Diagram by author.

Low dikes (also known as August dikes) are 1.0-1.5m high *(figure 2.1.31)* and allow for floods to inundate the fields naturally in August as flood levels rise. In the dry season, the soil is typically acidic with farmers depending on flood waters to flush acidic soil away from the fields *(figure 2.1.41)*.

These regions significantly change the physical form of the landscape in the flooded months of the year, causing inaccessibility to services, roads, and infrastructure *(figure 2.1.40)*. At the same time, these areas also provide an equalizing effect for poor farmers who depend on fishing as an economy during the flood season with little overhead costs *(figure 2.1.42)*.[1]

1 Howie, Charles Alexander. *Co-operation and contestation: farmer–state relations in agricultural transformation, An Giang Province, Vietnam*. MSc Thesis, University of London, UK, 2011. 165.

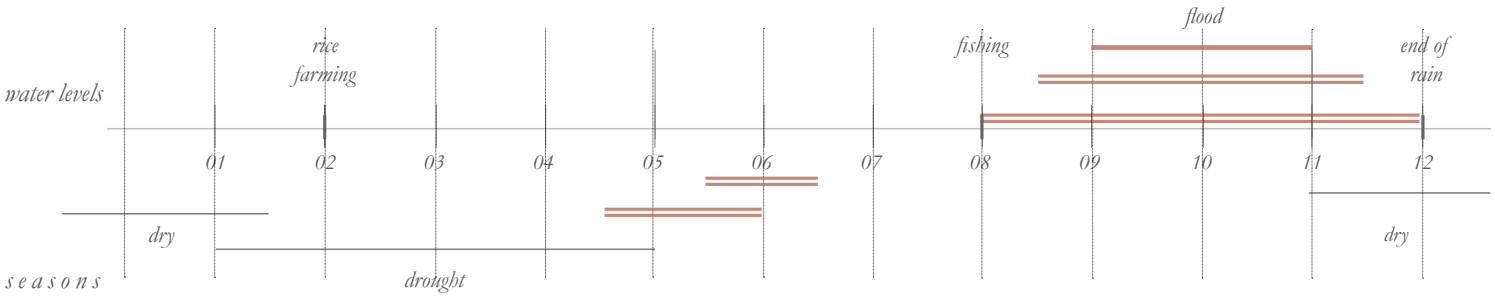


figure 2.1.34
Flooding and water level calendar for low dike fields.
Diagram by author.

Free Goods from Flooded Fields:

+ Water Chestnut
+ Fish
+ Shrimp
+ Crabs
+ Wild Fish
+ Yellow Snail
+ Rice Stubble
+ Eels
+ Alluvial Sediment
+ Ducks
+ Water Flow

figure 2.1.35
Free-goods of flooded fields.
Source: Howie, C. 165.



figure 2.1.36
Amphibious home in a floating rice field during the flood season.
Photo by Pham Duy Tien, 2018.



figure 2.1.37
View of floating rice field during the flood season.
Photo by Pham Duy Tien, 2018.

root vegetables, chives, various crops

when floating rice is not grown in these fields, the soil is suitable for growing other dryland crops such as jicama, taro, and chives, allowing for a variety of harvest throughout the year.



economy + labour

jobs are abundant in the rice field during the dry season. however, during droughts, the dependency on livestock is much higher

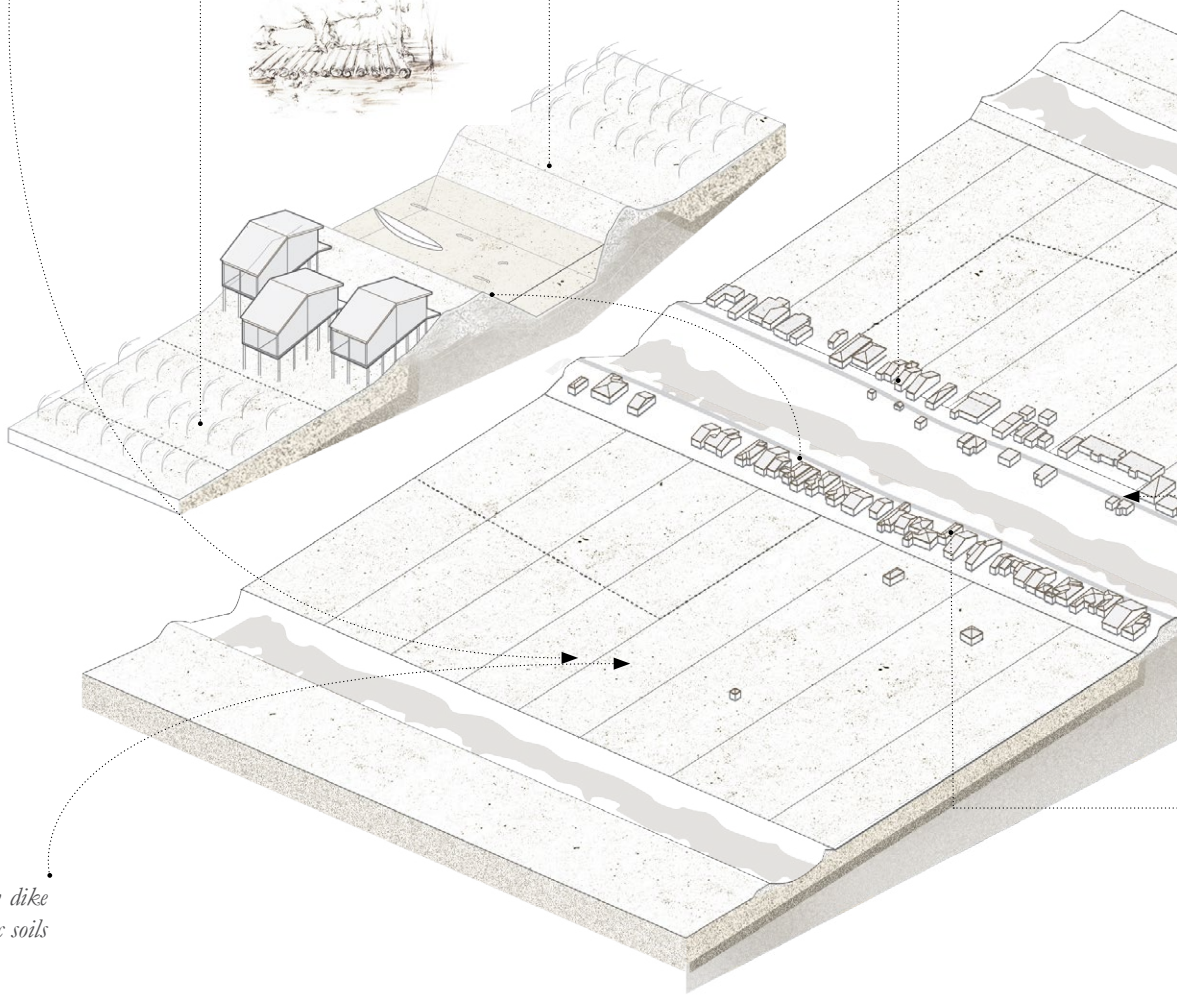


transportation

road become damaged after the flood season, causing many to require repairs

health

drought conditions at the end of the dry season are difficult for households who require access to water.



double-crop rice

double-crop rice is common for low dike areas, where floods flush away acidic soils after the harvest is done in august



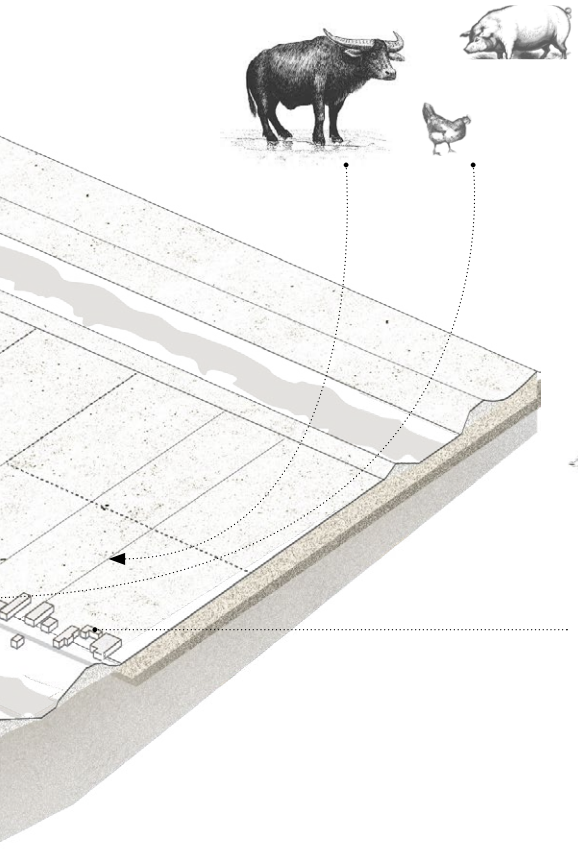
figure 2.1.38

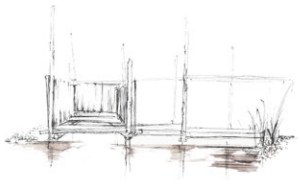
Swath of dry low dike systems with social and agricultural/ecological conditions.
Diagram by author.

agricultural/ ecological conditions
factors affecting land use, ecological health and landscape

socioeconomic conditions
factors affecting livelihoods, economy, health and labour

livestock
during the dry season, livestock can inhabit fields dropping waste as natural fertilizer. water buffalo are used to plow the rice fields at the start of the growing season.



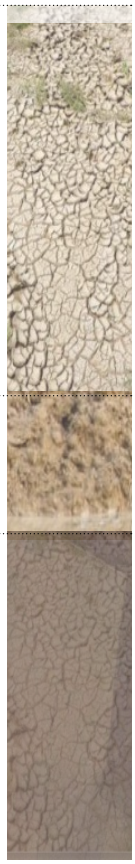


sanitation
during dry conditions, many houses use ditches or use latrines hanging directly over canal systems. sometimes the waste is mixed with livestock waste into ponds that must be dredged each year before the flooding.



water quality
many residents rely on rainwater harvesting and storage to last them through the dry season. if the water runs out, many resort to surface water if they cannot purchase bottled water.

soil conditions
[acidic soil]
rice fields in the dry season naturally become acidic after the rice is harvested. the field is cleared and husks are used for building materials, thatch, fertilizer, insulation, and other various functions. the field is prepared for the flooding in august through plowing.



economy + labour

due to the changes in the landscape, many households must taken up secondary jobs to make money during the flood season.

transportation

during the flood season, many roads become inaccessible and make travel much more difficult to services and schools.

health

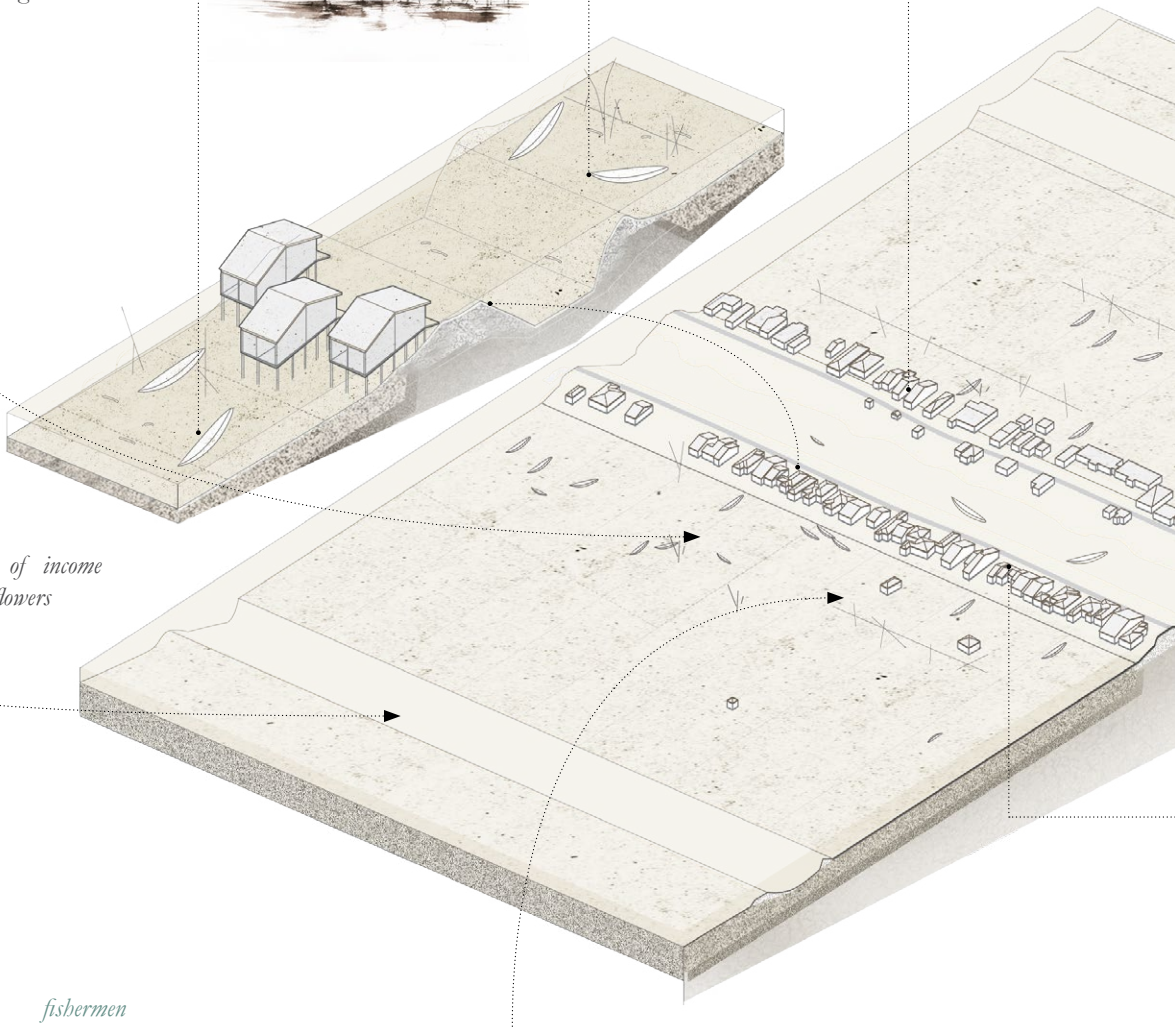
many homes who cannot afford to raise their elevations become inundated by flood levels.
many children drown in flood waters each year.

floating rice

floating rice is a special type of rice that can only be grown in the flood season. it has the ability to adapt to flood conditions by growing higher with the water.







harvesting

farmers have an additional source of income from harvesting aquatic plants and flowers



fishermen

during the flood season, poor fishermen have an additional source of income from fishing and gathering shrimp and snails







figure 2.1.39
Swath of flooded low dike systems with social and agricultural/ecological conditions.
Diagram by author.

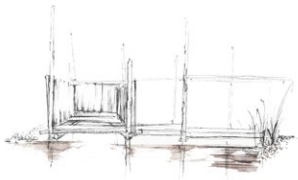
agricultural/ ecological conditions
factors affecting land use, ecological health and landscape

socioeconomic conditions
factors affecting livelihoods, economy, health and labour

livestock
all livestock must remain on higher dike areas or are placed on floating rafts above the water.

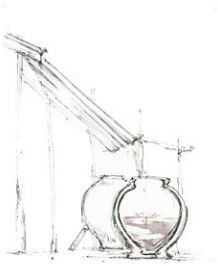






sanitation
during the flooding season, septic tanks are clogged and latrines are sometimes lower than the water level. in this season, there are no boundaries for the water and open-defecation happens into surrounding waters.

water quality
due to the flooded landscape, the water is mixed with a large amount of contaminants and pollutants - from the area as well as upstream users.



soil conditions
[alluvial soil]

in august, flooding inundates the rice fields naturally after heavy rains, and flushes out acidity in the soil. the flood waters carry upstream nutrients to restore the soil conditions. the water flushed from the fields is called "nuoc bac" or "silver water", due to its silvery, light-green colour that appears as it flows into the waterways.

alluvial soil from flooding

topsoil

plowed field

subsoil



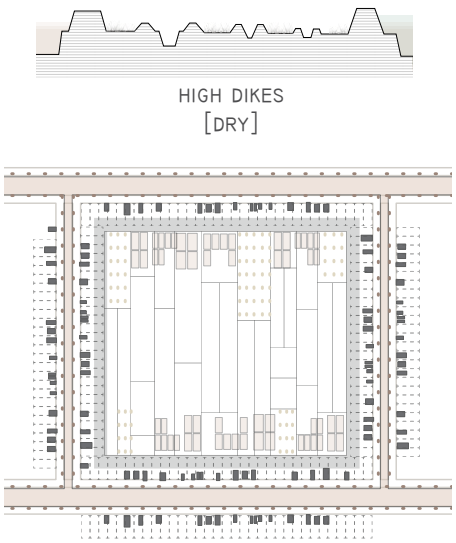


figure 2.1.40
Diagrams of high dike field.
Diagram by author.

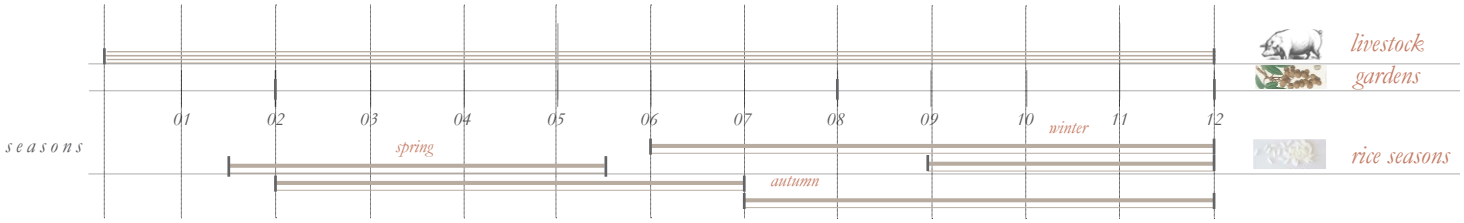


figure 2.1.41
Seasonal calendar for high dike field crops and livestock.
Diagram by author.

High dikes are 2.0-2.5m high *(figure 2.1.31)* and are mainly located in the upstream areas of An Giang province. These regions are typically higher in population density due to ease of access to infrastructure.

When high dikes are constructed, different benefits and drawbacks occur in comparison to low dikes (or August-dike fields). *(figure 2.1.46)* By omitting the entrance of flood waters year-round, crops can be grown in the field similar to an upland region without preparation for the flood season. *(figure 2.1.47)* This allows for year-round employment within the areas, as travel and access is easier reducing limitations for access to schools, health, and trade. Household diversification is also possible as homes can be constructed to anticipate protection from flooding year-round.[1] In terms of infrastructure, electricity and water infrastructure now have a higher road to run along, reducing limitations to the infrastructure in the flood season. This also allows for the use of toilets with flushing from water supplies, and if homes are built deep enough into the dikes, toilet pits for septic tanks can also be dug.[2]

1 Howie, Charles Alexander. *Co-operation and contestation: farmer–state relations in agricultural transformation, An Giang Province, Vietnam.* MSc Thesis, University of London, UK, 2011. 174-176.
2 Ibid.



figure 2.1.42
Aerial view of high dike fields and canal with orchards and 2-3 season rice.
Photo by Pham Duy Tien, 2018.

However, with these gains are also ecological and socioeconomic drawbacks. As floods are discontinued, less organic and inorganic alluvial sediment is able to enter the fields. In Howie's interviews with farmers, soil quality was determined to be better before the dikes were raised. Pollution tends to accumulate in the field from heavy usage of pesticides and fertilizers resulting in stagnant fields harmful to the health of residents.[3] In addition to this, "free goods" as described in the previous section for low dikes cannot appear, reducing the equalizing effects for landless residents that inherently increases the dependence on a stable economy and employment for families. The flood season also acted as a "resting season" for farmers and workers, which has become obsolete through the modern economy as farmers do not make enough to pay for their incurred costs within this season.[4]

Between Vietnam and the Cambodian border, the presence of high dike fields are obvious through the barring of flood waters flowing from Tonle Sap lake *(figure 2.1.48) (figure 2.1.49)*. Although their intensive uses for controlling irrigation within the fields are prevalent, recent flood events have caused many dikes to collapse, resulting in damaged homes built without flood protection.

3 Ibid.
4 Ibid.

fruit trees and flowers
high dike regions allow for upland fruit trees to be grown in the fields. flood waters cause damage to the plants which take many years to reach maturity.



economy + labour
there are a variety of jobs due to the diverse range of crops and livestock. fruit trees require intensive labour creating incentives to living near high dikes.



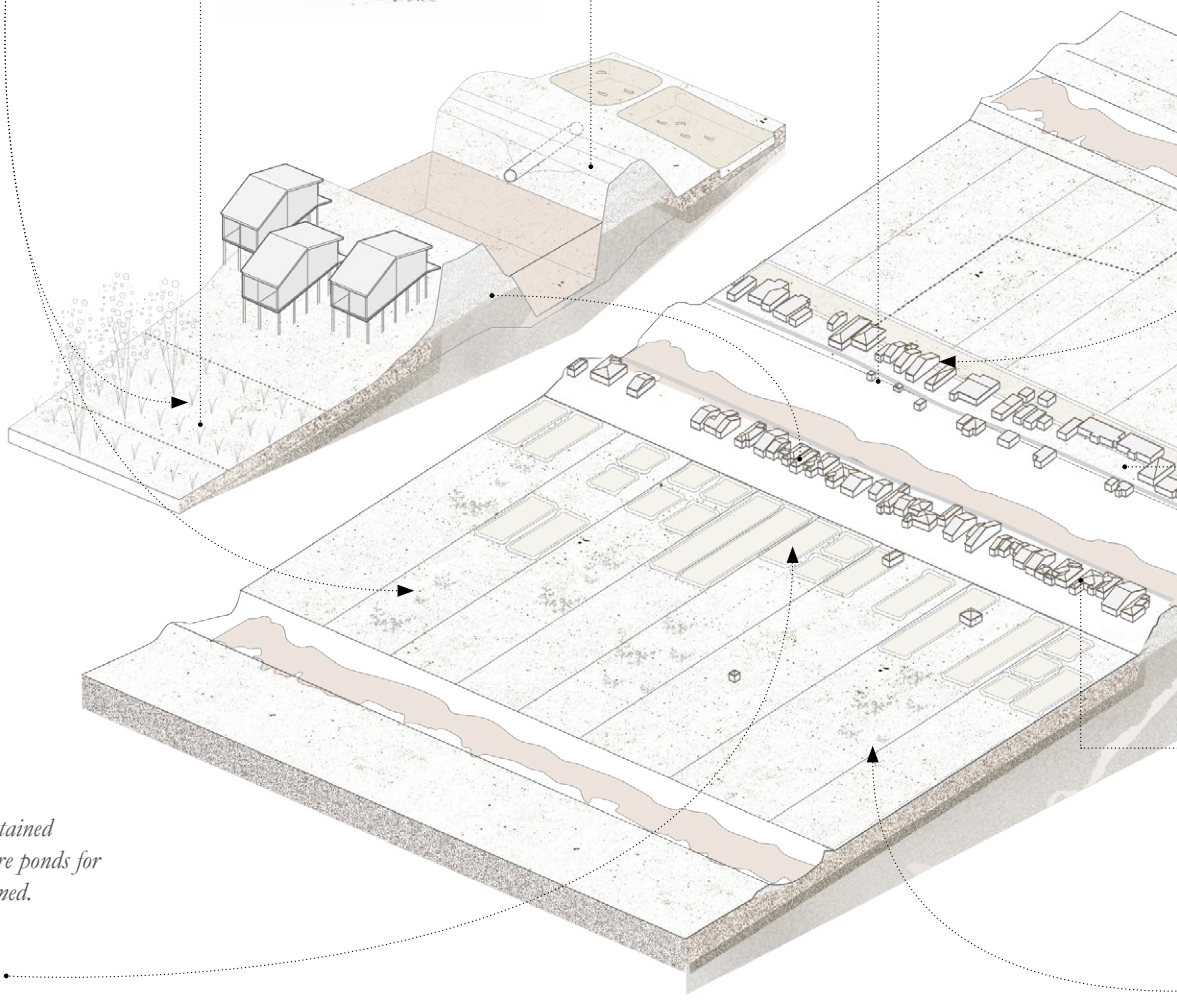
transportation
high dikes allow year-round transportation for villagers.

health
access to hospitals and limited risk of flooding are benefits to high dikes. dengue fever due to sitting water in canals and drainage systems are one of the increased risks.



pesticides
the lack of flooding increases the chances of pest outbreaks and infestations in crops. for fruits, heavy pesticides are used to ensure decent harvest.





aquaculture ponds
protection from flooding allows maintained separation of commercial aquaculture ponds for various fish and eel species to be farmed.

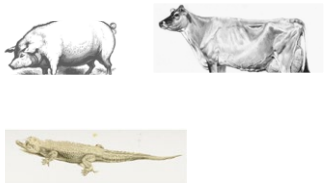


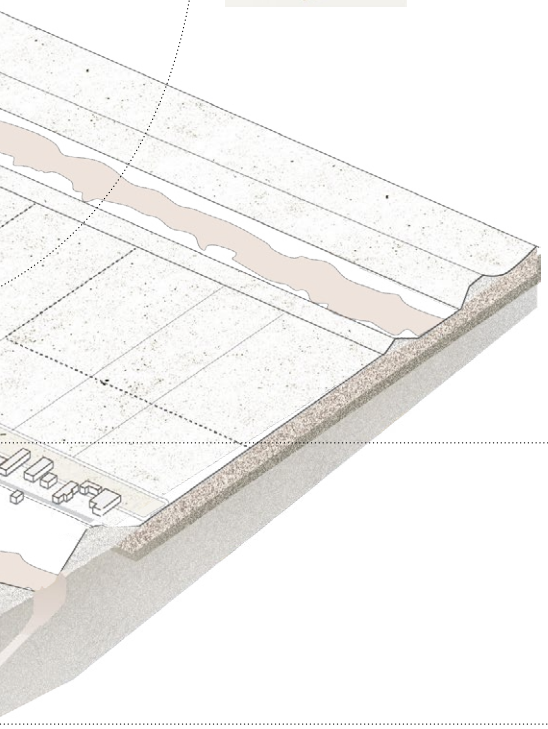
figure 2.1.43
Swath of high dike systems with social and agricultural/ecological conditions
Diagram by author.

agricultural/ ecological conditions
factors affecting land use, ecological health and landscape

socioeconomic conditions
factors affecting livelihoods, economy, health and labour

livestock
high dikes allow for livestock pens to be built within the fields without risk of flooding. more variety of livestock can be grown such as crocodiles, ducks, etc.







sanitation
the high dikes allow for easier transportation by road and infrastructure networks due to constant dry conditions. septic tanks are viable for wider major roads for wealthier households.

water quality
wealthier users have access to groundwater wells, while poor users are forced to use surface water sources. run-off from agricultural fields carries a large amount of artificial fertilizers, and pesticides into the water. the nutrients cause eutrophication in the waterways, killing many fish due to lack of oxygen in the water. pesticides pose a health risk for those who bathe and consume the water, causing many rashes and blindness among downstream users.

soil conditions
[alkaline soil]
the maximized production of rice for three seasons negatively affects the soil conditions. without flooding, soil conditions remain acidic and are incapable of flooding out toxins, pesticides and old nutrients from the field. the field becomes dependent on external artificial and chemical fertilizers to sustain crop growth. high dikes also prevent alluvium and organic matter from entering the fields.



triple-crop rice
high dikes allow for rice to be grown year round, where flooding is controlled via pumps at dike sluice gates. artificial fertilizers and pesticides are required to keep the crop healthy until harvest.





figure 2.1.44
Aerial view of high dike canal with string-housing typology.
Photo by Pham Duy Tien, 2018.

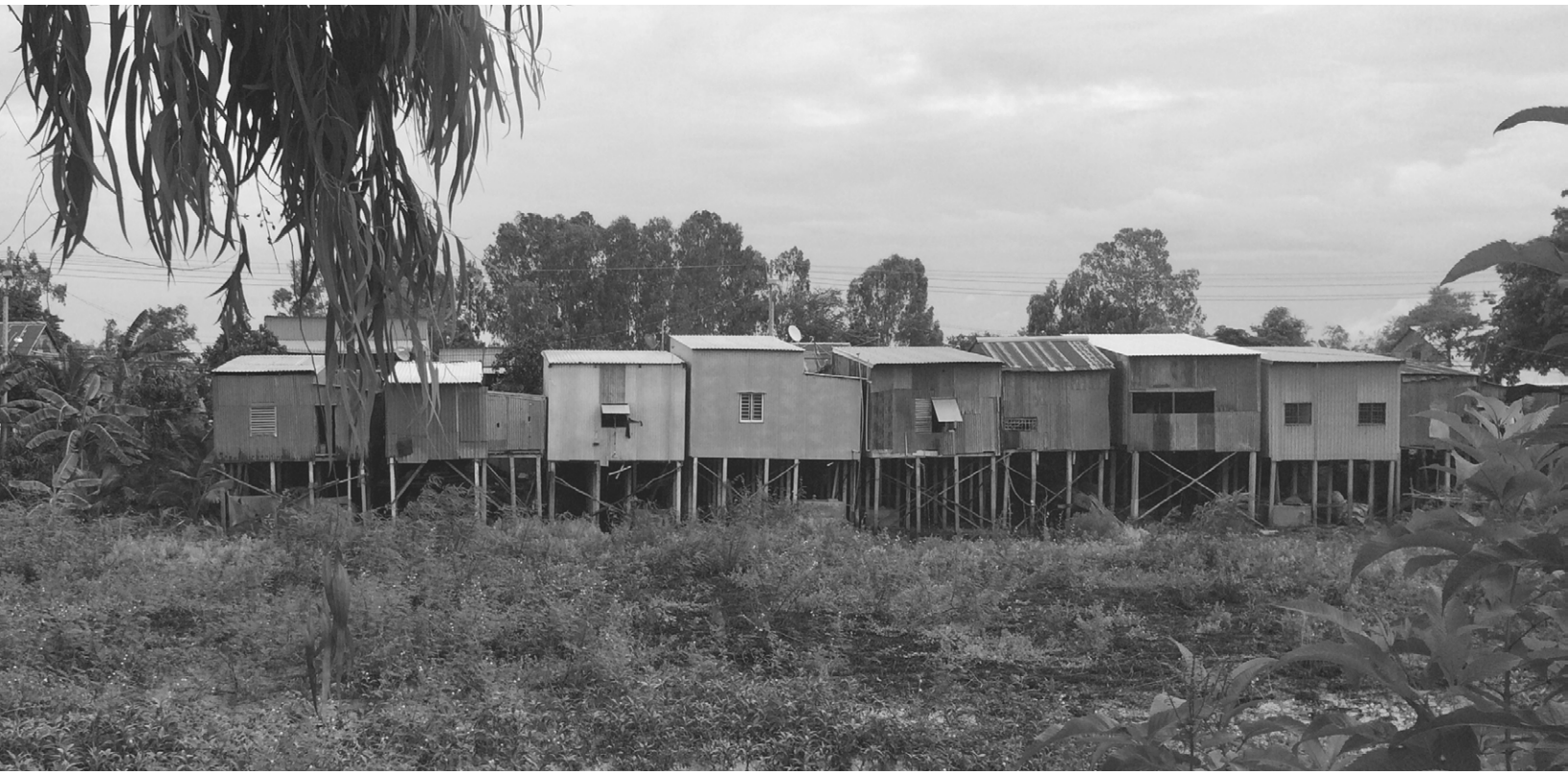
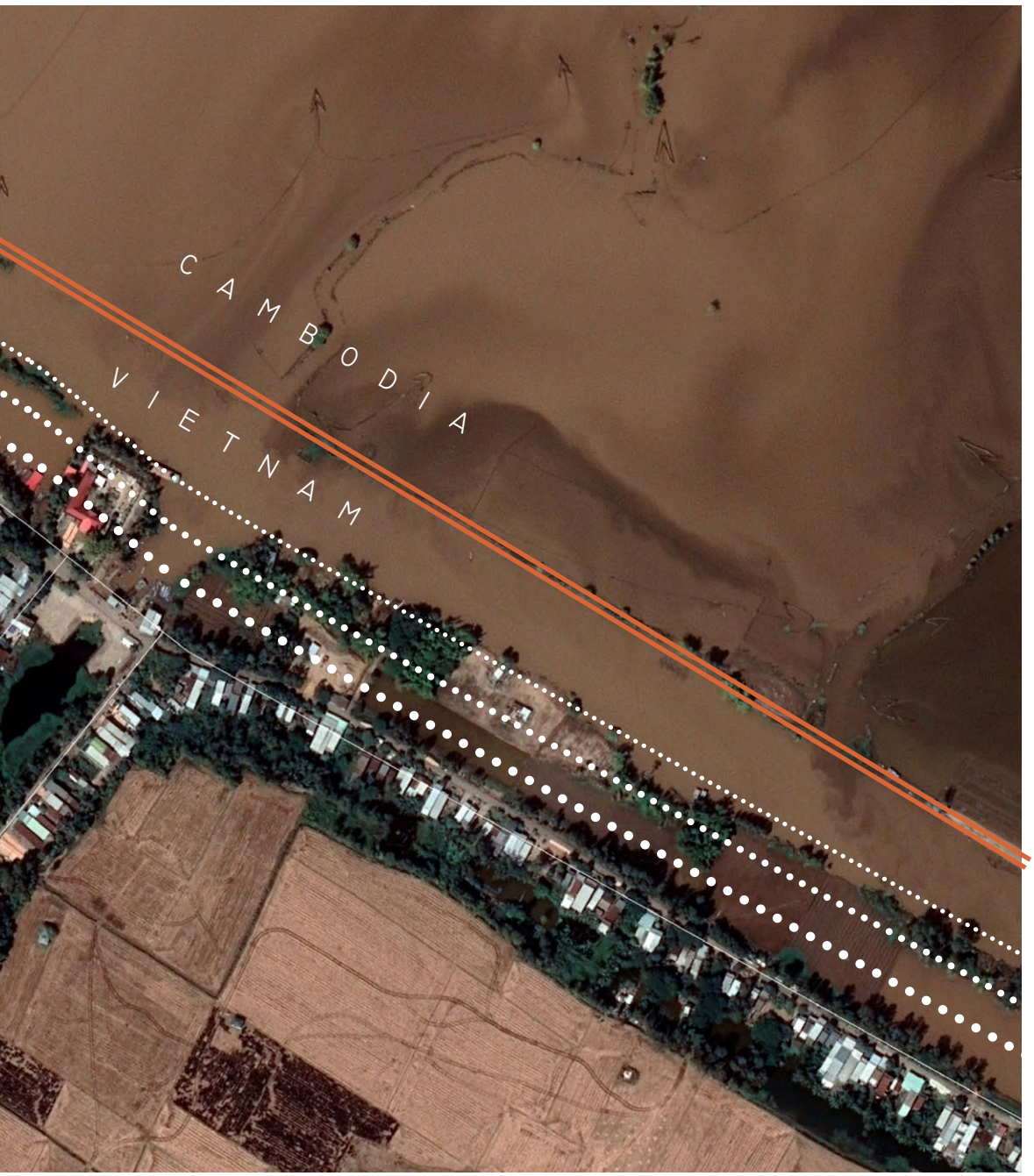


figure 2.1.45
Raised homes along canal Vinh Te.
Photo by author, 2018.

February 05 2007
[dry season]





NOVEMBER 29 2017
[FLOOD SEASON]

LOW DIKE ROAD
CANAL
HIGH DIKE ROAD
TRENCH

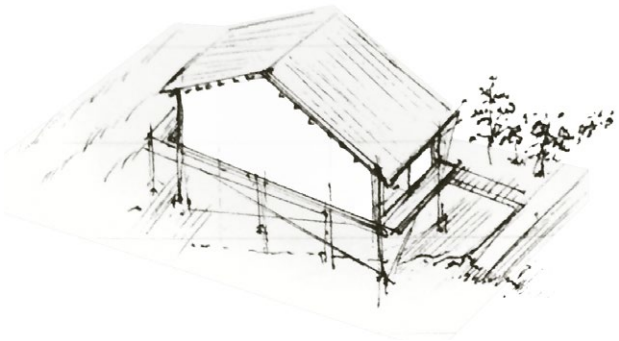
figure 2.1.46
Satellite imagery of a changing landscape at Vinh Xuyen village
Source: Google Earth.

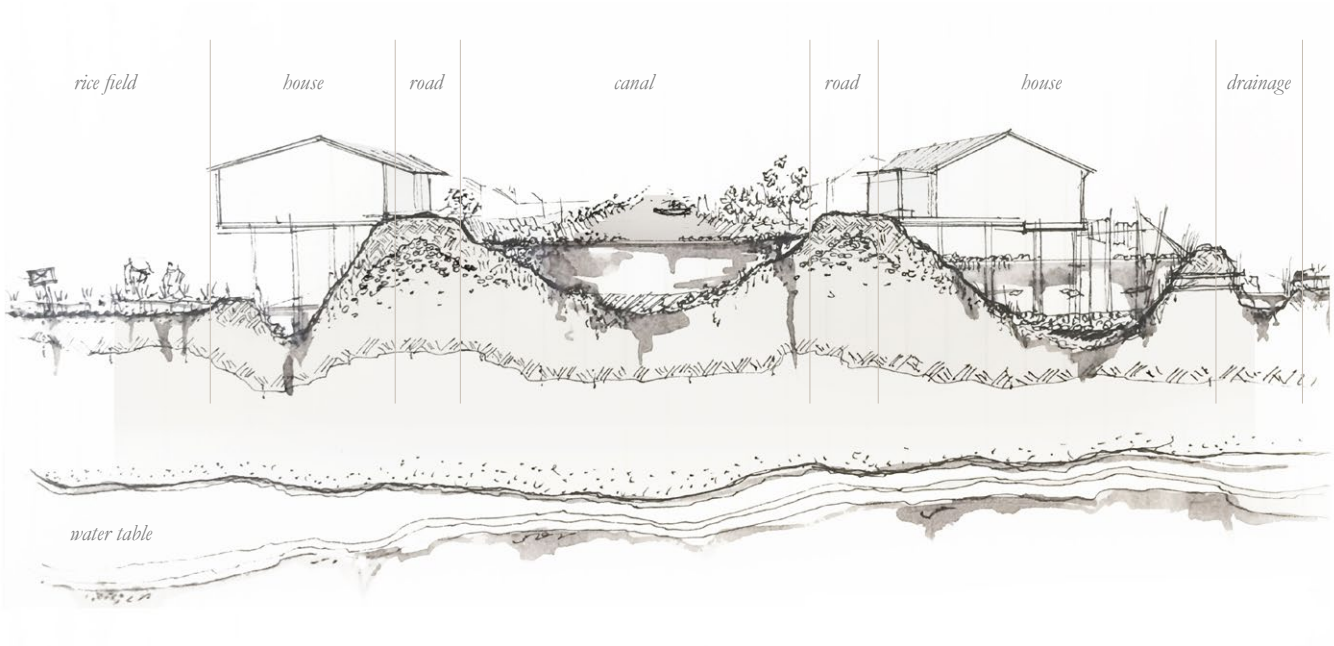


figure 2.1.47
View on a canal in An Giang province.
Photo by author, 2018.

Many homes in the province are constructed with a porch facing the road and a back of house over the water. Between the porch and the back of house is the living and sleeping area, typically accompanied by a religious altar for ancestors *(figure 2.1.50)*. The typology functions well due to the location of the water-related spaces—kitchen, washing and latrine areas that directly drain into the body of water—whether it be a trench, river, canal, or pond.

The elevation of the home is sometimes lowered as the home extends deeper into the lot. The back end is typically lowered to allow access and drainage to the water *(figure 2.1.52)*. The front of the home is typically raised to allow for easy access and reduce dust and debris from the road from entering the home. Elevations of the homes are highly dependent on the road height. Along the Cambodian border, homes reaching raised heights of six to seven metres off the ground were common. Areas backing onto a trench typically had lower elevations due to the difference between the height of the road and the field itself *(figure 2.1.54) (figure 2.1.57)*.





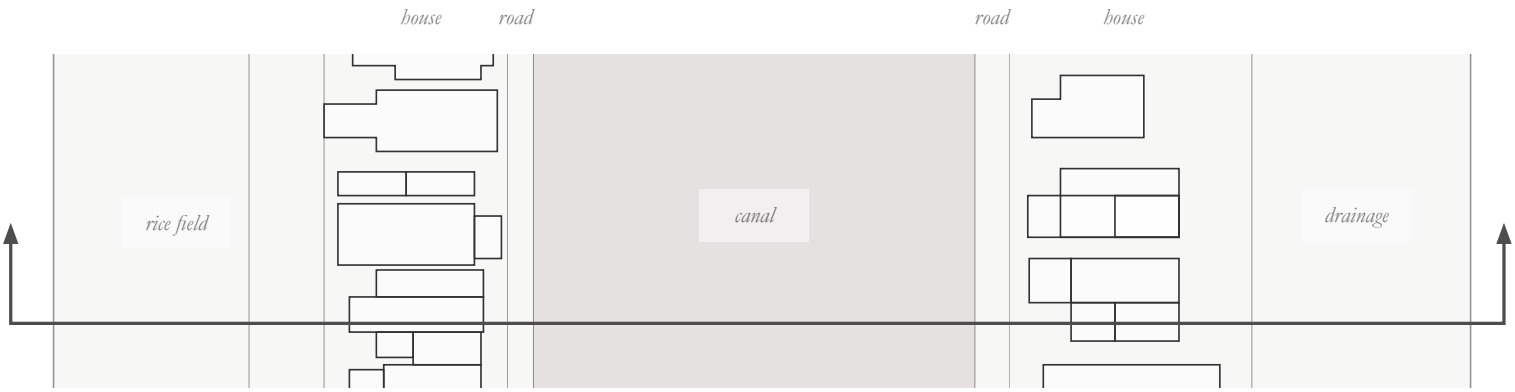


figure 2.1.48
Plan and section of typical homes over a major canal in An Giang province.
Drawing by author.



figure 2.1.49
Rear view of houses along a rice field in An Giang province.
Photo by Trần Văn Năm, Google Photos.





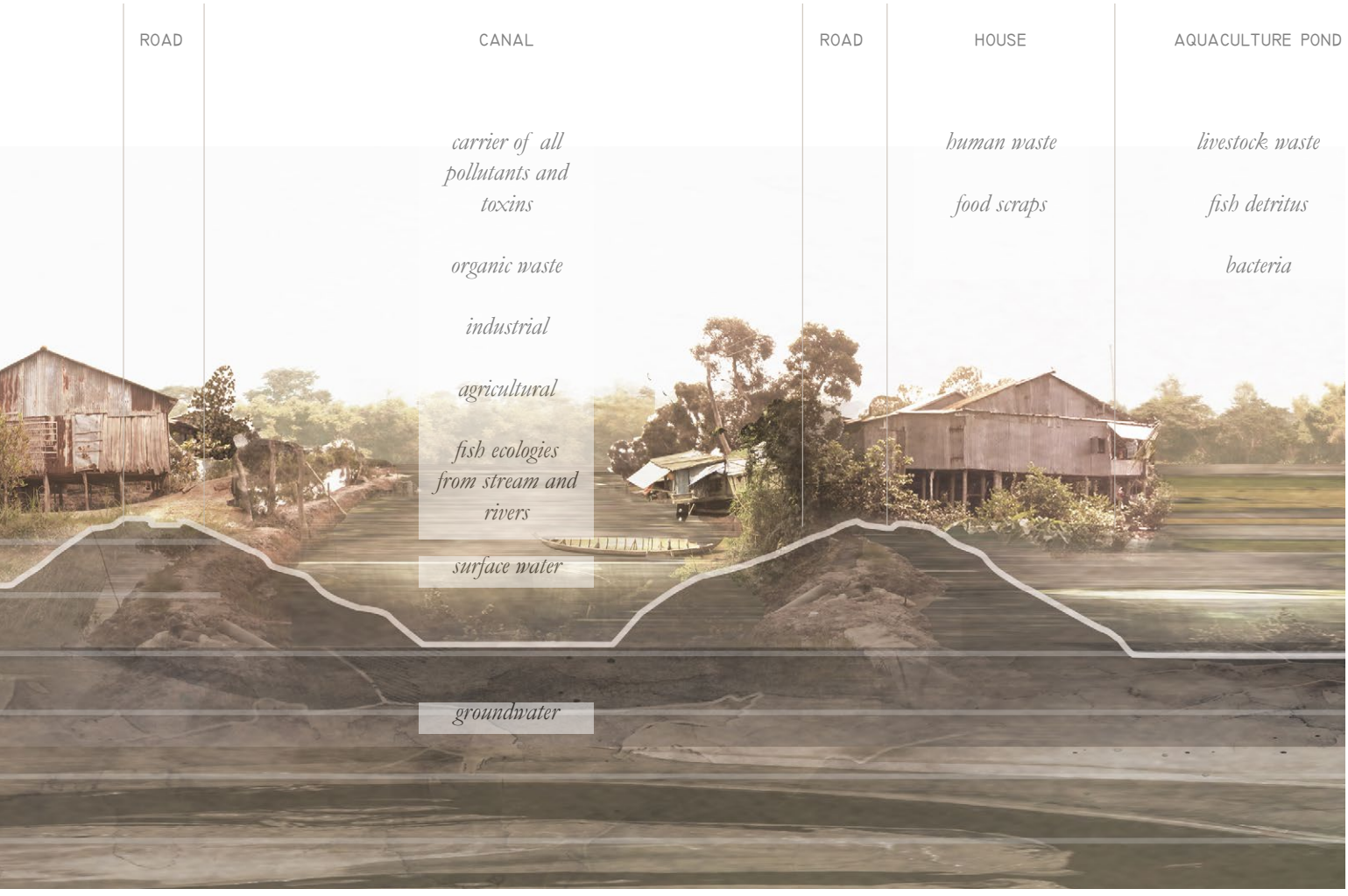


figure 2.1.50
Sectional perspective of canal, road and fields.
Drawing by author.



figure 2.1.51
Model of string-housing typology. Wood, plexiglass, and 3D printing filament.
Model by author.

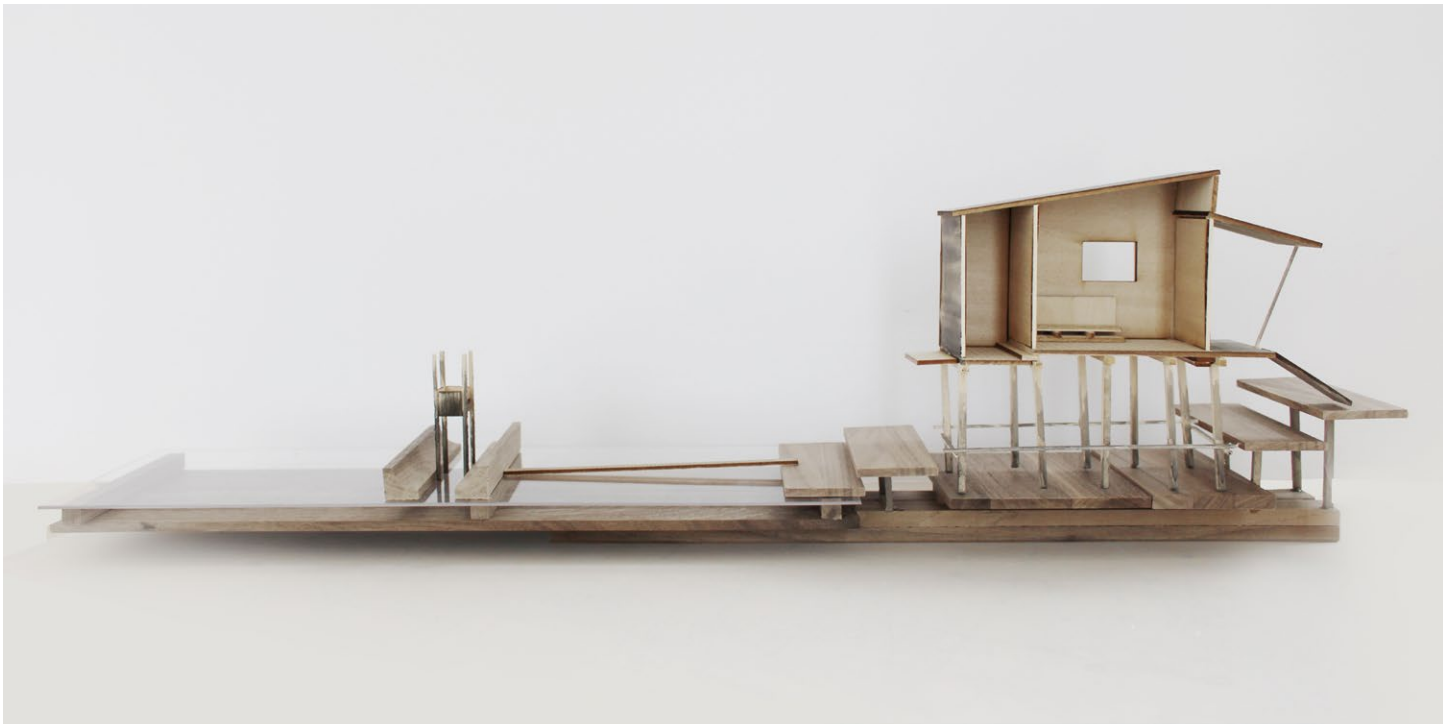


figure 2.1.52
Sectional model of existing home and pond.
Model by author.



figure 2.1.53
Model of string-housing typology. Wood, plexiglass, and 3D printing filament.
Model by author.

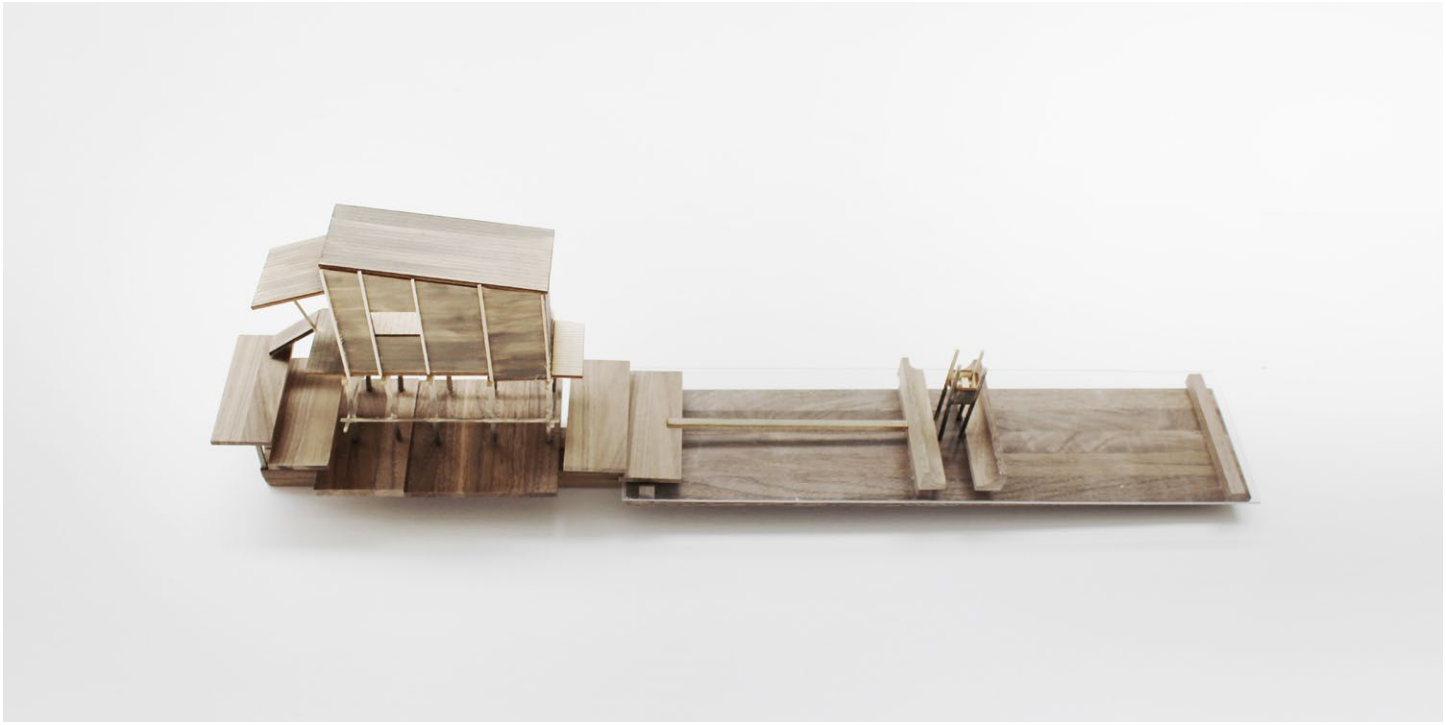
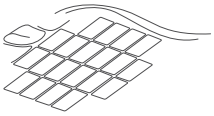


figure 2.1.54
Sectional model of existing home and pond.
Model by author.

modernity: design principles

released systems & adaptive infrastructure

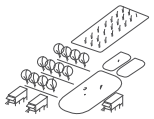


modernity ← *landscape* → *system*

Design principles stem from the naturalization of water systems,
the relationship between settlement patterns and the hydrological landscape,
and the adaptation to different seasonal cycles utilizing the benefits of high dike and low dike systems.

part 2.2





pollution

fields of industrial agriculture

This chapter focuses on pollution at the scale of a field, and its definition as different chemical constituents and nutrients within the water system and soils. Pollution is seen as a mismanagement of these factors—or following Douglas' theory of matter out of place—with opportunities for mediating nutrient cycles and leakages within a given system.



figure 2.2.1
Pesticide advertisements on a rice field in An Giang.
Photo by author, 2018.


Anti-xo
200WP
TROBIN TOP
325SC



saigon
[south]



hanoi
[north]

figure 2.2.2
Water Without Boundaries. Laser-cut plexiglass on watercolours & mylar. 6-0" x 18-0".
Model by author.

1. hanging latrine.



2. livestock.



3. agricultural pollution.



4. drainage.



5. drinking.



6. bathing.



figure 2.2.3
Water uses and effects.
Photos by 1. Truong Tuan Thanh Tran, 2. Anders Dalsgaard, 3, 4, 5 & 6. Luc Forsyth.

2.2.1 Mass Production - "Rice-First Policy"

Prior to the *Đổi Mới* period in 1986, the new socialist-oriented economy followed the Soviet model of industrial development; it maximized production but failed to regulate industrial and agricultural waste *(figure 2.2.2)*.[1] Seen as a "free resource" in this time, water was reduced from its former qualities as an important substance directly tied to livelihood and traditions to becoming a mere product for agricultural industrialization. When reformation of the country's market emerged after the 1980s, environmental resources were not valued unless used to produce for the global economy. This contributed to the machining of the landscape for production, resulting in disturbance to the country's mountains, forests and deltas.[2] The disruption of natural cyclical flows in the water system inherently affected all participants within these cycles. *(figure 2.2.3)* Water, as defined before with the pond, carries direct ties to health and culture, and therefore acts as a mirror to modernization by capturing all negative traces and actions within it.

During the 1980s and 1990s, rice production became a necessity for Vietnam's development in the global sector *(figure 2.2.6)*. In contrast to the famines that emerged during the recovery from the war, the deficit in rice had grown into a massive surplus economy with the export of low-quality shipments to other countries such as Africa, China and the Philippines.[3] This was reinforced by the "rice-first policy" which maintained quantities of rice-production, forcing the conversion of many fields and wetlands *(figure 2.2.1)*. Even recently in 2015, rice continues to be supported by the Vietnamese government with Decree No. 35/2015/ND-CP, making it more difficult for farmers to diversify their crops.[4]

1 Sikor, *Economic and Environmental Dynamics of Reform in Vietnam*, 603.
2 Ibid, 603.
3 Gro Intelligence. "Vietnam's Rice Caught Between Two Models of Development." Gro Intelligence. April 11, 2018. Accessed November 25, 2018. https://gro-intelligence.com/insights/vietnam-rice-caught-between-two-models-development. Decree no. 35/2015/ND-CP provides 500,000 VND ($21.73 USD) per hectare per year to farmers who have rice cultivation on their land. This creates incentives for farmers to maintain rice production for the country's quota expectations. However, moving away from rice is even more difficult due to the permissions required in order to diversify crops – as Decree 69 requires that rice farmers must receive proper permissions from local authorities in order to convert their rice production to alternative crops despite market prices and expenses.
4 Ibid.

2.2.2 Pesticides & Chemical Fertilizers

Numerous water sources, running like veins through the landscape, absorbed the consequences of industry and agriculture. Water now carried with it complex toxic and hazardous waste from industrial effluent and agrochemicals. New extensive industrial and agricultural contaminants included heavily used pesticides and chemical fertilizers to resist vulnerabilities in farming posed by altering flood cycles. These areas were typically rice fields and poorly-setup integrated farming systems, contributing to nutrient leakage.[5] Systematic pollution is seen as a mismanagement of nutrients due to inefficient farming mechanisms for maximized production. Due to the major changes in the wet and dry seasons brought about in the 1940s and accelerated within the 1980s, crops were vulnerable to pests that had been mitigated by natural landforms and flooding cycles. High-yielding varieties of rice from the highly-intensive systems that provide triple-crop seasons are more prone to disease and pests. Recently, rice production profits have declined due to the increased costs of inputs from imported fertilizers and agrochemicals. Vietnam now carries a reputation for its low-quality rice laden with heavy usage of pesticides.[6]

Quantity over quality has developed the rice mono-cropping landscape.[7] Rice-farmers have benefitted little from rice profits and sales. As prices continue to decline, production fails to meet household economic requirements for stable livelihoods and many farmers are forced to find income through other means of living. The socio-economic situation puts low-income farmers at risk for meeting day-to-day needs. Herbicides and pesticides are prevalent in order to prevent loss of crop yields and maximize agricultural output.[8] With this was the increased dependence on chemical companies that continuously fed the country's addiction. By importing pesticides from China, pesticide costs were lowered, justifying purchases by farmers in large quantities. However, high pesticide levels decreased the value of rice and resulted in small-profit margins for farmers. The resultant effects trickle down to hired labourers who are paid less each day.[9] However, at the same time, many farmers lacked the scientific knowledge behind the damaging effects of pesticide usage. During the sprouting season for the rice, farmers hire labourers to spray fields multiple times a day, paying out around 300,000 VND ($13.04 USD) on a daily basis.[10] As I witnessed in Tri Ton during the dry season, these labourers were also subjected to inhalation of pesticides due to the lack of protection and equipment while spraying the fields *(figure 2.2.4)*. However, the higher wages for labourers are desirable and health concerns are not always visible in the short-term.

5 Demonte. Matty, Pieter Rutsaert. "Article Restructuring the Vietnamese Rice Sector: Towards Increasing Sustainability." *Sustainability* 9(2), 325 (2017). doi.org/10.3390/su9020325, 2.
6 Ibid.
7 Ibid.
8 Ibid.
9 Ibid.
10 Anonymous Farmer. Personal Interview. May, 2018.

Loss of yield was feared as the harvest made up a significant portion of the household's income. In turn, the presence of these excessive spraying schedules within the natural cycle causes concerns with water usages as it spreads from the rice fields without boundaries.[11]

Metals and metalloids:

Cadmium (Cd), Chromium (Cr), Cobalt (Co), Molybdenum (Mo), Nickel (Ni), Zinc (Zn), Lead (Pb), Arsenic (As), Selenium (Se), Mercury (Hg), Copper (Cu), Manganese (Mn)

Nutrients:

(high concentrations suppress other nutrients and/or affect plant growth and aquatic life)
Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (C), Magnesium (Mg)

Salts and specific Ionic species:

Sodium (Na), Boron (B), Chloride (Cl)

Persistent organic pollutants (POPs):

Pesticides, Emerging Contaminants, Residual Pharmaceuticals, Endocrine Disruptor Compounds, Active Residues of Personal Care Products

figure 2.2.5
List of categories of high concentrations of chemical constituents in wastewater
Source: Scott, C.A., N.I. Faruqui, and L. Raschid-Sally. 2004. Wastewater Use in Irrigated Agriculture: Coordinating the Livelihood and Environmental Realities.

11 Sikor, Thomas O., and Dara O'Rourke, 605.



figure 2.2.4
Man spraying herbicides.
Photo by Luc Forsyth, 2015.

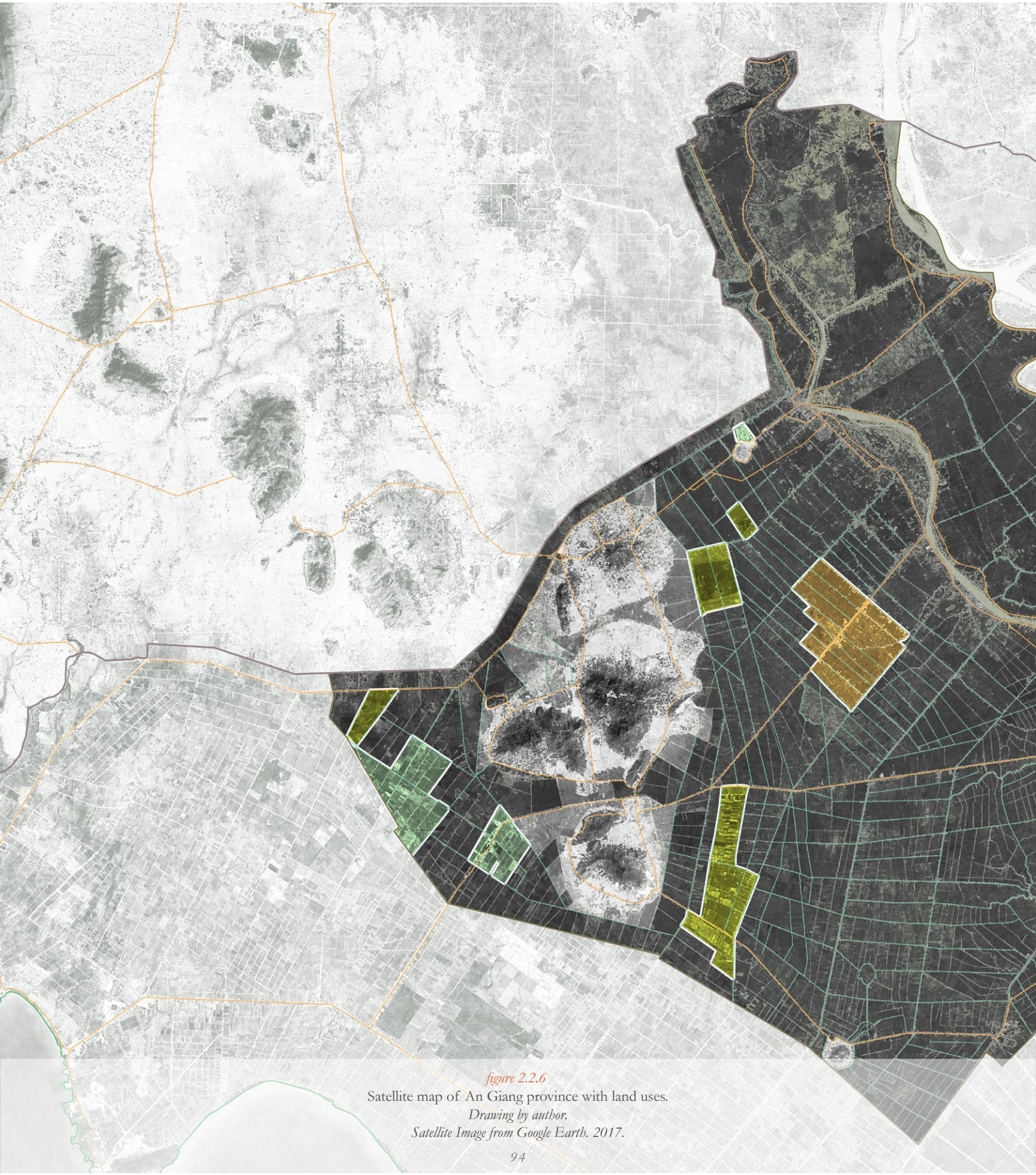


figure 2.2.6
Satellite map of An Giang province with land uses.
Drawing by author.
Satellite Image from Google Earth. 2017.



forested land

upland crops (chilli & maize)

rain + flood irrigated rice

irrigated 2-3 season rice

border

national roads

secondary road

This land use map of An Giang province visualizes the effects of the "rice-first" policy on the Delta. The rice dominant fields make up more than 80% of the landscape.



figure 2.2.7
Monocrop rice fields in An Giang.
Photo by author, 2018.



2.2.3 Diversity: Nutrient Recycling Systems in Agriculture

Diversification of land in the Mekong Delta occurred alongside the conversion of natural wetlands and forests to arable land uses. As population numbers increased with migration towards the south, the newly unified government provided land for families to develop their own subsistence farming methods at low capital costs.[12] Prior to industrialization and urbanization, rural village waste in Northern Vietnam had been managed in the natural nutrient cycle on small-scale plots of land and were balanced alongside the water cycle.[13]

Upland areas in the north had cleared forests in order to provide land for self-sufficient households. The amount of deforestation that took place caused significant land erosion and increased flooding in lowland areas.[14] However, deforested areas in upland regions were countered by household plantations for subsistence farming requirements where forest land converted to household plots. Preservation of forests failed due to decline in forested land from the 1940s to 1990s, but individual tree plantings initiated by households aiming for subsistence farming lifestyles proved to be more successful at the cultivation of wood and fruit trees than recovery through forest planting.[15]

The *Đổi Mới* reform, with its introduction of industrial agriculture, also brought about local government support and intervention for agricultural production on small plots of land. This was supported by the national land use policy plan which brought along Integrated Agriculture-Aquaculture Systems (IAAS) in the delta *(figure 2.2.9)*. Upland areas near mountains and hills thrived through the combination of animal husbandry, such as cattle, and land used for cultivating crop and orchard systems.[16] Lowland delta regions adapted a combination of aquaculture, orchards, and livestock in addition to rice.

12 Sikor, *Economic and Environmental Dynamics of Reform in Vietnam*, 608-609.
13 Ibid, 611-612.
14 Ibid, 612.
15 Bosma, *Agriculture Diversification in the Mekong Delta: Farmers' Motives and Contributions to Livelihoods*, 52.
16 Ibid, 53

With this traditional subsistence farming method, known in the country as the VAC (*Vườn, Ao, Chuồng*) system *(figure 2.2.8)*, poor families could sustain themselves through an integrated garden, pond, and livestock raising system allowing for nutrient cycling on a rural plot of land. This system for farming diversification would consist of: a garden providing fruits and vegetables; animals for the household's food supply; and all scraps and waste from humans and animal husbandry would either feed the pond fish and aquatic plants or be buried and composted.[17] Based on low capital investment, the system is highly intensive with all grown products used as fuel, food and fiber and reduces the family's dependence on rice.[18] Much importance was given to the return of waste to the environment to minimize nutrient leakage, as it was seen as misused if drained into flowing water systems.[19]

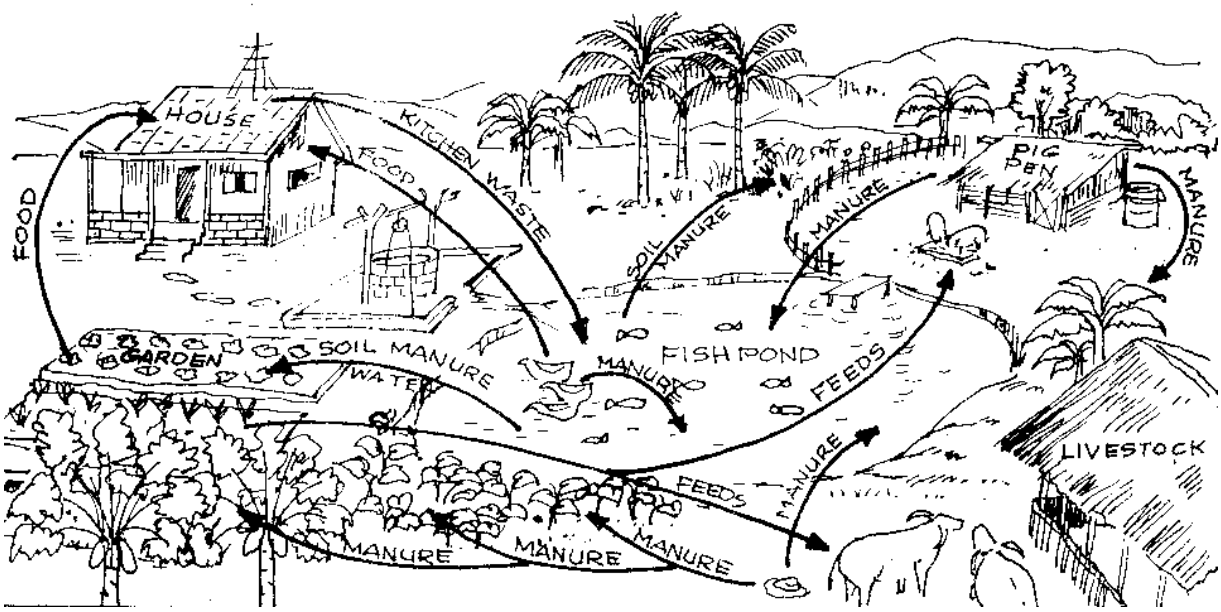
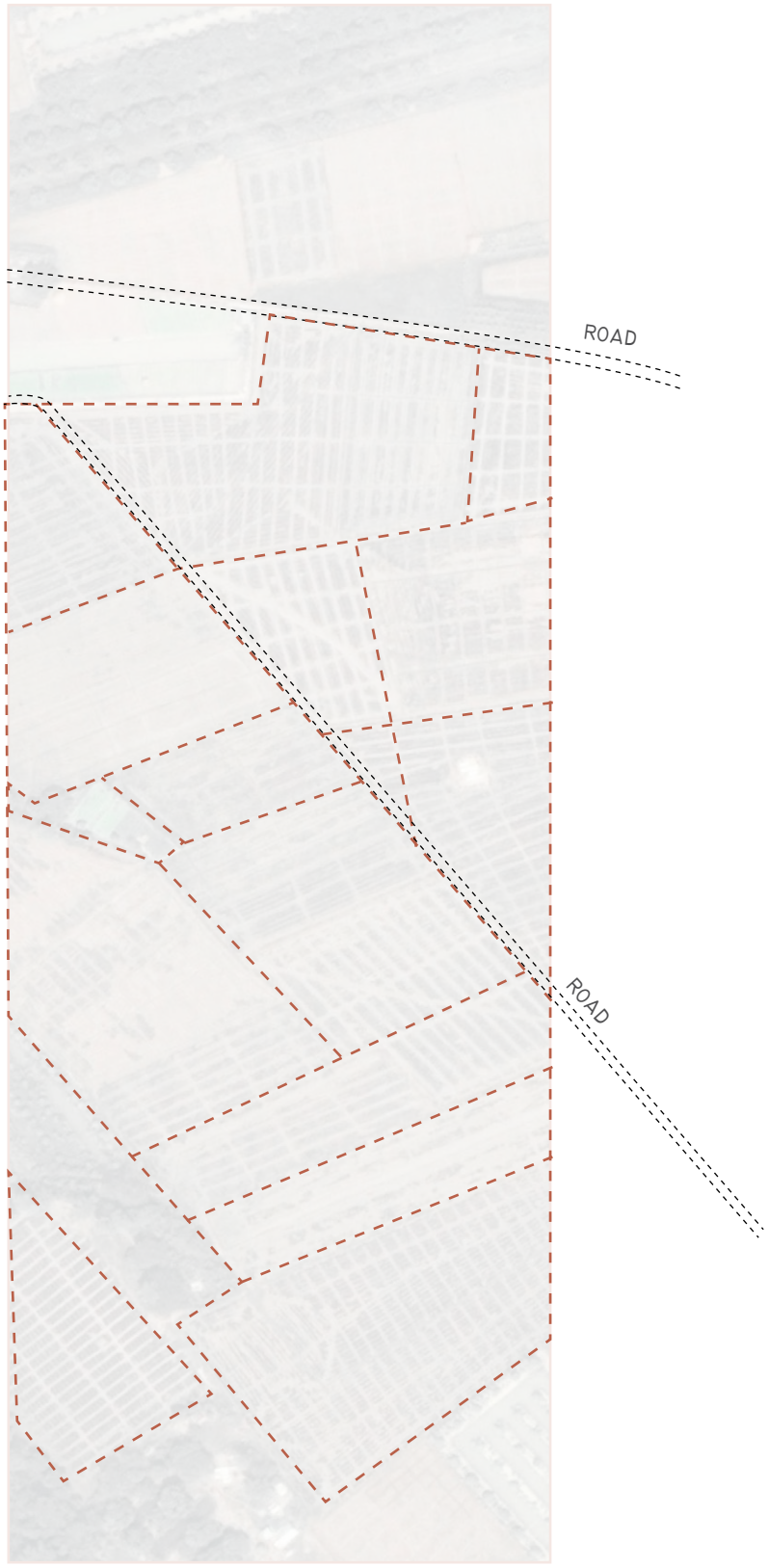


figure 2.2.8
Integrated Farming VAC System
Diagram by FAO.

17 Nguyen, Man Van. "Vuon - Ao - Chuong - The Traditional Vietnamese Farm." The Permaculture Research Institute, (2008).
18 Ibid.
19 Dang et al. *Integrated freshwater aquaculture, crop and livestock production in the Mekong delta, Vietnam*, 3.



figure 2.2.9
Areas of diversified land usage lots in An Giang.
Drawings by author.
Source: Satellite Imagery by Google Earth.



fields
for growing rice
and legumes



houses + trenches
located along roads
where trenches are
created from the
raising of a road

The VAC system was highly encouraged by the Vietnamese government during the time of the *Đổi Mới* policy. VACVINA is an NGO association that was developed to promote the development of VAC systems. The institution provided education on VAC topics and promoted technology transfer to support and enable farmers to practice VAC systems while also connecting them with international organizations.[20]

Based on the region that the system is adapted in, different inputs and outputs and variations occur. Within the Mekong Delta, due to the lowland areas and prominent rice cultivation, the VAC systems include the addition of rice and other aquatic field species forming the VAC-R system. High dikes have allowed for the cultivation of orchards with maturing fruit trees within the fields and the protection of aquaculture ponds from flood events. With similar intentions for nutrient cycling, this system can be seen as a larger scale adaptation of the fishpond and the latrine *(figure 2.2.10)*. The application of nutrient cycling for farming is a natural tendency for farmers who have an understanding of fertilizer application and its benefits *(figure 2.2.11)*.

20 Nguyen, Man Van. *Vuon - Ao - Chuong - The Traditional Vietnamese Farm.*

Small-scale integrated VAC-R system to promote subsistence farming through economical inputs and nutrient cycling.

Households benefit through a diverse diet and minimal inputs required for farming.

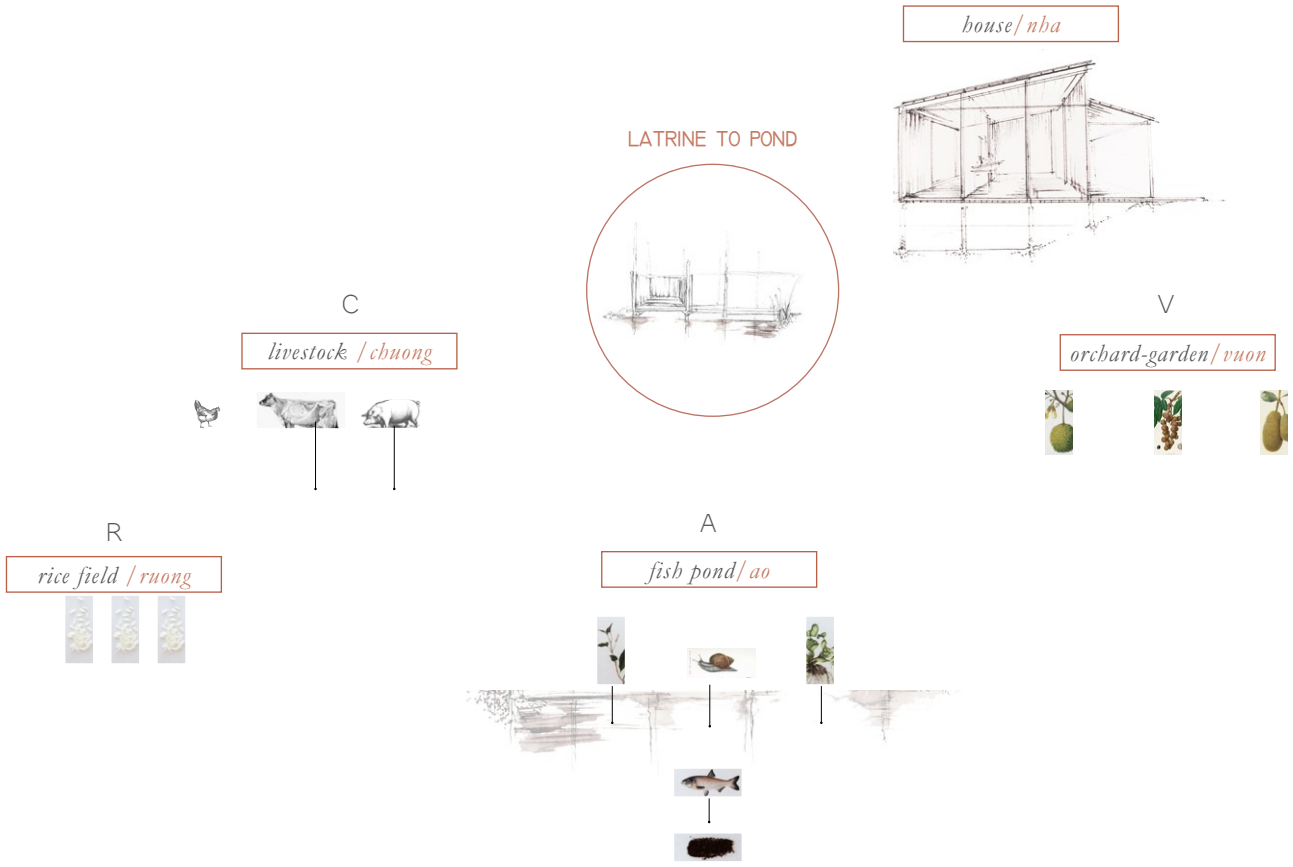


figure 2.2.10
Integrated Farming VAC System
Diagram by author.

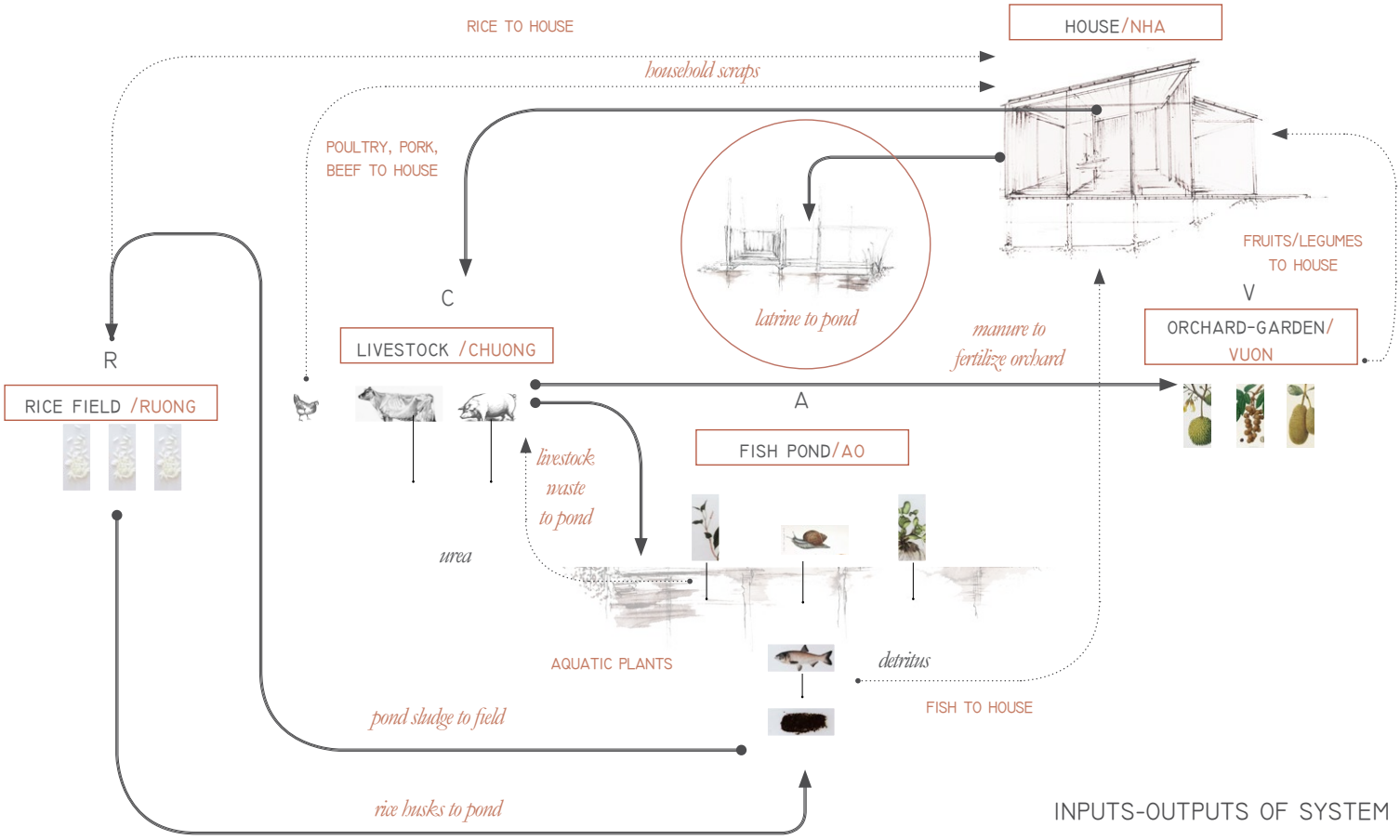
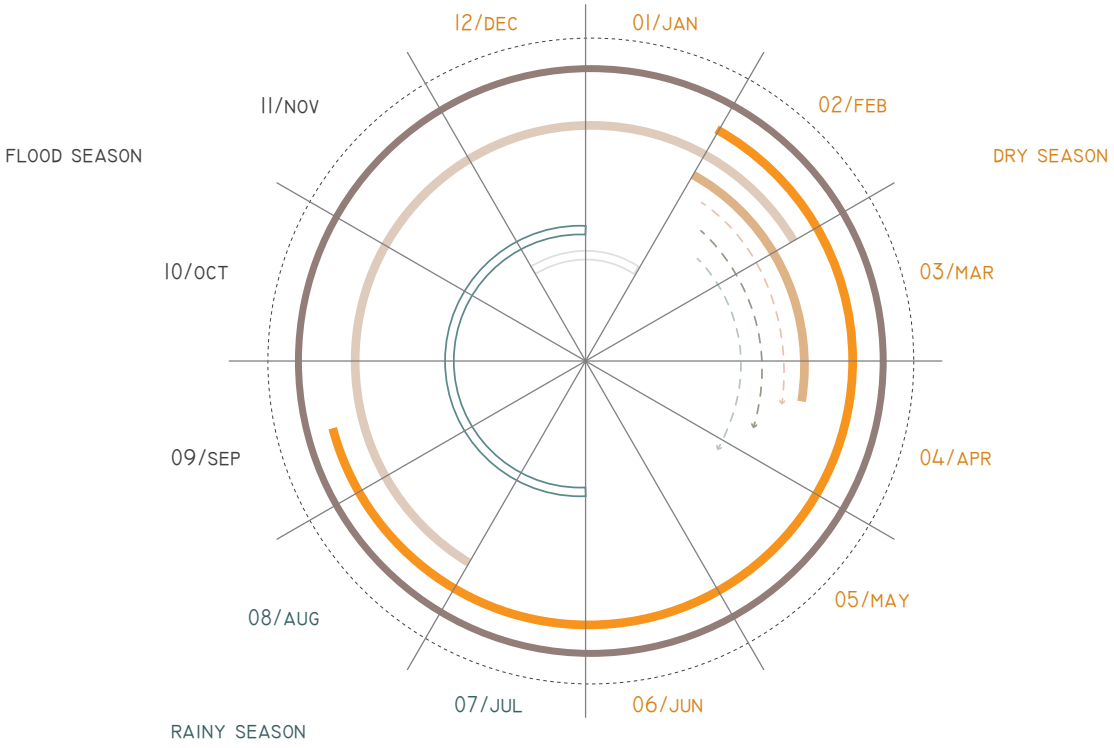


figure 2.2.11
Inputs & outputs of a small-scale integrated farming system with nutrient recycling.
Diagram by author.



LEGEND

MONTH

LIVESTOCK

RAISING OF LIVESTOCK ALL YEAR ROUND

CULTIVATION

CULTURING SUMMER/AUTUMN VEGETABLES

CULTURING WINTER/SPRING VEGETABLES

CULTURING/CARING FOR LONGLIFE TREES

POND

CLEANING THE POND

FILLING THE POND WITH WATER

STOCKING THE POND WITH OVERWINTERED FINGERLINGS

HARVESTING

HARVESTING OF FRUITS

LAST HARVESTING OF THE POND

SOURCE: LE, THANH LUU, HTTP://WWW.FAO.ORG/DOCREP/005/Y1187E/Y1187E10.HTM

figure 2.2.12
Seasonal Calendar for Cultivation & Harvest
Diagram by author.
Source: FAO.

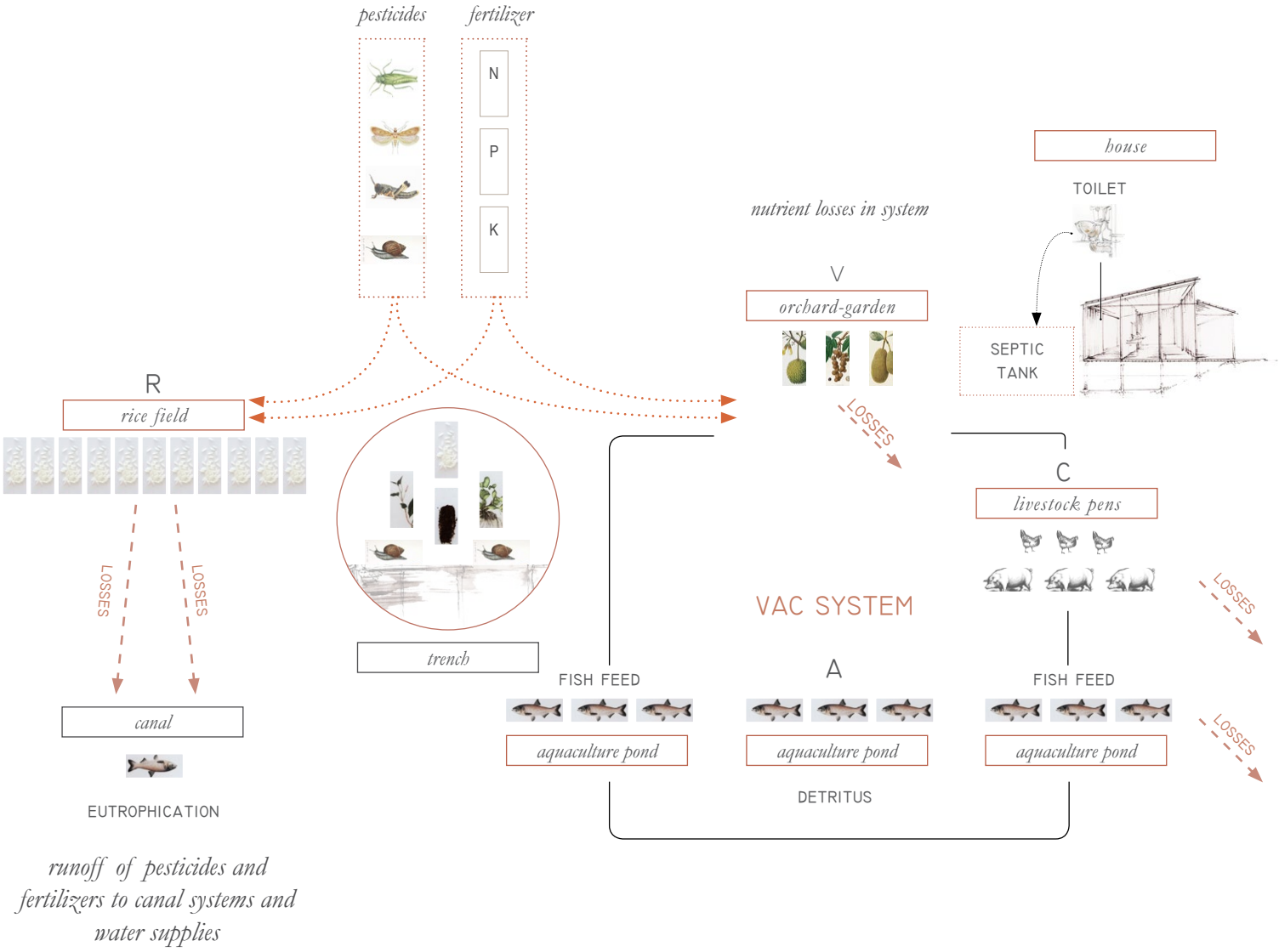


figure 2.2.13
Inputs & outputs of a commercialized farming system with nutrient leakage and external inputs.
Diagram by author.

However, the VAC system today has several challenges and is only accessible for farmers who own plots of land—typically rice, for transforming their fields. It has evolved today based on new inputs and the commercialization of agriculture, as well as the loss of outputs through non-point source runoffs *(figure 2.2.13)*. These outputs contribute to eutrophication of the water, resulting in the death of aquatic species and ecological damage *(figure 2.2.14)*. Capital costs for the system for constructing proper trenches and conditions can restrict farmers on their adaptation of the methodology. Due to the legacy of rice production, many families are hesitant to understand VAC farming due to the extensive range of new skills and knowledge required to monitor and ensure the system's productiveness.[21]

Dang et al conclude their study by outlining the essential approach for the VAC-R system to integrate socio-economic considerations such as household livelihoods and ecological systems.[22] One example includes the fishpond within the system and has been studied for its potential and safety of processing household excreta by reducing nutrient leakage.[23] Ponds make up ten to thirty percent of plots but have heavy environmental concerns as farmers tend to change the pond water too often due to high-intensity farming. Excreta contaminated water can be filtered or captured for orchards that require higher nutrient loads for fertilization instead of being sent out to canal systems.[24]

Despite the current situation with environmental degradation due to high dike systems, VAC systems can be viewed as opportunities within this condition and can provide new systems that support traditional practices while supporting household livelihoods at the same time. If given the right setting, the VAC system can be wholly integrated with households to move away from its commercial focus today. As the traditional fishpond has evolved with modernity to the larger aquaculture pond with a variety of options for fish, ducks, and various aquatic species, the fishpond latrine also holds the potential to develop into a system integrated with this process in order to safely manage household waste within the rural context.

21 Dang et al. Integrated freshwater aquaculture, crop and livestock production in the Mekong delta, Vietnam.

22 Ibid, 7.

23 Dang. Nhan K., Marc J.C. Verdegem, Nguyen T. Binh, Le T. Duong, Ana Milstein, and Johan A.J. Verreth. "Economic and nutrient discharge tradeoffs of excreta-fed aquaculture in the Mekong Delta, Vietnam." *Agriculture, Ecosystems, and Environment* 124 (2008), 59.

24 Dang et al. Integrated freshwater aquaculture, crop and livestock production in the Mekong delta, Vietnam, 10.

eutrophication

Is defined as an excessive richness of nutrients from land use run-off causing a dense growth of algae and plant life, resulting in the death of aquatic life from the deprivation of oxygen.



figure 2.2.14
Dead fish in eutrophied water.
Photo by Greenpeace China.

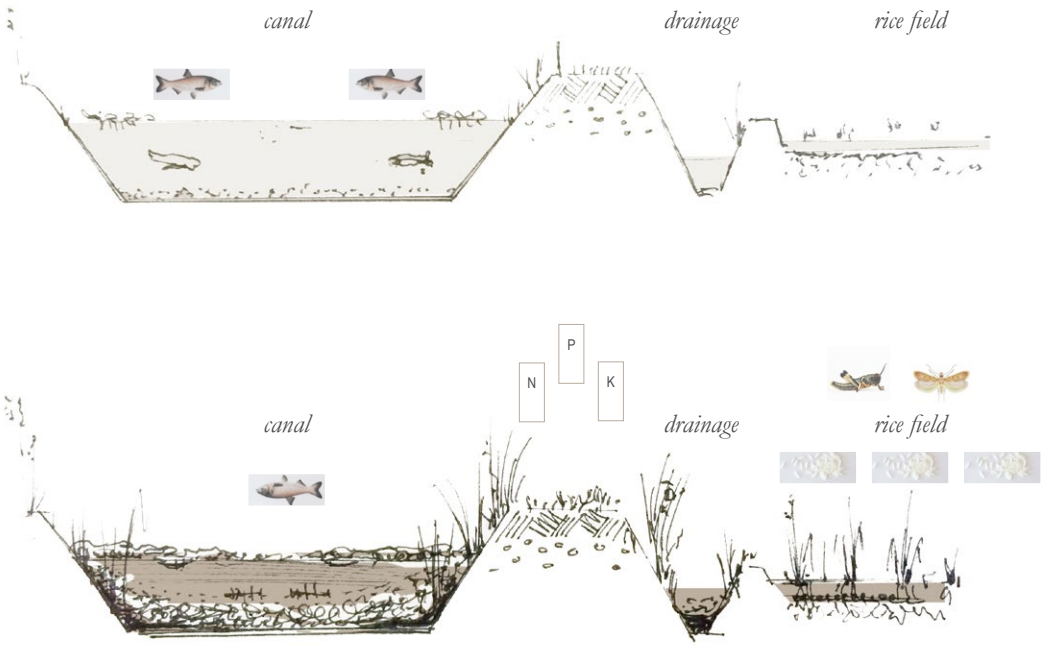


figure 2.2.15
Diagram of effects of eutrophication on canals.
Diagram by author.

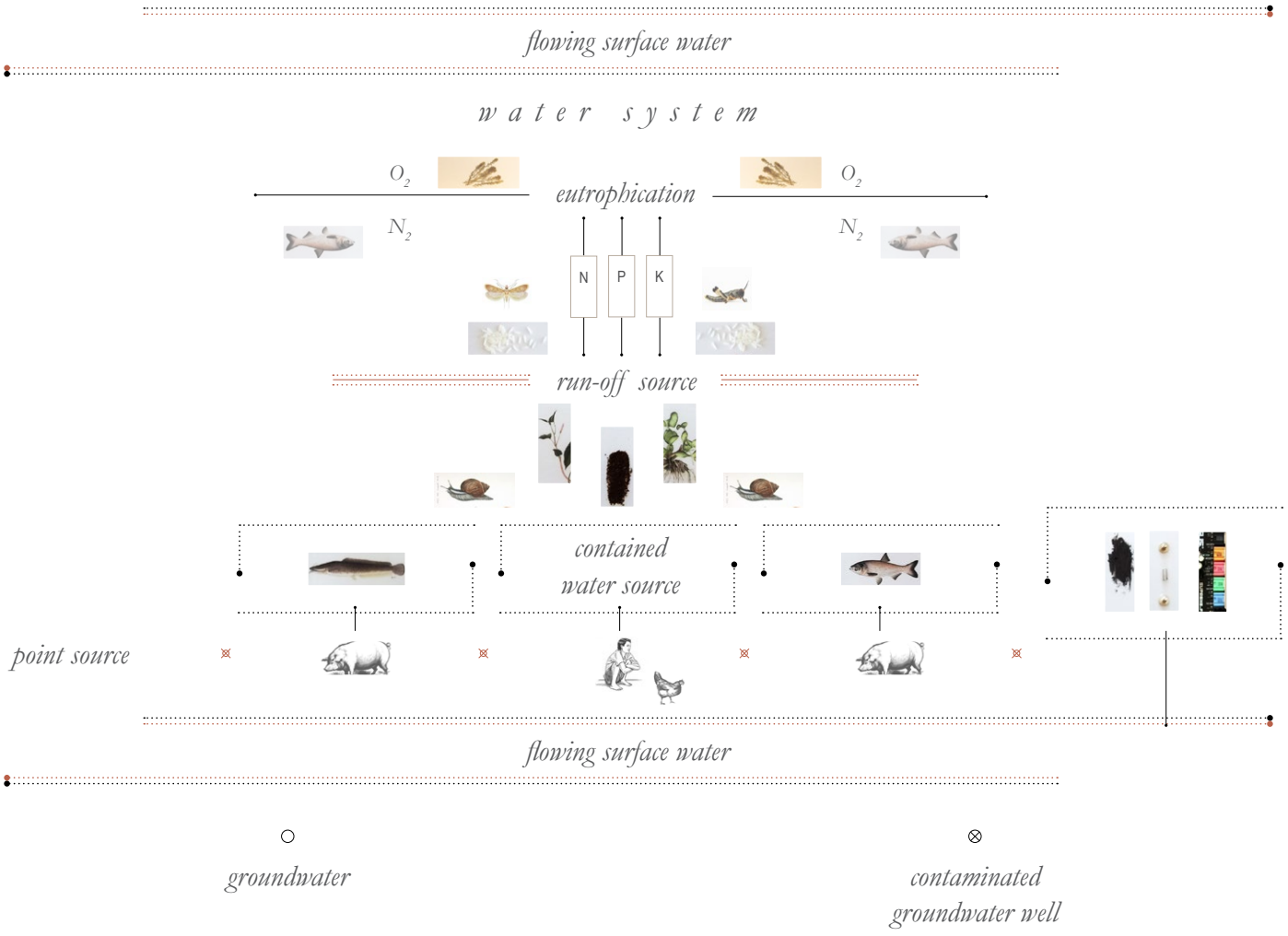
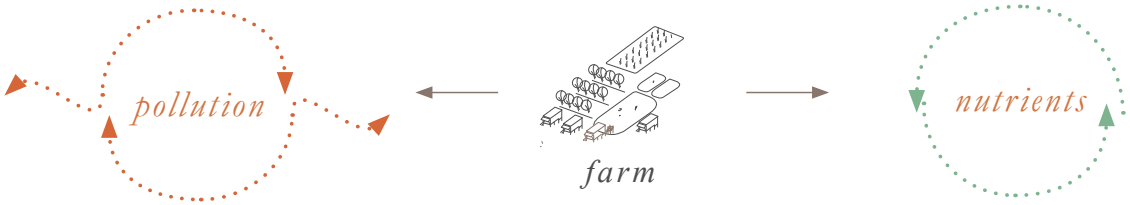


figure 2.2.16
Diagram of run-offs contributing to eutrophication.
Diagram by author.

pollution : design principles

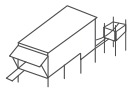
nutrients



Design principles allow for a diversified field utilizing the VAC-R system with integration of garden/ orchard, field, livestock, ponds and wetlands. Each plays a different role in circulating and managing nutrients within the site, minimizing nutrient leakages and the need for artificial and chemical fertilizers.



part 2.3



s t i g m a

p o l a r i z i n g i m p u r i t i e s i n t h e h o u s e h o l d

This chapter addresses stigma, and the detachment experienced by existing populations who have depended on the natural resources surrounding them. Sanitation poses a problem as it aims to polarize impurity and purity for waste and water, limiting the benefits of the conservation of water and recycling of nutrients—two essential economic practices for households living in poverty.



figure 2.3.1
Hanging latrine beside a rice field sluice gate.
Photo by Truong Tuan Thanh Tran, 2018.


HANGING LATRINE

2.3.1 Necessary Impurity: Sanitation for All

As latrine usage decreases with modernization, rice monocrop practice increases with the greater demand for production yield. There is a false separation between the toilet and agricultural practice *(figure 2.3.1)*. Waste is now waste, while agriculture is now commonly composed of imported artificial nutrients and pesticides, in order to maintain maximized production and yields. Currently, residents who depend on surface water sources for household uses are subject to pollution and contaminants pulled through flow cycles. *(figure 2.3.5)* During flooding seasons, these networks have even weaker spatial boundaries, causing more issues with the control of contaminants.

Vietnam's continued movement towards modernization puts human waste and open defecation under heavy blame for pollution of surface water resources. The outbreak of health concerns forced government actions to be taken into consideration in attempt to regulate the wastewater discharge and inevitably seek cleaner approaches for water sources for the rural population.[1] Even then, only twenty-six percent of households in the Mekong Delta are reported to have "hygienic latrines" *(figure 2.3.4)*.[2]

These modern bans on latrines have disregarded the infiltration of pesticides, herbicides and artificial fertilizers—all having a significant factor in affecting water quality. Modern systems *(figure 2.3.2)* have also reversed many relationships that villagers previously held with water, and have done it through the lack of tolerance for levels of impurity, the dismissal of economical actions taken by poor villagers, and the erasure of the traces of human activity from daily life *(figure 2.3.6)*.

1 WHO/UNICEF. "Vietnam Water and Sanitation Sector Assessment Report: Year 2011," 2012, accessed September 25, 2018. 20.

2 Ministry of Health (MoH), & United Nations Children's Fund (UNICEF). (2007). "A summary of national baseline survey on environmental sanitation and hygiene situation in Vietnam." Hanoi, Vietnam: MoH & UNICEF.

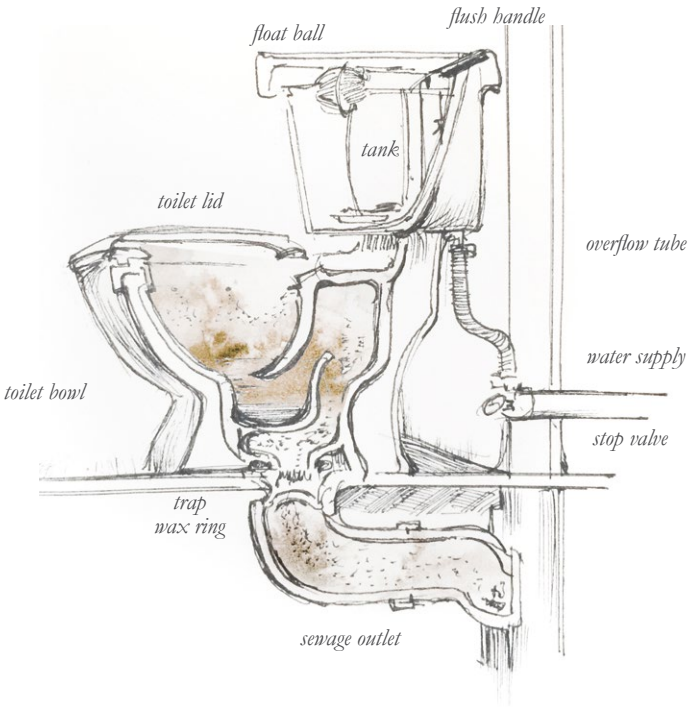


figure 2.3.2
Section of a modern flush toilet with sewage outlet.
Drawing by author.



figure 2.3.3
A monkey bridge over a smaller canal in Tri Ton, An Giang.
Photo by Elizabeth English, 2018.



figure 2.3.4
Houses and boats along a river in An Giang.
Photo by Elizabeth English, 2017.



figure 2.1.5
Traditional interactions with water sources in An Giang.
Diagram by author.

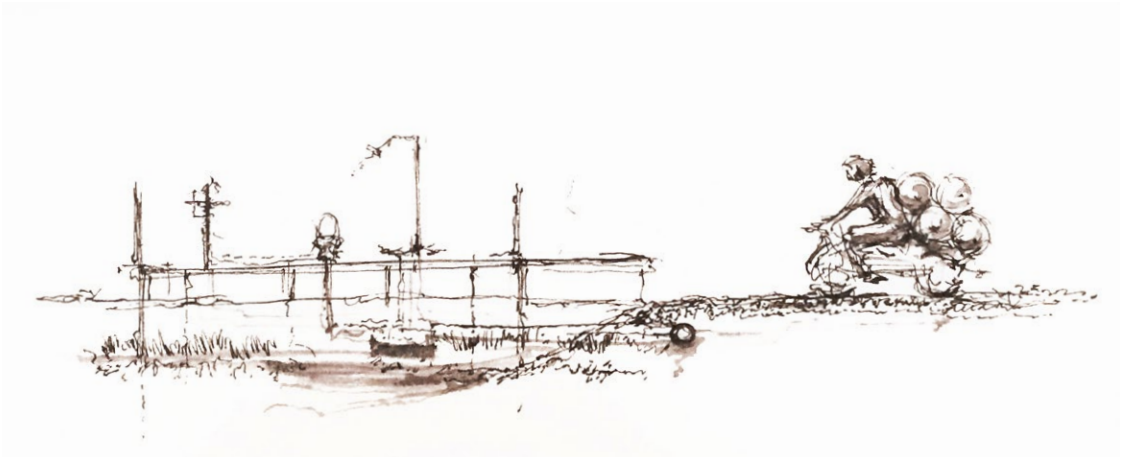


figure 2.3.6
Modern relationships with water through delivered jugs on scooters and piped systems in An Giang.
Diagram by author.

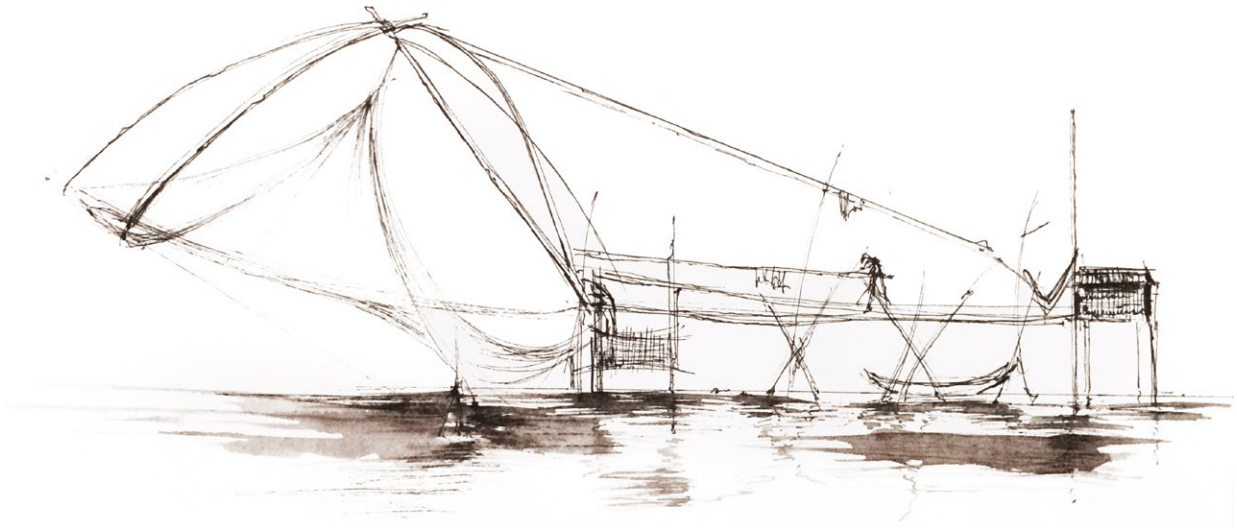


figure 2.3.7
Vo ca - a fishing net system used commonly around the Mekong Delta.
Diagram by author.

2.3.2 Spectrum of Water

In addition to the return of nutrients found within waste to the environment, the village water systems considered a wider spectrum of water for daily activities *(figure 2.3.8)*. In contrast to viewing water as a homogeneous fluid, there is value to viewing it as a nuanced continuum of "useful" water that ranges from "highly impure/polluted" to "pure/safe". Viewing water as more than a single substance is important in understanding the different meanings held for water by the Vietnamese. Naturally occurring supplying flood waters are depicted via colours. For example, at the beginning of the season, supplying water that brings in new alluvial soils from upstream is called *nước sơn* (red water). After flooding, water that drains is light green in colour and is called *nước bạc* (silver water) because it washes the acidity away from the soil.[3] The spectrum of water is symbolic of the diversification of functions and needs to ensure wastewater recycling, similar to the diversification of agriculture and minimizing nutrient leakage *(figure 2.3.9) (figure 2.3.10)*.

The spectrum redefines water as a range that possesses a function at every level as it carries more matter, contaminants, and nutrients. As risk is increased, its ability as a resource changes: from its purest state, where hydration is prioritized; to its range of greywater used for washing and watering; to the next state used to rinse soil or waste; finally to the state left for agriculture or aquaculture. In each phase, the matter settles in the ground, returning to the nutrient cycle, and the remaining water percolates through the soil or is released back into the atmosphere through evapotranspiration *(figure 2.3.11)*.

Means for reusing "used" water is crucial for times of water scarcity within the villages. The extensive dry season that takes up around half the year calls for an intimate relationship between the household and their water resources. Practices for conserving water can include the reuse of light grey water or allowing blackwater to be flushed into fish ponds and at the base of trees to reduce irrigation needs. The polarization of pure and impure water dismisses the notion of conservation of water and nutrients for rural households.

3 Tuan, L. A., Hoanh, C. T., Miller, F., & Sinh, B. T. "Floods and salinity management in the Mekong delta, Vietnam." 26.

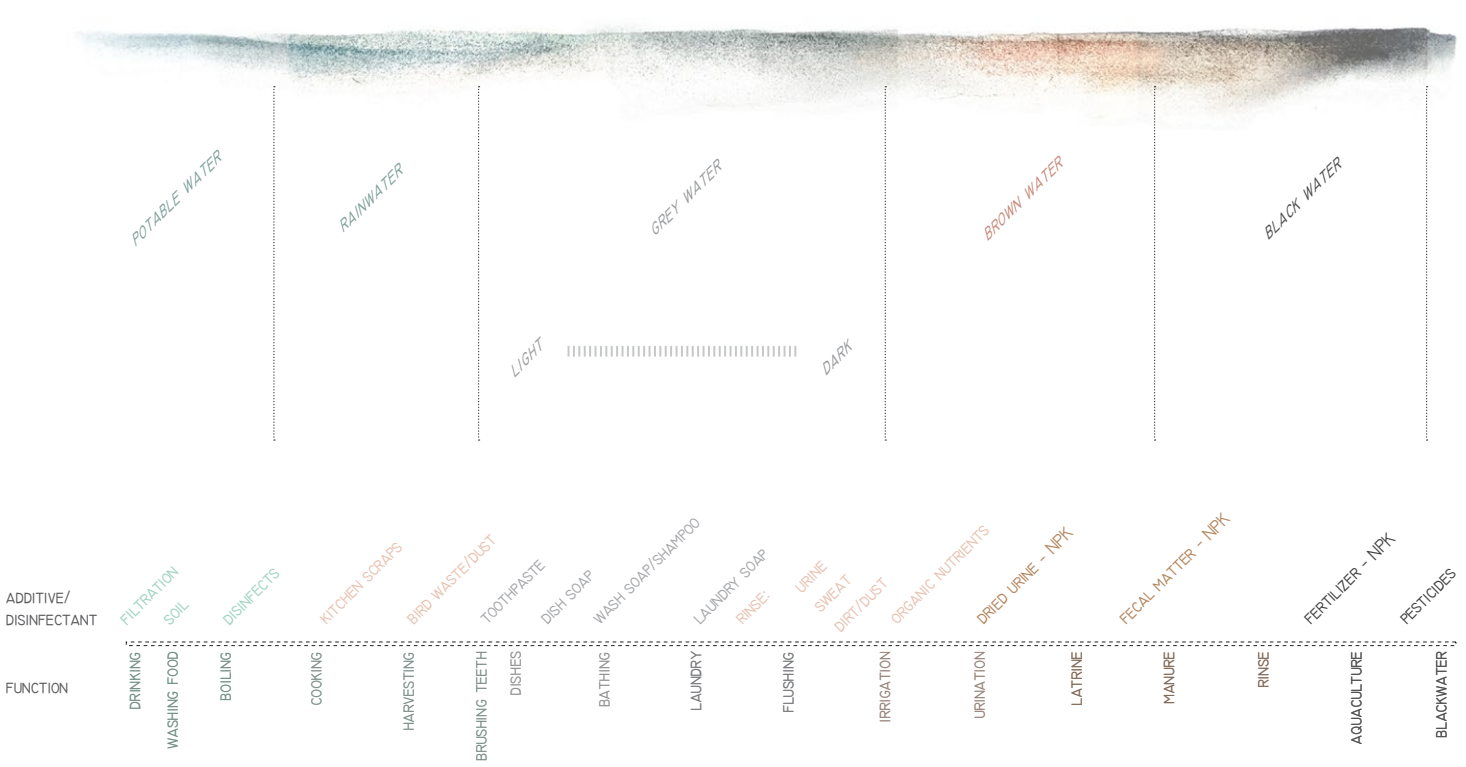


figure 2.3.8
Sectional model of existing home and pond.
Diagram by author.



figure 2.3.9
Photo of wooden framed-model displaying the spectrum of water within the context.
Model by author.



figure 2.3.10
Photos of site context fragments suspended in wooden-framed model.
Model by author.





figure 2.3.11
Photos of glass vials with different materials submerged in water.
Model by author.



figure 2.3.12
Spectrum of water diagram.
Diagram by author.

At a domestic scale, different sources of water, either naturally derived or from household usage, are classified based on levels of contaminants and their origins *(figure 2.3.12)* [4]:

Natural:

Bluewater *is freshwater from surface and groundwater sources such as rivers, streams and ponds.*

Greenwater *is moisture from the soil that is utilized by plants by transpiration processes in the hydrologic cycle.*

Rainwater *that was collected was considered the purest quality, and was consumed as is or boiled to disinfect prior to drinking.*

Anthropogenic

Water that is deemed safe to drink and cook with is considered potable water.

All water that has been in contact or used with anthropogenic activities *is considered wastewater and is categorized from grey to black:*

Greywater *is the product of domestic activities without contact with excrement, and can used for irrigation.*

Blackwater *is considered sewage that requires additional processes to safely break down bacteria and pathogens within the environment.*

4 "What Is Blue, Green and Grey Water?" The Water Network | by AquaSPE. 2010. Accessed December 11, 2018. https://thewaternetwork.com/question-0-y/what-is-blue-green-and-grey-water-6uuv13bt8lVovKyD7Andyw.



figure 2.3.13
Road in Vinh Xuyen village on a high dike canal.
Photo by author, 2018.



figure 2.3.14
Piped water supplies along the road in Vinh Xuyen village.
Photo by author, 2018.



figure 2.3.15
Raised houses adjacent to polluted ponds of water in Vinh Xuyen village.
Photo by author, 2018.



figure 2.3.16
Lower houses adjacent to polluted ponds of water in Vinh Xuyen village.
Photo by author, 2018.



figure 2.3.17
A latrine hidden behind some bushes over a trench in Vinh Xuyen village.
Photo by author, 2018.



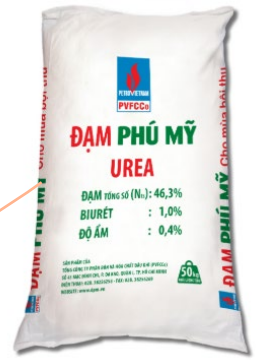




figure 2.3.19
"Dam Phu My brand" urea fertilizer bags.
Source: http://www.dpm.vn/

figure 2.3.18
A hanging latrine structure covered by a "Dam Phu My brand" fertilizer bag.
Photo by Truong Tuan Thanh Tran, 2018.

2.3.3 Detachment as Sanitation

In 1998, the government carried out a National Target Program on Water Supply and Sanitation that would improve what they considered as the "backward customs and behaviours of people"[5] by eliminating all fishpond latrines in order to reduce untreated feces contamination into water supply areas. During Vietnam's economic growth, rural villages are seen as delayed in progress due to their traditions and ways of adapting with the landscape *(figure 2.3.15)*. In turn, their coexistence with waste and wastewater have created stigma that all waste is toxic and should be kept separate from daily life *(figure 2.3.16)*.[6] There was no tolerance for actions that would recycle human waste, and to achieve a purer form of sanitation modern toilets must be installed. In 2020, expectations outlined by the National Strategy for Rural Water Supply aimed for 100 percent of the rural population to have access to water supply services and "sanitary latrines".[7]

Reports published in 2005 by Can Tho University (CTU) noted how previous attempts to boost sanitation in the region have been less successful due to socio-economic limitations such as:

+ *Low income for households and high costs for a "sanitary toilet"*
+ *Lack of clean water and costs for distribution of infrastructure*
+ *Lack of building materials to construct latrines (figure 2.3.18)*
+ *Poor awareness in hygiene and different standards*
+ *Locals do not prefer to defecate in a cramped toilet (figure 2.3.17)*
+ *Consider human and animal excrement as a source for raising fish*
+ *Lack of interest to cooperate with local government and rural development staff*
+ *Lack of resources and documents for education for locals and academics* [8]

Another reason that modern toilets fail to be implemented are the different requirements that latrines require based on geographic context *(figure 2.3.20)*. Through different variations of latrine typologies, each has their own adaptation to their surrounding environment. Compost pit latrines are commonly used in highland regions to promote tree planting. *(figure 2.3.21)* Sewage based and septic latrines are used in urban areas to centralize waste management. *(figure 2.3.22)* Hanging latrines are used for lowland regions that dispose waste into water bodies from land or boats. *(figure 2.3.23)* However, economic factors and hygiene influence decisions for latrines to be constructed at each household.

5 WHO/UNICEF. 2012. "Vietnam Water and Sanitation Sector Assessment Report: Year 2011." 16.
6 Royte.
7 WSP. 2014. "Water Supply and Sanitation in Vietnam: Turning Finance into Services for the Future." Washington, D.C.: World Bank Group.
8 Le, Anh Tuan. "Thiết Kế Định Hình Các Mẫu Nhà Vệ Sinh Nông Thôn" [Toilet Design for Rural Areas]. Can Tho: Can Tho University, 2005, 3.

A survey published in 2012 by Reis and Mollinga found that villagers considered the differences between traditional latrines and septic latrines to be marginal and found the costs inequivalent to the presented benefits.[9] Higher volumes of water requiring supply infrastructure are required for flushing, and can only be afforded by wealthier villagers with access to pumped water systems *(figure 2.3.14)*. The further exploitation of groundwater sources for "cleaner" water for privileged households only exacerbates the drought conditions during the region's dry seasons.[10]

Their research into the adoption of latrines in the rural areas of the Mekong Delta identified four models approved by the Ministry of Health (MoH) that could receive micro-financing loans for construction. These latrines ranged from dry and cheap to wet and costly:

+ Double Vault Latrine – a dry option where ash is thrown in directly after use to reduce moisture; is used for six months until filled, then the compost can be used as fertilizer, liquids can be used to water trees and plants (est. cost $1 million VND = $43.45 USD),

+ Ventilated Pit (VIP) Latrine – a variation with a hole that is ventilated by a pipe emerging out of the ground; drawbacks are the smell (est. cost $1 million VND = $43.45 USD)),

+ Pour flush Latrine – a latrine with one tank with small holes where the waste is decomposed by bacteria (est. cost $1 million VND = $43.45 USD)), and the (iv) Septic Tank Latrine – typically used in cities where excreta is contained in a large tank installed beneath the home but cannot decompose.

+ Septic tank vehicles must travel to each home and pump out residues every 5-10 years. (est. cost $4 million VND ($173.82 USD) excluding septic tank pumping fees).[11]

9 Reis, 18.
10 Reis. 19.
11 Ibid.

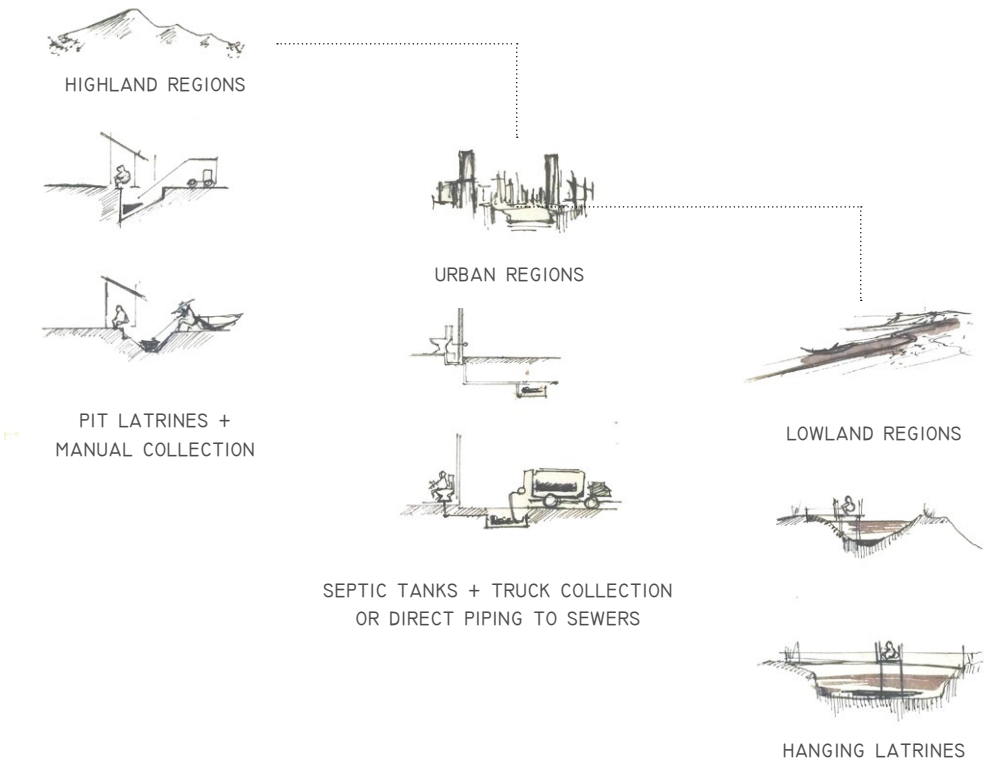


figure 2.3.20
Diagram of latrine and landscape relationships based on surrounding geographical context.
Drawing by author.

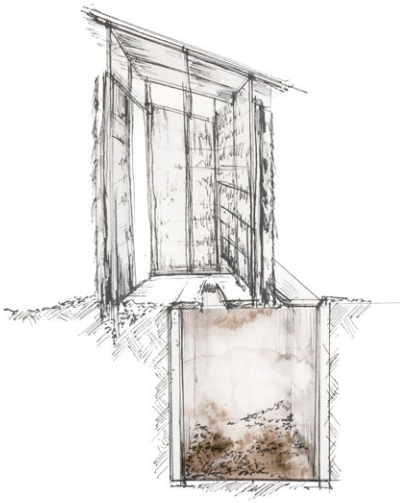


figure 2.3.21
Dug pit latrine for highland regions in Vietnam.
Drawing by author.

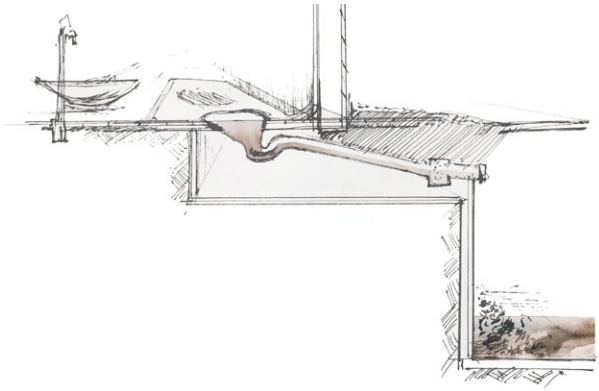


figure 2.3.22
Section drawing of a pour-flush latrine system with a septic tank.
Drawing by author.

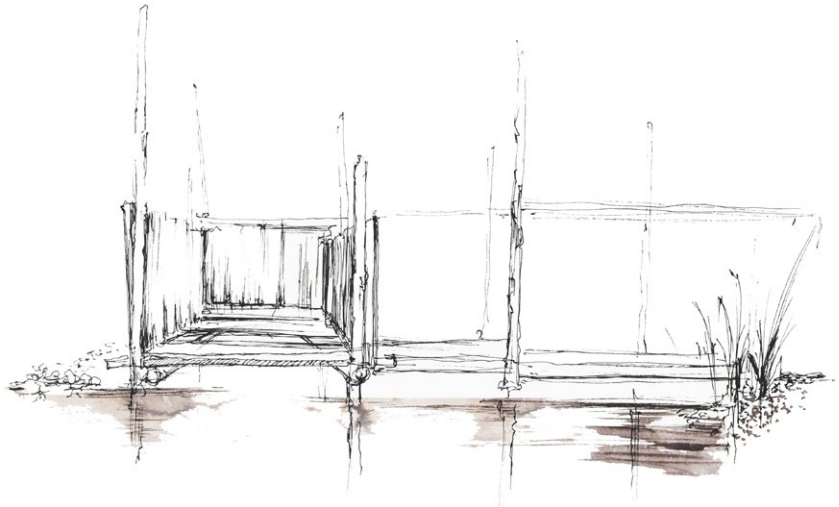


figure 2.3.23
Section drawing of a hanging latrine.
Drawing by author.

However, micro-financing loan support for latrine construction favored the septic tank option - an option unaffordable by many residents. As a result, the other options were dismissed due to the stigma of using human excreta and implications of "inconvenience" to operate and maintain. The lack of economic concern for poor households who could not afford modernity has caused inconsistent sanitary improvement among villagers. In rural regions of the Mekong Delta, poor villagers rely mainly on rainwater and surface water sources for household usage. Due to heavier droughts each year, rivers and canals are drier and the availability of water becomes an issue for households without access to alternative sources. [12] Furthermore, water scarcity is an issue that fails to be addressed by the installation of modern toilets.

Along with these concerns, water stations have been limited in construction for poor villagers, preventing their ability to access to clean water. These constructions have been intervened by higher state officials to push residents to purchase external sources from water supplier companies—these suppliers are typically owned by or are connected to government officials.[13] Low connection rates within the Mekong Delta are found to be associated with numerous socio-economic factors. [14] Modern interventions inevitably fail to achieve their goals if systems are unsustainable to the users and increases their state dependence for infrastructure management and external supplies for their basic needs. [15]

12 Özdemir, Semra, Mark Elliott, Joe Brown, Pham K. Nam, Vo Thi Hien, and Mark D. Sobsey. "Rainwater Harvesting Practices and Attitudes in the Mekong Delta of Vietnam." Journal of Water, Sanitation and Hygiene for Development 1, no. 3 (2011). doi:10.2166/washdev.2011.024 Many households prefer rainwater to surface water and bottled water sources- due to taste and practices. Using rainwater has limitations due to limited storage capacity for poor households and the potential health risks in mishandling and consumption of rainwater post-harvest.

13 Reis, 22.

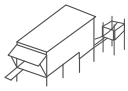
14 Wilbers, Gert-Jan, Zita Sebesvari, and Fabrice G. Renaud. "Piped-Water Supplies in Rural Areas of the Mekong Delta, Vietnam: Water Quality and Household Perceptions." *Water* 6, no. 8 (July 2014). doi:10.3390/w6082175. 5-6. In Wilber's study, reasoning behind the limited connection rates of piped-water supplies are explored. The studies found connection rates were limited to date, and many people are still reliant on rainwater and surface water sources for their household needs. Interviews discovered that households lacked piped-water supplies due to (i) high connection fees, (ii) preference for other water sources, and (iii) perceived poor quality/quantity.

15 Reis, 56. Through interviews, Reis and Mollinga discover that piped water supplies are also inconsistent during electrical failures and have been known to shut down for half a month at times, leaving households dependent on piped water supplies without proper sources.

Due to lack of governance in water supply systems and wastewater control, proposing large-scale interventions, such as "sanitation and sanitary latrines for all rural areas", are prone to being misled from intentions to aid rural populations.[16] In *Slow Violence and the Environmentalism of the Poor,* Nixon describes how top-down approaches typically disregard local customs, as it proposes a new "developed" framework over a vernacular landscape.[17] Villagers are either convinced or involuntarily exploited for "beautiful" and modern technologies that would improve their conditions. However, the consequences of widespread modernization are not addressed into rural areas where cultural identity is prominent and existing infrastructure for new systems is not readily available. The result is temporal, geographical and technological displacement of populations as their environments change, forcing adaptation that typically requires economic or cultural sacrifices.[18]

Unlike the concept of the fishpond latrine that is shared between households and neighbours, modernization through the installation of toilets and water supply per household enforces the privatization of water and sanitation to those who can afford it. Although each person has the right to perform sanitary acts in private, the access and availability of these areas should be accessible to all without stigma and embarrassment. The notion of sanitation also risks these sensitive understandings of water in its various states and forms. Water is a carrier of matter—including nutrients, waste, bacteria, disease and organisms. [19] If water can move from one source of nutrients to the next, it has the capacity to redirect nutrient leakage and lower risks of disease for households.

16 Reis, 23.
17 Nixon, Rob. *Slow Violence and the Environmentalism of the Poor*. 17.
18 Ibid.
19 Bunting. "Wastewater aquaculture: perpetuating vulnerability or opportunity to enhance poor livelihoods." 63. Bunting describes how many farmers receive conflicting messages between sanitation and nutrient management through wastewater usage. Health departments raise concerns about disease transmission through lack of sanitary measures for waste disposal, while farmers are also told that the "reuse of human excreta as fertiliser has economic implications for many farmers in agricultural production" (Ministry of Construction & Ministry of Agriculture & rural Development, 2000). As a result, target groups may find confusion from the issues of public health when associated with economic and conservative practices for excreta usage. Messages need to convey clear connections between safe practices and processing of waste for farmers to embrace both practices without associated stigma.



stigma ← household → *spectrum*

Design principles allows for the spectrum of water to become the guidelines for designing the spaces of the home. The home is directly related to the passive flows of the farm and field, allowing for easier water conservation and recycling of nutrients.

Water is a carrier of material that brings different benefits to the different programmatic functions of a home:

face washing and brushing teeth, kitchen, laundry, bathing, and latrine

As a result, the stigmatization of traditional practice is removed from these acts.

modernity

the control and concealment of living water and industrialization of agriculture.

system

bridging and exposing waste and water systems within a hybridized landscape



pollution

the contamination of water from mismanagement of nutrients and chemical constituents.

nutrients

closing cycles for essential compounds to remove dependence on external inputs

stigma

the erasure of traditional practice through modernity and pollution.

spectrum

conservation through the direct use of a range of waters as carriers of nutrients to travel from stages of pure to impure

figure 3.1
Design through the framework of a hanging latrine.
Diagram by author.

3.1 Scaling up via the Latrine

The latrine, a result of human adaptation to modified processes in the delta's landscape, becomes the parameter for designing a scalable framework that reinforces nutrient recycling, linkages to water and waste, and bridging land uses and spaces together.

Utilizing the framework of the fishpond latrine in order to tackle the current conditions and threats of modernity, pollution, and stigma that An Giang's rural settlements face today, the design proposes methods of re-establishing past relationships between inhabitants and the landscape—a natural resource relied upon to support their basic needs of water, waste management and nutrients *(figure 3.1)*.

The resultant proposal is an open field *(figure 3.23)* where infrastructure and wastewater systems are exposed, unconcealed to the users in order to destigmatize the practices around the conservation of water and the recycling of nutrients. Rural settlements, now unrestricted by previous land divisions enforced by canals and dikes, occur across the field and are constructed in relation to the manmade and natural landscape systems such as their agricultural land use and household spaces. *(figure 3.51)*

Drawing from the writings of Ivan Illich's symbolic views on water and the vulnerabilities it faces with modern technological advancements, the current threats are addressed through release and exposure of systematic flows and pollutants are minimized through the new path management and boundaries for waste and nutrients. Stigma is countered through active local practices at varied levels of impurity that depends on the passive systematic flows of the anthropogenic landscape. *(figure 3.50)*

the landscape

Bounded by canals, the field is the crucial link between the larger hydrogeological cycles and the resultant gains and damages on the farm.

If the field is addressed first, utilising working modern technological approaches for new opportunities in exposed hybrid infrastructural systems, the land use can effectively follow its forms and systems. The design aims to release the field by freeing it from its perimeter, and allowing streams to link freely between fields, removing the restrictive artificial divisions previously imposed upon it.

Participatory Integrated Farming System

This scale is informed by socioeconomic conditions and settlement patterns existent on the site. These patterns are then explored for their potentials to bring new relationships within a former mono-crop rice field while also increasing the population density. Using infrastructural networks, new roads are proposed based on predicted population density for the field with streams running between them *(figure 3.2)*. New growth contributes benefits where attachment and dependency on the landscape are essential, while also promoting strategies to help resolve current challenges related to environmental damage and household vulnerabilities.

Based in this highly mechanized and controlled landscape, the thesis proposes a participatory VAC-R system[1], that considers the household, waste and waters in working together to destigmatize vernacular knowledge, as it resists the pollution of pesticides, artificial fertilizers and detachment from bio organic waste. The proposal uses the process of rearranging to allow cycles to feed into one another, and for the villages to share resources for living in conviviality. As a result, many benefits are gained including the ecological restoration of the Mekong Delta's natural systems, the reinforcing of agricultural practices that circulate nutrients and water in less wasteful ways, the improvement of livelihoods in villages by reducing operational costs, adaptive resilience to changing conditions, and the reduction of stigma by allowing homes to have interrelated spaces for sanitation *(figure 3.4)*.

1 Nhan. Development of "VAC" Integrated Farming. 101-125.



figure 3.3
A road in An Giang along a settled canal.
Photo by author, 2018.

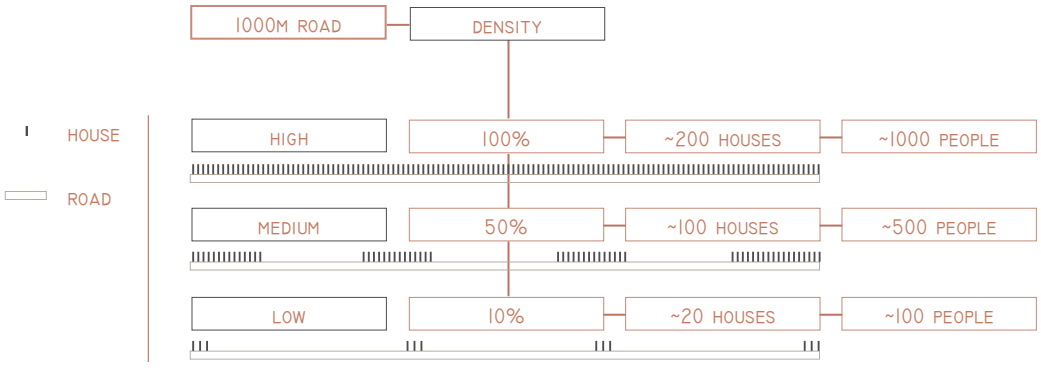


figure 3.2
Density diagram for houses along various roads.
Diagram by author.



figure 3.4
Flow map with Bassac River and proposed site.
Drawing by author.


PROPOSED SITE



figure 3.5
Proposed Site.
Source: Satellite Imagery by Google Earth.


0m
100m
200m
400m
800m



LATRINE + POND



HOUSEHOLD
ONE PLOT
RICE, MONOCULTURE FIELD



NEIGHBOURHOOD
MULTIPLE PLOTS

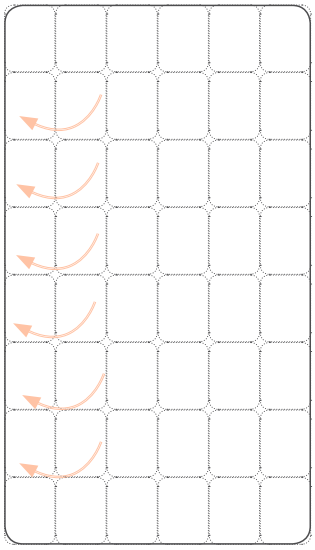


DIAGRAM OF A FIELD

PESTICIDES + FERTILIZERS
APPLIED EXCESSIVELY



figure 3.6
An existing rice field, An Giang.
Source: Satellite Imagery by Google Earth.



figure 3.7
Proposed Site with existing irrigation systems, trenches and streams.
Drawing by author.



OLD STREAMS

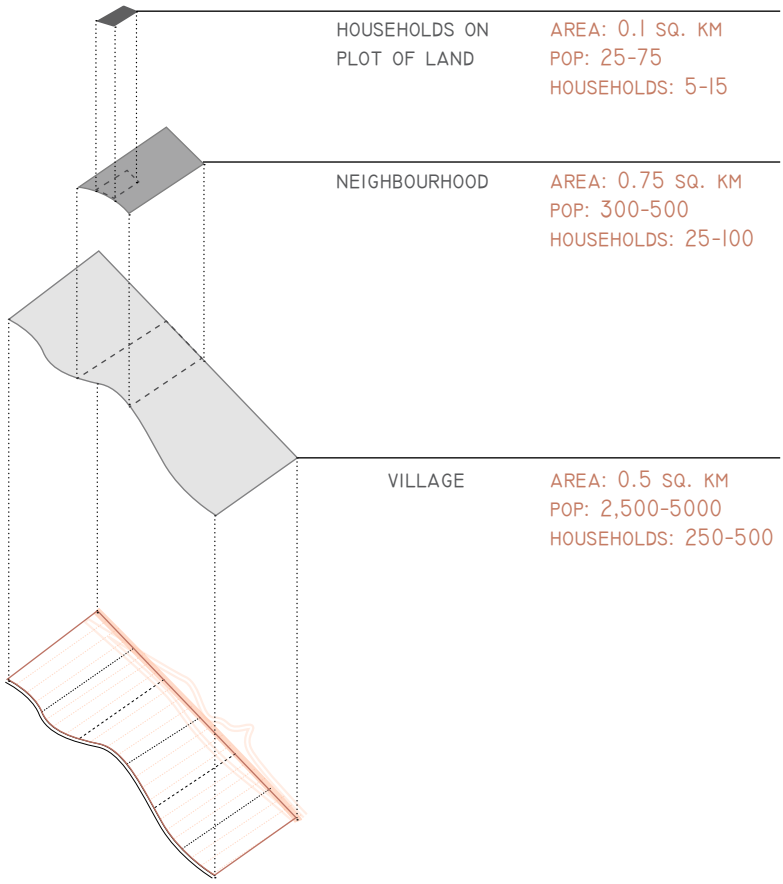
EXISTING STREAMS

0m 100m 200m 400m 800m



figure 3.8
Proposed Site with uncovered streams and roads.
Drawing by author.


0m
100m
200m
400m
800m



Land is divided to allow multiple communities to share holdings in agricultural farmland.

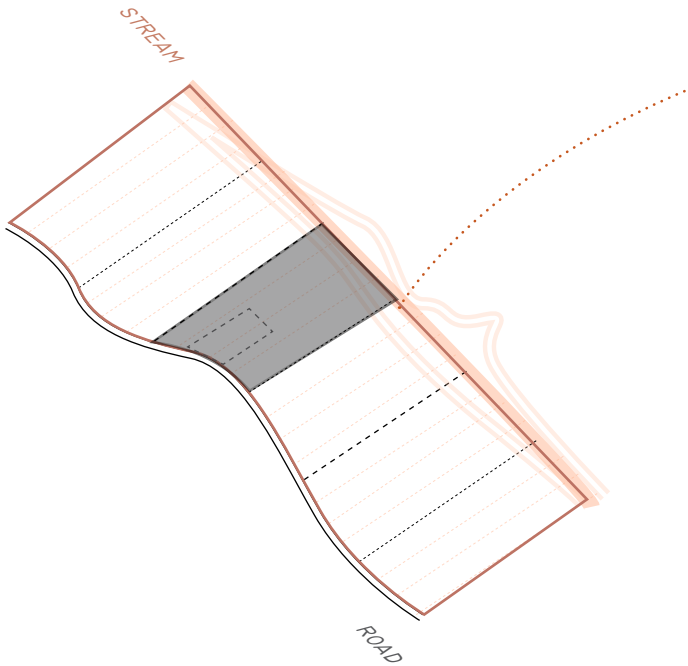


figure 3.9
Proposed Site and divisions to land to create new villages and neighbourhoods.
Drawings by author.

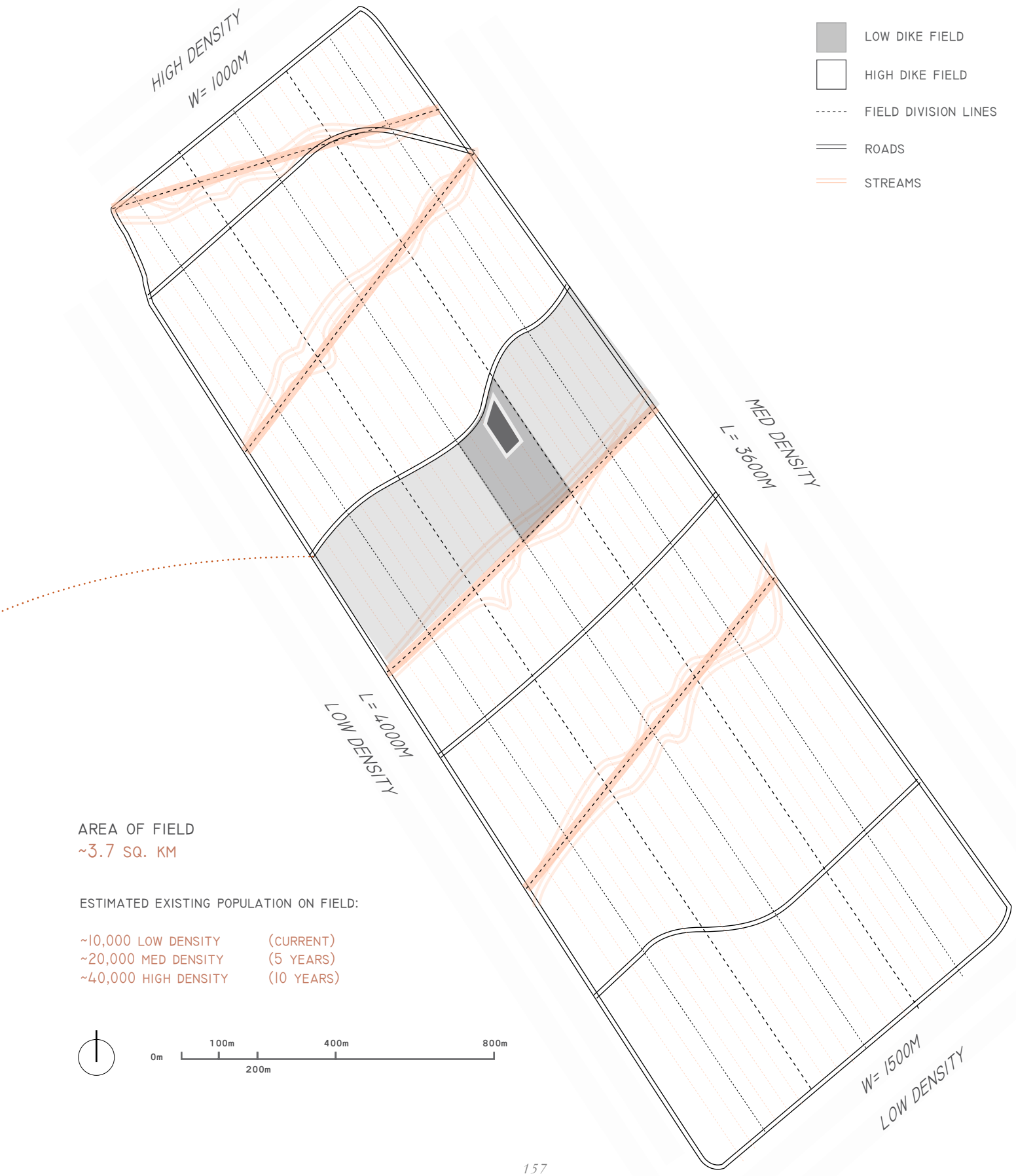

HIGH DENSITY
W= 1000M
LOW DIKE FIELD
HIGH DIKE FIELD
FIELD DIVISION LINES
ROADS
STREAMS
MED DENSITY
L= 3600M
L= 4000M
LOW DENSITY
W= 1500M
LOW DENSITY
AREA OF FIELD
~3.7 SQ. KM
ESTIMATED EXISTING POPULATION ON FIELD:
~10,000 LOW DENSITY (CURRENT)
~20,000 MED DENSITY (5 YEARS)
~40,000 HIGH DENSITY (10 YEARS)
0m
100m
200m
400m
800m



figure 3.10
An existing rice field decomposition diagram.
Source: Satellite Imagery by Google Earth.

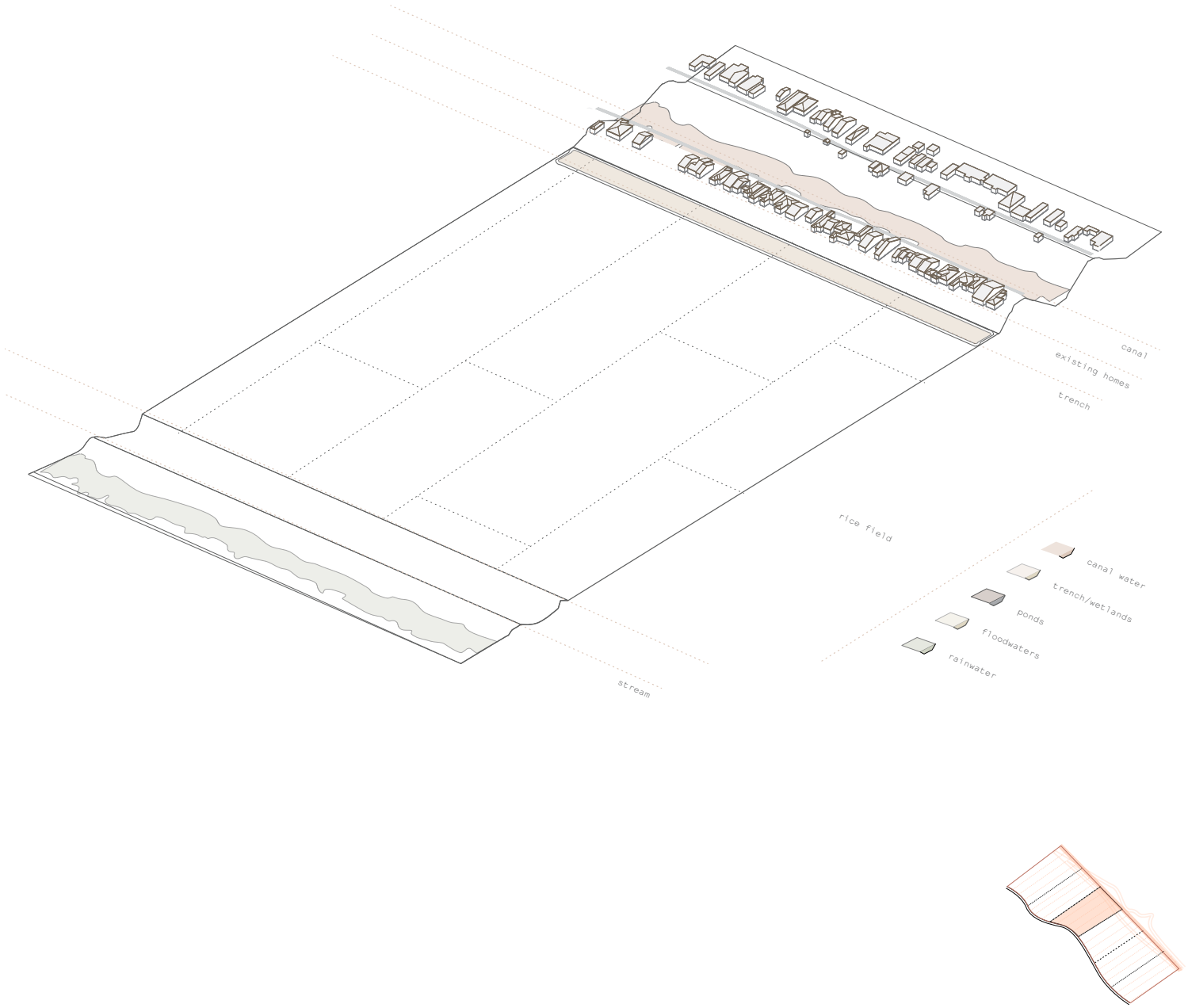
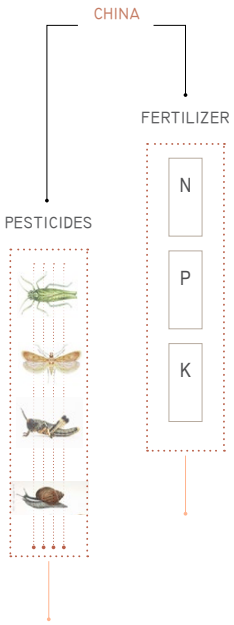


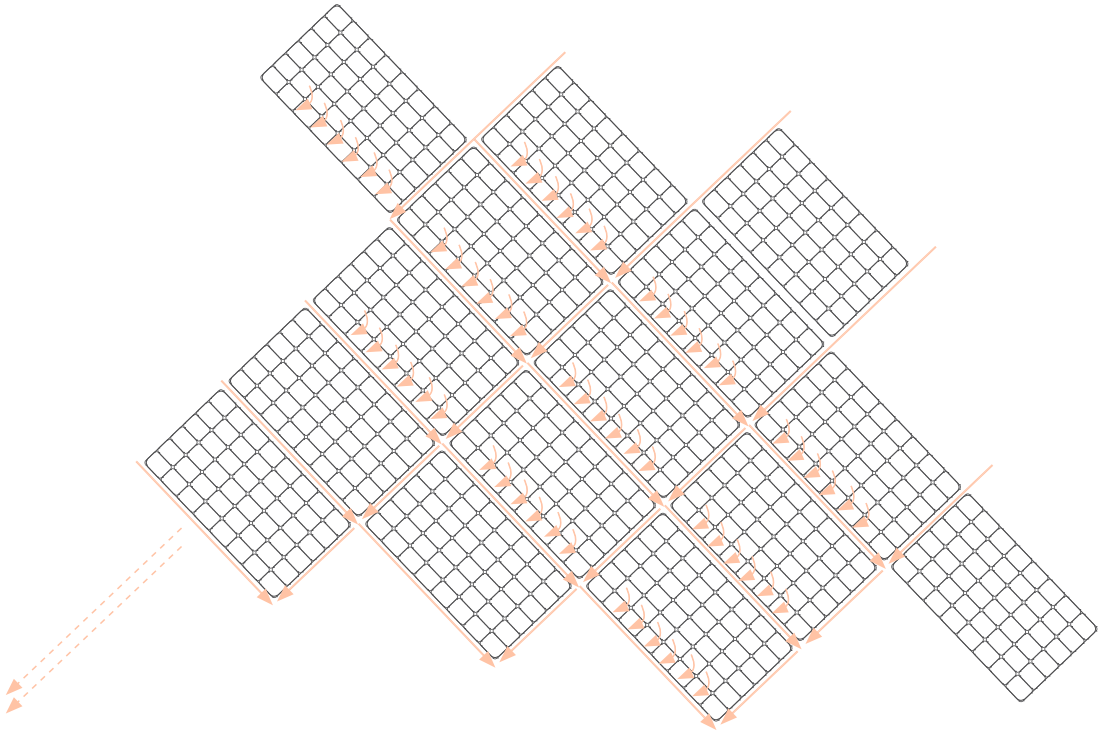
figure 3.11
Proposed site village with new roads and streams and existing monocrop rice field.
Drawing by author.

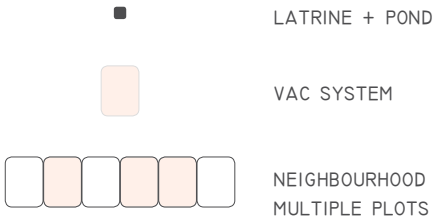


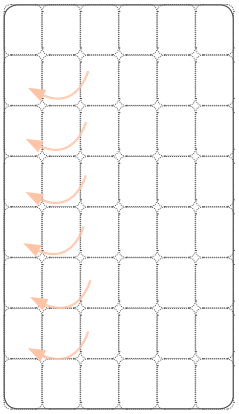
MONOCROP HIGH DIKE RICE FIELDS

RUNOFF OF PESTICIDES AND
FERTILIZERS TO CANAL
SYSTEMS AND WATER SUPPLIES





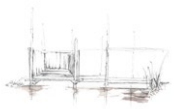




USING APPROACH OF
LATRINE + POND COMBINED WITH VAC SYSTEMS,
THE SCALE OF THE ENTIRE FIELD IS REDESIGNED

EXISTING COMMERCIAL
AGRICULTURE FIELD

figure 3.12
Monocrop high dike rice field diagram.
Drawing by author.



PROPOSED DIVERSIFIED FIELDS

NEW AGRICULTURAL SYSTEM WITH LATRINE + POND PRINCIPLES

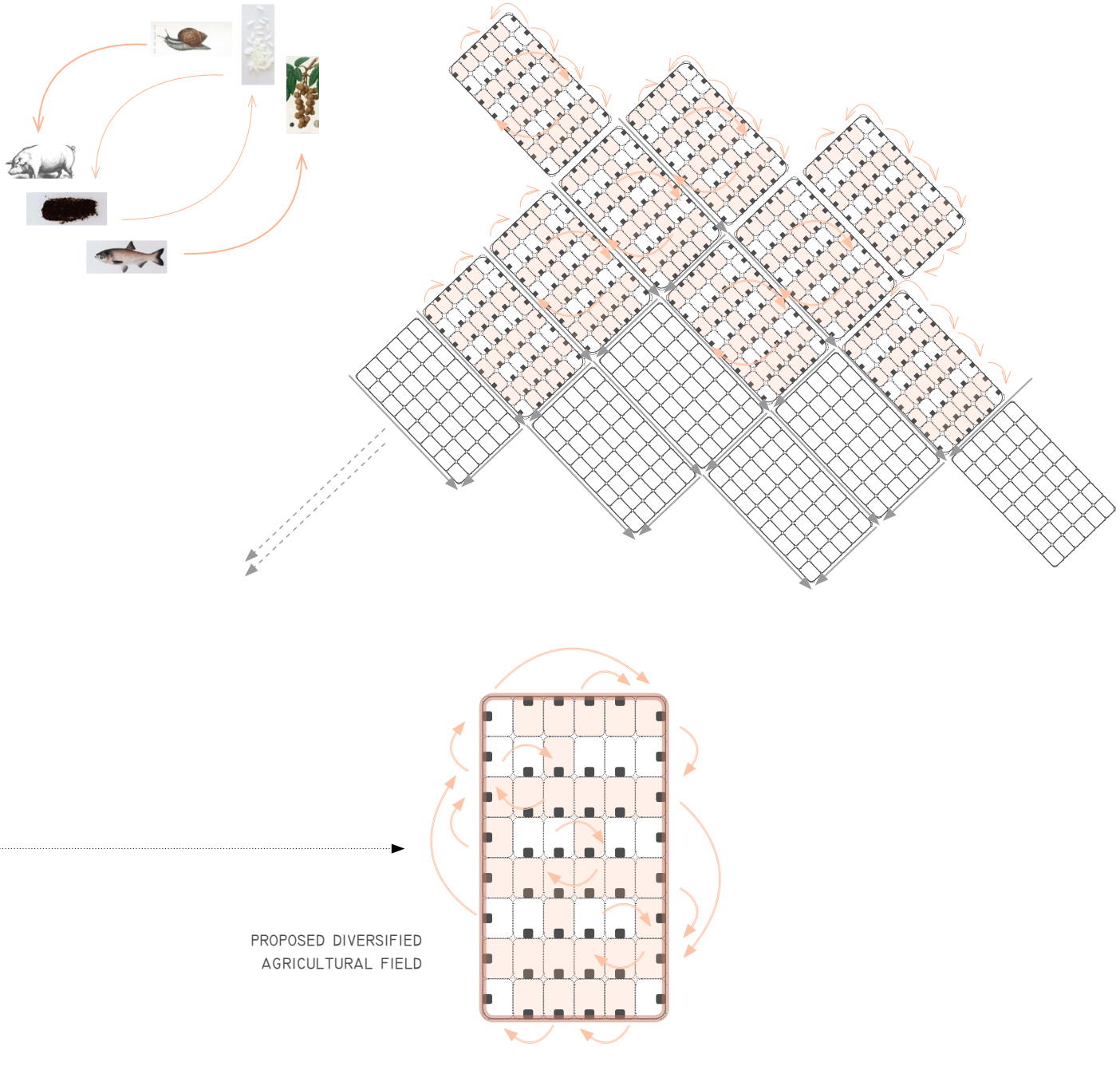


figure 3.13
Proposed diversified field diagram.
Drawing by author.

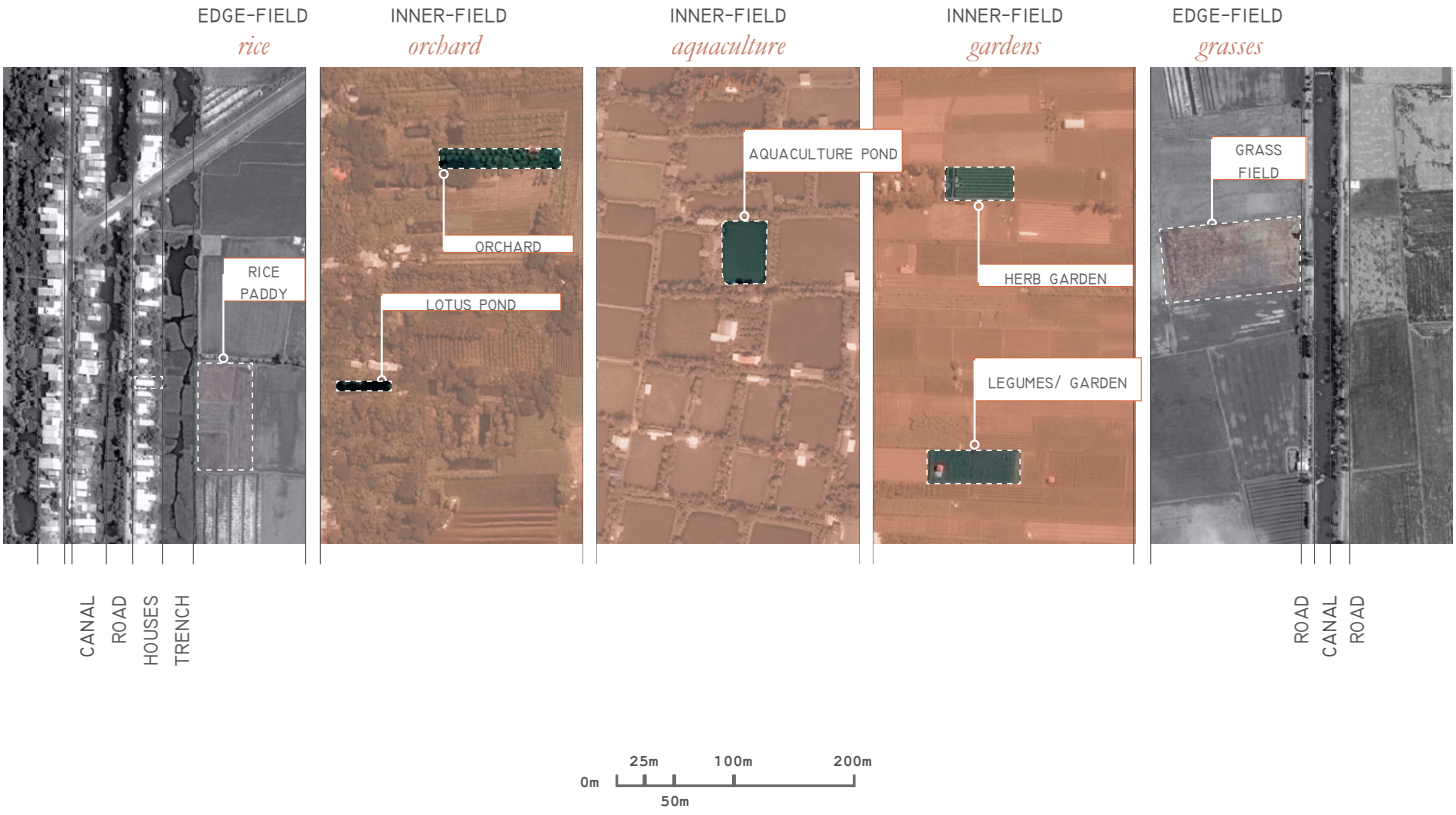


figure 3.14
An diversified VACR field decomposition diagram.
Diagram by author.
Source: Satellite Imagery by Google Earth.

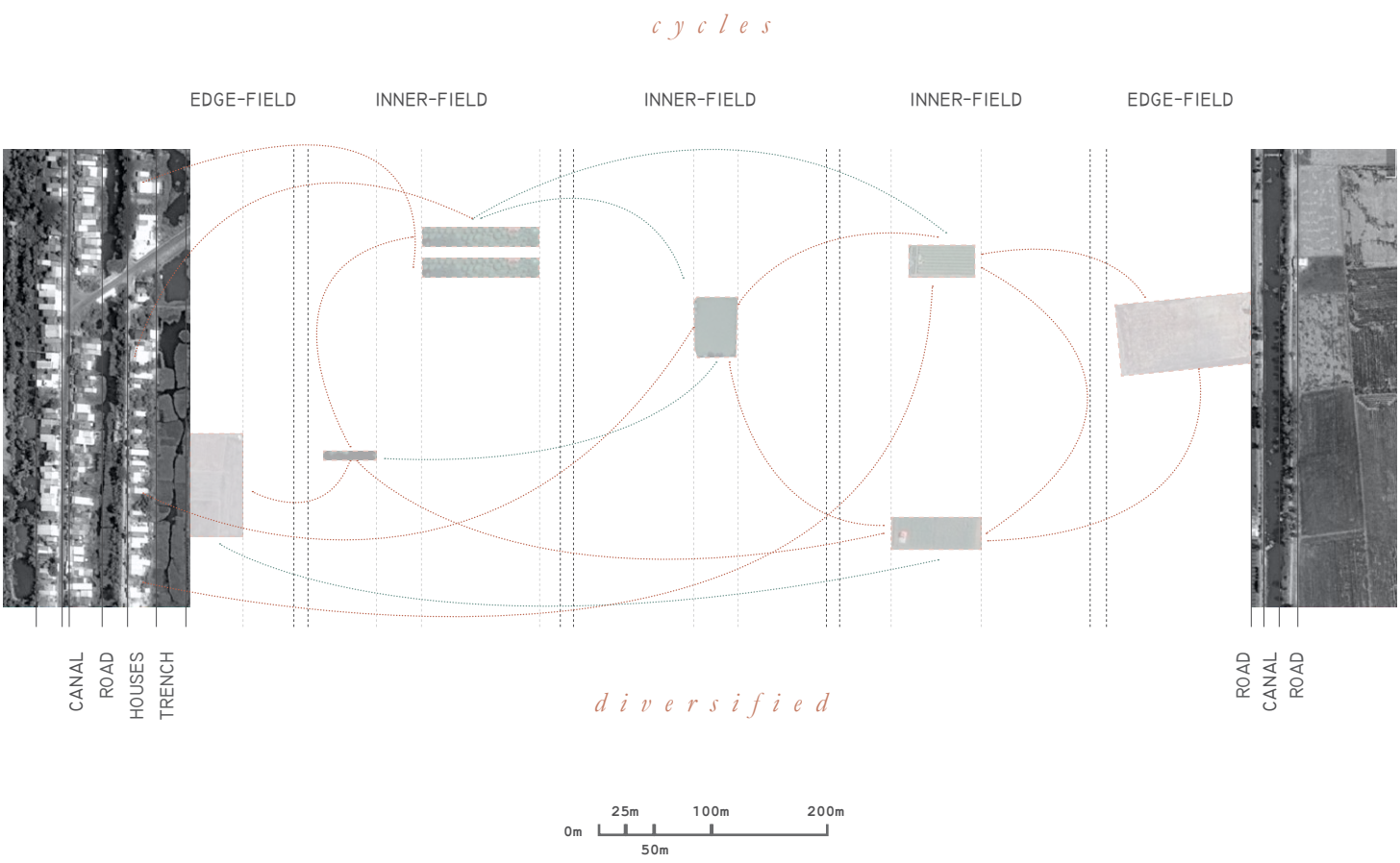


figure 3.15
An diversified VACR field with cycles decomposition diagram.
Diagram by author.
Source: Satellite Imagery by Google Earth.

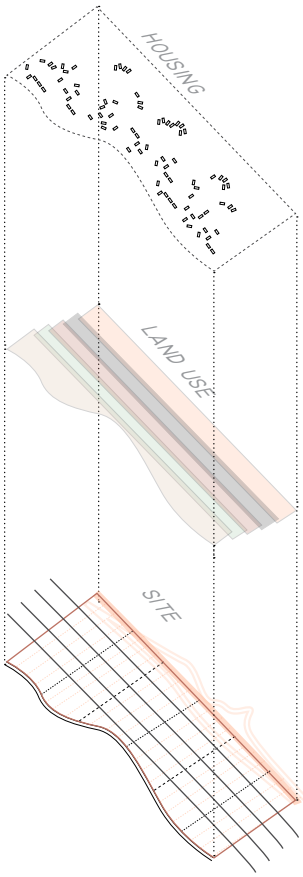


figure 3.16
Proposed Site with new divisions, houses and land uses.
Diagram by author.

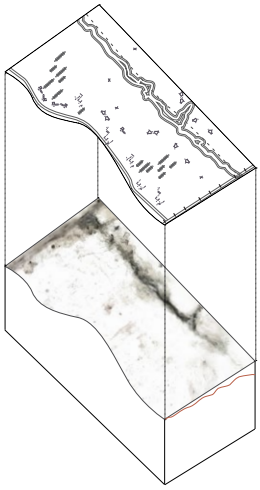
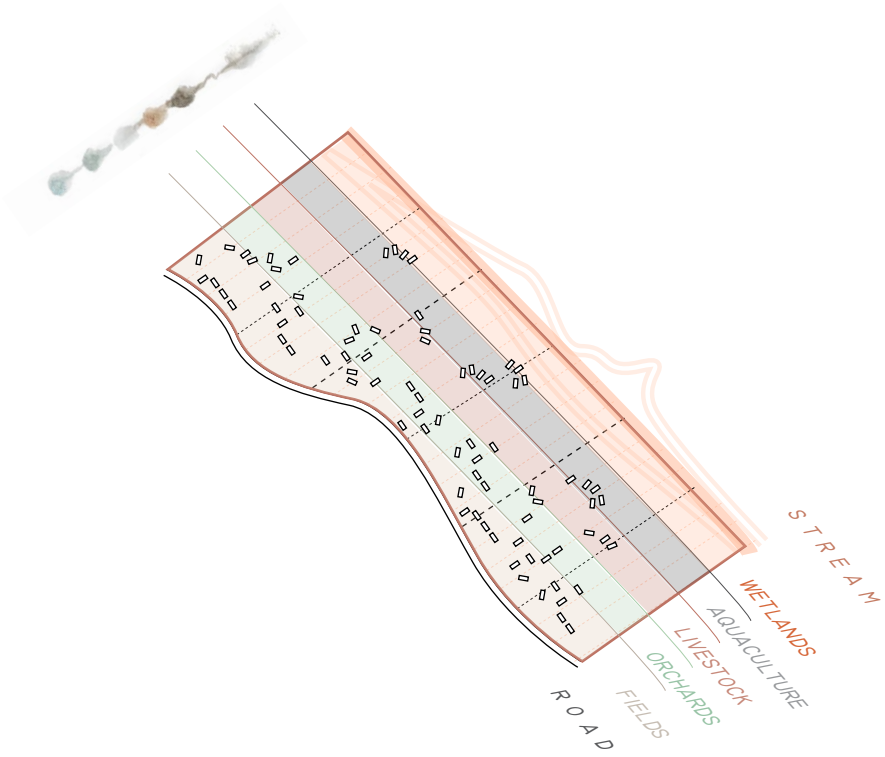


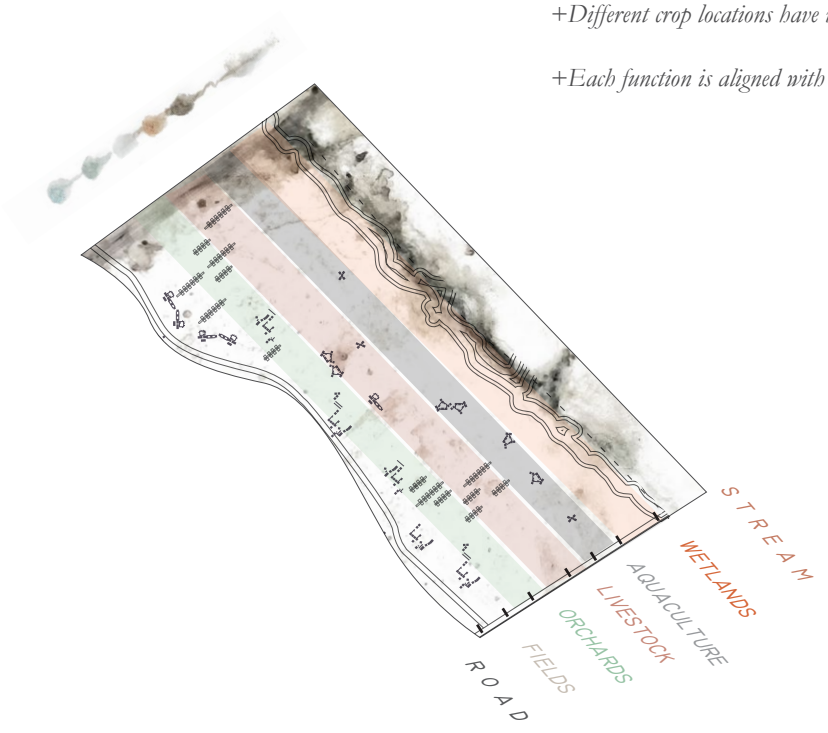
figure 3.17
Village swath with new site changes.
Diagram by author.



+Same swath with new divisions in agricultural land use.

+Different crop locations have varying access to roads and canals.

+Each function is aligned with the spectrum of water to minimize risks.



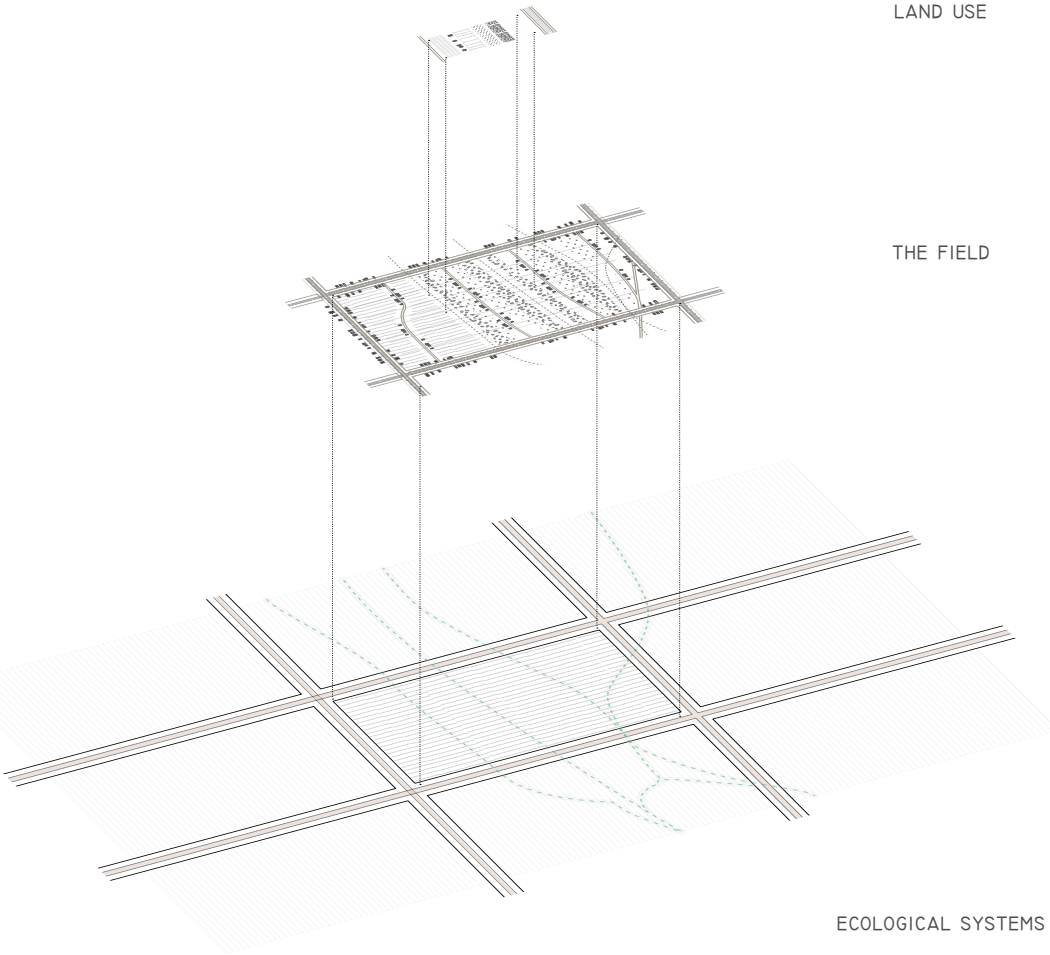


figure 3.18
Diagram of proposed field systems.
Diagram by author.

Phasing

The proposed timeline *(figure 3.20)* for the construction of the field is based on reclamation of triple-season rice paddies from owners and allowing them to also benefit from economic gains in the new diversified field. Diversification of the field reduces the need for chemical controllers and inputs for feeding and fertilization.

Owners will be asked to lease their land out to workers who in turn pay with their labour for the cultivation, harvesting and farming of crops, orchards and livestock. Increasing densification in the field allows for more households to require services giving way for local businesses to thrive.

Timeline

0 existing	*monocrop-rice field*
1 year	*uncovered stream, road construction*
2 years	*digging ponds, build home foundations*
3 years	*homes constructed, orchards built, trenches dug*
4 years	*more homes constructed, integrated farming*
5 years	*market development, population growth*
expansion	*expansion to adjacent mono-crop fields*



figure 3.19
Existing section of field with monocrop rice culture.
Diagram by author.

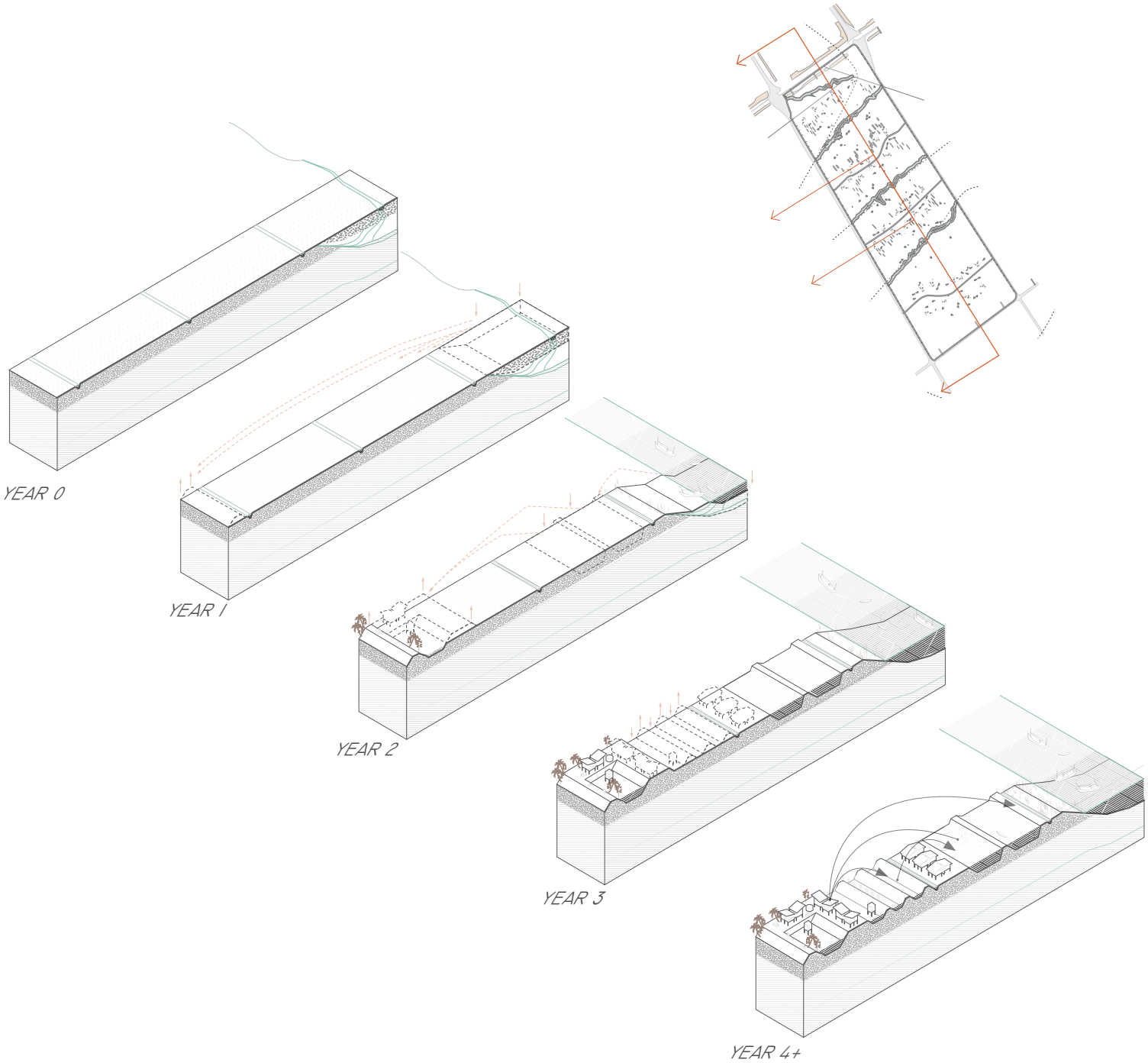


figure 3.20
Phasing for field proposal.
Drawing by author.

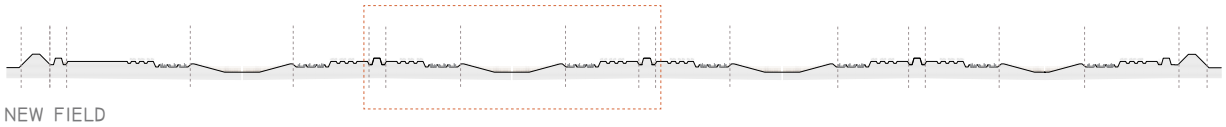


figure 3.21
Proposed section of field with diversification of plants, livestock and ponds.
Diagram by author.

year 0
existing high dike rice field with triple-crop harvest.

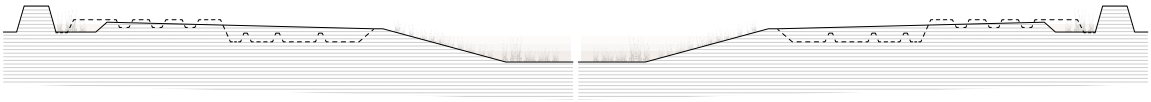
existing rice field

year 1
first roads are dug with new trenches created, new villagers move in with jobs to help prepare the field. homes exist on the trench. stream restoration begins.



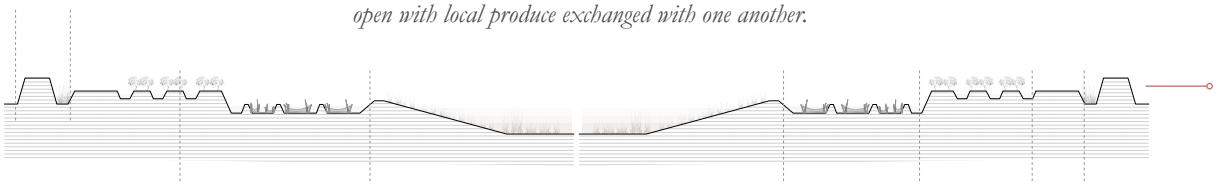
creation of roads

year 2
old streams are restored by displacing soil to build up new bunds and roads and orchards. aquaculture ponds are prepared and filled.



restoration of streams and wetlands

year 3
site is completed as population density increases with more villagers taking up vacr related operations, markets begin to open with local produce exchanged with one another.



digging of ponds and orchards bunds

3.2 The Field: Boundaries Above and Below

The design begins at the scale of the larger hydrogeological landscape, in restoring the natural streams and wetlands existent amongst the fields to allow for natural seasonal flows to occur, resisting the confinement from the canals and dikes. *(figure 3.22)*

Restoring Streams

Streams also reduce the channelization of water and dredging requirements required for canal maintenance. The naturalization of channels is common in the awareness that the control of floods may contribute to higher damages and ecological impacts. Flooding areas upstream allows downstream areas to have reduced flood levels, protecting downstream residents in the long term.[1]

Flooding & Wetlands

Beginning with one field, the dikes would be allowed to open up at the location of the existing streambed. The stream would be allowed to flow from one field after crossing the canal to the next *(figure 3.24)*. Along the stream would be wetland areas planted with reeds, vetiver and hyacinth that absorb flooding during the wet and dry seasons. These wetlands mimic the existent trench that is a result of the construction of the high dike. Streams and wetlands have the capacity to provide "free-goods" during the rainy season for landless farmers, whether they live within the communities or not. These areas would be open for fishermen who in turn help harvest and collect the products from these areas, maintaining access on waterways.

Allowing the fields to be linked reduces the industrialization of the landscape from the grid to a part-naturalized to part-controlled areas *(figure 3.25)*. The combination of these two systems allows the design to benefit from flood-free zones while also allowing the flood to bring in alluvial soils in low-lying areas. From the waterways, the scale of the field is then considered, in how an integrated hybrid-VACR system with partial flooding and partial protection can mediate between the two practices.

---

1 Strategic Partnership Arrangement on Climate Change Adaptation and Water Management. *Mekong Delta Plan.* Socialist Republic of Vietnam & Kingdom of the Netherlands, 2013, accessed December 16, 2018. 86-87. https://www.wur.nl/upload_mm/2/c/3/b5f2e669-cb48-4ed7-afb6-682f5216fe7d_mekong.pdf
One approach from the 2013 Mekong Delta Plan is the "Controlled Flooding – coupling double rice crop and fish farming" in the Upper Delta regions of the Long Xuyen Quadrangle & Plain of Reeds in An Giang and Long An province, respectively. Wet season flows are prioritized over triple-rice policies reducing flood-risks as the waters are able to be retained over larger areas, but also allowing the return of alluvial soils to high dike fields. These flooded regions enable fish farming as well as floating vegetable cultivation to improve economic activities for rural residents.

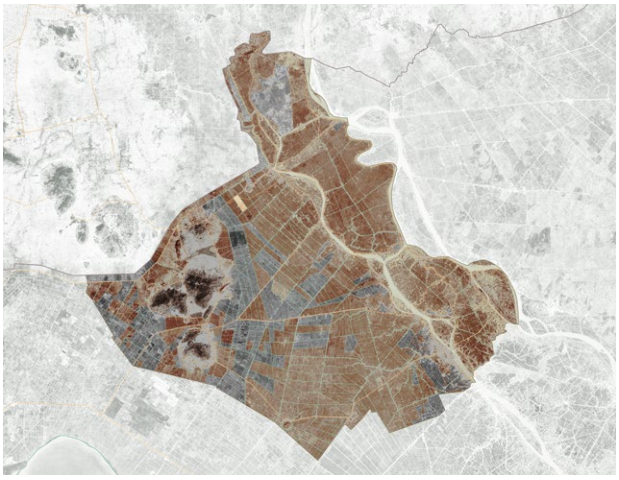


figure 3.22
Painting of diversified field.
Laser-cut Plexi over watercolours on mylar.
Model by author.



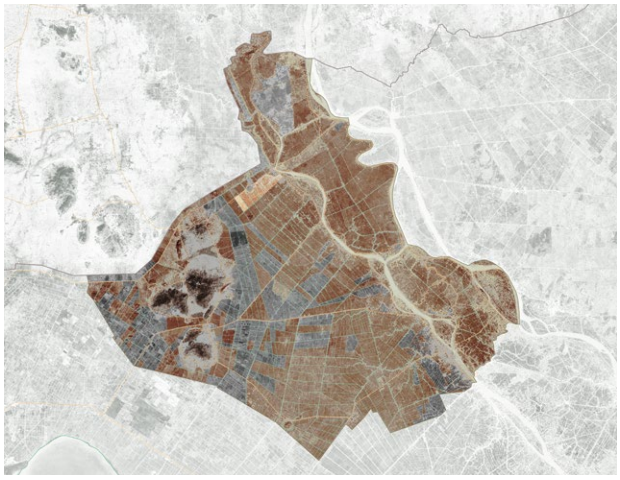
figure 3.23
Proposed Site with uncovered streams, roads and diversified agricultural systems.
Drawing by author.


0m
100m
200m
400m
800m



phase 1

first field is diversified.



phase 2

adjacent fields are diversified, linking towards the Bassac River.



phase 3

another band of fields are diversified, linking the Bassac River to the low dike fields.





phase 4

more bands are converted, creating strong links for flooding along wetlands and reducing pesticide and chemical fertilizer pollution.



phase 5

An Giang is diversified and converted from a major high dike monocrop rice field.

figure 3.24
Phase Map of diversified field proposal.
Diagram by author.
Source: Satellite Imagery by Google Earth.



0m 0.25km 0.5km 1km

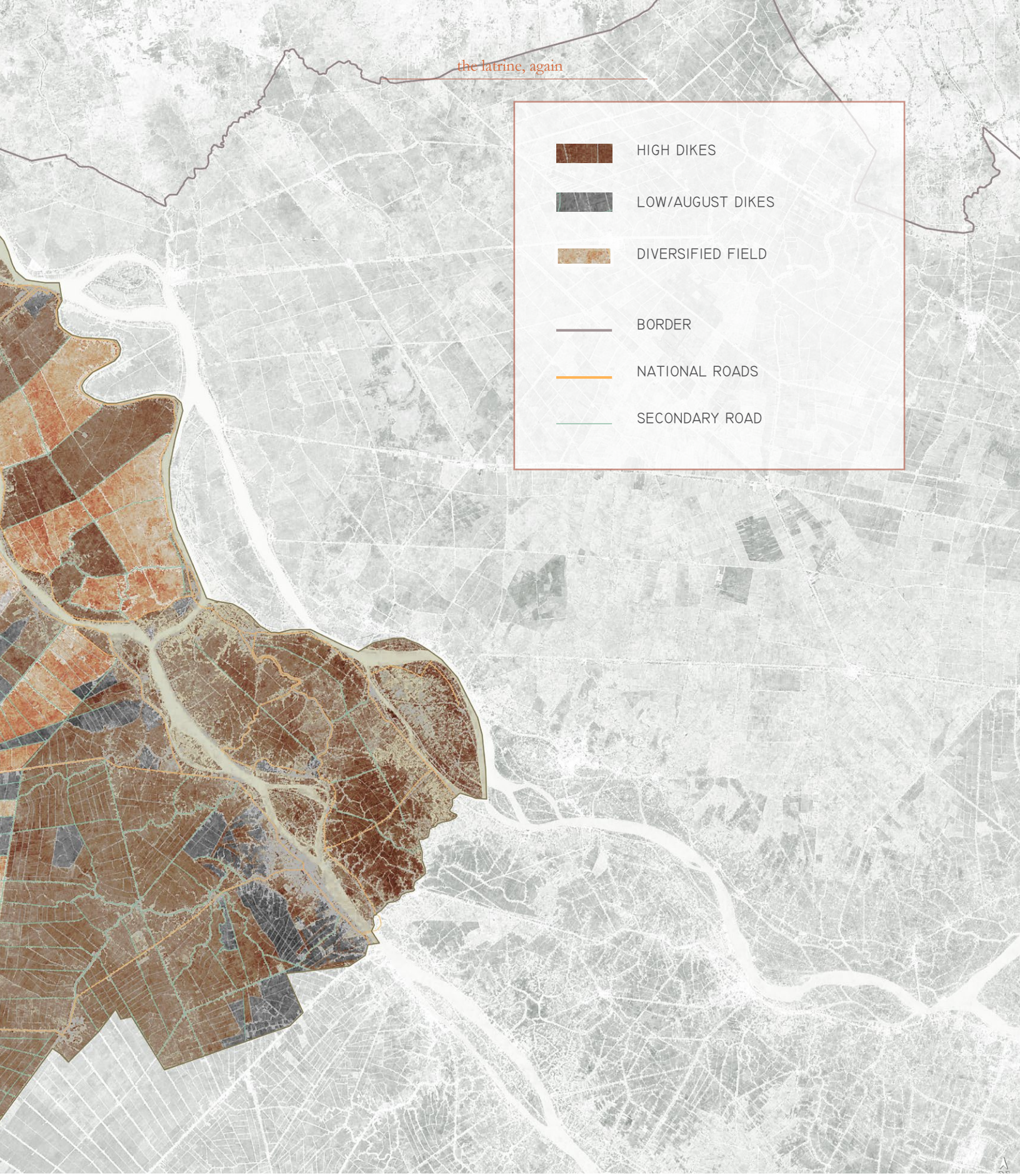


figure 3.25
Map of diversified field proposal.
Diagram by author.
Source: Satellite Imagery by Google Earth.

the farm

When the canal is freed, the homes are freed as well. Free from the constraining roads and canals, the village formerly confined by the infrastructural grid of roads and canals, is able to take on a new form that scatters across the field and is in direct contact with the landscape.

These new connections and cycles are able to counter the restrictions that force households to use polluted resources. If managed properly, many of the concerns for pollution can be mitigated through nutrient management and the natural seasonal cycles of the delta. Agriculture and infrastructure is not separated from the home, but maintains a crucial link allowing households to contribute to the water and nutrient cycles on a daily basis.

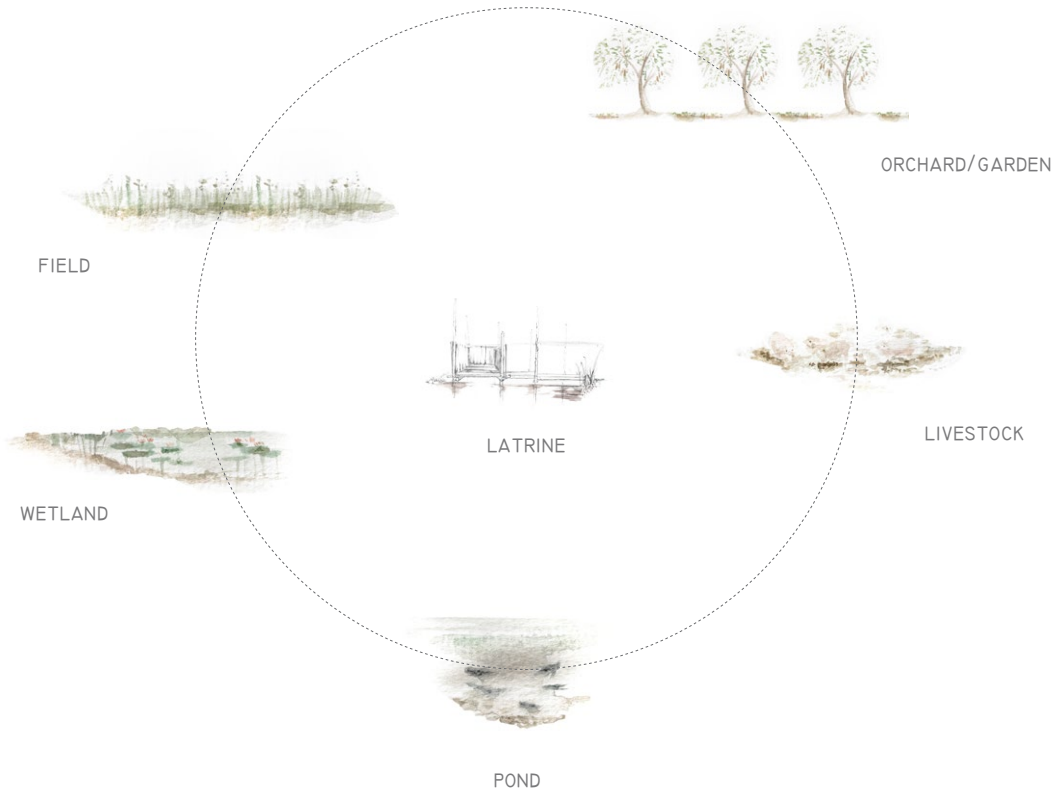


figure 3.26
Diagram of latrine with VACR system.
Drawing by author.

3.3 The Farm: Integrated Farming Systems and Land Use

Socioeconomic Capital

Addressing the many socio-economic relationships between each domestic space is integral to the performance of the agricultural system. Bosma et al outline the integration of *Natural Capital, Social Capital, Human Capital, Physical Capital and Financial Capita*l in the development and maintenance of diversified farming practices:

> *Natural*
> *The natural stock from which resource flows are derived (e.g. land, water, wildlife).*
>
> *Social*
> *The social resources (networks, membership of groups, relationships of trust, access to wider institutions of society) upon which people draw in pursuit of livelihoods.*
>
> *Human*
> *The skills, knowledge, ability to labor and good health needed.*
>
> *Physical*
> *The basic infrastructure (transport, shelter, water, energy and communications) and the production equipment and means which enable people to pursue their livelihoods.*
>
> *Financial*
> *The financial resources which are available to people (whether savings, supplies of credit or regular remittances or pensions) and which provide them with different livelihood options*[2]

Using the approach of an integrated farming system as seen in high dike regions, the current integrated farming system is reconfigured for its direct inclusion of wetlands and the household. The wetlands help to contribute to the ecological cycles of the region while the integration of the household contributes to the social interaction with the proposed systems. The new VAC-R system *(figure 3.26)* is designed with the spectrum of water at multiple scales in the order of homes to orchard, to field, to livestock, to pond and finally to wetland. These are located to minimize risks for the household and allow wastewater to flow from higher nutrient concentrations to lower areas.

---

2 Bosma, *Agriculture Diversification in the Mekong Delta: Farmers' Motives and Contributions to Livelihoods*, 55-56.

Infrastructure

Infrastructural developments can occur at the same time as the development of the agro-systems and households. Decentralized infrastructure such as rainwater harvesting and filtration as well as ponds to capture wastewater, limiting the requirement for water supply pipelines and sewage management. The proposal prioritizes that natural flow of materials from one point to the next in order to limit the energy requirements for each system.

Adjacencies

This design also brings traditional ways of farming on small-plots with external and indirect benefits gained from access to different programs. Adjacencies at a larger scale contribute through different farmers sharing resources with one another. Pig farmers can share their pig waste with fish farmers, and orchard cultivators can use scraps and branches to help with construction and pond feed as well. These cycles in this set up are endless and have already been practiced at the scale of a smaller household. The design takes this relationship and expands it to the scale of the field, allowing for less nutrient leakages in the commercial practice.

At a smaller scale, one example is the location of trees adjacent to the house for shade and microclimate conditions, reduction of land erosion, and for access to fruits for kitchen uses. Livestock are located close to the home within sight for occasional checks throughout the day. Smaller livestock can be kept close to the home to feed on scraps from kitchen waste such as vegetables and meat bones.

Adaptations & Variations

The arable land use proportions and cultivation options for each system are varied depending on users *(figure 3.27)*. Some systems may adapt to more aquatic livestock and ponds with less orchards, or more orchard-intensive designs with more cattle, gardens and household interactions. These variations are outlined in existing VAC-R systems and the new proposal draws on these varieties.[3] A teaching model will be adopted to allow farmers to share different cultivation techniques and livestock- raising skills with one another. Workshops are vital to ensure that risks are clearly outlined, but benefits of wastewater usage and nutrient cycling are informed as well. Farmers with previous experience have opportunities to hire new labourers as apprentices – a common means of transferring skills in the region.

3 Dang et al. *Integrated freshwater aquaculture, crop and livestock production in the Mekong delta, Vietnam*, 4.

VAC System	Agro-ecological environments	Geographical Locations	Farm Household Situations	Animal husbandry
Intensive orchard - low-input aquaculture	Low or medium flood depth Alluvial soil Fruit tree-dominated trees	Rural and peri-urban	Less experience in aquaculture	With or without very small-scale pig raising (1-2 pigs/ household)
Intensive orchard - medium-input aquaculture	Low or medium flood depth Alluvial soil Fruit tree-dominated trees	Rural and peri-urban	Better-off with experience in aquaculture	Small-scale pig raising (5-10 pigs.household) or commercial poultry production
Semi-intensive orchard - low-input aquaculture	Medium flood depth with less fertile soil or high flood depth and alluvial soil Rice-dominated areas	Rural and peri-urban	Worse-off or less experience in aquaculture	With or without very small-scale pig raising (1-2 pigs/ household)
Semi-intensive orchard - medium-input aquaculture	Medium flood depth with less fertile soil or high flood depth and alluvial soil Rice-dominated areas	Rural and peri-urban	Better-off with experience in aquaculture	From small to medium-scale pig raising (5-30 pigs. household) or commercial poultry production
Semi-intensive orchard - high-input aquaculture	Medium flood depth with less fertile soil Rice-dominated areas	Peri-urban, near aqua processing industries	Better-off with more experience in aquaculture	With or without pig raising
Extensive orchard - medium-input aquaculture	Medium flood or high flood depth Less fertile soil Rice-dominated areas	Rural and peri-urban	Better-off with experience in aquaculture	From small to medium-scale pig raising (5-30 pigs. household) or commercial poultry production
Extensive orchard - high-input aquaculture	Medium flood or high flood depth Less fertile soil Rice-dominated areas	Peri-urban, near aqua processing industries	Better-off with more experience in aquaculture	With or without pig raising

figure 3.27
Common VAC systems applied in the Mekong Delta and their influence factors.
Chart by Nhan et al, 2005.



figure 3.28
A garden and orchard in Long Xuyen.
Photo by author, 2018.



figure 3.29
Cu Lao My Hung, Long Xuyen: A section indicating relationship between trees and trenches.
Photo by author, 2018.

The Garden & Orchard

Typically a small plot of approximately 50-500 m^2 and located nearby the home (ideally the kitchen). The garden and orchard is used to grow a variety fruits, leafy greens and herbs. Some areas grow ornamental trees and flowers as another income source for the household. Varieties of vegetables and legumes grown include green onion, sweet potato, cress, tomato, cabbage and water spinach.

Typically, both varieties of perennial and annual crops are cultivated to provide year-round food to the home and all excess is grown to be sold at the market.

Luu, Le Thanh. "The VAC System in Northern Viet Nam." International Rice Commission Newsletter Vol. 48. Accessed December 13, 2018. http://www.fao.org/docrep/005/Y1187E/y1187e10.htm.

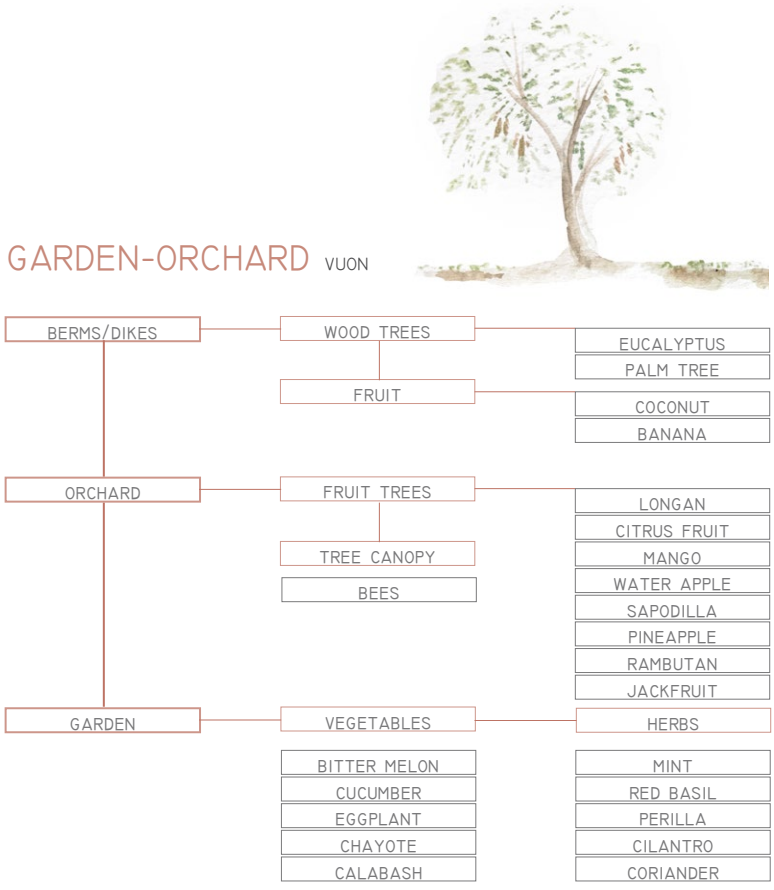


figure 3.30
Diagram of trees, garden vegetables, legumes and orchard fruits.
Diagram by author.

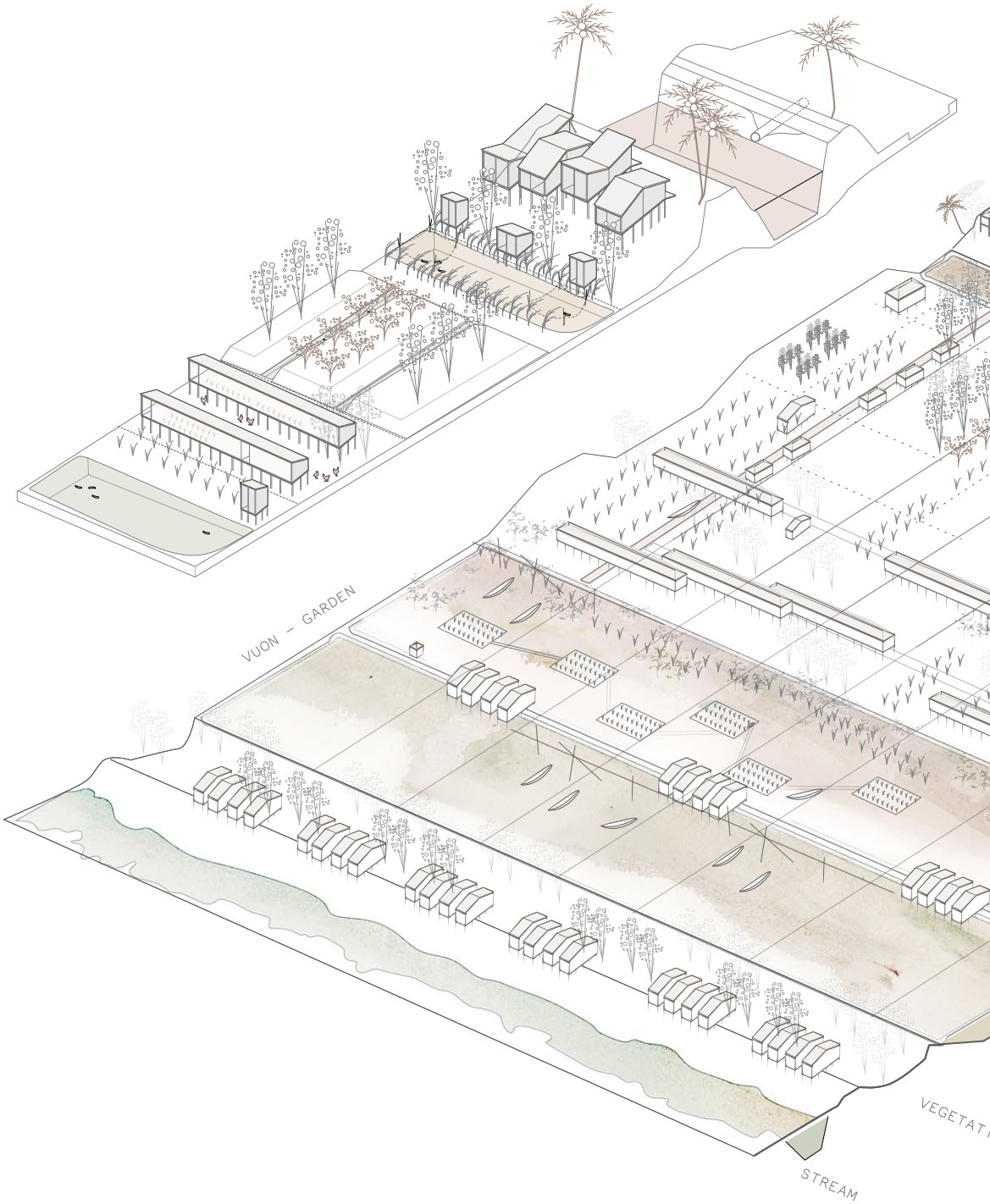
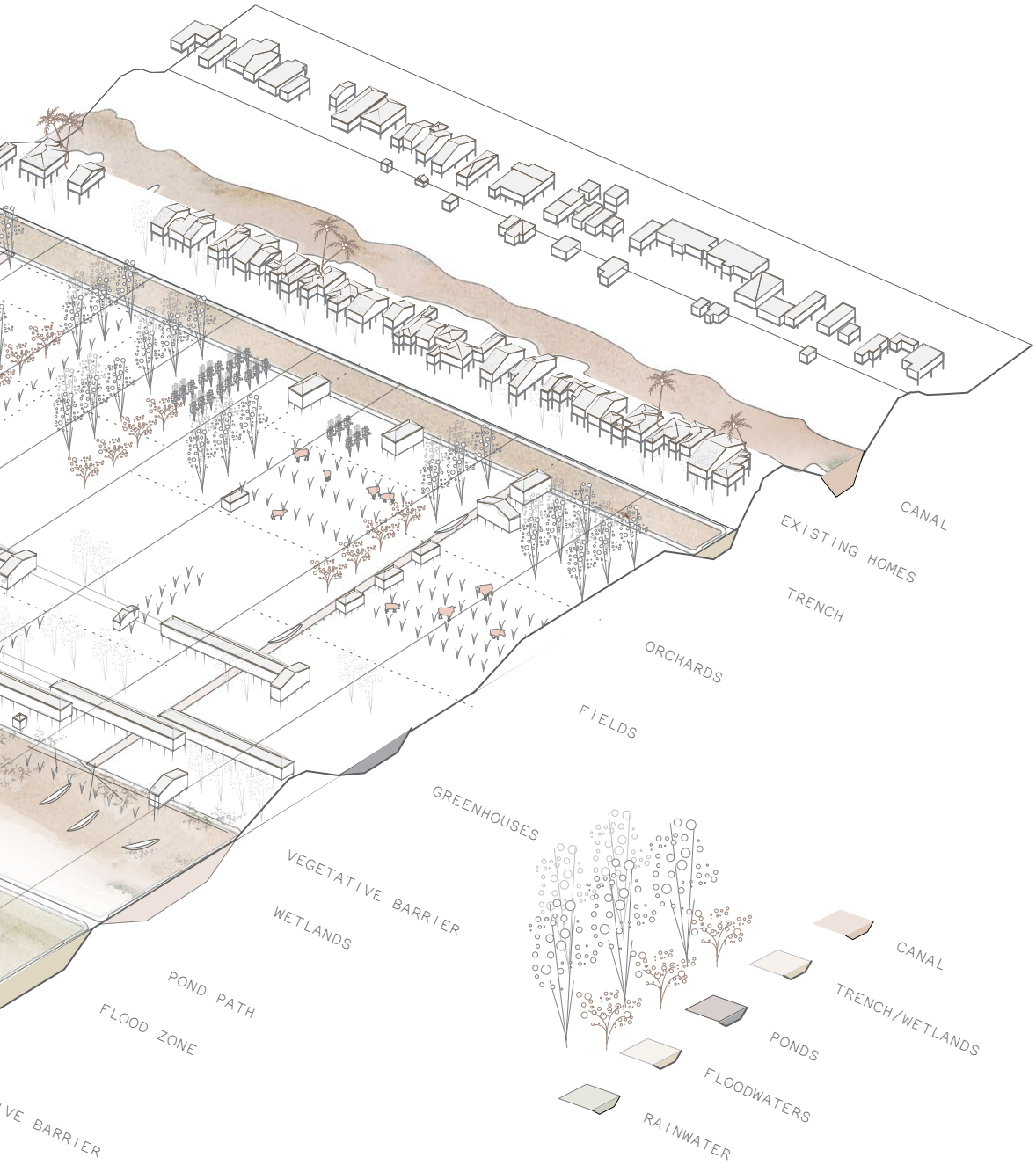


figure 3.31
Proposed garden and orchard dominant VAC-R system at the village scale.
Drawing by author.


CANAL
EXISTING HOMES
TRENCH
ORCHARDS
FIELDS
GREENHOUSES
VEGETATIVE BARRIER
WETLANDS
POND PATH
FLOOD ZONE
VE BARRIER

CANAL
TRENCH/WETLANDS
PONDS
FLOODWATERS
RAINWATER

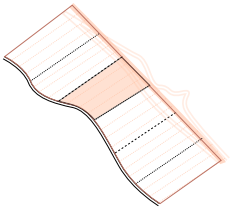




figure 3.32
A grass field for livestock in Tri Ton.
Photo by author, 2018.

The Field

The field can either consist of rice or wild grasses, depending on flood cycles. Rice can be grown in in rotation with other varieties of root vegetables.

These areas provide food and spaces for larger livestock such as cattle and water buffalo to roam and feed. The animal waste can be used to fertilise the field while stalks and bran can be used for feeding the livestock. Scraps found from the field are also used to manure the ponds.

Luu, Le Thanh. "The VAC System in Northern Viet Nam."



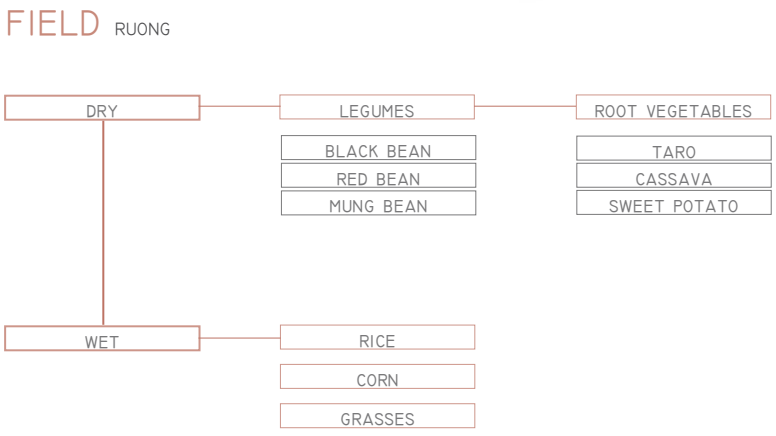


figure 3.33
Diagram of field crops with rice. grasses and legume rotation.
Diagram by author.

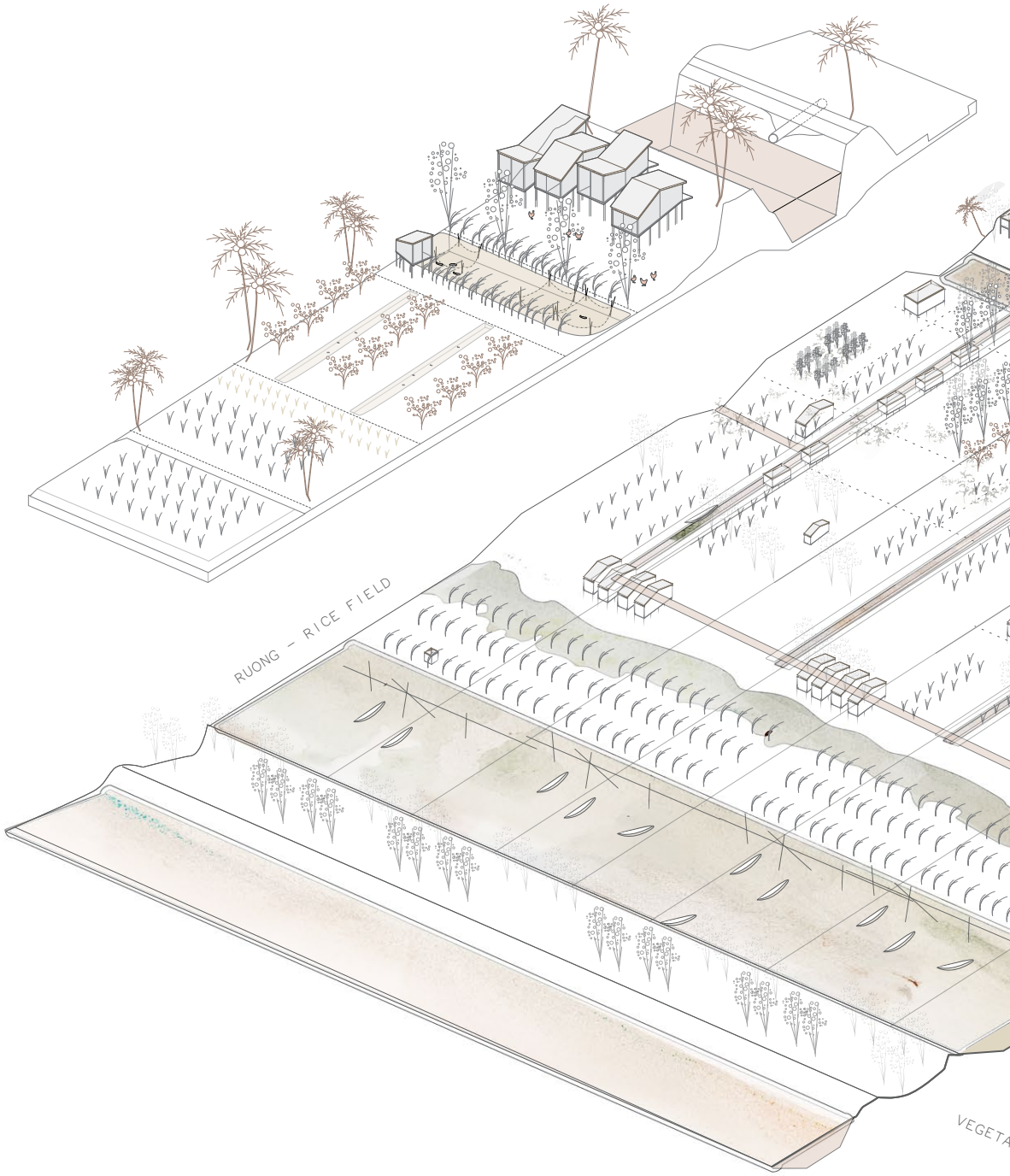
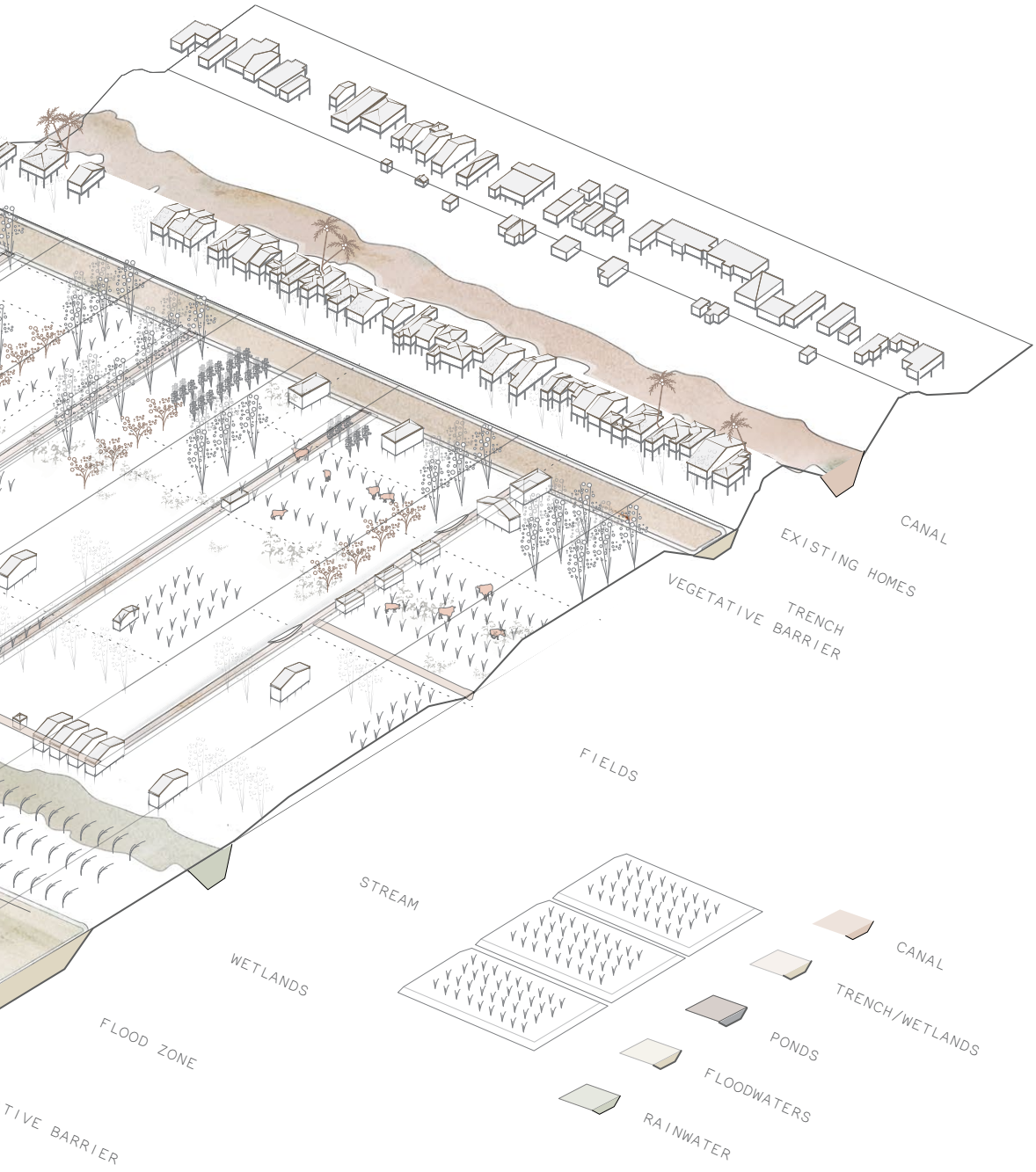


figure 3.34
Proposed field dominant VAC-R system at the village scale.
Drawing by author.


CANAL
EXISTING HOMES
TRENCH
VEGETATIVE BARRIER
FIELDS
STREAM
WETLANDS
FLOOD ZONE
TIVE BARRIER

CANAL
TRENCH/WETLANDS
PONDS
FLOODWATERS
RAINWATER

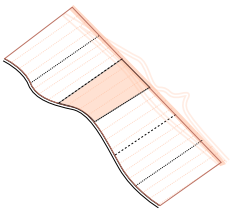
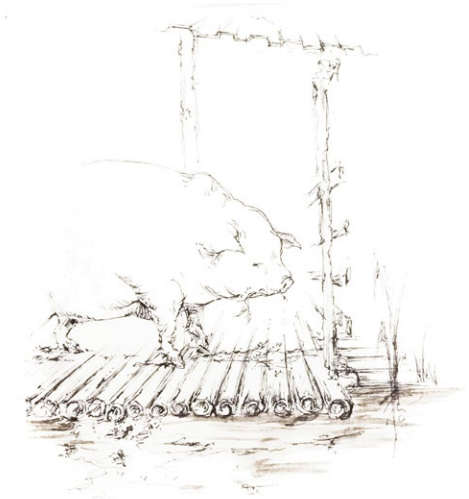




figure 3.35
Cattle laying in the grass on the side of a road in Tri Ton.
Photo by author, 2018.



Livestock

Households can raise various animals dependent on their resources on the farm. Water buffaloes and cattle, pigs, ducks and chickens are commonly raised, but require heavy feeding. Farm-byproducts allow reduced costs of raising livestock, sometimes only an investment in time to gather the material is required. these materials can come from the garden, fields, wetlands and even the household kitchen.

The livestock pens for pigs, buffaloes and cows can be constructed at the corner of the garden close to the pond to allow them to conveniently manure it on a daily basis.

Luu, Le Thanh. "The VAC System in Northern Viet Nam."

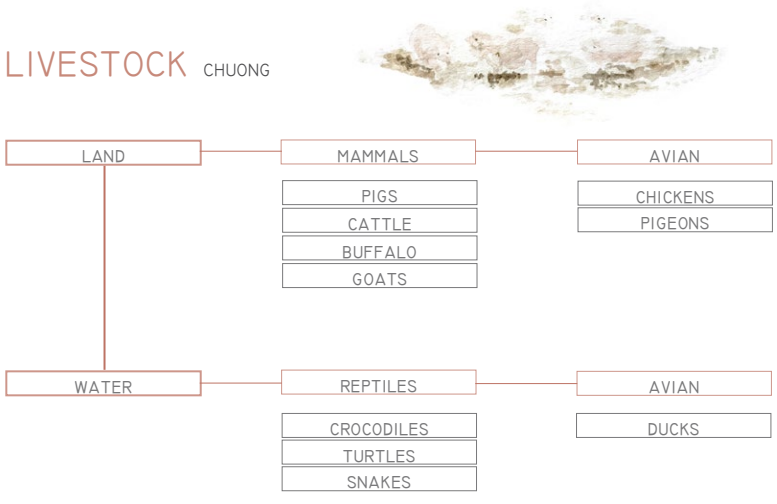


figure 3.36
Diagram of livestock animals in dry and aquatic conditions.
Diagram by author.

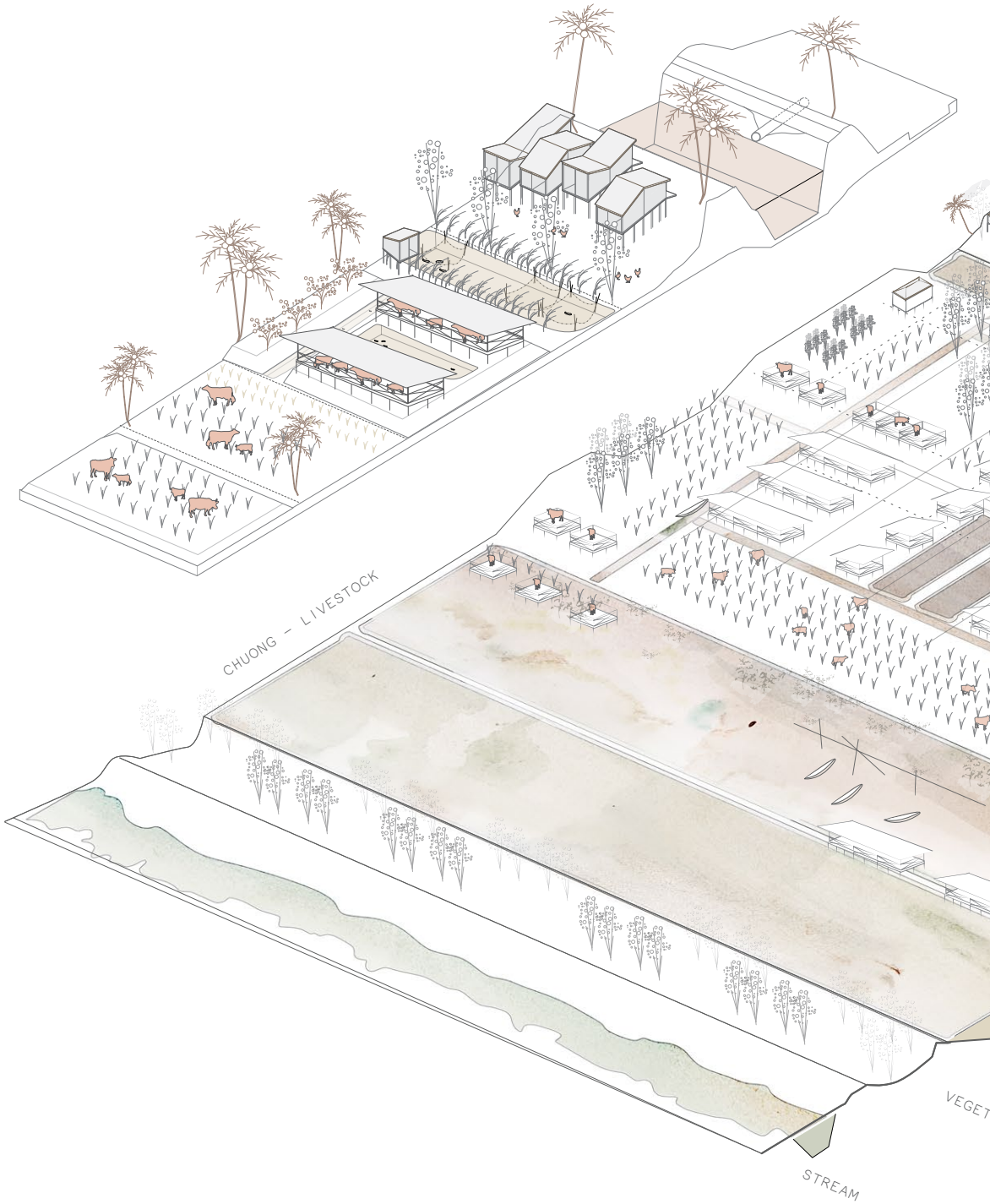
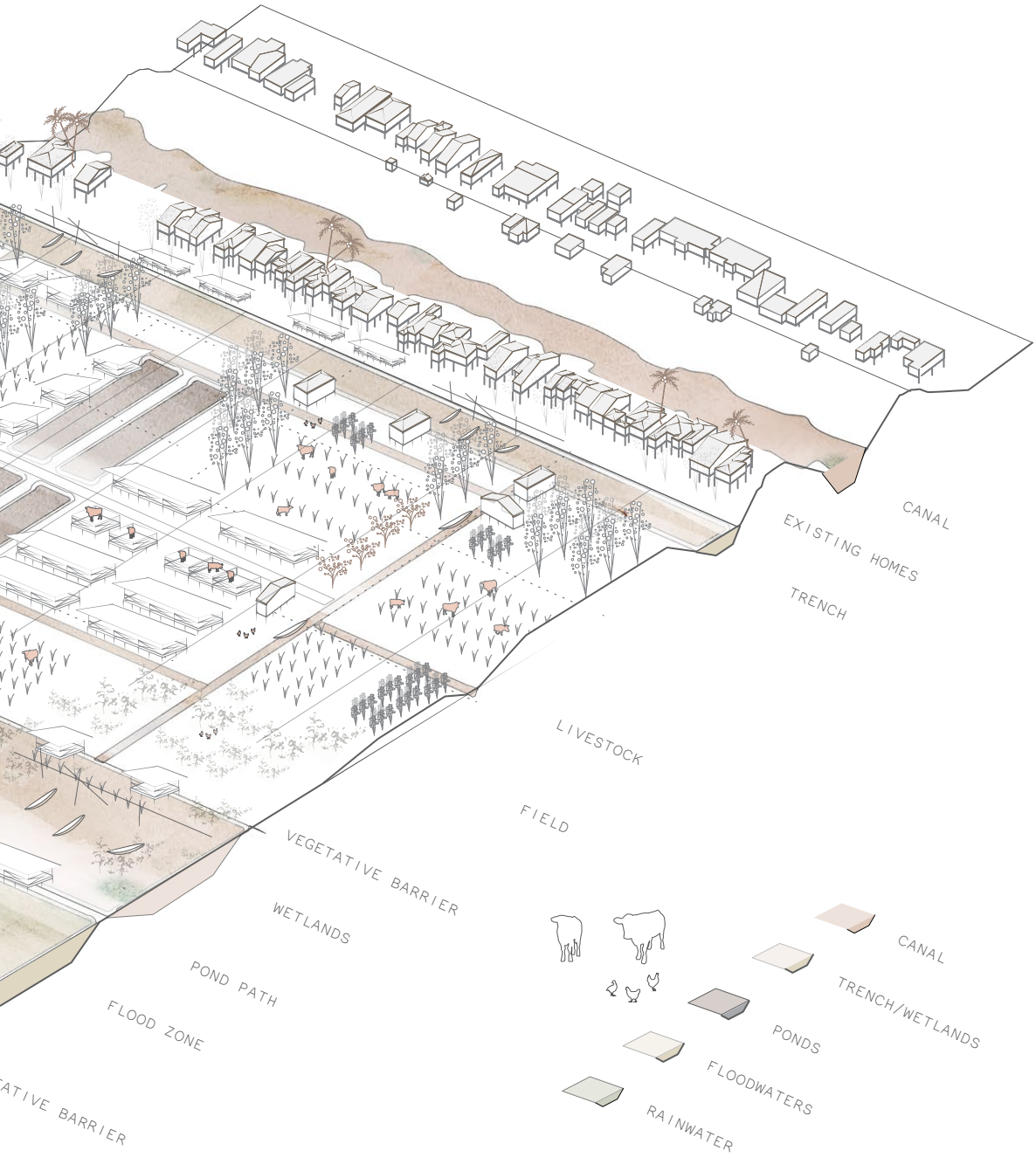


figure 3.37
Proposed pond-wetland dominant VAC-R system at the village scale.
Drawing by author.


CANAL
EXISTING HOMES
TRENCH
LIVESTOCK
FIELD
VEGETATIVE BARRIER
WETLANDS
POND PATH
FLOOD ZONE
ATIVE BARRIER
CANAL
TRENCH/WETLANDS
PONDS
FLOODWATERS
RAINWATER

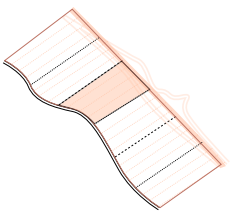




figure 3.38
A trench providing wetland conditions and fish farming in Vinh Xuyen.
Photo by author, 2018.



The Pond & Wetlands

Household ponds can range from 50-400m^2, and even larger at commercial scales. Pond depths typically range from 1m to 1.2m, making them quite shallow. The pond can be used for multiple functions around the farm: mud is annually removed and can be used for fertilizing fruit trees while the pond water is best for irrigation of gardens and orchards.

In January-February, ponds are drained after harvesting the last fish that have matured fully. After this, the pond is then kept dry for several days, limed, manured and refilled with rainwater or irrigation water from the rainfalls at the end of the dry season.

Wetlands provide a link between the ponds and the larger water systems, filtering out excessive pollutants and blackwater. The wetlands are a bountiful place where fishermen can catch fish, snails while also harvesting water lilies and other aquatic plants.

Luu, Le Thanh. "The VAC System in Northern Viet Nam."

POND A0

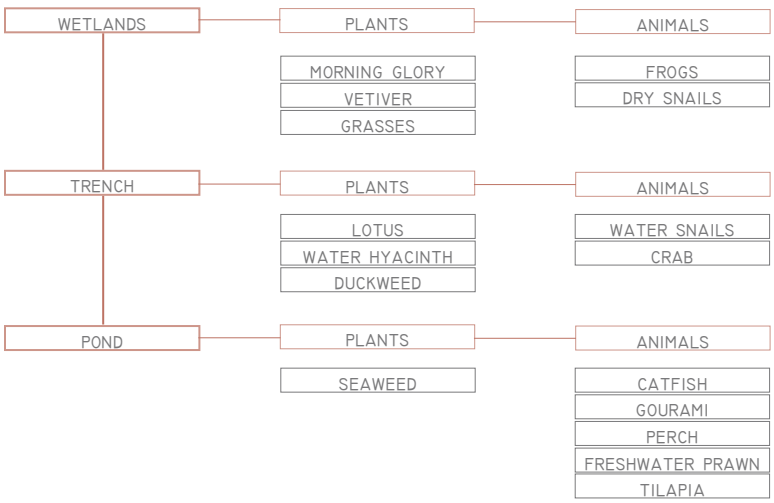


figure 3.39
Diagram of pond and wetland creatures and plants.
Diagram by author.

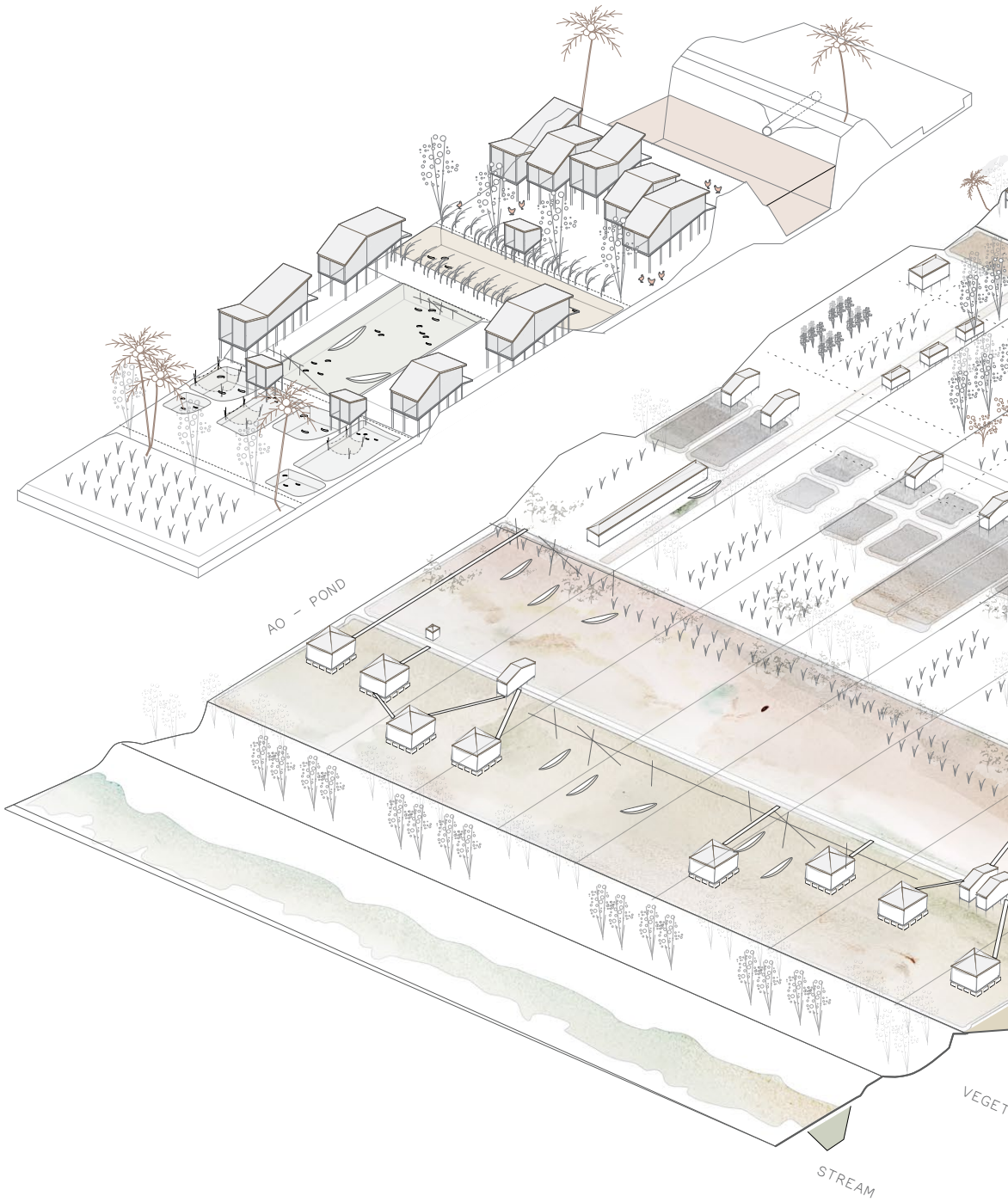
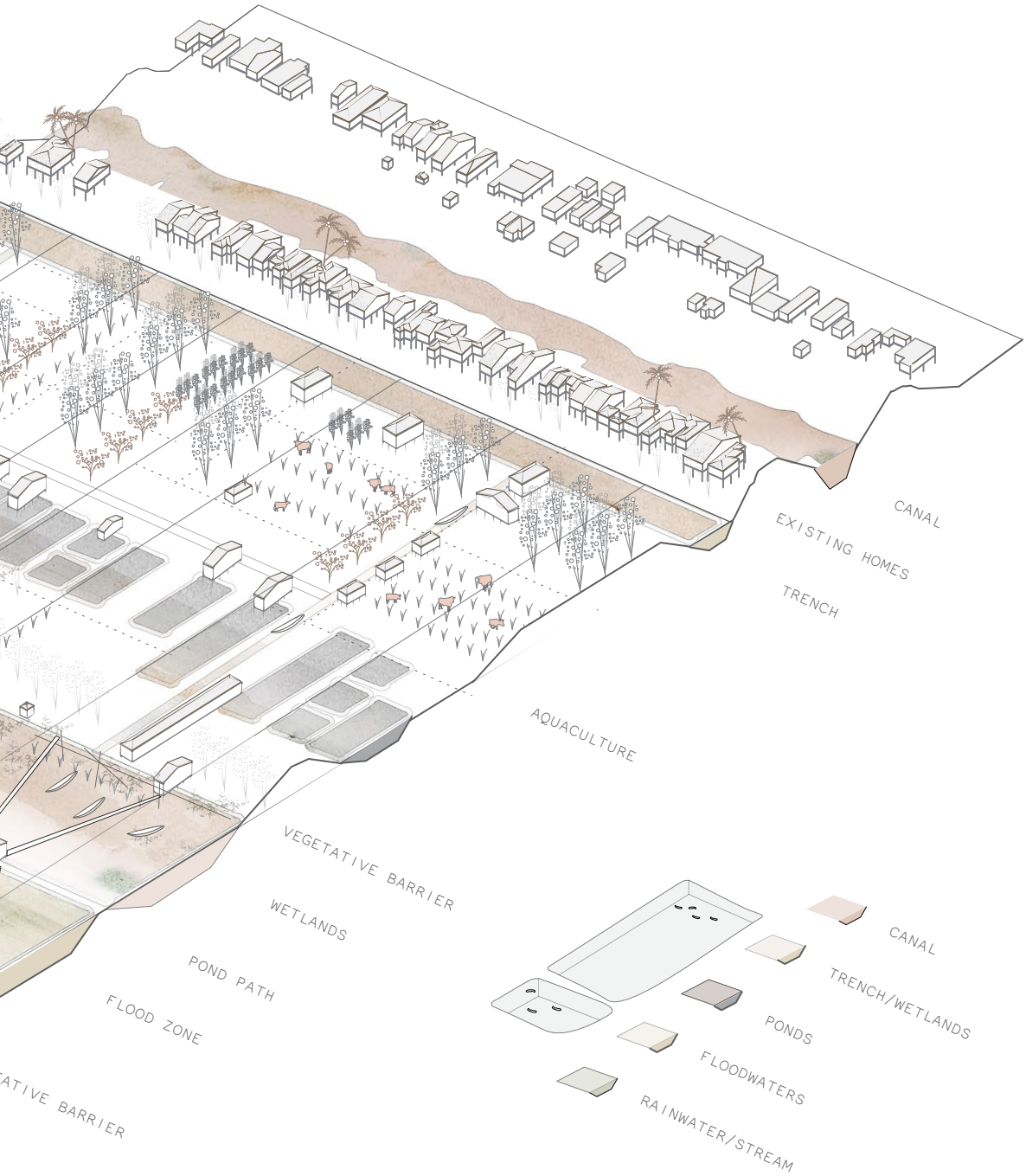
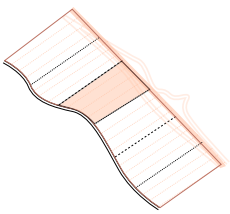


figure 3.40
Proposed livestock dominant VAC-R system at the village scale.
Drawing by author.


CANAL
EXISTING HOMES
TRENCH
AQUACULTURE
VEGETATIVE BARRIER
WETLANDS
POND PATH
FLOOD ZONE
ATIVE BARRIER

CANAL
TRENCH/WETLANDS
PONDS
FLOODWATERS
RAINWATER/STREAM



the structures

The house is a median between the landscape and occupants. Structures are built based on their relationship to the activities directly linked to the landscape. The spectrum of water, used to counter the stigma attached to the conservation of water, is integrated into the designs making it a direct part of spaces for living, eating, washing, bathing, defecating, working, and so on.

Sanitation is not merely a household occurrence, but an action at multiple scales that trickles down from the field, to the village, and finally, to the spaces of the home where it becomes a symbol of reliance on the landscape.

3.4 The Structures: Cascading Systems and Shared Water

From the field, the cluster of homes are addressed on how their interaction with the landscape and farming is created from the location of the structures and their capacity to adapt to seasonal changes such as rainwater storage capacity and flotation during flooding.

These neighbourhoods are tied into water systems that are divided into different spectrums and allow for waste management to occur with reliance on the agricultural fields and landscape *(figure 3.42)*. The structures range from private sleeping spaces, living spaces, to the shared kitchens and laundry area that work as links for the neighbourhood *(figure 3.50)*.

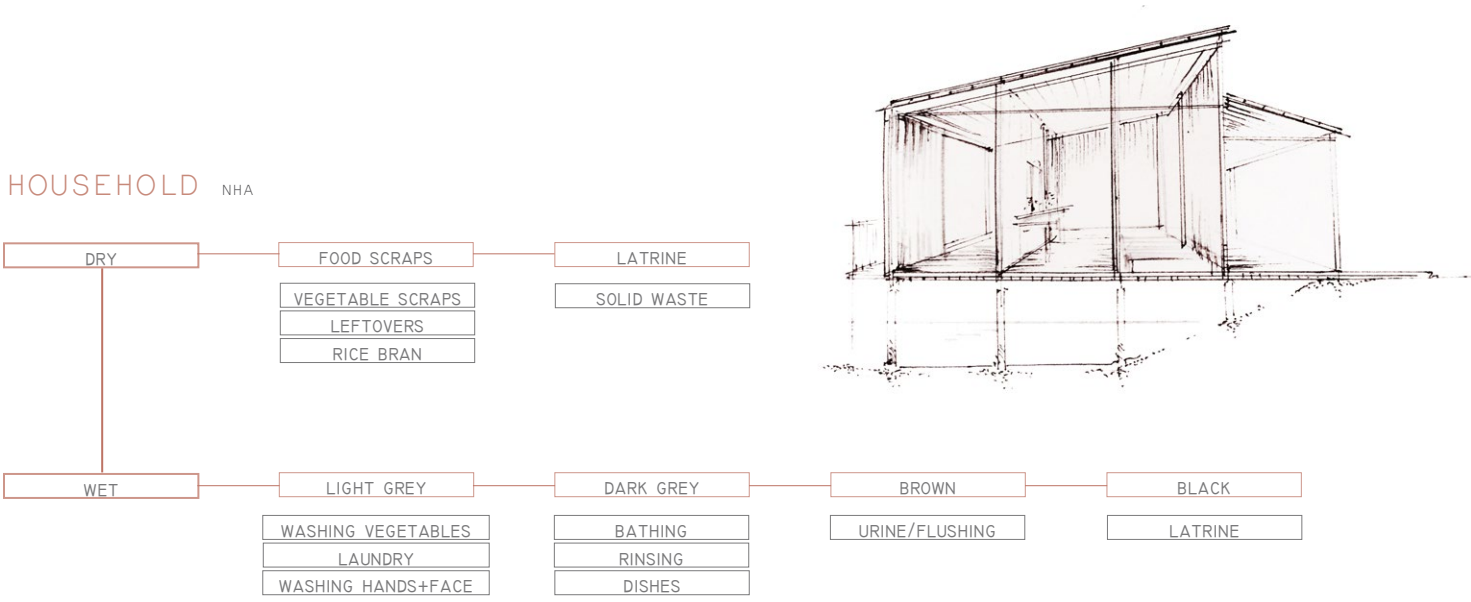


figure 3.41
Diagram of household water and waste usage.
Diagram by author.

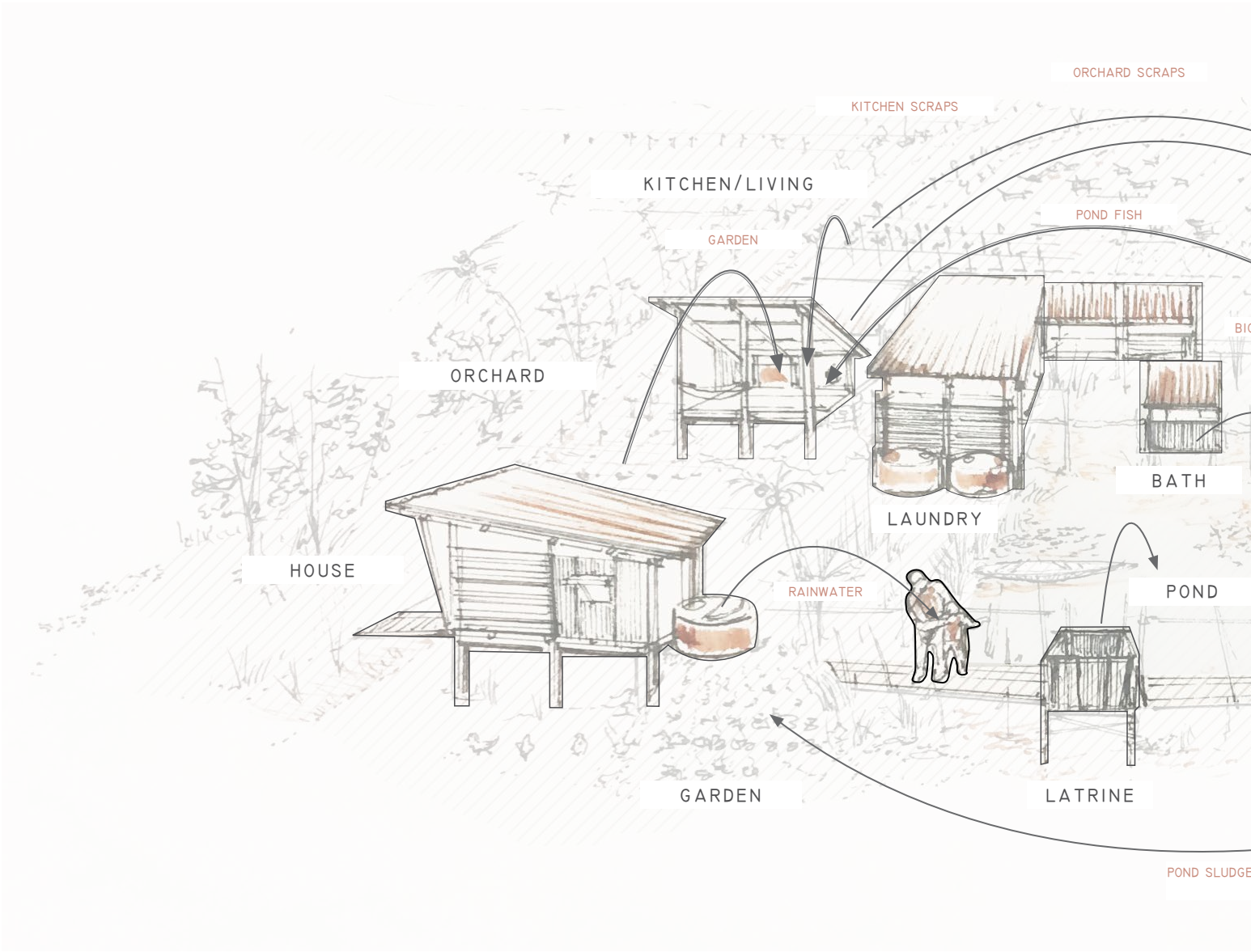


figure 3.42
Diagram of proposed integrated agricultural system.
Drawing by author.

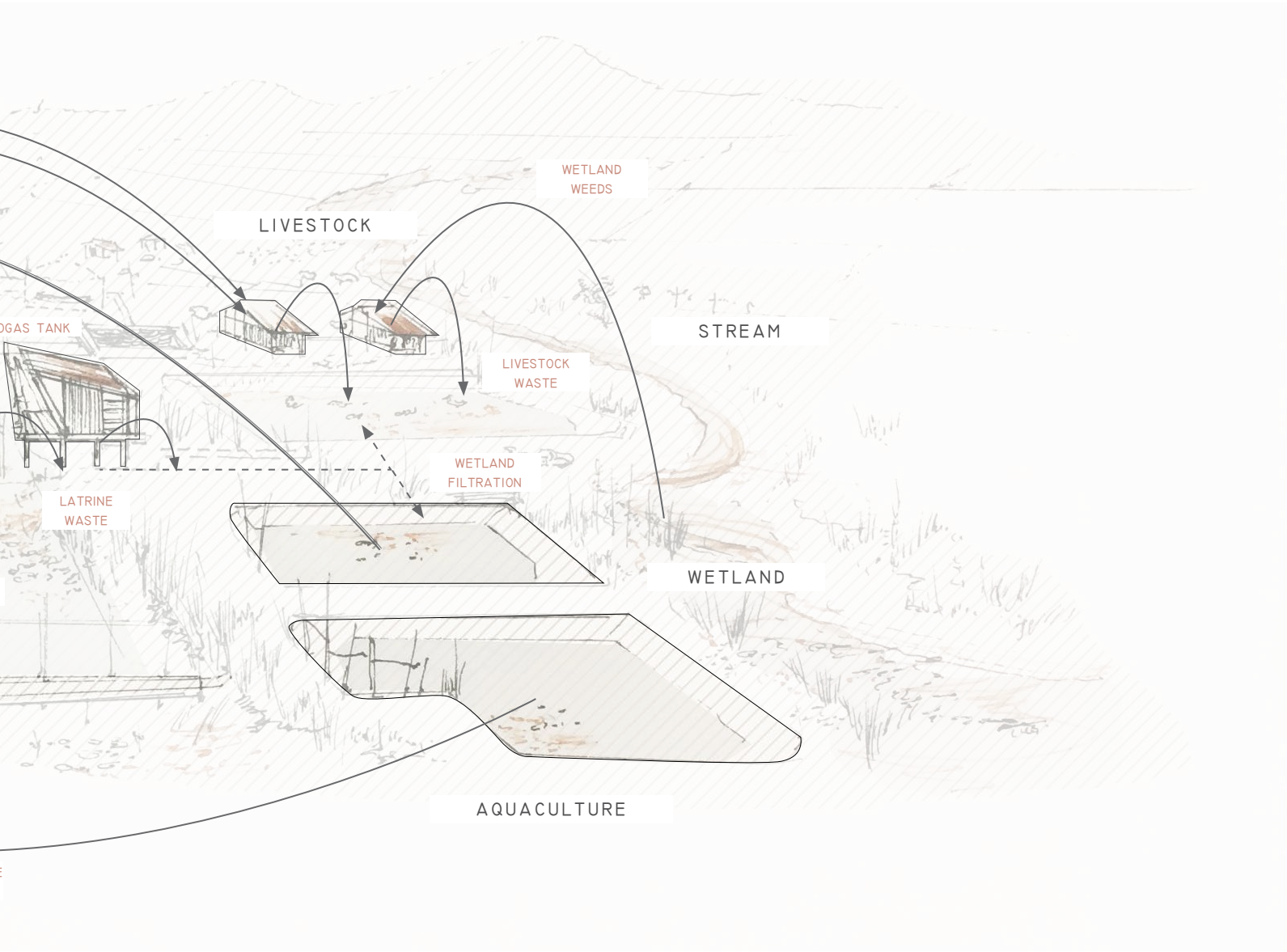

WETLAND
WEEDS
LIVESTOCK
OGAS TANK
STREAM
LIVESTOCK
WASTE
WETLAND
FILTRATION
LATRINE
WASTE
WETLAND
AQUACULTURE



figure 3.43
Informal housing settlement along a flooded field.
Photo by author, 2018.

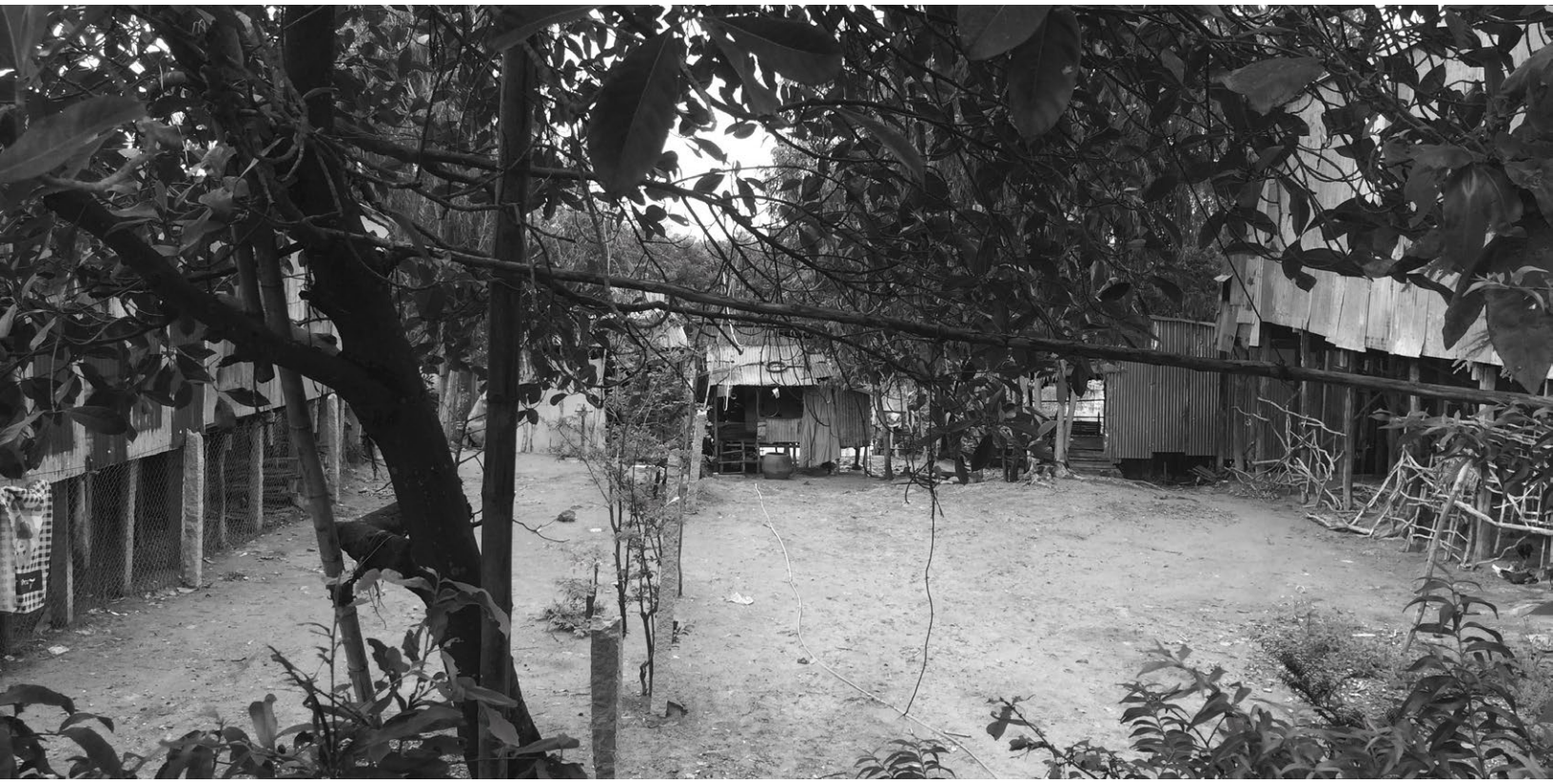


figure 3.44
Landless household constructed adjacent to the trench in Vinh Xuyen.
Photo by author, 2018.



figure 3.45
A long home housing a family and extended members in Vinh Xuyen.
Photo by author, 2018.



figure 3.46
A raised home over an overgrown trench in Vinh Xuyen village.
Photo by author, 2018.

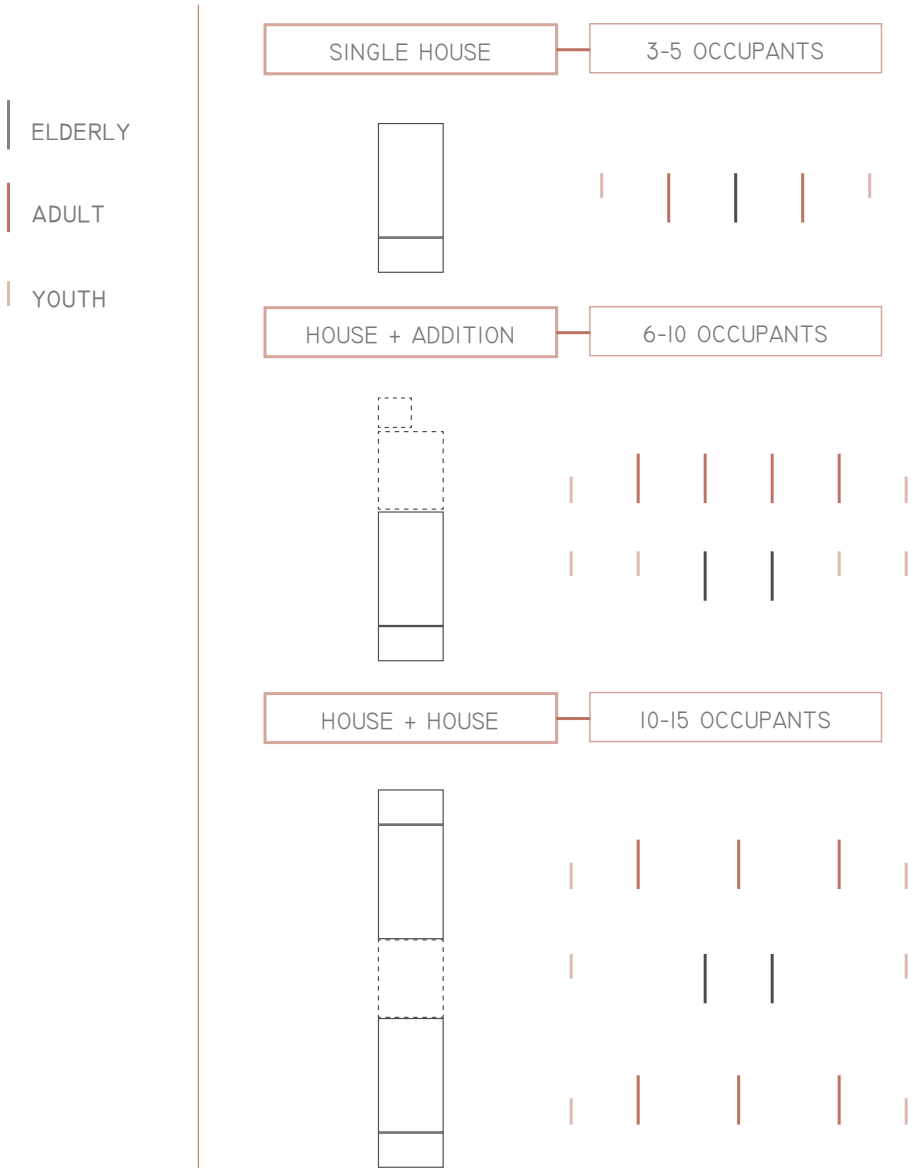


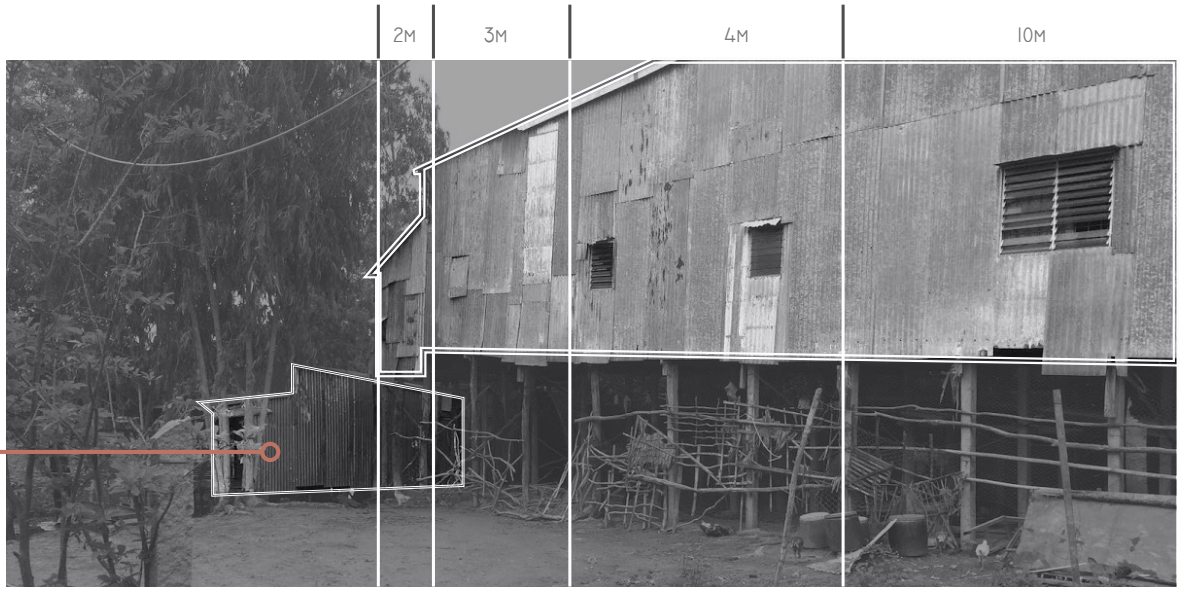
figure 3.47
Diagram of family members living in different housing typologies.
Diagram by author.

Community

The communities are designed to be composed of families, extended families, and close friends/workers from existing villages. Priority will be given to landless labourers *(figure 3.43)* *(figure 3.44)* in the region by allowing land to be shared between occupants. The direct relationship between occupants and their occupations within the community is essential to allow for close proximity to easily perform daily tasks.

The spaces are designed stemming from the string-typology of homes *(figure 3.45)* *(figure 3.46)*. Currently, these homes can host multiple families in a single house composed of multiple spaces sectioned off. These typologies are reoriented and split to multiple spaces that allow different families to access their required tasks easily.

Aside from each community having enough products shared between one another in a convivial lifestyle, a market area located close to high-traffic zones for roads and waterways can allow agricultural products and crafts to be sold to nearby villages.



smaller house: typically used for sanitation and/ kitchen in the home due to its location beside the trench.

figure 3.48
An extended house of approximately 20m in length, in Vinh Xuyen village. A smaller house is located on a trench at the back-end of the larger home.
Photo by author, 2018.

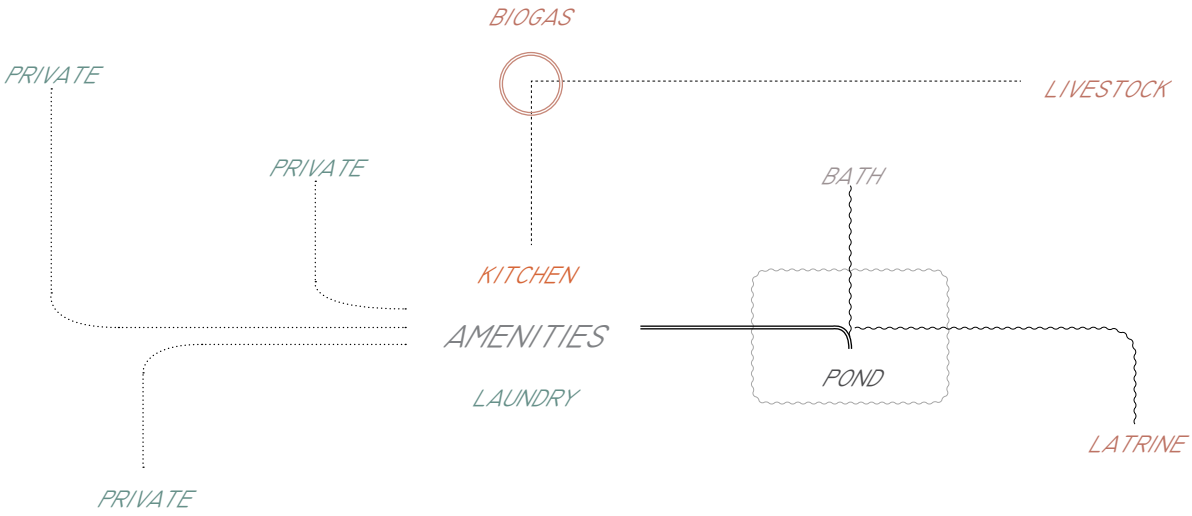


figure 3.49
Program of proposed community structure.
Diagram by author.

Spaces

Private	*Sleeping, Resting, Guests*
Kitchen	*Break time, Gathering, Celebration, Cooking, Drinking, Dishes*
Laundry	*Laundry, Public Bathing, Children Washing*
Bath	*Private Washing, Urination*
Latrine	*Private Urination, Defecation*
Market	*Cafe, Sales, Travel*

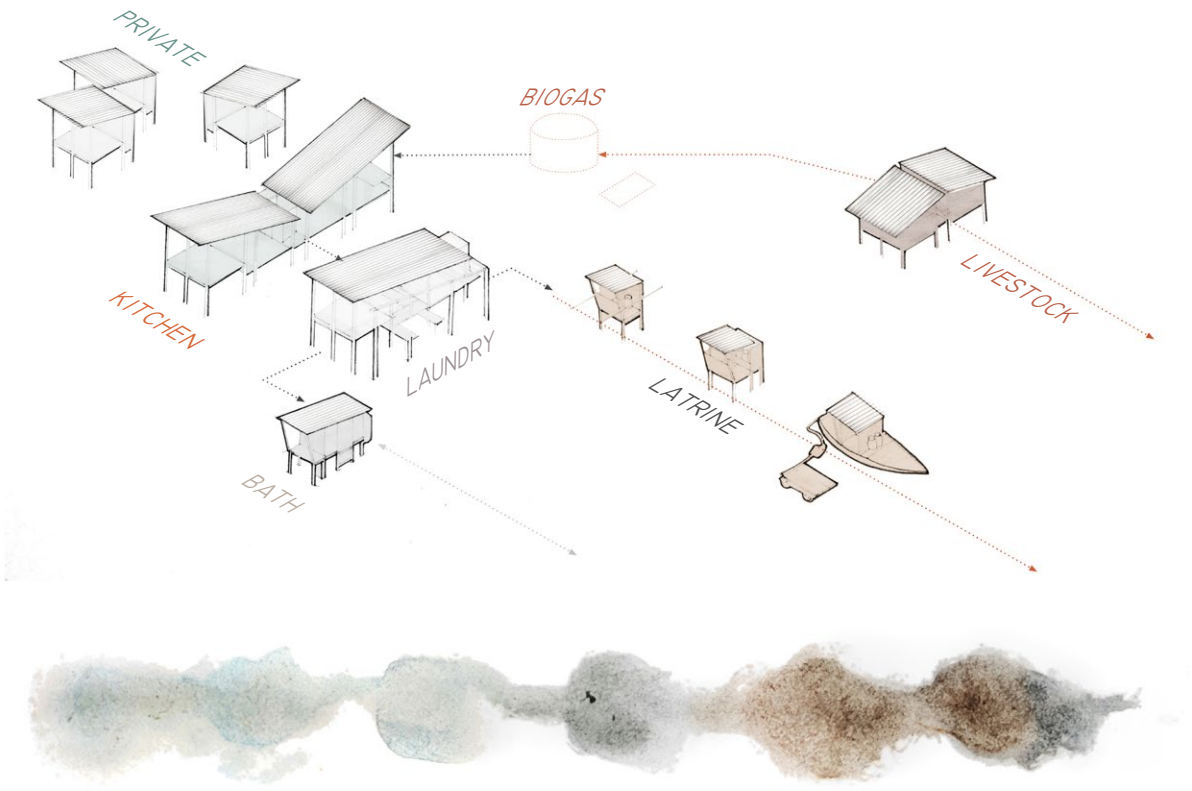


figure 3.50
Proposed community structures with Spectrum of Water.
Diagram by author.

Shared Ponds

Households may choose to keep a pond for daily functions away from agricultural intensive properties *(figure 3.50)*. This pond can be shared between two to three homes and is able to capture wastewater from daily activities such as face-washing, rinsing, bathing, laundry, washing dishes etc. Another section of the pond separated by an intensive wetland buffer will be able to hold blackwater and latrine waste. Blackwater ponds can be linked to livestock areas as aligned with the spectrum of water. The pond maintains the smaller scale of the cluster of homes to ensure that the household has access to its daily needs with regard to recycling of water and nutrients.[1]

1 Le, *Toilet Design for Rural Areas*, 54

Programs & Massing

Using a massing model, different variations of typologies and program adjacencies were explored for different land conditions. The massing models helped determine which typologies would provide the best relationships to the pond and limit distances for households to access various tasks on the farms. Different massing iterations also display how each household may construct homes based on their own personal needs as well.

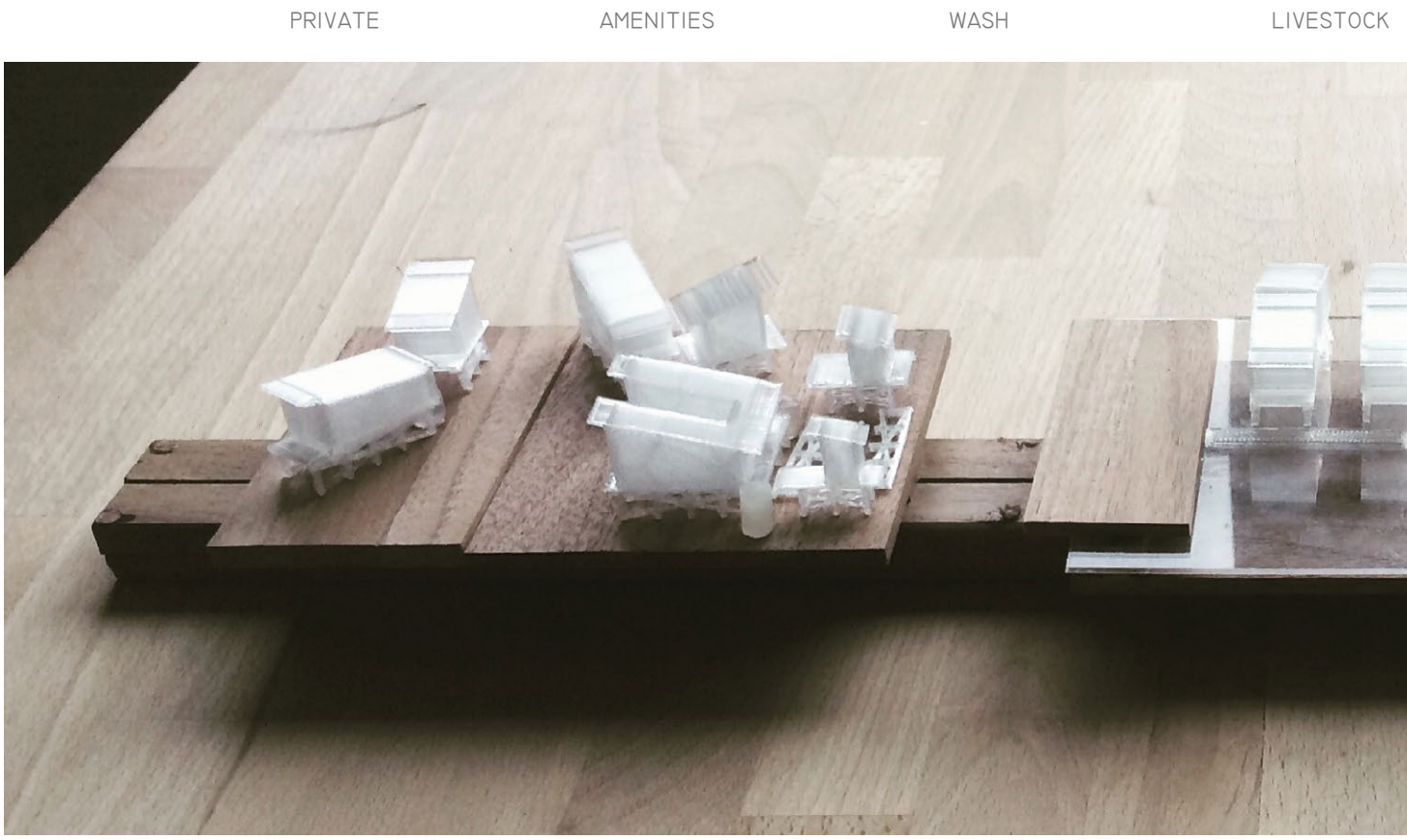


figure 3.51
Photographs of potential settlement arrangements.
3D printing on wood & plexi.
Model by author.

PRIVATE SPACE



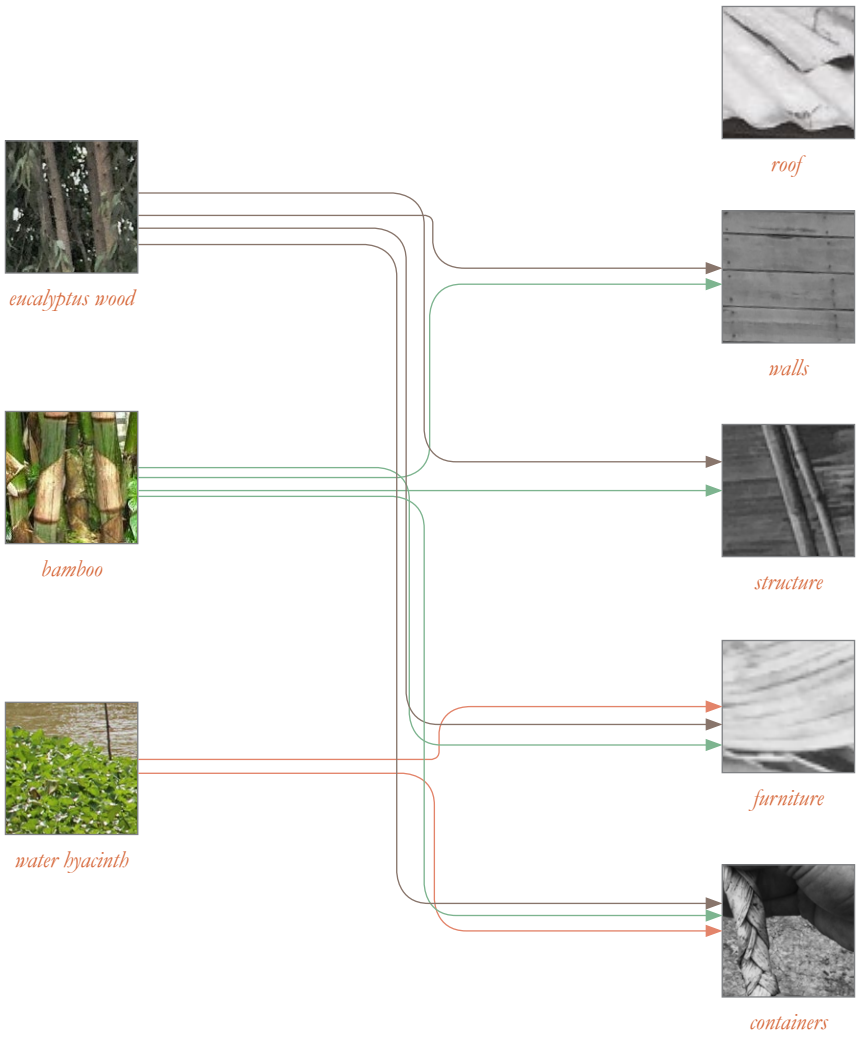
CLUSTER VARIATION



PONDS

WETLANDS





Materiality - Cultivating Spaces

With the agricultural programs surrounding the site, the growth of materials for home construction is a benefit that communities can adopt *(figure 3.52)*. Materials such as eucalyptus, bamboo, water hyacinth weaves, and thatch are all available with cultivation efforts. These plantings can be adopted early-on during the development of the field to allow for sufficient materials.

roof	corrugated metal, thatch, bamboo
structure	eucalyptus, melaleuca, bamboo
walls	eucalyptus, melaleuca, bamboo, thatch, weaved hyacinth/palm, metal
floors	eucalyptus, melaleuca, bamboo
systems	metal, wire, pipes, bamboo
furniture	eucalyptus, melaleuca, bamboo
containers	wire, bamboo, thatch, weaved hyacinth/palm

figure 3.52
Materials for structures.
Diagram by author.



figure 3.53
Woman leaving home in An Giang.
Photo by author, 2018.

Gender Equity, Privacy, and the Liberation of Women

Although located adjacent to one another for easy access, the spaces are also designed for privacy and support of gender equity. Previous homes in the delta may have separate areas for the kitchen and the entertainment spaces, where many wives are subjected to isolation and limited in their roles in the family. Studies show that diversified systems have also empowered women with multiple tasks aside from child-rearing and house care to caring for livestock, feeding ponds, and harvesting fruit.[2]

2 Bosma, *Agriculture Diversification in the Mekong Delta: Farmers' Motives and Contributions to Livelihoods*, 56.

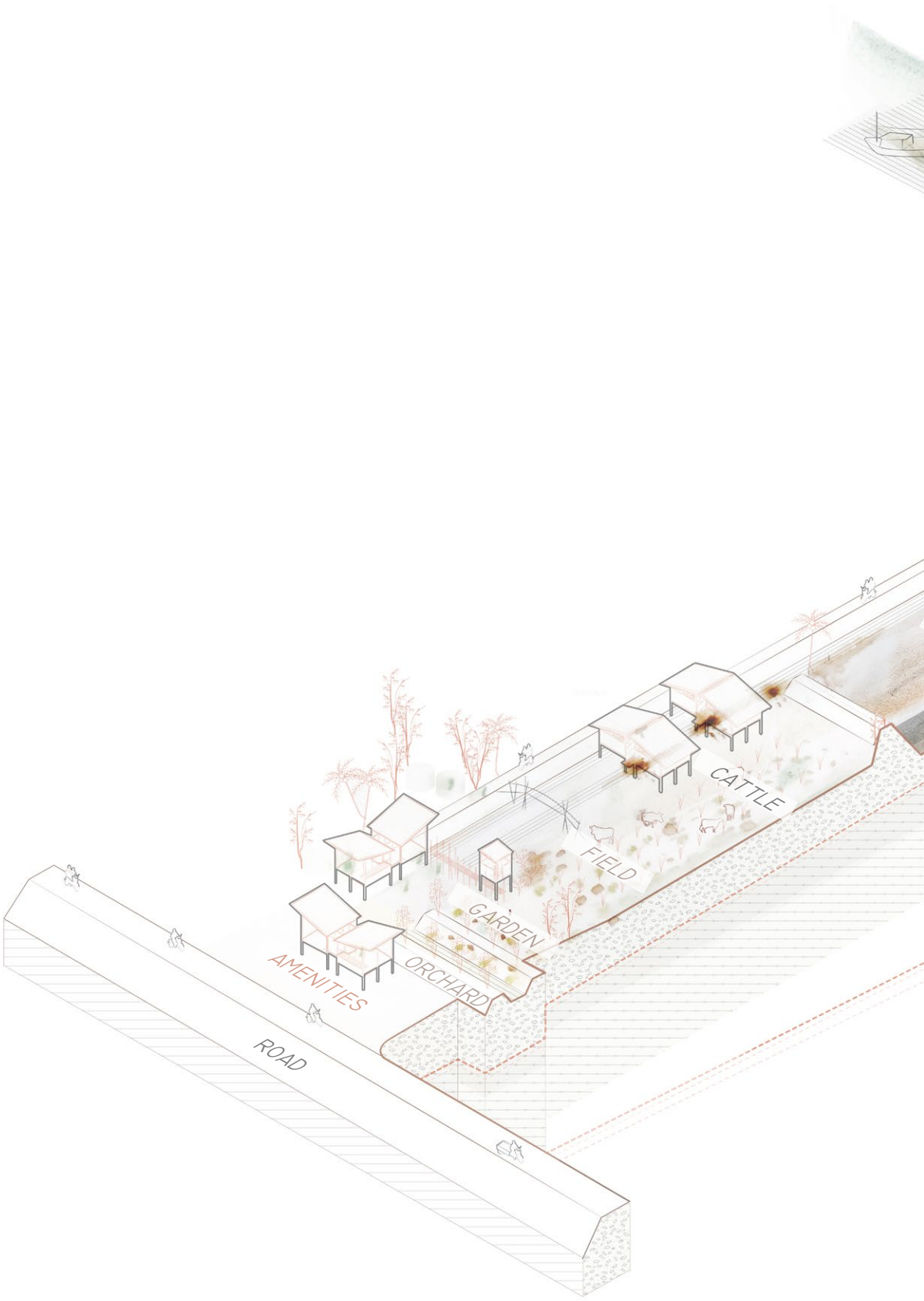
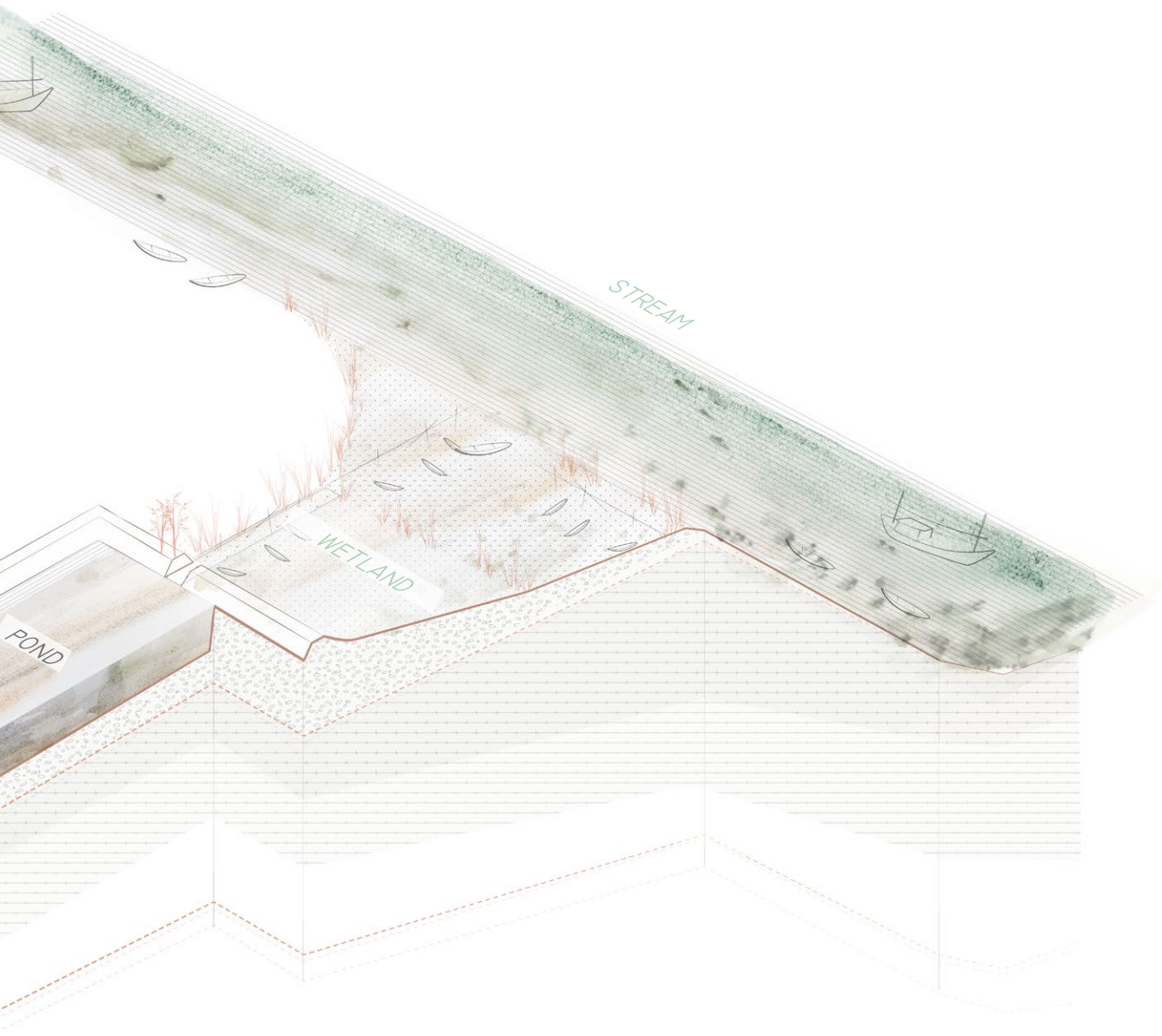
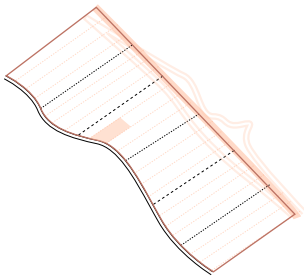


figure 3.54
Proposed Settlement: Generic Model
Drawing by author.


STREAM
WETLAND
POND



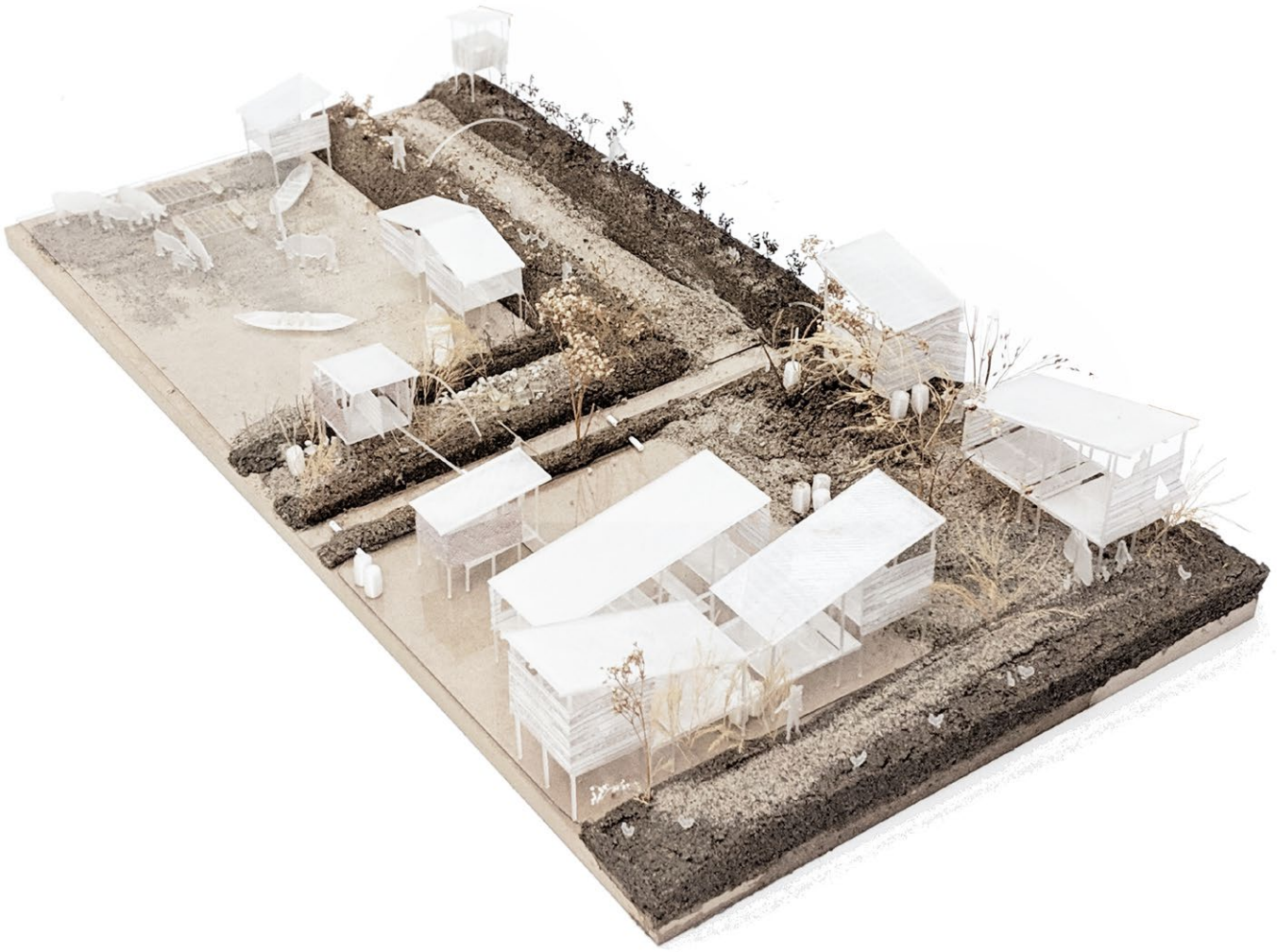


figure 3.55
Photographs of 1:50 scale potential settlement arrangements and build-up of site.
3D printing on wood, sand & plexi.
Model by author.

Construction Timeline of 1:50 Model



1. Construction of model through sand roads, ponds, and orchard trenches.



2. Addition of homes, sheds and latrine structures for workers.



3. View of model with increased housing density and amenities centered around the pond.

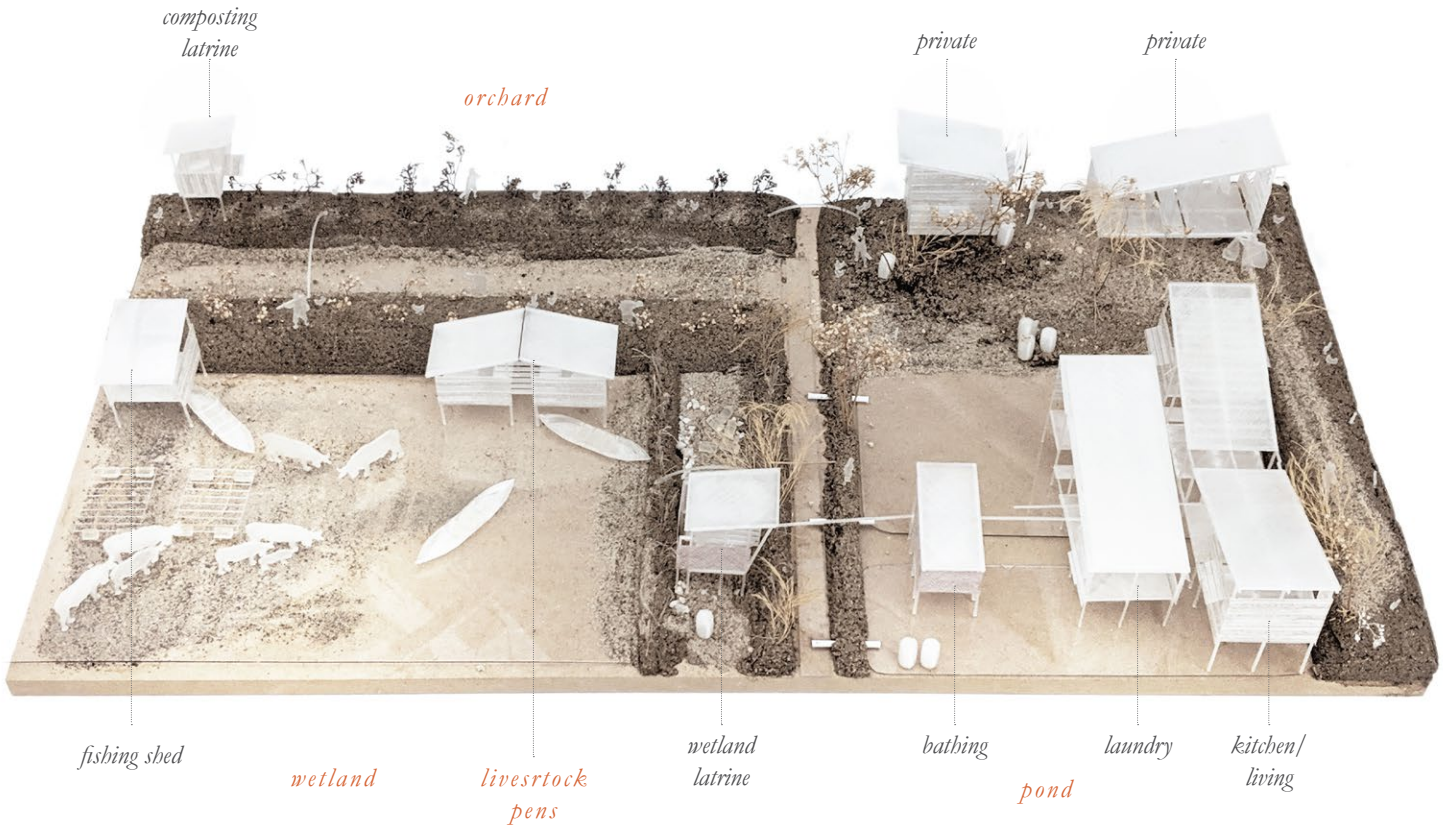
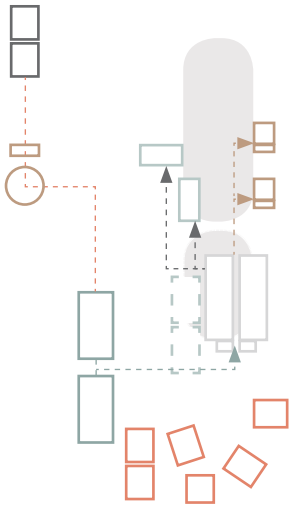
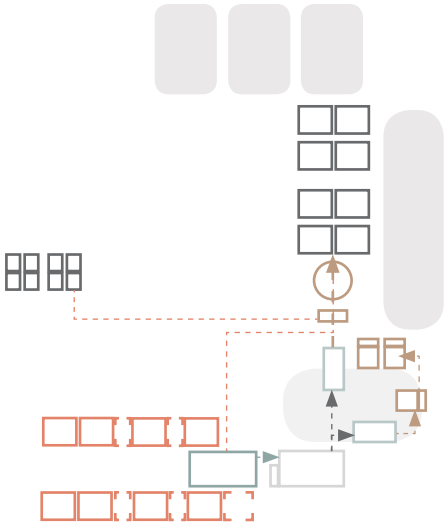


figure 3.56
Photographs of 1:50 scale potential settlement arrangements and build-up of site.
3D printing on wood, sand & plexi.
Model by author.



TYPE A

LINEAR SETTLEMENT
DRY

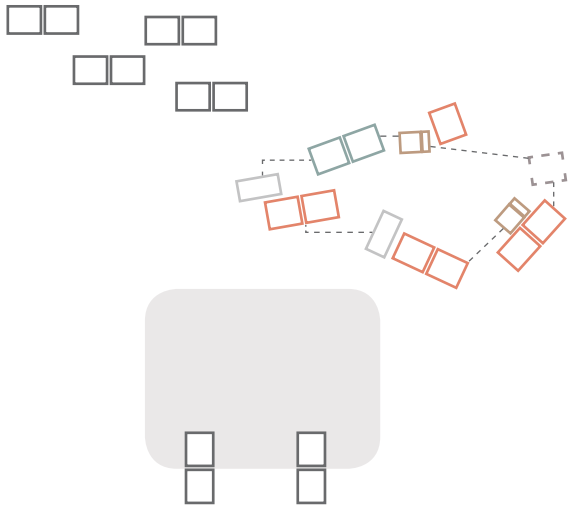


TYPE B

CENTRAL POND SETTLEMENT
WET

Three possible typologies *(figure 3.57)* are explored in detail, showing variations of land use, settlement patterns, cycles, and flows.

Different land uses contributed to different cycles of waste and the resultant nutrients, as well as the passive flows of water systems within the hybridized artificial and natural landscape.



TYPE C

WETLAND SETTLEMENT
FLOOD

figure 3.57
Variations of proposed settlements.
Drawing by author.

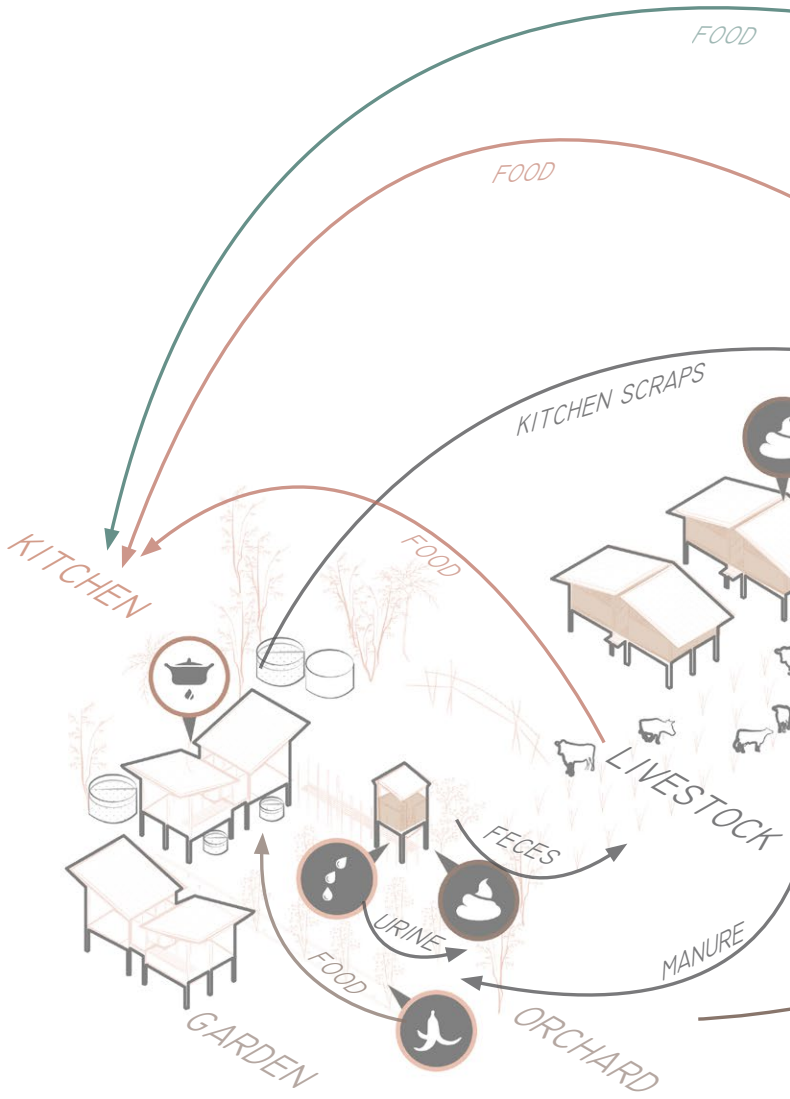
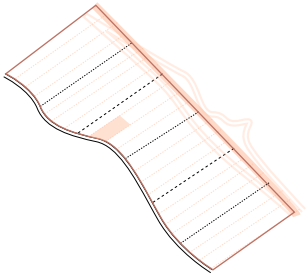
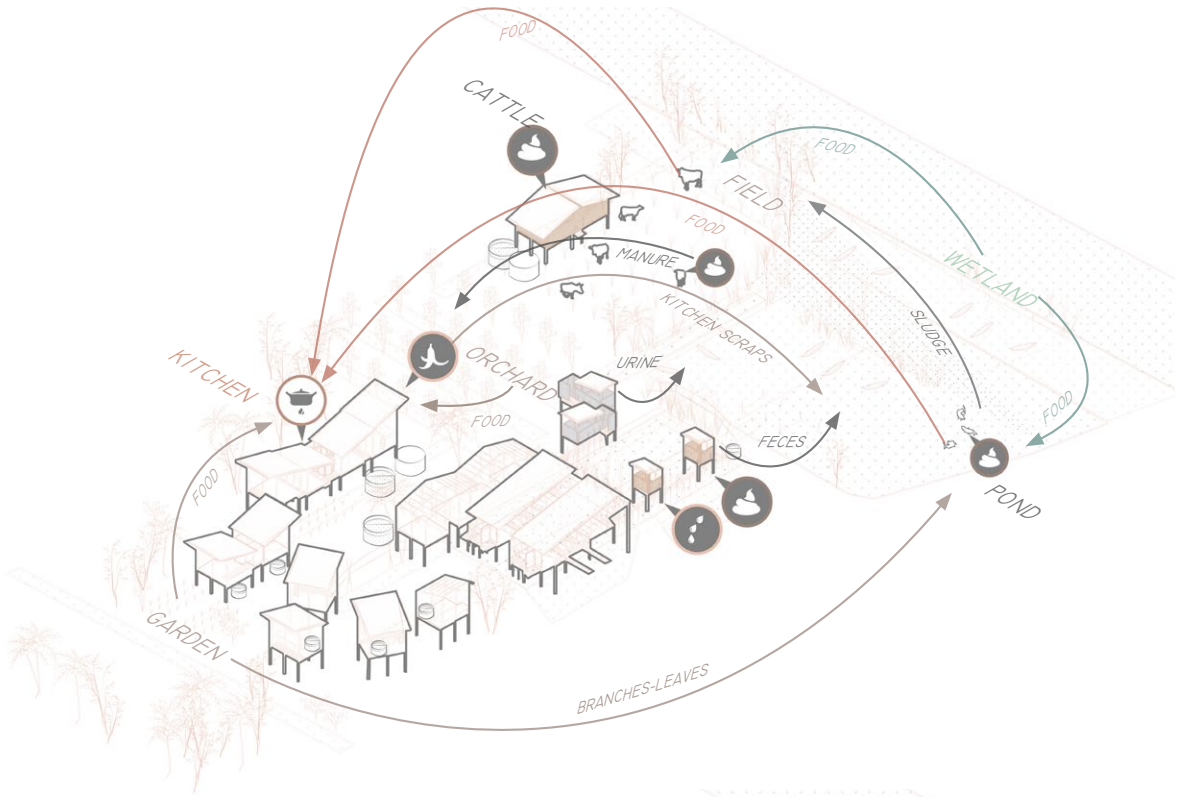
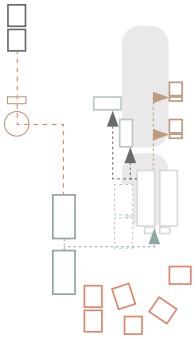


figure 3.58
Proposed Settlement: Generic Model Nutrient Cycles
Drawing by author.


FOOD
FOOD
WETLAND
POND
MANURE
SLUDGE
STALKS
FIELD
BRANCHES-LEAVES

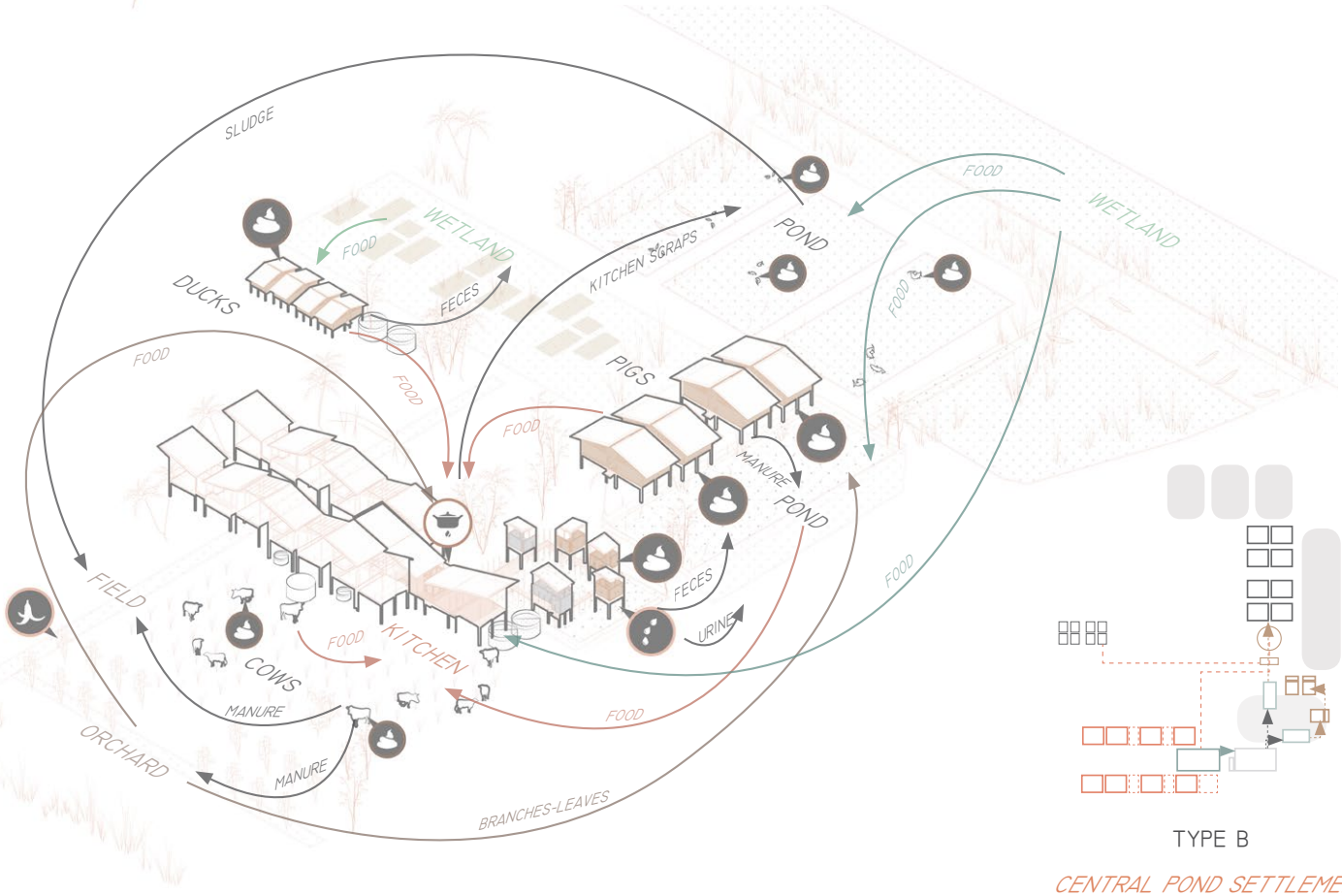






TYPE A

LINEAR SETTLEMENT
DRY



TYPE B

CENTRAL POND SETTLEMENT
WET

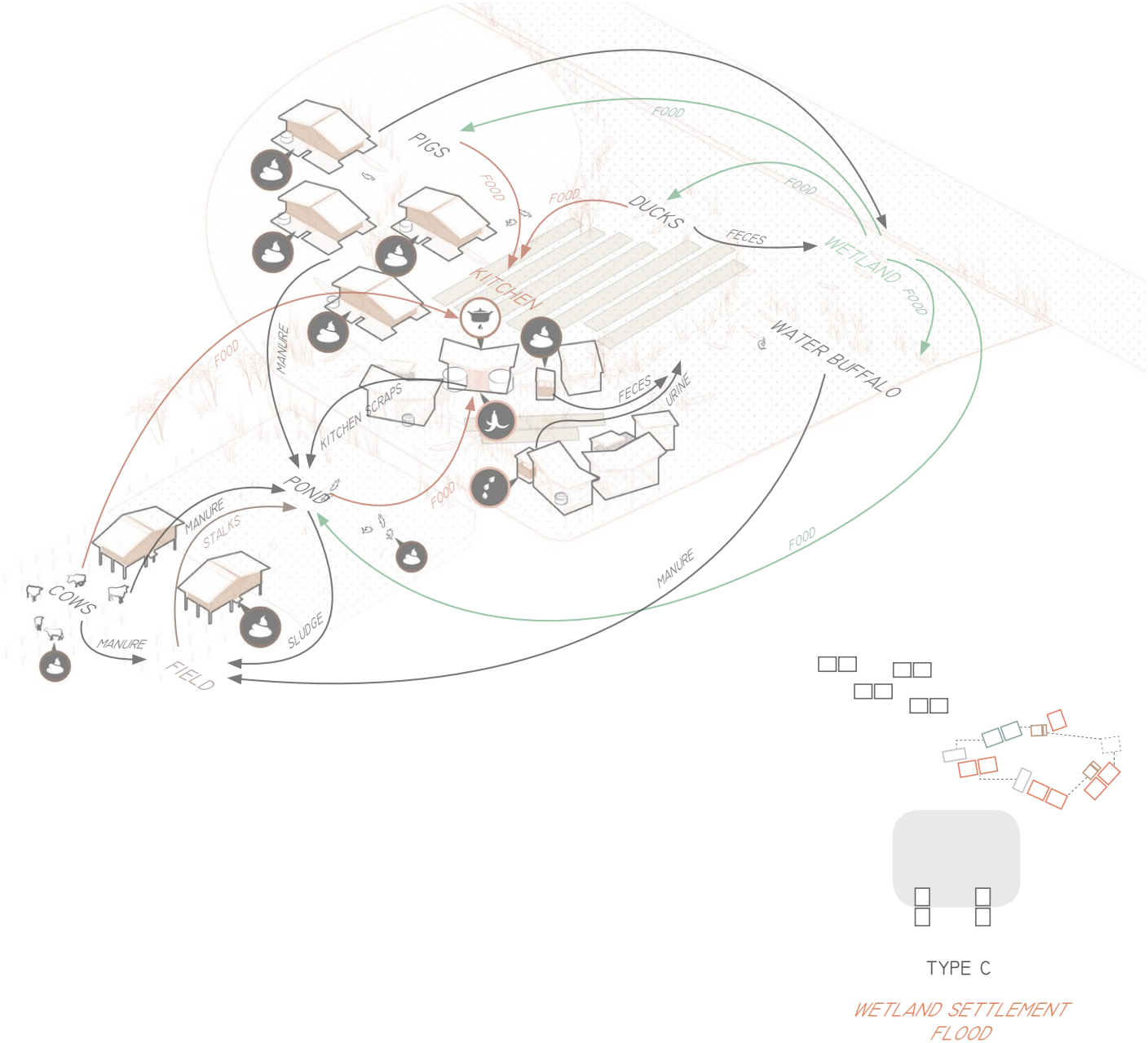


figure 3.59
Proposed Settlement: Nutrient Cycles
Drawing by author.

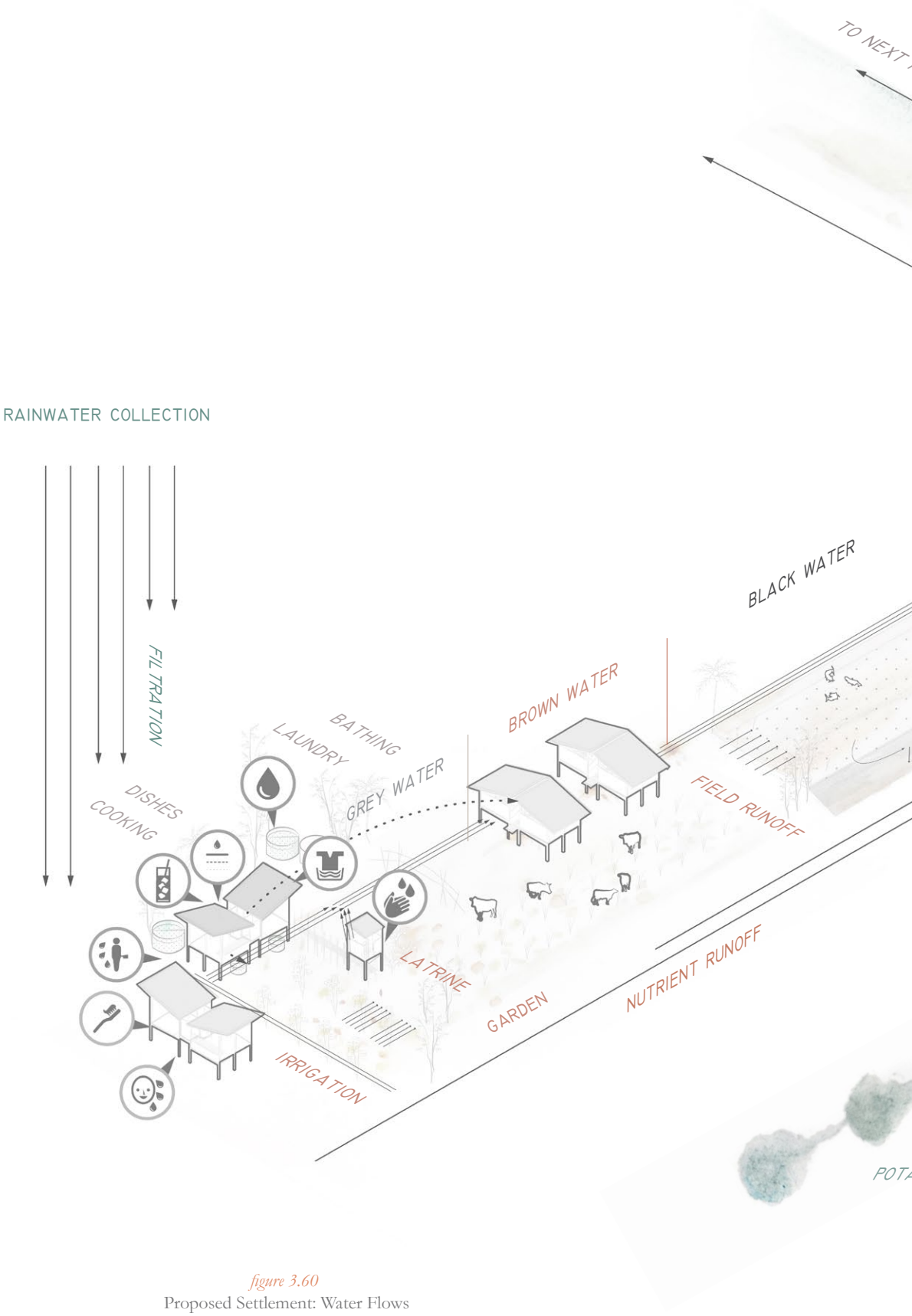
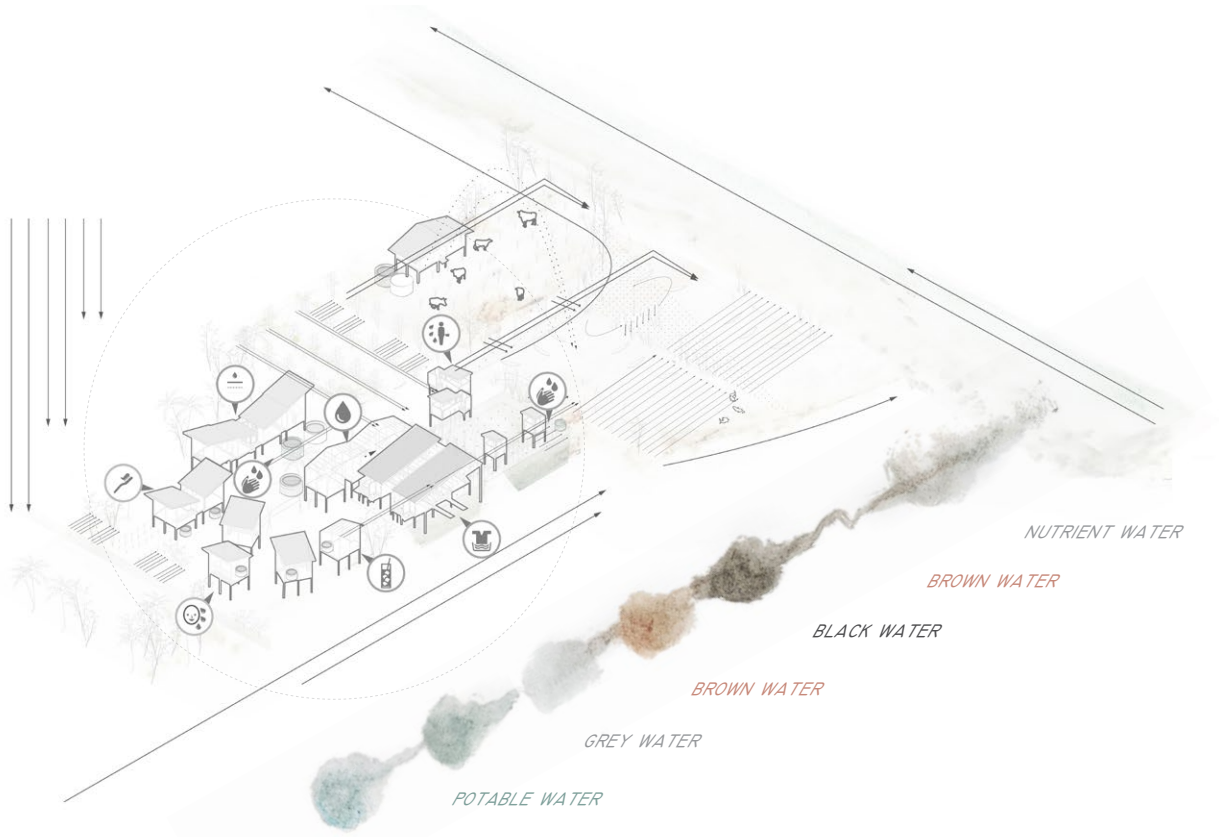
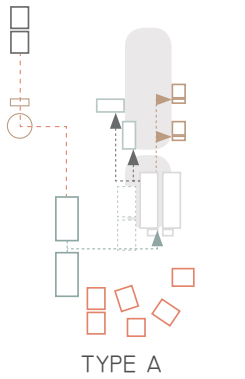


figure 3.60
Proposed Settlement: Water Flows
Drawing by author.


FIELD
GREEN WATER
WETLAND FILTRATION
RESTORED STREAM
WETLAND FILTRATION
DIGESTIVE REACTION
NUTRIENT WATER
BROWN WATER
BLACK WATER
BROWN WATER
GREY WATER
ABLE WATER





LINEAR SETTLEMENT
DRY

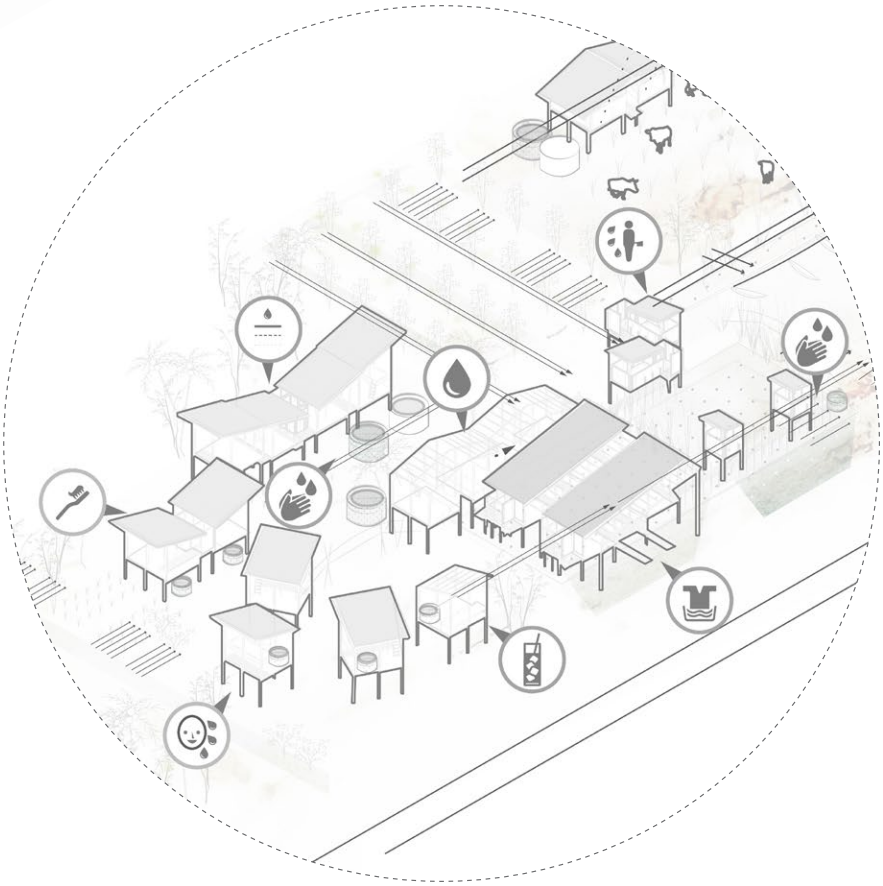


figure 3.61
Proposed Settlement: Water Flows
Drawing by author.

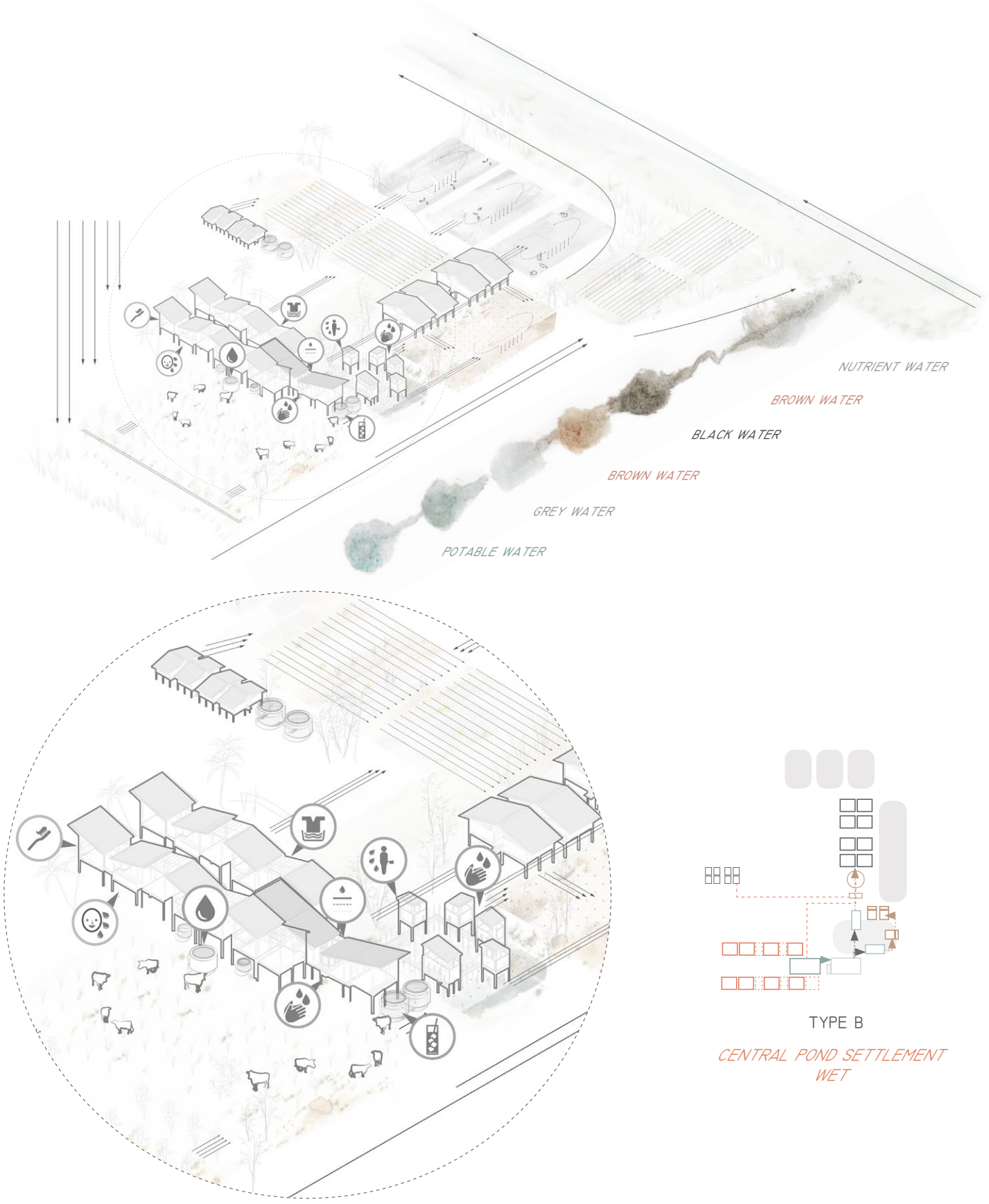


figure 3.62
Proposed Settlement: Water Flows
Drawing by author.

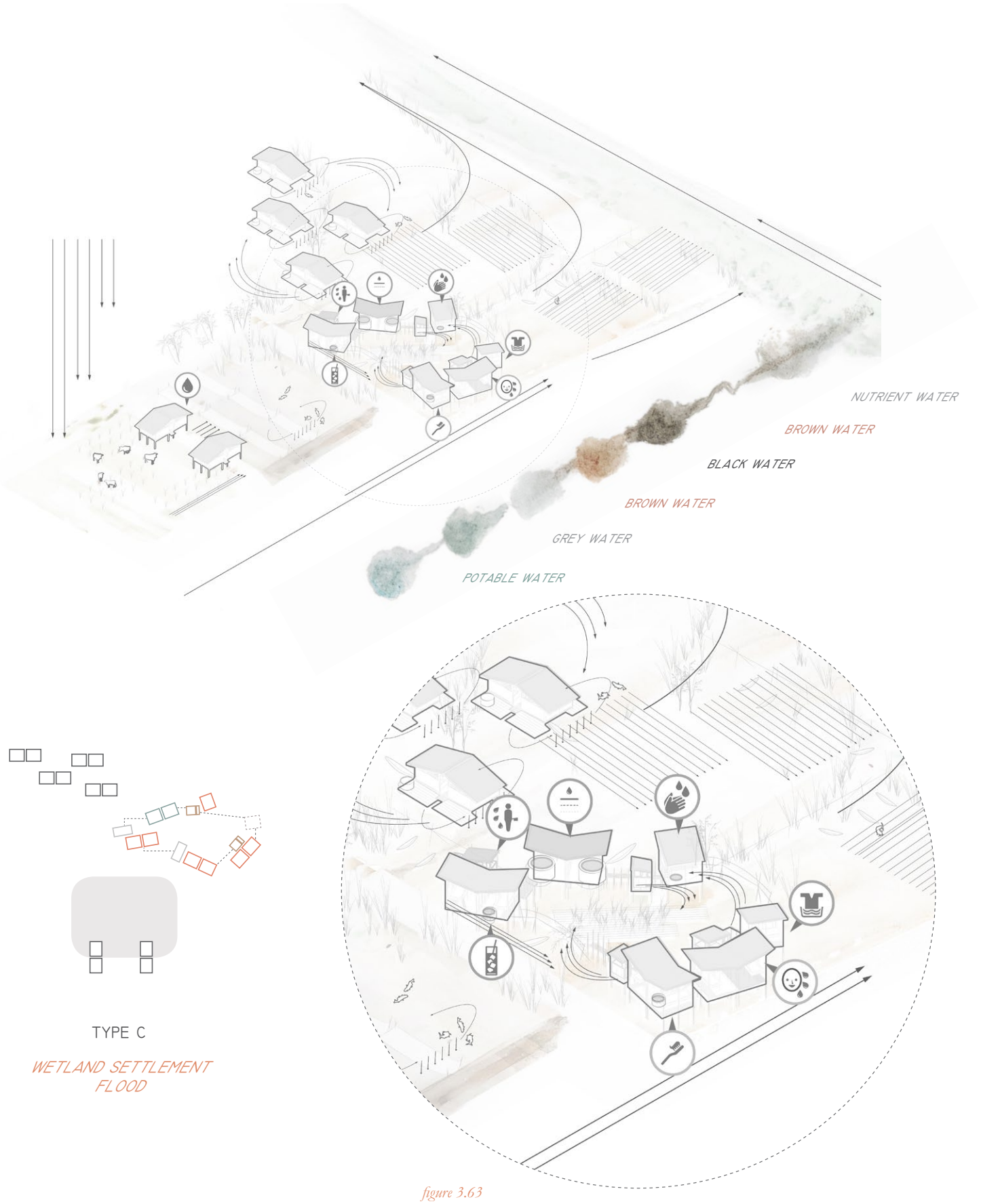


figure 3.63
Proposed Settlement: Water Flows
Drawing by author.

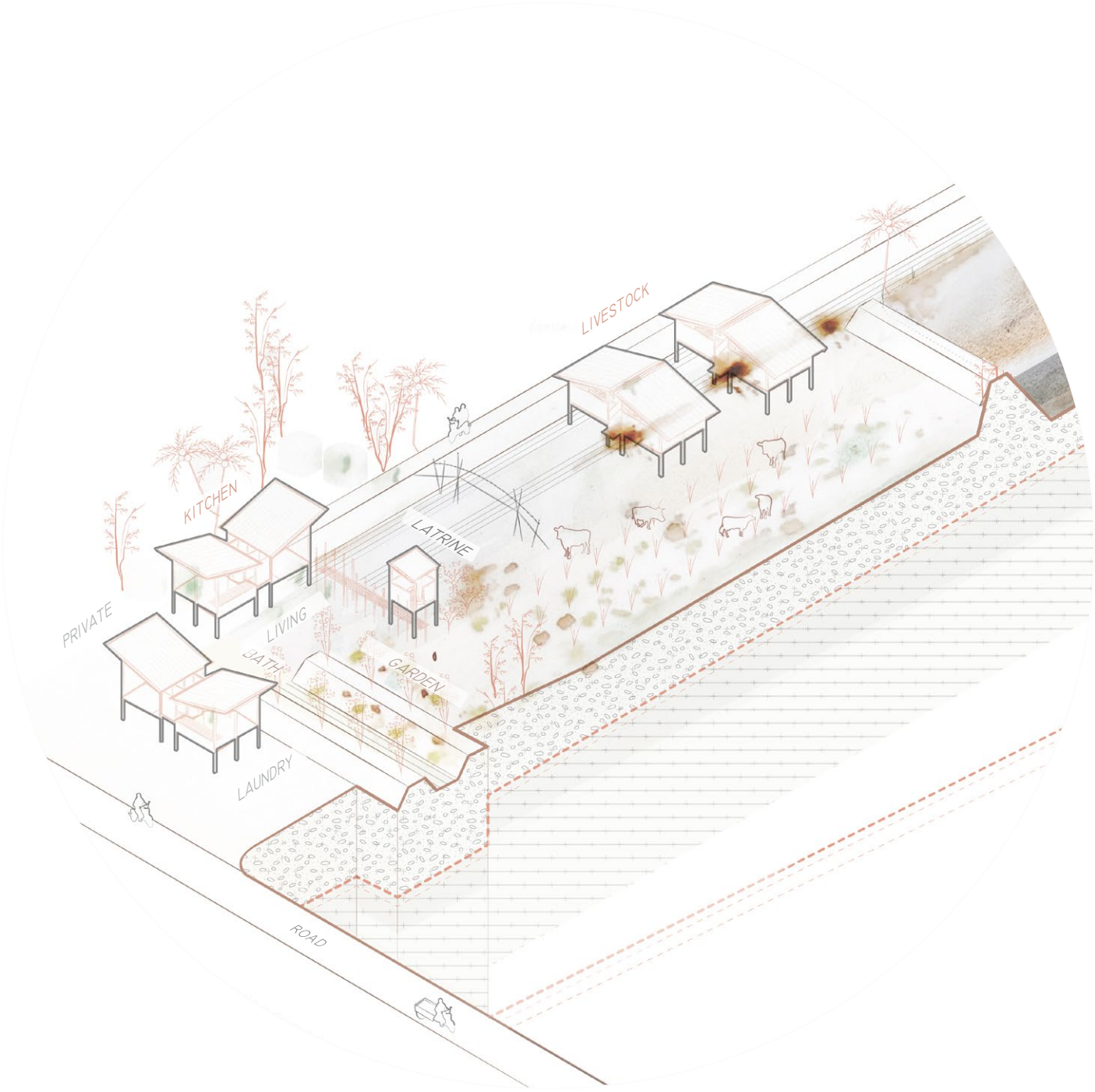


figure 3.64
Proposed Settlement: Amenities & Spaces
Drawing by author.

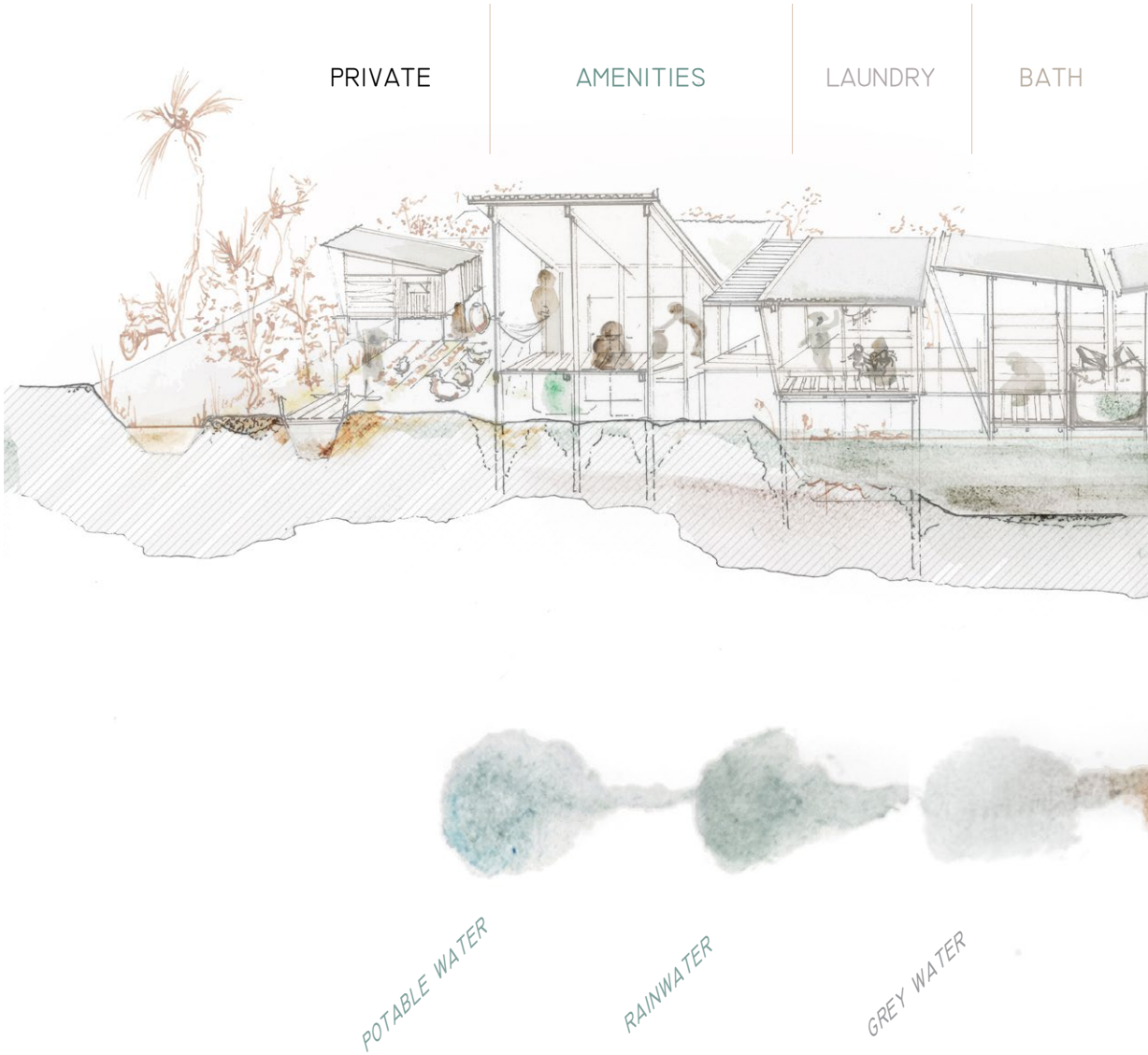


figure 3.65
Section of settlement with spectrum of water.
Drawing by author.

LATRINE

LIVESTOCK



BROWN WATER

BLACK WATER

NUTRIENT WATER

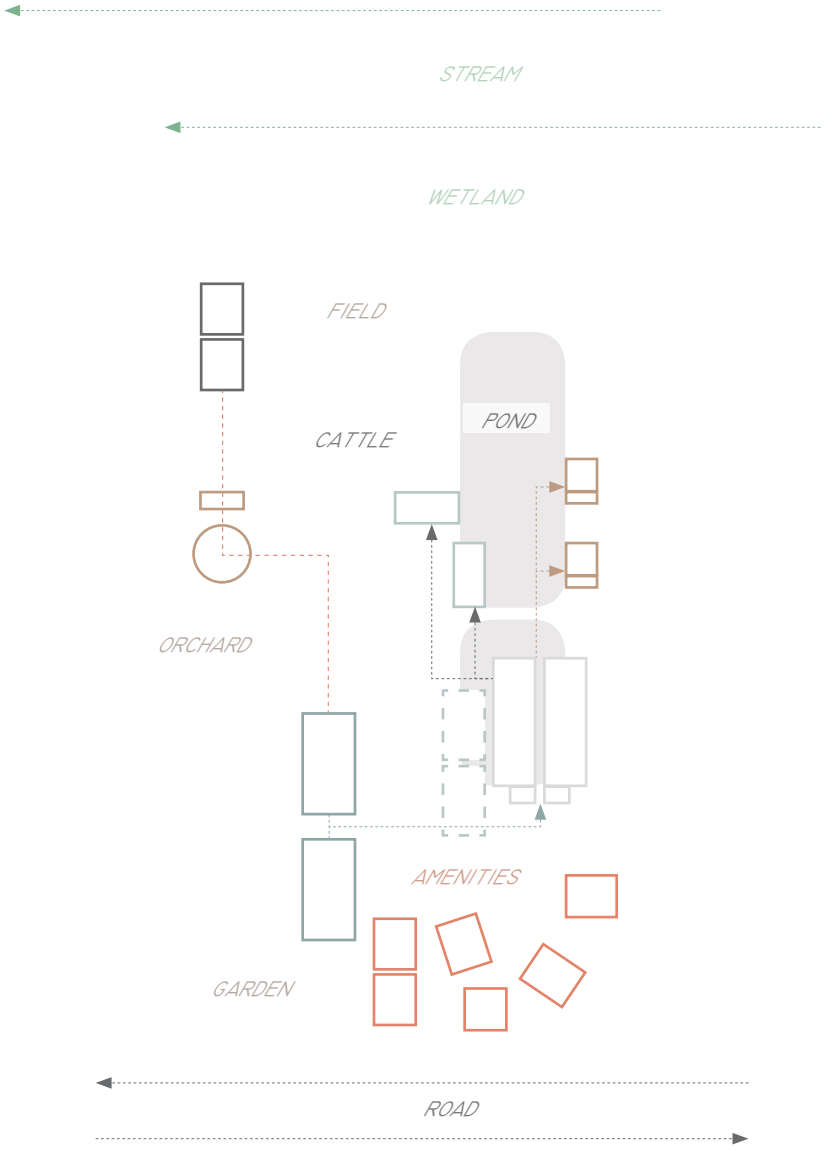


figure 3.66
Proposed Settlement: Type A
Drawing by author.

Type A - Linear Settlement "Dry"

The linear settlement prioritizes the cultivation of orchards and gardens through many trenches and raised mounds. Homes are located on higher ground along with the fruit trees. Gardens grow a variety of organic herbs and leafy greens for the other homes and businesses in the field.

Homes are constructed among the trees in the orchard, allowing for shade and materials for building structures. Bathing and laundry areas are located along a widened trench, with latrines located downstream nearby the livestock pens. The latrine is constructed with composting latrines *(figure 3.73)*, that can be lifted before a tree is planted.

This design is based off of my experience visiting a rice field that was recently converted into a orchard with a small garden and some livestock. The typology was an economic benefit for the family, who had been rice farmers for generations.

"Giờ này mình không cần lo gì hết.
Trước đây, vùng đất này lúc đó cũng tròng cây măng cầu."

A son and his parents with an annona orchard

Travelling from Long Xuyen, I was introduced to a young man who worked in an orchard with his parents. He explained how his family used to be rice farmers, and had trouble having a consistent income due to unexpected droughts, floods, and infestations. After finishing university studying agricultural development, he convinced his family to buy this plot of land and convert it into an orchard. The orchard was bordered by coconut and banana trees to prevent land erosion and thieves from coming in to the steal the harvest.

They grew annona, also known as custard apples, where their trees had reached maturity after two years. He told me it only took one year to plow the field and construct it to be suitable for growing the fruits. Now his family does not have to worry about their income because the fruits give them a consistent market price.

"When we first came here, everyone laughed at us for converting our rice field for fruit trees. The first year was tough, but now we do not worry". He states how before they harvest the fruits down, they do not spray with pesticides for a while beforehand.

"I wouldn't want my family to eat that. So we do our best to cultivate the quality we would want for our family." He talked about how they used to raise cows, but the labour was too much for his family. Beside the home are cages with herbs for household usage - keenly eyed by the wandering hens.

"We have eggs, herbs, chicken and fruit. It's a simple life."

Anonymous son and parents in An Giang. Personal Interview.

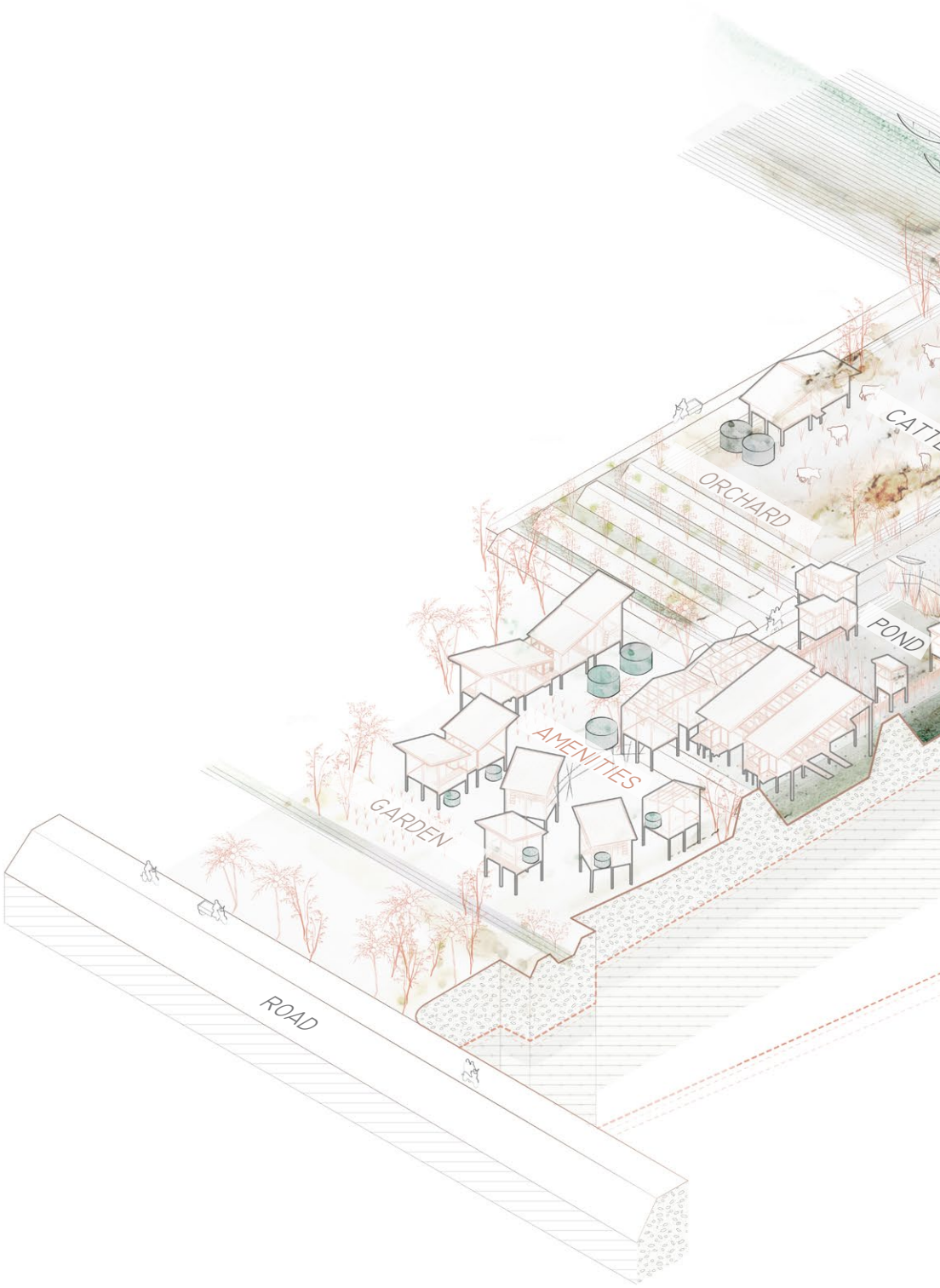
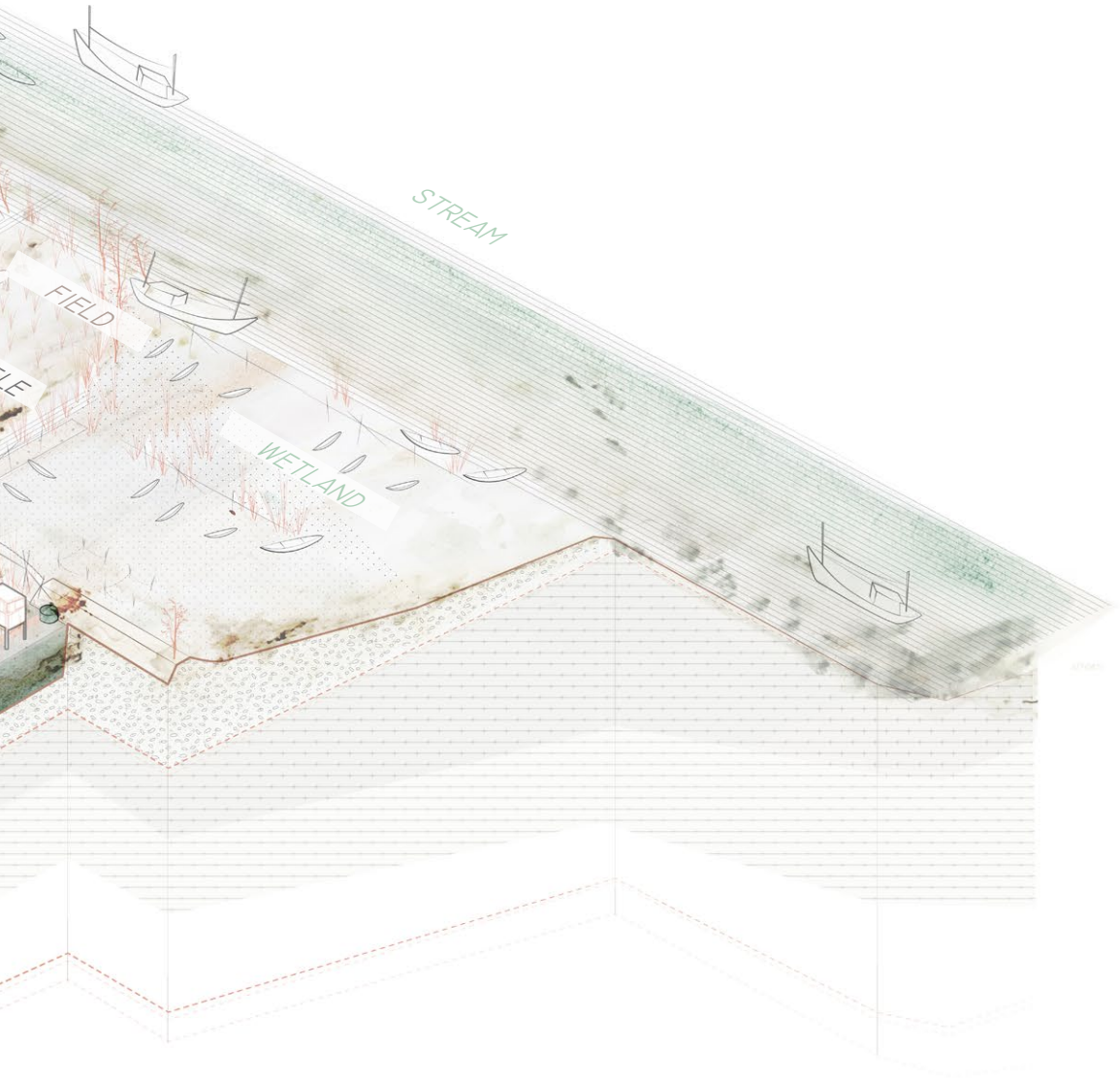
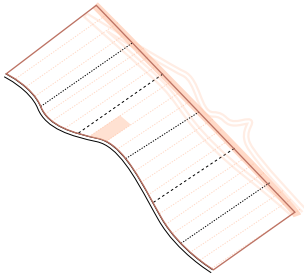
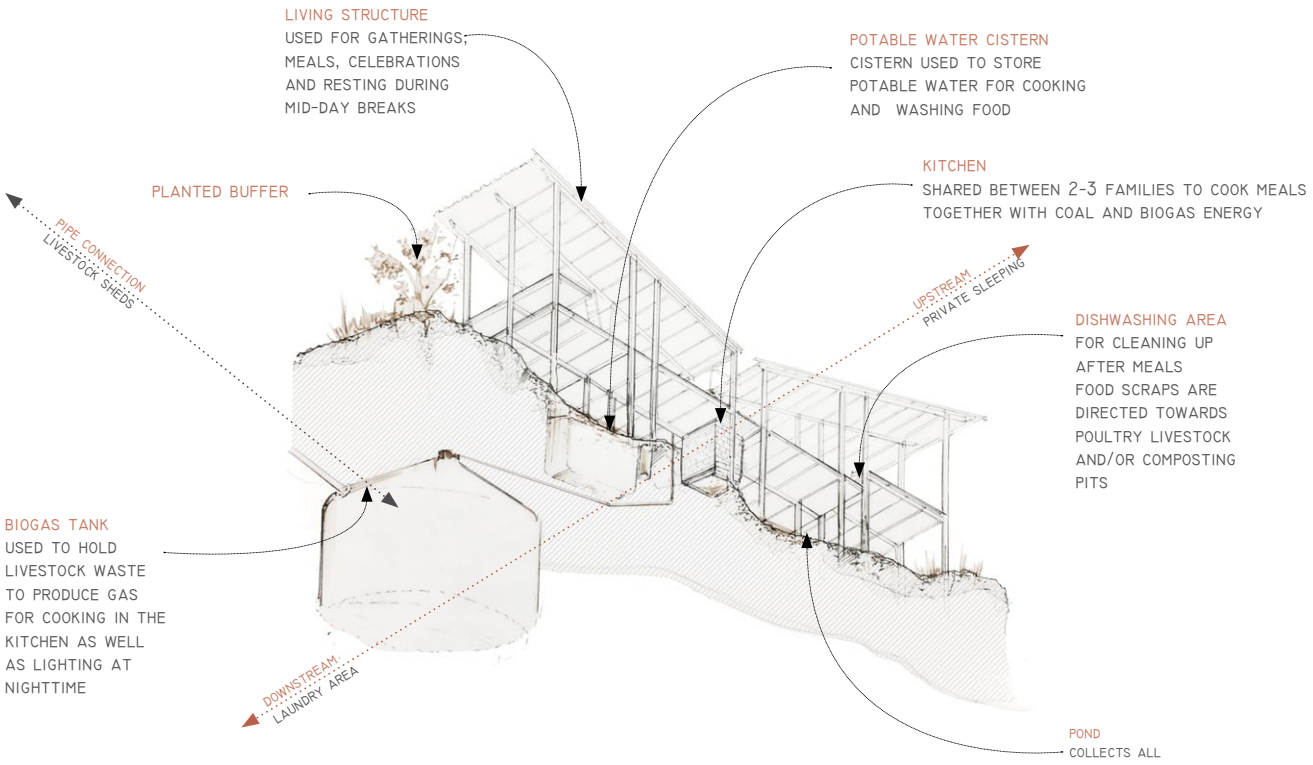


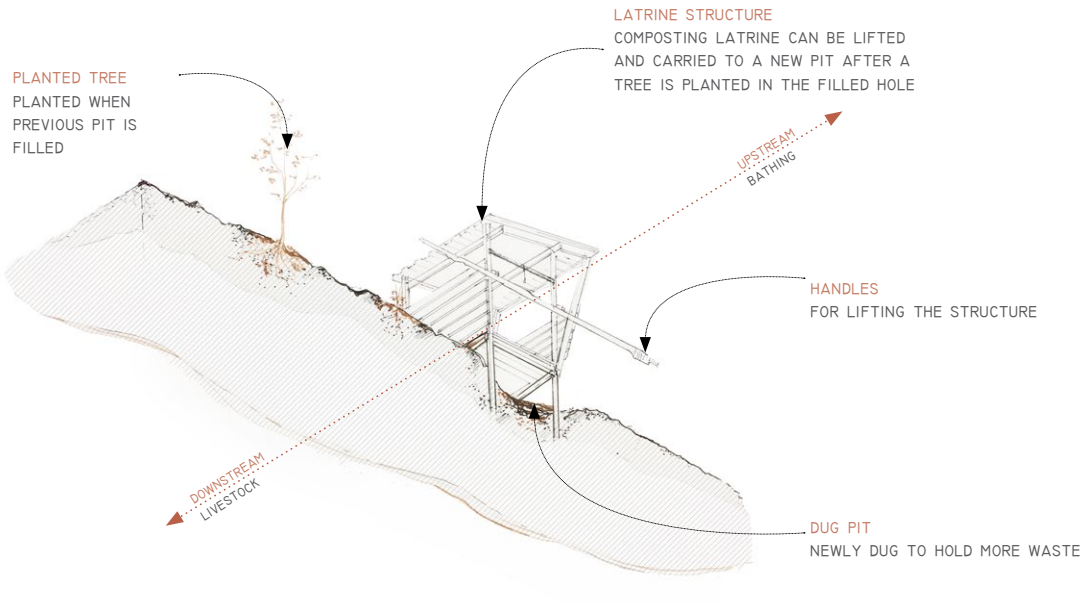
figure 3.67
Proposed Settlement: Type A
Drawing by author.


STREAM
FIELD
WETLAND





KITCHEN



LATRINE

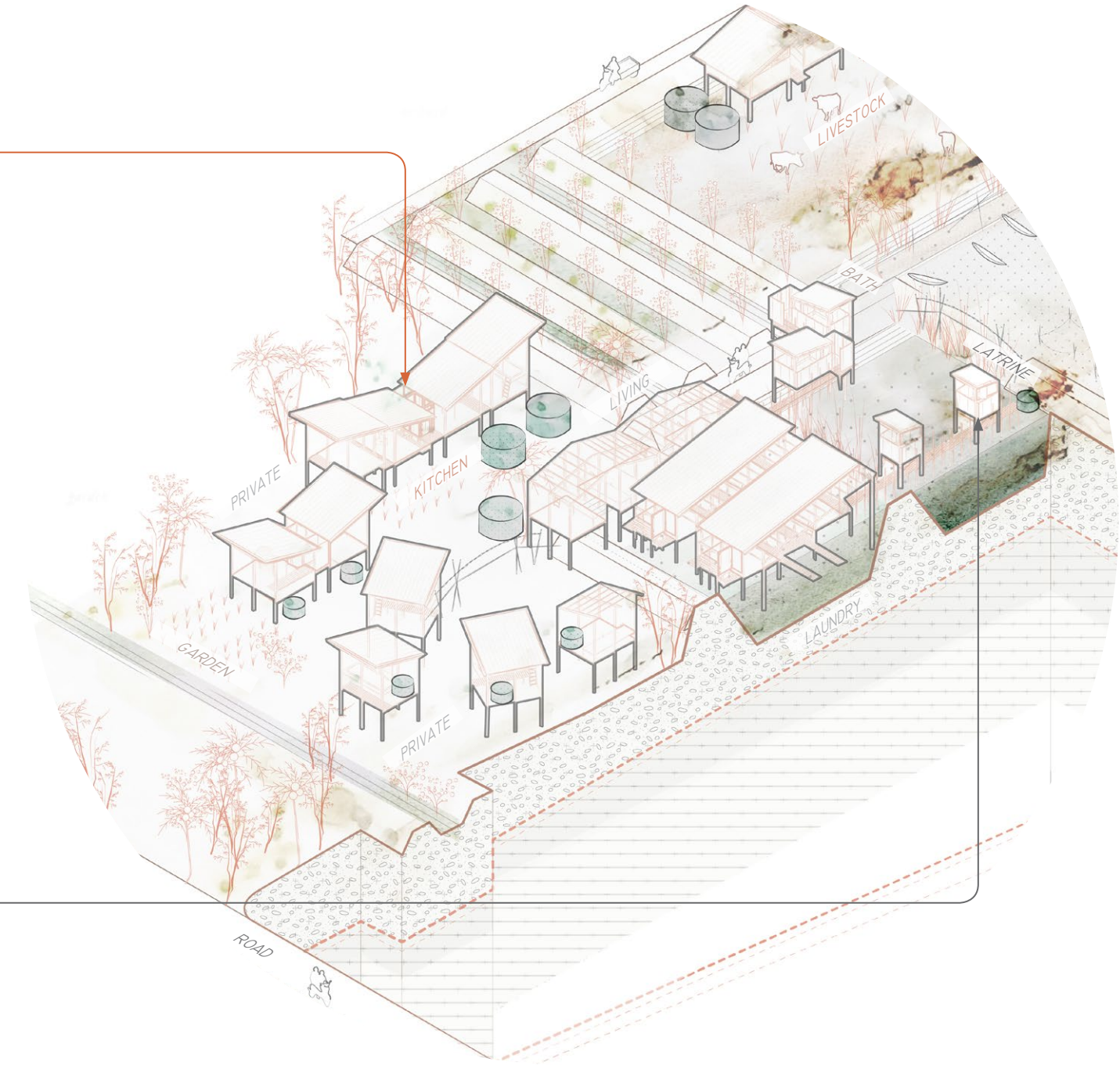


figure 3.68
Proposed Settlement: Type A
Drawing by author.

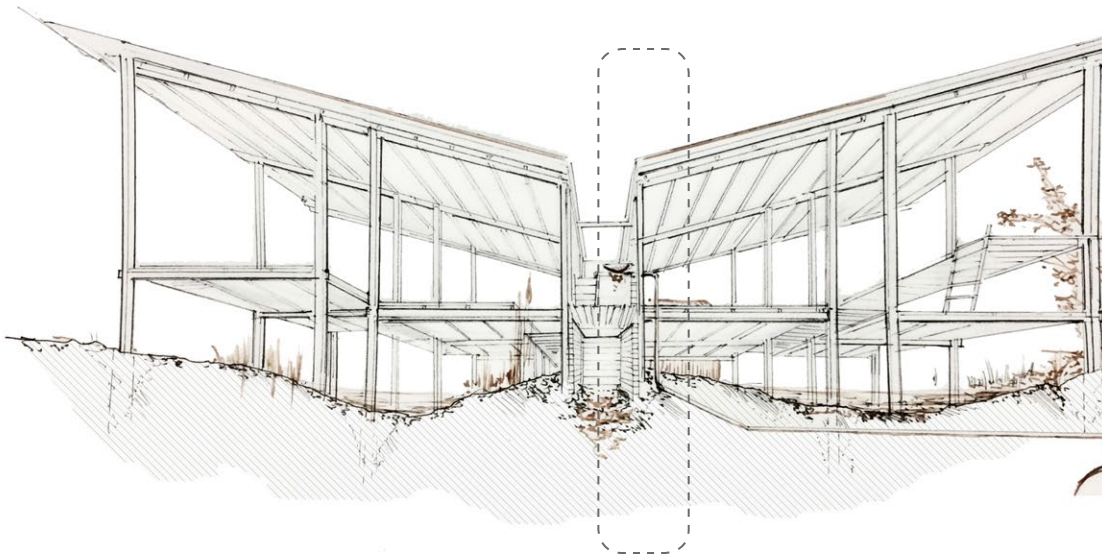
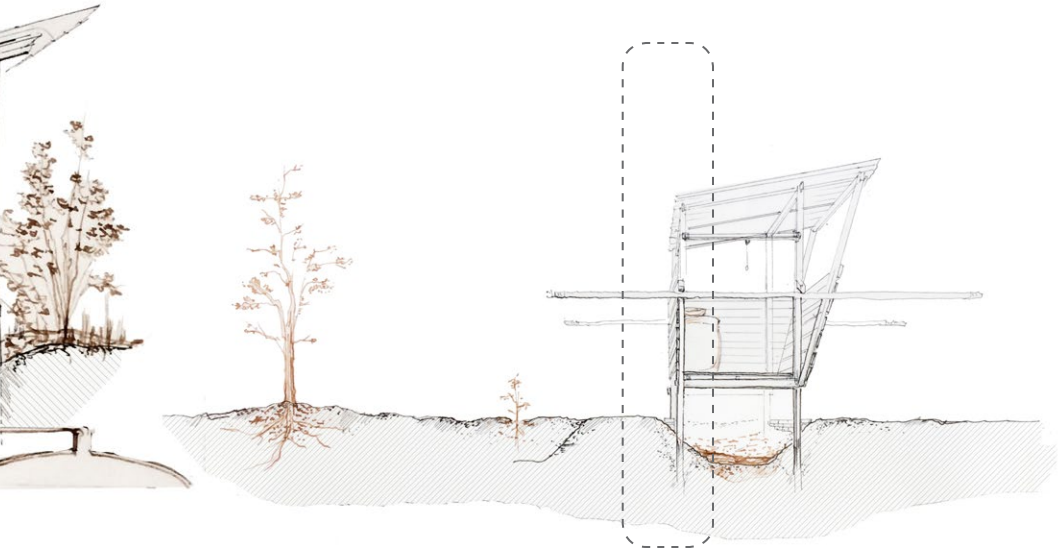


figure 3.69
Proposed Settlement: Type A
Drawing by author.



LATRINE

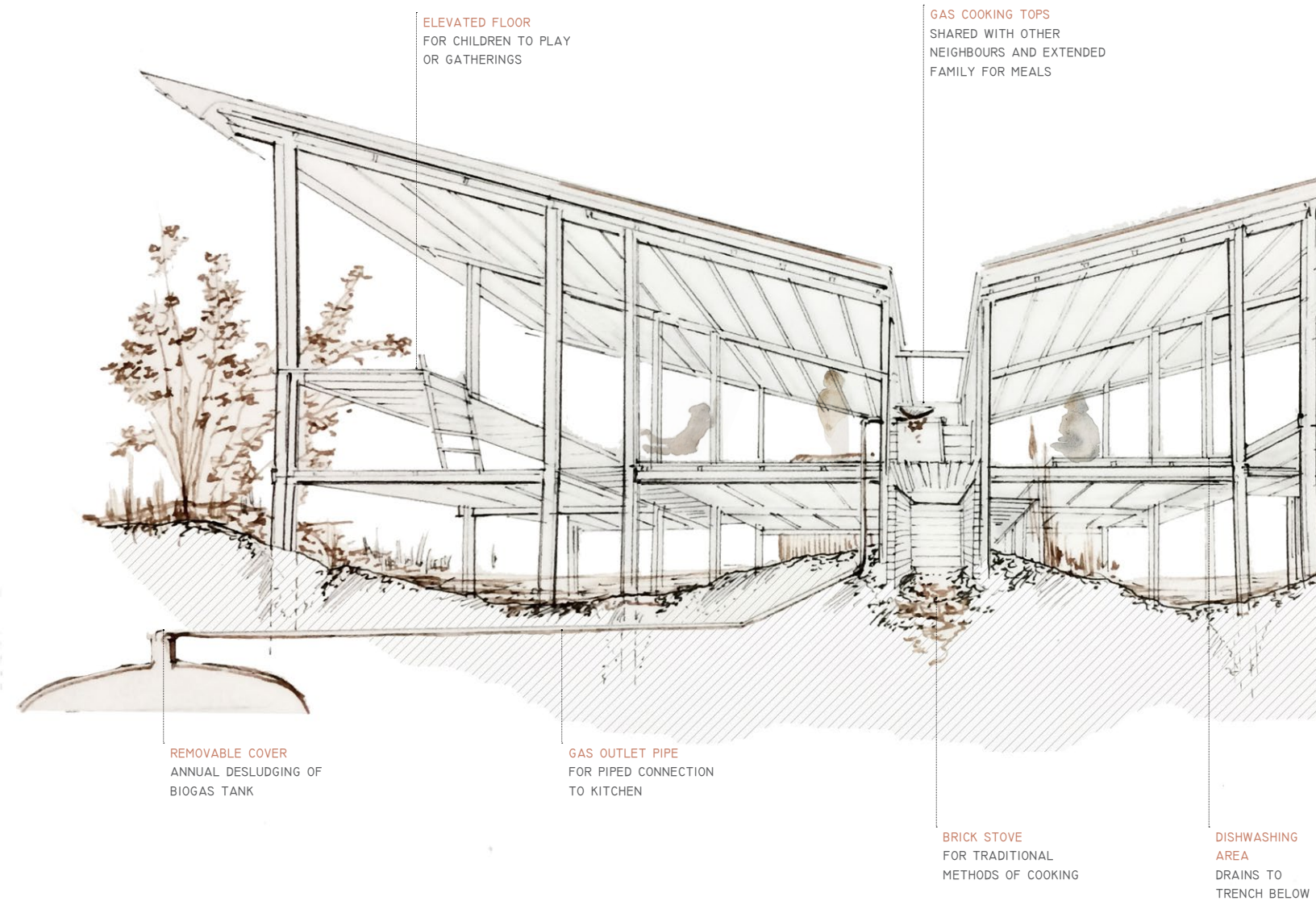


figure 3.70
Proposed Settlement: Type B Structures
Drawing by author.

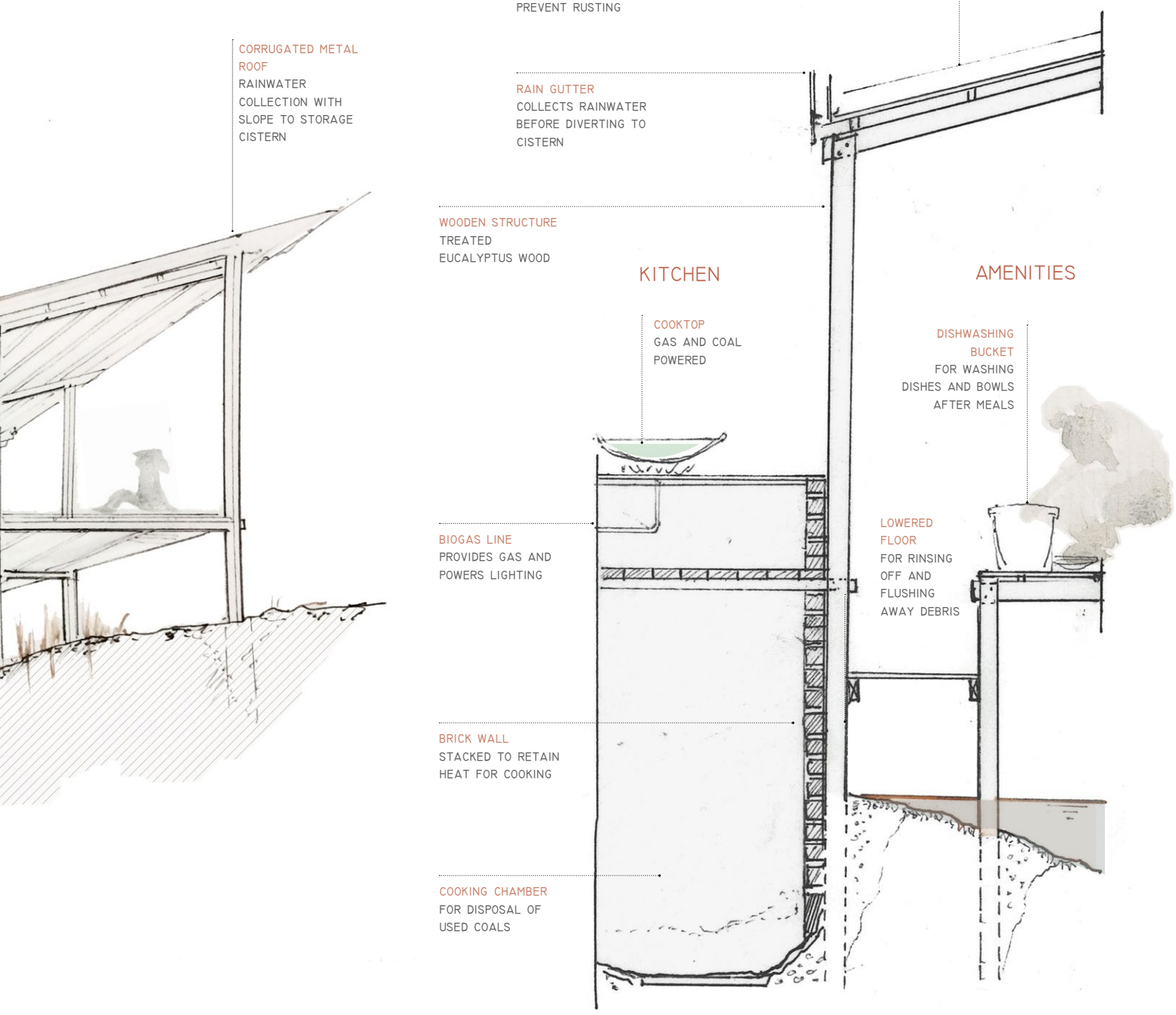


figure 3.71
Proposed Settlement: Type A Detail Sections
Drawing by author.

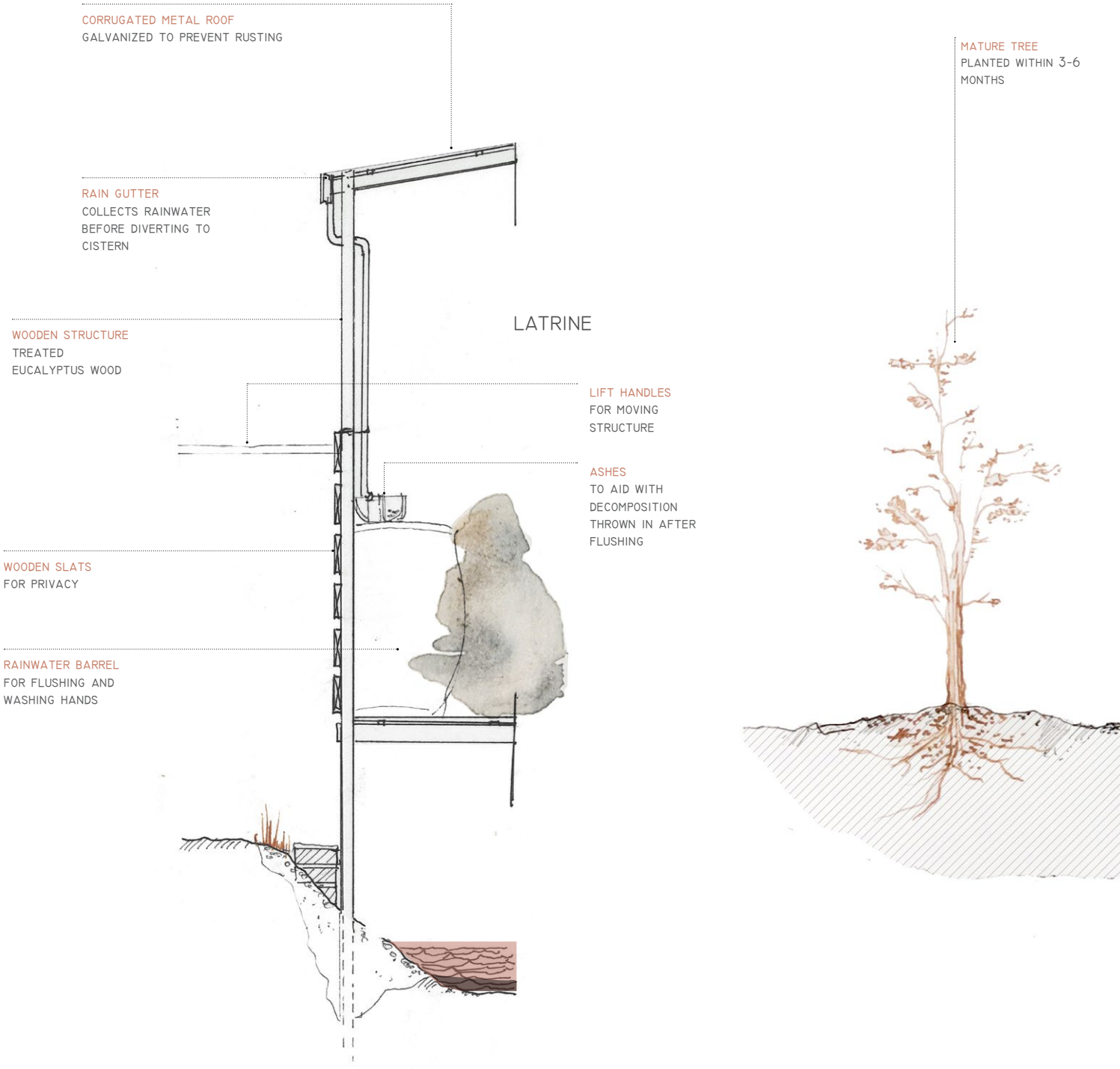


figure 3.72
Proposed Settlement: Type A Detail Sections
Drawing by author.

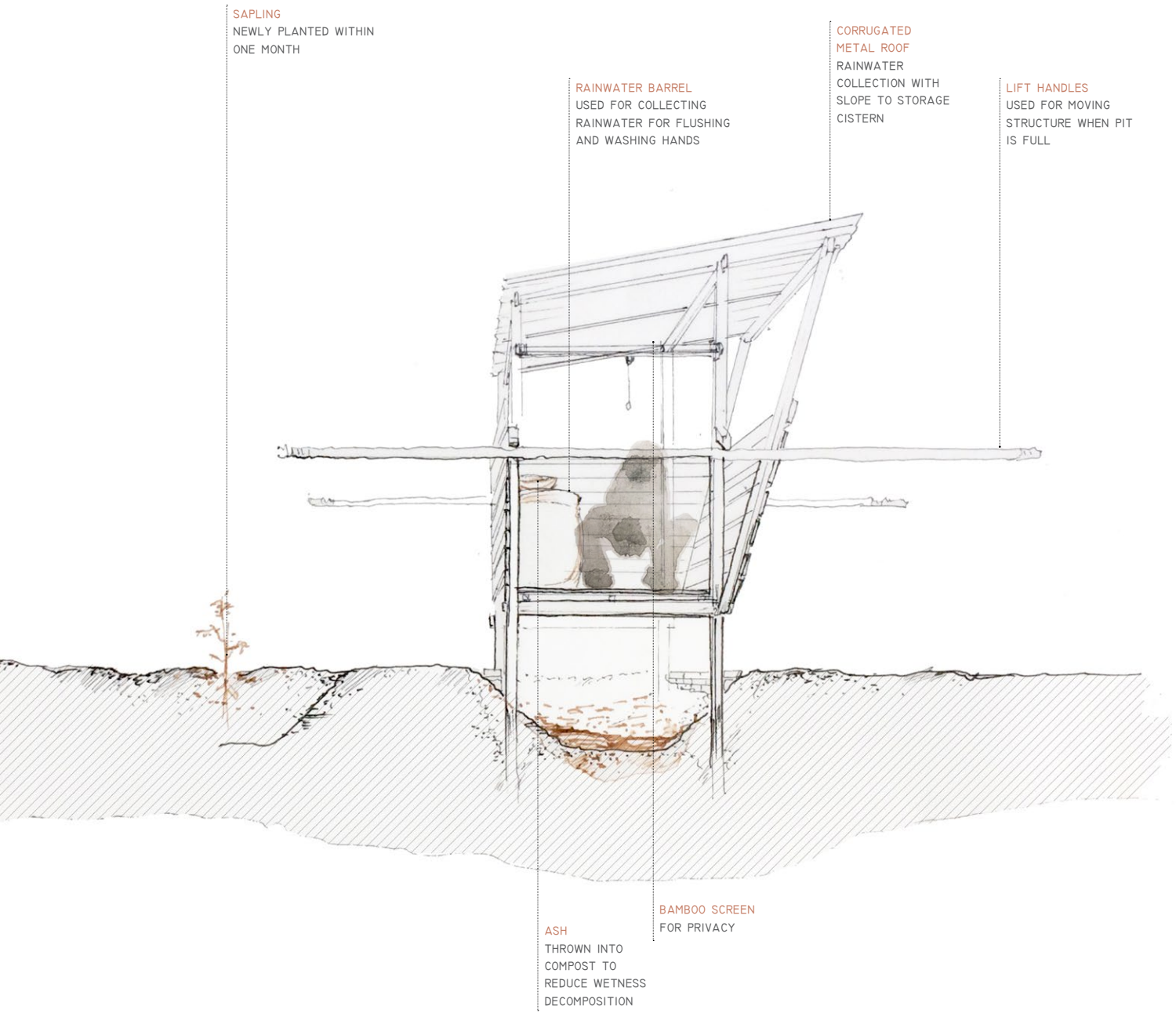
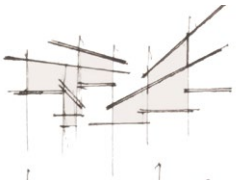


figure 3.73
Proposed Settlement: Type B Structures
Drawing by author.



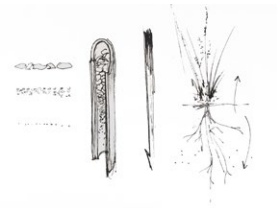
1 COLLECTION

Collection is managed by the added roofs. The edges of the roofs meet at the connection between spaces to make a butterfly roof.



2 FILTRATION

As rainwater is collected and travels down the eaves, the water is filtered through gravel, sand and cocopeat for preliminary treatment. Afterwards, the water travels through a microbial treatment to achieve a potable quality, and finally is boiled by the household prior to drinking.



3 STORAGE

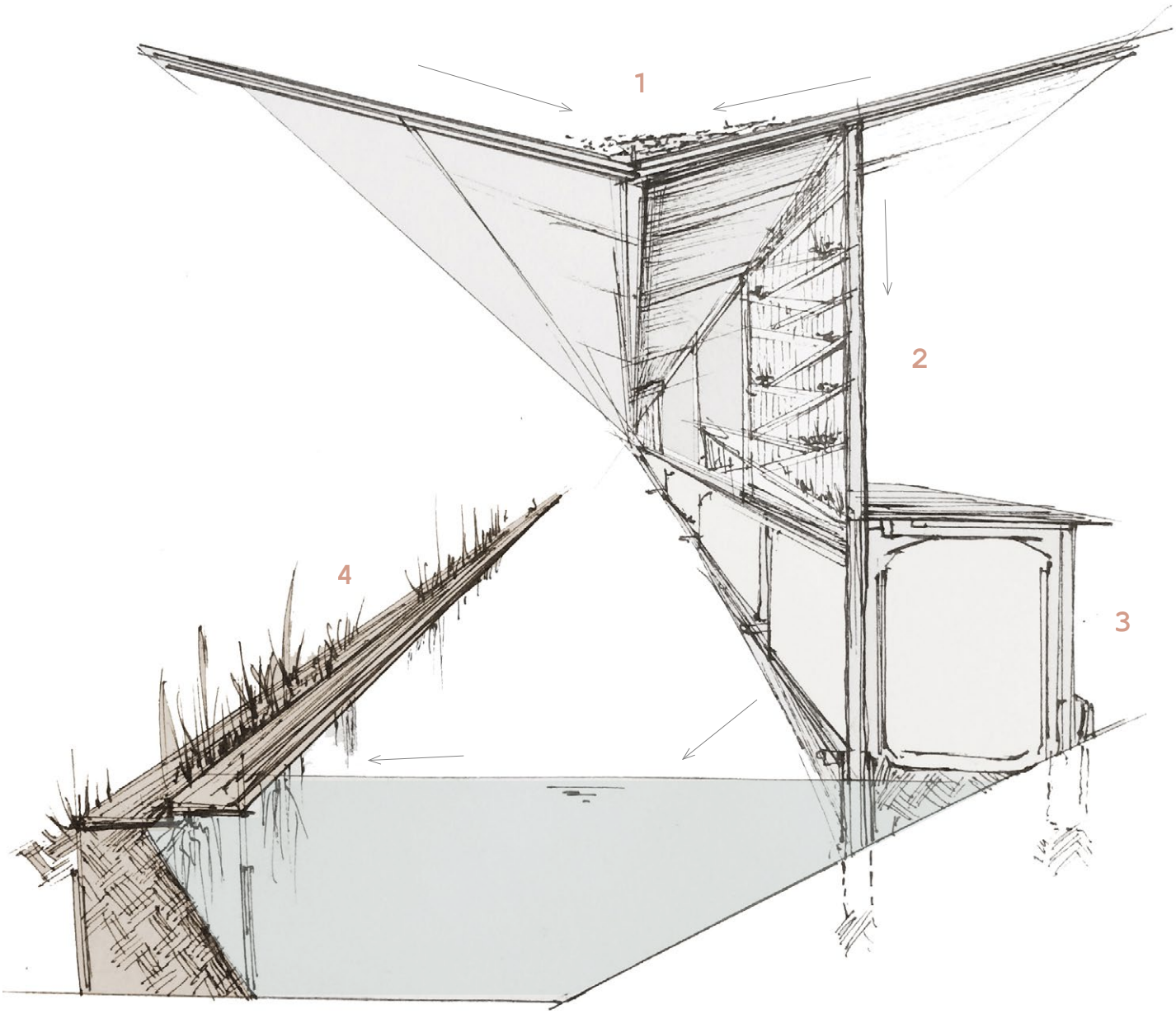
After being filtered, the potable water is stored in tanks beneath the link between the spaces and amenities. Unfiltered water that can be used for bathing is stored in the cascading space at a lower elevation.



4 BOUNDARIES

Used water that turns into grey and black quality are kept at seprated levels. These separations are enforced by builtup marshes and floating rafts with vetiver plants to remove contaminants further. The flow of water is controlled to prevent black water from returning to the grey water spaces.

figure 3.74
Proposed Settlement: Type A
Drawing by author.


1
2
3
4

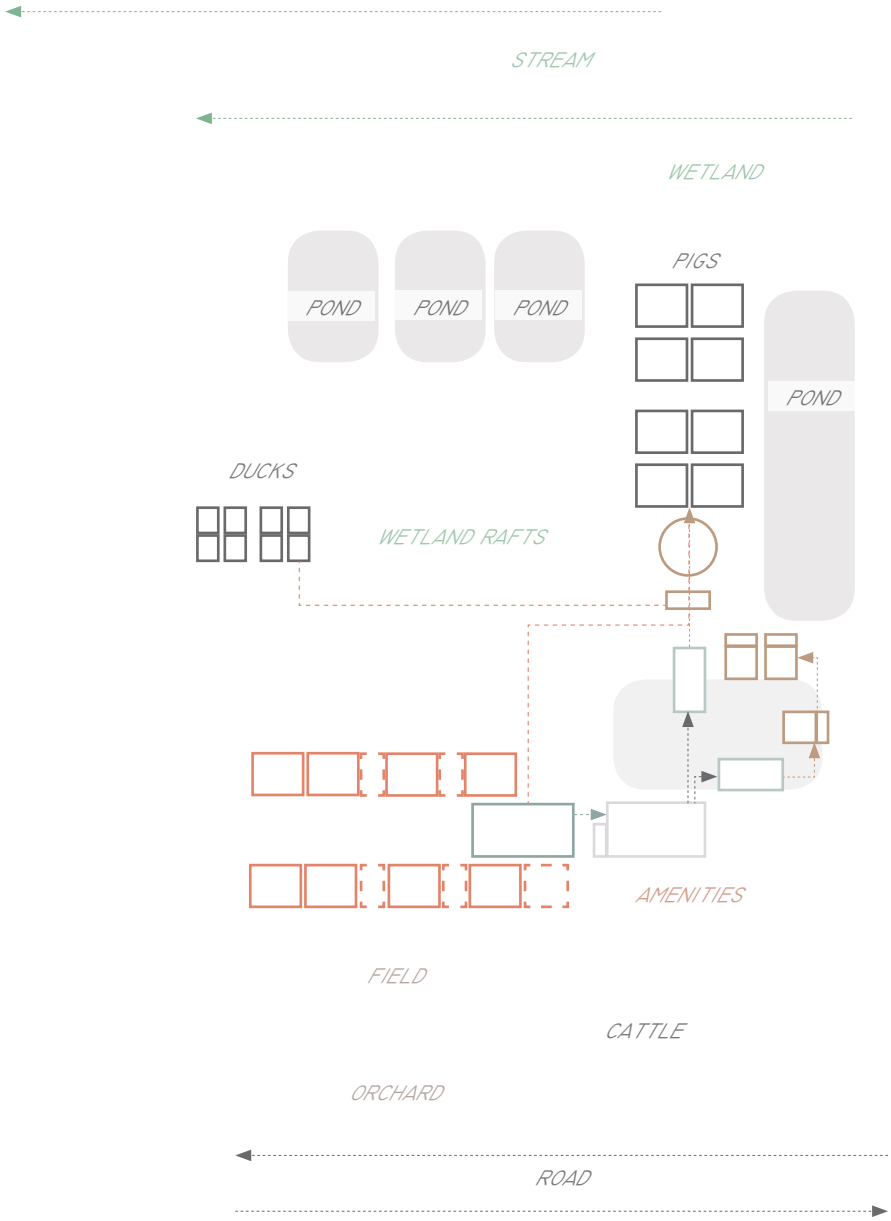


figure 3.75
Proposed Settlement: Type B
Drawing by author.

Type B - Central Pond Settlement "Wet"

The central pond settlement prioritizes livestock raising and aquaculture ponds. Gathered around a household pond, the family members share their laundry *(figure 3.80)*, bathing *(figure 3.81)*, and kitchen with one another. Linking the privates spaces for rest and sanitation is the kitchen, a shared space for gatherings and shared meals.

Private sleeping areas are constructed as extensions from the main living space and kitchen, but with views to the pig pens on the small road and the duck pens along the wetlands. The latrine *(figure 3.82)* is linked to a wetland where blackwater is flushed out for filtration. Solids are captured within a tank beneath the latrine for decomposition.

This design is based off of my experiences meeting a family who lived beside a trench. A neighbouring woman wearing *nón lá* (bamboo palm-leaf hat) was borrowing the family's boat to capture snails in the trench to sell for extra money. The trench and wetlands are intended to be a bountiful landscape ecologically and socially.

"Mình nghèo, vì người ta sẽ cho ở đây."

A sister and her brother beside the trench

Riding along the high dike roads in Vinh Xuyen village, I noticed a home set back quite a distance from the road that was situated beside the trench. The ground was extremely muddy, since it had rained in the morning. This made it difficult for me to walk down the slope of the road and across the empty lot before the home. The mud was uncomfortable, as I thought I could fall at any moment.

There were two smaller homes beside one another, built humbly beside the trench filled with wilted water lilies. In one of the homes, I met a man who sat up from his bed, and asked me what I needed. Inside the home I saw a plastic water jug set at the porch and an old fan that ran beside the man's bed. After a few questions, a woman came by on a motorbike and explained that she was the homeowner and the man's sister. She told me that her brother was ill and could not work, and as a result, they had to sell their land to make ends meet. They built their new home along the trench, and told me that the buyers for the plot of land would let them stay - simply because they were poor. I asked them who owned the trench. The woman explained it was divided between the houses, similar to a backyard. She then mentioned it was owned by the government. But then said, "Well technically, it isn't. It is owned by the people who live here".

As I left, I noticed behind one of the homes was a hanging latrine draped with yellow and white tarps. It was very easy to miss as it was hidden well behind the eucalyptus trees and lumber piles.

Anonymous sister and brother in An Giang. Personal Interview.

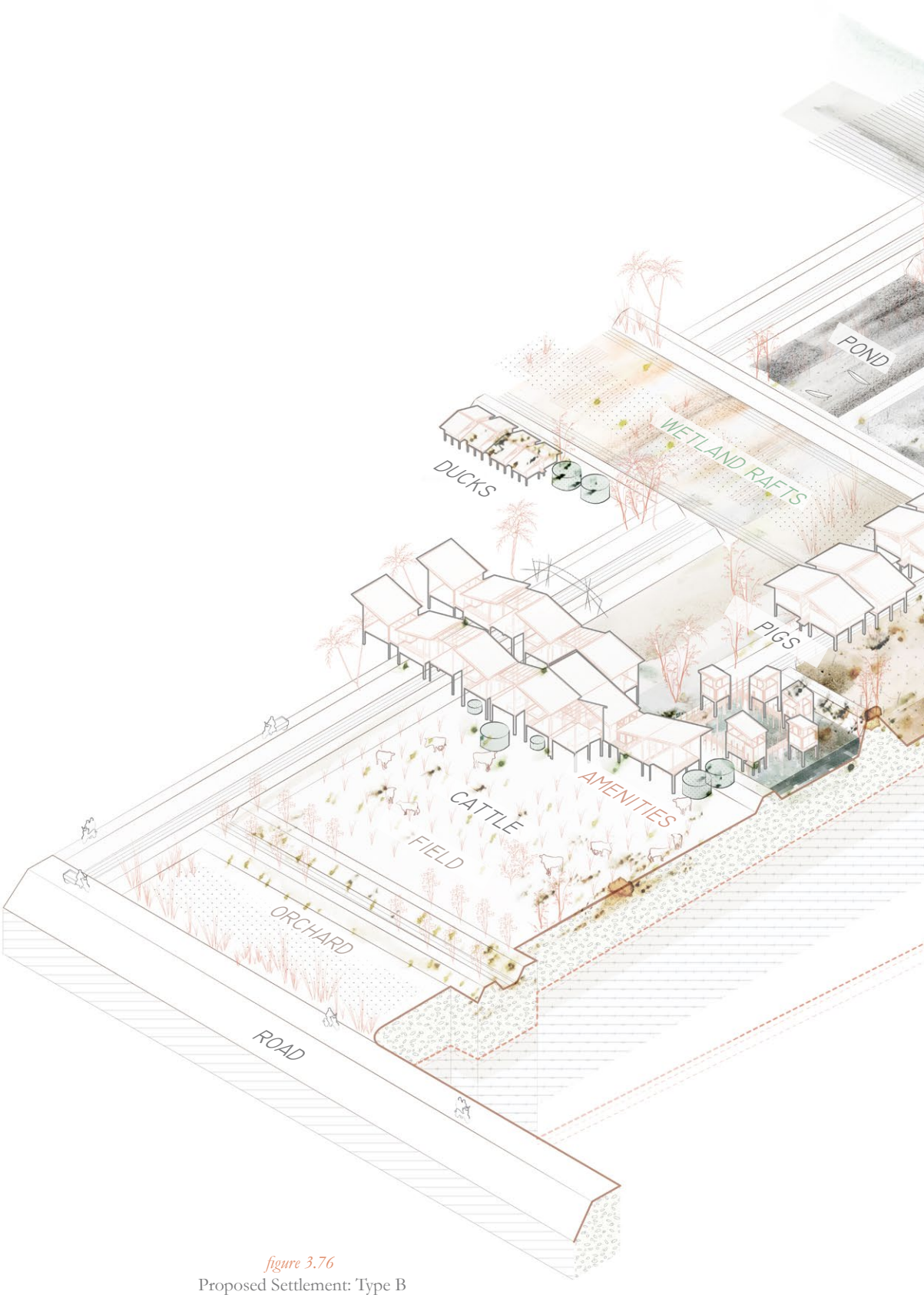
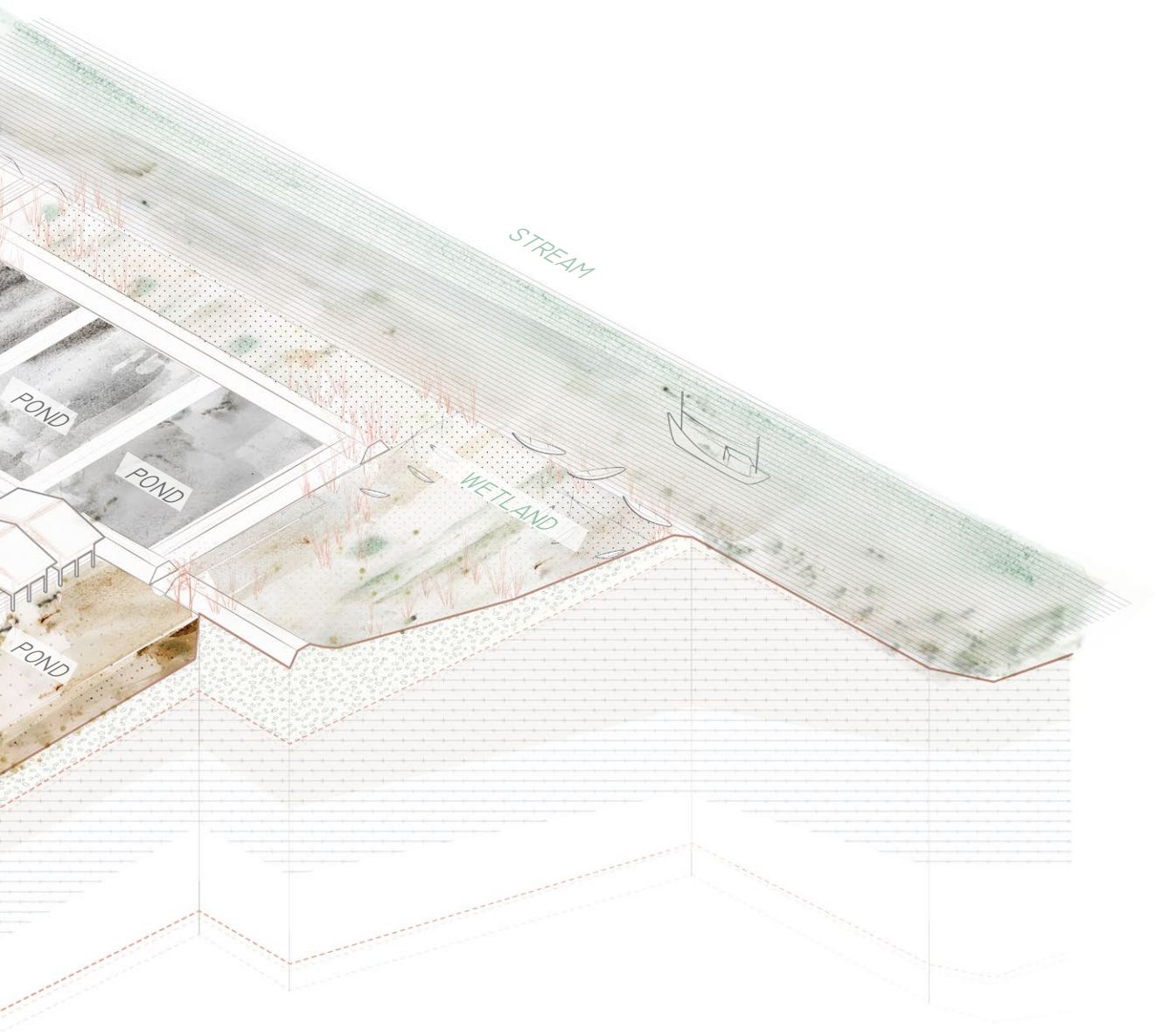
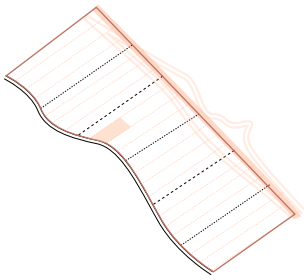
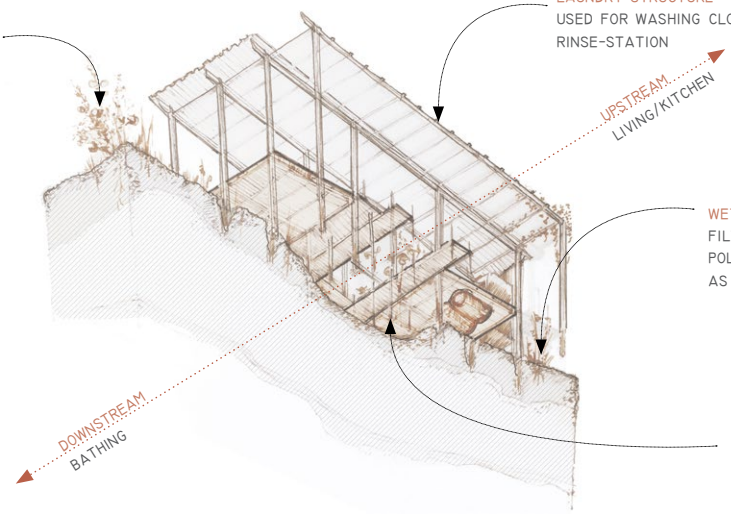


figure 3.76
Proposed Settlement: Type B
Drawing by author.

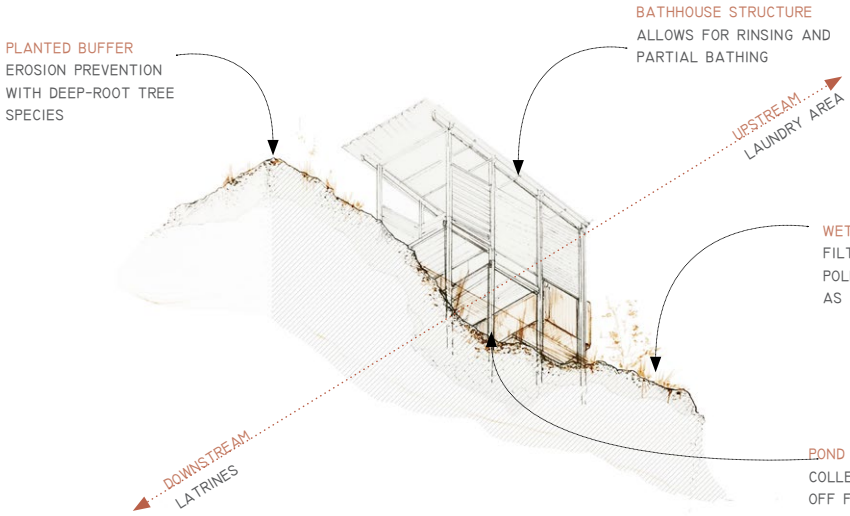

STREAM
POND
POND
WETLAND
POND



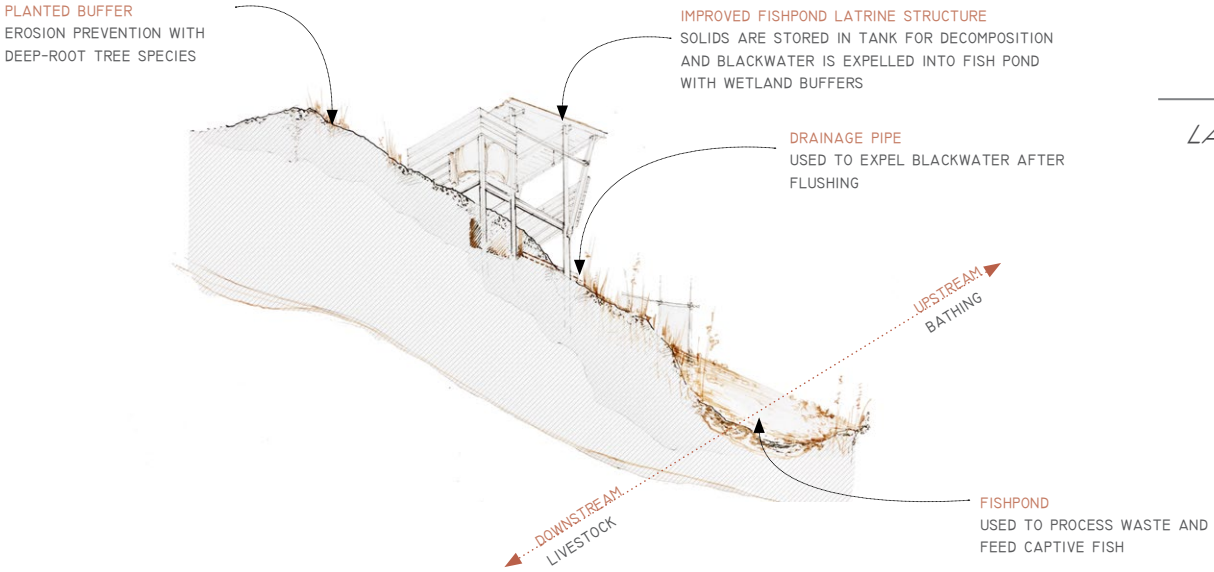
LAUNDRY



BATH



LATRINE



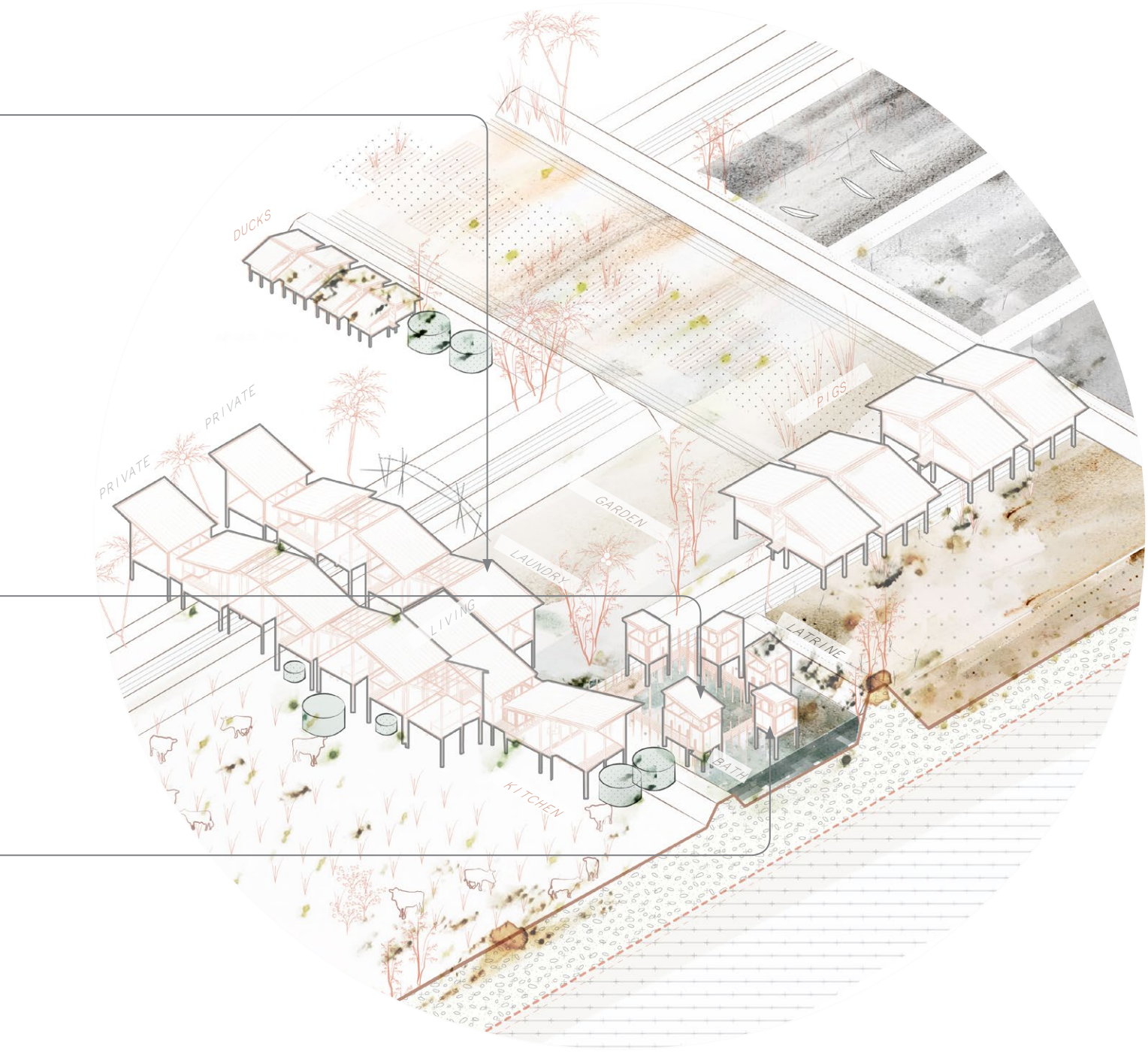


figure 3.77
Proposed Settlement: Type B
Drawing by author.

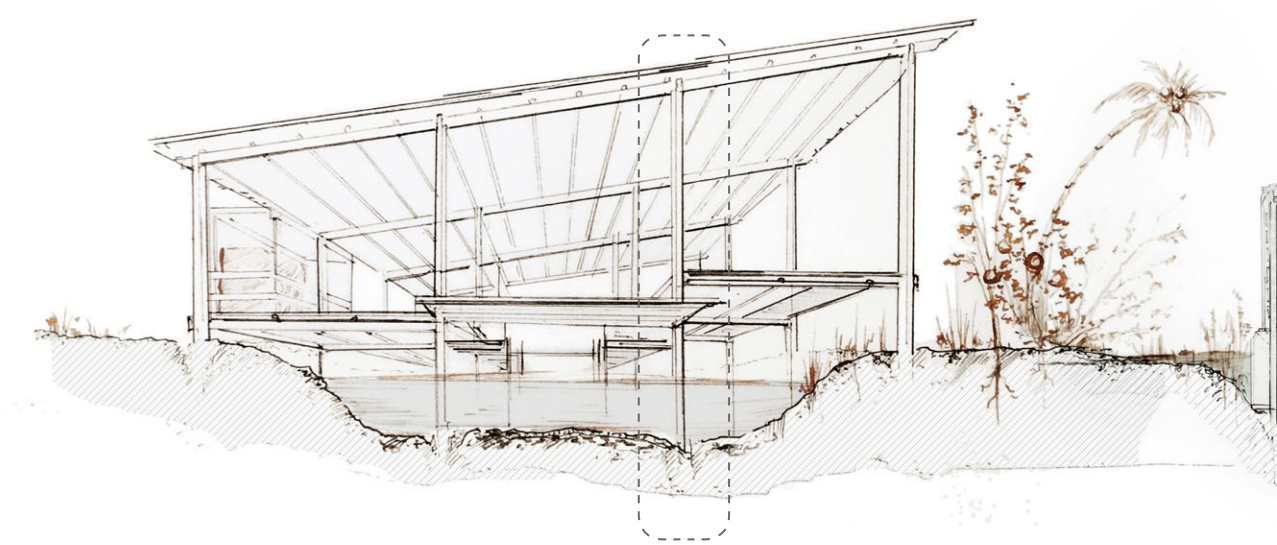
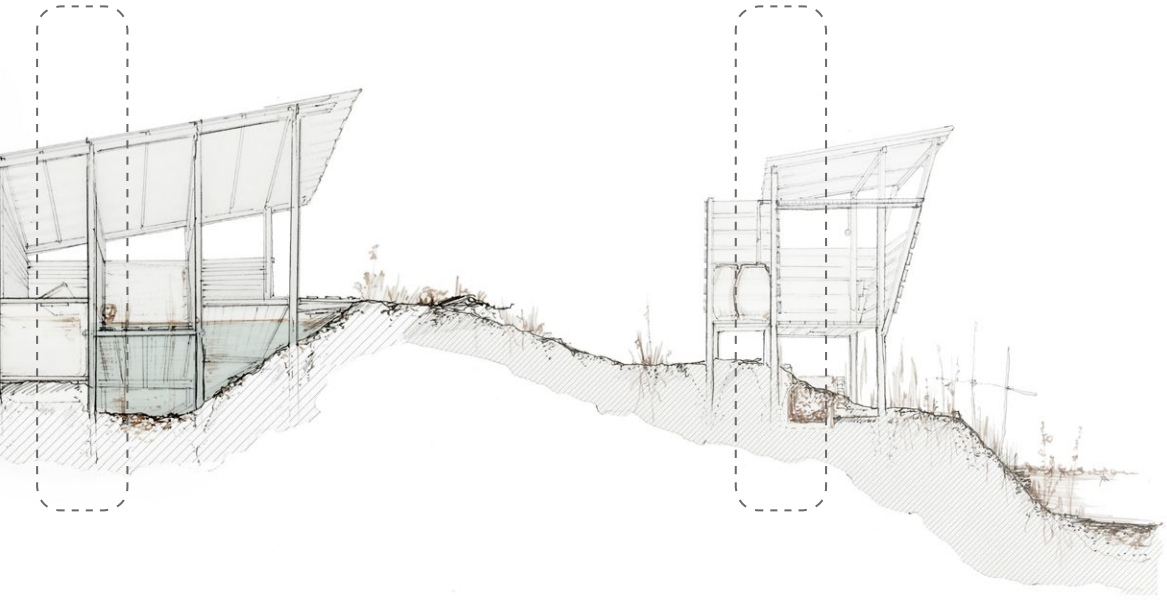


figure 3.78
Proposed Settlement: Type B
Drawing by author.



BATH

LATRINE



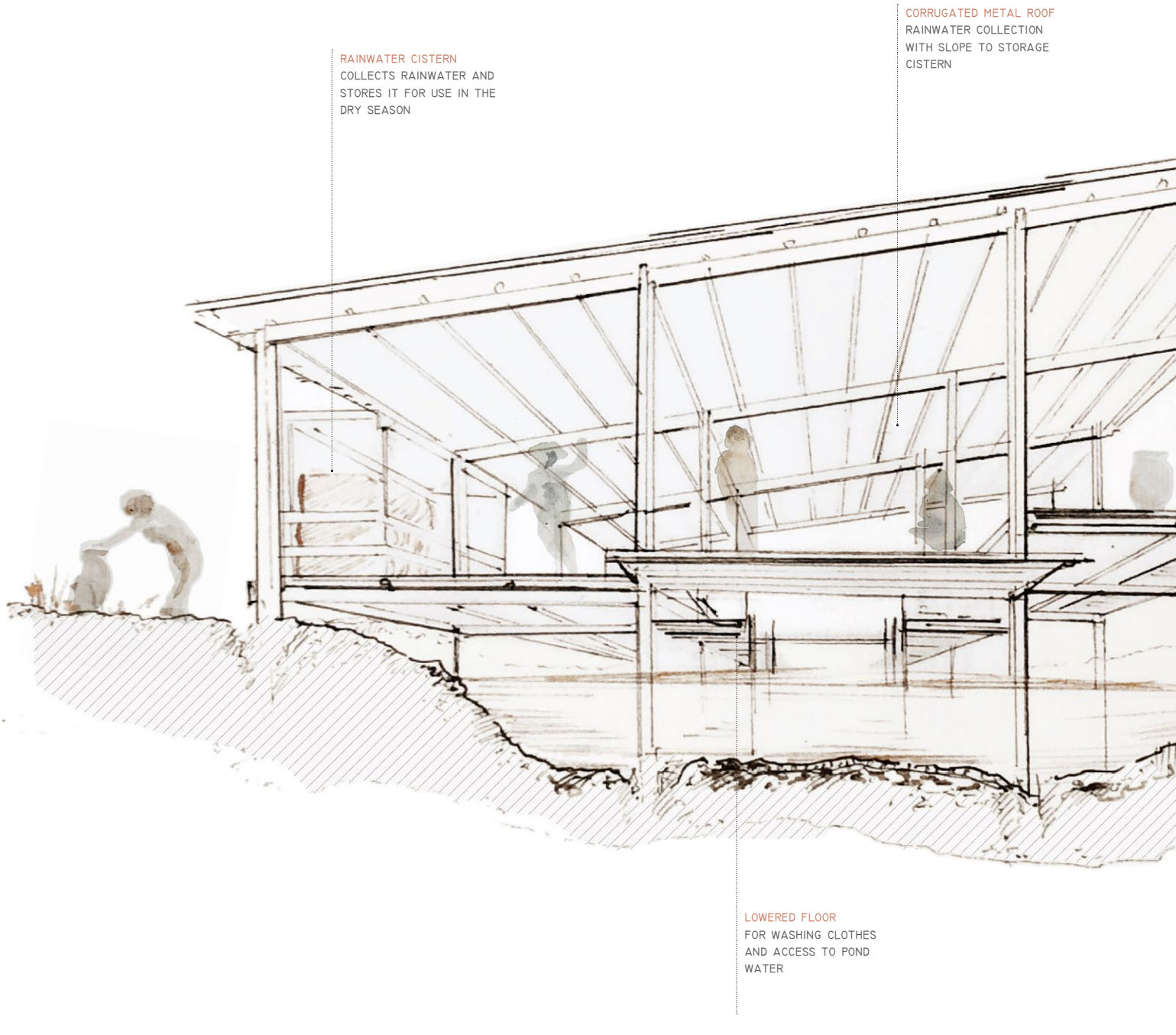


figure 3.80
Proposed Settlement: Type B Structures
Drawing by author.

GRAPEFRUIT TREES
FRUITS USED FOR VARIOUS NATURAL SOAPS AND SHAMPOOS
LEAVES CAN BE USED FOR SCRAP MATERIAL





figure 3.81
Proposed Settlement: Type B Structures
Drawing by author.

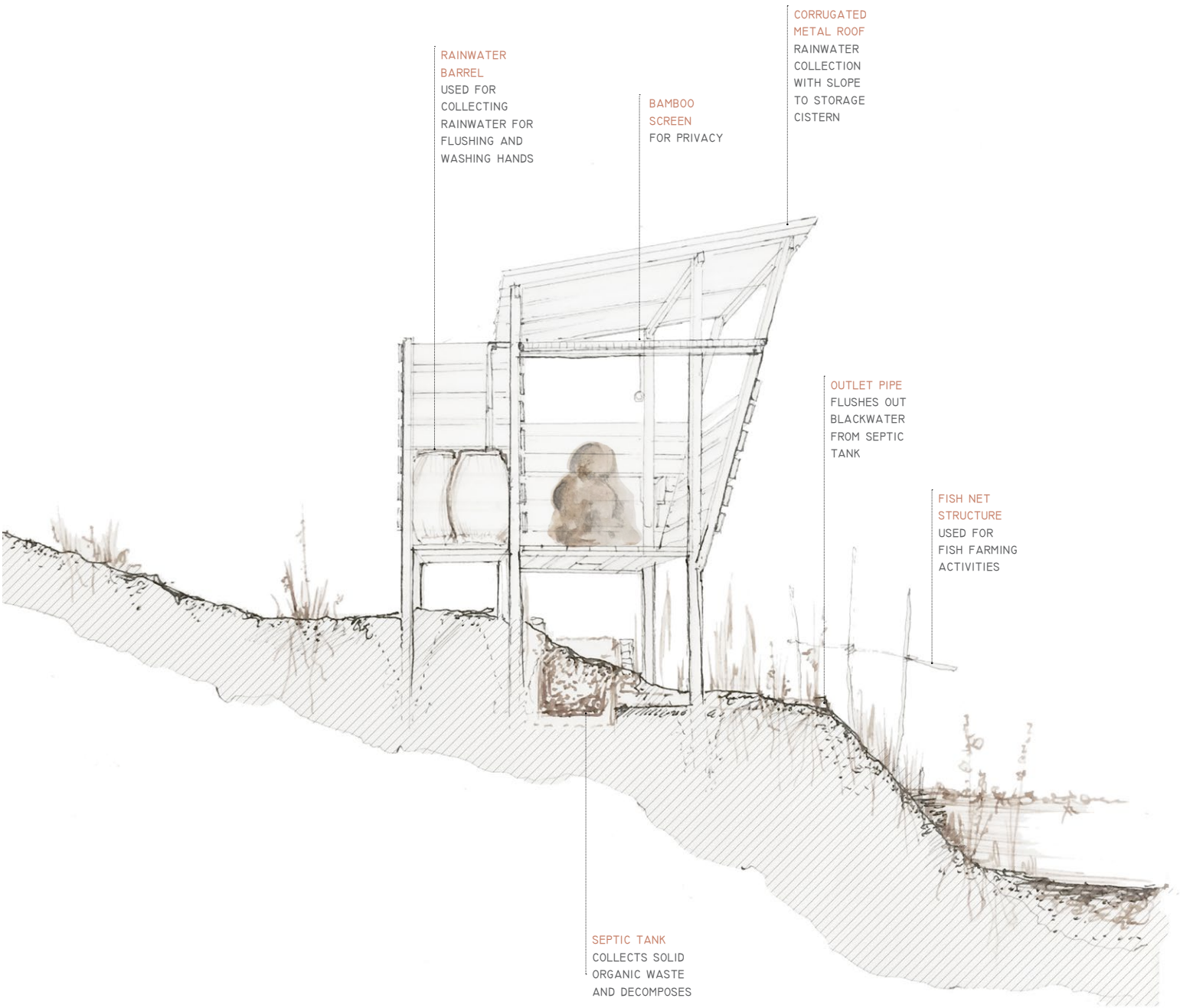


figure 3.82
Proposed Settlement: Type B Structures
Drawing by author.

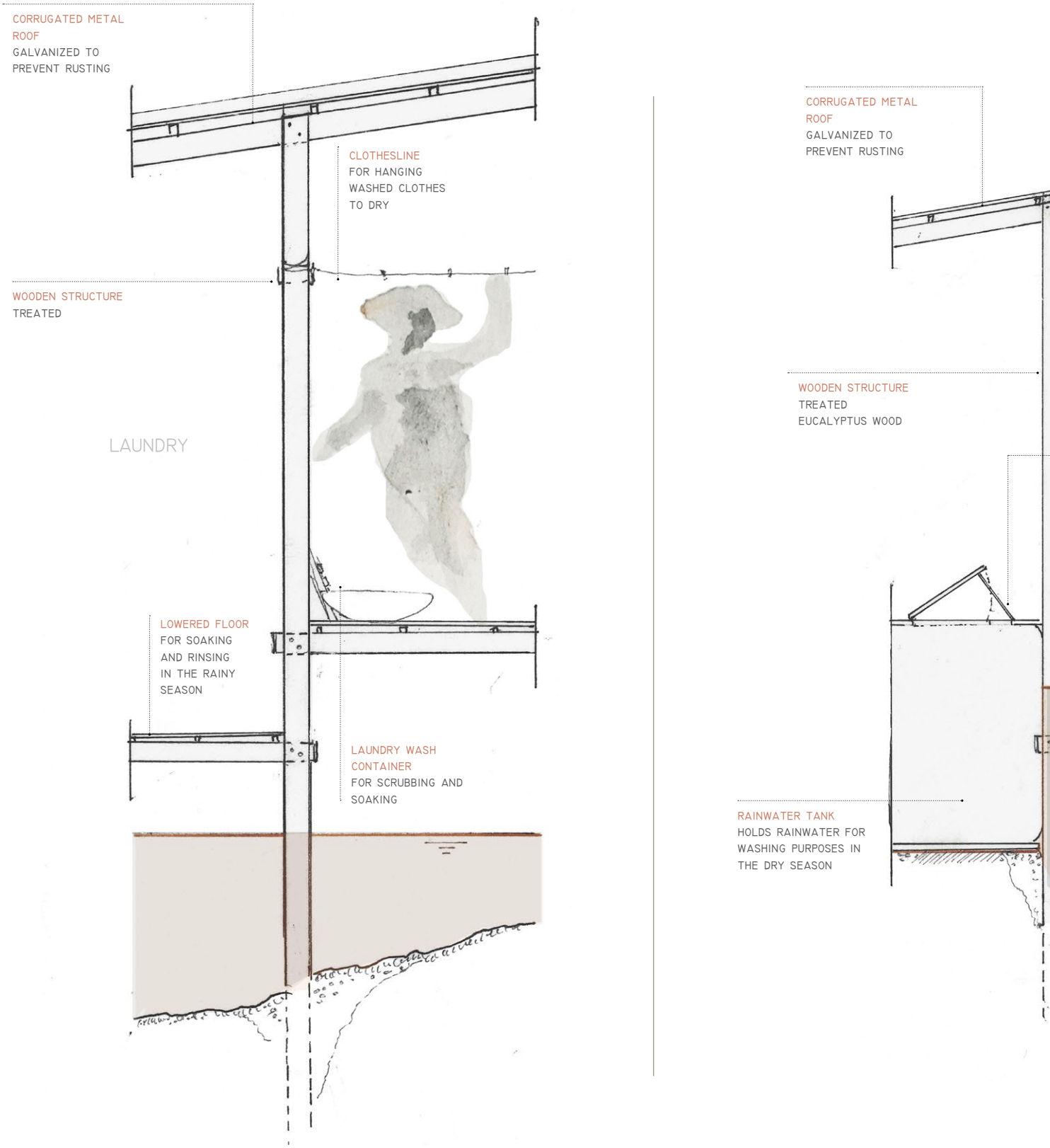
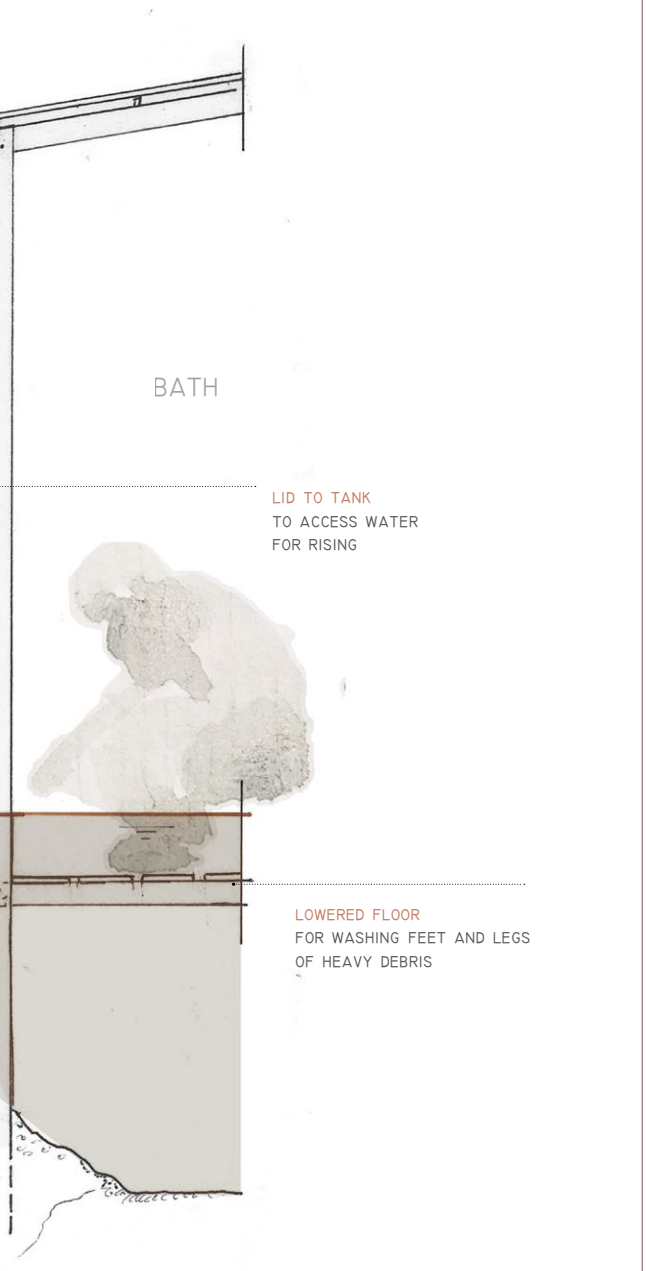
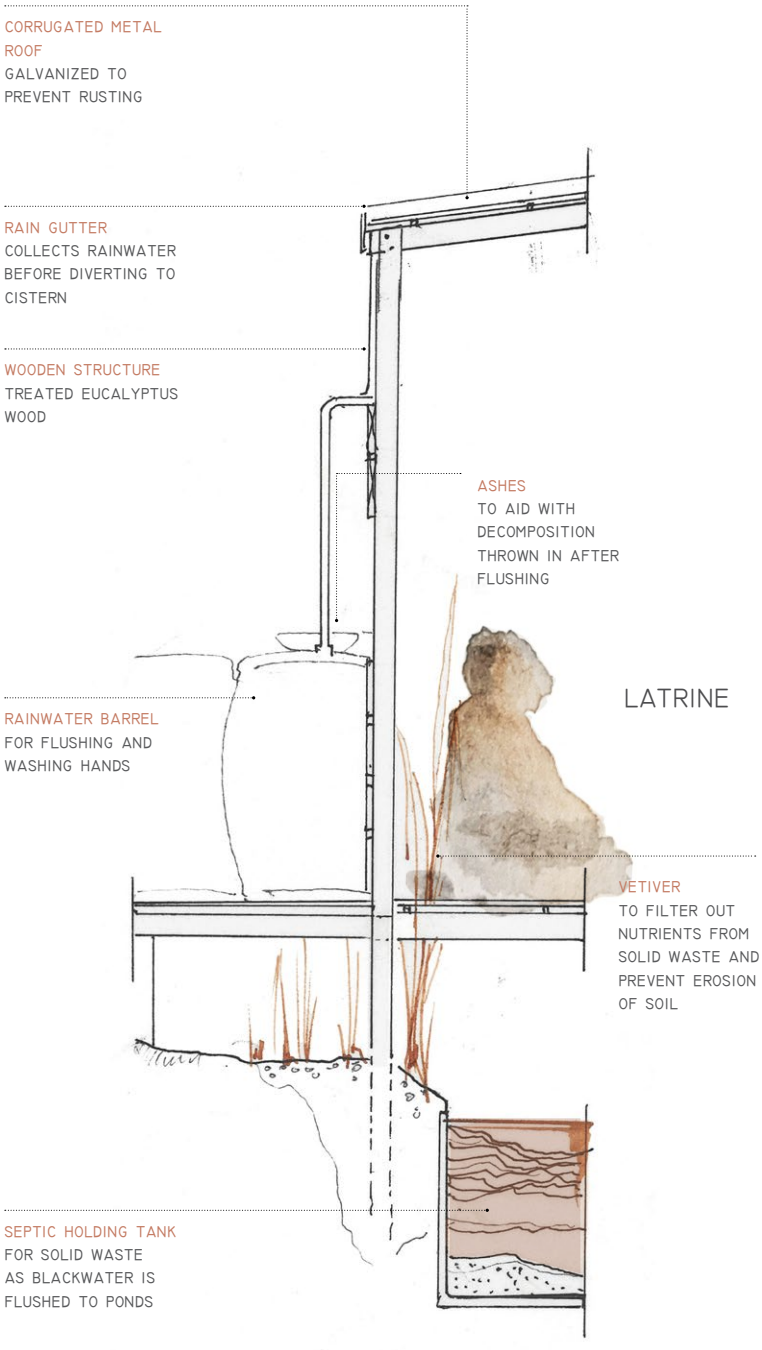


figure 3.83
Proposed Settlement: Type B Detail Sections
Drawing by author.


BATH
LID TO TANK
TO ACCESS WATER
FOR RISING
LOWERED FLOOR
FOR WASHING FEET AND LEGS
OF HEAVY DEBRIS


CORRUGATED METAL
ROOF
GALVANIZED TO
PREVENT RUSTING
RAIN GUTTER
COLLECTS RAINWATER
BEFORE DIVERTING TO
CISTERN
WOODEN STRUCTURE
TREATED EUCALYPTUS
WOOD
ASHES
TO AID WITH
DECOMPOSITION
THROWN IN AFTER
FLUSHING
LATRINE
RAINWATER BARREL
FOR FLUSHING AND
WASHING HANDS
VETIVER
TO FILTER OUT
NUTRIENTS FROM
SOLID WASTE AND
PREVENT EROSION
OF SOIL
SEPTIC HOLDING TANK
FOR SOLID WASTE
AS BLACKWATER IS
FLUSHED TO PONDS

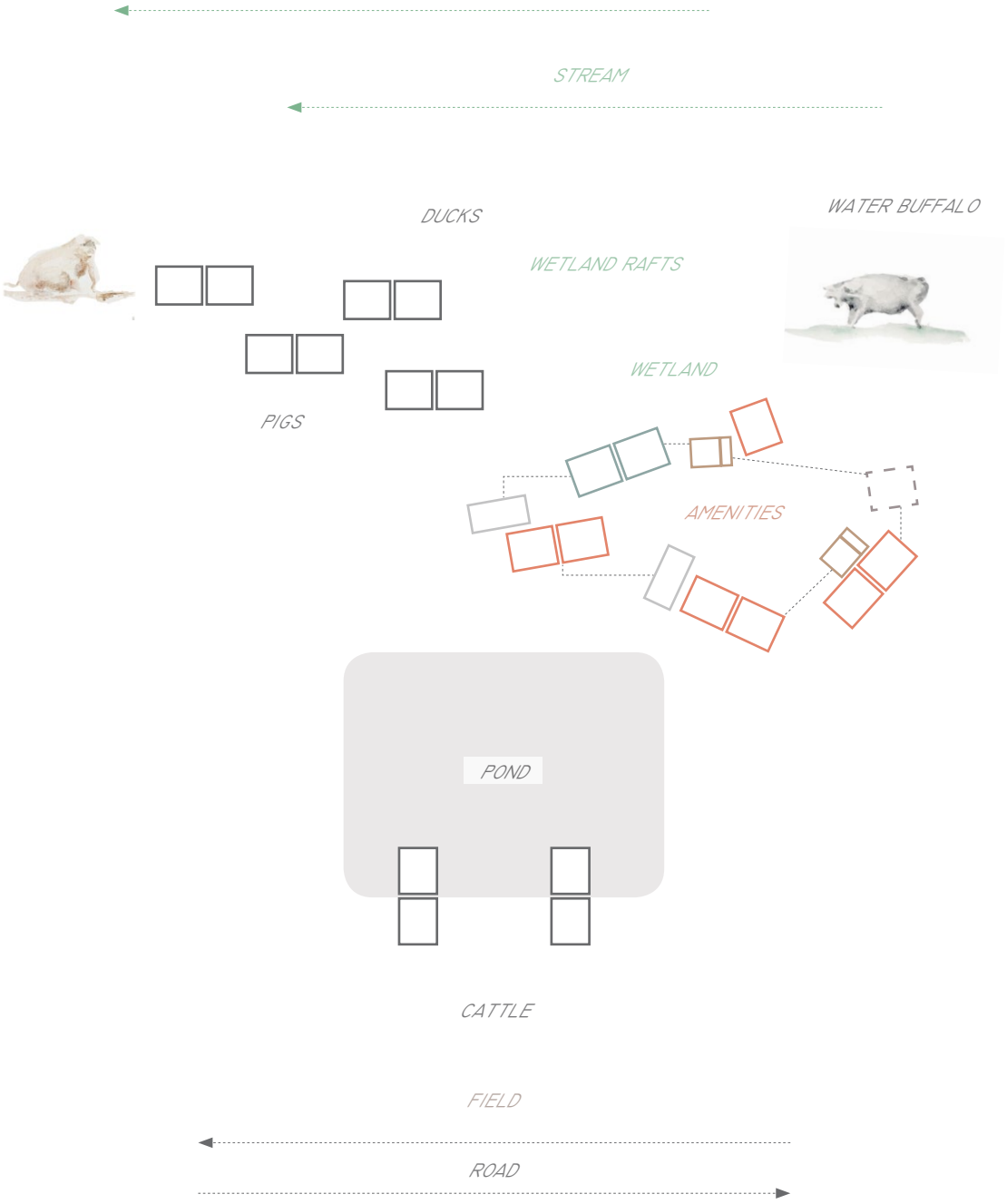


figure 3.84
Proposed Settlement: Type C
Drawing by author.

Type C - Wetland Settlement "Flood"

Floating peacefully, the wetland settlement prioritizes fields and wetlands, the aquatic aspects of the field. Wetland settlements typically occur nearby streams where plentiful reeds and floating lily pads and water hyacinth are abundant. Water buffalo swim by the homes and help to plow the surrounding rice and grass fields.

Houses are designed to float as water levels rise throughout the season, adapting to to natural changes. A floating latrine *(figure 3.86)* designed into a boat with a filtering wetland system minimizes bacteria from disposed waste.

This proposal is based off of my experience meeting with a man and his daughter in one of the flooded fields beside Nui Sam mountain. Although intentionally left to flood for touristic purposes, informal housing settlements from landless residents had developed along the edge of the field. To prevent flooding, these homes were typologies that varied from boats, raised houses, and houses built onto boats.

"Khi nước lên, không biết đi đâu nữa."

A man and his daughter in a flooded field

During my travels within the province, I came across an informal settlement of houses constructed on boats. These homeowners were landless, and subjected to flood conditions each year. The field is unique at this location for its lack of high dike conditions as many tourists come by here to experience the views of Nui Sam mountain and the flooded paddy fields.

One homeowner who had a young daughter said that he used to have a boat, but it sunk several times in the past few years. Now, he has built a small house on raised stilts, but it floods above his floor level each year. Running from the main pipe along the road is a diverting water supply connection the the home. The connection has a fee each month paid to owners along the road. For a living, the father collects garbage from the houses along the road and sells it back to recycling facilities.

He has no toilet in his home, and people are reluctant to go in the water. Up on the road, there is a wealthier home with a woman who lets him and his daughter use the toilet. As the rain fell upon both of us, his daughter brings out a blanket and covers her father's shoulders. As I left, he mentioned how the government officers said he would be able to have a home soon and things would be better.
He just does not know when.

Anonymous man in An Giang. Personal Interview.

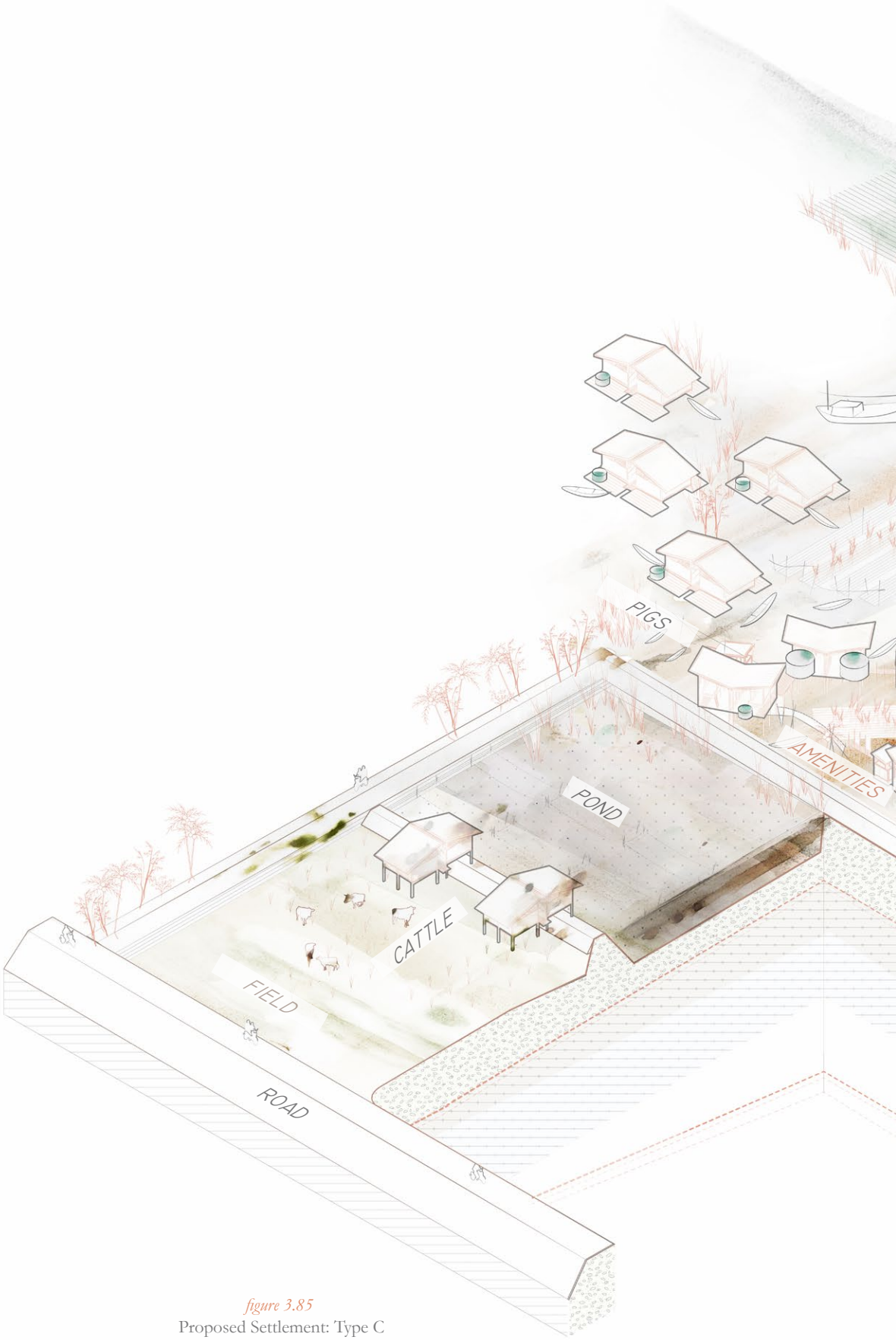
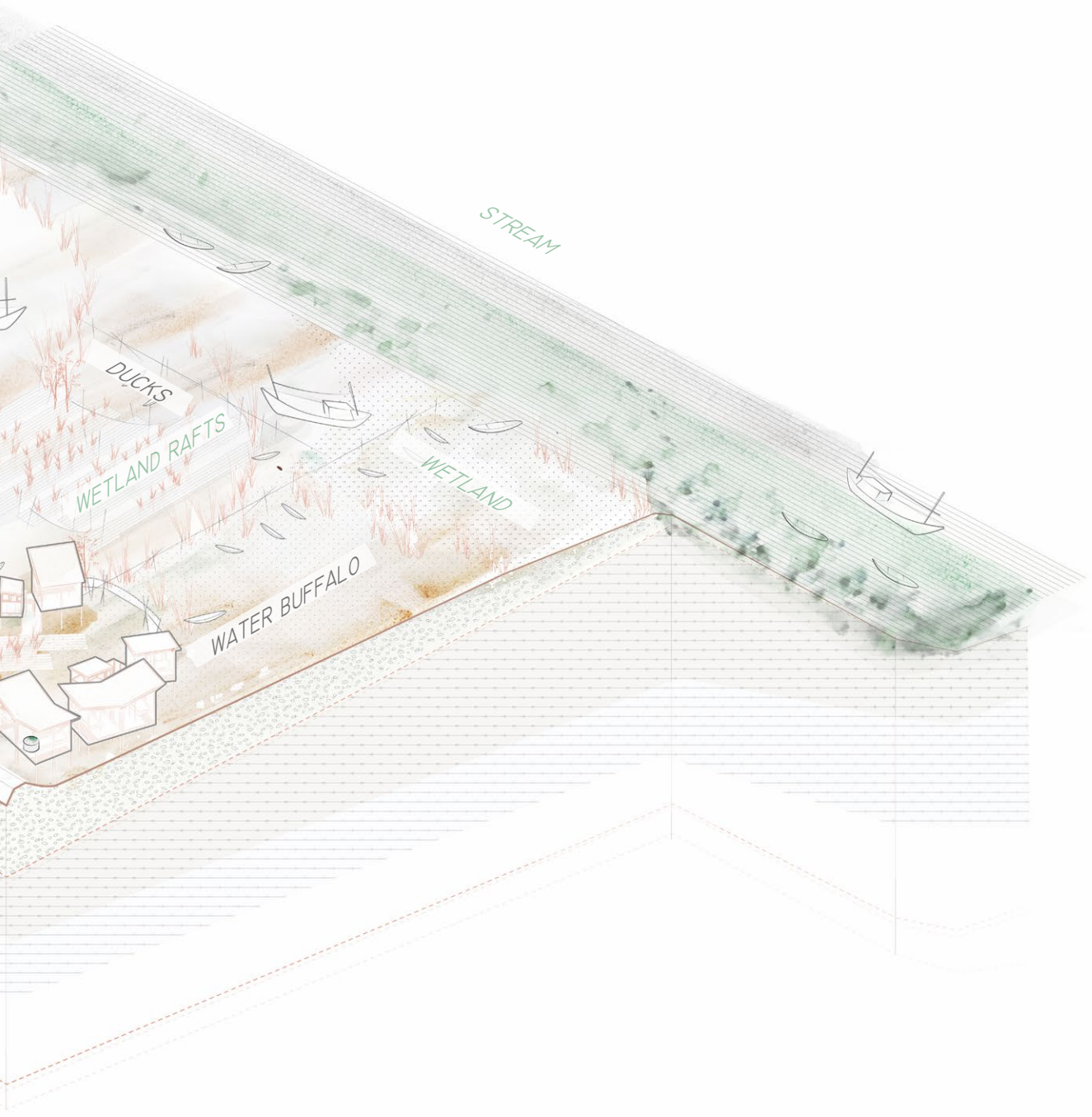
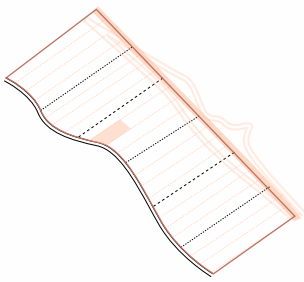
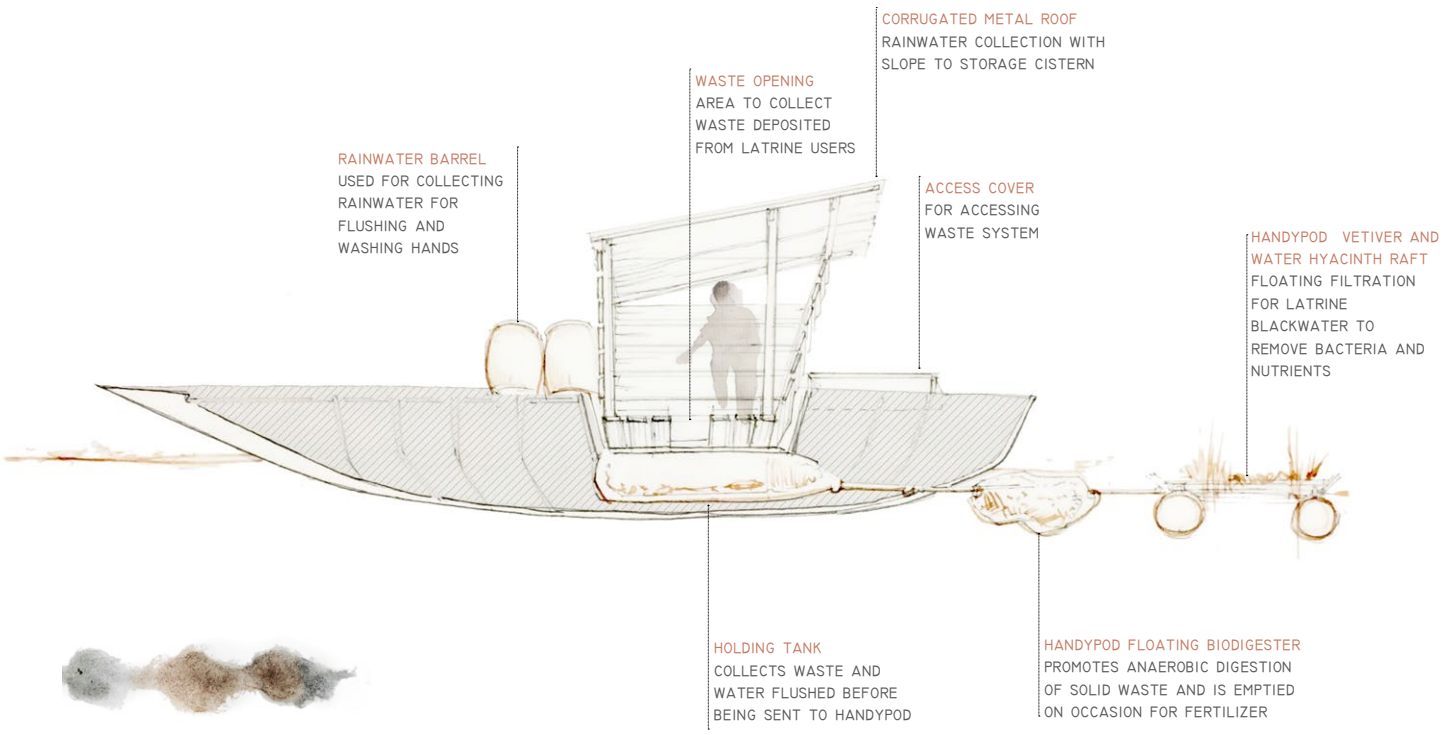
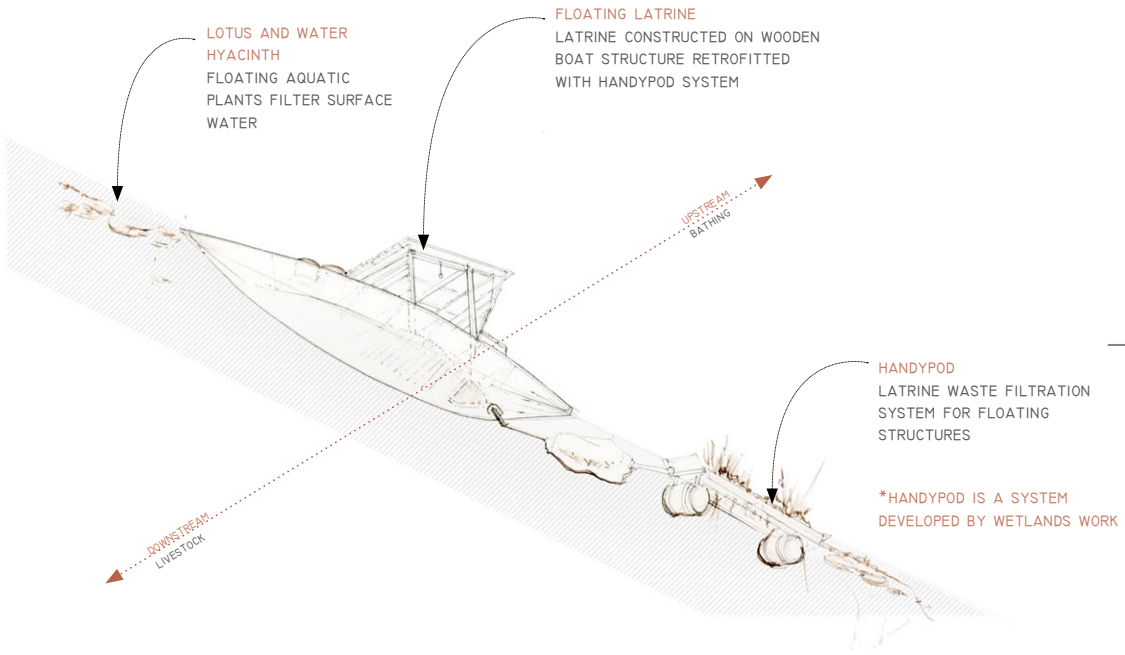


figure 3.85
Proposed Settlement: Type C
Drawing by author.


STREAM
DUCKS
WETLAND RAFTS
WETLAND
WATER BUFFALO

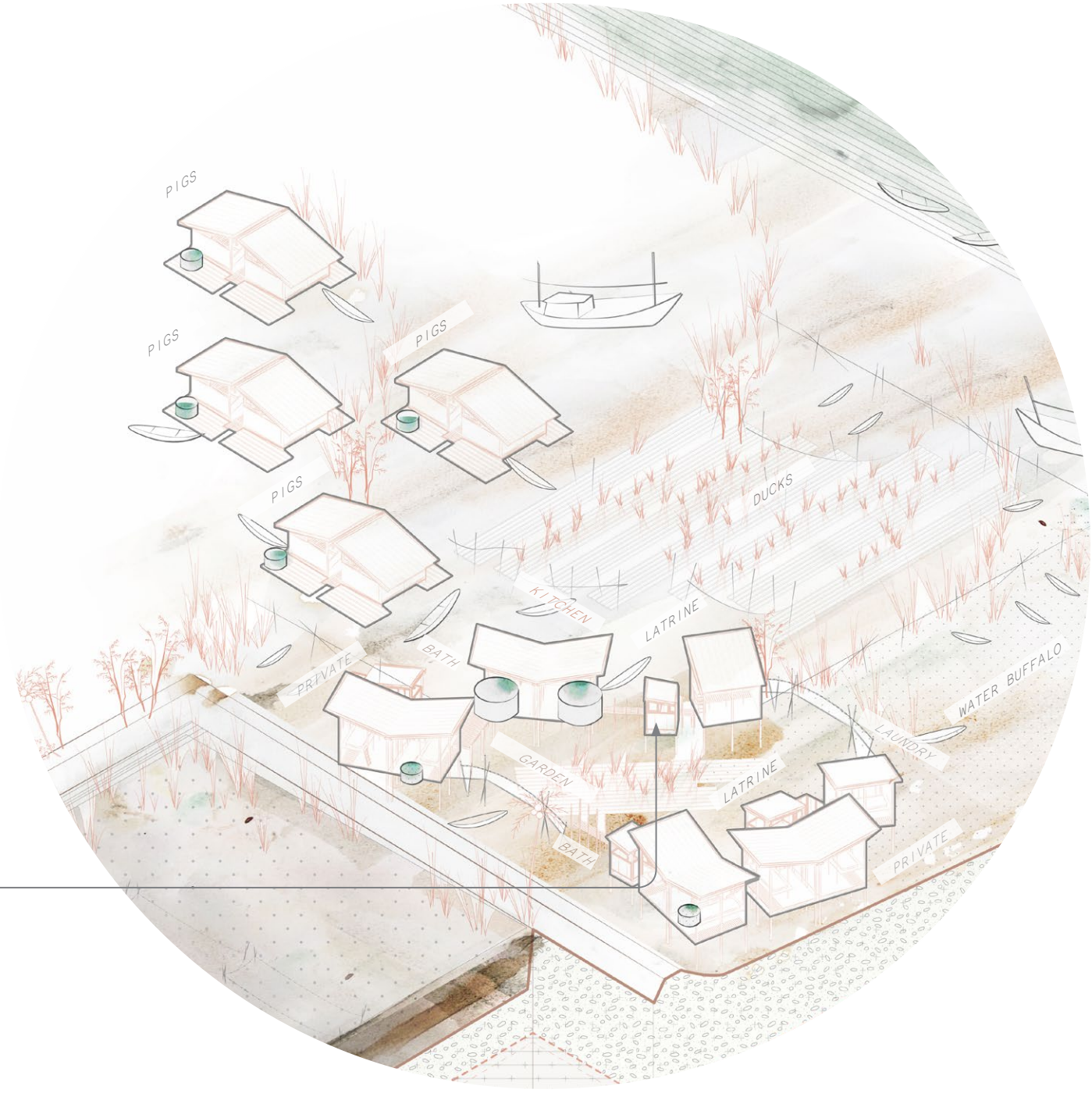






LATRINE

figure 3.86
Proposed Settlement: Type C
Drawing by author.
"Floating Villages and The HandyPod." Wetlands Work! January 24, 2017.


PIGS
PIGS
PIGS
PIGS
DUCKS
KITCHEN
LATRINE
PRIVATE
BATH
WATER BUFFALO
LAUNDRY
GARDEN
LATRINE
BATH
PRIVATE

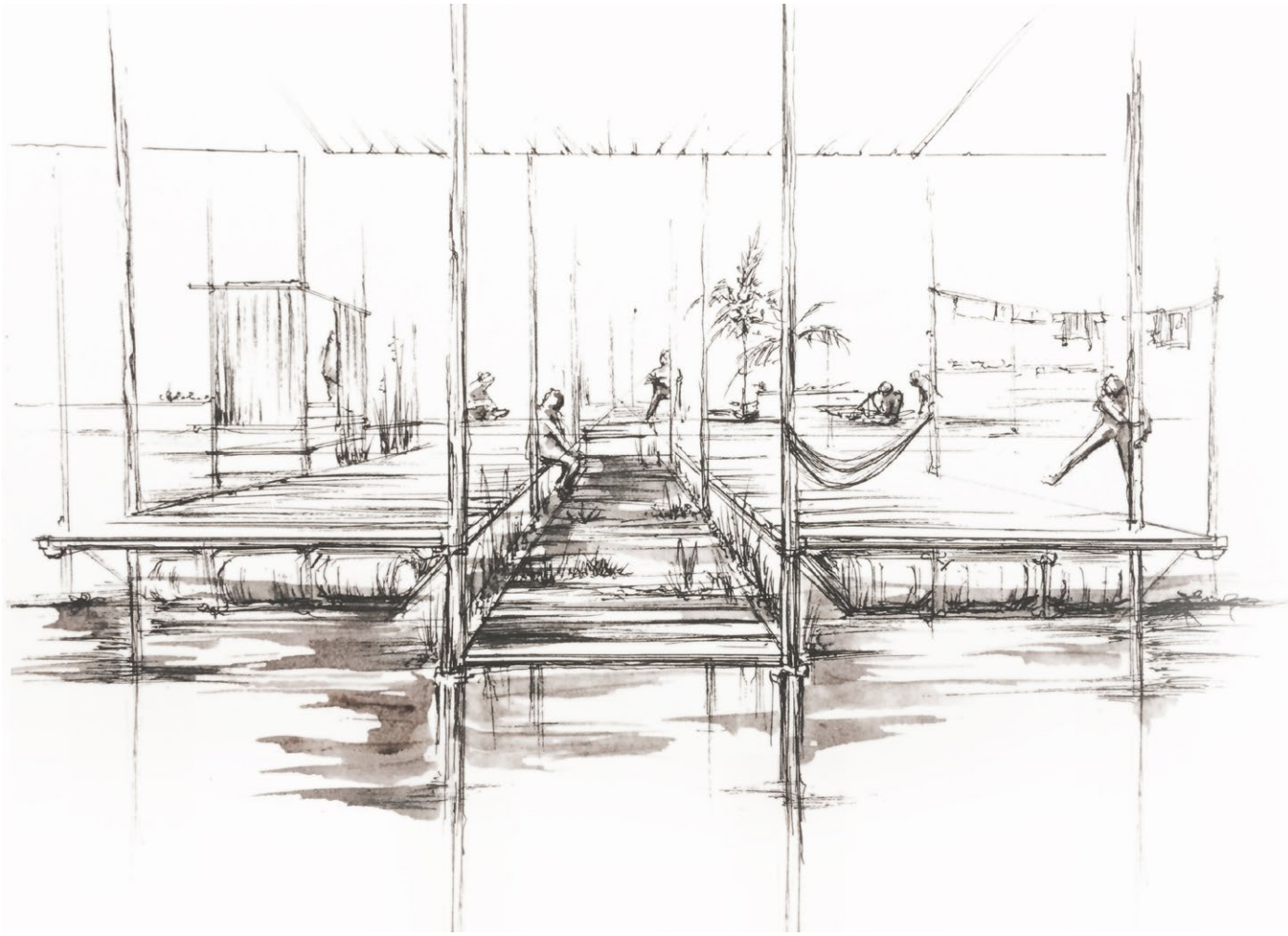


figure 3.87
Proposed shared spaces for interacting with water.
Drawing by author.

Due to its dominant scale, the agricultural landscape has the potential to be a major player in the fight for health and economy within the province *(figure 3.91)*. The field is reinterpreted to work with the natural forces versus against them. Households are able to live and practice the knowledge they have developed over the years in times of crisis with drought and famine *(figure 3.87)*.

Waste and water are seen as carrier of nutrients, and can be mediated to reduce the amount of risks to health but also bring an economic means of fertilization and lowered overhead costs for farmers. And finally, the proposal returns to the small-scale and intimate nature of sanitation spaces with new latrines, designed for all users and is carefully located over ponds and wetlands within a larger system that relies on the waste instead of wasting it.



laundry



bath



latrine



figure 3.88
View of orchards, gardens, homes & amenities.
Rendering by author.





figure 3.89
View of ponds, wetlands and livestock.
Rendering by author.





figure 3.90
View of streams with surrounding wetlands and floating produce market.
Rendering by author.




274
e Earth



figure 3.91
New proposed landscape at the scale of multiple linked fields.
Rendering by author.



figure 3.92
Drawing of trench at Vinh Xuyen.
Rendering by author.

Wasted Water takes the existing research on how sanitation's role in Vietnam has affected the livelihood of rural villagers. Concerns are not viewed as a singular issue of a lack of access to proper toilets, but a problem that exists within the province at multiple scales. Managing of waste, and its separation from water systems is crucial at the household scale, but involves a forgotten link between agriculture and nutrient deposition from domestic waste and defecation. Using the theoretical works of Illich's views of modern influences on water and Douglas' beliefs on "soil" simply being "matter out of place", the proposal foregoes the stigma and risk that limits opportunities for positive change. From there, it is built from field research and studies conducted by Dang, Le, Bosma, Reis and Mollinga to support the design through the geographical, environmental and socio economic threads within the existing province.

Countering the National Geographic photo taken at Vinh Xuyen village, and the negative portrayal of local knowledge and the stigma behind a system with enduring potential, this thesis proposes a positive way of looking at the latrine and improving its design to fit the evolving and globalizing context amongst existing changes to the agricultural landscape. The changes in the natural landscape are not seen as obstacles, but opportunities for more changes that allow for the bridging of home and landscape through agro-infrastructural systems to develop new socio-economic conditions for the rural population. The traditional values of the latrine are scaled up and are used as principles for redesigning rural sanitary spaces, households, villages, fields, and surface water systems within the province. Under the framework of structures and systems, nutrient cycling and the spectrum of water, negative implications can become holistic opportunities for local livelihoods and environmental protection. Architecture is a space that links landscapes to domestic and rural life within the field, acting as mediums for processing human interactions with landscape. This allows the bridging of domestic relationships with waste and water for villagers who have depended on the surrounding resources as a provider of their basic needs. The fishpond latrine has been a crucial structure that links households to the nutrient cycles of the landscape as well as providing a means of managing waste.

If sanitation is a term that can be positively applied without detaching users from their local practice, rural agricultural landscapes, infrastructure and livelihoods can be integrated into multiple cycles that leverage opportunities instead of dismissing them. Within the proposal, there is a firm belief that the issue is not with the fishpond latrine itself, but its displacement from the systems around it. To conclude, the latrine is not removed from the system, but wholly integrated within the larger cycles occurring within the region.



figure 3.93
Collection of hanging latrines in An Giang.
Photos by Truong-Tuan-Thanh-Tran, 2018.



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