Advocating for Natural Resources: Empowering the Riverine Communities of the Amazon through Landscape Architecture

by

Thomas Schreiber Costa

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ABSTRACT

Cultural identity in the Amazon region has been destabilized by tensions between tradition and progress. This architectural thesis explores a contested landscape that both balances and revalues nature. The riverine people of the Amazon basin, the so-called *ribeirinhos,* are among the traditional communities living in the rainforest that have rich cultural history but are deprived of the basic benefits of development. Like many Indigenous peoples, they are dependent on local resources that are threatened by socioeconomic models that persistently degrade the land which jeopardize their main sources for food, water, and leisure activities.

The proposed infrastructure and design focuses on agroforestry systems and water cycles, providing opportunities for individuals for a more equitable quality of life. Its main result, a conservation and awareness center in the Amazon delta region, will steward nature and deepen the understanding of the human relationship to natural resources in service of subsistence.

ACKNOWLEDGMENTS

I dedicate this research to both of my parents who have supported me along my academic journey. Their legacy will carry on through their efforts of helping people directly depended on natural resources which have inspired me to follow a similar path thought architecture. Thank you for being respectful to both people and nature.

To all the friends I have made along the way at Dalhousie Faculty of Architecture and Planning, your camaraderie and constructive criticism taught me that architecture is always an open ended collective exercise. Thank you Elisa Dainese, Christine Macy and Ted Cavanagh for your guidance, insight and wisdom in developing this project.

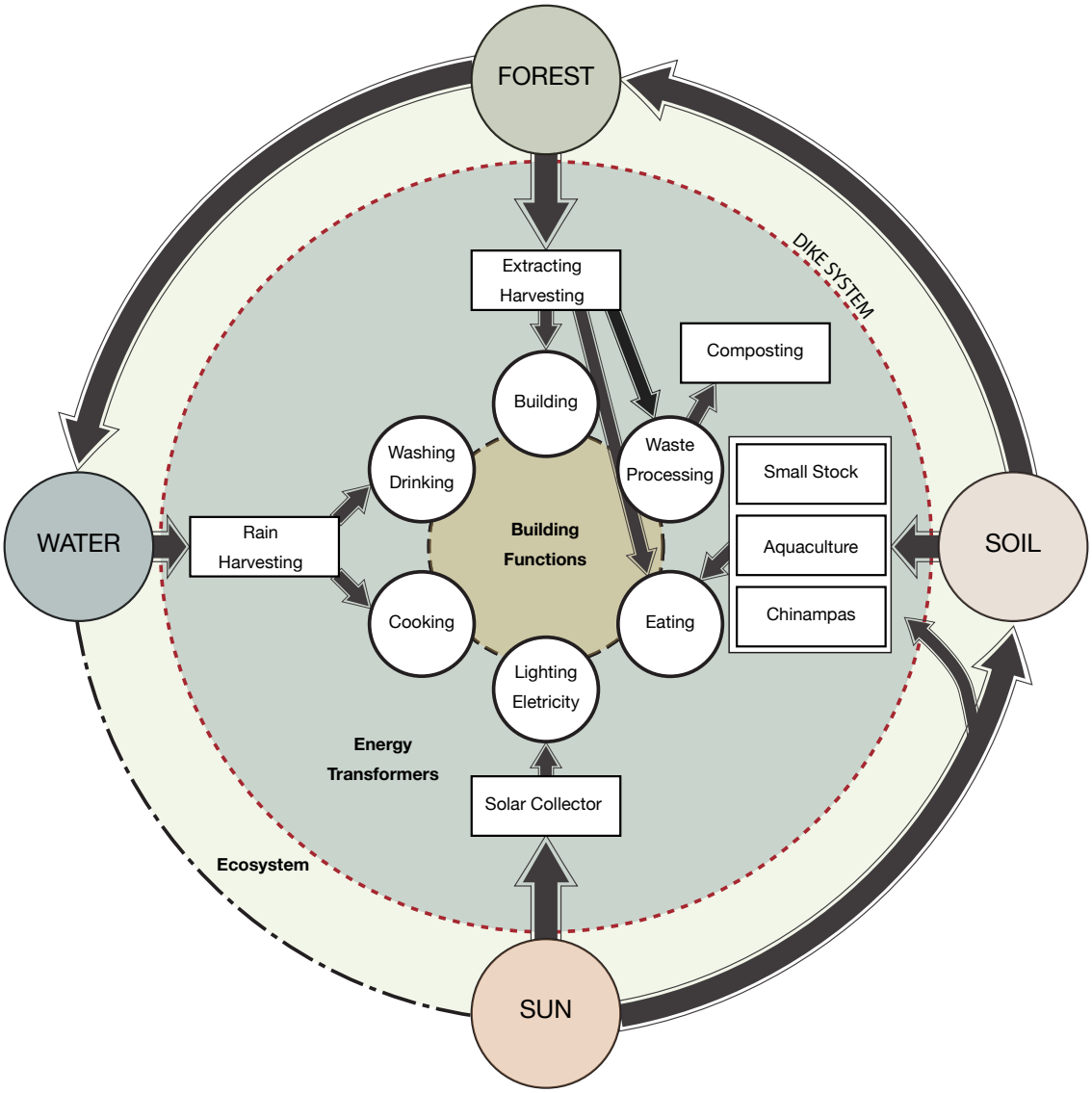
CHAPTER 1: INTRODUCTION

In the Amazon, for millennia Indigenous civilizations have thrived in nature by utilizing sophisticated methods of agroforestry and water cycles to harness the environment (Posey 1985, 140). However, traditional ways of dealing with natural resources have slowly been succeeded by foreign practices of exploitation. In a pattern common to post-colonial globalization, the implementation of large-scale infrastructure, the use of fossil fuels, and industrial methods of food production have jeopardized the interdependent relationship between Indigenous people and their natural environment. The loss of biodiversity in exchange for monetary gain has greatly impacted the many traditional communities whose livelihoods are dependent upon healthy ecosystems. In *Landscape Ecology Principles in Landscape Architecture and Land-use Planning*, Olmsted (1996) states that “it is evident that in our daily lives nature must be thought of not as a luxury to be made available if possible, but as part of our inherent indispensable biological need”(11). Paradoxically, human subsistence has moved away from valuing nature.

Forest dwellers in the Amazon have also been a voice in the battle against climate change, advocating for conservation of natural resources and a line of defense in mitigating biodiversity loss. Their resilience, self-determination as guardians of the forest, and deep understanding of the importance of biosystem preservation can be considered as historical evidence of sustainable resource management. Humans are the catalyst of environmental change, and balancing the social, environmental and economic needs of individuals whose livelihoods depend on a subsistence lifestyle, is critical to guarantee the longevity of the Amazon forest as the nation’s most precious asset.

The riverine communities of the Amazon that are now facing water scarcity in a water-rich environment, are left with questions of how to ensure their access to clean water as a basic human right. This is made more difficult by an increasing disconnect between people and nature, while at the same time, they are facing population growth and increasing demand for natural resources. The compounded effects of modern consumer society, which devalues traditional practices of subsistence and sustainable development, has resulted in rural communities experiencing pressure to secure water. According to *The World Bank* (2019) “increases in human population can impact natural resources and social infrastructure

which therefore can place pressure on a country's sustainability". Industrialized agriculture is particularly impractical for people in remote locations. Its highly mechanized methods often demand skills training, the costly use of fertilizers, and dependency on fossil fuels — all of which negatively impact both people and the environment, and disregard sustainability and local development. Conversely, managing local resources sustainably provides people with the tools for social change and conservation of natural resources.



Flow diagram describing the relationship between landscape design and building design.

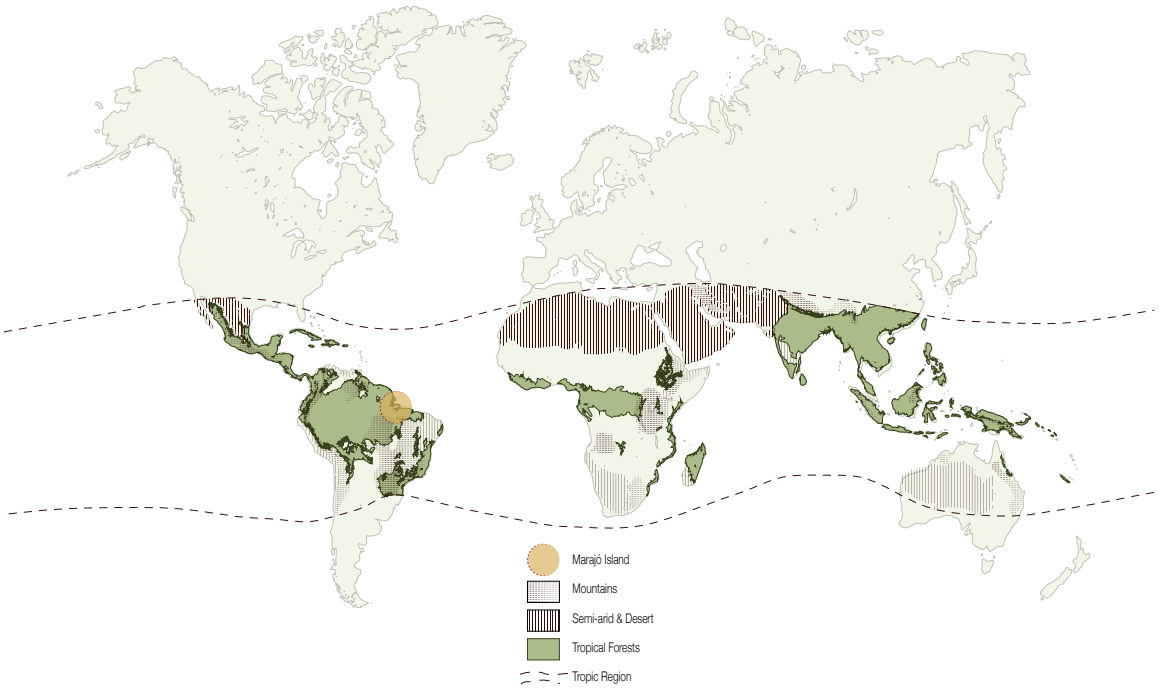
This thesis suggests a hybrid approach to community planning that synthesizes appropriate technologies of landscape architecture and contemporary methods of building in tropical climates to propose a pilot project for subsistence. By addressing the unstable situation of riverine communities through agriculture, community development, and commerce, this new landscape design would support basic human needs — the architecture reinforcing cultural identity, demonstrating respect for the environment, and conceived as a space for traditional knowledge. By applying Aldo Leopold's approach to "land ethic", in which earth should be thought not as a commodity but a community of which humans are an integral part (Guy & Farmer 2001, 143), the program will support the community's needs and dignify the responsibility of society to steward the environment.

The thesis is intended to empower the ribeirinhos' (river dwellers) landscape of aquaculture. By securing water as a natural asset, the architecture of a community building would provide for basic human needs such as cooking, hygiene, and drinking; while the artificial landscape would accommodate food production (agriculture and fish farming), water treatment, and symbiotic co-existence with seasonal flooding. The positive environmental strategy for land-use would support the predominantly fishing and fruit harvesting subsistence culture of the place and uplift river dweller's lifestyle.

CHAPTER 2: THE AMAZON REGION

Context

The Amazon river basin is recognized by scientists and climate change activists as a highly biodiverse home to some of Earth's most precious natural systems. It provides fifteen percent of the world's natural freshwater supply (Collen, Mordt & Torres 2016, 3). It sustains the largest tropical rainforest in the world, which in turn is responsible for important services to the atmosphere in mitigating climate change. Studies carried out by the University of Leeds have shown the importance of mature forests for nations within the Amazon basin. Test results demonstrate that the carbon sequestering capability of this region equals the combined emissions from deforestation and fossil fuels (Phillips & Brienen 2017). However, if on-going deforestation of the world's largest rainforest continues, at the rate of two soccer fields per minute in some regions of Brazil (Imazon 2019), environmental deterioration may reach a point of no return — where restoring it becomes exponentially difficult while severe global consequences are accelerated.



World map describing tropical zone and landscapes types.

The Amazon — with its immense natural wealth of complex ecosystems — should also be thought of as an asset for human development, as it is inhabited by approximately 33 million people (Collen, Mordt & Torres 2016, 9). Most of these people live in urban centers, yet many Indigenous groups maintain a subsistence lifestyle in less-developed areas, relying on small-scale farming, resource harvesting, and fishing. These communities are not benefited by economic models that deplete natural resources and aggravate species extinction; instead, the use of local resources must be aligned to opportunities that will empower them economically and politically. The culture and history of land occupation show us that traditional communities living at the “margins” of society can benefit from harnessing and managing their resources, to obtain dignity and better quality of life.

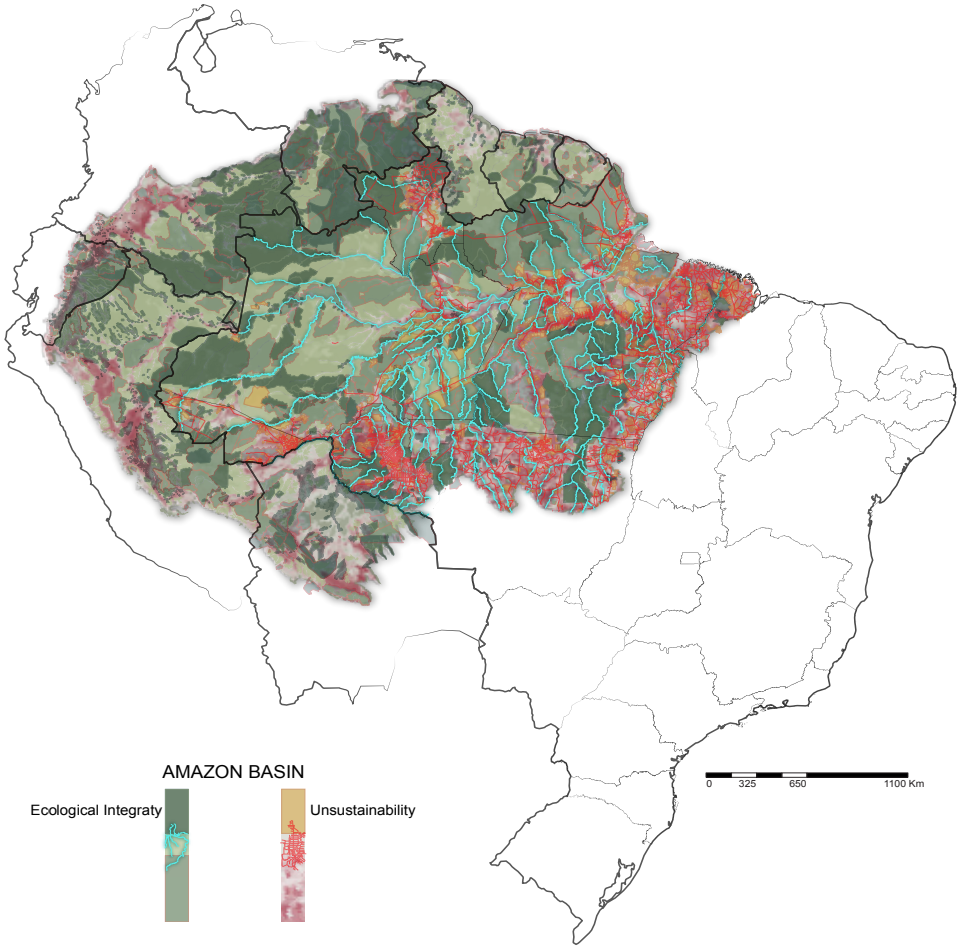

Rural dwelling (photo by Fábio Ramos).


Urban dwelling.

The Amazon river basin is characterized by a high social inequality gap between rural and urban areas that favors the latter. Increases in large-scale extractive projects, which are often important to national gross domestic product (GPD), are rarely accompanied by provisions to geographically isolated rural settlements. Indeed, the benefits — such as access to proper education, jobs, health care institutions and infrastructure systems that should support the livelihoods of these remote communities (Collen, Mordt & Torres 2016, 7) — are controlled by private corporations and reinvested in agro-business. Social inequality is also partly related to the contested landscape of the forest, which is difficult to access by land but well connected through waterways. Streets become rivers, wheels are substituted by propellers or paddle canoes, and flooding is a phenomenon that people have grown accustomed to, especially during the winter season of heavy rain. All the daily routines of live, work and play in the region are deeply influenced by water — a resource that has been a determining factor in human development and one which most likely will become a symbol of status in the future, if not preserved and managed correctly.

> Forests are our strongest allies in securing the freshwater resources life depends on. It is common knowledge that tree roots suck water from the soil to survive. But what is less known is the “rainmaker” role trees play. (UNDP 2019, www.undp.org)

Tropical forests do much more than retain and release water, they are multi-layered structures that also prevent erosion of rivers, retain nutrients on soil, dissipate strong wind currents, support wildlife habitat, help mitigate climate change and are most likely the most powerful living machine on Earth. Given the abundance of water and vast biodiversity in the Amazon region, there is a need for infrastructure and facilities to sustainably manage resources and help stop deforestation. This pilot project has the potential to be a symbol of conservational awareness while providing jobs tailored to community needs in support of aquatic and forest resources.

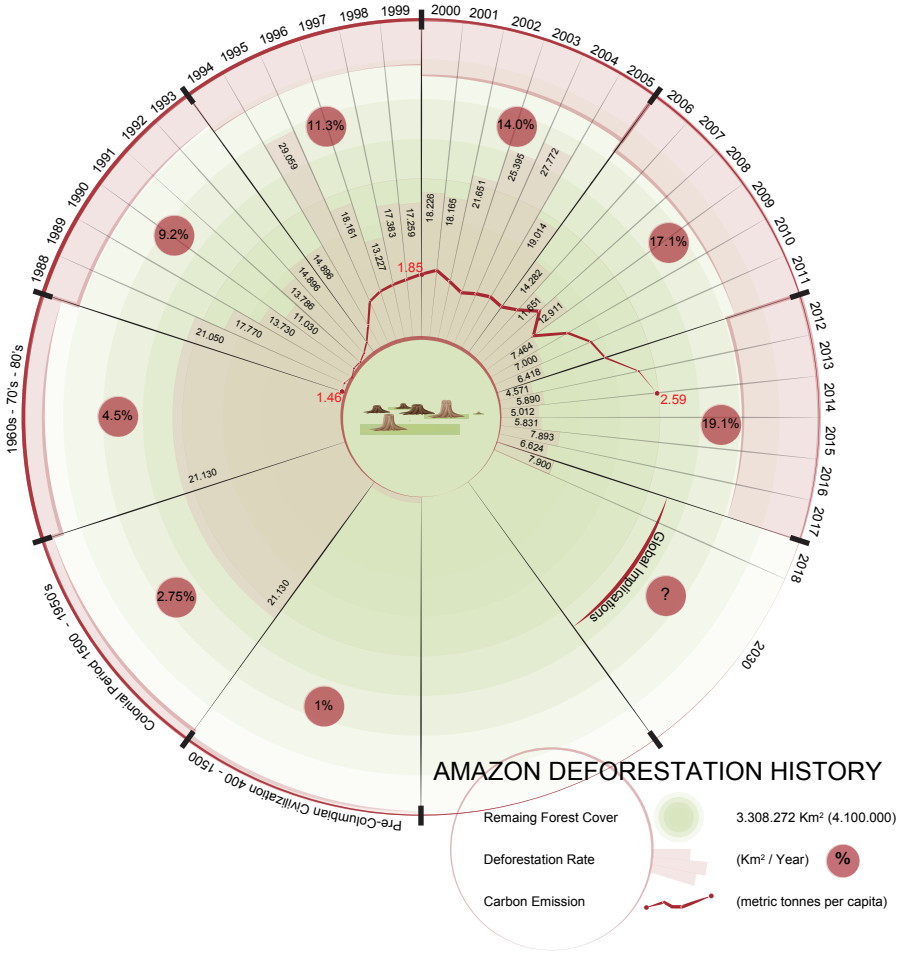


Amazon regional map.

The previous map shows the extent of the Amazon region. Covering seven countries, most of its territory (80%) is within Brazil's boundaries. The warm colors on the map indicate areas of urbanization, agriculture, mining and other resource-extracting land uses in the Amazon since the 1960s. The green patches indicate Indigenous reserves, mosaics of intact forests, and more sustainable uses of conservation lands, currently being threatened by present-day economic model in Brazil.

Settlements in the Amazon and Deforestation

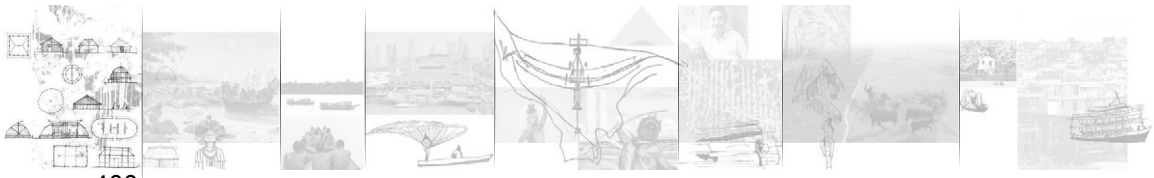
Land appropriation in the Amazon region is directly related to deforestation. At the same time, the average rate in which Brazil's Amazonian rainforest has been cleared is proportionate to the displacement of people to rural communities seeking better life opportunities. In the last 50 years, nearly a fifth of the rainforest has been clear-cut, and according to the United Nation “the most common drivers of deforestation are derived from economic growth, facilitated by road expansions, migration and resulting in land-use change, often from livestock and agriculture production”(Collen, Mordt & Torres 2016, 5). The late 1960s



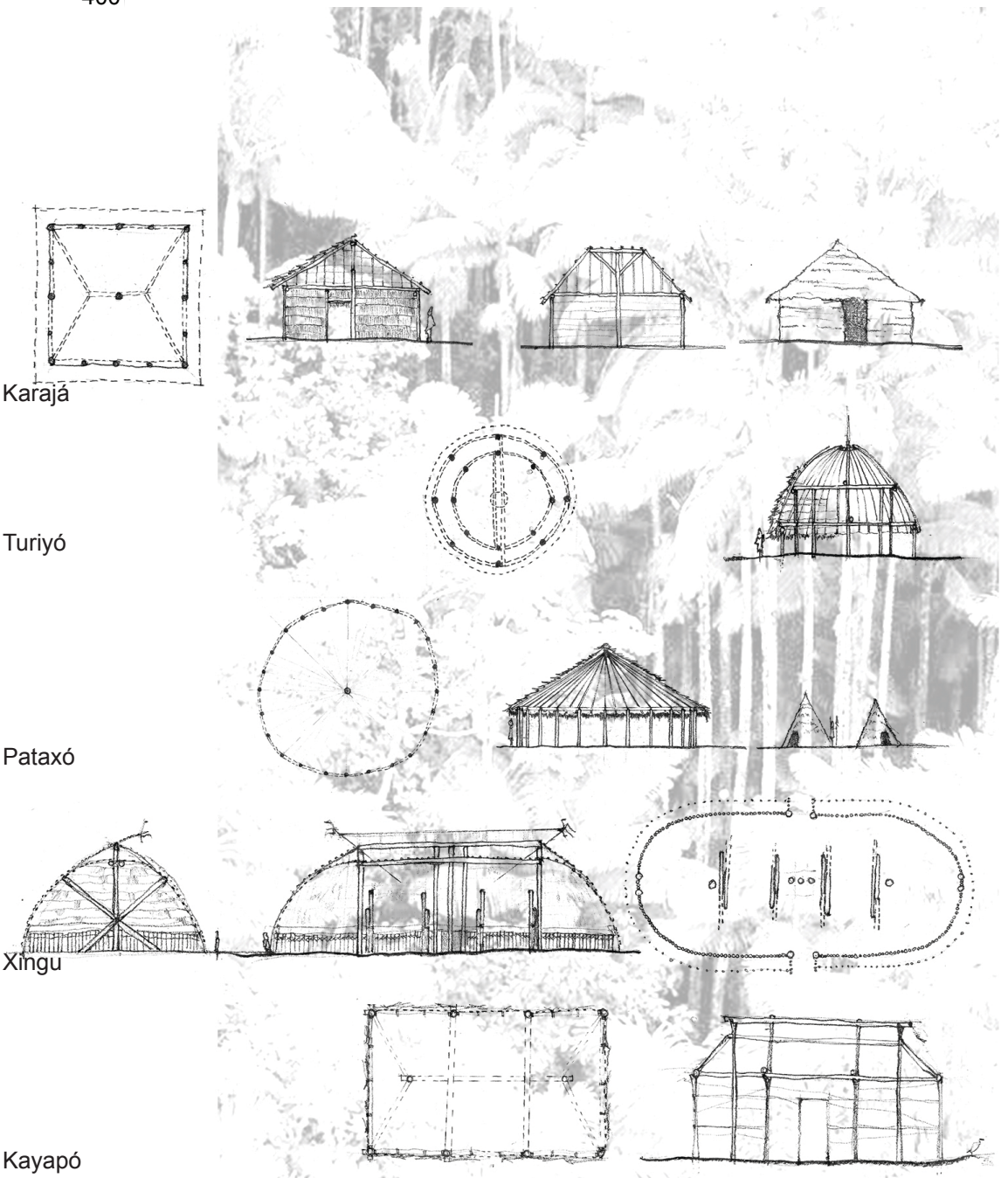
marked the “modern” era of deforestation with the development of major transportation infrastructures and the goal of integrating the Amazon into the national economy (Fearnside 2005, 680). Yet its vast size (7.8 million Km^2) also makes it difficult to monitor, for example, satellites have only been used to track deforestation since the late 1980s. A recent analysis of tropical forests by UNESCO researchers attributes the continuing deforestation to unsustainable land-use strategies concerning agriculture and infrastructure development that prioritizes economic growth (Sanz 2018, 26).

At this same period (1960s-1980s), the military government set in place a mass-media campaign advertising “people without land to land without people” (May, Gebara, Barcellos, Rizek & Millikan 2016, 9). This was a geopolitical strategy to boost the national economy and establish sovereignty over land during the tensions of the cold war, but it lacked technical support for human development. Specifically, it ignored the rights of pre-existing settlements, of Indigenous peoples and traditional communities, who lived in harmony with nature through sustainable practices. As urbanized working-class populations moved into rural regions and global demand for foreign natural resources increased, Amazonian deforestation escalated, made even worse by illegal activities, which facilitated land degradation. Over the course of 30 years, around 425,000 families were forced to settle through agrarian reform initiatives, the majority in forest regions that continue to burden the environment (Amazônia S/A 2015, Ep 3).

Indigenous peoples, who now represent only a fraction of Amazonian populations, are known for their sophisticated methods of agroforestry systems. By managing the forest structure, they facilitated the production of food, and animals to hunt, they harvest medicinal plants, and sourced materials from fallen trees to build shelters. “Indigenous knowledge is extremely important in developing new strategies for forest conservation while improving the productiveness of ecological zones” (Posey 1985, 139). For thousands of years, they have lived in harmony with nature with minimal impact on the environment. But since the settlement of the New World by the Europeans, nature has been viewed as an endless resource to be mined, exploited and dominated. One example of this in Brazil is the indiscriminate use of fire for agriculture expansion, with and eye to economic control rather than community well-being, resilience and long-term sustainability.



400



Karajá

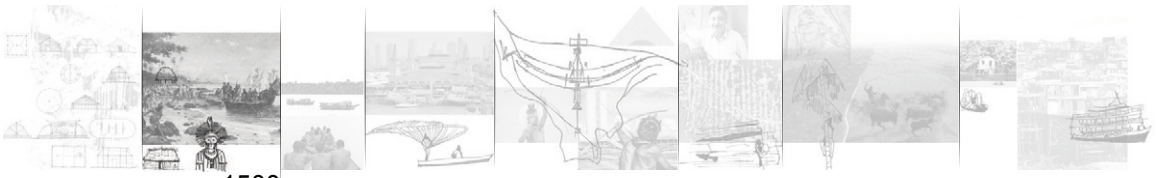
Turiyó

Pataxó

Xingu

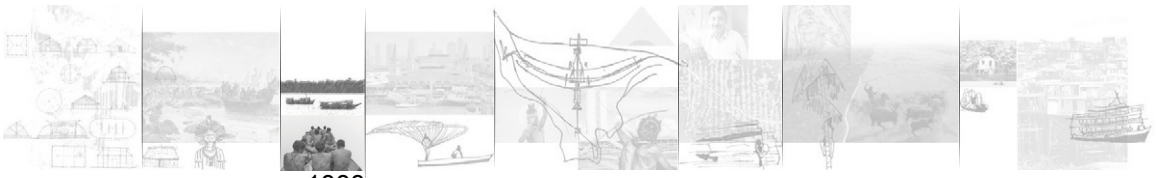
Kayapó

Deforestation chronology collage - 400: Indigenous architecture typologies sketches.

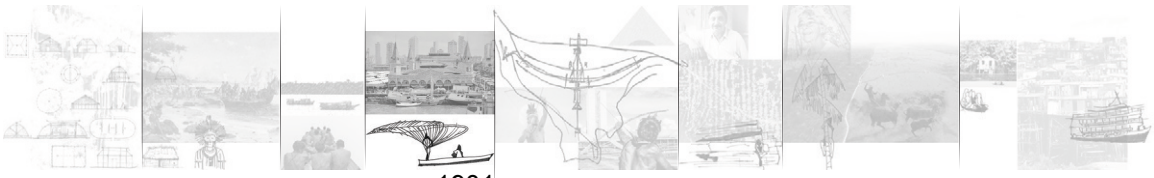


1500

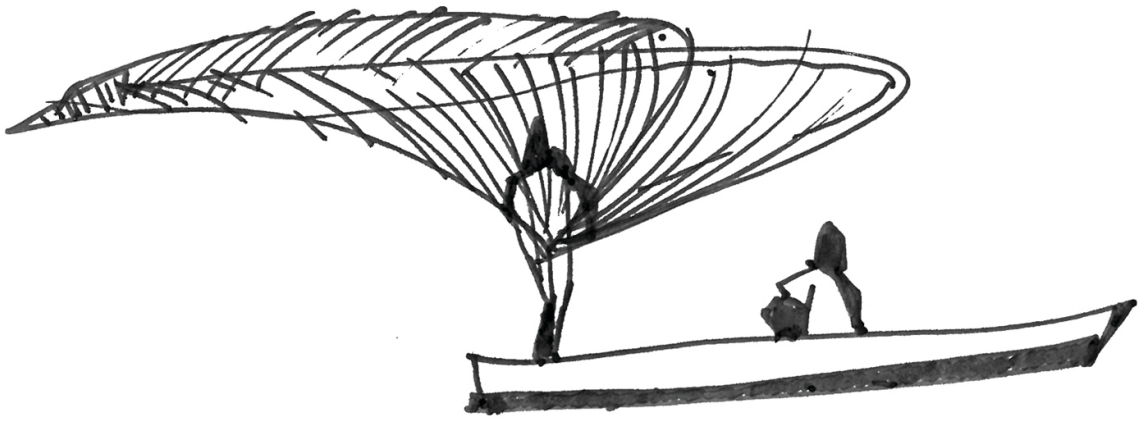
Deforestation chronology collage - 1500: 'Arrival of Pedro Álvares Cabral in Porto Seguro in 1500’ (Painting by Oscar Pereira da Silva, 1865-1939).



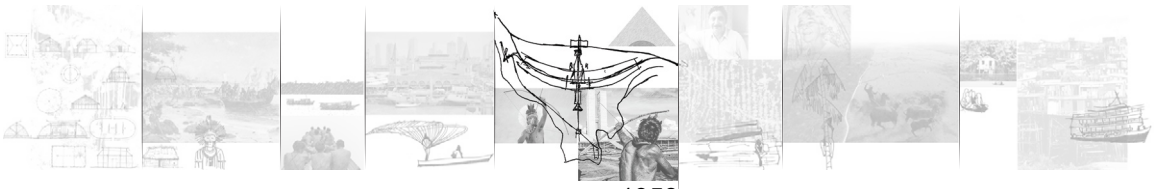
Deforestation chronology collage - 1888: Munduruku Indian Warriors (photo by Lunae Parracho).



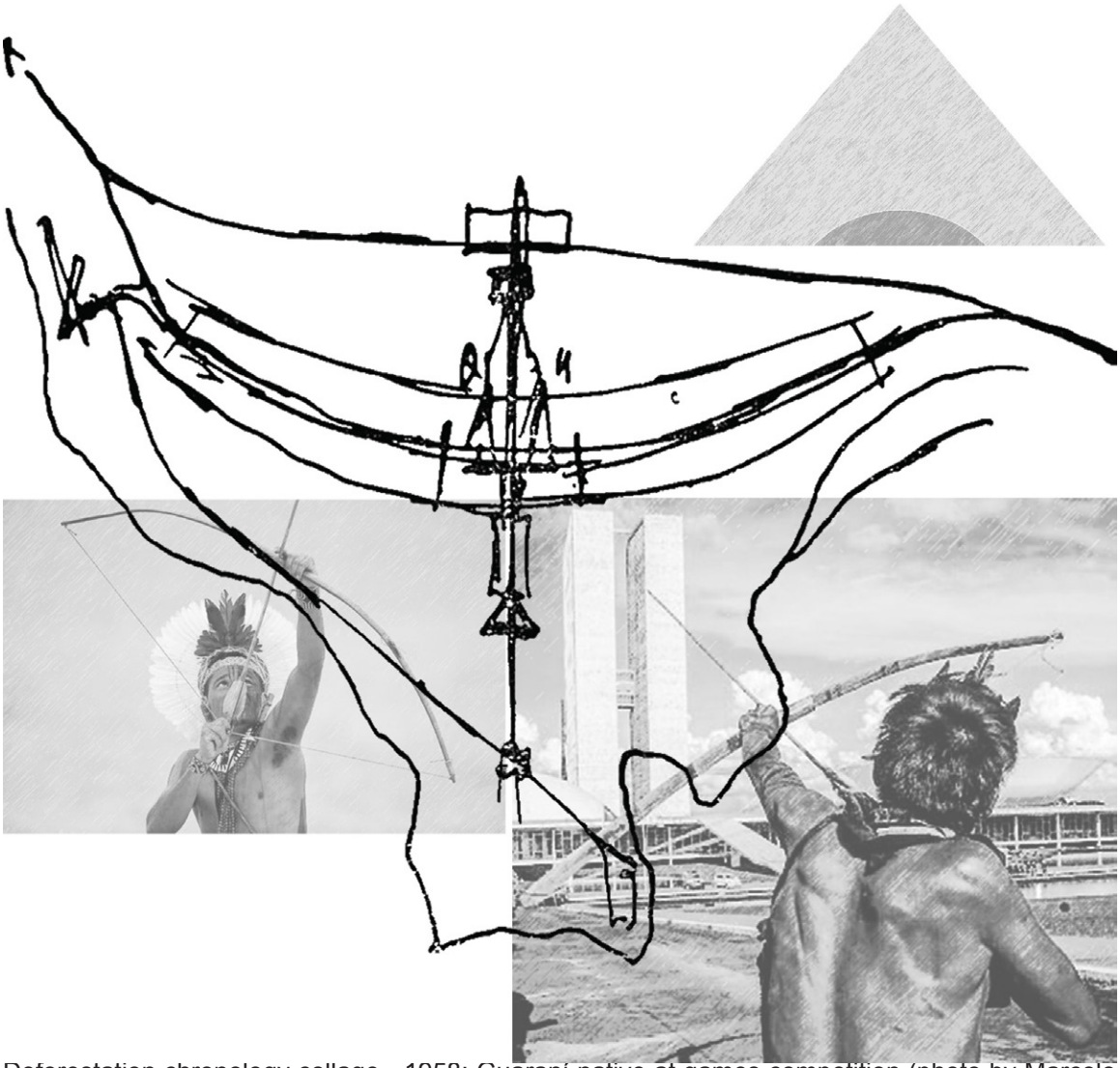
1901



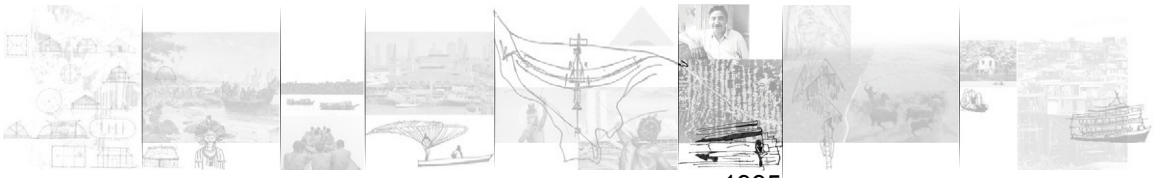
Deforestation chronology collage - 1901: Ver-o-peso fish market (photo by Carlos Macapuna) in the city of Belém becomes the first taxation checkpoint for products leaving the Amazon forest.



1958

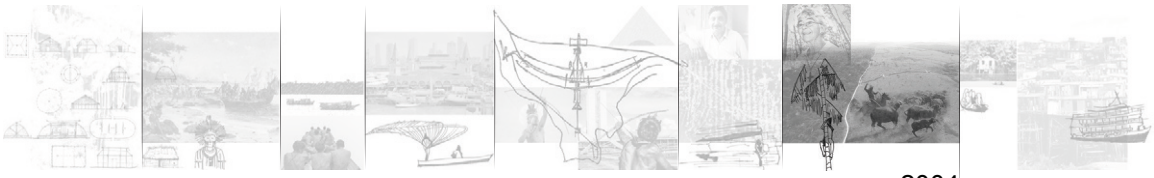


Deforestation chronology collage - 1958: Guaraní native at games competition (photo by Marcelo Camargo, 2017); Indigenous at congress palace in Brasília (photo by André Coelho); Master plan 'croquis' (sketch) of Brasília by Lúcio Costa.

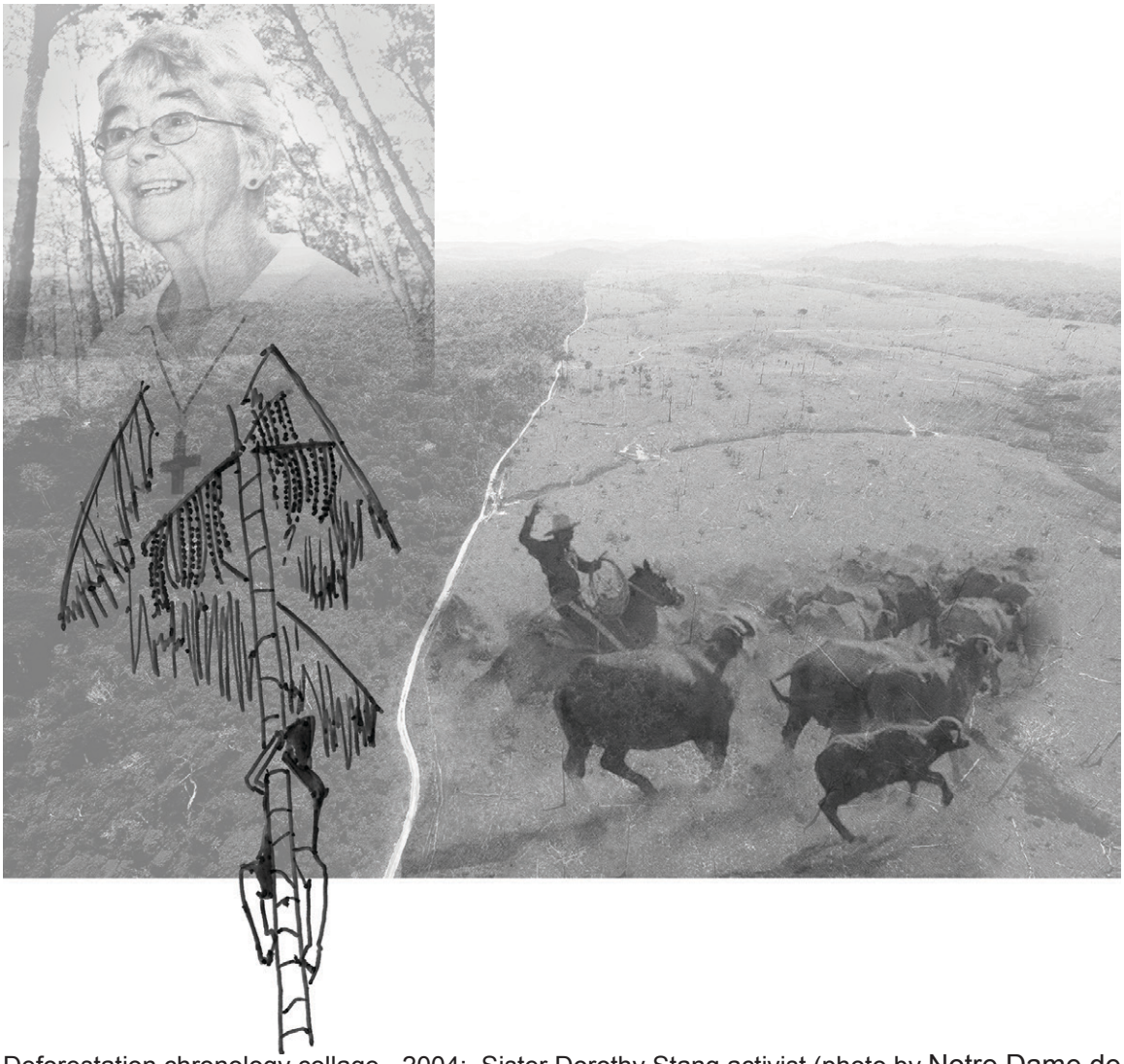


1995

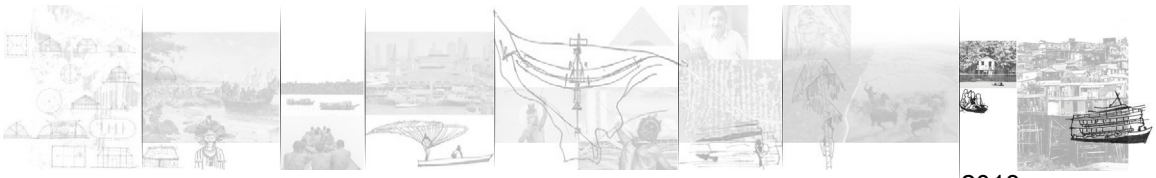
Deforestation chronology collage - 1995: Chico Mendes activist (photo by Denise Zmekhol); Patterns of deforestation along highway BR 230 in estate of Pará (Google Image 2019).

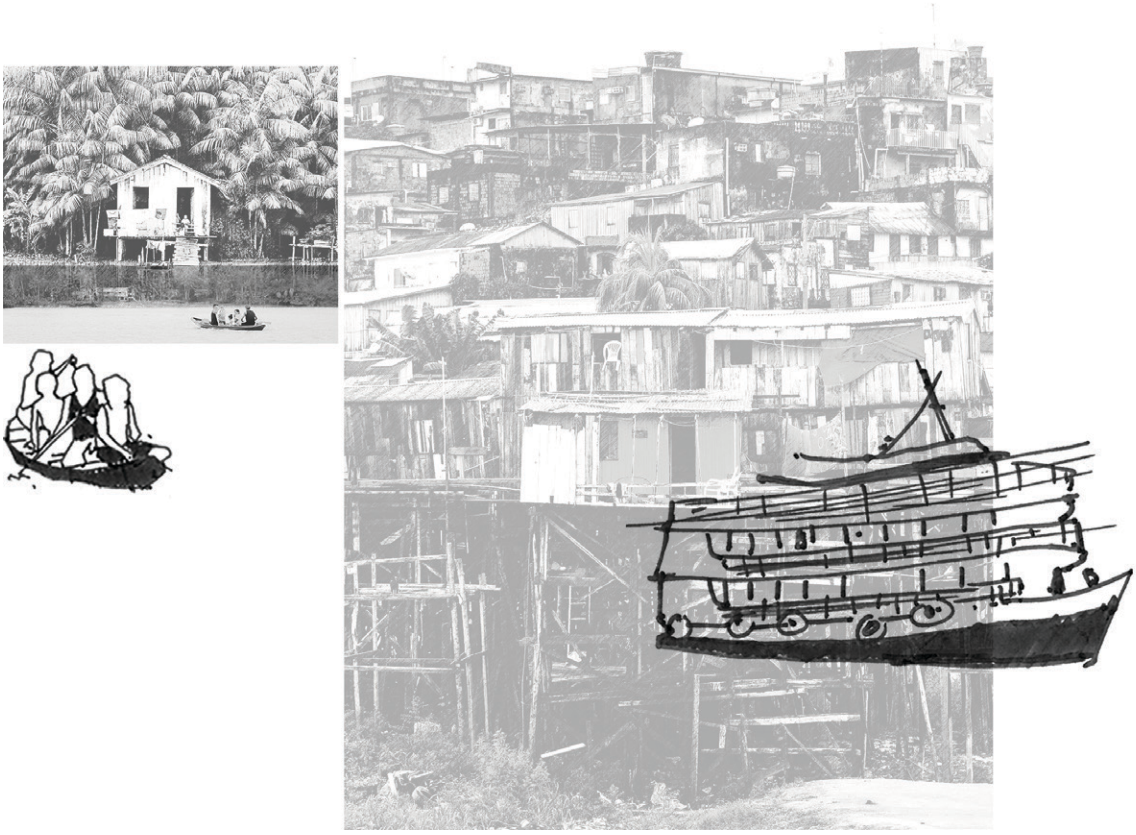


2004



Deforestation chronology collage - 2004: Sister Dorothy Stang activist (photo by Notre Dame de Namur University); Deforestation area in Brazil's northern state of Pará (Photo by André Penner).

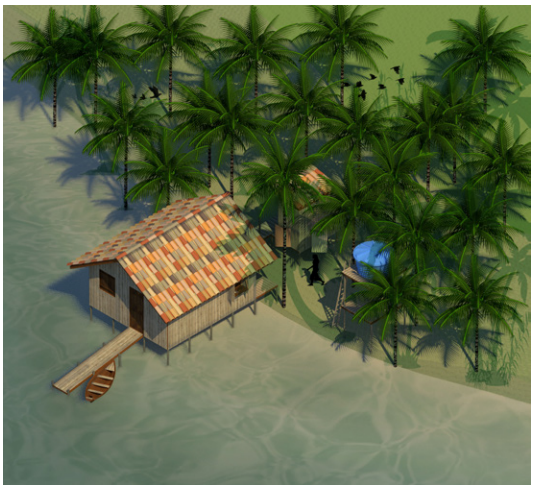




Deforestation chronology collage - 2018: Ribeirinho dwelling along Furo dos Macacos (Photo by Estadão); ‘Nature of Disaster’ Manaus settlements (Photo by Folha de S. Paulo).

Remote communities of the Amazon have strong ties to water (river) and land (forest). Dwellings within the basin region are typically built on stilts to protect users of the space from rising waters and infestation of terrestrial animals. Structures can be permanent or temporary, like in the case of the *Turiyo* Indigenous people, who live a nomadic lifestyle (Grupioni 2018). In most cases, they are constructed using rudimentary materials that are locally harvested and constructed with techniques that are pass down from generations. Settlements tend to be located in major river junctions and individual dwellings near water for ease of connectivity.

The current situation suggests that if the forest is to thrive and continue nourishing communities — especially settlements living a subsistence lifestyle — sustainable alternatives of interacting with nature must be implemented. A successful example of such intervention has been implemented by the *Mamirauá Institute for Sustainable Development* in the region of mid-Solimões river located between two national reserves along the Amazon river. Mamirauá Institute has pioneered an economic model, which prioritizes the preservation of the environment to guarantee a healthy ecosystem for future generations. Within the sustainable development reserve of Mamirauá, the locals collaboratively manage, harvest, process, buy, sell, and have successfully improved the stock of *Pirarucu*, the largest freshwater fish in the world. Deborah Lima explains how “the ideology of the free market treats the economy as if it were not embedded in social and environmental matrixes”(801). Here, the forest dwellers limit themselves to size, and amount of fish that could be harvested each year, to provide a better yield of Pirarucu fish and ultimately increase aquatic



The environment and the Amazonian house; Pirarucu fisherman (photo by Ricardo Oliveira)

life. The result was that ribeirinho*s* felt empowered to take ownership of conservation land to improve their quality of life while contributing to the environment. Therefore, economic models that are associated with the management of natural resources need to consider: sensitive ecological constraints, community engagement, and traditional knowledge to ensure a better relationship between forest dwellers and the natural world in support of their livelihoods and the environment. As per article 225 of the *Federal Republican Constitution of Brazil* of 1988:

> Everyone has the right to an ecologically balanced environment, to the common use of the public as essential to a healthy quality of life. To ensure the effectiveness of this right, it is the responsibility of the Estate...to control the production, marketing and use of techniques, methods and substances that may endanger life, quality of life and the environment [and] promote environmental education at all levels of education and public awareness for the preservation of the environment. (Trombka 1988, 131)

Every region of the Amazon rainforest is plentiful and unique in biodiversity, so by regarding rural communities as assets for economic development, and traditional knowledge as a driving force for sustainable land use, then architecture can benefit both people and nature. Relearning to adapt to the environment by preserving natural and cultural diversity will provide long-term benefits for this unique region aligned with the spirit of the constitution for the preservation of the Amazon. Since inhabitation of tropical forests was an agrarian reform initiative, its essential that local and indigenous peoples' perspectives be incorporated into the livelihood framework in the future — to provide food security, potable water and improve the overall quality of life of individuals and households.

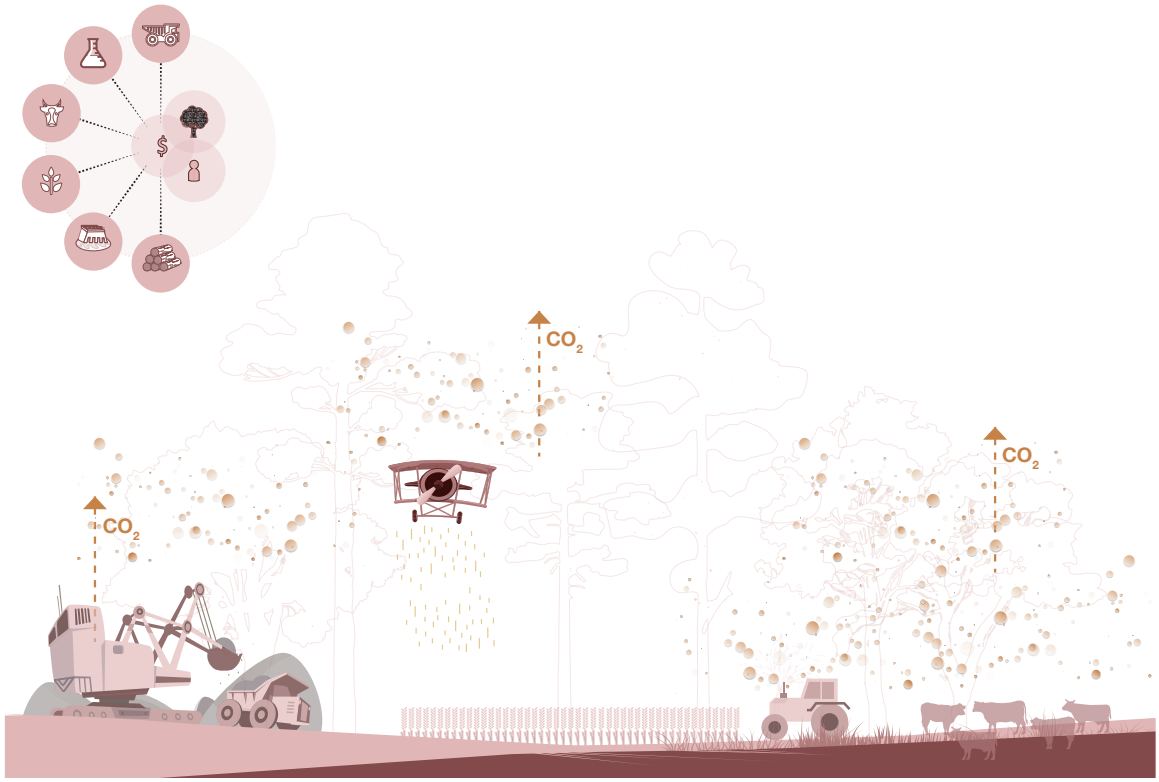
CHAPTER 3: ENVIRONMENTAL RESPONSE

Rainforest, Architecture & Climate Change

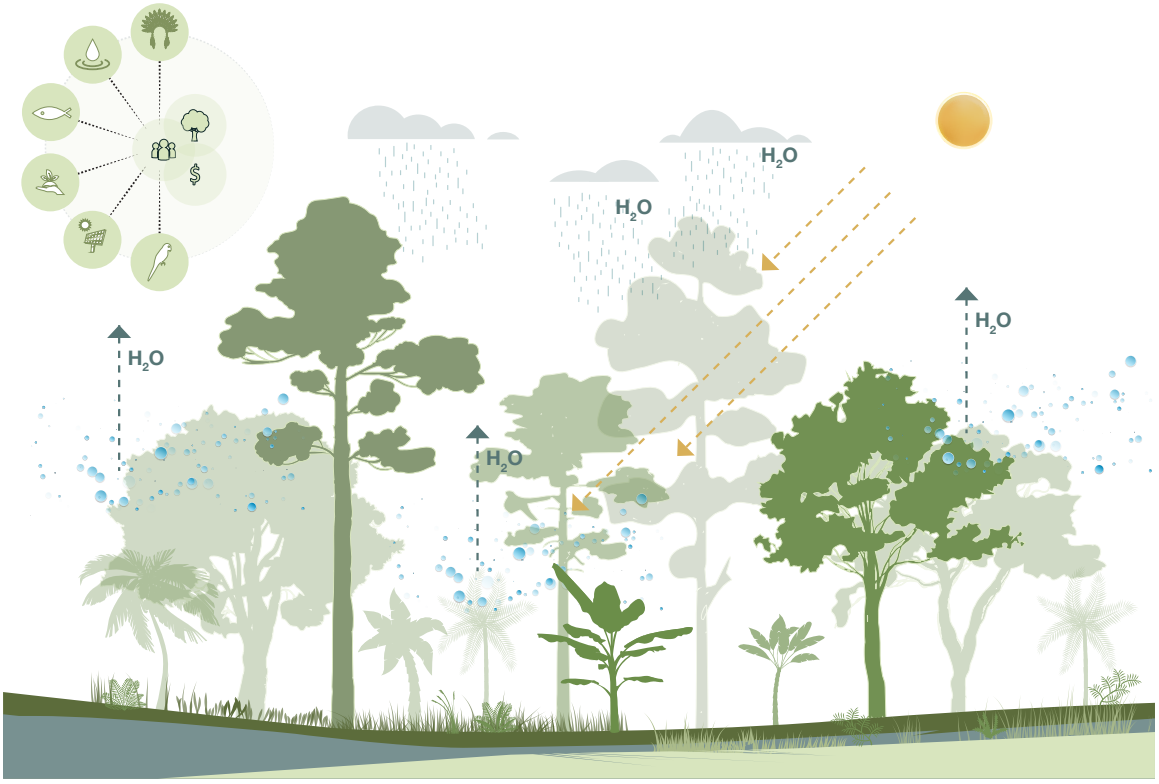
The natural state of the rainforest consists of several layers of complex systems that are indispensable to a subsistence lifestyle. These include the efficient capability of mature trees to sequester carbon; emergent canopies to protect from strong wind and hurricanes; the provision of natural wildlife; plants that can cure diseases; the recycling of organic matter through decomposition on the forest floor; and the supply of fresh water and food (Hays 2018). Nowadays, the destruction of the forest canopy to provide for unsustainable land-uses is motivated by economic growth and the interconnectedness of political and business interests in the Amazon.

As the Amazon's remaining ecosystems become fragmented and people are displaced as a result of biodiversity loss and land degradation, alternative land-uses could, in fact, guarantee the sovereignty of traditional communities. By reinterpreting local and natural assets for sustainable development, community design could reconcile the basic needs of riverine communities with environmental conservation and stewardship. Such a grassroots approach to ecological integrity would stabilize the relationship between people and natural systems. According to the recent Living Planet Report: “Despite numerous international scientific studies and policy agreements confirming that the conservation and sustainable use of biological diversity is a global priority, worldwide trends in biodiversity continue to decline” (Grooten 2018, 25).

The sustainable development goals set out by the United Nations Development Program is the best practical guide available to face the on-going challenges in the Amazon. It includes the value of Indigenous knowledge for the future development of both degraded and intact forest mosaics and the promotion of water integrity in service of aquatic life, which can improve the income of fishery families (Collen, Mordt & Torres 2016, 6). The equatorial region can also produce steady clean energy from solar output. Organic farming, using decentralized wastewater treatment and processing of forest waste could help reverse land degradation. A sustainable framework would lessen the dependency on state resources and improve the sovereignty over reserves (that are being degraded) by including the local population in the decision-making process about land-use strategies.



Current unsustainable model diagram / Environmental impact.



Sustainable model diagram / Natural forest structure.

Designing in the Tropical Environment

Building design can promote environmental awareness of conservation. The Utinga State Park is a recently opened public space that has become a symbol of biological diversity in the metropolitan city of Belém. Since its opening, the facility has been a popular gathering space for people to enjoy nature's exuberance. Its located in one of the few remaining patches of ecologically preserved lands in the peninsula, between the city's primary water supply and a sprawling low-income neighborhood. In this case, the architecture serves as a threshold between the urban fabric and nature, connecting the scenic fauna and flora trails to the park's main access. Primarily used for sports such as running, biking, rollerblading, and meditative exercises, it also advocates for ecotourism and environmental education programs related to catchment, treatment, and distribution of water. The park-goer's experience is enhanced by the architecture while the landscape infrastructure underscores the natural environment as an integral part of the design. The result is a pleasant microclimate within the city, a public amenity with better air and one which highlights the importance of conservation.

Utinga State Park Community Center (photo by Igor Brandão)

Community Center skylight detail (photo by André Lacerda); Hikers (photo by Erika Nunes)

Building typologies and the architectural discourse in the tropics have been highly influenced by colonization. Europeans building in the tropics imported an architecture that worked well in temperate climates — with heavy walls and closely packed buildings that reduced heat loss in the winter, but they did not look at Amazon's vernacular architecture nor did they understand the high humidity, heavy rainfalls and need for cross ventilation that is essential in the tropics for human comfort. This pattern can be seen in cities across the tropical regions of Brazil — popular homes are densely conglomerated, requiring air conditioners to regulate indoor temperatures. Architects must consider the vernacular and culture of a place when designing for people, as they must consider the collective good when designing infrastructure.

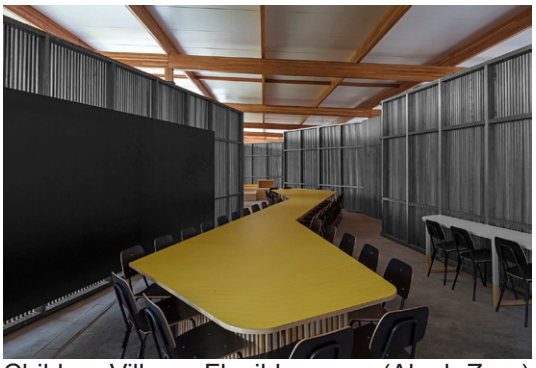
The following case study describes an example of contemporary architecture that considers both the culture and tropical considerations of placemaking. It received the 2018 RIBA International Prize award and is described by the architect as being a reinvention of the Brazilian vernacular.

Case Study: Children Village by Rosenbaum + Aleph Zero

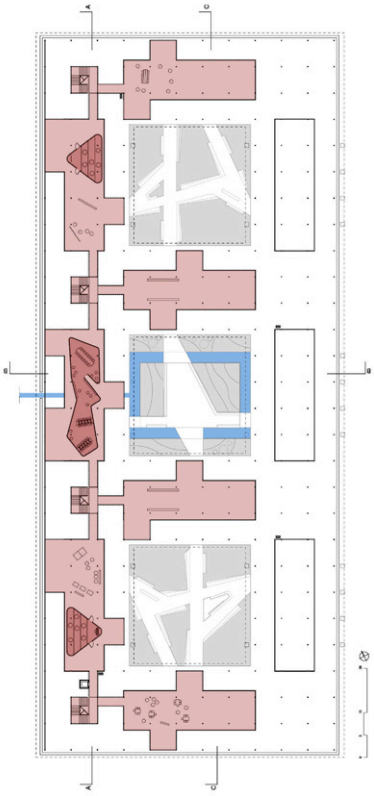
The Children Village designed by Gustavo Utrabo and Pedro Duschenes is located on an Amazon tributary river in Tocantins, just south of the delta. It is an example of contemporary architecture that uses a tropical vernacular. Courtyards and native plants help regulate the heat and air humidity of surrounding blocks, expansive roofs with long overhangs provide shade and shelter from intense rainfalls, while also serving as the building's main feature, creating a perimeter veranda framing views to both interior and exterior landscape. A substructure of stilts — made of locally-sourced glued laminated eucalyptus wood — allows for natural cross ventilation under the floors.

The two structures located at the edge of the community integrate the natural environment with adjacent settlement and farmlands. Conceived as a boarding school for boys and girls who reside in separate terms, the ground floor nestles small-scale dormitories between veranda-lined courtyards for uninterrupted natural ventilation. The upper levels support flexible spaces for community events, education activities, and children's play.

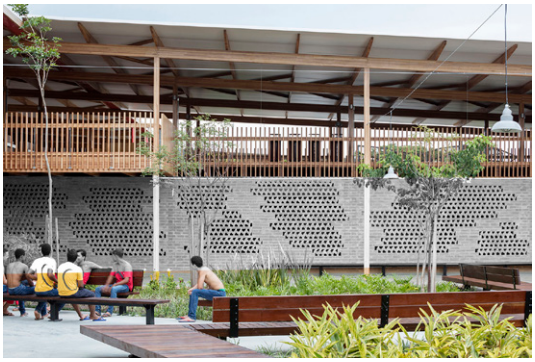
Children Village: Interior and exterior.(Aleph Zero)



Children Village: Flexible space.(Aleph Zero)



Children Village: Floor plan.(Aleph Zero)



Children Village: Courtyard.(Aleph Zero)

Children Village: Overview.(Aleph Zero)

Children Village: Modularity.(Aleph Zero)

Children Village: Site plan.(Aleph Zero)

Indigenous Methods of Subsistence

These examples integrate an understanding of the environment and indigenous principles of subsistence with agriculture and social organization. Darrell Posey, a scholar who studied the *Kayapó* Indigenous people of the Amazon for many years, describes the Kayapó's use of ecological zones in their "forest islands". In these, the Kayapó cultivate a variety of plants to create a comfortable microclimate for humans, provide food resources, repel pests and increase biological diversity (141).

The Kayapó's forest islands use organic waste from the forest as a natural fertilizer, minimizing erosion from heavy rains and land degradation. Posey finds that, by closely observing natural forest ecosystems, the Kayapó natives were able to create "forest islands" from scratch (144).

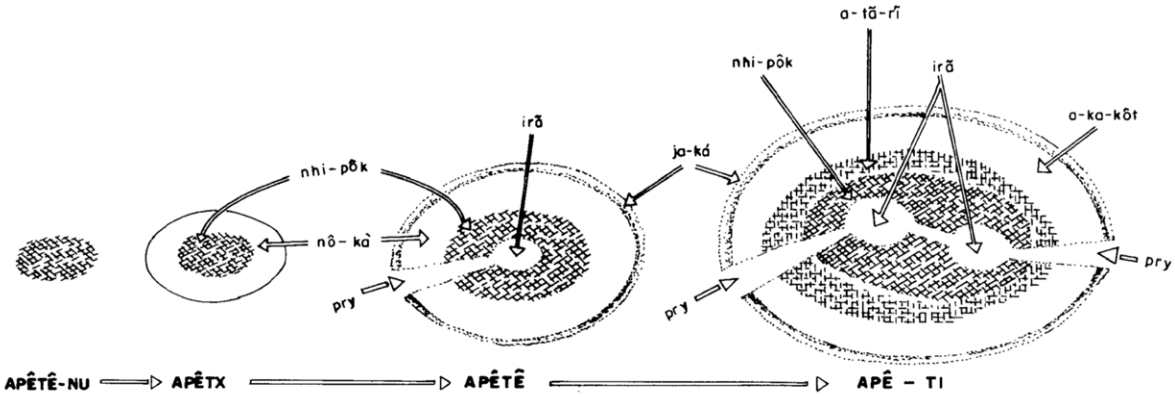
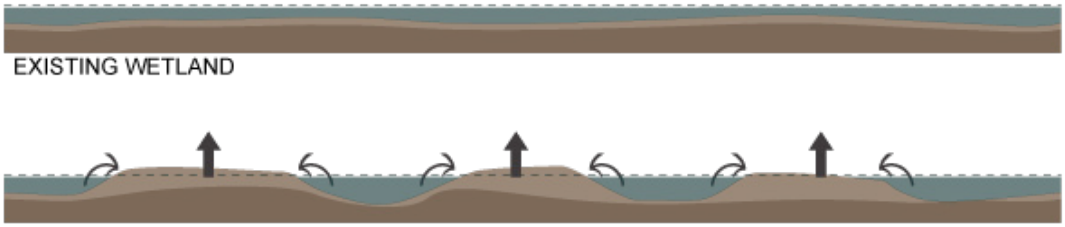


Figure 1. Apêtê formation: planting zones.

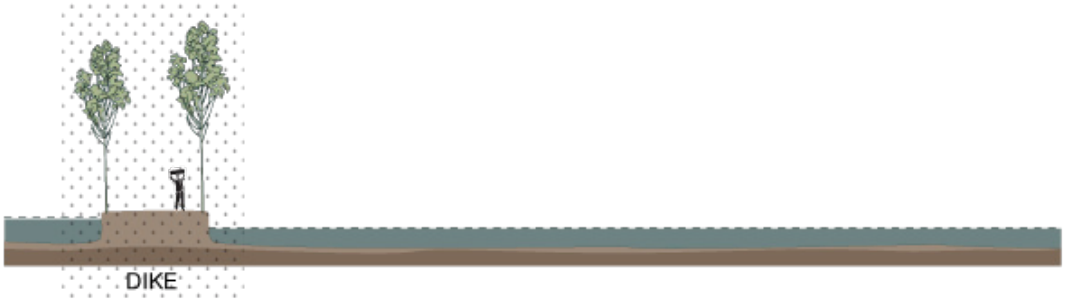
Ecological zones diagram of the Kayapó Indigenous (Posey 1985, 153).

Constructed Wetlands: Chinampas

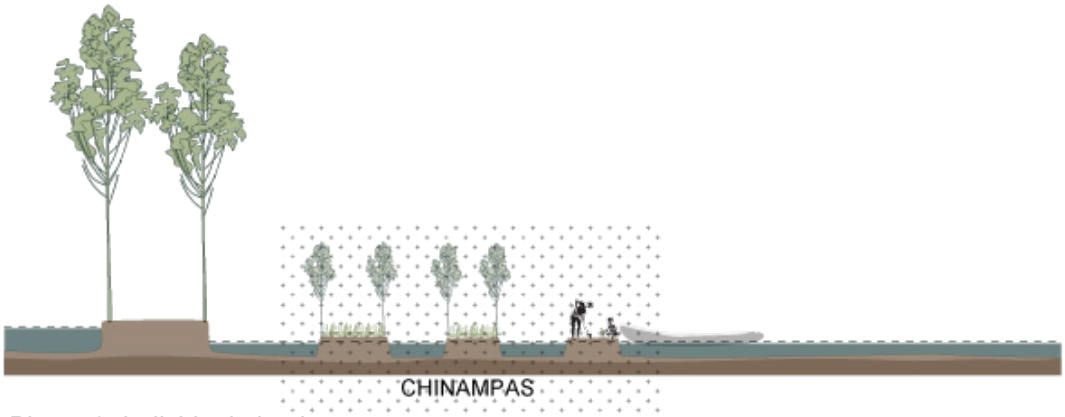
The Aztecs (1300-1500 CE) were another Amerindian culture that created a landscape ecosystem from scratch. Founding their society in the centre of Lake Tenochtitlan, their ability to grow food and expand would have been limited without the development of the chinampas, or "floating gardens". These too, much like the Kayapó natives of the Amazon, involved manipulation of forest structures. The Aztecs drove wooden takes into the shallow lake, and then wove reeds between the stakes to form basket-like enclosures. These were filled with earth and organic matter to create planting beds. This decentralized system grew, bed by bed until expansive artificial islands were created.



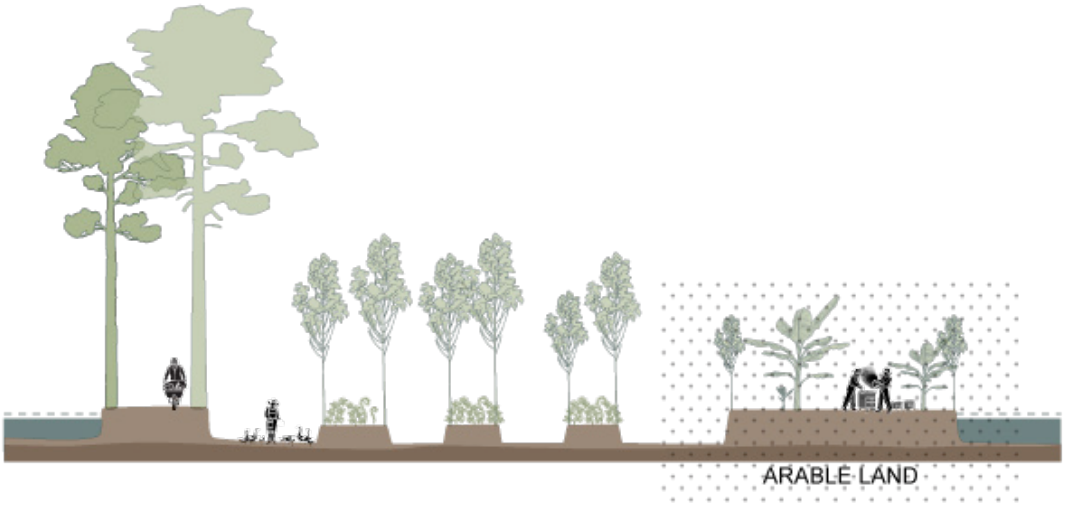
Phase 1: Land built-up



Phase 2: Circulation



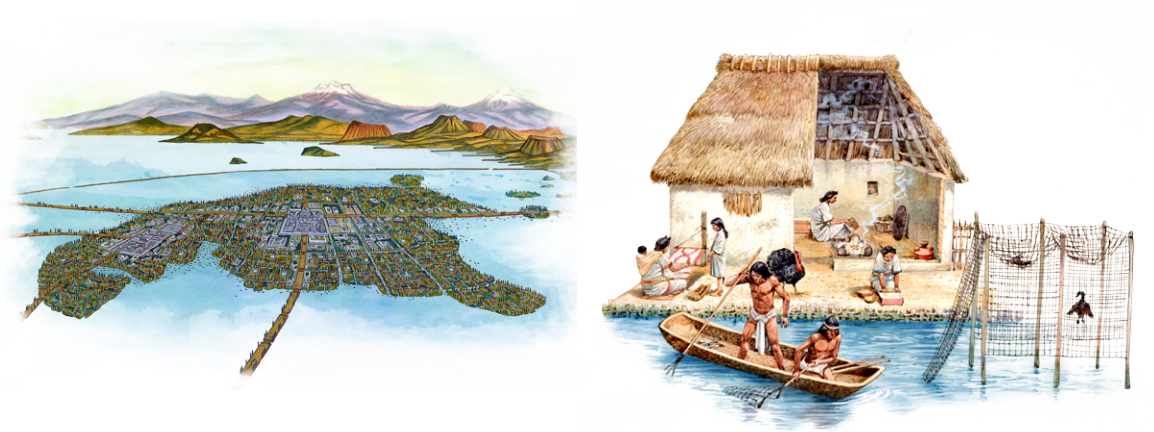
Phase 3: Individual planting zones.



Phase 3: Willows and "forest islands"

The lack of water infrastructure is one of the biggest challenges faced by riverine communities. This leads to the proliferation of infectious diseases that cause high infant mortality rates, low yield of aquatic resources, and ultimately a poor quality of life. The United Nations Development Program has identified that “80 percent of wastewater from human activities is discharged into waterways without any pollution removal.”(www.undp.org). Water, as fundamental necessity, should be considered a human right. Ancient civilizations thrived by recognizing the importance of properly managing water. Constructed wetlands can contribute to habitat preservation, pollution mitigation, and wastewater treatment with fairly limited resources. Landscape can be designed to reduce erosion and direct the flow of water, while also providing for agriculture and aquaculture.

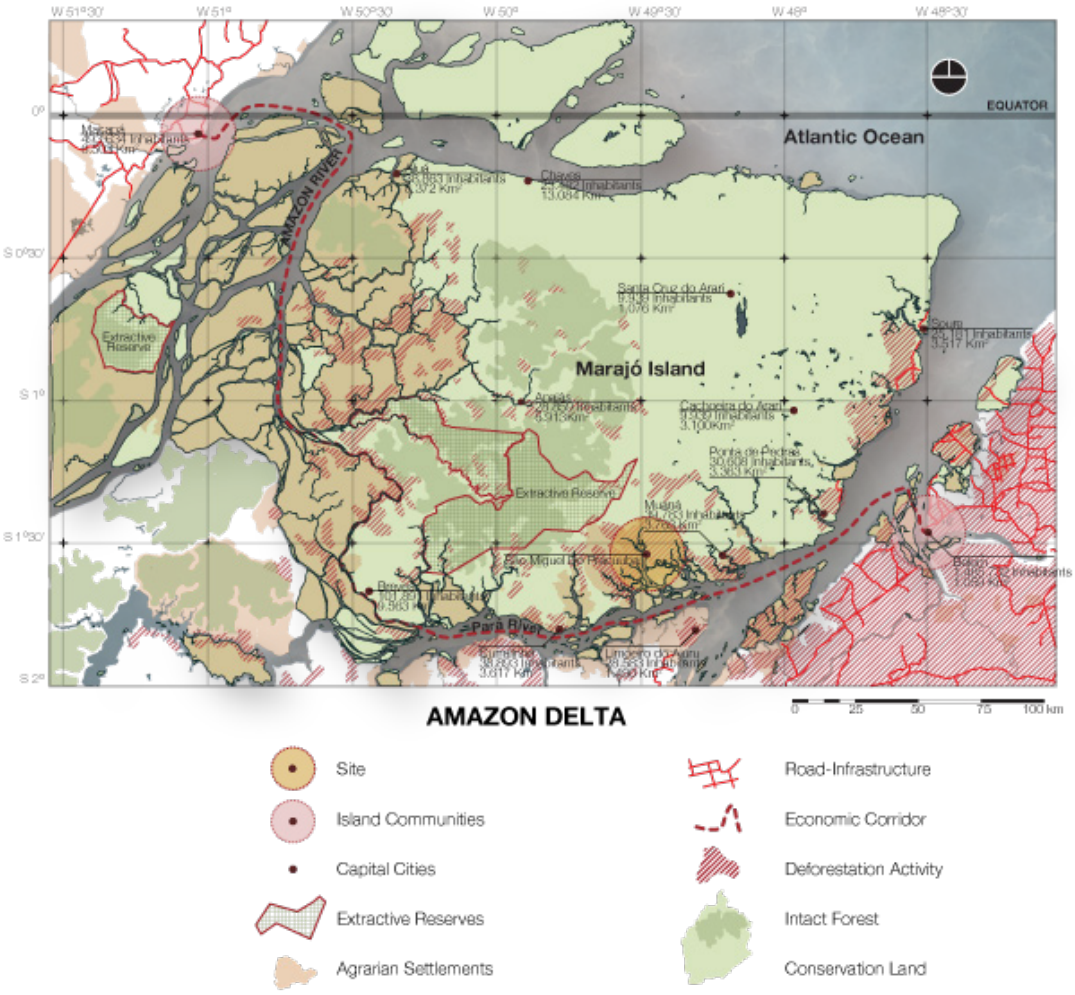
To reimagine sustainable community design in the rainforest delta region, one of the first issues to be considered is how to support agriculture and aquaculture in a seasonally flooded landscape. In this regard, the Kayapó's "forest islands" and the Aztec's "chinampas" provide us with a starting point.



"The Aztec Empire" of Tenochtitlan (Oil Painting by Luis Covarrubias); The Typical Aztec Dwelling (courtesy of www.pinterest.com).

CHAPTER 4: DESIGN

Siting

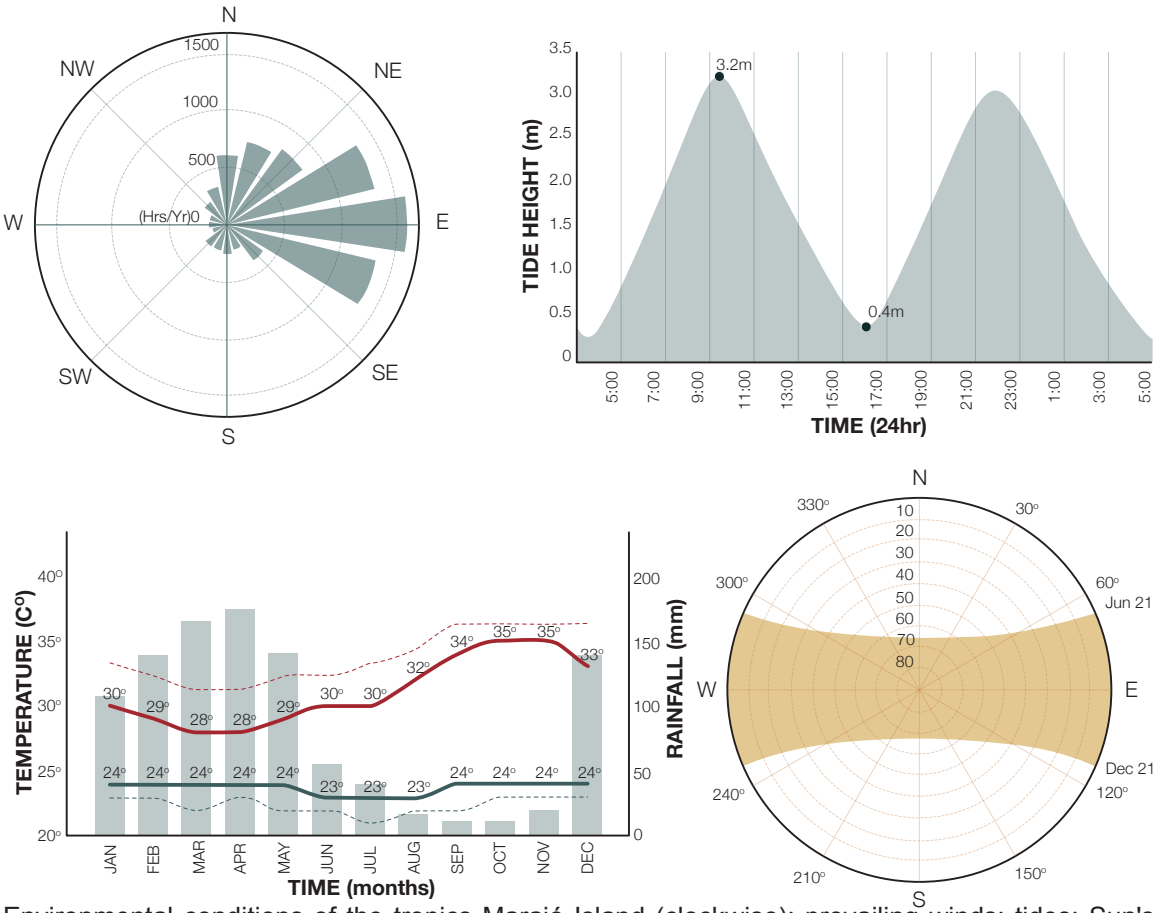


Marajó is historically known as the economic gateway to the Amazon; it has sustained human occupation since 5000 BC with an abundance of aquatic resources (Schaan 2010, 183). In 1989, in recognition of environmental degradation as a result of economic exploitation, the Marajó archipelago was declared a sustainable-use conservation unit. While this government initiative was intended to help mitigate climate change, it did not address many of the issues faced by Marajó's inhabitants, such as water pollution, lack of education and access to health care. As a symbol of the rustic Amazon landscape, the island is failing to live up to the ideals of the indigenous civilizations that once populated its rich floodplains.

> It is different to walk where there is no asphalt. It is different to open your house door and see a horizon of endless water. It is different to find yourself within the wilderness that vibrates away from the concrete. It is different to use the river as if was your street. It is different from what is used to us.(Oliveira 2016)

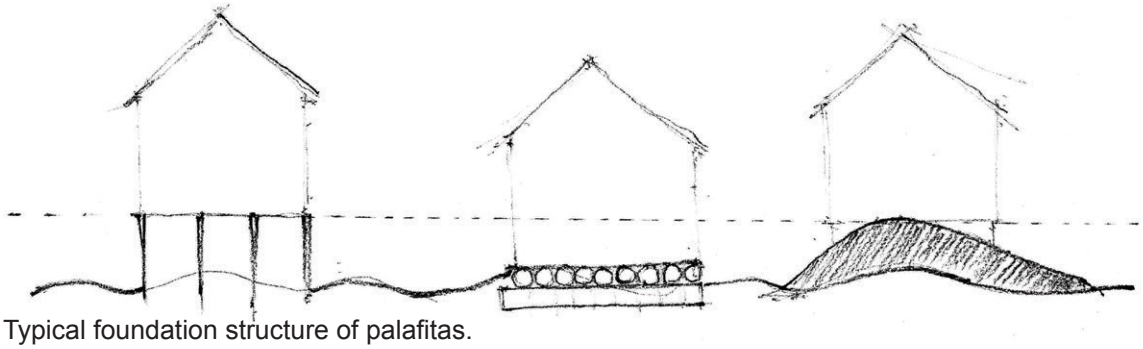
This is a translation of a poem by Cilene Costa, a native professor from a community in the Marajó island. Marajó is surrounded by water — the Atlantic Ocean to the northeast and the Amazon River to the west. It is very humid and rainy, precipitation averaging between 2.8 to 3.4 meters per year. As is usual in tropical environments, it has two well-defined seasons: a hot and rainy winter and a dry summer. The island's “fine-textured, clayey soil, with limited infiltration capacity, [...] tends to become waterlogged during the rainy season and to dry out excessively during the period without precipitation.”(Schaan 2010, 188).

This information was confirmed by resident Gilfran Ramos, a student of ethnology at the federal university in the metropolitan region of Belém and fourth-generation ribeirinho of the Marajó Island.



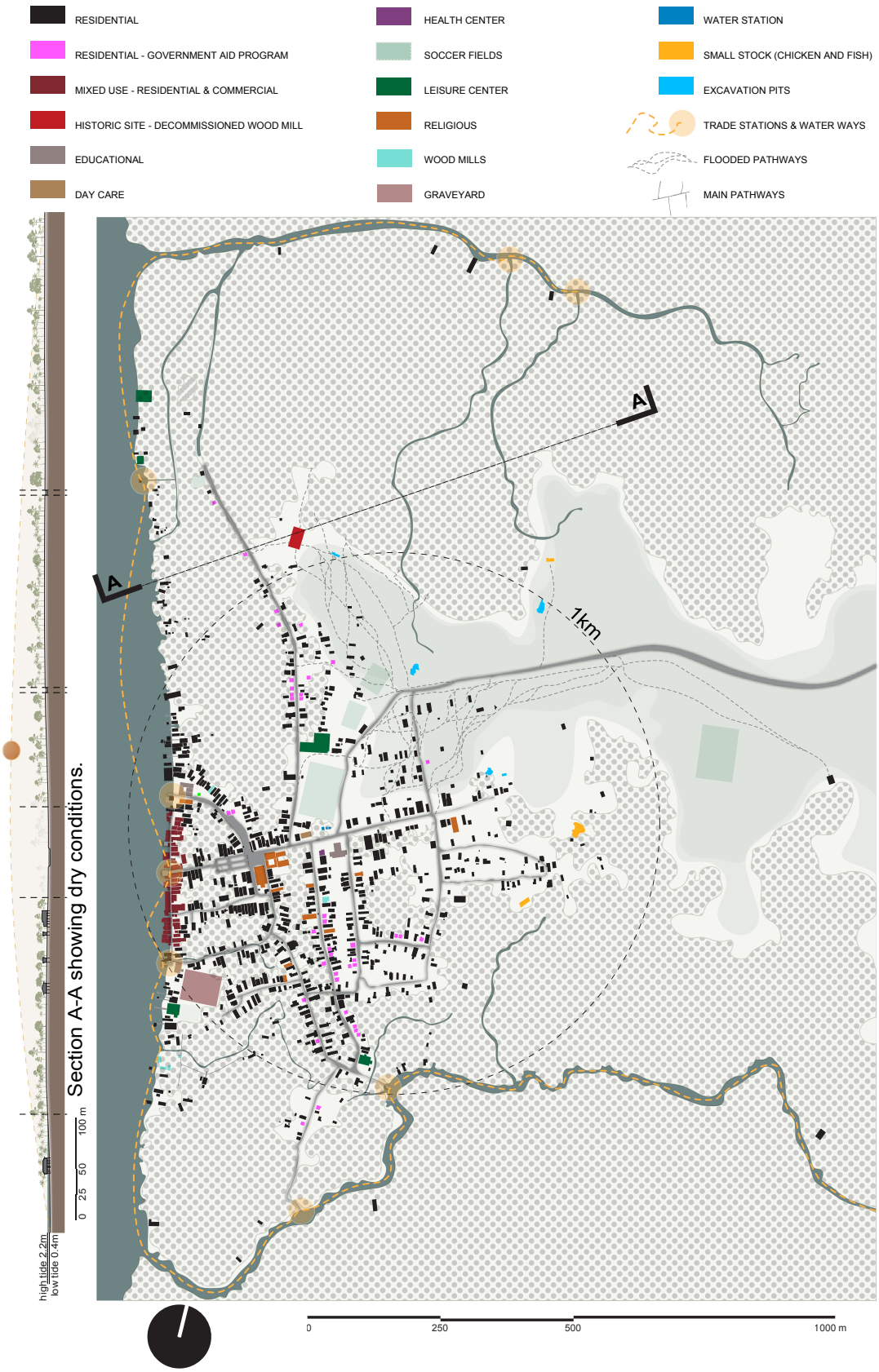
Environmental conditions of the tropics Marajó Island (clockwise): prevailing winds; tides; Sun's azimuth; high and low temperatures and rain precipitation.

The lifestyle of the ribeirinho*s* is influenced by the two seasons: flood and drought. During the rainy season, over the course of 5 to 6 months, fish migrate to the island to find shelter to spawn, turning the wetlands into a natural fish nursery. According to Denise Schaan - a post-graduate anthropologist of the Federal University of Pará, there is evidence that societies from the Marajaora Phase (400-1350 AD) "built mounds and dams as part of efficient hydraulic systems with the underlying purpose of controlling aquatic fauna and water supplies"(183). This ability to control and use water becomes possible due to the high volume of water descending the Amazon river, strong northeast winds and currents from the Atlantic Ocean that characterizes the flood season. The dry season is extremely hot and dry, with daily highs of 35ºC and cooler nights of 23ºC with lower humidity. Daily tidal fluctuations contribute to coastal flooding, causing rivers and lakes to rise to four meters during rainy seasons. These environmental patterns are now being influenced by climate change and sea level rise. Marajó Island's climate and context have long informed the delta's vernacular dwellings. Commonly referred to as *palafitas*, these structures along the Amazon's estuary are made of locally sourced materials and constructed in three typologies: on stilts, floating and inland.

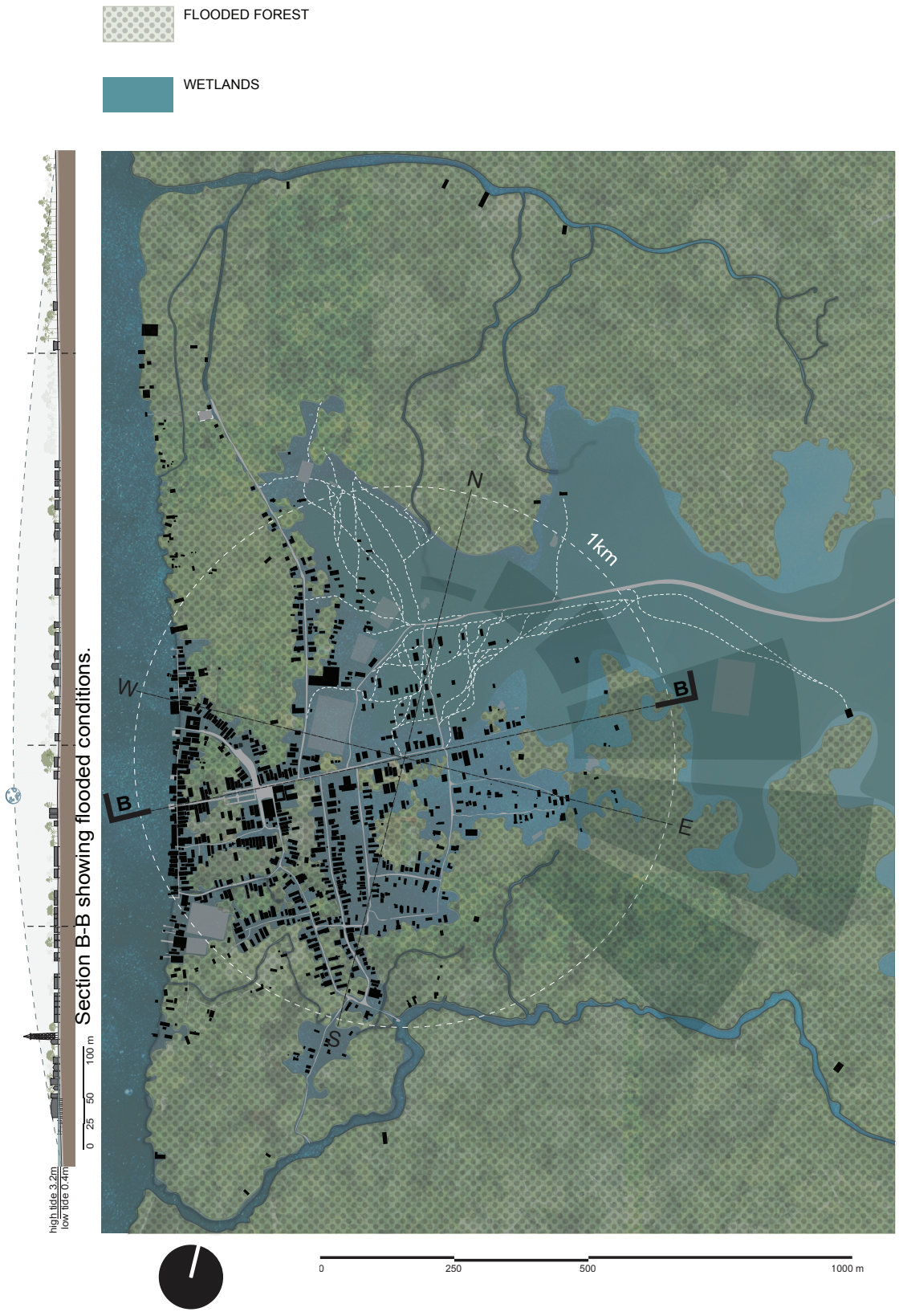


Typical foundation structure of palafitas.

São Miguel do Pracuúba, the site of this project, is a village central to the economic water corridor between the urban centers of Belém and Macapá, two important port cities serving as a gateway to the Amazon. Development here has always been directly related to the global demand for Amazon forest products. The village chosen for this thesis has a rich cultural history and is typical of most communities in the island: with great potential for development, but lacking basic infrastructure — restricting the health, wellbeing, and livelihoods of its inhabitants and pressuring the environment. Although the whole island is considered to be a sustainable use conservation land, according to data collected from *Imazon*, regarding deforestation activity, the district of this community is also a major target for illegal logging.



Map of São Miguel do Pracuúba showing summer condition and human activity.



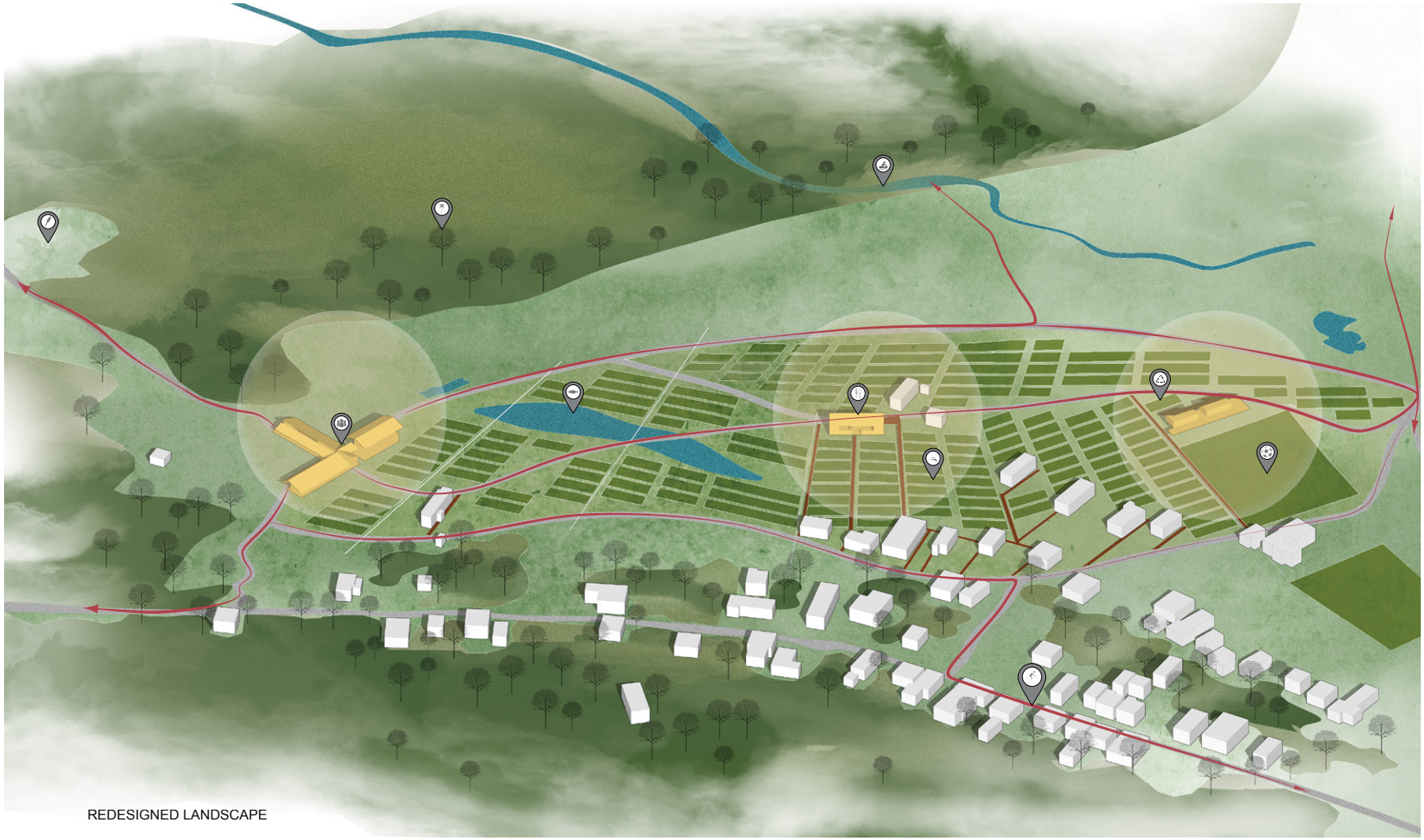
Map of São Miguel do Pracuúba showing winter condition and ecosystem.

Because the floodplains in Marajó island are underutilized during flood seasons, they could become a "common ground" for water to be retained and released in constructed wetlands, used for agriculture and aquaculture. Community buildings in these zones would then become the anchors for lifelong environmental education, deepening individuals' understanding of conservation. Buildings and infrastructure would be designed to improve the community's subsistence and need for environmental education classrooms, sports amenities, extracurricular activities, recycling, and spaces for community events. Among the community assets, the riverine people of São Miguel have the advantage of immediate proximity to natural capital, such as land, water, and rich biodiversity, as the basis for a sustainable livelihood framework. By maximizing the use of wetlands for organic agriculture production and fish farming, in addition to the sustainable harvest of forest products and aquatic resources, the surplus income would address seasonal constraints and consumer market fluctuations with year-round social-environmental activities for the community.

Redesigned Landscape

The proposed pilot project master plan — anticipating development expansion towards the wetlands — is aligned with a proposed new access road from adjacent communities and provides amenities that will strengthen the community's self-reliance. By creating small patches of planting beds at the scale of individual dwellings, mosaics formed by diverse native plant species would provide food and resources year-round in close proximity, providing supplementary income and social activities relevant to the island culture. With the aim of integrating the existing settlement into to the surrounding landscape, the new common ground preserves the forest standing while intensifying the harvest of non-timber resources.

The long-term proposal to create 6.8 hectares of chinampas would support sport, leisure and work activities, with higher ground allowing for land-use even during flooded seasons. Water retention, control, and conservation is achieved through artificial ponds, dams, planting beds, and rain harvesting infrastructures, used for drinking, fish farming, and irrigation. The perimeter dam and dikes serve as circulation routes, and the chinampas limit soil saturation in the redesigned landscape. The artificial ponds are used for aquaculture and for irrigation, the excavated material combined with organic waste from the forest



REDESIGNED LANDSCAPE

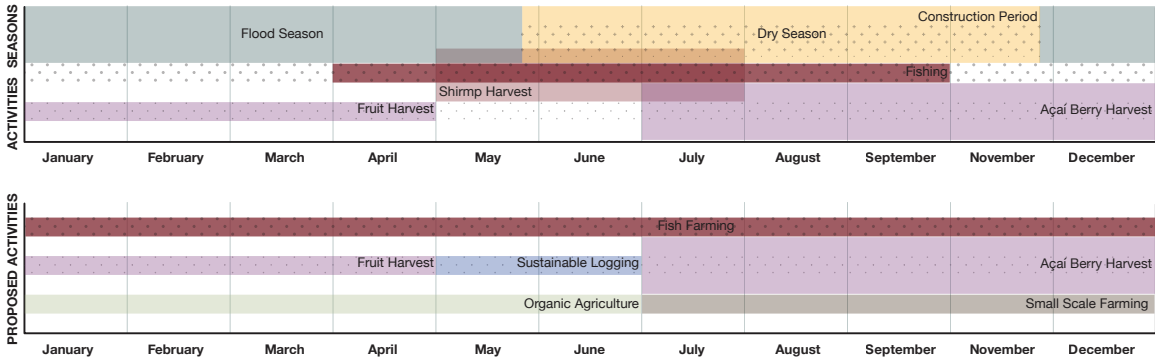
0 10 30 100 m

FISH FARM
COMMUNITY CENTER
SOCCER FIELD
RIVER ACCESS
NATURAL HABITAT
NATIVE FOREST
ARTIFICAL ISLANDS
TOOL SHED
RECYCLING

to enrich the soil for agriculture. Along the spine of this reconstructed landscape are the architectural anchors which support of live, work and play.

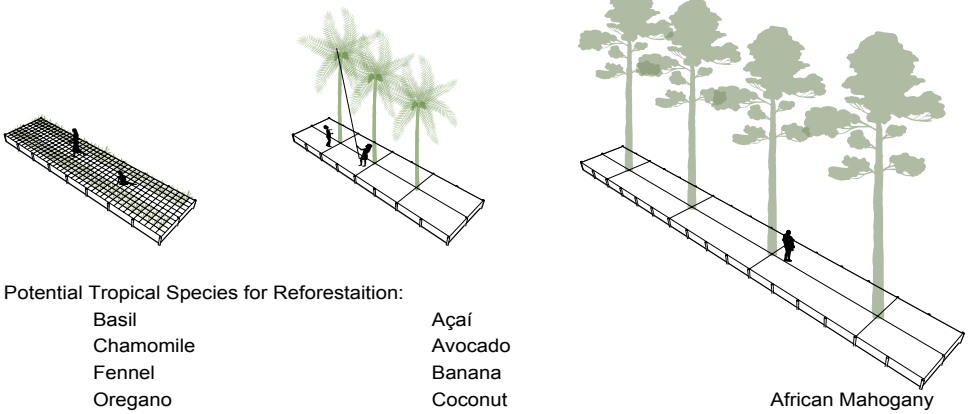
Among the native species of the island, the Açaí berry is responsible for the economic stability of São Miguel do Pracuúba and other island communities. Its high nutrient content and other benefits continue to gain it global popularity. This non-timber product is abundant in the seasonally flooded forests because its roots require humid soil and are adapted to flooded conditions. However, economic overdependence on Açaí harvesting is risky, given fluctuations in its market value during low-yield periods. Such undependable income leads forest dwellers to resort to predatory practices such as illegal logging. By preserving and enhancing the wetlands, leveraging their seasonal flooding to support a more diverse agriculture- and aquaculture-based economy, new opportunities for community self-reliance emerg. These include not only alternative sources of income through small to medium scale organic farming, but also year-round sports activities, environmental education programs, recycling and sustainable management of resources.

As expressed by Gilfram, a community leader from São Miguel, fish catches continue to decrease due to land and water degradation, which makes fruit and berry harvesting and entrepreneurship a better and more reliable occupation for ribeirinho families. From an ecological point of view, the agricultural potential in this village can be divided into three major categories of large, medium and small scale production. These would respectively be related to hardwood trees to be sold as certified sustainable logging and used in the construction industry; fruit trees for food security with surplus directed to trade markets like the prestige açaí berry; vegetables and medicinal plants to improve nutrition and alternative health benefits of community residents.



Existing and proposed seasonal activities chart (data from community leader Gilfran Ramos)

Natural Landscape

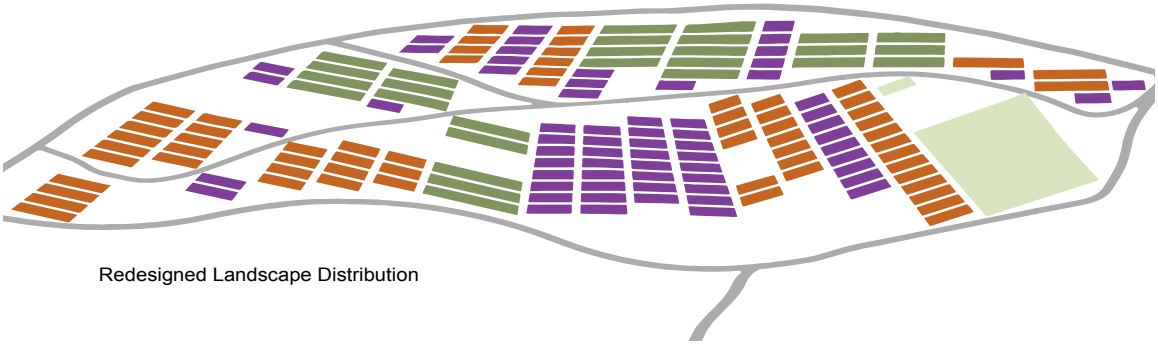


Potential Tropical Species for Reforestaition:

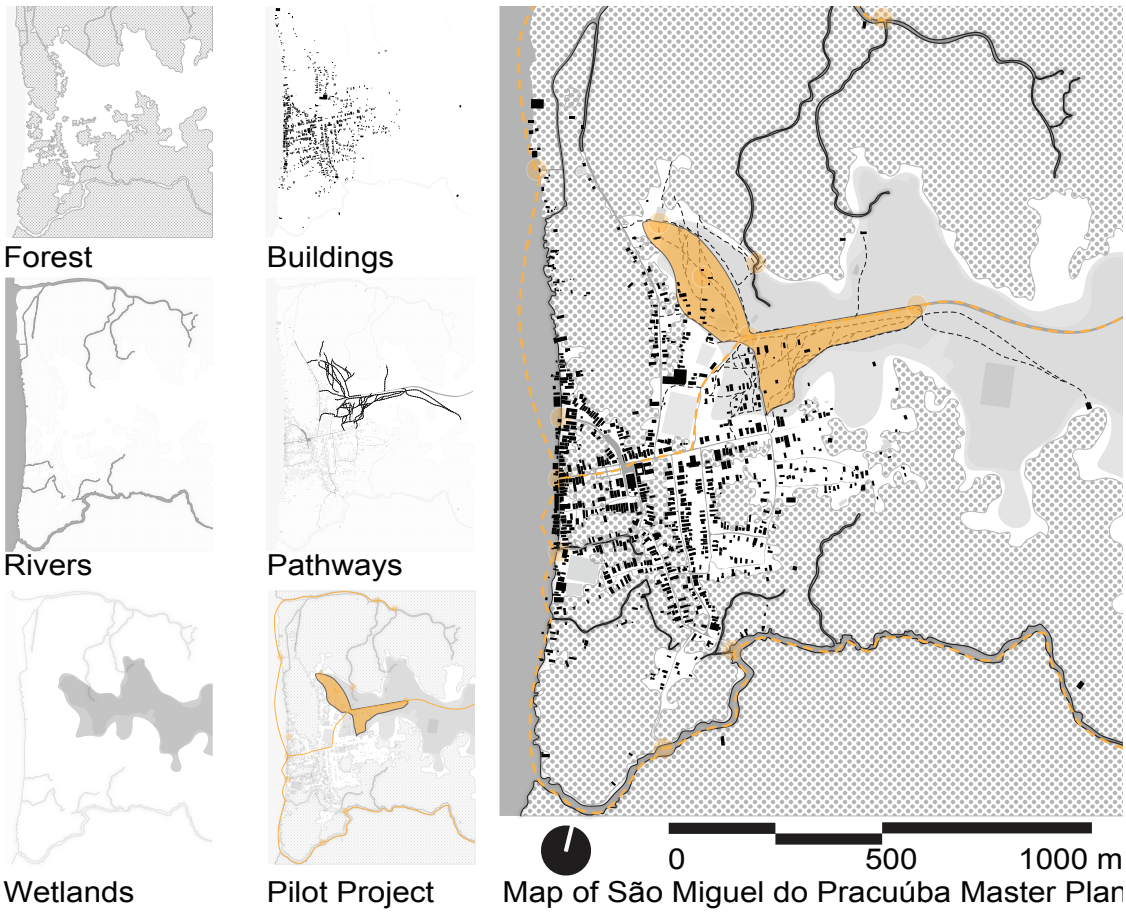
Basil	Açaí	African Mahogany
Chamomile	Avocado	Cupiúba
Fennel	Banana	Eucalyptus
Oregano	Coconut	Pau-Brasil
Peppermint	Cupuaçu	Ipe
Manioc	Orange	
Rosemary	Lime	
Rue	Mango	

Plant Cultures Breakdown

Small	Medium	Large



Redesigned Landscape Distribution



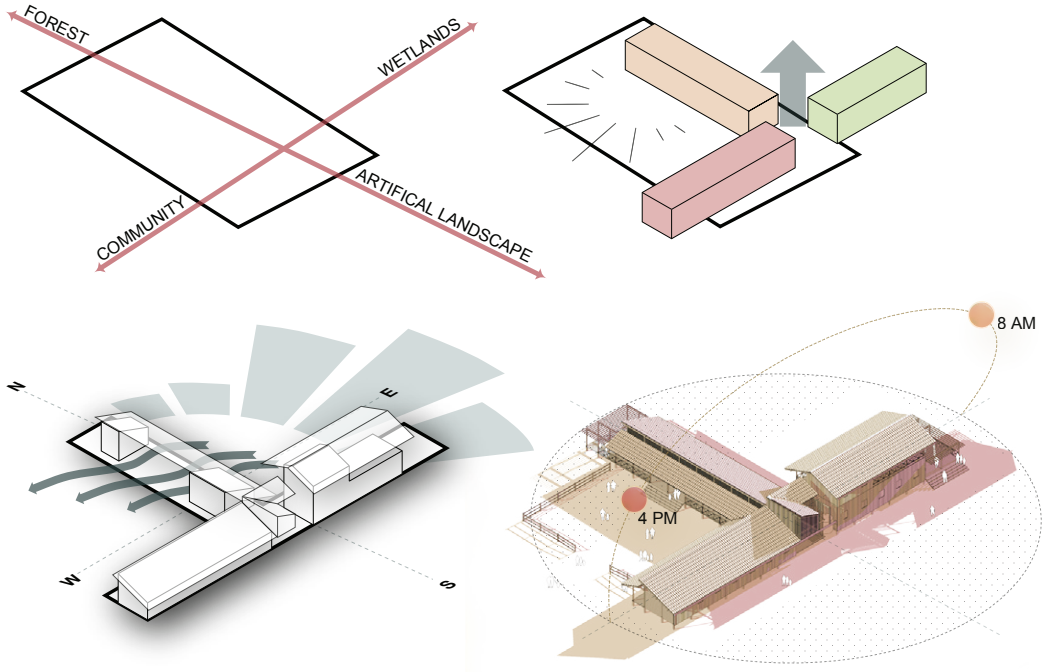
Architectural Anchors

Construction methods and materials are based on the availability of resources and traditional knowledge. This is because transportation of building materials and the use of specialized equipment is unfeasible due to the remote location and site logistics of wetlands. The proposed buildings are designed as modular and lightweight pavilions at the scale of palafita dwellings. They employ the traditional method of pile-driven foundations topped with a platform, and balloon frame construction above that. Cladding uses simple lapped joint connections making it easy to change if required. These "architectural anchors" will support education, sport, and sustainable land-use activities, and are therefore strategically situated along the circulation spine to support these activities in synergy with environmental resources. This strategy recognizes that people are essential participants in the environmental restoration to ensure better opportunities for future generations.

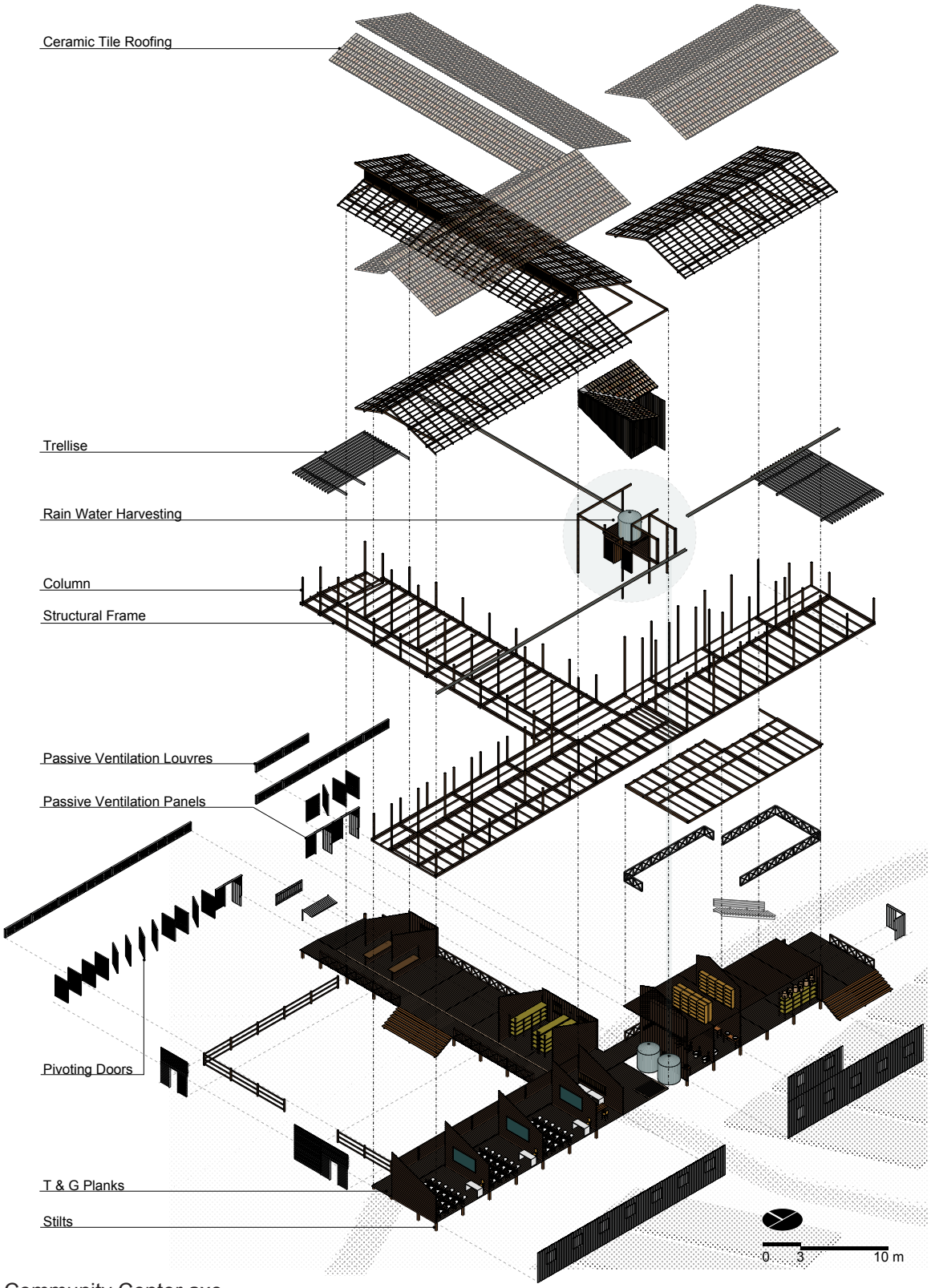
Community Center

The community center is located at the northern edge of the village on a historically significant site formerly occupied by an illegal sawmill and currently used as a soccer pitch. This site was selected for its proximity to the natural forest, main river access, and wetlands. This intersection of existing natural assets is relevant to the pilot project's goal of promoting environmental awareness through architecture design. At this location, the village landscape is representative of the different ecological typologies — of wetlands and flooded forests — providing opportunities for an exchange of practical knowledge between the ribeirinhos and the new common ground. The program is comprised of indoor and outdoor classrooms, library, canteen, natural medicine cabinet, storage for food & resources, office, washrooms, a rainwater harvesting tower, and a multi-purpose space for community gathering events that can be expanded to adjacent outdoor patio and courtyards. Oriented to take advantage of prevailing winds and minimize solar radiation, wide shaded verandas to the north side serve as informal outdoor rooms and circulation corridors well above the flood plains.

For ease of construction, the structural grid uses a 3 x 6 meters span that is based on available tree sizes in the market. The building is built completely of wood and is roofed

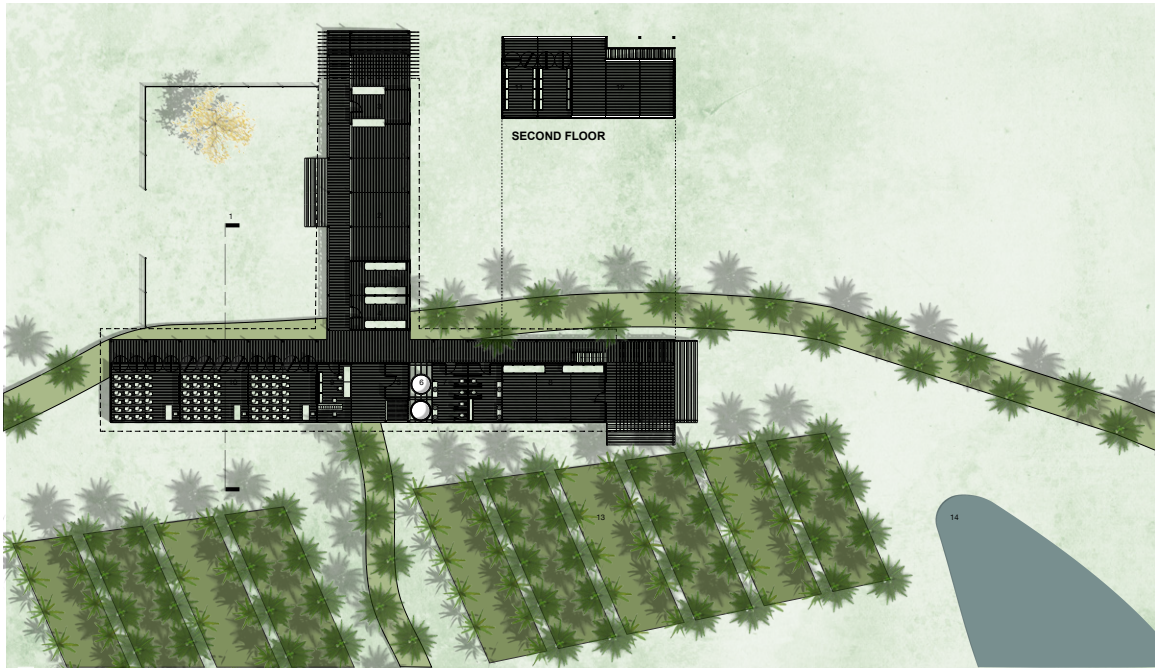


Community Center diagrams.



Community Center axo.

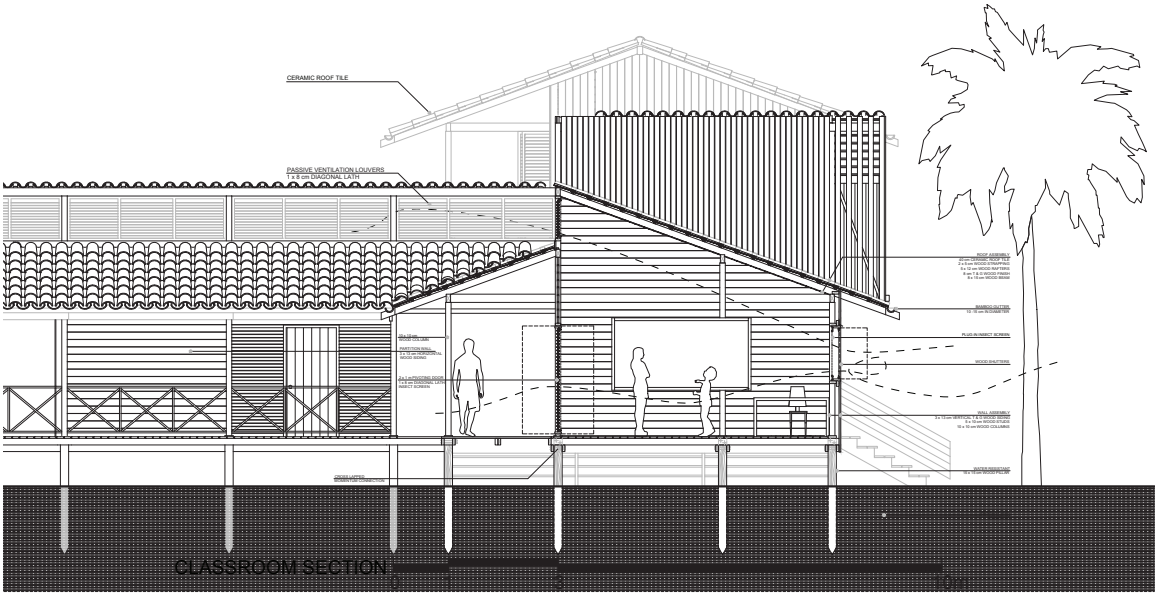
with ceramic tiles, in accordance with ribeirinho material culture. Appropriate technology was used throughout the design, to extend the concept of 'community self-reliance' from the sustainable harvest of resources to all aspects of the architecture. To provide sheer stability at floors, wall, and ceilings, cross-lapped moment connections in conjunction with vertical and horizontal toungue and groove boards reinforce the simple post and beam connections. The foundations are made of high density, water-resistant wood pillars driven



COMMUNITY CENTER FLOOR PLAN

0 1 3 10m

1. PATIO
2. MULTI-PURPOSE SPACE
3. CANTEEN
4. NATURAL MEDICINE BANK
5. PUMP ROOM
6. CISTERN
7. WASHROOMS
8. FOOD & SEED BANK
9. ADMINISTRATION
10. CLASSROOMS
11. LIBRARY
12. OUTDOOR CLASSROOM
13. CHINAMPAS
14. FISH FARMING



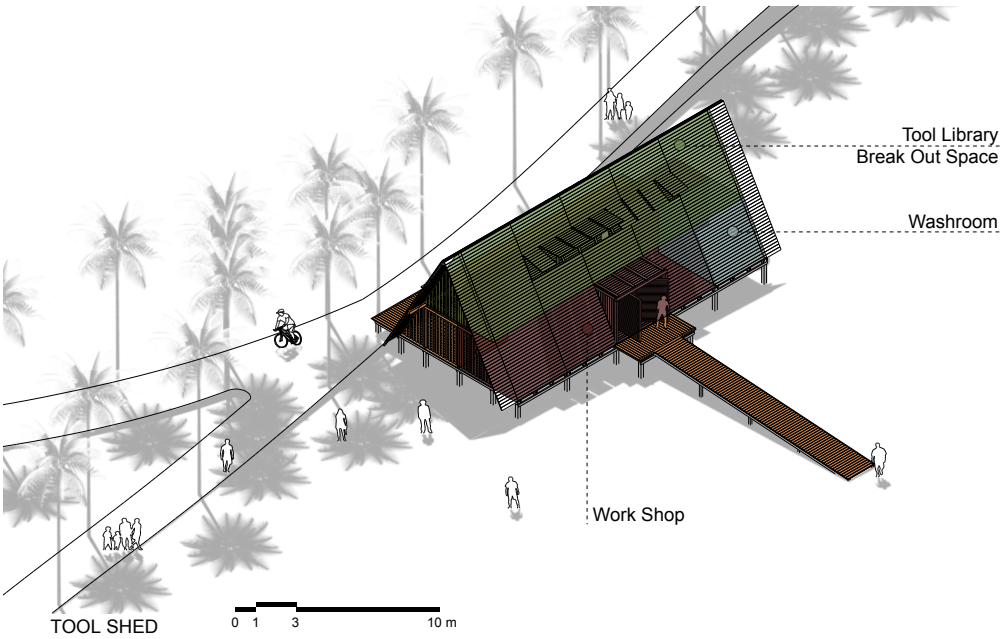
into silty clay soil, to a depth that insures bearing. Cross-ventilation is provided in all rooms through the use of passive louvre systems integrated in door and window assemblies, to ensure thermal comfort and natural light control.

Community Center section through classrooms.


Community Center south approach.

Tool Shed

This secondary building references the traditional dwellings of the Turiyó. This ethnic group lives a nomadic lifestyle of resource harvesting, living in temporary camps where they clear small patches of land for food cultivation, for several growing seasons until soil is exhausted and they move to another area. But here, the Turiyó-style warehouse is more contemporary and also conceived as a permanent structure to support the settled community of São Miguel, in their traditional subsistence lifestyle. It is used for storage of garden equipment, the repurposing of supplies, as a workspace and a place where community residents can take breaks during intensely hot days or heavy tropical storms.



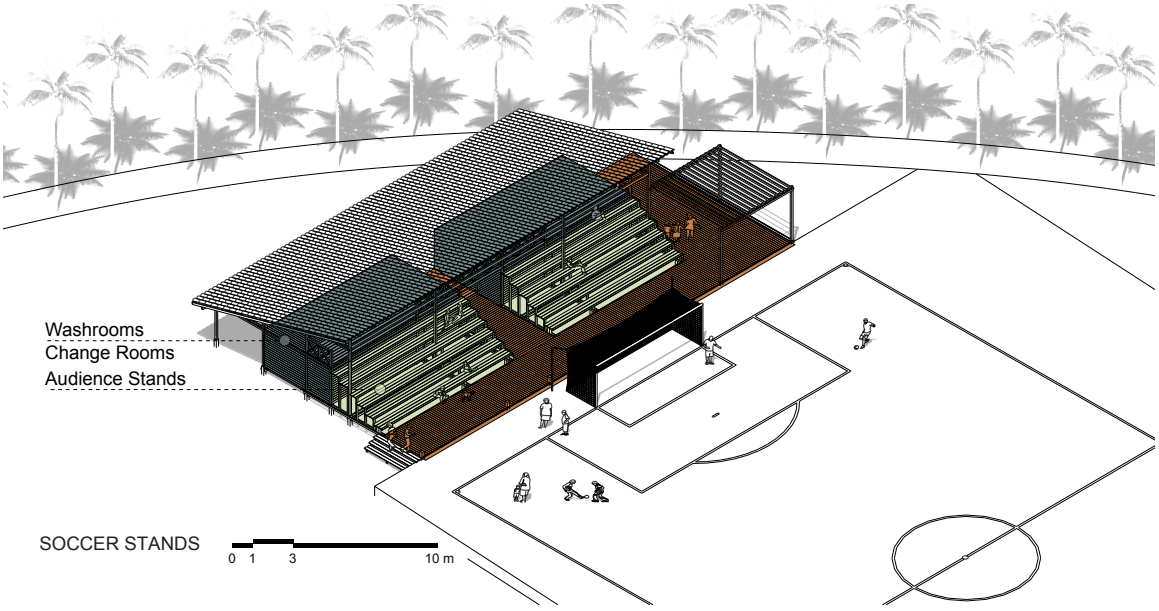
This out-building of the environmental education community center, extends the center's focus on applied practical knowledge through hands-on activities. Its main axis is aligned with the longer dimension of the redesigned landscape, and its views connect the center with both the forest and the rest of the settlement. With immediate access to the cultivated fields, the tool shed serves as a threshold between the natural and redesigned landscapes.

Soccer Stands

A sport facility was added to the pilot project, to add pleasure, a sense of community, and dignity to the livelihoods of ribeirinhos. The incorporation of the existing women's soccer field in the redesigned landscape, symbolizes the importance of women in ribeirinho

culture and advances equal opportunity in play activities. The amenities here included a terraced viewing stand, washrooms, rainwater collectors, two changing rooms and a sheltered space at the rear for sorting recycled materials to be repurposed.

Soccer has always been an escape for Brazilian youth and a fun activity to mingle with friends, but the saturated soils furing the flood season make it impractical for residents to play. By building up the land, much like the chinampas, this sports field would be surfaced with wood chip waste from local mills, The structure could also become a service station during large cultural events, like the shrimp festival and harvest season celebrations.



CHAPER 5: CONCLUSION

This thesis argues that the present-day development of the Amazon forest is unsustainable and destructive of the forest's natural ecosystems, and completely marginalizes the people (mostly indigenous) who are on the frontline of ecological preservation in the region. The landscape design in this thesis shows how landscape infrastructure can be used to change this situation for the better — by integrating economic activities with natural cycles and ecosystems, so these communities may develop economically while respecting and protecting the valuable ecological resources. By redesigning the wetlands of São Miguel do Pracuúba to support a ribeirinho way of life that directly depends of natural resources, this thesis presents a paradigm shift from current development to truly sustainable village development. It would be relevant to the many other fishing communities on Marajó Island, and vulnerable coastal communities around the world.

The community "hubs" are proposed as sites to support community activities, learning traditional knowledge from others, and other forms of education and social development for the ribeirinhos, as they pursue universal goals such as food, water, income, education, community, and recreation. The architectural design of the hubs makes best use of tropical conditions, using passive cooling strategies and sustainable construction and other building technologies which are appropriate for local materials and trades.

Beyond these goals, this thesis recognizes that such interventions are best realized in collaboration with community members, scientific and development experts, and partners who share a vision for the sustainable management of tropical forests to help mitigate climate change. Furthermore, the involvement of indigenous leaders in all levels of planning and program implementation is essential if we hope to preserve both biodiversity and culture. *The Amazon and Agenda 2030* policy paper developed by the United Nations provides an essential background for this thesis, setting out detailed guidelines and sustainable goals for equity in the social, economic and environmental spheres.

Ultimately, this thesis is about design that respects the environment and empowers ribeirinhos to be confident in their traditional knowledge and to reconnect them with their identity as keepers of the forest.

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