

Valuing the Cerrado

Designing a Botanical Garden in the Brazilian Savanna



Valuing the Cerrado

Designing a Botanical Garden in the Brazilian Savanna

Msc Landscape Architecture

Thesis report

June, 2025

Author

Camila Rosado

Student Number: 6082300

First mentor

Dr. ir. Inge Bobbink

Chair of Landscape Architecture

Second mentor

Dr. ir. U.D. Hackauf

Chair of Environmental Technology and Design



Delft University of Technology

Faculty of Architecture and the Built Environment

Master Architecture, Urbanism, and Building Sciences

Flowscapes graduation studio

Circular Water Stories Lab

This thesis received support from the following grants:





Introduction

Identity and Cultural Landscape of Cerrado	8
Fascination and Curiosity	
Western Bahia: an agro-export region in Cerrado	12
Context and Problem statement	
Rediscovering the Cerrado	16
Process and Methods	
Research Question	17
Design Assignment	17
Chapter 1: Landscape, Culture, and the Cerrado	18
Underestimation of the biome	
Theoretical framework	
Chapter 2: Cerrado: the Cradle of Waters	30
Dossier of the Brazilian Savanna	



Chapter 3: Water as Commodity	48
Western Bahia Biography	50
A Water Export Region	54
Chapter 4: Valuing the Cerrado	58
An Unsuccessful Preservation Area in Western Bahia	60
Rethinking Janeiro River Basin	78
Sowing Changes	82
The Urucua Botanical Garden	96
A Network in Janeiro River Basin	132
Conclusion	134
Reflection	136
Reference list	138
Table of Images	141

Where I was born, a river flows

Where I was born, a river flows
That flows through the endless unchanged
Unchanged, Endless, my land
Flowed inside me
It flowed as if time
Could change nothing
It flowed as if the river
Would not flow into the sea
The river flows into the sea
So many things I have learned
But what's most my singing
Is what I sing here
Today I know the world is big
And the sea of waves is done
But born together with the river
Is the singing I sing the most
The river only reaches the sea
After wandering through the ground
The river of my homeland
Flows into my heart

Onde eu nasci passa um rio

Onde eu nasci passa um rio
Que passa no igual sem fim
Igual, sem fim, minha terra
Passava dentro de mim
Passava como se o tempo
Nada pudesse mudar
Passava como se o rio
Não desaguasse no mar
O rio deságua no mar
Já tanta coisa aprendi
Mas o que é mais meu cantar
É isso que eu canto aqui
Hoje eu sei que o mundo é grande
E o mar de ondas se faz
Mas nasceu junto com o rio
O canto que eu canto mais
O rio só chega no mar
Depois de andar pelo chão
O rio da minha terra
Deságua em meu coração

Lyrics by Caetano Veloso

Introduction

Identity and Cultural landscape of Cerrado

Fascination and Curiosity

The song expresses the river as a metaphor for life in a poetic reflection about origins and time. The river flows consistently, carrying and gathering experiences. Although it has a long path until it reaches the sea, passing by diverse situations and landscapes, there is a profound connection to where it comes from. The interpretation of the lyrics is the starting point of this thesis: our origins and experiences in life are profoundly rooted in our essence.

So far, on my life journey, moving to other places has been essential for constructing and reflecting on who I am. The first realization happened when I moved from the central part of Brazil to the region of São Paulo, a place where industry was implemented first in the country. I left Goiânia, my city, to study Architecture and Urbanism. At that moment, I noticed that I was different from people who belonged to that region, and now I understand that a big part of it had to do with the influence of the cultural landscape on people's identity.

My childhood is filled with memories of the weekends and holidays on my grandparents' farm. All the trees around the house had different meanings for a playful adventure. The small mango, with the help of some sticks, could be transformed into animals. The tamarind tree was a perfect universe for climbing. The avocado tree had horizontal branches, ideal for sitting and rocking on them, changing the moment into a horse race. Seeds and leaves could become objects, grains for cooking, and brushes for

cleaning the imagined house. A very dark liquid from other plants could be extracted and used as medicine if the play's theme was visiting the doctor.

Different seasons meant different adventures and dynamics at the farm. During the corn harvest, the family would gather to make the most expected traditional dish: the 'pamonha'. Each time of the year focused on specific trees and how their fruits could be utilized: jams with blackberries, liquor with 'jaboticaba', juice with tamarind, acerola, compote with guava, rice with 'pequi'.

And all those memories were nurtured by my grandparents' knowledge of the natural context. It was engraved in their bodies how to do everything, grow crops and use the land for their sustenance, understand the cycles, and use the plants and grains at the right time. Some of those experiences were far from the reality of my colleagues who grew up in a more industrialized region.

My grandparents' lives changed dramatically when industrialized agriculture arrived on their land. The traditional grains were changed to genetically modified ones. Milk production increased with mechanization, antibiotic use, and enriched cattle food. The use of fertilizers, pesticides, and new irrigation systems was implemented. An inevitable 'progress' arrived in Brazil's traditional agricultural backland, bringing urbanization and convenience to daily life. The farmers became strongly dependent on new technology and expensive products.



Image 1.0 - Landscape at my grandparents farm

Meanwhile, the climate was changing, becoming out of rhythm. At the end of his life, my grandfather struggled with a considerable debt.

My interest and curiosity about agricultural landscapes and the vast backlands of Brazil might come from this cultural heritage and my family's story. The happy times playing at the farm became memories, and I strongly believe that I had the chance to inherit part of the essence of my grandparents' and mother's lives, who grew up more connected to this cultural landscape.

During and after completing the degree in architecture, my river passed through Brazil, France, Scotland, England, and, most recently, the Netherlands. Living in those places familiarized me with their cultural aspects and gave me a new outlook on my origins. It is like having a foreigner's gaze on the culture rooted in my essence and still shaping my identity through where I go.

Going deeper into the landscape architecture field boosted my will and curiosity to look back and reflect on the Cerrado, a biome from the area where I came from that has largely been replaced by large-scale agriculture focused on livestock and grain exportation. Cerrado, known as the Brazilian savanna, is 24% of Brazil's territory.

The starting point of this thesis is the curiosity and fascination about the Cerrado and its cultural landscape. It intrigues me how little and superficial knowledge is known about this ecosystem in the ordinary sense of the Brazilian population, including myself. Why is the Cerrado not appreciated, and why is its ecological importance so neglected? What are the characteristics of this Biome? How did it become the frontier of agricultural expansion in Brazil?

The satellite image reveals an intriguing pattern of a highly productive agricultural landscape. The large group of circular shapes refers to the center-pivot irrigation systems, a mechanized technique that enables irrigation of large fields by rotating sprinklers around a central axis. Each circle is approximately 100 hectares in size, which is information that denotes the impressive dimension of this agricultural landscape.

This image captures a fragment of Western Bahia, a region rapidly transforming into one of Brazil's leading agro-export zones. It is currently among the country's largest hubs for center-pivot irrigation and a major contributor to soybean exports.



Western Bahia: an agro-export region in the Cerrado

Context and Problem Statement

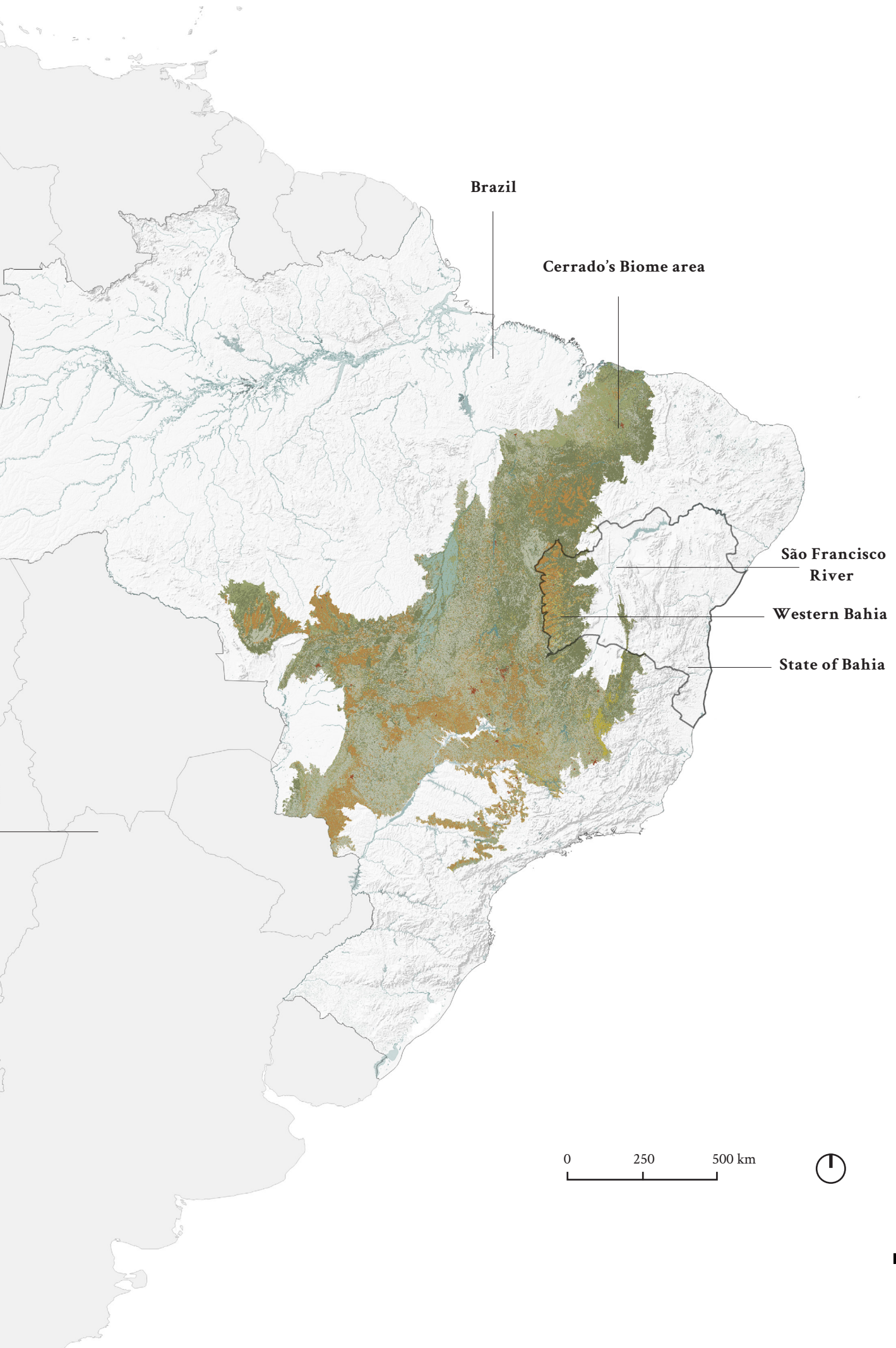
Western Bahia is included in the bigger territory known as MATOPIBA; The term refers to the initials of four states - Maranhao, Tocantins, Piauí, and Bahia - a frontier of agricultural expansion, especially for soybean, corn, and cotton production with the Cerrado biome. MATOPIBA¹ has been gradually integrated into Brazil's agribusiness economy since the 1990s, but it became officially defined and part of a governmental plan for agricultural development in the 2010s.

Since colonial times, human occupation in Western Bahia has happened slowly and with low density. The region is connected with more expressive occupations along the São Francisco River, a water body of extreme importance that connects the southeast to the northeast of the country. For a long time, Western Bahia was associated with the "Beyond São Francisco", in other words, the backlands of the river. The very low density and distance from the bigger urban center made Western Bahia, culturally, a landscape with a strong connection between humans and the natural elements of the cerrado biome. (Santos & Pinho, 2001)

(1) Source from EMBRAPA.

Available at: <https://www.embrapa.br/en/tema-matopiba>





The region lies on an enormous underground water storage area, known as the Urucuia Aquifer, which is one of the largest groups of aquifers within the Cerrado Biome. This system, composed of sub-aquifers, has an extension of 76,000 km². The aquifer is an important water source for Western Bahia and plays a significant role as a regulator of the São Francisco River flow. In that season, the downstream area of the Sao Francisco River relies on 80% of the water supplied by the rivers that are fed by the aquifer.²

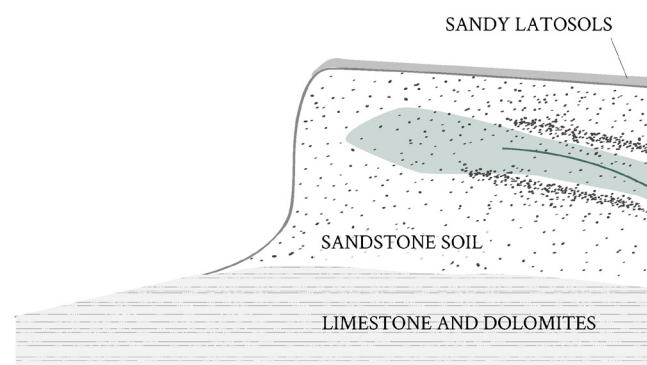
From the 1970s on, Western Bahia has rapidly transformed into a region of large-scale agriculture, followed by suppressing the native Cerrado vegetation. This transformation accelerated urbanization and brought significant socio-environmental changes to the area. While urbanization and industrialization introduced “progress” to the region, they also triggered profound impacts, including altering hydrological conditions on both local and regional scales. These transformations have led to environmental degradation of the Cerrado and conflicts with local communities.

In a remarkably short time, Western Bahia transitioned from a low-populated region with traditional communities that lived in symbiosis with the Cerrado ecosystem to an agro-export hub marked by extensive deforestation and intensive exploitation of the aquifer resources. The story of Western Bahia is, in many ways, a sample of the broader story of the Cerrado.

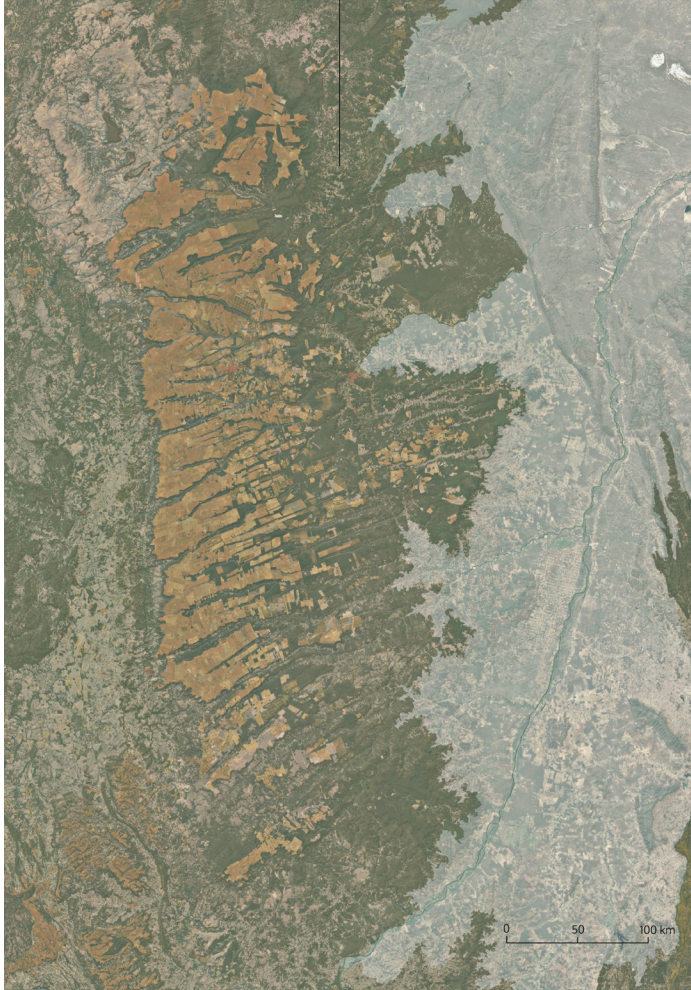
(2) Source online. Available at:
<https://cbhsaofrancisco.org.br/noticias/novidades/>

Cerrado, meaning “closed,” refers to the dense and low-lying vegetation typical of this ecosystem. The Cerrado plays a critical hydrological role in Brazil, serving as a source for many of the continent’s major river basins. As the second-largest biome of the country, the Cerrado’s area is nearly one-quarter of Brazil’s territory, an area comparable to Western Europe.

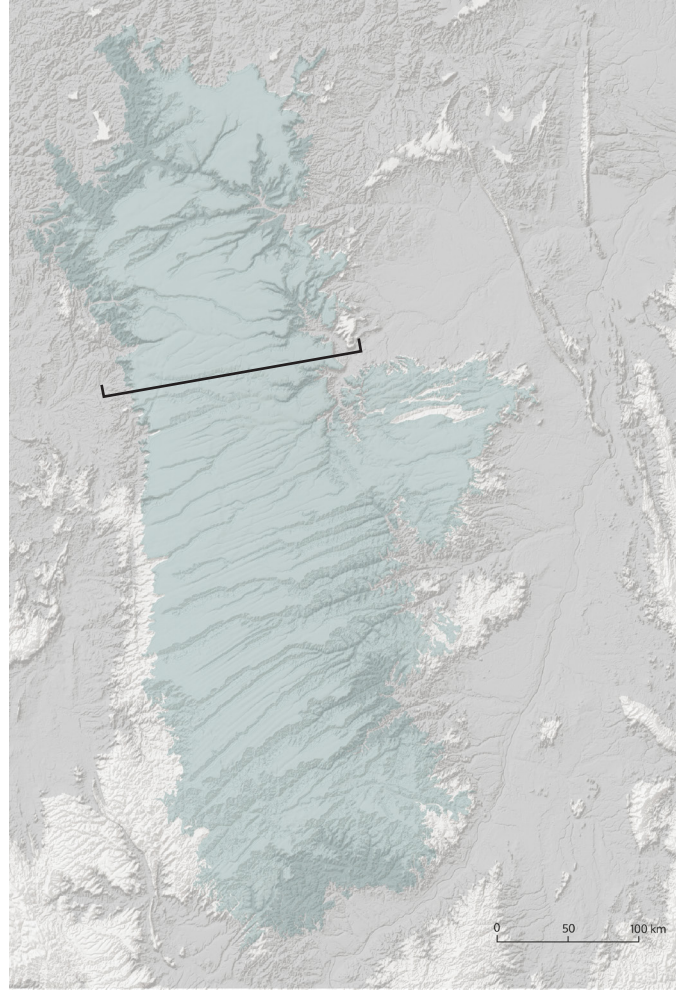
Historically seen as Brazil’s agricultural frontier, the Cerrado has endured increasing pressure from agribusiness over the past 30 to 40 years. This has led to widespread deforestation, disruption of the hydrological cycle, biodiversity loss, rising temperatures, and more frequent and severe droughts. Overall, the expansion of large-scale agriculture is the main cause of the degradation of the Cerrado (Bustamante, 2016).



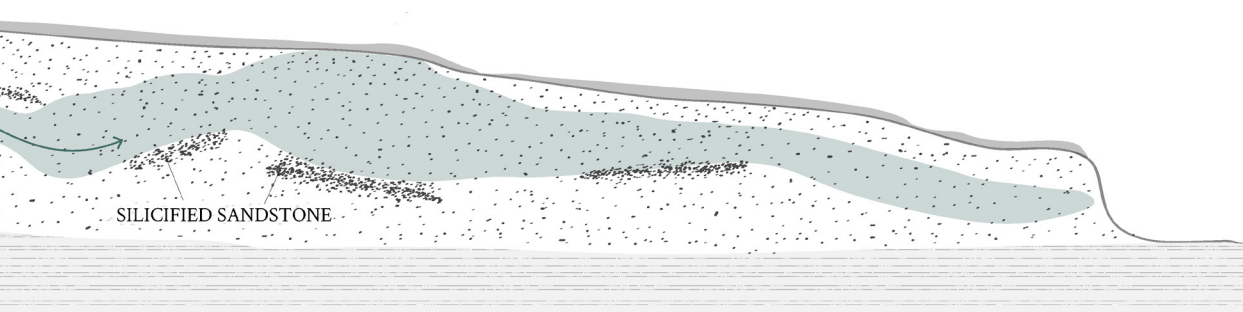
Cerrado's Biome area



Western Bahia



Urucuia Aquifer System Area



Schematic Section of the Urucuia Aquifer

Rediscovering the Cerrado

Process and Methods

The research process began with an analysis and understanding of the characteristics of the Cerrado Biome at the national scale, including its current situation and the historical and anthropological context of the colonization and occupation of the central part of Brazil, which contributed to the formation of the cultural landscape of the Cerrado. This phase involved extensive research, resulting in a rediscovery of Cerrado through a wide range of data sources: scientific articles, books, environmental reports, maps, historical documents, and online media (videos, documentaries, news articles); It also included geospatial data analysis using GIS layers to understand topography, hydrology, vegetation cover, land use changes, and patterns of agricultural expansion. The goal of this phase was to grasp the ecological, hydrological, historical, and socio-political dynamics of the Cerrado biome.

Through a process of investigating and reflecting on areas of interest and potential design assignments connected to these contexts within the Cerrado, the research led to the selection of an agro-export region in Western Bahia, that overlaps with the Urucuia Aquifer. In this sense, the process of selecting a location and defining a design assignment was not linear: it was exploratory, involving testing and evaluating different possibilities.

The local context of the thesis is located within the protected area of the Rio de Janeiro River Basin, part of Western Bahia. At this stage, understanding the local scale, fieldwork became essential as a method to develop a grounded and situated understanding of the landscape and local cultural practices. Site visits included a trip to the community of Jalapão, where traditional water systems and the community's relationship with the biome were studied, as well as a longer visit to the Rio de Janeiro River Basin in Western Bahia. The methods used included informal interviews with residents and community members, photography and field notes to document environmental conditions, water bodies, vegetation, and land use, and engagement with a local university to gather insights on ongoing Cerrado conservation research and community collaboration efforts.

While refining the problem statement and narrowing it down to a specific design location, the research encountered a complex and entangled set of relationships, shifting from local to regional and global scales. This rich realization of interconnected scales influenced both the framing of the design assignment and the design decisions.

Research Question

How can landscape design enhance the relationship between aesthetic and ecological perception of Cerrado Biome while mitigating the impacts of the large-scale production landscape in this ecosystem?

What are the Characteristics of the Cerrado Biome?

What are the historical transformations and perceptions of Cerrado's cultural Landscape and the Western Bahia region?

What are the impacts of large-scale agriculture, such as agro-export regions, have towards the natural ecosystem and cultural landscape of Cerrado?

How can a design raise awareness for the ecological importance and impacts of large-scale agriculture in Cerrado?


How can a small scale design mitigate the social-cultural-ecological problems large-scale agriculture causes on a regional scale?

Design Assignment

Set in Western Bahia, a region characterized by large-scale agriculture and water extraction, the design explores how landscape architecture can respond to socio-ecological degradation by creating a space that shifts people's perception of the aesthetic and ecological value of the Cerrado biome.

The design assignment focuses on the creation of the Urucua Botanical Garden, located in the Janeiro River Basin preservation area, Western Bahia. On this scale, the design has the potential to initiate changes in the Janeiro River Basin. Situated between the large-scale productive landscape and local communities, the project transforms an existing municipal park into a site that integrates ecological restoration, research on productivity, environmental education, and community engagement. The garden serves as a model for reconciling productive landscapes with the biodiversity of Cerrado, offering spatial experiences that make the ecological processes of the Cerrado visible and tangible.





Chapter 1
Landscape, Culture, and the Cerrado:
Underestimation of the biome
Theoretical Framework

Image 1.1 - Community 'Fecho de pasto' in Western Bahia

The cultural roots of underestimation

The Atlas Miller is a world map created in 1519 by a group of cartographers and artists at the request of the Portuguese king, to illustrate the power and extent of the Portuguese Empire at the time. The map is the earliest known representation of what is now known as Brazil's territory, dating to the first stages of its colonization. During this phase, the colonizers limited their settlements to the coastal regions. As a result, the vast backland of the territory remained beyond the reach of European knowledge, which initiated the imaginary conception of Brazil's backlands as a mysterious land that could not be quantified and carried immense potential for exploitation, idea that is expressed in the map by the lack of defined boundaries and the rich illustrations.

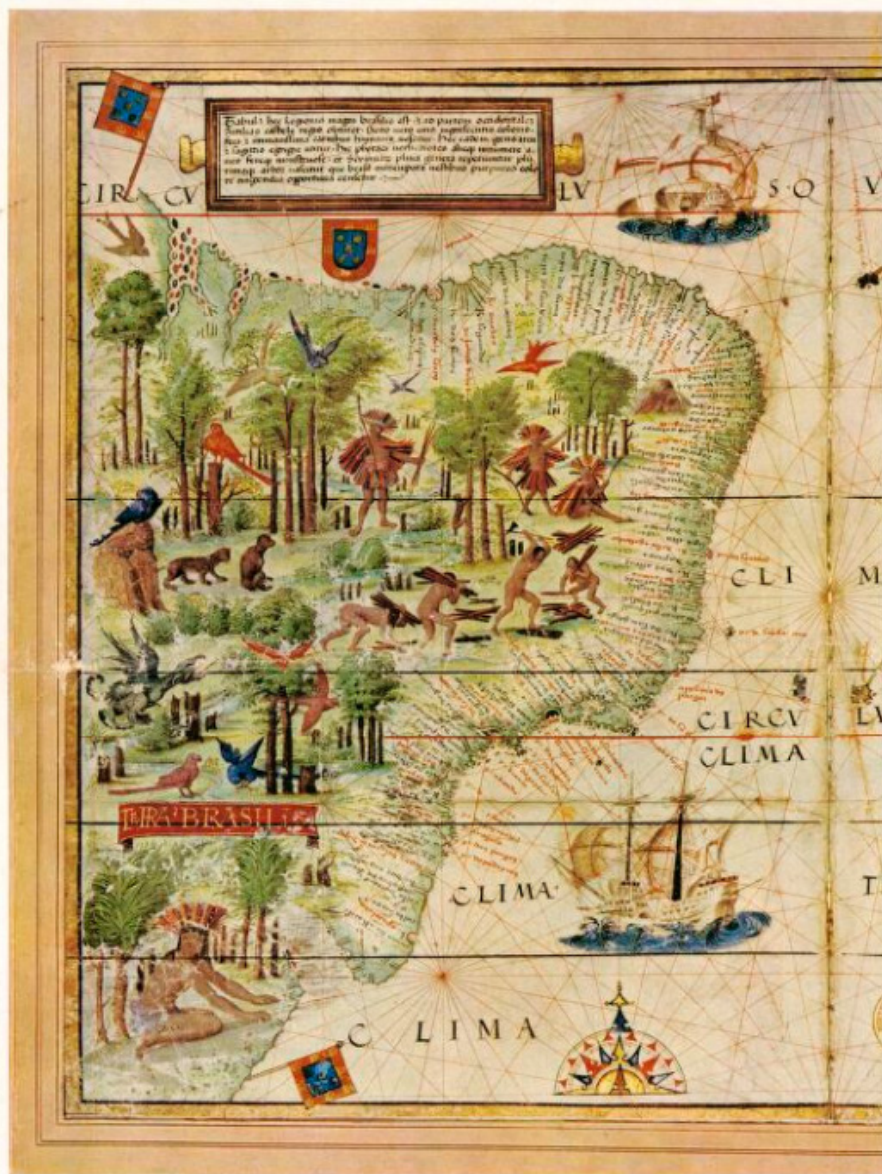
The initial phase of Portuguese colonization was defined as coastal and focused on exploiting resources from tropical forest formations (Holanda, 1936). The model focused mainly on the commercial relationship with Africa and India and on directing the exploited resources to the metropolis rather than occupying the interior. It was the start of a nation that faced the sea and turned its back on the land.

"The many novelties of America enchanted the Europeans, and many, lulled by the stories of the natives, began to imagine the other wonders that the interior of this continent had to offer". (Ribeiro, 2002)

The unknown inland nurtured speculations of being a place of inestimable mineral riches and a mysterious water body, such as enormous lakes responsible for the origin of large rivers. According to Ribeiro (2002), such narratives reflect creative projections of early cartographers and travelers; however, as with many myths, there may have

been a factual basis, specifically, the meeting of several large river systems that drain into the Atlantic Ocean from different directions. This convergence suggested a common source of great hydrological importance somewhere in the elevated heart of South America. This theoretical water source aligns with the Cerrado biome, often called the Brazilian savanna and South America's "rooftop", located between 300 and 600 meters in the Central Plateau. This ecosystem has a significant hydrological role, feeding the continent's key watersheds.

Despite the hydrological importance, it is common sense that this biome is unimportant (Bustamante, 2016). The twisted and low trees, the poor soil conditions, and the arid season are images of this ecosystem that have been undervalued compared to the rainforest formations. The misconception of this cultural landscape of Cerrado dates from the 16th century. At the time, the central region of Brazil was occupied predominantly by indigenous groups of the Macro-Jê linguistic trunk. According to Ribeiro (2002), from the coastal Tupi-speaking peoples' perspective, the Jê were referred to as "Tapuias", meaning 'barbaric', a term which colonial chroniclers borrowed.



LE BRÉSIL EN 1519

Atlas exécuté, cette année-là, par Lopo Homem pour le roi de Portugal et possédé, plus tard, par Catherine de Médicis.
Bibliothèque Nationale, Géographie.

**Spécimen d'une planche en couleurs
de l'«Histoire de la Découverte de la Terre».**

Image 1.2 - Cartography of Brazil in 1519, part of the Atlas Miller

The biased narrative continued into the 20th century, which portrayed the Jê as “technologically primitive and environmentally marginalized” (Ribeiro, 2002). Lévi-Strauss (1973), for example, viewed the Cerrado as biologically poor and unsuitable for cultivation compared to the Amazon rainforest.

The value of Cerrado gained another cultural layer from the 1960s and 70s, when agricultural lands in the South and Southeast of Brazil reached a state of complete saturation, prompting the need to expand the boundaries of the productive landscape in the country. In this context, the Cerrado and Amazon biomes became potential areas for economic exploration (Ribeiro, 2002). Although environmental awareness of the Amazon Rainforest was rising then, several factors contributed to the Cerrado becoming the primary target for agricultural expansion. These included its central location and greater existing infrastructure, the lower perceived value of its savanna vegetation compared to the rainforest, and technological advances that made it possible to convert the Cerrado’s typically poor soils into arable land.

Only in the last few decades have researchers started to uncover the recognition of Cerrado’s importance, along with layers of prejudice and lack of knowledge. However, the devastation rhythm goes more rapidly than the change in awareness and consciousness about its relevance.

Nature and Landscape as Cultural Constructs

Like any landscape, the Cerrado is a cultural landscape, reflecting centuries of interaction, from indigenous to modern exploitation. This characteristic makes the biome an example of how concepts such as Nature and Landscape are not fixed or objective but rather culturally constructed and continually reshaped by human activity and perception.

As Arnold Berleant (1997) notes, “Nature alone is therefore a fiction; even in its wildest places, nature is always culture.” The idea of untouched Nature is an abstraction. From harmonious interactions with natural ecosystems to massive environmental destruction, humankind’s relationship with the Earth’s resources has influenced the atmosphere, oceans, and climate. Human presence is inevitable even in the planet’s most remote areas, where direct and indirect impacts can be perceived. Thus, genuinely untouched Nature existed only before the emergence of humankind.

For instance, even the most pristine idea of Nature can result from human management, interference, or co-evolution. For example, Posey’s pioneering study on the Kayapó indigenous people’s management of secondary forests in Brazil demonstrates that these environments have undergone continuous domestication.¹ The study suggests that nomadic agrosystems developed over millennia by this group of people greatly influence the biodiversity of forests in a big part of what is known to be “natural” Amazon rainforest and the Cerrado.

Therefore, Nature’s concept is not an objective reality but a human construct. The distinction between natural

and managed ecosystems is artificial, and humans have influenced both. What we recognize today as natural landscapes are often the result of centuries or even millennia of human interaction and management, or have suffered changes due to anthropogenic actions.

¹ Posey, an anthropologist and biologist, is a pioneer researcher of traditional knowledge of indigenous populations in Brazil and a pioneer in the field of ethnoecology.

Likewise, the concept of Nature, a purely natural landscape, is an illusion. Humans are inseparable from their natural environment. Whether in rural areas, forests, or dense cities, people and ecosystems interact continuously, shaping and influencing one another. In that sense, the landscapes we inhabit reflect culture. Political and economic systems, aesthetic preferences, and social customs influence their form, structure, vegetation, and management. These landscapes, in turn, are influenced by the unique ways people interact with them, patterns that shift over time with historical events and technological developments (Berleant, 1997).

According to Munárriz (2011), landscapes guard unique values and constitute cultural heritage. They are imprints of human civilization, preserving the outcomes of past actions and serving as projections of identity and memory within a specific space. Therefore, analyzing landscapes becomes a powerful method for understanding a society's cultural and social dimensions and how these dimensions evolve.

However, Cultural landscapes are often narrowly associated with historically significant sites. In reality, Cultural landscapes not only justify the preservation of historically significant places but also aid in interpreting

the layers and structures of all kinds of landscapes and help us understand the basis of a place's past and current transformations despite their apparent historical importance.

Moreover, as Nassauer (1995) points out, humans do not simply exist within landscapes; they engage with them, observing, experiencing, and responding to their surroundings. Those decisions are often based on the Value that mediates the interaction between Landscape and people.

Nevertheless, humans and the natural environment are not always harmonious. Human-altered landscapes often emerge from drastic interventions that result in significant ecological impacts: deforestation, biodiversity loss, pollution, erosion, flooding, and river burial. Overall, the interaction between people and landscapes exists in constant flux, sometimes enriching, at other times degrading.

Human-modified landscapes are often perceived negatively as damaged, unattractive, or degraded.

Misalignment between Aesthetics and Ecological Value

Despite being a crucial water source and biodiversity hotspot, the Cerrado biome is not even recognized as part of Brazil's national environmental heritage in the 1988 Constitution. That omission is not merely bureaucratic: it reflects how deeply aesthetic and cultural biases influence environmental valuation and protection. The document lists the Atlantic Forest, Amazon Rainforest, Serra do Mar, Pantanal, and Coastal Zone as national heritage sites, but excludes the Cerrado and Caatinga. From an ecological point of view, however, all biomes are equally important. When laws and policies prioritize specific natural environments over others, undervalued ecosystems like the Cerrado remain vulnerable to degradation, often resulting in irreversible impacts.

According to Berleant (1997), aesthetic appreciation is rooted in perceptual experience, a human phenomenon. Therefore, the meaning and beauty of natural environments are not fixed; they are shaped by subjective interpretation and influenced by historical and cultural developments.

Over time, human civilizations have cultivated new ways of perceiving beauty in Nature, broadening our aesthetic sensibilities. Nature, in this sense, can be likened to art. Just as art requires human engagement to be perceived and interpreted, so does Nature. It becomes a kind of artifact, shaped not in its physical form but in how we experience and assign meaning to it (Berleant, 1997).

Aesthetic values in both art and Nature can be positive or negative. Just as art can stir discomfort or provoke thought, Nature can be appreciated for its overwhelming scale, unpredictability, or destructive power. According to Nassauer (2003), people's aesthetic perceptions and values

towards natural environments are related to the inherent landscape qualities and are affected by the observer's perspective, cultural aspects, and customs.

A fundamental distinction exists between a landscape's ecological functioning and cultural perception. In many cases, landscapes perceived as unattractive or "messy", such as overgrown gardens, are dismissed despite their high ecological Value (Gobster et al., 2007). In that sense, a critical misalignment exists between human aesthetic preferences and ecological principles.

Cultural expectations often inform what is considered a "healthy" or "natural-looking" ecosystem, which can lead to problematic outcomes. Landscapes that appear natural may be ecologically degraded, while ecologically functional environments may face public resistance if they do not align with conventional aesthetic norms. The conflict of visual appearance with ecological Value may result in the degradation of specific systems and influence design and management decisions.



Image 1.3 - Landscape of Cerrado



Image 1.4 - Contrast between native vegetation of Cerrado and monoculture crop

The Change of Cultural Perceptions

The historical, political, aesthetic, and ecological misunderstandings surrounding the Cerrado illustrate the cultural construction of nature, and the consequences of privileging cultural bias over ecological aspects. A redefinition of value is urgently needed, one that integrates scientific understanding with landscape architecture and design.

There is growing recognition of the Cerrado's value. Today, important groups and research institutions from around the world are studying the biome's environmental significance, emphasizing its role in conserving biodiversity and exploring the economic potential of native species. However, deep-rooted prejudices remain, and transformation continues at a slow pace compared to the rapid transformations of the landscape. Meanwhile, the ecological and cultural losses are immense, the agricultural frontier continues to advance. Nearly 50% of the biome remains open to exploitation. (Bustamante)

As Gobster et al. (2007) highlight, ecological knowledge alone is insufficient; integrating aesthetic appreciation to ecologically beneficial landscapes remains a major challenge. While cultural conventions tend to resist change, they are not fixed. Cultural expressions, such as literature, music, and visual arts, have historically shaped public sensibilities. For example, the modernist movements in art challenged traditional aesthetic norms and introduced new ways of seeing and valuing form and space.

In this sense, culture not only interprets existing landscapes but also opens up possibilities for new, socially and ecologically driven designs. As Gobster et al. (2007) argue, culture suggests the vast range of potential human

actions in the landscape, including the creation of spaces that do not yet exist, but could be imagined and designed to support ecological processes.

Nassauer (2003) emphasizes that ecologists and designers must recognize that cultural perceptions of nature often operate independently of ecological performance. To enhance ecological function in landscapes, professionals must navigate and integrate both spheres. The authors stress both the urgency and the difficulty of creating new cultural conventions that combine ecological functionality with diverse, and sometimes conflicting, cultural values.

This ongoing conflict between aesthetic values and ecological integrity raises practical and ethical questions: To what extent are aesthetic sensibilities changeable? And what is the responsibility of landscape professionals in guiding public perception toward more sustainable values?

Cultural transformation is essential to protect the cultural landscape of the Cerrado. Awareness must precede legislation and land-use change, reinforcing the idea that ecological success depends on how landscapes are culturally perceived, valued and cultivated.

The Role of design in changing values

Landscape Architecture Position

Landscape architecture stands between multiple fields - architecture, ecology, geography, sociology, etc. - creating a framework for integrated solutions and the potential to address numerous dimensions. The discipline designs outdoor spaces for humans, fauna, and flora, shaping environments that combine the understanding of ecosystems and the needs of society. Furthermore, it is not only a problem-solving tool. A fundamental aspect of the discipline is its ability to unfold the sensorial and spatial qualities of a place. These qualities enhance the experience of spaces, making them meaningful and memorable for people. A sensible design is open to considering the textures, sounds, and smells of space, as well as its visual characteristics, creating places that invite interaction and evoke emotional responses. Therefore, a landscape design has the potential to influence people's perception and the aesthetic experience of a space, which can function as a tool to transform public awareness.

Landscape architecture alone has no power of transformation. However a landscape design can include and collaborate with a wide range of different users and stakeholders, including communities, researchers, farmers, governments who together could transform realities, mitigate problems such as the alarming impacts that large-scale agriculture has over ecosystems such as the Cerrado biome.



Image 1.5 Public Hearing in 2023 that marks the beginning of the articulations at the federal level for the approval of the Constitutional Amendment Project (2010) which transforms Caatinga and Cerrado into national heritage protected by the Federal Constitution.



Image 1.6 The 3rd National Meeting of Voices and Practices of Women of the Cerrado. 70 women from traditional communities from different parts of the Brazilian Cerrado gathered to strengthen the sociobiodiversity of the Biome.

This first chapter revealed how cultural biases and historical narratives have influenced the aesthetic and ecological underestimation of the Cerrado. By understanding nature and landscape as cultural constructs, this part of the thesis highlights the importance of reinterpreting this biome through new lenses that integrate ecological value and cultural significance. This theoretical framework lays the ground for the following chapter, which explores the intrinsic environmental and cultural characteristics of the Cerrado, its importance in sustaining Brazil's hydrological systems, and its current challenges.





Chapter 2
Cerrado: the Cradle of Waters

Dossier of the Brazilian Savanna

Dossier of the Brazilian Savanna

A vast biome

Biome: "The largest geographic biotic unit, a major community of plants and animals with similar life forms and environmental conditions."¹

Cerrado: The word comes from Portuguese and means closed or shut. The name expresses the very dense vegetation typical of the savanna, mostly located in Brazil's Central Plateau. (Walter & Sevilha, 2019)

After the Amazon rainforest, the biome area is the second biggest in the country. The area of Cerrado is approximately 24% of Brazil's territory, accounting for roughly 2 million square meters and a strategic position as it acts as a transition to the other four biomes to which it is connected. Sharing boundaries with other biomes has led to an enrichment of biodiversity in this ecosystem. (Souza et al., 2019; Walter & Sevilha, 2019; Durigan et al., 2022; Salmona et al., 2023)

(1) definition from Britannica. Available at: <https://www.britannica.com/science/biome>

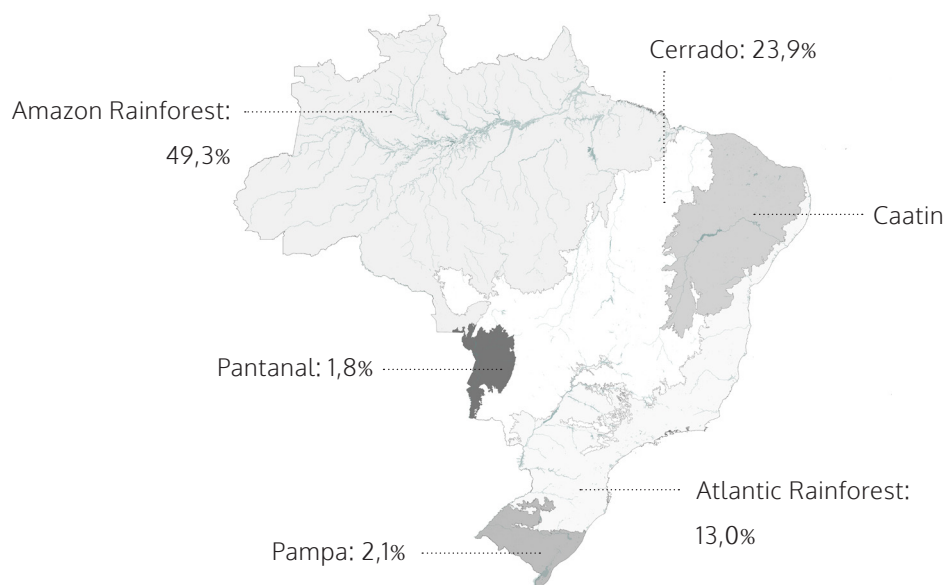


Image 3.01 - Map of Biome areas in Brazil



- native areas
- anthropogenic use

Map of anthropogenic use and native areas in Cerrado

0 250 500 km



Two well defined seasons

Generally, the climate in Cerrado's area characterizes two well-defined seasons and an annual average of 1,200 to 1,500 mm of rainfall, which is concentrated within only six months of the year. The remaining half of the year is marked by water scarcity, a condition to which the vegetation is adapted (Souza et al., 2019; Walter & Sevilha, 2019).

Not only is the dry season a key feature of the development of the biome, but fire also plays an important role in the natural ecological processes of this biome. Through natural selection, numerous plant species adapted to fire occurrence over thousands of years. For example, some species have thermal insulation and thick bark that serves, and others have storage organs responsible for guarding nutrients that allow rapid regeneration (Walter & Sevilha, 2019; Durigan et al., 2022).



Image 2.1 Landscape of cerrado during the wet season (top image) and dry season (bottom image)

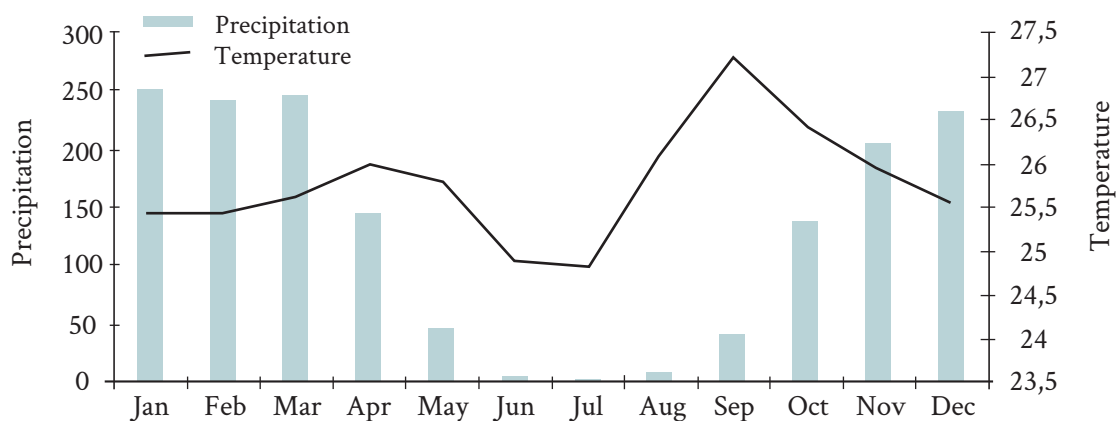


Image 3.2 - Data on annual precipitation and temperature variation in the Cerrado Biome

High biodiversity

The region's distinct combination of soil characteristics, topography, seasonal rainfall distribution, abundance of water resources, exposure to fire, and natural selection has contributed to a high biodiversity, with many endemic plant and animal species (Walter & Sevilha, 2019; Durigan et al., 2022). In 1998, researchers officially classified the Cerrado as one of the world's biodiversity hotspots. The term refers to threatened areas with an exceptionally high number of species and an expressive concentration of endemic species. Globally, 36 regions meet the criteria for this designation, and within Brazil, the Cerrado and the Atlantic Forest are the two biomes included on this list. (Walter & Sevilha, 2019).

This savanna is a habitat for:

- 200 species of mammals
- 860 species of birds
- 180 species of reptiles
- 150 species of amphibians
- 1,200 species of fish
- 90 million species of insects.
- 60 vulnerable animal species, 12 of which are critically endangered.
- 11,000 plant species, from which approximately half is endemic.

Data source: World Wild Life

Available at: https://www.worldwildlife.org/places/cerrado?itid=lk_inline_enhanced-template

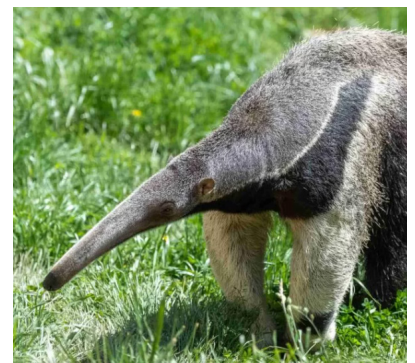
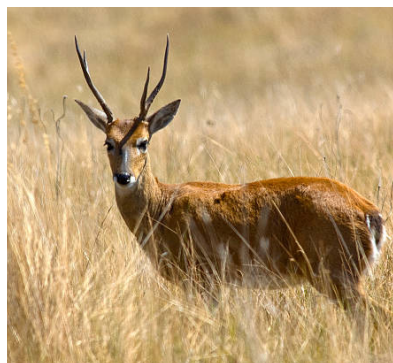
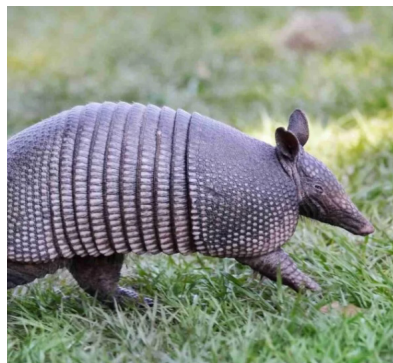


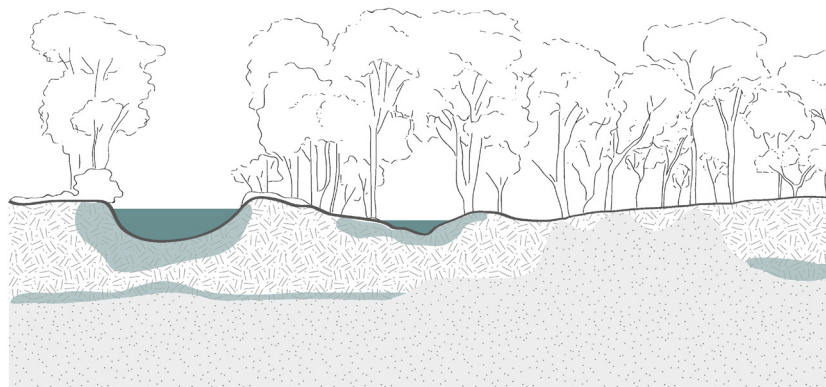
Image 2.2 Species of fauna from the Cerrado Biome

Diverse landscape

The Cerrado features diverse landscape types, forming a complex mosaic that includes formations, savannas with scattered small trees and shrubs mixed with herbaceous plants, and expansive grasslands primarily composed of herbaceous species. Wetlands, marked by palm trees and an important water source for biodiversity, are also present in this variety of typologies (Walter & Sevilha, 2019).



FOREST FORMATION





SAVANNA FORMATION

FIELD FORMATION

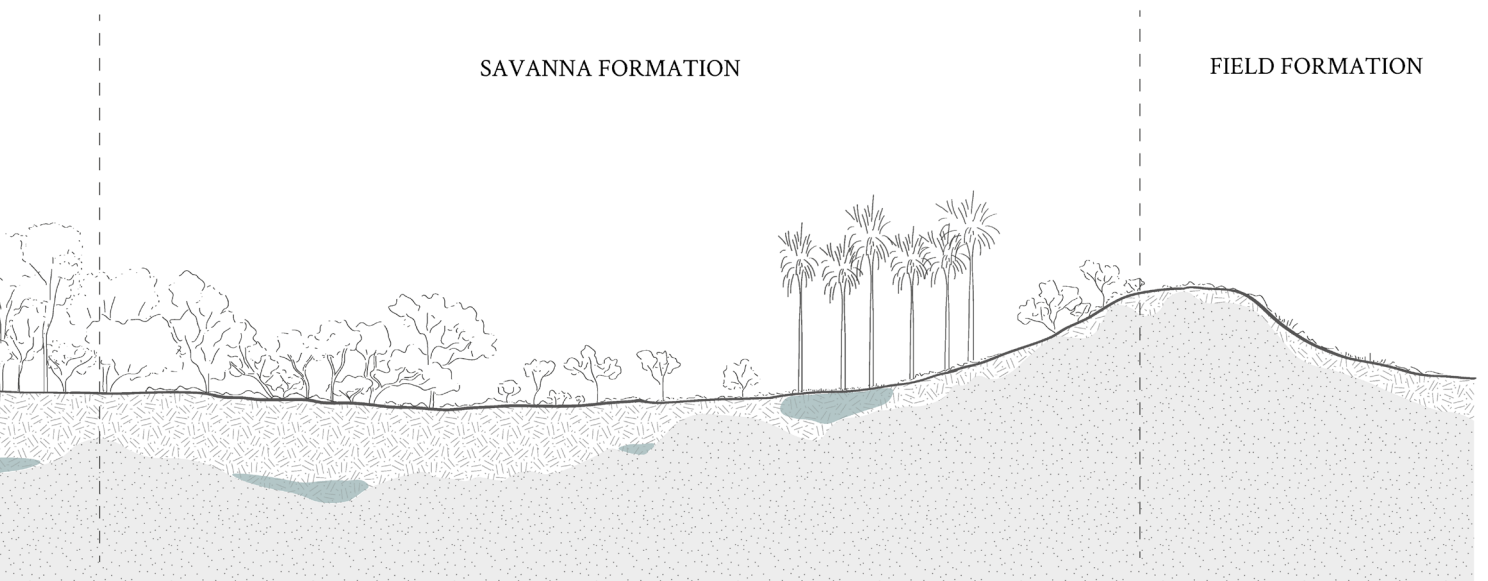


Image 2.3 Abstract section that illustrates the variety of typologies within the Cerrado Biome

Cultural diversity

Indigenous groups such as the Xavante, Tapuia, Karajá, Avá-Canoeiro, Krahô, Xerente, and Xacriabá, among others, were the earliest inhabitants of the Cerrado (Ribeiro, 2002; Walter & Sevilha, 2019). With the arrival of Europeans in South America, the first indigenous population to have contact with the new arrivals was the Tupi, who had their territory by the coast. By the time explorers reached the backlands of the colony, epidemics had reached some populations from the Cerrado and caused decimation before ethnographic documentation., which explains the misinformation about the early populations of this biome's region (Ribeiro, 2002).

The Cerrado is also home to various traditional peoples: quilombolas (Afro-Brazilian communities), *geraizeiros*, *vazanteiros*, *sertanejos*, and *ribeirinhos*, etc. Representing a mixture of European, Indigenous, and African cultures, those populations historically lived in relative isolation, and through generations, they developed socio-ecological practices in symbiosis with the natural resources of Cerrado (Lúcio, 2019; Walter & Sevilha, 2019; Ribeiro, 2002). In that sense, traditional communities are intrinsically part of Cerrado's landscape, from where they developed specific ways of producing food and artisanal crafts and understanding natural cycles. Their importance lies in the fact that they are living sources of biodiversity knowledge. At the same time, they help conserve the biome and carry rich cultural manifestations such as dances, rituals, cuisine, and lifestyle in general (Souza et al., 2019; Ribeiro, 2002).

Over the past few, Cerrado has been the scenario of significant agricultural expansion. This landscape transformation resulted in disturbance, threats, and conflicts with traditional populations, reducing their lands, altering

the natural cycles, and decreasing natural resources, resulting in profound and often irreversible environmental and social impacts (Walter & Sevilha, 2019; Ribeiro, 2002). Those communities suffer from environmental consequences and are undervalued by a socio-economic system that undervalues their traditional knowledge (Lúcio, 2019; Souza et al., 2019).



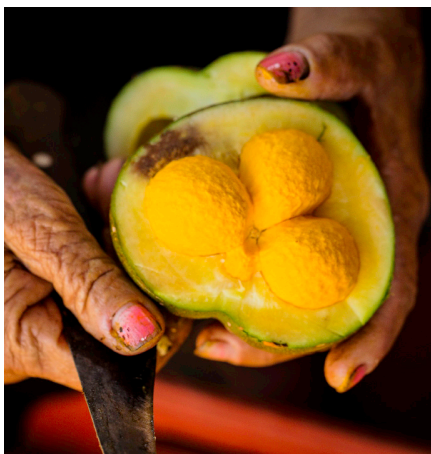
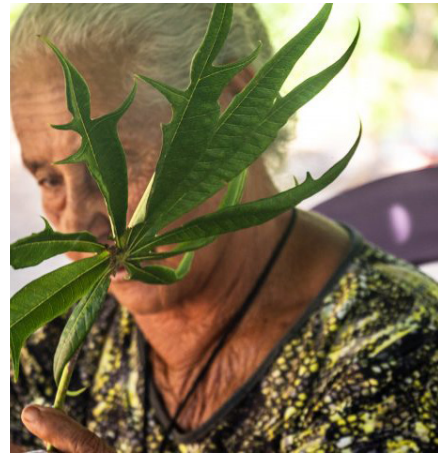


Image 2.4 Group of Images from the traditional peoples of Cerrado

Cradle of waters

The biome forms an important hydrological ecosystem for Brazil. The area is a central watershed divider with abundant springs, small to medium-sized water bodies, and elevated terrain in the country's territory. (Gaspar & Campos, 2007; Souza et al., 2019). Six of Brazil's twelve major hydrological regions originate in the biome, including the biggest wetland in the world: Pantanal (Durigan et al., 2022; Salmona et al., 2023). This biome is also essential for energy generation, as an estimated nine out of ten Brazilians rely on hydroelectric power derived from water systems with headwaters in the Cerrado. (Souza et al., 2019; Salmona et al., 2023).

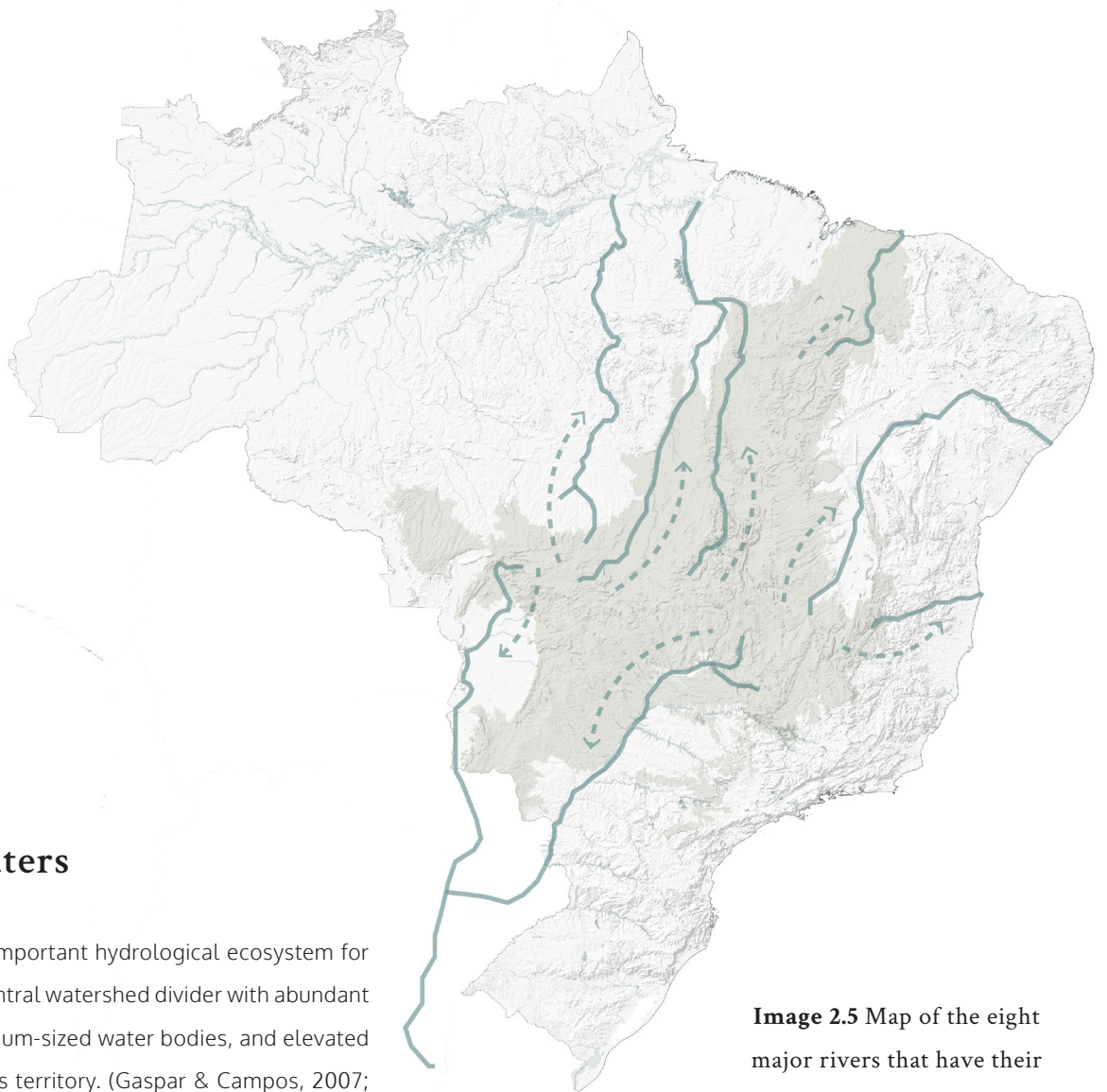


Image 2.5 Map of the eight major rivers that have their headwaters in Cerrado's area

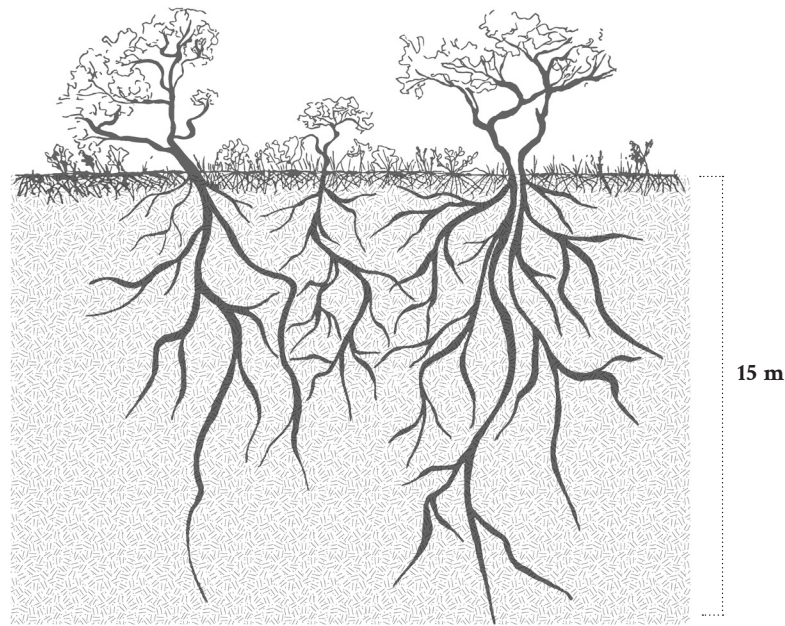


Image 2.6 Illustration of the deep roots from Cerrado's trees

Underground forest

The cerrado's vegetation mainly comprises medium-sized trees and lower layers such as grasses and shrubs. However, about 70% of its mass hides underground. With roots reaching more than 10 meters of deepness, the biome acts as a relevant carbon storage. This characteristic has given Cerrado the title of underground forest, an ecosystem important in balancing the planet's climate (Bustamante, 2016; Durigan et al., 2022). In that regard, the deforestation of cerrado has an even more significant influence on climate change, as with the cut of native vegetation, carbon dioxide that was previously stored underground goes into the atmosphere (Walter & Sevilha, 2019; Beer et al., 2024).

The biome is not just a carbon storage but also a sponge. This system is an example of adaptation to a climate during a drought. The deep roots reach underground water and can survive in dry conditions. The roots are also responsible for keeping the underground water and aquifers (Souza et al., 2019; Gaspar & Campos, 2007).

Agricultural frontier

Commodities in Cerrado have intensified significantly since 1970, with new technologies adapting the poor and typical acid soil to large-scale agricultural practices. With intensive governmental programs and the arrival of multinationals, Cerrado has become one of Brazil's principal agricultural granaries (Walter & Sevilha, 2019; Bustamante, 2016).

However, this intensive development of large-scale agriculture implies negative environmental consequences. Approximately 45% of the area previously covered by native vegetation has been replaced by monoculture fields, which has led to significant impacts such as a reduction in biodiversity, changes in the hydrological cycle, and vulnerability to climate change (Salmona et al., 2023; Durigan et al., 2022).

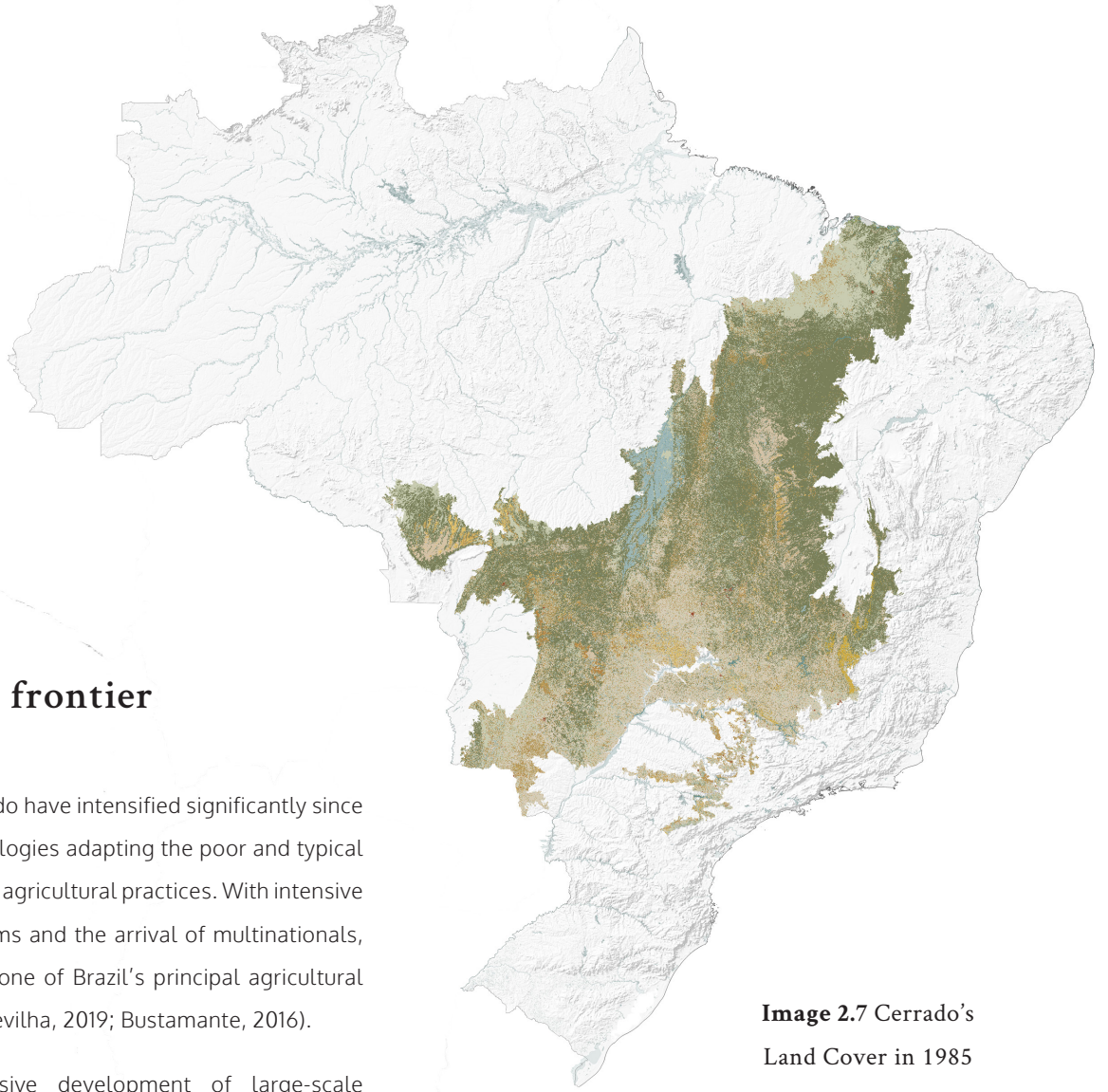
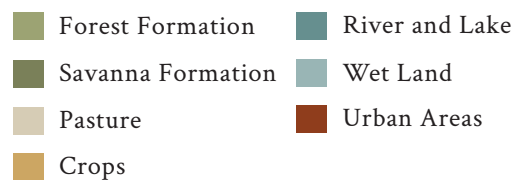


Image 2.7 Cerrado's Land Cover in 1985



0 250 500 km



86% of cotton production
 50% of soybeans
 34% of beef production¹

This reduction in Cerrado is more significant than that of the Amazon Rainforest. For example, while the Amazon has lost approximately 700,000 square kilometers of native forest, the devastation in the Cerrado is estimated at around 1 million square kilometers (Walter & Sevilha, 2019).

Cerrado's devastation is still escalating. "The remains of the Cerrado are in isolated conservation areas, which enable the circulation of species and the maintenance of important ecological processes." (Durigan et al., 2022; Beer et al., 2024)

(1) Source: FAPESP research, 2023. Available at: <https://revista-pesquisa.fapesp.br/en/now-in-its-50th-year-embrapa-rethinks-its-strategies/>

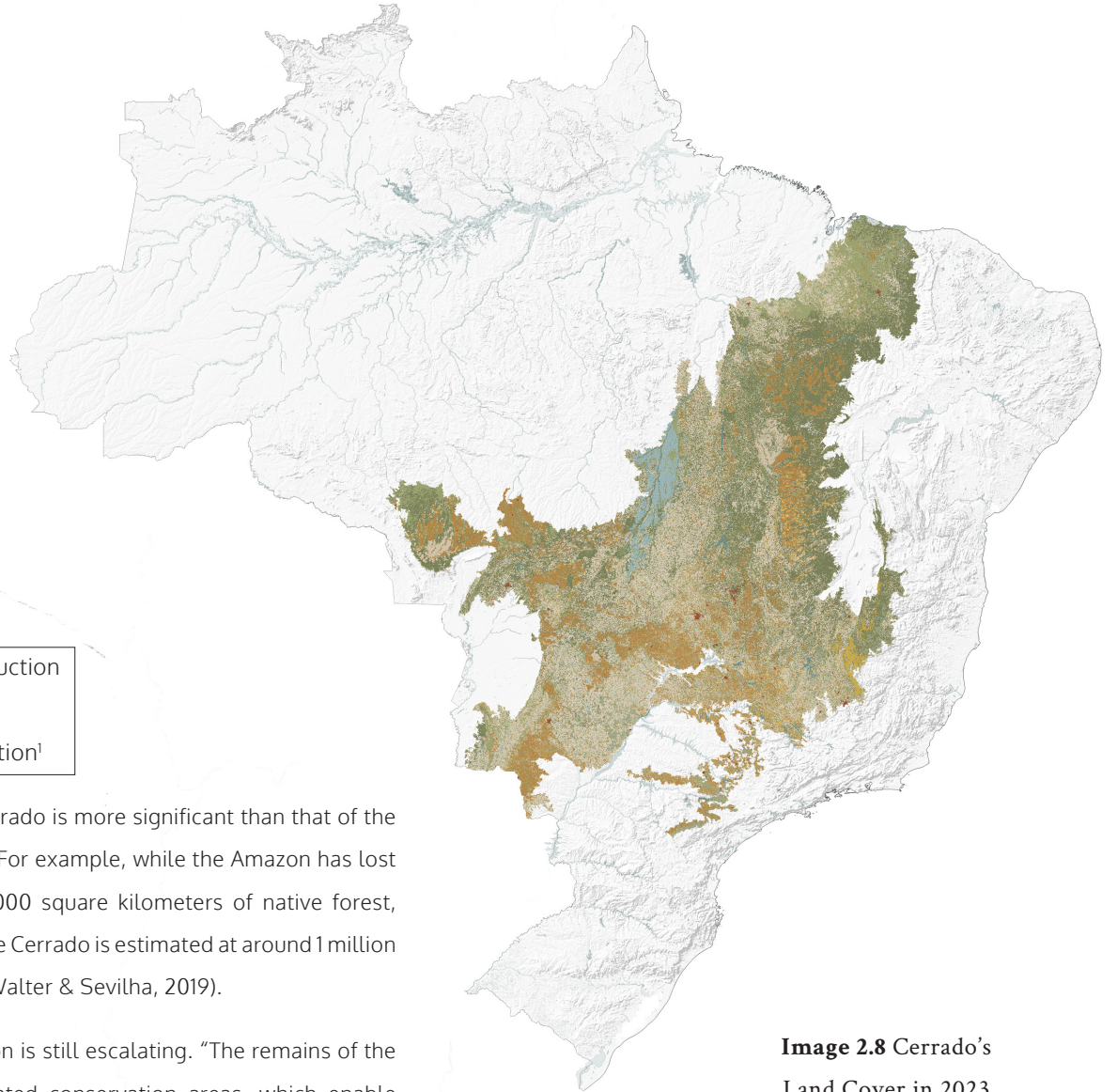


Image 2.8 Cerrado's Land Cover in 2023

- Forest Formation
- Savanna Formation
- Pasture
- Crops
- River and Lake
- Wet Land
- Urban Areas

0 250 500 km



Central Pivot Irrigation system

This map indicates the center pivot irrigation systems across Brazil. It is noticeable that there is a prevalence of this system in the Cerrado biome, and the high concentration in some areas, including the Western Bahia Region. The pivot irrigation technique has intensified the agricultural exploitation of the biome since the 1970s. While the method allows for high productivity in dry periods, it contributes to the depletion of water resources.

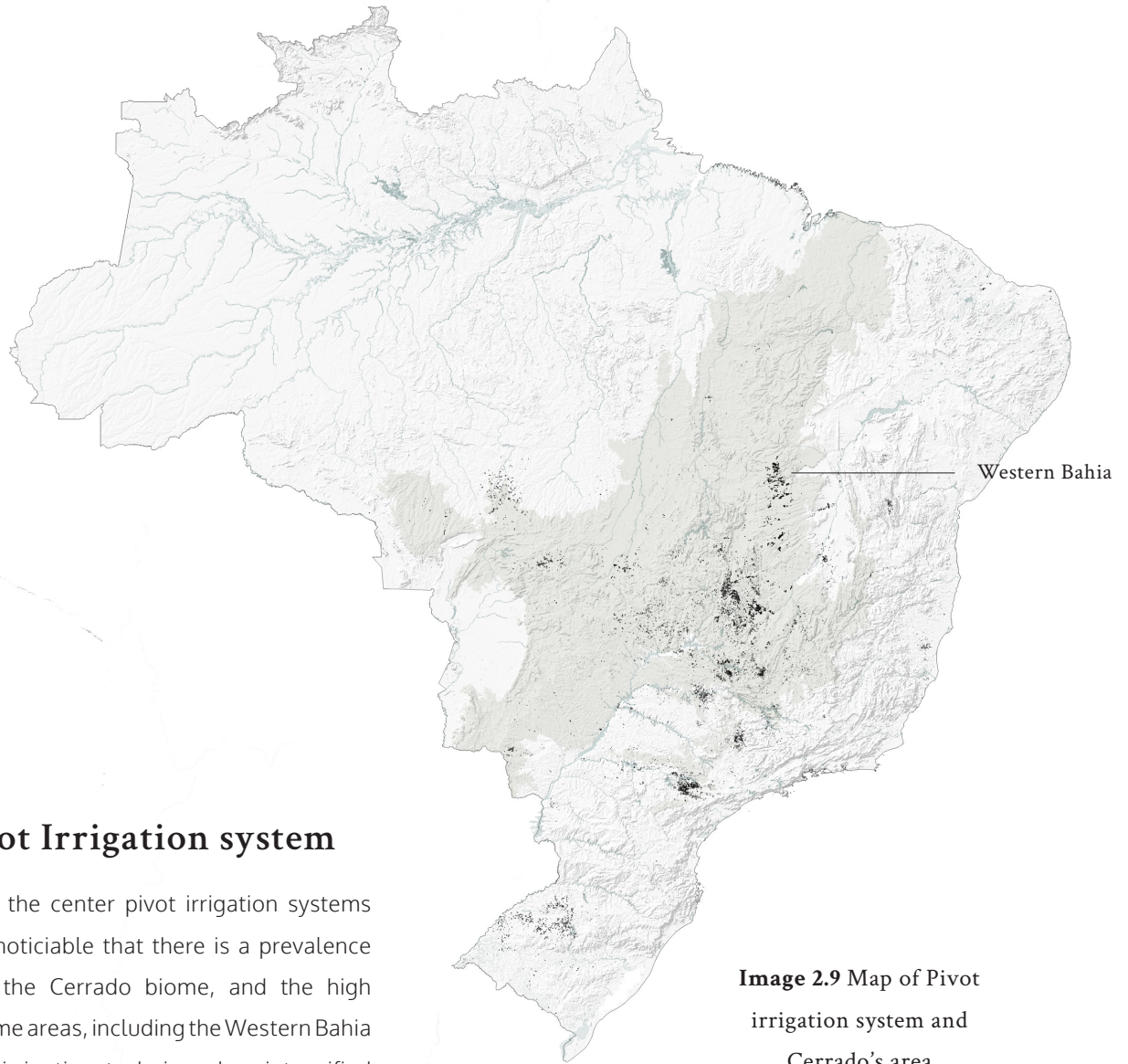
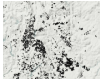


Image 2.9 Map of Pivot irrigation system and Cerrado's area

 Concentration of Pivot irrigation systems

0 250 500 km





Image 2.10 Image of the soya crop and the rotational metallic mechanism that irrigates the fields



Image 2.11 Agricultural landscape pattern with in Western Bahia. The large presence of the round shapes shows the dominance of mechanized irrigation system in the region.



Image 2.12 Zoom-in in the Agricultural pattern that utilizes center pivot irrigation.



Image 2.13 Zoom-in in the Crop fields and water retention reservoir, used for irrigation during the dry season.



Image 2.14 Water pumping station connected to the river. The infrastructure captures water directly from the river, pumping it into reservoirs that support irrigation systems.

Delving into the Cerrado biome and its current context, this dossier highlights the biome's biodiversity, hydrological significance, and rich cultural connections with traditional communities. The Cerrado is not just a savanna but a vital ecological infrastructure. Yet, despite its environmental value, this landscape faces increasing pressure from agriculture. The next chapter examines how large-scale agricultural expansion in Western Bahia has commodified water, transforming the Urucuia Aquifer into an extraction source resulting in socio-environmental conflicts.



An aerial photograph of a vast agricultural landscape. A winding river flows through the center of the image. The land is divided into numerous rectangular plots, many of which are irrigated, creating a pattern of circular and semi-circular shapes. The colors range from dark brown and black (possibly water or shadows) to light tan and green. The overall scene depicts a complex system of water management and land use.

Chapter 3
Water as Commodity

Western Bahia Biography

Until the 1970s, the vast land of Western Bahia the 'Gerais' was public land, predominantly used communally by the traditional communities known as 'geraizeiros'. The Geraizeiro communities settled in the valley bottoms, where they cultivated crops near rivers and streams utilizing traditional irrigation systems. On the Hillsides, they practiced rainfed agriculture and established pastures. During the rainy season, the cattle stayed in the naturally formed pastures. In the rainy season, the animals were moved to the 'fecho de gerais', more distant areas upstream, in the upper areas of the plateau, characterized as public land (Santos & Pinho, 2001).



Region 'Beyond the Sao Francisco'

Until the mid-20th century, the regional economy was centered on extensive livestock farming and simple commercial agriculture to meet the region's needs.

First urban settlements along the rivers

XVII



From this moment, Western Bahia underwent more enormous transformations with the expansion of the agricultural frontier. Introduction of modern techniques in agriculture and region start to gain relevance as grain producer. "Thus, with these economic characteristics, the Western Region acquired its current territorial identity, no longer being referred to as 'Beyond the São Francisco'"(Santos & Pinho, 2001).



Brasilia Construction

The planned modern capital located in the center of the country, gave the region new influence. Central Brazil became accessible, with roads connecting the more industrialized areas to Brasília.

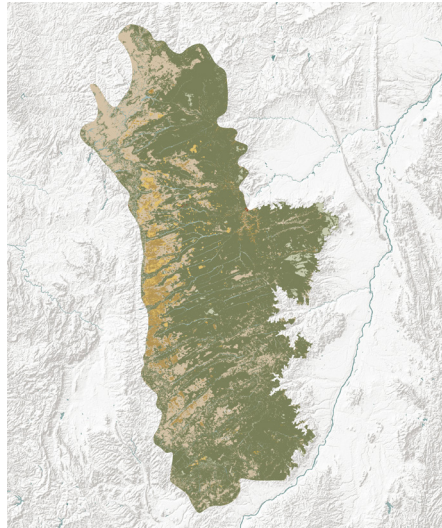
1960



Public and private investments for occupation and irrigation projects

1970

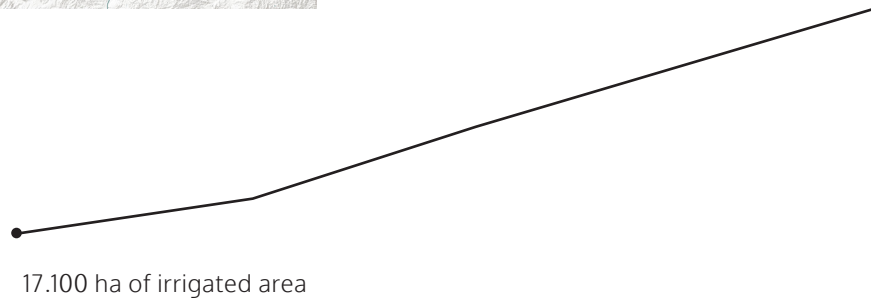
Land cover in 1985



- Forest Formation
- Savanna Formation
- Pasture
- Crops

Land grabbing

An illegal process through which the Grileiros (land-grabbers) employ a range of coercive strategies, sometimes even using violence, to force the Posseiros (informal landholders) off the lands that they have occupied for centuries. Very often, the Grileiros started the approach of showing false documents to the Posseiros. The origin of the name Grileiro comes from a method used to fake ownership certificates in the past, which was to leave the paper in a box with live crickets (Grilos in Portuguese). In that way, the papers would look stained and yellow, with an old aspect. (Arioaldo, 2023)



17.100 ha of irrigated area

Between 1990 and 2018, the agricultural land in Western Bahia expanded by approximately 440 %. The irrigated area uses the center pivot technique mainly and comprises 5,81% of the cultivated land in Western Bahia, a practice that intensifies productivity.

1980

1990

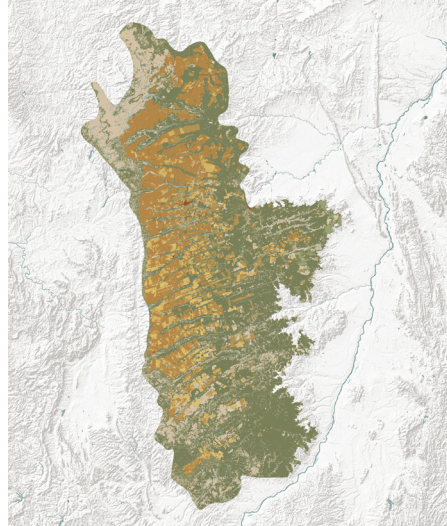
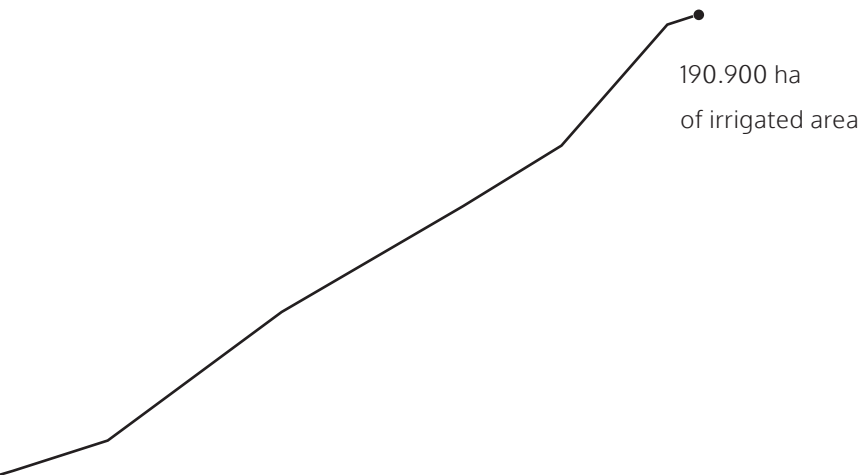
2000

Land concentration

Introduction of soya as the main product

The population migrated from rural areas to urban areas.

Land cover in 2023



Commodity production

Soya - 67% of the total area

1.9 million hectares

Production: **7.4 ton million**

Cotton

345 hundred ha

Production: **1,6 ton million**

The Netherlands:

4.15 million hectares

2012

2020

2025

For production in 2024/2025, a rise of 7.5% in the soya area, 10.1% of the cotton area, and a reduction of 8.9% in the corn area is expected.

A Water Export Region

Since 2012, government policies have allowed disproportionate water extraction for irrigation purposes. Salmons et al. (2023) emphasize that this intensive irrigation regime, combined with extensive deforestation of the Cerrado biome, will imply future water scarcity scenarios in western Bahia.

Rainfed agriculture has been largely impacted by recent extreme climate changes, such as droughts and excess rainfall, which has led to farmers opting to invest in center-pivot irrigation.

Western Bahia has reached the leading position in the center-pivot irrigation industry in Brazil. The tendency of increase in the center pivot is higher productivity per hectare, two to three times higher than that of rainfed crops. Production in the dry season decreases the pressure of deforestation to expand the agricultural frontier. However, water resources are being consumed heavily.

“The watersheds spatially located in the west of Bahia state, for example, showed clear decreasing trends and significant reductions in river flows, which will potentially worsen surface water availability, especially during dry periods [...]” (Salmons et al., 2023).

The consequences of such a large-scale productive landscape have dramatically affected local communities and water resources. The region has become known for socio-environmental conflict. More critically, the continued expansion of this unsustainable production threatens not only local water availability but also the viability of

the agribusiness model itself, which depends on stable hydrological cycles.

Donahue and Johnston (1998) argue that water scarcity is not only a consequence of geographical or climate events. Examples around the world of water management often result in an imbalance of water distribution or alter hydrological systems that bring short-term benefits but impact ecosystems in the long term.

This observation helps understand the Western Bahia case as an example of how water scarcity is not necessarily connected to a lack of water resources; it also relates to how the resource is managed and distributed among different groups of society. Even though the aquifer offers an abundant water resource, the allowances for water extraction do not consider its recharge capacity.

Moreover, the transformation of western Bahia into a hub of global commodity production reveals the link of local water issues within broader geopolitical and economic systems. Through the export of water-intensive crops, the region effectively exports water itself, an idea encapsulated in Allan’s (1998) concept of “virtual water,” which refers to unseen ‘water consumed in the production process’.

According to Vos and Boelens (2018), the boom of global agricultural trade has led to a significant rise in virtual water exports, which has complex consequences for the regions producing these goods. On one hand, Export-oriented agriculture benefits the local economy, creating employment opportunities and generating profits



Image 3.1 Local farmer on a dry canal in Brejo Verde, a rural village in Western Bahia

Photo from Dado Galdieri



Image 3.2 Pumps taking water from the Arrojado River to the irrigation system of Rio Claro farm in

Wester Bahia. Photo from Dado Galdieri

for landowners and investors. On the other hand, it often causes depletion and pollutes water resources. As a result, these transformations alter both global and local water governance structures, raising concerns about water access and distribution, or, in other words, water justice.

The authors highlight that agro-export economies are supported by narratives of “efficiency,” “productivity,” and “modernity.” However, such discourses, rooted in neoliberal water governmentalities, mask the inequalities and ecological degradation imposed on local territories. As Vos and Boelens (2018) argue, these rationalities are reinforced by national water policies, international financial programs, and private certification schemes, all of which help institutionalize a model that privileges profit and efficiency over sustainability and equity.

The Western Bahia case illustrates how socio-political dynamics fundamentally shape water scarcity rather than natural constraints. The crisis unfolding in the region reflects deeper tensions in contemporary water governance, tensions between global commodity production and local ecological limits.

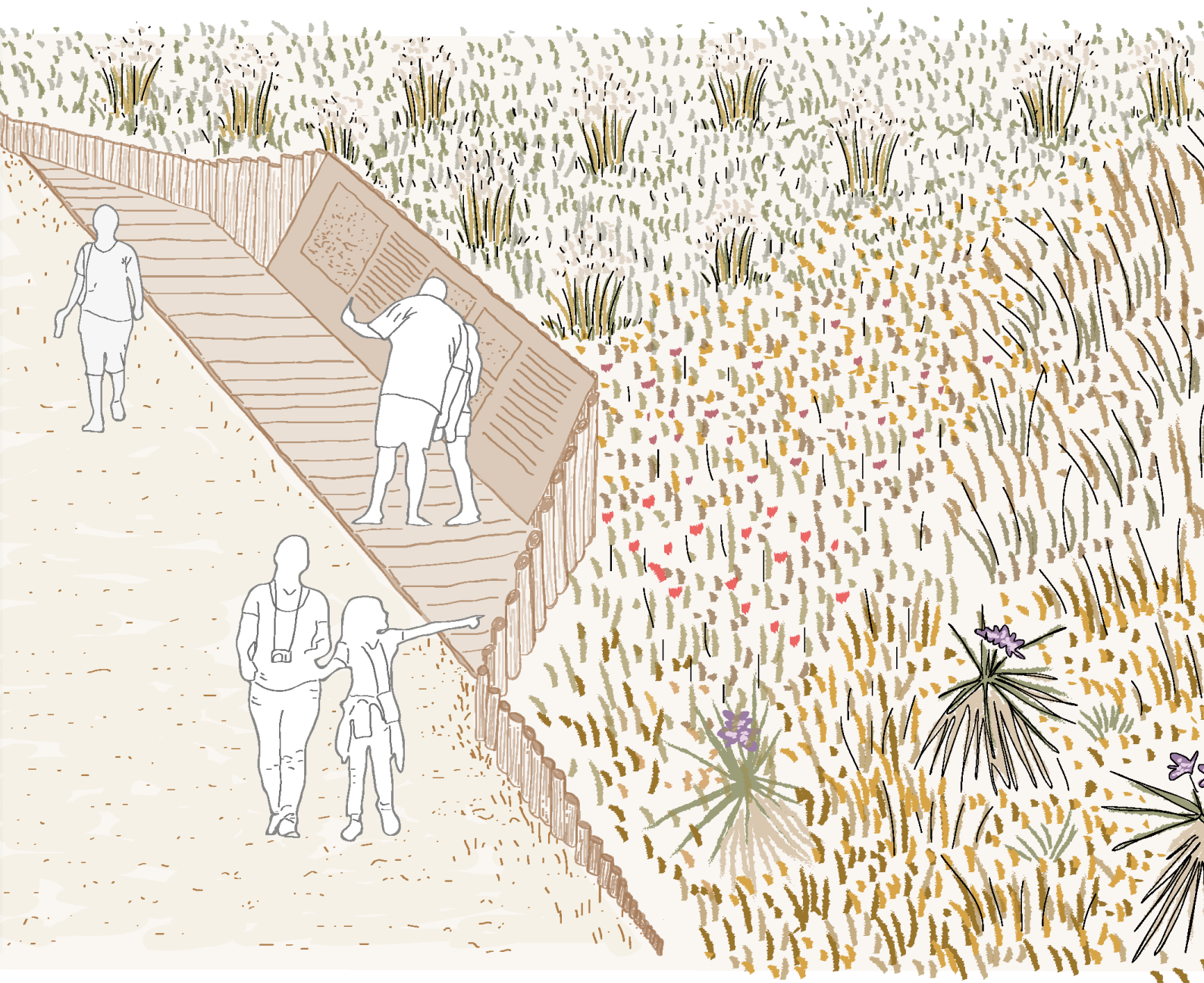




Image 3.3 Main international destination of soya beans produced in Western Bahia

Data adapted from AIBA

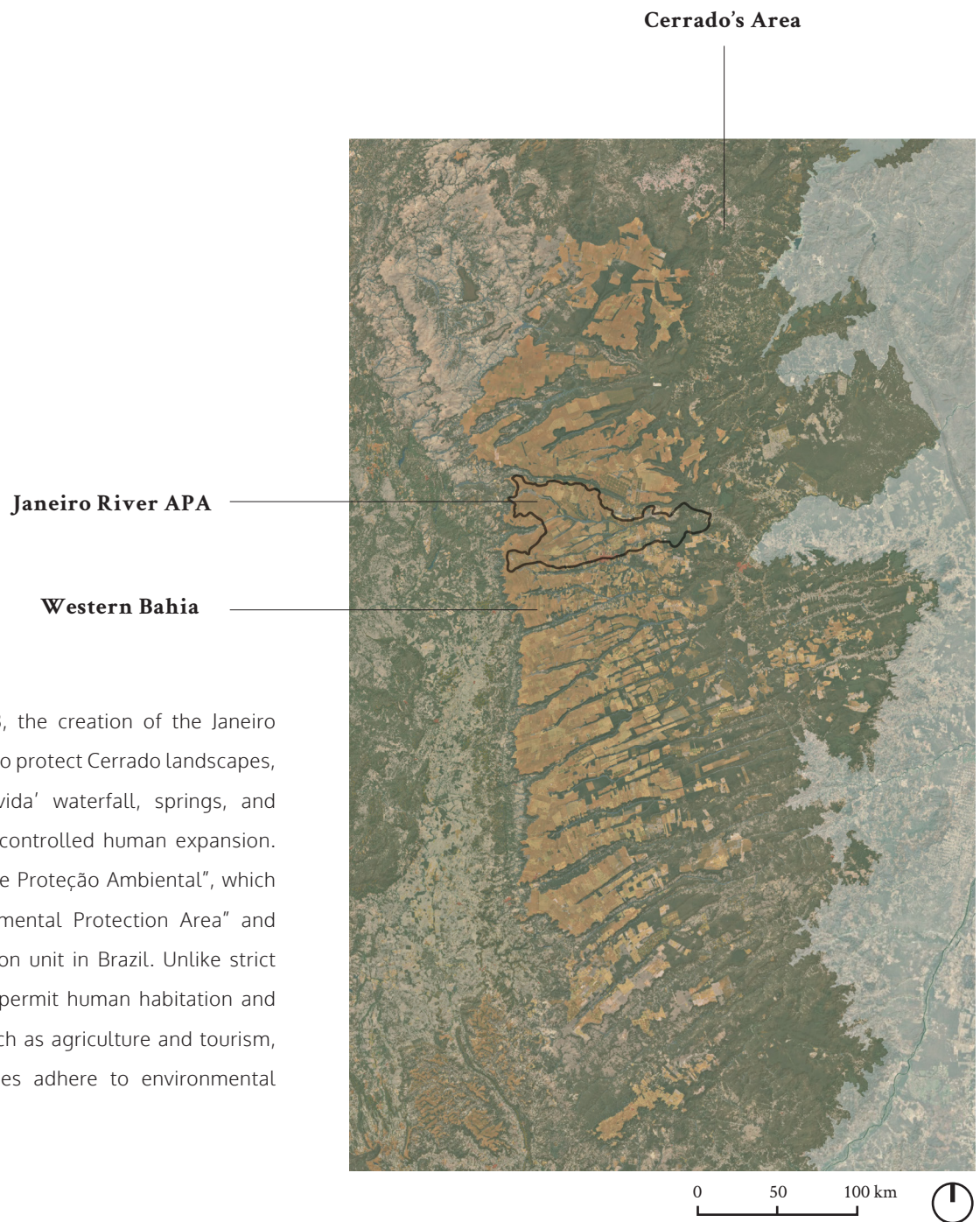
Chapter 3 goes deeper into the transformation of Western Bahia into an agro-export hub, where water is seen as a commodity embedded in global markets. The rise of irrigation-based monoculture has intensified ecological degradation and social inequalities, particularly for traditional communities. Within this context, the next chapter presents a design site in Western Bahia and envisions alternative futures, reclaiming value in the Cerrado.



Chapter 4
Valuing the Cerrado



An Unsuccessful Preservation Area in Western Bahia



Established in 1993, the creation of the Janeiro River Basin APA aimed to protect Cerrado landscapes, including the 'Acaba-vida' waterfall, springs, and swamp areas, from uncontrolled human expansion. APA stands for "Área de Proteção Ambiental", which translates to "Environmental Protection Area" and is a type of conservation unit in Brazil. Unlike strict nature reserves, APAs permit human habitation and economic activities, such as agriculture and tourism, provided these activities adhere to environmental zoning regulations.

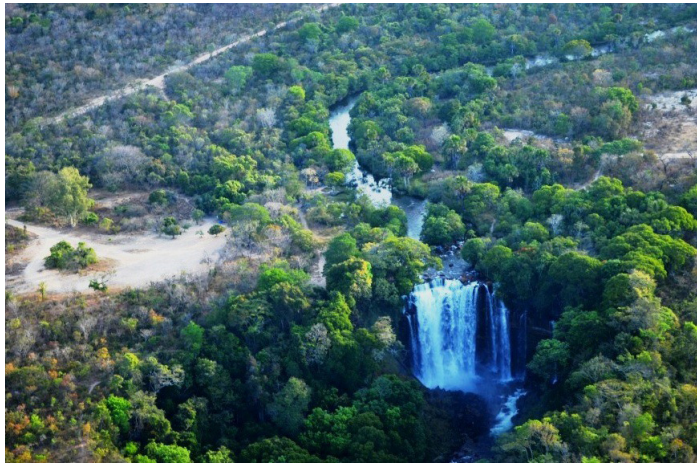


Image 4.1 'Acaba-vida' waterfall. With a dramatic fall of 36 meters, it is considered a natural monument.



Image 4.2 The clear water and natural pools attract the Janeiro River and local tourists.



Images 4.3 -Janeiro River and Swamp Areas. Photos from the site visit during January 2025



Despite being designated a protected area, the landscape feels no different from the rest of Western Bahia's massive grain production machine. Vast, monotonous fields of soya as far as the eye can see. Driving for tens of kilometers, the scenery repeats itself without a single native tree in sight. It made me ask: Why even designate it as a preservation area?



Images 4.4 Monoculture fields of soya in the Janeiro River APA.
Photos from the site visit during January 2025



Everywhere you look, you are surrounded by the signs of agribusiness. Advertisements promoting fertilizer brands, irrigation systems, seed companies, and the newest technologies. It's clear: the local economy is driven entirely by—and built around—the grain export industry. You don't just pass through this place; you become immersed in the only theme of large-scale agriculture.



Images 4.5 Monoculture fields in the Janeiro River APA. Photos from the site visit during January 2025



Yet, while visiting local communities, a contrast emerges. In this industrial landscape, small backyard gardens appear. Open and welcoming, locals shared stories from the past, revealing a deep and intimate relationship with the land and the Cerrado that is at risk of disappearing. Their connection to native vegetation and traditional ways of living quietly resists the dominance of monoculture.



Images 4.6 Local communities in Janeiro River APA.
Photos from the site visit during January 2025

Current Situation of the Janeiro River Basin

Despite being a conservation unit designed for sustainable use, the absence of a management framework allowed for the uncontrolled spread of monoculture farming, especially soy, and cotton, which now occupy nearly two-thirds of the area, more than the surrounding landscape, outside of the preservation borders.

This land-use pattern contradicts the APA's original conservation intent. According to geographer Mário dos Santos (2022), the current agribusiness model prioritizes short-term commodity production, resulting in little employment and minimal value generation for local communities, thereby exacerbating income inequality¹. While some Brazilian producers have adopted more sustainable methods, such practices remain absent in the APA region.

The current management of the preservation area fails to regulate or even describe the environmental impacts agriculture causes, such as the use of pesticides or water consumption. Meanwhile, local communities—mostly smallholders with limited access to services—were overlooked in the planning process.

Moreover, legal justifications for deforestation were upheld by authorities, even though legal mechanisms exist to limit environmental damage. Ultimately, the adopted zoning reflects a preference for agribusiness development over meaningful conservation, revealing the political priorities driving land use in the APA.

(1) Information available at: <https://cbhsaofrancisco.org.br/noticias/novidades/>. Accessed on November 2024.





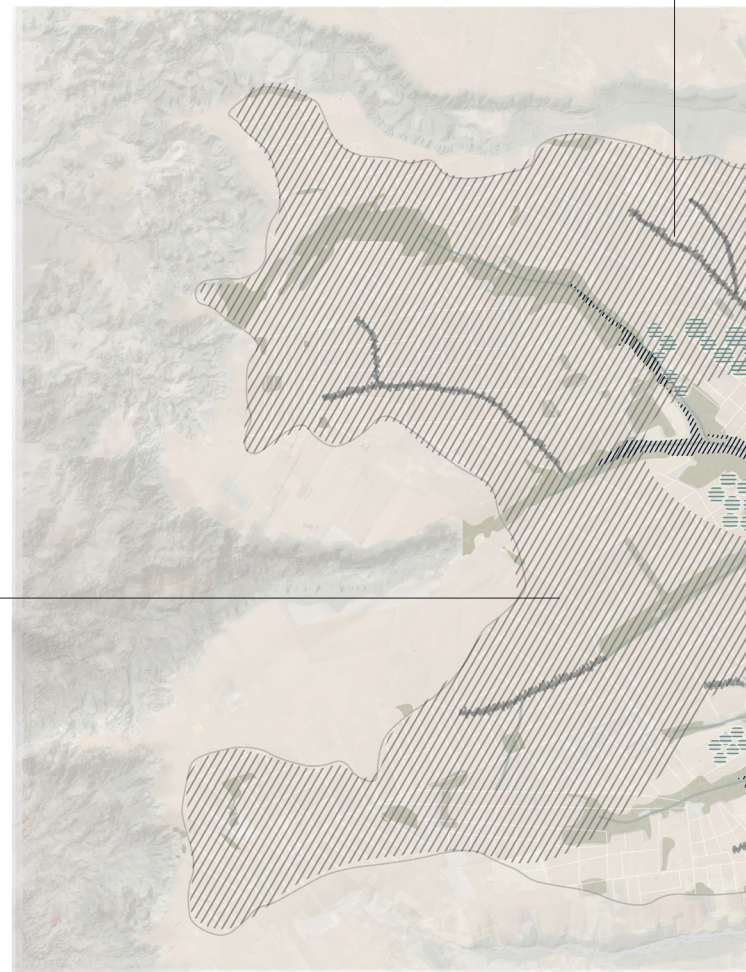
Current Situation of the Janeiro River Basin



Loss of riparian vegetation
Fields over headwaters



Recharge of the aquifer is
compromised



Lack of connectivity

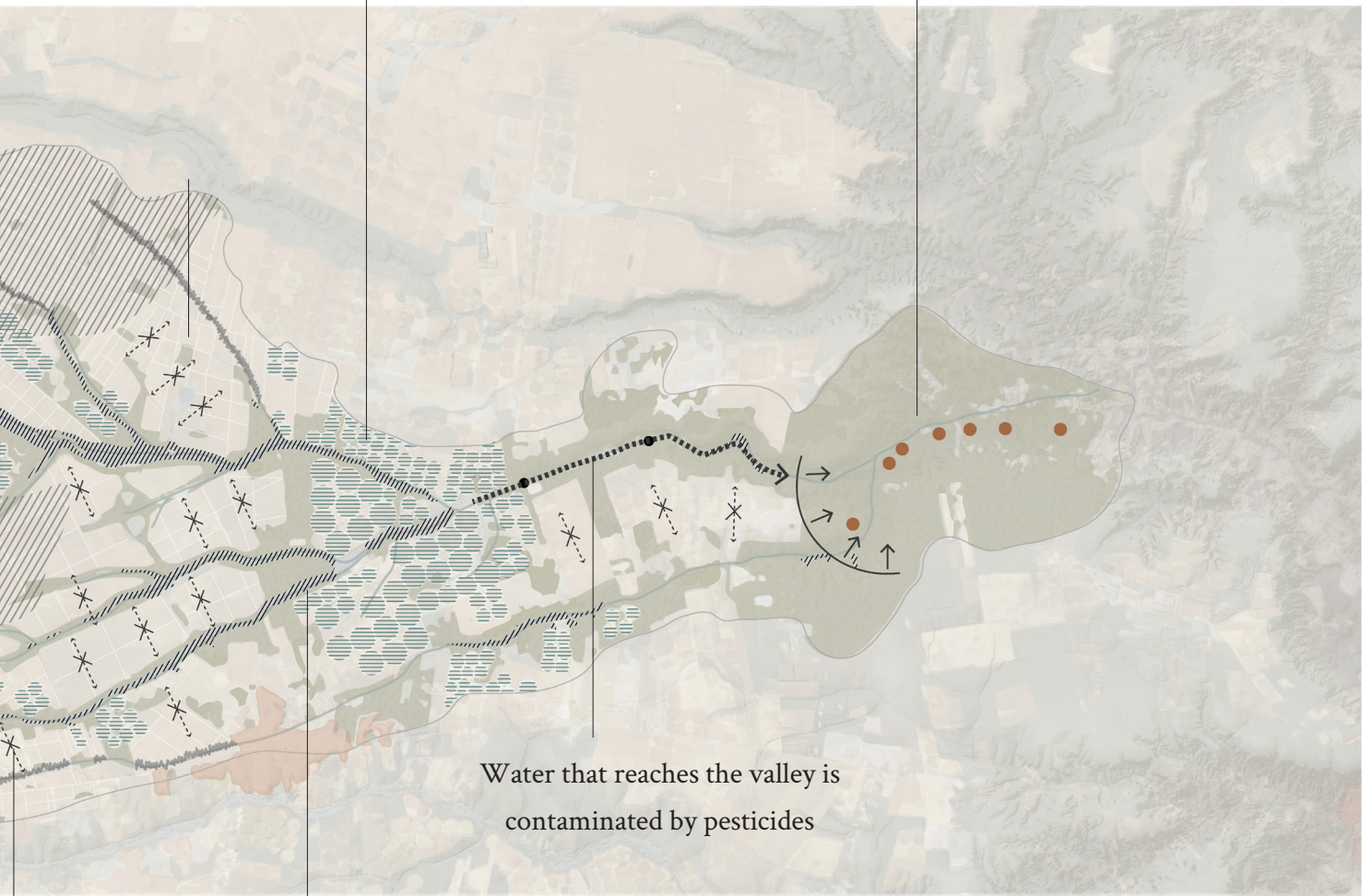




Depletion of water resources by the Pivot irrigation system

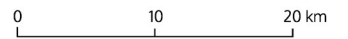


Traditional communities apart from the productive areas



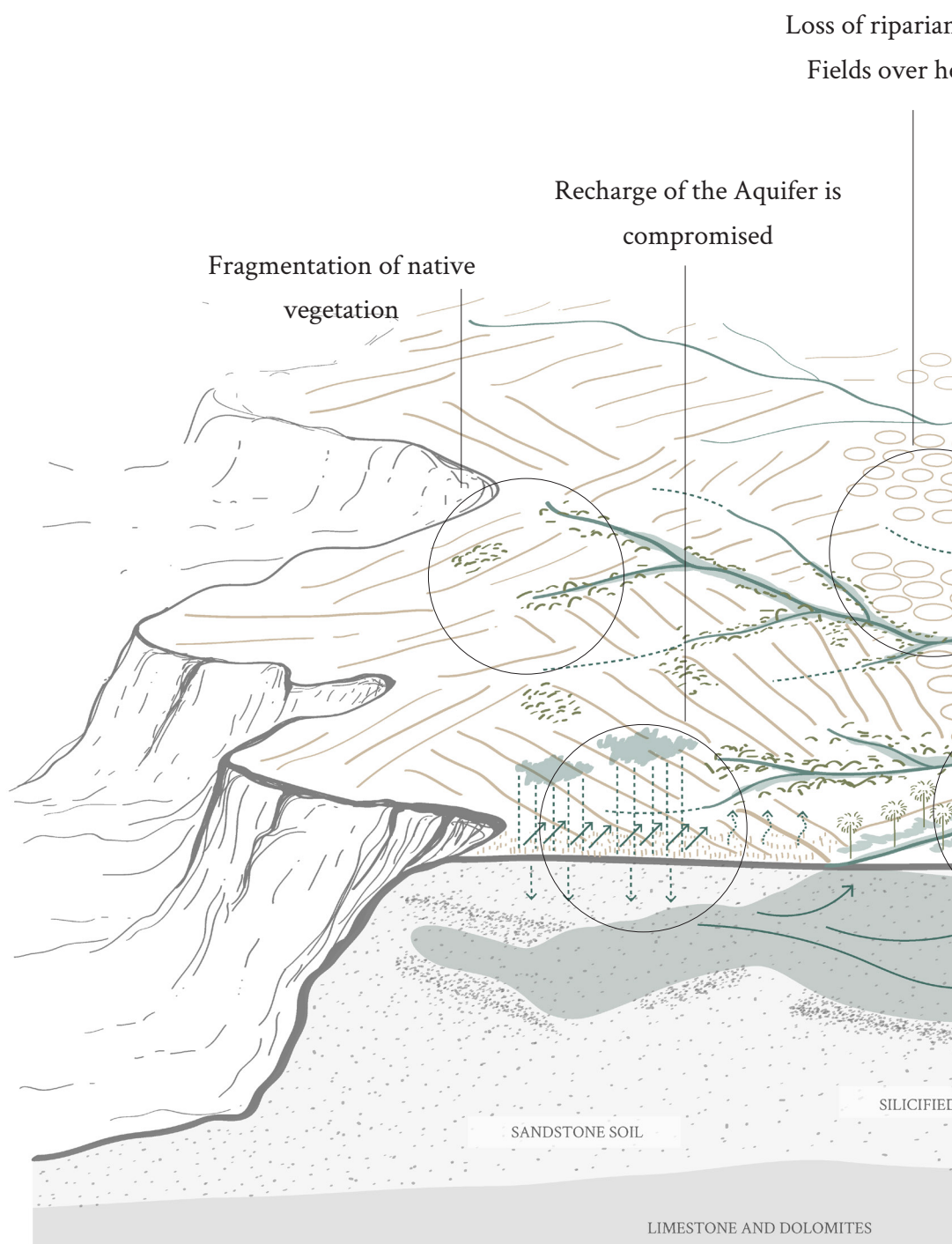
Water that reaches the valley is contaminated by pesticides

Swamp areas are drying

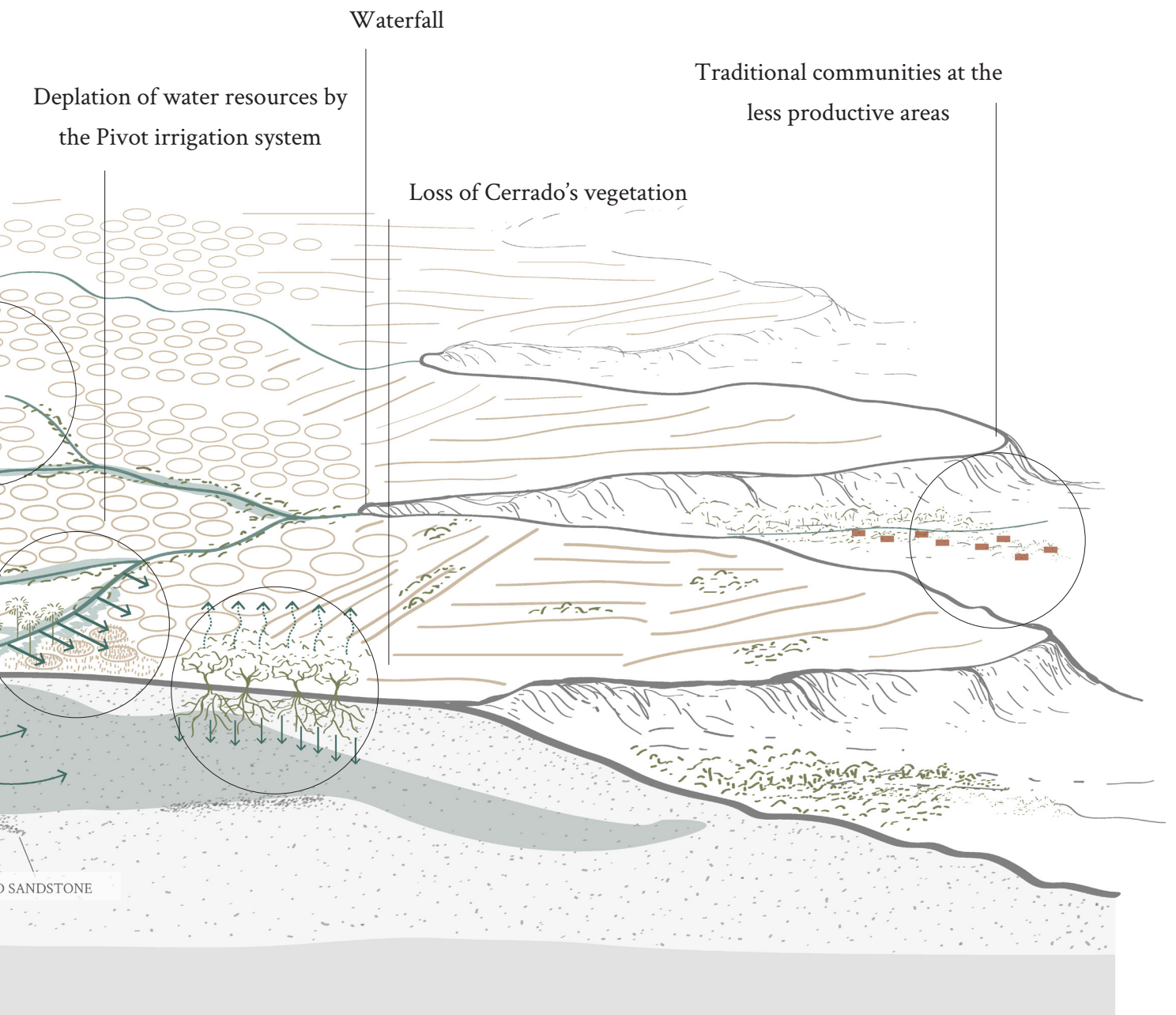


Imaginary section of the current situation

The illustration is an imaginary section that resumes the current situation of large-scale agriculture in the Janeiro River Basin and Western Bahia, which impacts the aquifer Urucuia, Cerrado's ecosystem, and local communities.



in vegetation
headwaters



Cerrado's fauna as a tool for rethinking Janeiro River Basin

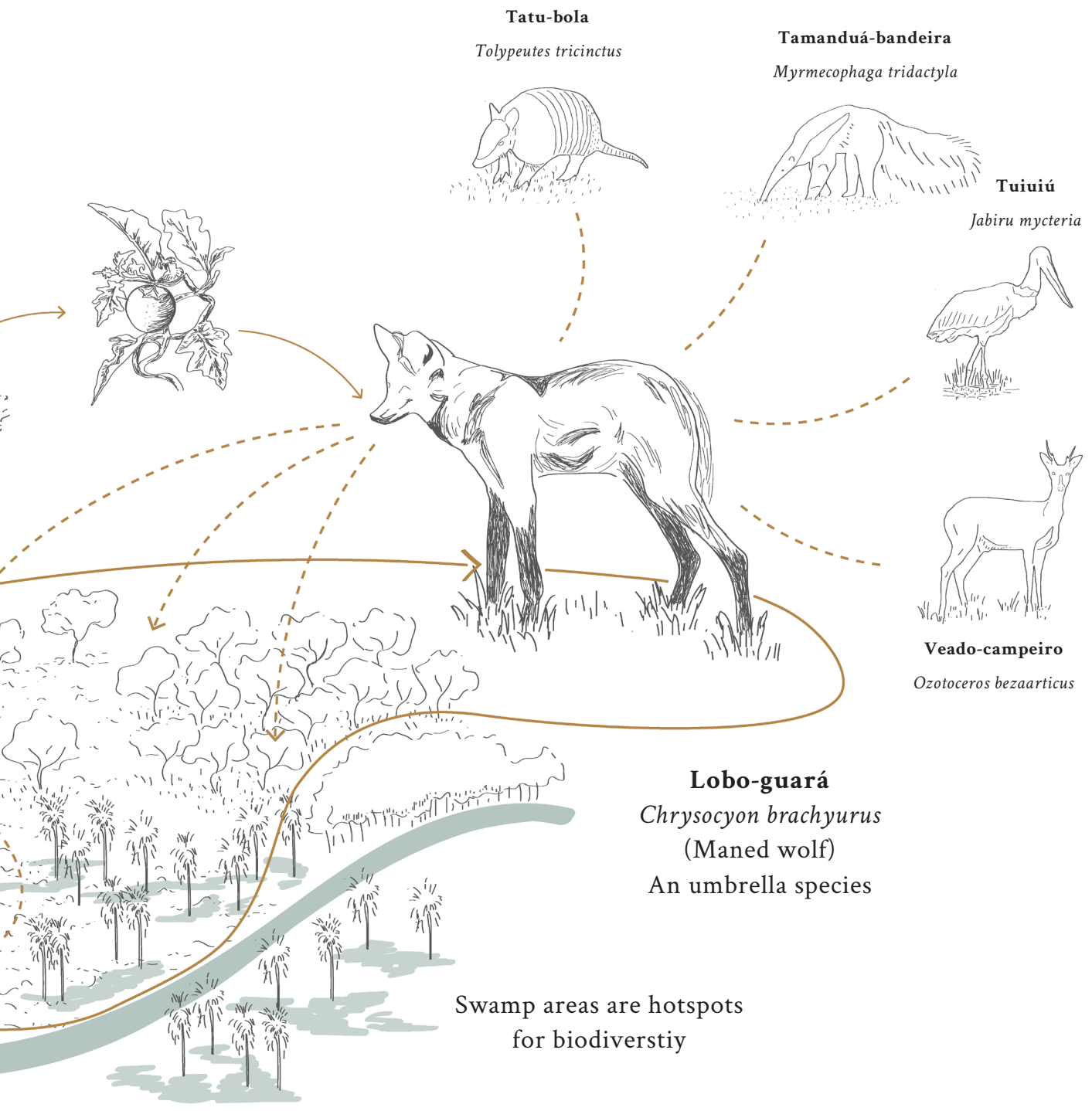
Looking into the animals of the Cerrado as tools to guide a vision for the Janeiro River Basin reveals the potential of species like the lobo-guará (*Chrysocyon brachyurus*), or maned wolf. Recognized as a vulnerable species and an iconic symbol of the Cerrado, the lobo-guará serves as an umbrella species—its conservation supports the protection of many other species and their habitats. This solitary, wide-ranging omnivore requires a large territory, between 25 and 100 km², and can travel up to 14 km per night. Its diet favors native Cerrado fruits, and it is an important seed disperser, contributing to the ecological balance and regeneration of the biome. (Motta-Junior & Martins, 2002) Understanding and supporting the needs of such species is used as the base for a vision for the Janeiro River Basin.

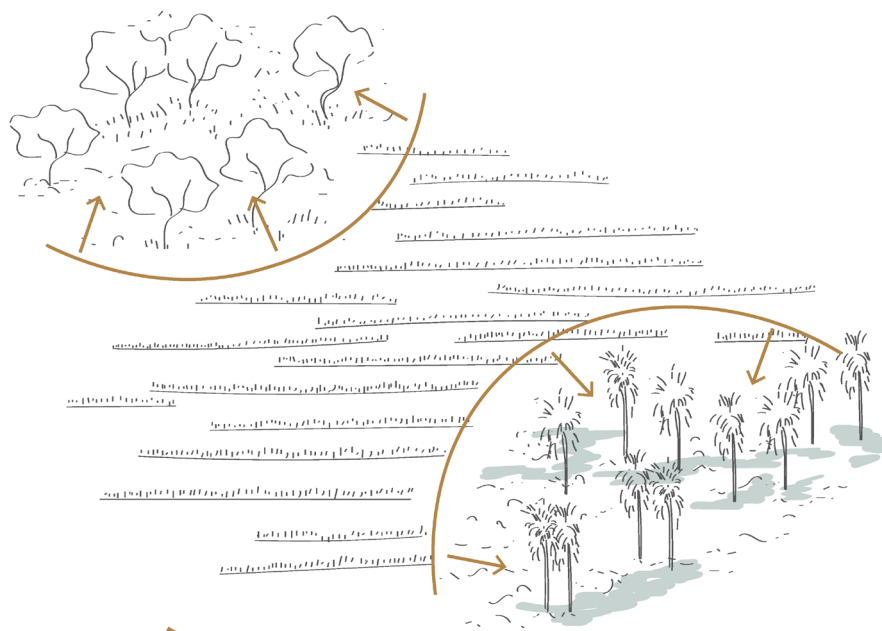
Lobeira (Wolf fruit)
Solanum Lycocarpum
Favorite fruit from the
Cerrado



Wide territory
25 / 100 km²

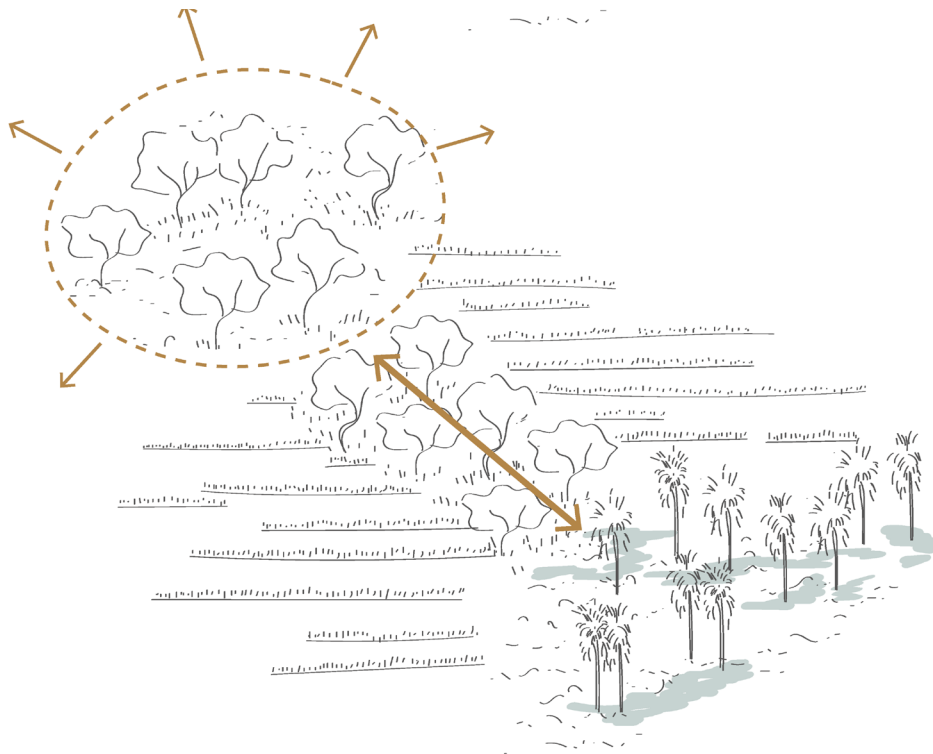
Preferable habitat:
open fields, grasslands





Threats for the maned wolf:

- Fragmentation of habitat
- Scarcity in food (fruits and small animals)
- Roads
- Expansion of agriculture
- Less habitat
- Urbanisation



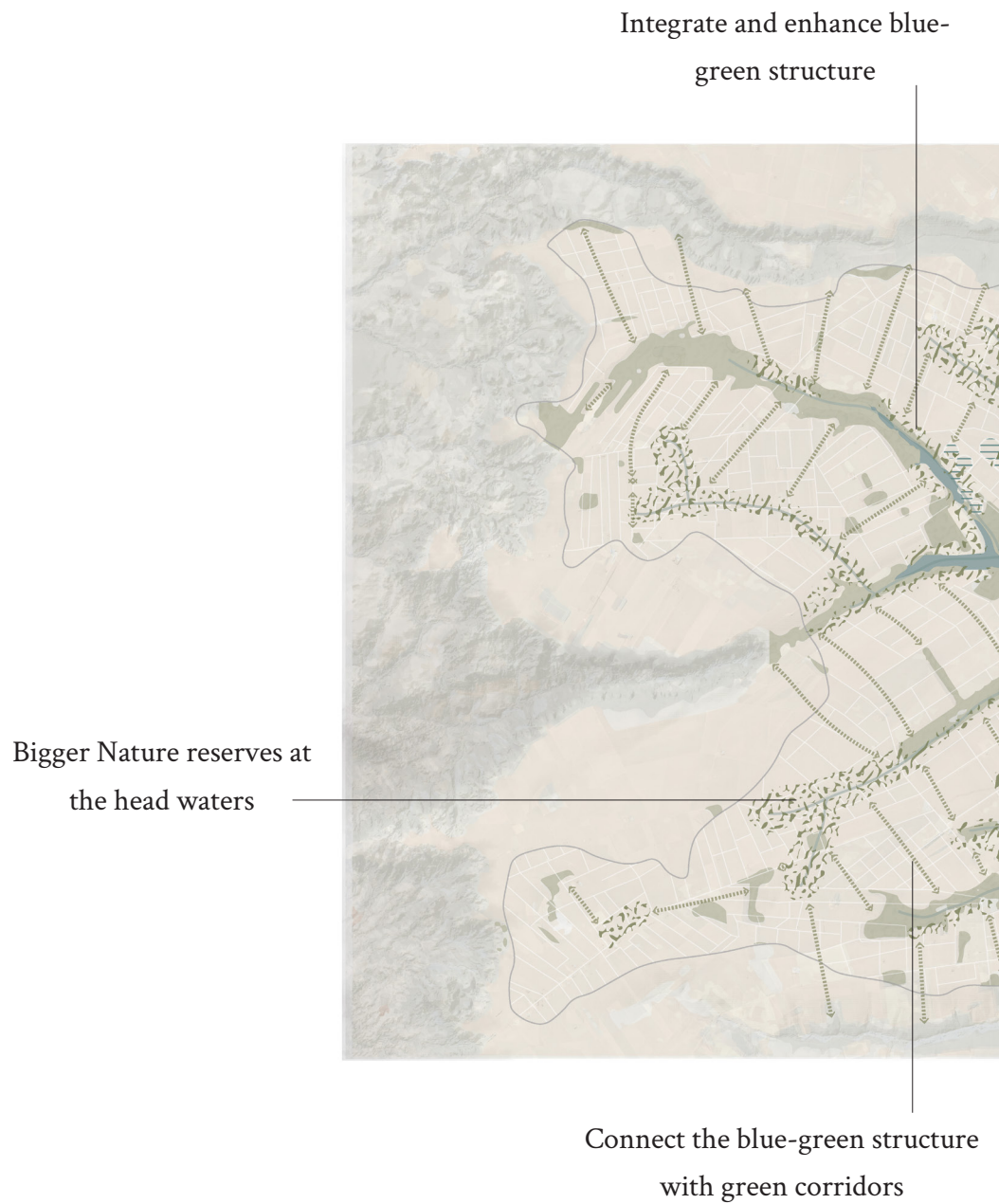
Strategies:

Expand habitat

Creation of Corridors for movement
and to connect habitats

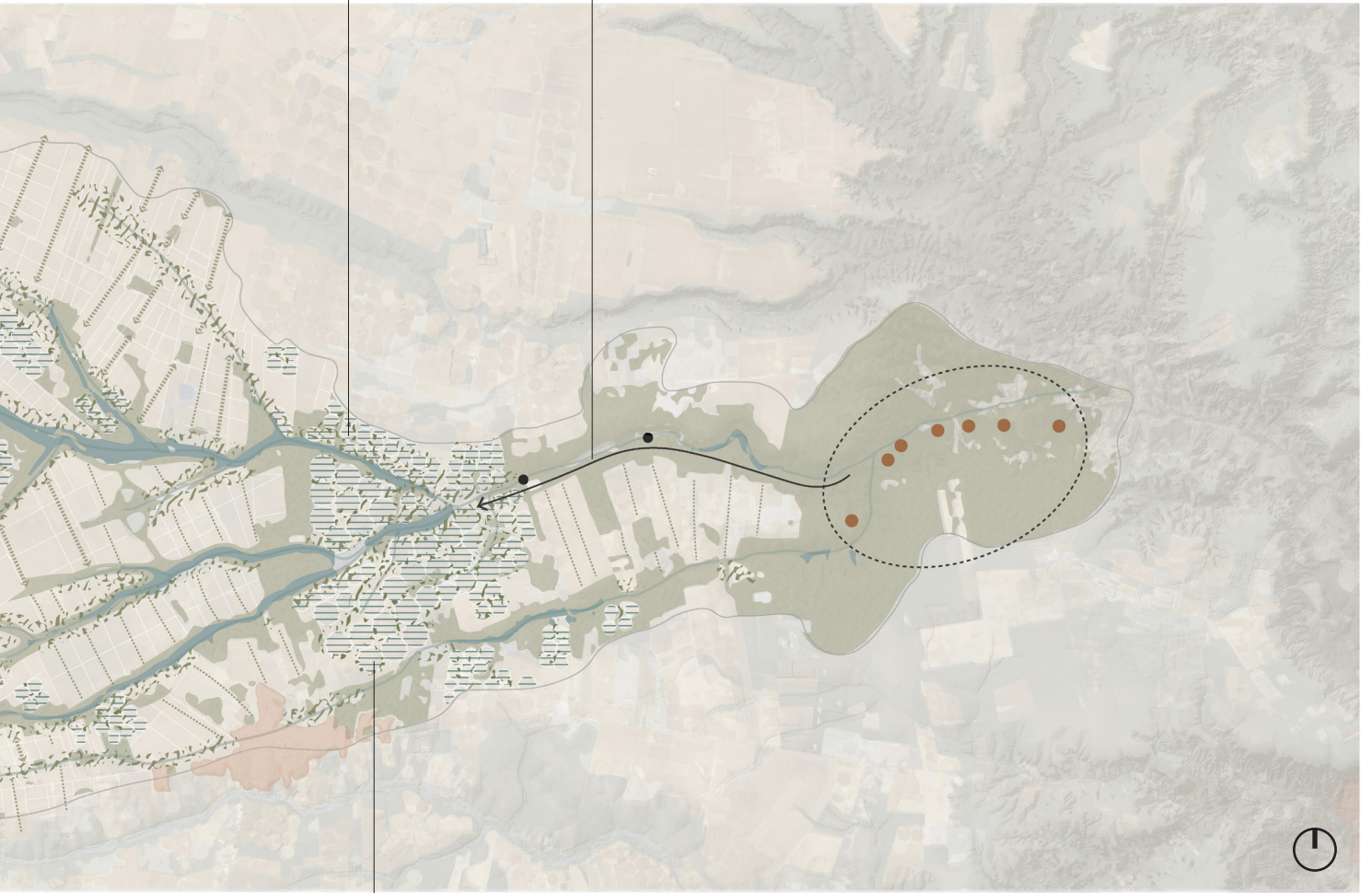
The wolf is a great agent for
reforestation as they act as seed
dispersal agent

Rethinking Janeiro River Basin

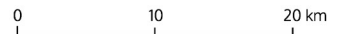


Native vegetation in between
Pivot fields

Include and give space to local communities in
productive and restoration projects



Strict regulation over the use of water
by the irrigation system





Current Situation

The current land use in the region has led to the reduction and fragmentation of native vegetation. Monoculture plantations have expanded over headwater areas, compromising aquifer recharge and leading to the large-scale use of irrigation systems, which contributes to the depletion of water resources. This imbalance in land use disrupts local ecosystems, as large-scale crop cultivation rules over the habitats of native fauna and flora, disturbing the hydrological cycle and negatively impacting surrounding communities.

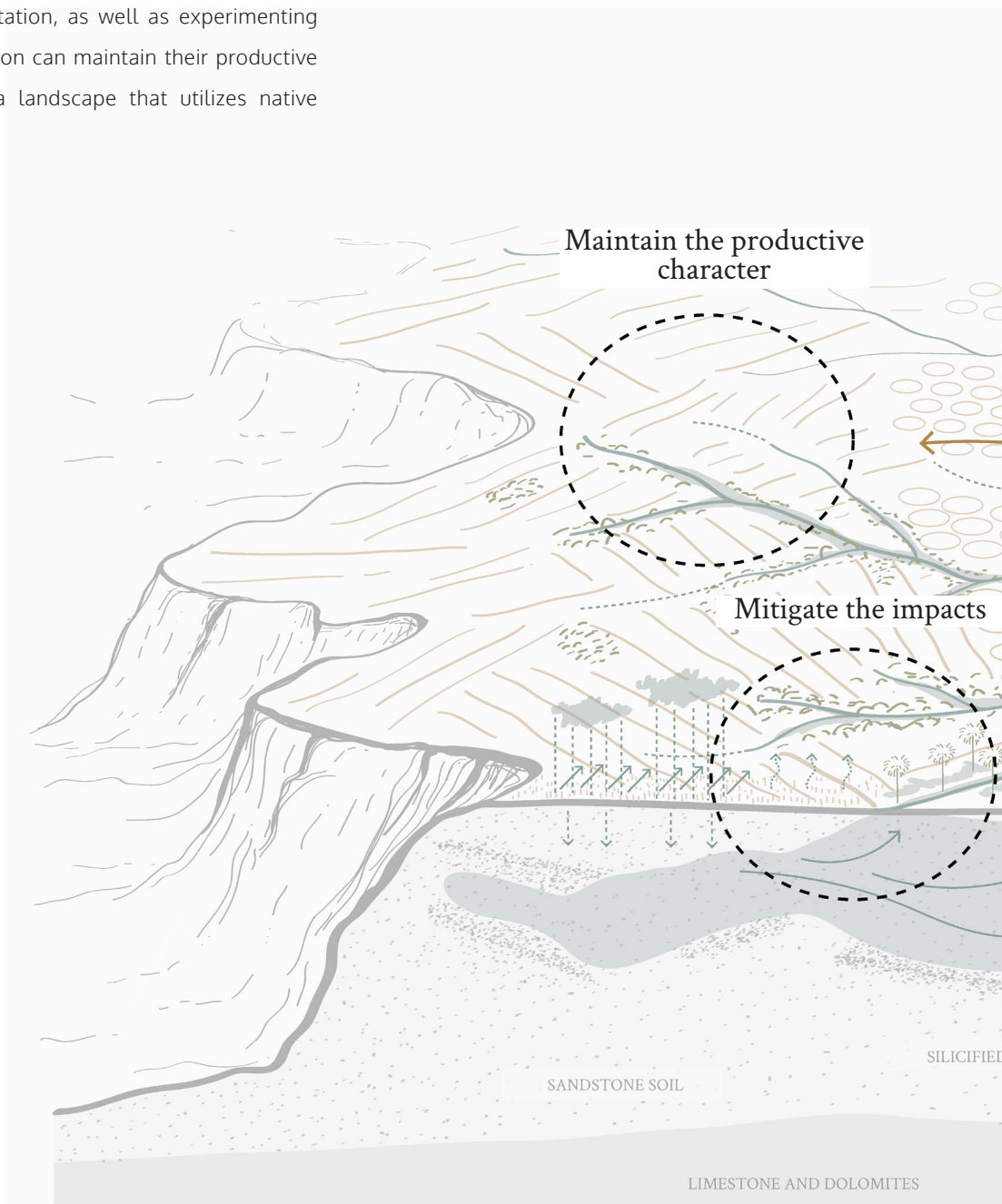


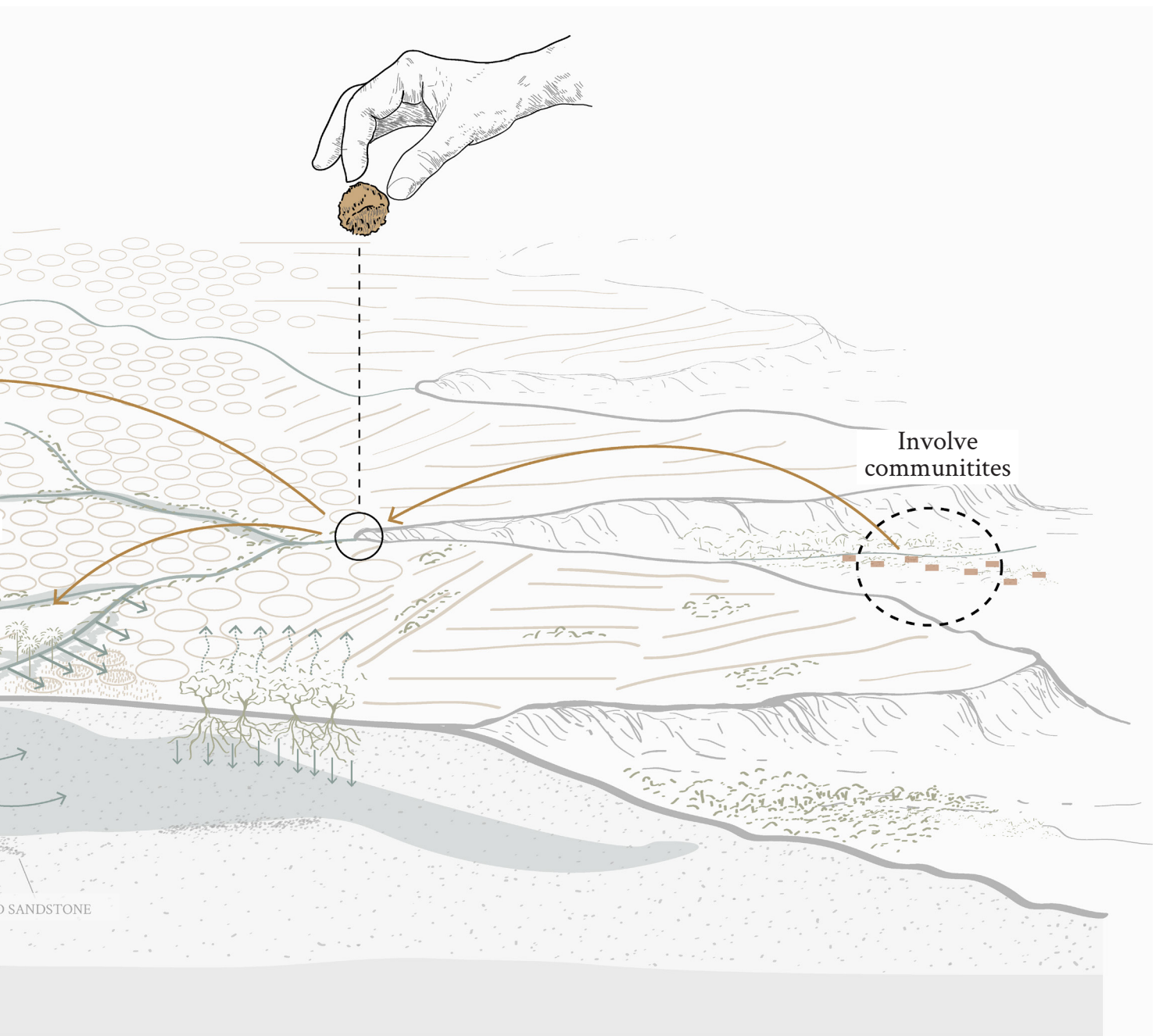
Vision

The vision offers a critical and constructive response to the basin's primary objective: to function as a model of sustainable land use. It aims to strengthen the region's blue-green infrastructure by increasing native vegetation cover and establishing ecological corridors that enable greater movement of species across the landscape. These efforts would help mitigate the environmental impacts of agriculture, while maintaining the essential character of the current land use, acknowledging the region's significant reliance on commodity-based agricultural exports.

Sowing Changes

The project sows a seed: a design that has the potential to impact the complex regional context, situated in a highly symbolic location, a site of transition from the large-scale agricultural landscape to the plateau valley, where local communities reside. In that sense, the design location is a strategic place for uniting the groups involved in this watershed. The design serves as a starting point for the development of tests and reforestation, as well as experimenting with how the Cerrado and the region can maintain their productive character while transitioning to a landscape that utilizes native Cerrado species.



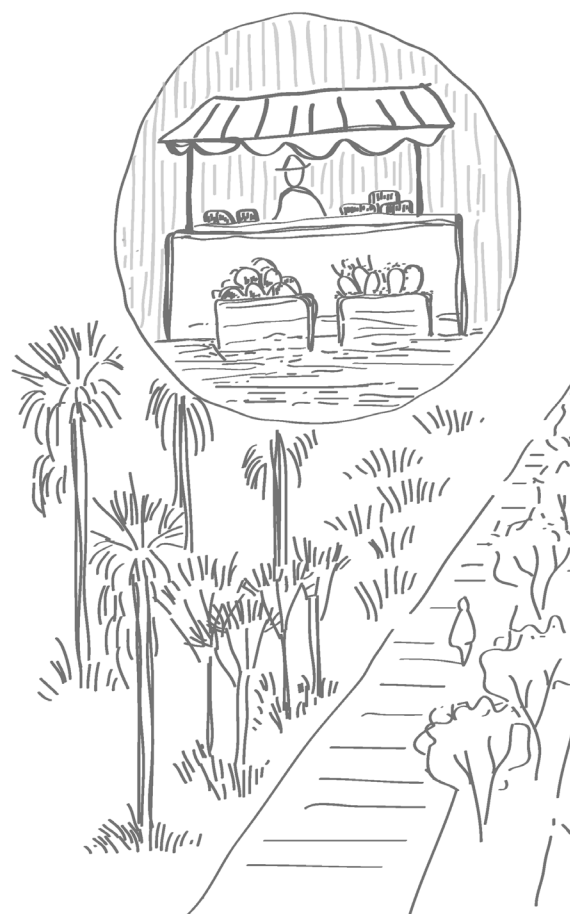


The Seed

The Urucuia Botanical garden

The design features a botanical garden space that combines the aesthetic and ecological aspects of the Cerrado while providing space for local communities and fostering research on the Cerrado and productive landscapes. A garden ensemble with a collection of native plants of cerrado for scientific research, plant conservation, display, and education.

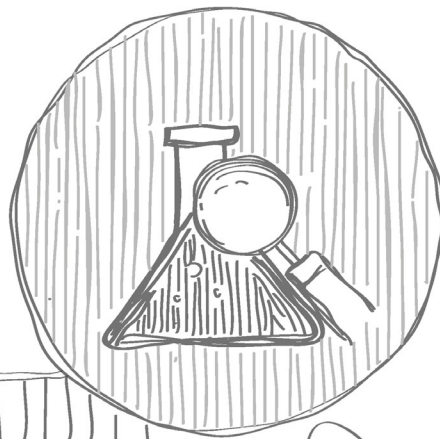
Local economy



Aesthetic value

Ecological awareness

Research



Values in Change

The design's proposal draws inspiration from a variety of initiatives throughout the Cerrado biome, ranging from university-community partnerships and ecological restoration programs to research efforts and movements aimed at valuing the traditional knowledge of Cerrado peoples. These diverse approaches highlight how research and traditional knowledge can inspire new practices that raise awareness of the biome and inform the development of more sustainable forms of productive landscapes.

The “Restaura Cerrado” Project

The project aims to restore grasslands and savannas in the Cerrado region of Brazil, specifically focusing on techniques for direct seeding of native grasses, shrubs, and forbs. This project is a collaboration between several organizations including organisations for conservation of biodiversity, the University of Brasília, the Cerrado Seeds Network, and research institutions . The project seeks to develop efficient and sustainable restoration methods for areas that have been historically converted to grazing lands .with exotic grasses.

Cerrado Seed Collection Group

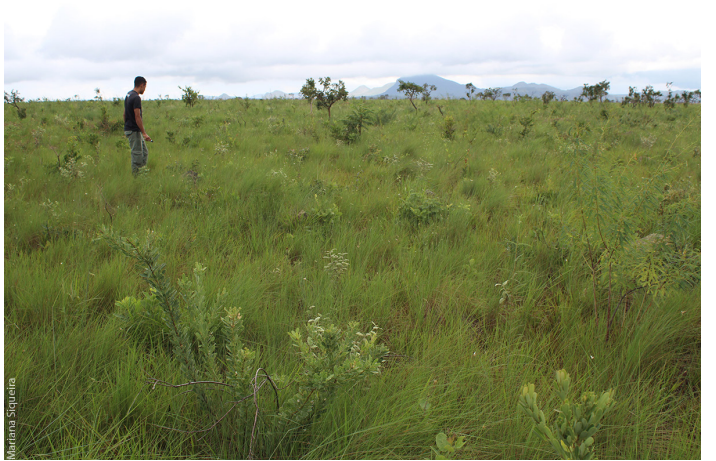
Across the Cerrado biome, community-based seed collection groups have emerged focusing on collecting, processing, and distributing native seeds to restore degraded areas and promote agroforestry. In 2023, as part of the “Resiliências Climáticas” project, a group of women from the ACAM (Association of small agricultures of some traditional communities in Janeiro River Basin) created the Cerrado Seed Collection Group to collect, process, and commercialize native seeds. Partnering with the Western Bahia Seed Collectors Network, they established a refrigerated seed room to support restoration efforts in the APA of the Rio de Janeiro River Basin. The project promotes women’s empowerment through income generation and the production of native seedlings.



Image 4.7 Images from “Restaura Cerrado” project.
Photos from Mariana Siqueira.



Image 4.8 Images showing the work from the association “Cerrado de Pé” that focuses on seed collection and biome restoration.
Photos from Márcio Sanches/WWF-Brasil



Silvopastoral Systems in Cerrado

The material is a Guide on examples of Silvopastoral Systems (SPS) that uses native trees, researches that were carried out in various regions of the Cerrado and aimed to deepen the understanding of native tree species present in pasturelands. The material introduces the concept and significance of these systems, along with propagation and cultivation methods, spatial arrangements, management practices, local case studies, and a selection of native tree species and their characteristics.



Image 4.9 Images from Silvopastoral Systems in Cerrado.

Gardens of Cerrado Project

The landscape architect Mariana Siqueira experiments with how native vegetation of the Cerrado can be utilized in garden design. The project collaborates with multiple initiatives around the biome's theme, serving as an inspiring action to raise awareness and discover new relationships with this ecosystem. The project is a pioneer in introducing native species of the Cerrado in Urban settlements. Expeditions searching, identifying, and experimenting in a nursery the landscape architecture potential of native plants. Overall, the project values the aesthetic and ecological qualities of the biome.



Image 4.10 Images from the Gardens of Cerrado Project.
Photos from Mariana Siqueira.



Mumbuca Memorial

The Mumbuca Memorial is a space open to visitors at the Mumbuca Quilombola community in the remote Jalapão region of Brazil. Quilombola refers to Afro-Brazilian communities descended from enslaved people who escaped the colonial plantation system. These groups sought refuge in isolated areas, far from European control, where they established self-sustaining lifestyles rooted in a deep reliance on natural resources. For nearly two centuries, their livelihoods have depended on the offerings of the Cerrado biome and the unique geographical conditions of the region.

Among these natural resources, the Buriti palm holds particular cultural and practical value. Its leaves, fruit, and fibers are used for construction, handicrafts, and traditional medicine. The Veredas and seasonally flooded gallery forests that support the Buriti palm are vital ecosystems, helping to ensure year-round water availability, particularly during the dry season.

The Quilombola communities preserve and transmit their cultural memory to the Cerrado through practices that blend tradition and adaptation. The crafting of Buriti fiber items and the use of golden grass from the wetlands are examples of how they maintain a living cultural heritage. These crafts are not only artistic expressions but also a form of ecological storytelling, honoring the relationship between people and the biome. Craft production and community-based tourism are emerging as strategies that foster economic resilience while raising cultural and environmental awareness among visitors.



Image 4.11 Mumbuca memorial

Photos from the site visit during January 2025.

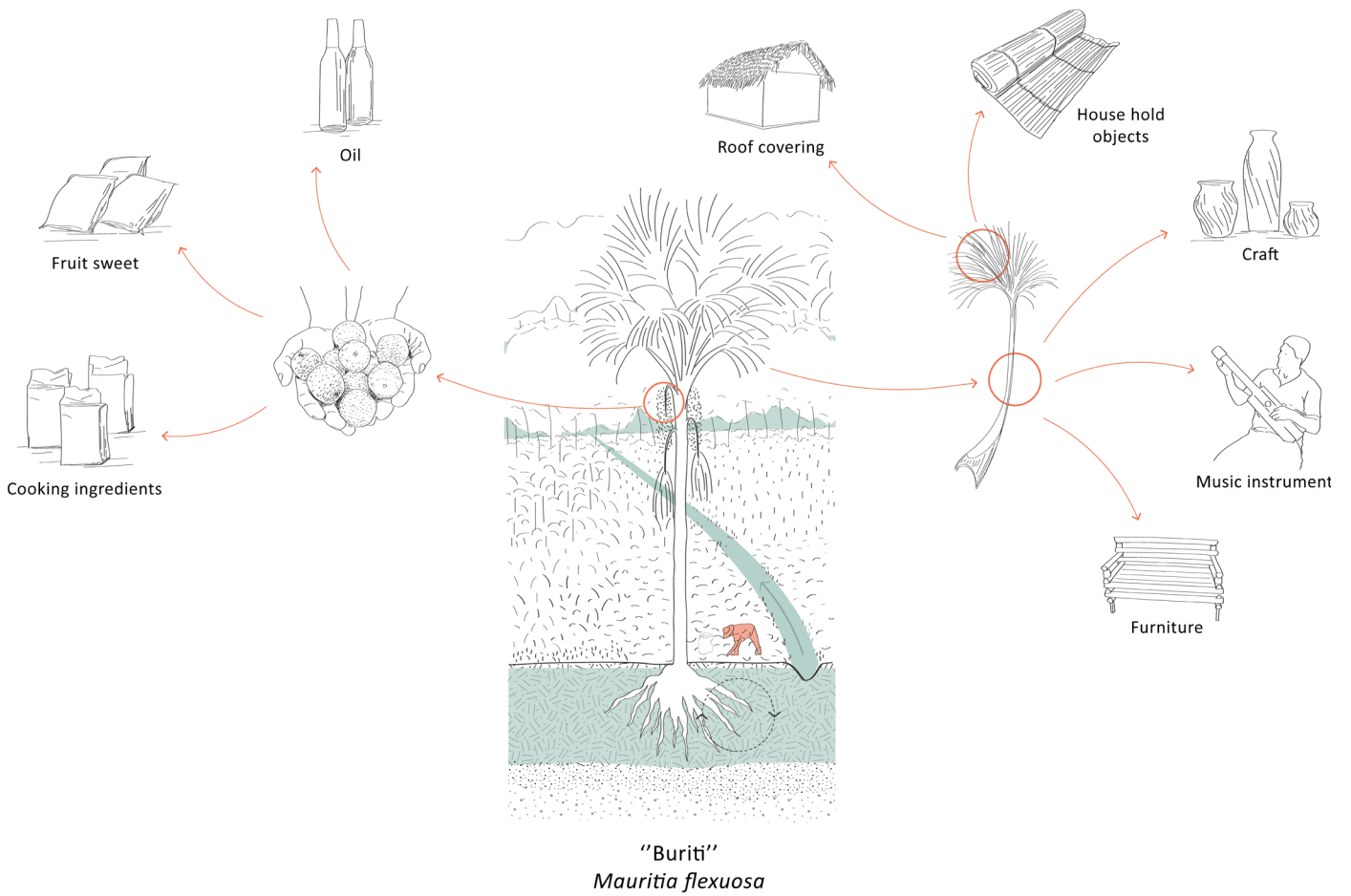




Image 5.12 Buriti palm tree and it's cultural uses.

Illustration by the author for the Circular Water Stories Research Lab

Botanical Garden program Comparative study

The comparative study of four botanical gardens—Inhotim Open Air Museum, Brasília Botanic Garden, Santa Bárbara Botanic Garden, and Kirstenbosch National Botanical Garden—was fundamental in informing the conceptual, spatial, and functional program of the proposed Urucua Botanic Garden. Inhotim stands out for its innovative integration of contemporary art and landscape, offering a relevant Brazilian reference in landscape, architecture, and art. In contrast, while the Brasília Botanic Garden succeeds in preservation and environmental education, its spatial organization remains disconnected from its mission to represent the Cerrado biome. Santa Bárbara provides a compelling model at a smaller scale, with its exclusive focus on native flora and strong integration into the local landscape. Kirstenbosch, despite its somewhat artificial aesthetic, offers a notable example of how to enhance the visual and cultural appeal of indigenous vegetation. These case studies contributed to defining key aspects such as area, visitor capacity, and programmatic elements. However, the proposed design seeks to move beyond them by emphasizing ecological processes and how these can be transmitted to visitors, positioning the garden not only as a site for displaying a variety of vegetation.

	Inhotim Open Air Museum
Location	Brumadinho, Brazil, 2006
Area	Total: 786 ha Open to the public: 140 ha
Visitors	Limit of 5000 visitors per day
Finance sources	Non-profit organization. Donations, Governmental program for culture, money from tickets and events.
Description Concept	Open air contemporary museum and botanic garden. 1862 artwork, from 43 countries. With 4300 species (from all the continents), Inhotim has a collection of native Brazilian species and exotic used for research, conservation and education. Ornamental and regional flora, with priority to rare species, endemic or in risk, raising awareness in society about biodiversity conservation.
Plan, Map	 <p style="text-align: center; font-size: small;">Passe o mouse sobre os nomes para ver a localização.</p>
Images	

<p align="center">Brasília Botanic Garden</p>	<p align="center">Santa Bárbara Botanic Garden</p>	<p align="center">Kirstenbosch National Botanical Garden</p>
<p align="center">Brasília, Brazil, 1985</p>	<p align="center">California, USA, 1926</p>	<p align="center">Cape Town, South Africa, 1913</p>
<p align="center">Total: 4,518 ha Open to the public: 526 ha</p>	<p align="center">Total: 32 ha</p>	<p align="center">Total: 528 ha Open to the public: 58 ha</p>
<p align="center">Unknown</p>	<p align="center">275 visitors per day 100,000 visitors per year</p>	<p align="center">1,000 to 3,000 visitors per day 900,000 visitors per year</p>
<p>Non-profit organization. Donations, Government funding, entrance fees, partnerships and donations.</p>	<p>Entrance fee, Donations and memberships, gift shop and plant sale, grants and endowments.</p>	<p>Entrance fees, government funding, donations and sponsorships, events</p>
<p>A conservation area located in the capital of Brazil, within the Cerrado biome. The garden serves both as a protected natural reserve and as a space for public education, leisure, and scientific research. The garden features native Cerrado vegetation, thematic trails, ecological exhibits, greenhouses with orchids and medicinal plants, and educational programs.</p>	<p>Dedicated exclusively to showcasing and conserving California's native plants and habitats. Over 1,000 species of rare and indigenous plants. As the first botanic garden in the United States dedicated solely to native flora, it aims to foster an appreciation for the state's botanical diversity and promote sustainable, water-wise gardening practices.</p>	<p>Preservation of indigenous flora, particularly the Cape Floral Kingdom (fynbos biome) with the aim of conserving, studying, and displaying South Africa's unique plant biodiversity, particularly the fynbos ecosystem. It serves as a hub for botanical research, environmental education, and public recreation, blending conservation with aesthetic and cultural experiences.</p>
		
		

Where to Sow the Seed?

Design location

The project's location, at the current municipal waterfall park, is well-visited and an essential spot for local tourism, which is one of the reasons the watershed is considered a preservation area. Besides attracting many local visitors, this place is also very significant because it marks a transition zone from where the large farms and large-scale agricultural production are located to the valley where most of the local communities live. Symbolically, this area is a bridge between the productive landscape and the traditions of the region.





Images 4.12 The Waterfall municipal park. Photos from the site visit during January 2025.

The Urucua Botanical Garden

The Program

Total Area: **150 ha**

Area open for visitors: **30 ha**

Property: **Municipality**

Capacity: **500 visitors daily**

Finance sources: Municipality, Governmental programs for culture, University, Entree fee for the memorial, Events, Restaurant, Local Shop, Donations.

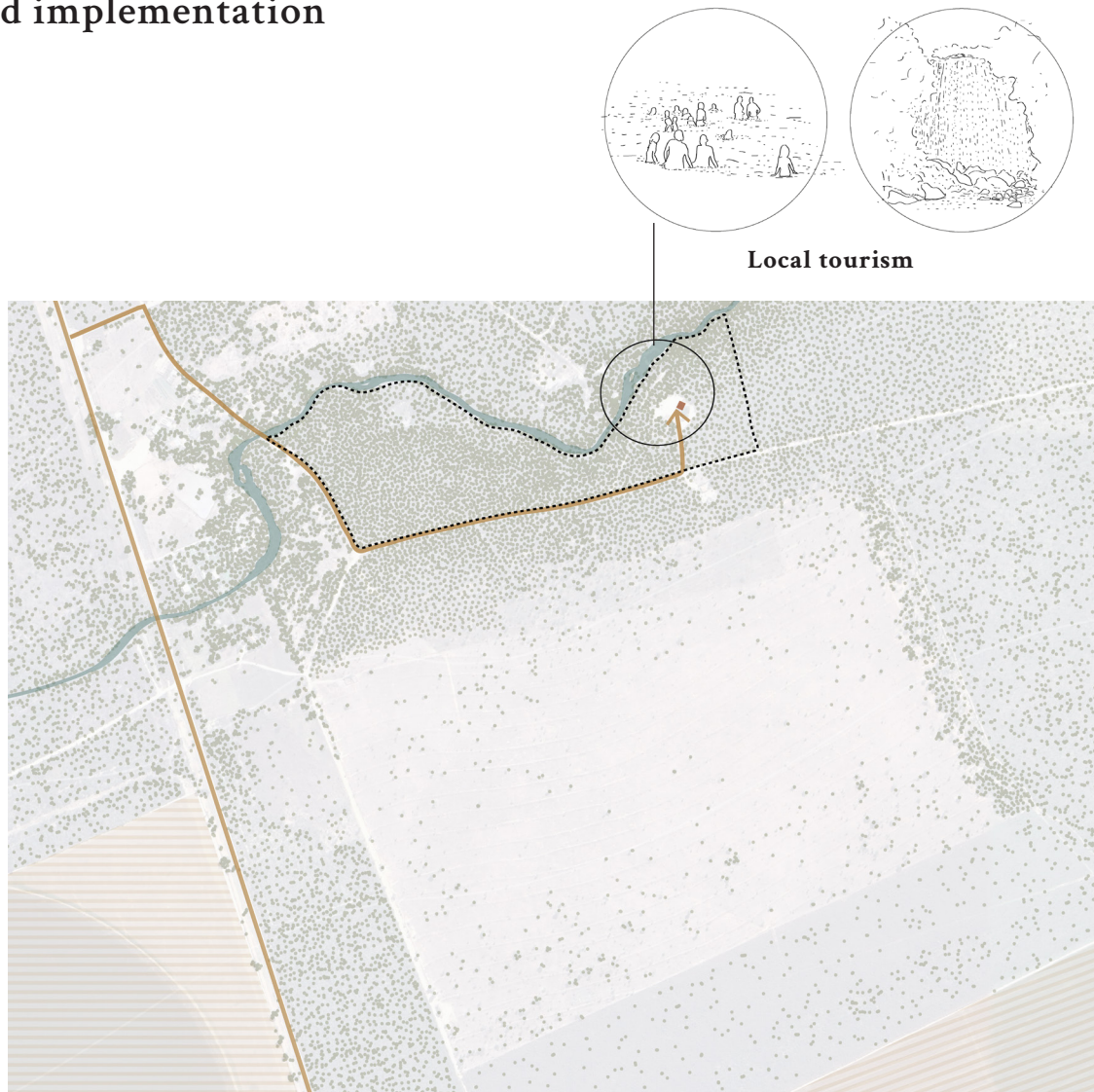




0 100 200m



Phased implementation



Current Situation 2025

The Park is a vital leisure area for local people, especially for the two closest cities: Luís Eduardo Magalhaes and Barreiras. During the weekends, the place often gets crowded. There is a lack of infrastructure and facilities for the users.



Local Economy



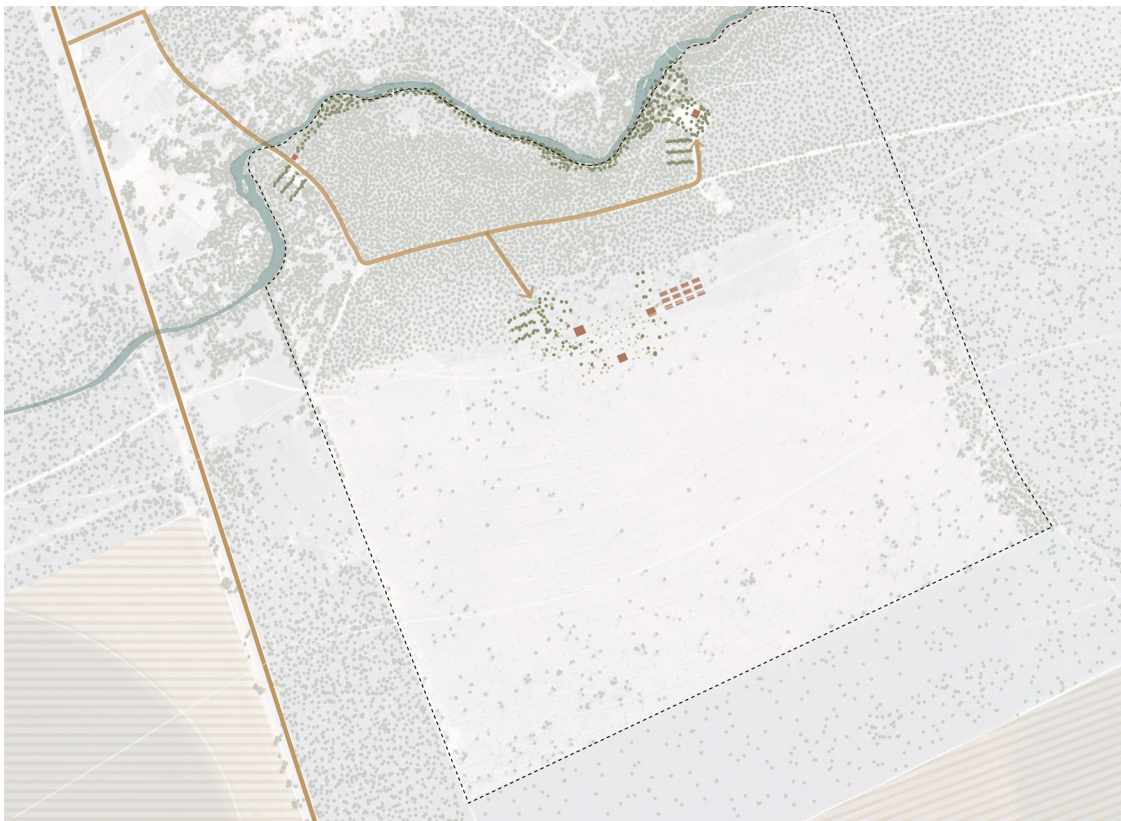
Nursery



Culture



Research



Phase 1
0-5 years

Phase 1 starts with the Extension of the Municipal Park area, incorporating the adjacent existing grazing field. Local communities operate a shop near the waterfall where they can sell their products. During the first years, the botanical garden establishes the Research Center, Cerrado’s Memorial, a Restaurant, a Seed Bank, and a Nursery.



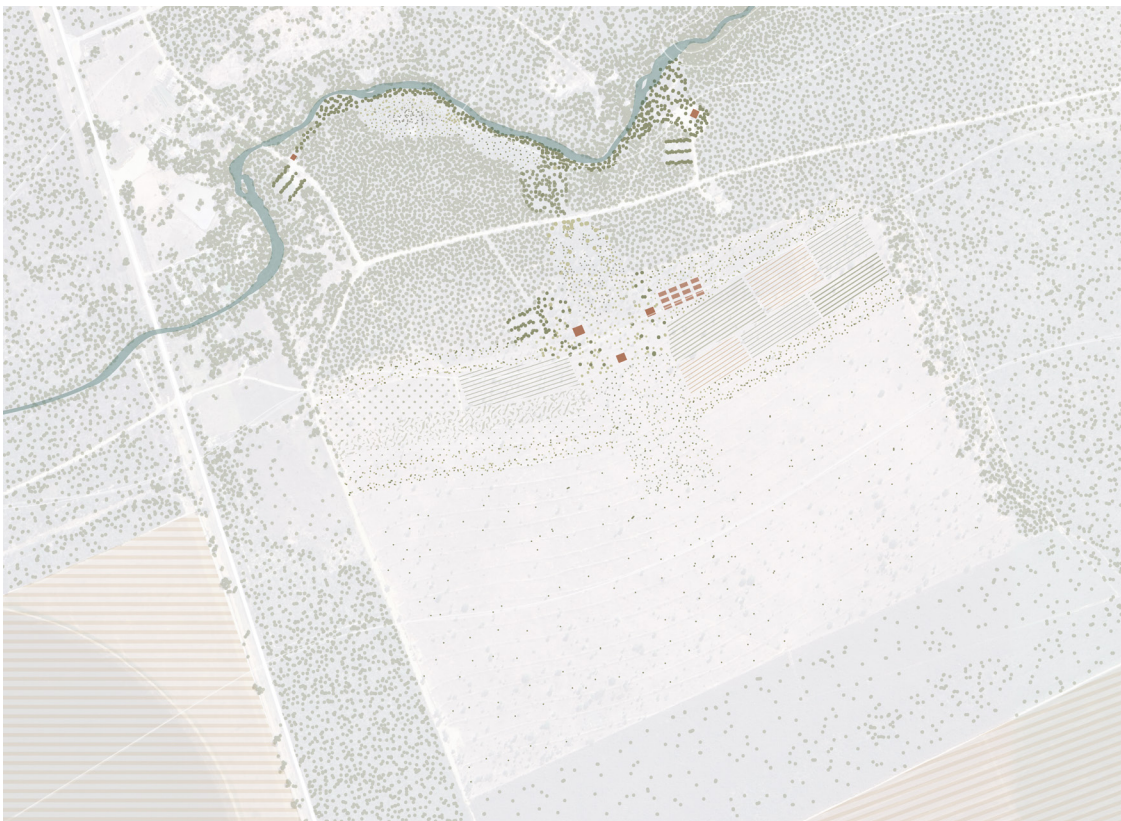
Start of the Gardens



Expansion of the Nursery



Expansion of Research



Phase 2
5-10 years

Phase 2 involves the expansion of the nursery and the initiation of research on productivity and biome restoration in the testing fields. The study is also expanded in the process of implementing the Cerrado's route and the ecological corridor. At the same time, the knowledge developed in the botanical garden can be applied to the Janeiro River APA.



Opening of the Gardens to the public



Involvement of the public in the gardens

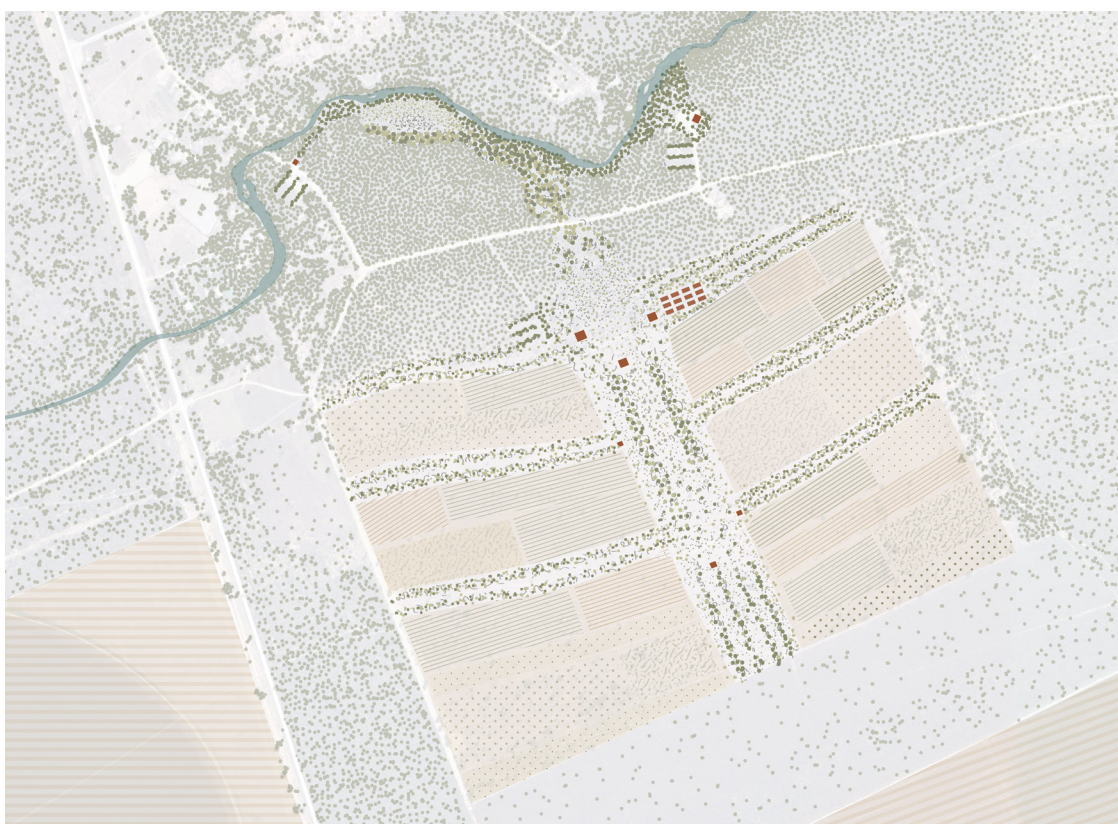


Phase 3
10-20 years

In Phase 3, the gardens and the ecological corridor are open to the public. The other programs in this phase allow visitors to follow the process and the time development of the botanical garden. While expanding its size, the botanical garden requires considerable effort and offers open programs for volunteers from nearby schools and universities, as well as additional job opportunities for local community members.

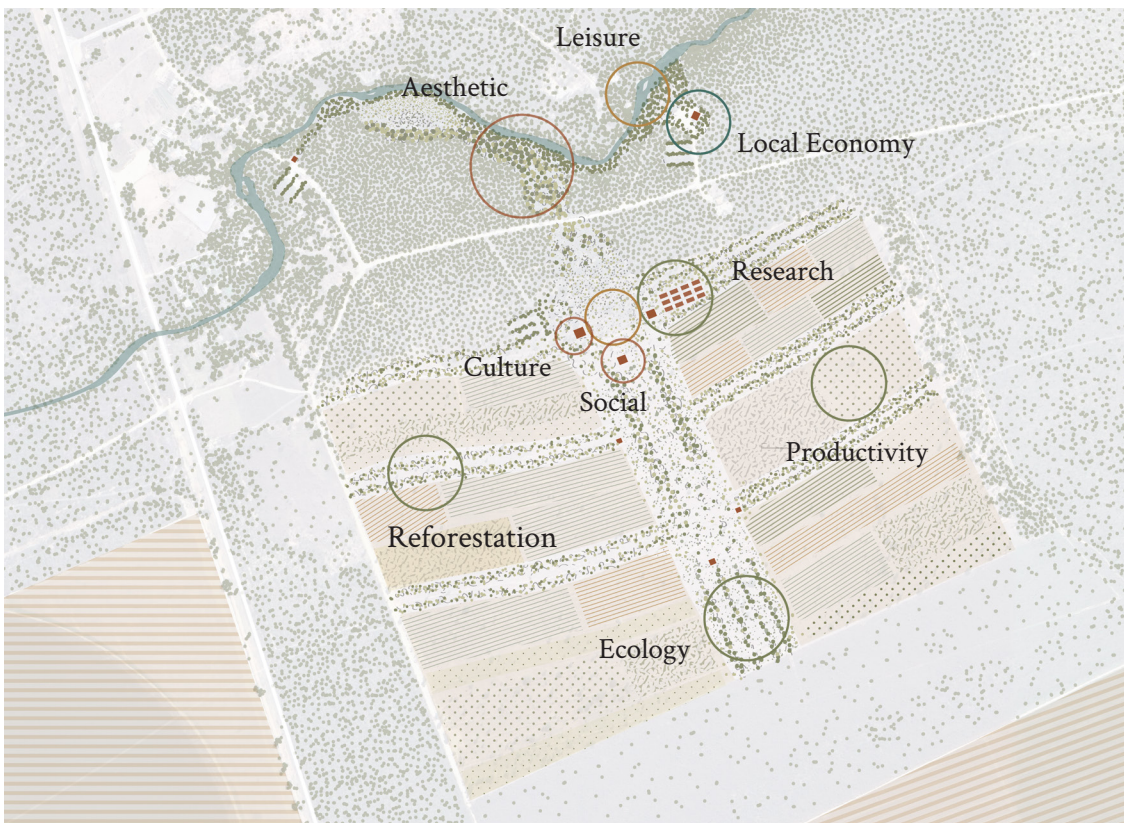


Mature phase of ecological and productive corridor



Phase 4
20-50 years

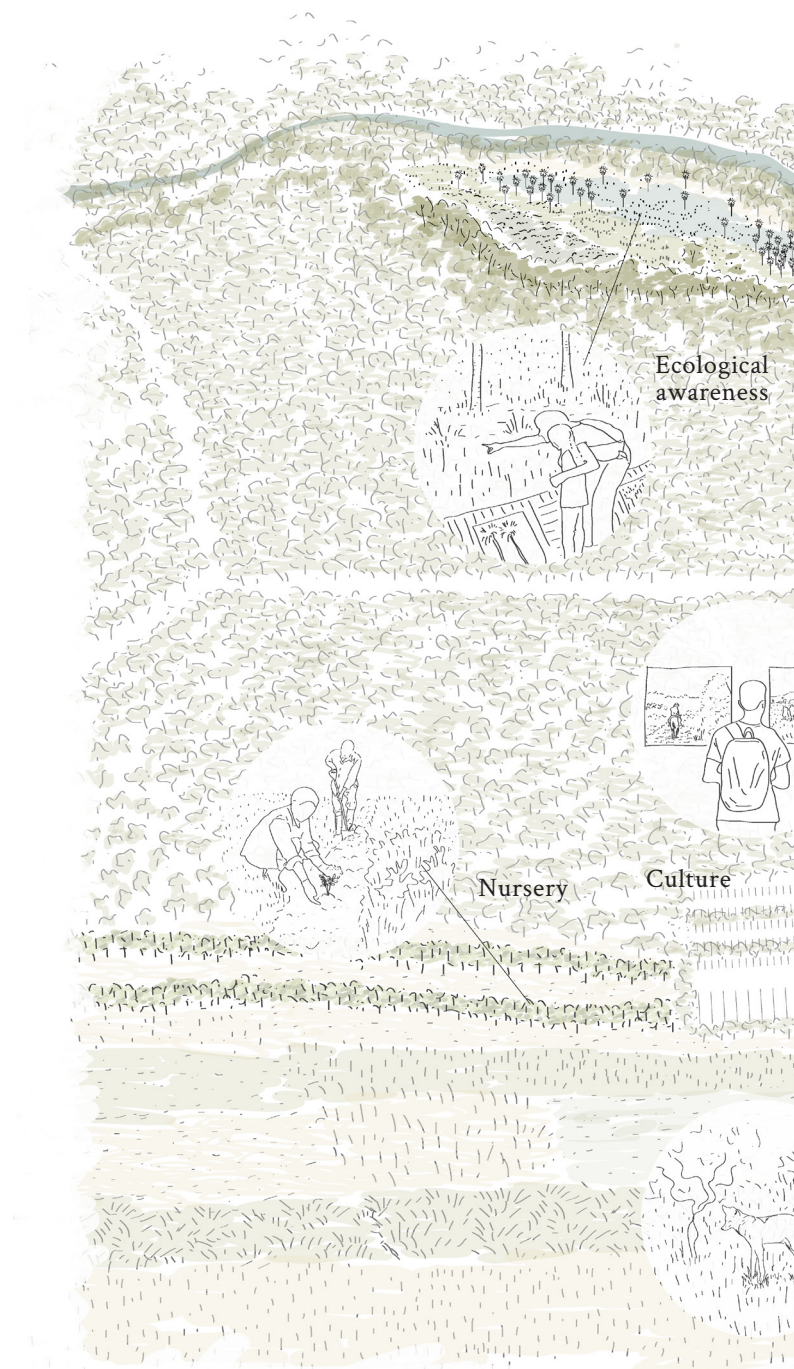
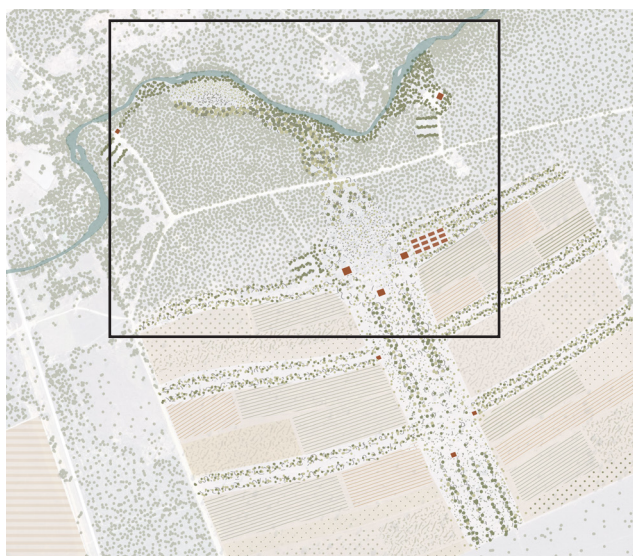
In Phase 4, the botanical garden as a whole achieves maturity. The ecological and productive functions of the gardens are evident, and the research results are more pronounced. In this phase, the trees begin to produce fruit and enter an adult stage, as well as the social, cultural, and economic life of the Botanical Garden. In this phase, the social aspect of this place has also matured, becoming a venue for social events that celebrate the seasons and tune the visitor to the rhythms of the Cerrado.

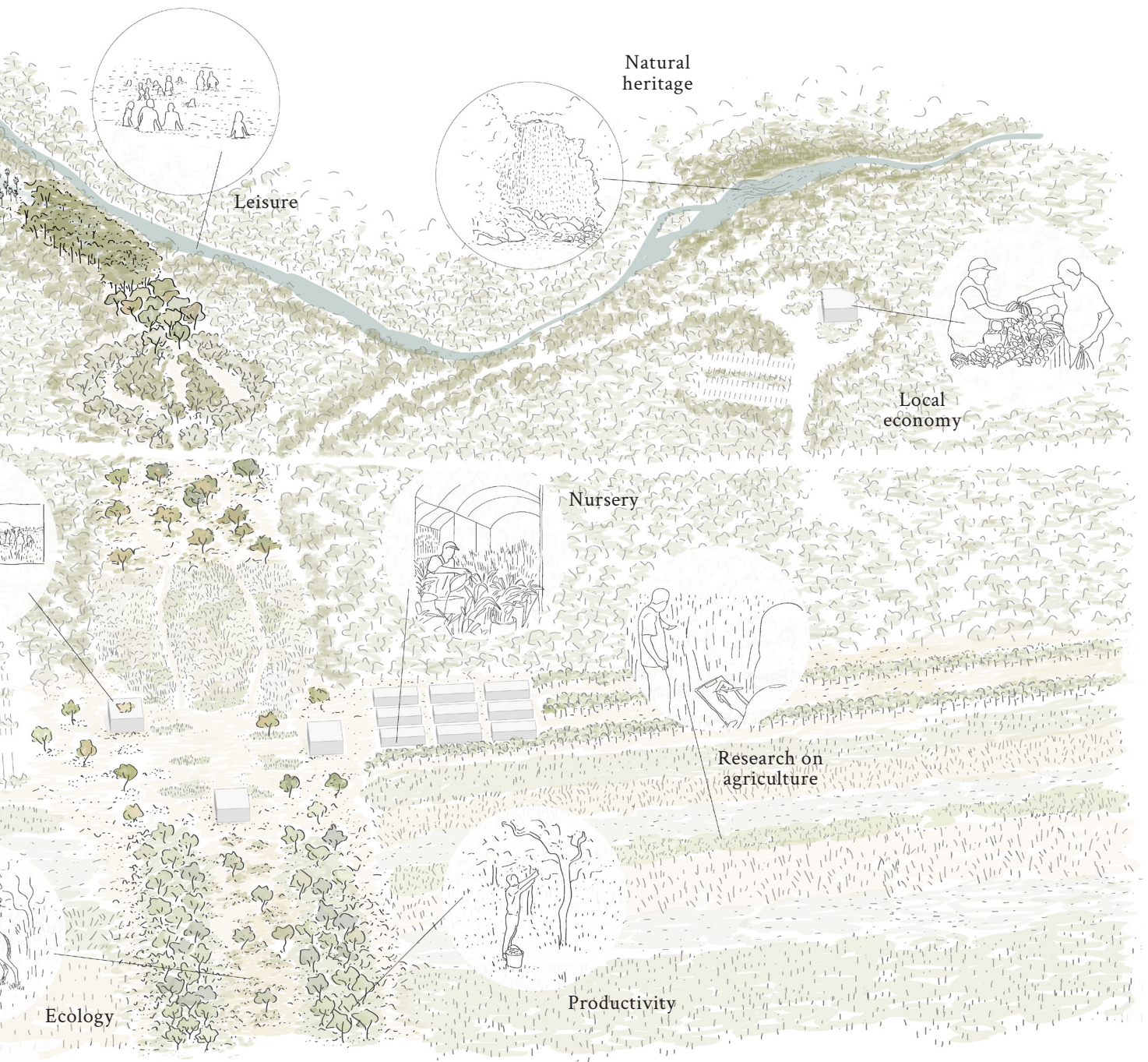


50 years onwards

After 50 years, the long-term results of the Botanical garden are visible. The trees now have solid roots, and the project's program has a clear outcome. Perhaps, at this moment in time, the world has changed drastically, and it is time to redesign and rethink the programs, expanding or adapting to the new conditions and social-political context.

A key aspect the Botanical Garden is that it is both an attraction and a symbolic meeting point between social groups within the Janeiro River water basin. Thus, the project's program combines research, leisure, education, and productivity, while enhancing culture, social gathering, reforestation and local economy. The research supports productivity, and the site also serves as a memorial to Cerrado. Visitors who come to the waterfall also have access to this large open-air museum of the Cerrado.





Ecology

Leisure

Natural heritage

Local economy

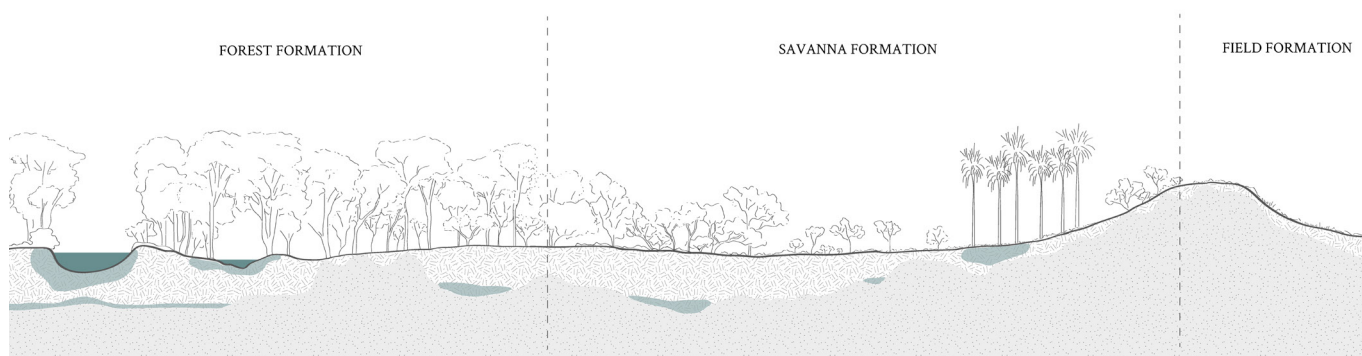
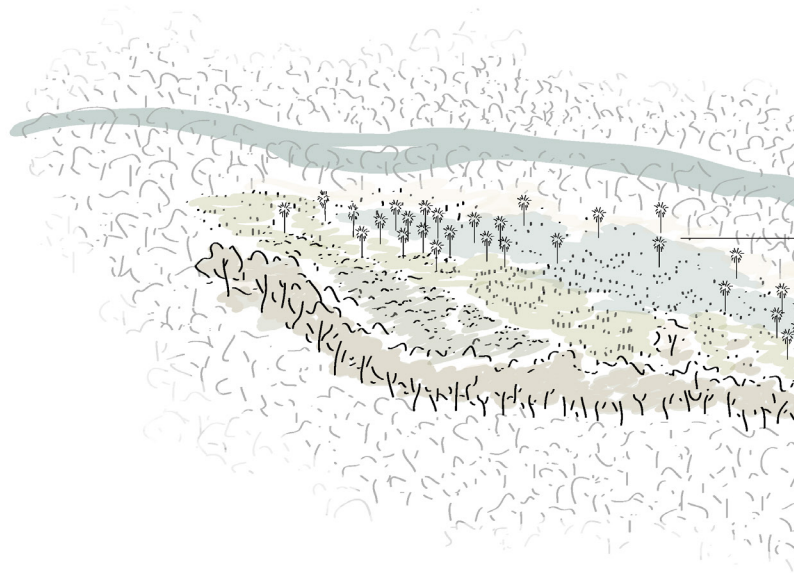
Nursery

Research on agriculture

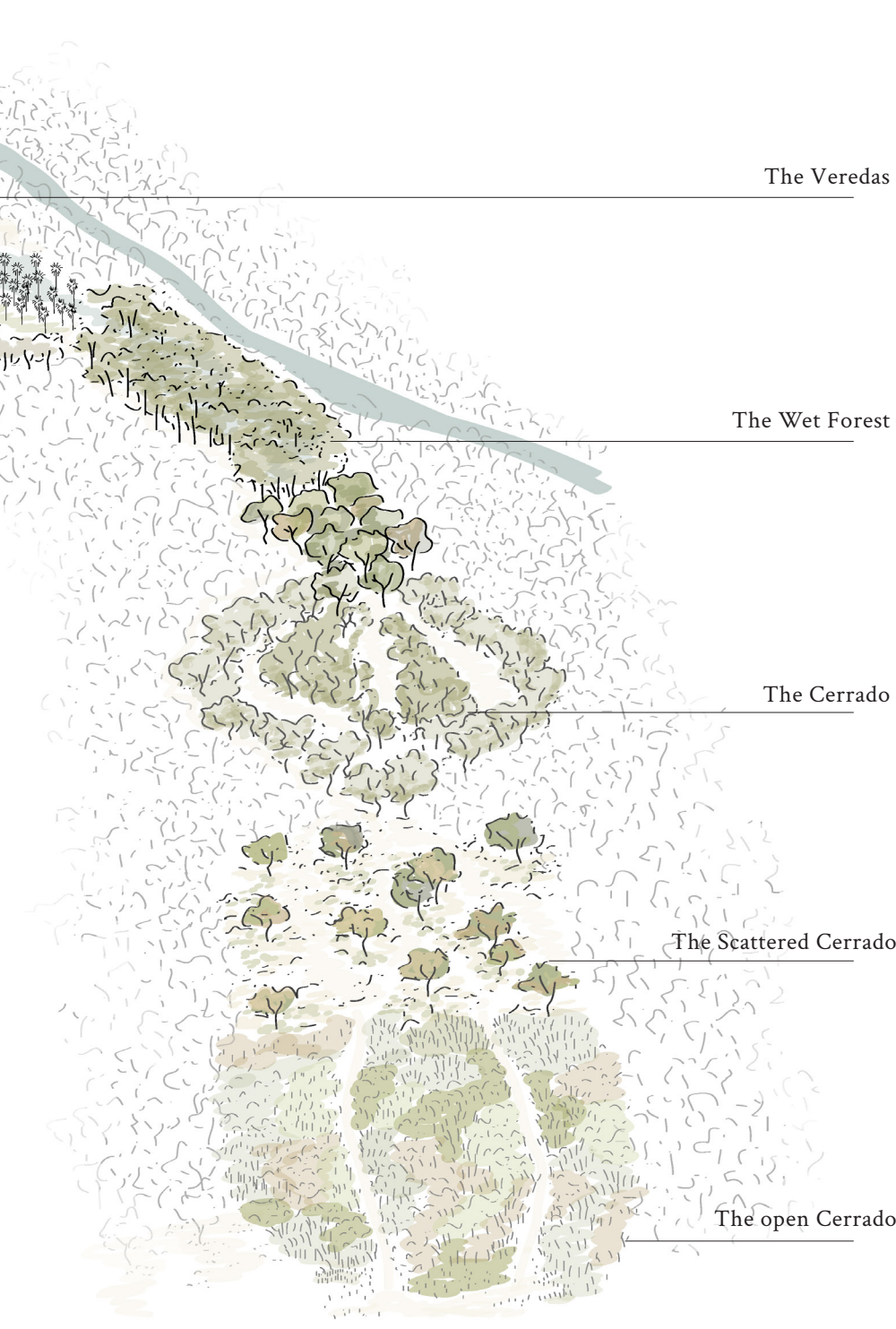
Productivity

The Cerrado's route

The route is designed to recreate the various sub-ecosystems of the Cerrado. The path crosses a set of gardens, transitioning from wet and moist environments to drier conditions within the designated area of the Botanical Garden. The primary purpose of the gardens is to display the diversity of Cerrado vegetation to the public while offering an aesthetic experience. In addition to their visual appeal, the gardens serve an educational role by illustrating how this vegetation functions and performs ecologically across different environmental conditions, from wetter to drier areas, closed to open. The design of the paths reveals a key feature of the surrounding vegetation. Each vegetation typology was considered regarding texture and how visitors should interact during the design process. As a result, the paths play a central role in the project, shaping the visitor's experience and emphasizing the spatial qualities of the Cerrado.



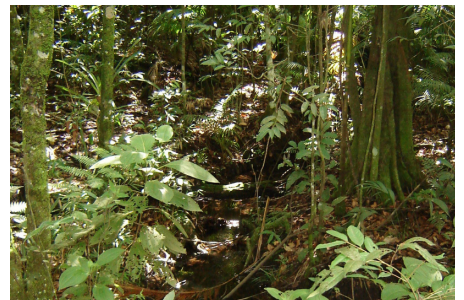
Abstract section that illustrates the variety of typologies within the Cerrado Biome



The Veredas



The Wet Forest



The Cerrado



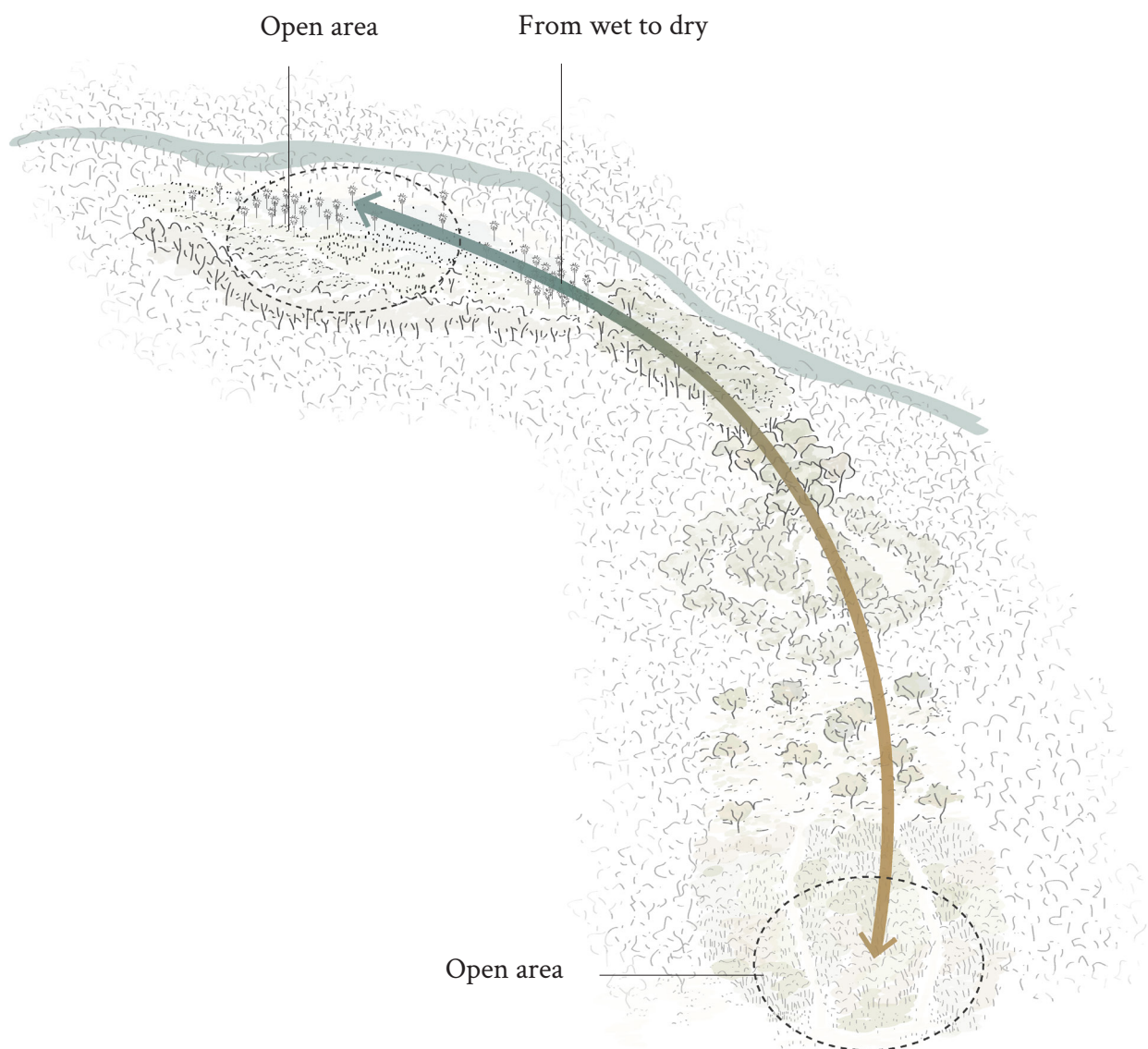
The Scattered Cerrado



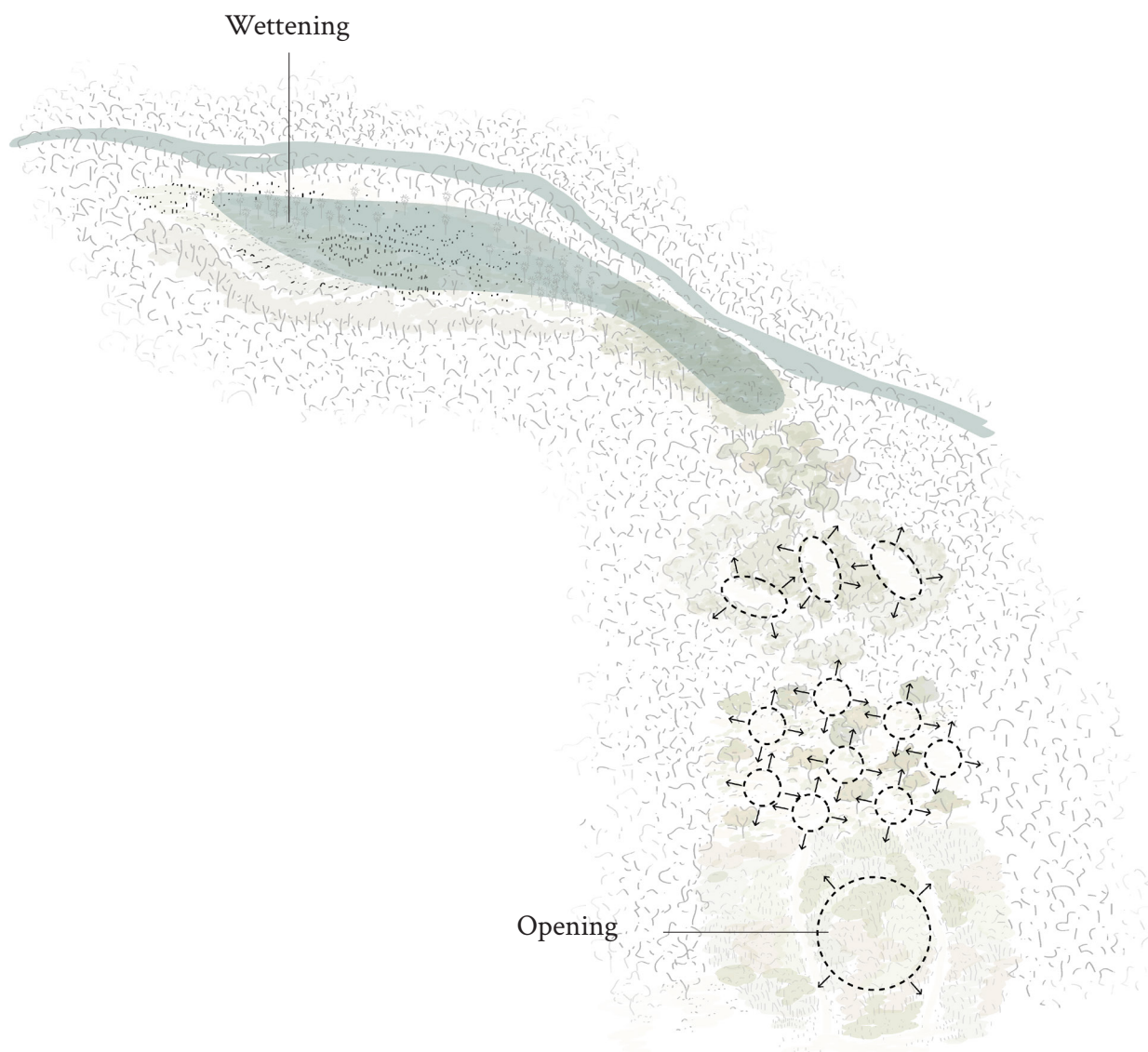
The open Cerrado



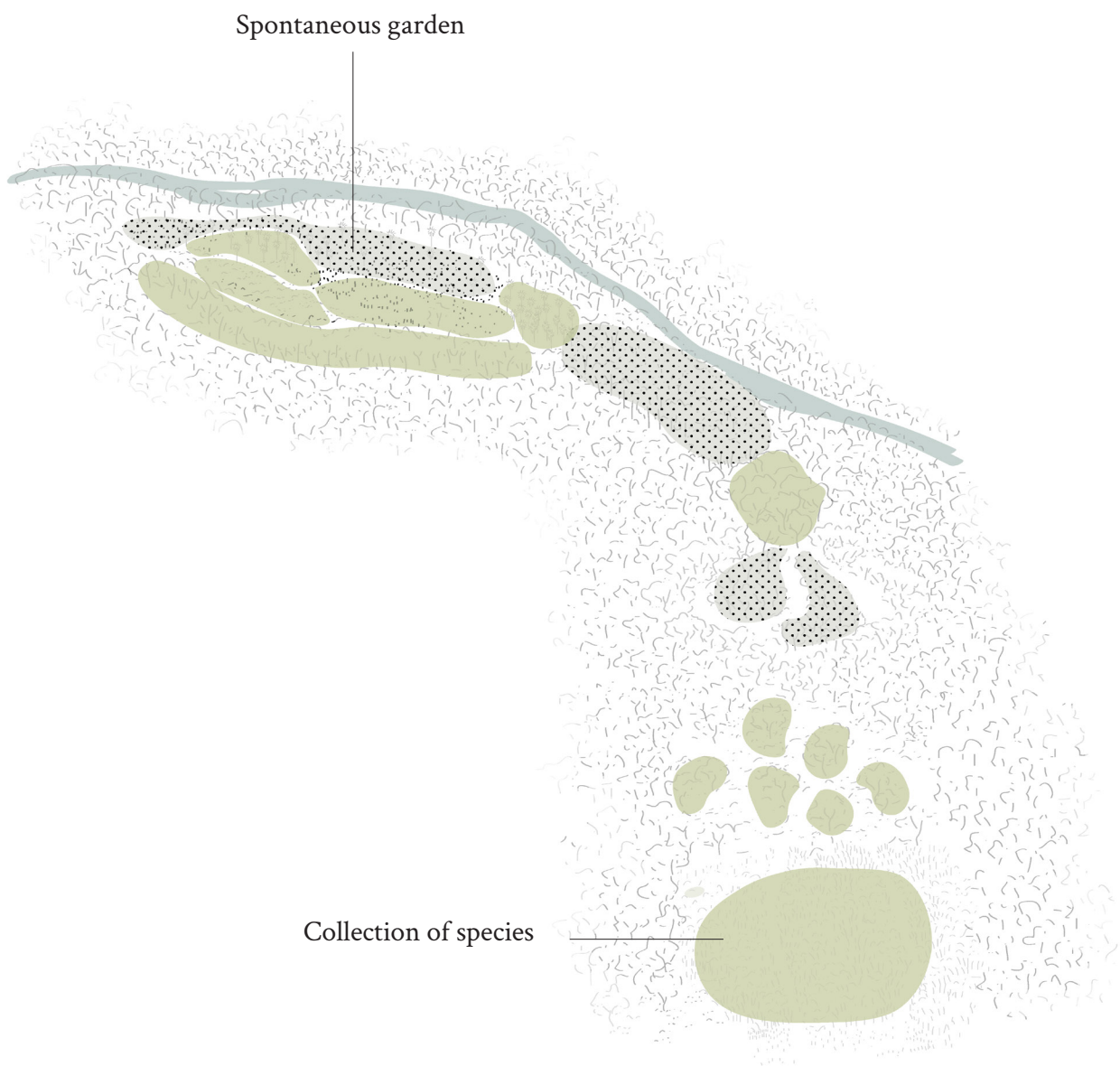
The Cerrado's route Layers



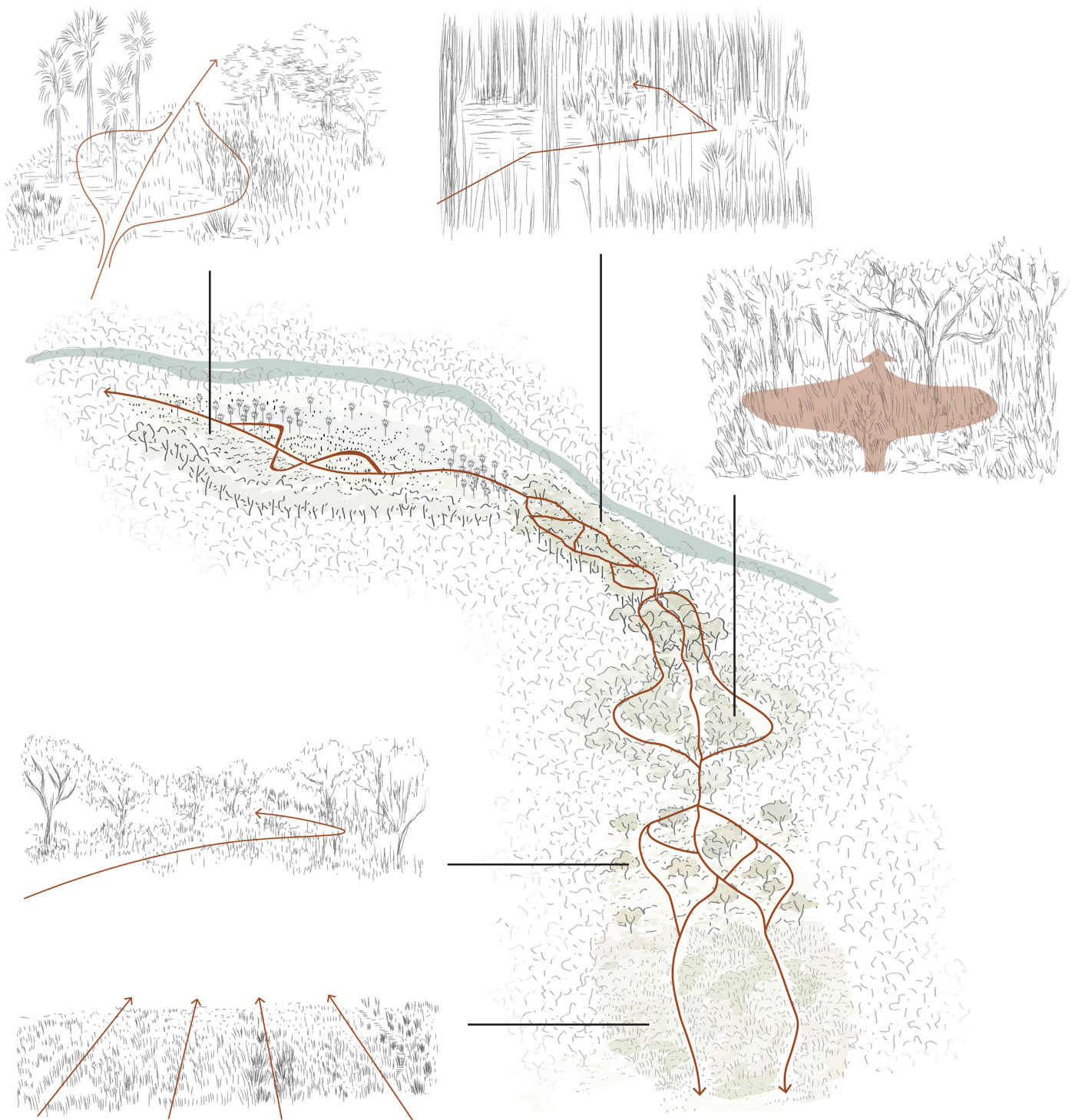
The route utilizes the existing, more open areas. It follows the natural conditions of the site, transitioning from wet to drier conditions, which influence the different typologies created by the gardens.



The garden ensemble introduces new conditions that influence both the development of vegetation through natural succession and the variation of spatial configurations with changes in openness and enclosure within the existing vegetation.



In certain areas, the garden is formed by spontaneous vegetation that is either already on site or has developed under the new conditions.



The design of the path and possibilities to circulate through the route consider the spatial characteristics of each typology and the experiences that each case could afford.

Zooming in

To understand and materialize the program and concept of the Urucuia Botanical Garden, specific areas are selected to explore how different aspects of the design take shape and come to life.

The Vereda (Swamp) garden

This section recreates a key sub-system of the biome: the Vereda—swampy areas of high ecological value in the Cerrado, marked by the Buriti palm. This species helps retain water and has deep cultural significance for traditional communities. By manipulating the terrain and excavating selected areas to reach the groundwater table, wet conditions are created to support the formation of a Vereda garden.

The Vereda's shrubs

In some areas, the Vereda garden evolves through natural succession, while in others, it is established through the introduction of characteristic shrub and grass species. This zoom-in highlights the shrub layer of the Vereda and how ecological and landscape information is displayed on Information panels and wooden installations integrated along the visitor path—an approach also adopted in other parts of the garden.

A serial vision through Cerrado's route

Visitors follow a pathway that goes through a sequence of gardens, transitioning from wet to drier conditions. Beyond showcasing a variety of plant species, the route is designed to offer diverse spatial experiences within the existing vegetation, inviting new perceptions, rhythms, and understandings of the Cerrado landscape.

The open Cerrado

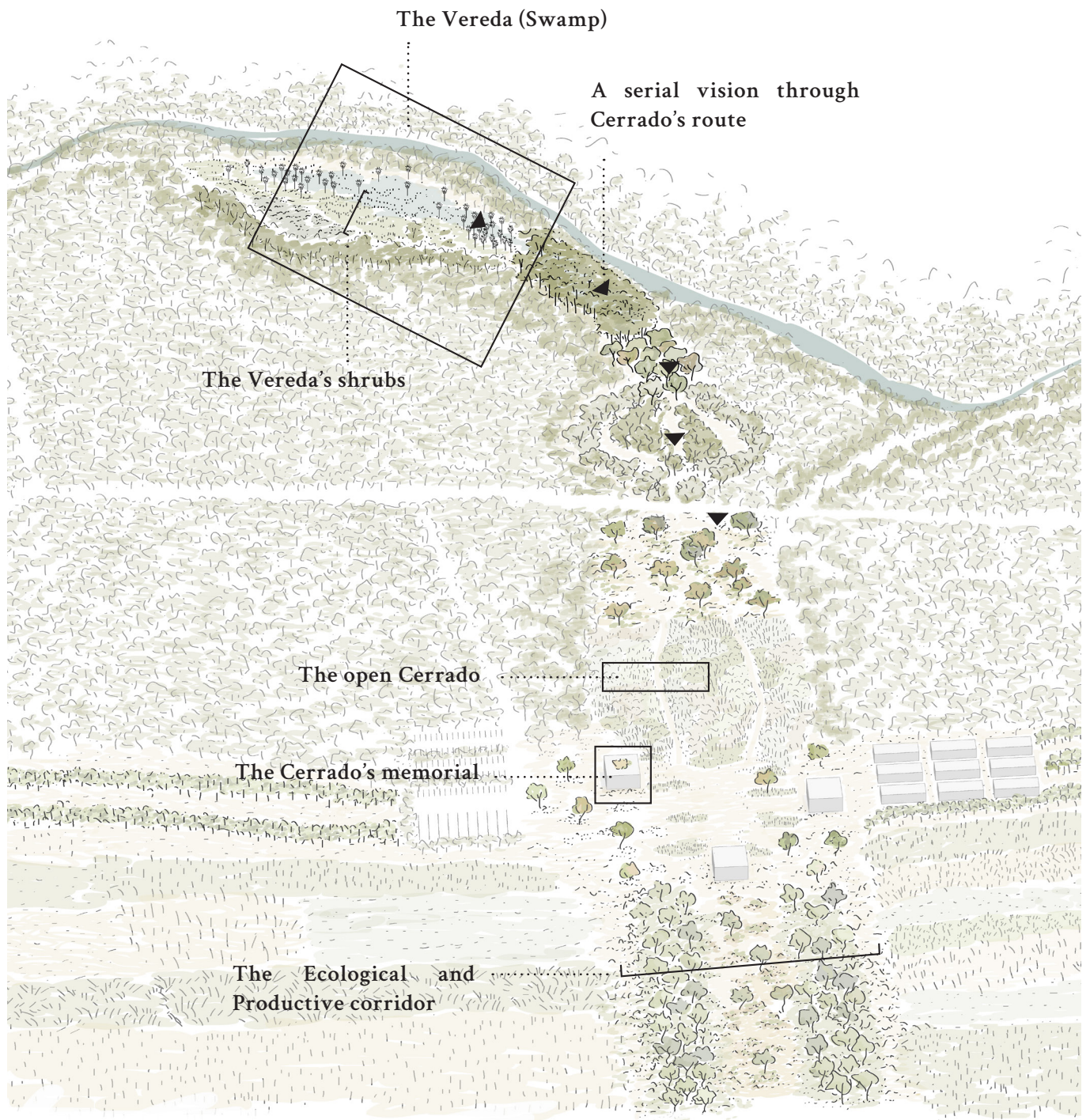
This garden presents a collection of shrub and herbaceous species typical of the open fields of the Cerrado—layers that hold much of the biome's plant biodiversity. A zoom-in reveals the contrast between wet and dry seasons, illustrating the garden's intention to challenge the misconception that the dry season is lifeless. This design strategy invites visitors to rediscover the aesthetic and ecological richness of both seasonal expressions.

The Cerrado's memorial

Here, visitors are invited to explore one of the Cerrado's hidden yet essential features: the roots. The memorial building is a space dedicated to the culture and knowledge of traditional peoples. At its core, an inner garden recreates the essence of the savanna, providing access and visibility to the underground layers, highlighting the soil's structure and the importance of root systems in maintaining the Urucuia aquifer.

The ecological and productive corridor

This area presents a fragment of the green corridors envisioned for the Janeiro River basin. It serves as a testing ground for integrating native species that combine ecological functions with productive potential. This section also includes research on biome restoration, experimenting with time processes and human interference, and estimating how long it might take to start producing with Cerrado's native trees.



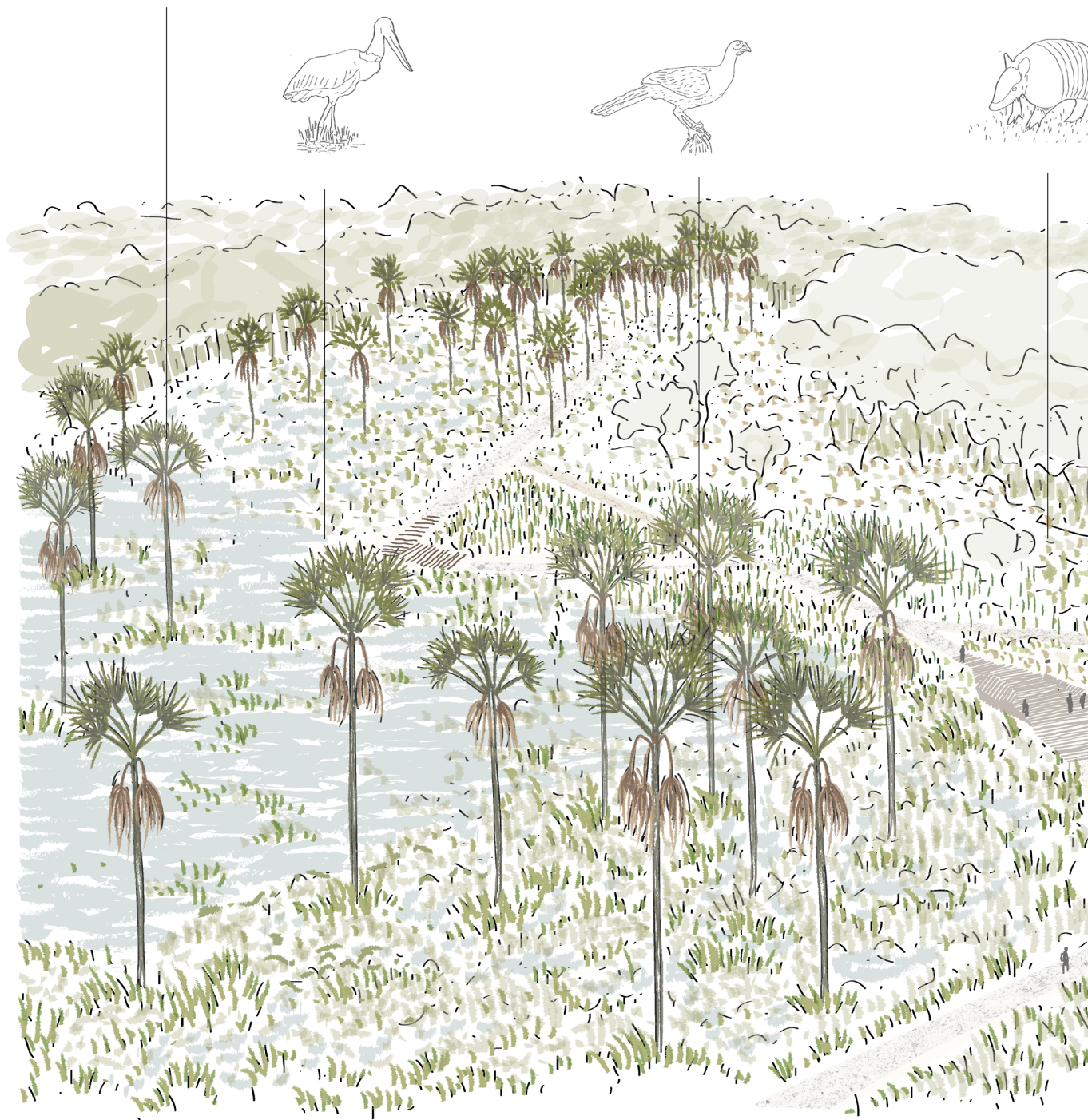
The Vereda (Swamp) garden

Buriti
Mauritia flexuosa

Tuiuiú
Jabiru mycteria

Aracuã-do-Cerrado
Ortalis canicollis

Tatu-bola
Tolypeutes tricinctus



a
inctus

Veado-campeiro

Ozotoceros bezaarticus

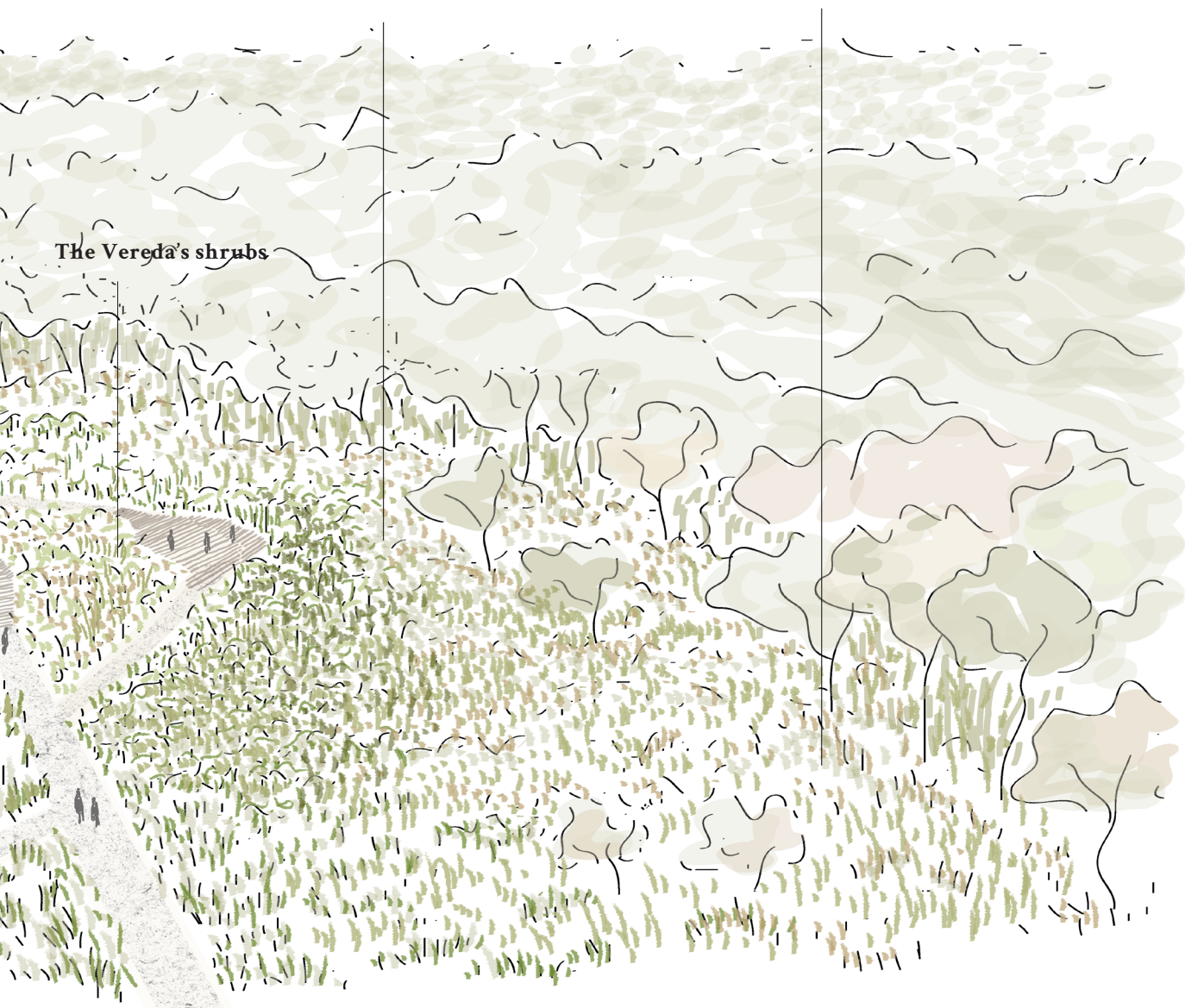


Lobo-guará

Chrysocyon brachyurus



The Vereda's shrubs



The Vereda's shrubs

Lambari

Astyanax spp.



Rã

Physalaemus cuvieri



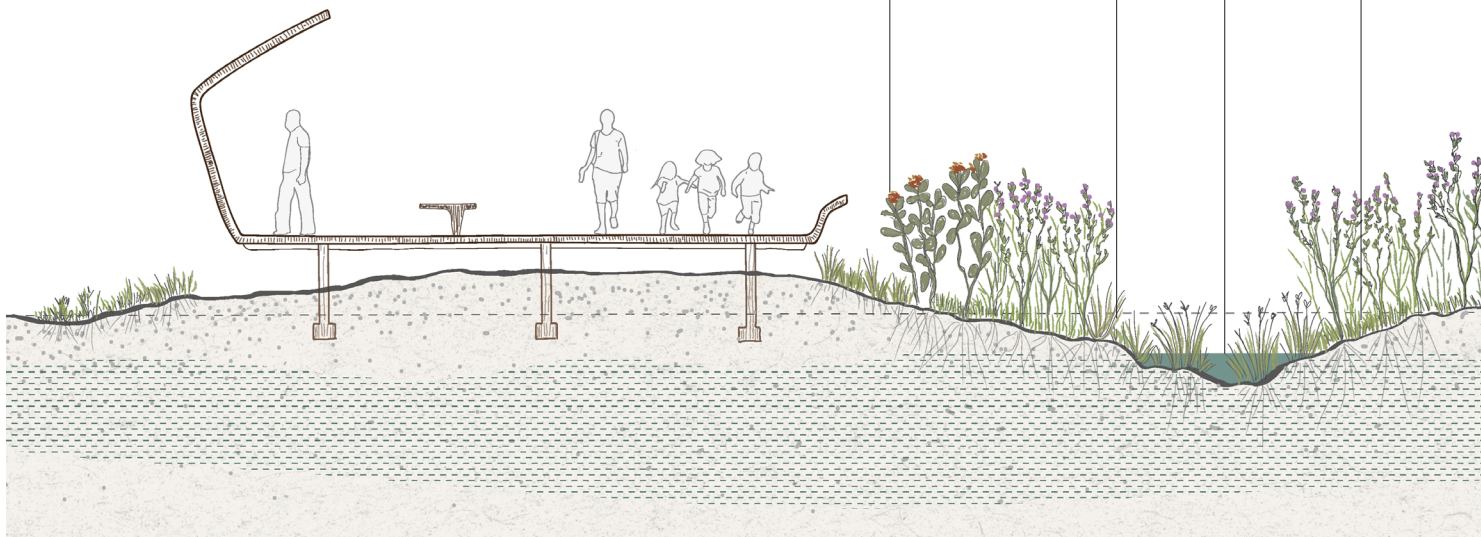
Douradinha

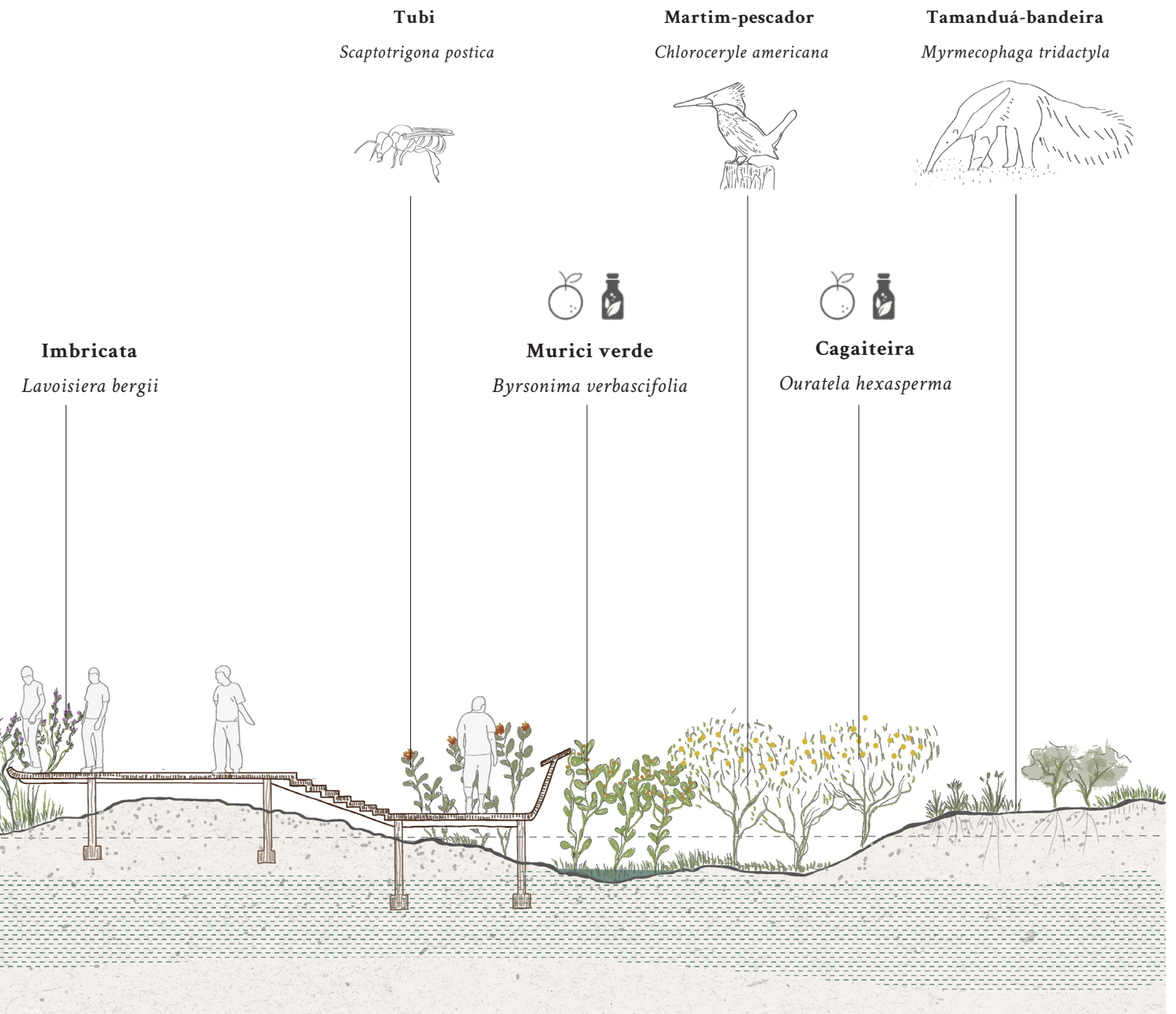
Palicourea rigida



Sempre-viva aquática

Syngonanthus spp.

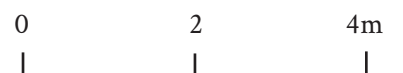




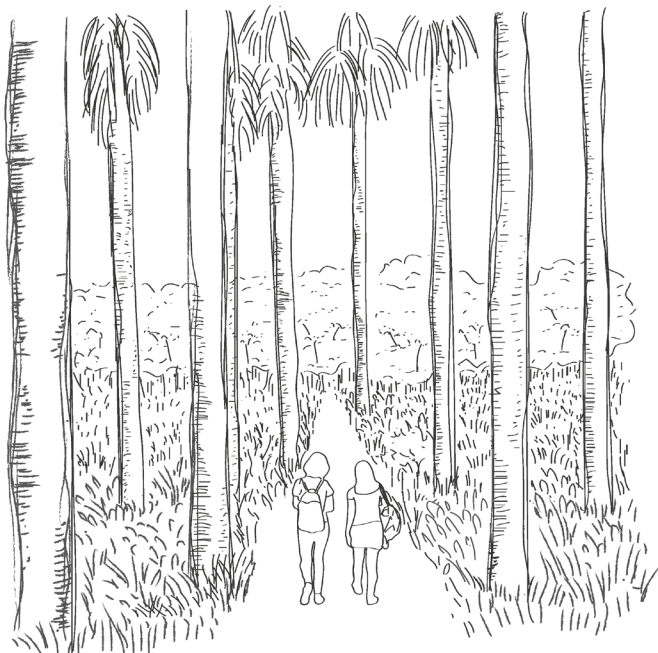
Fruit



Medicinal use



A serial vision through Cerrado's route



Walking through the Buriti



The wet forest



Opening the Cerrado



Approaching the Cerrado

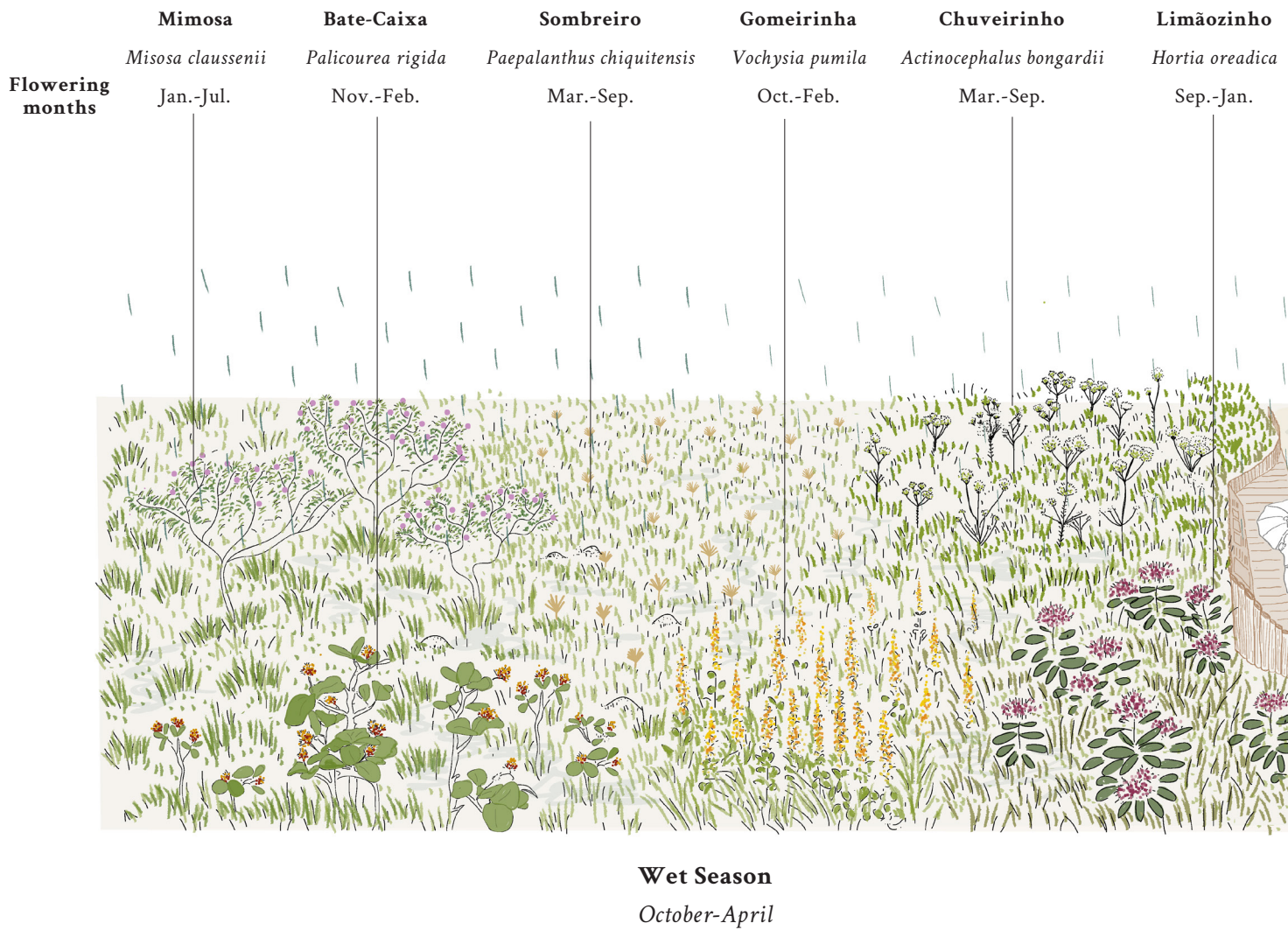


Entering the Cerrado



The scattered Cerrado

The Open Cerrado

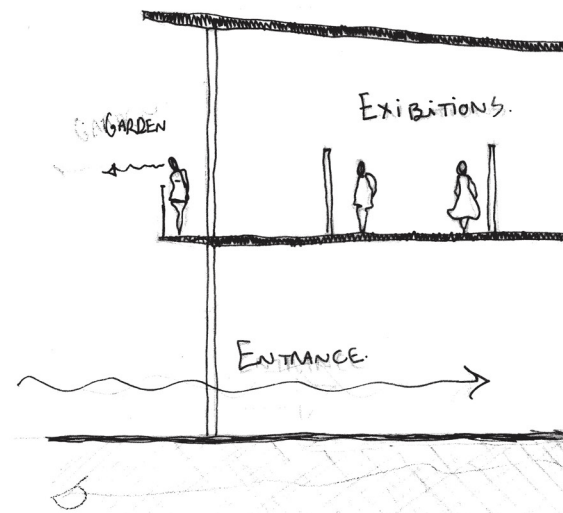
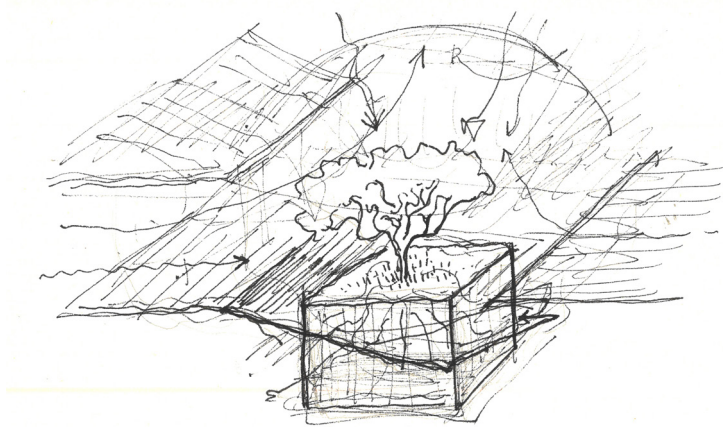


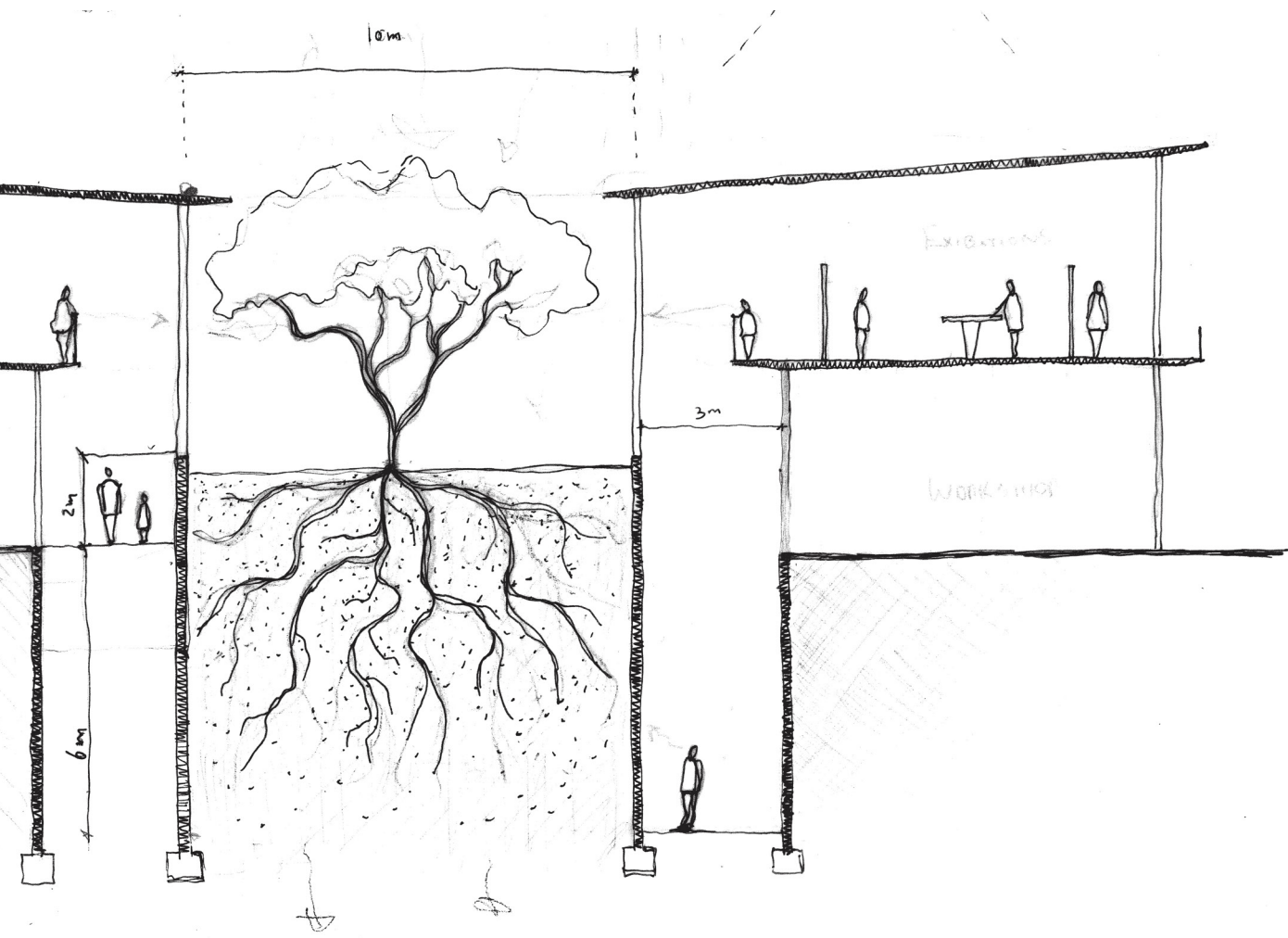
Capim-membeca	Candombá	Capim-rabo-de-raposa	Canela-de-ema	Cidreira-do-campo
<i>Andropogon leucostachyus</i>	<i>Vellozia variabilis</i>	<i>Aristida riparia</i>	<i>Vellozia squamata</i>	<i>Lippia lacunosa</i>
May.-Jul.	Apr.-Aug.	May.-Jul.	Apr.-Aug.	Jun.-Sept.



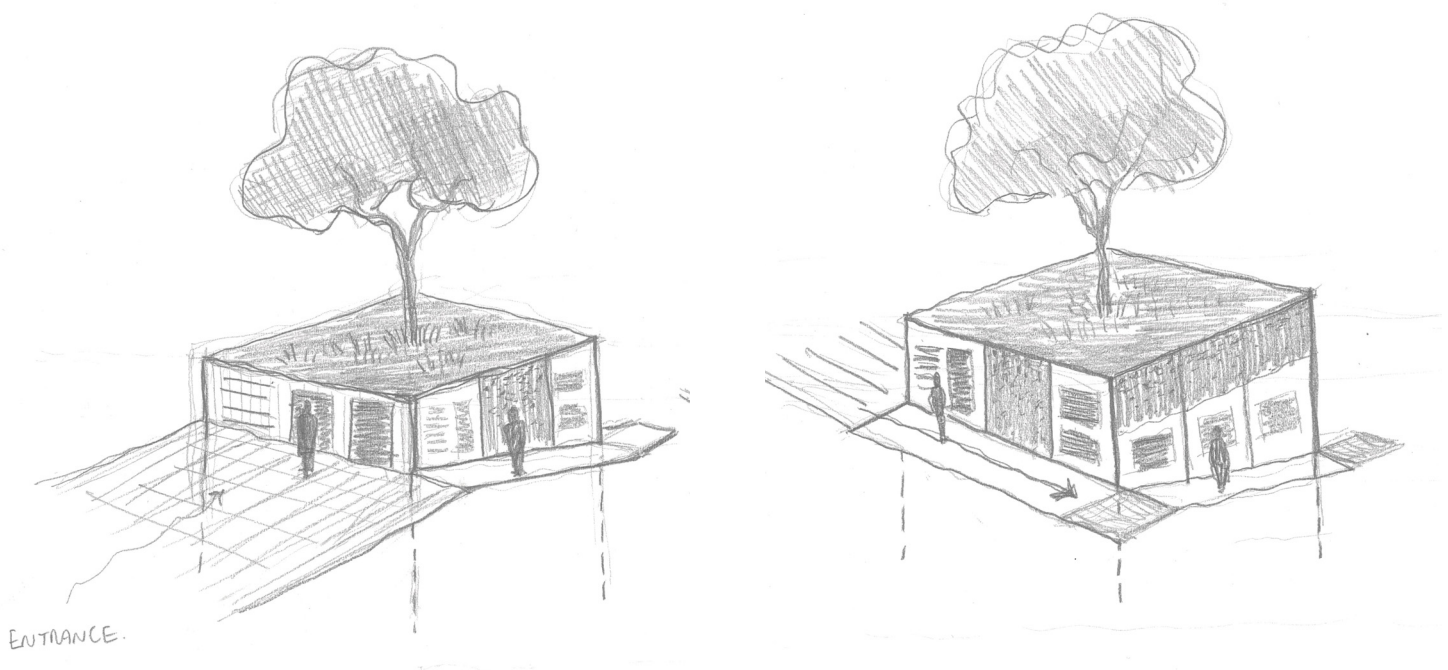
Dry Season
May-September

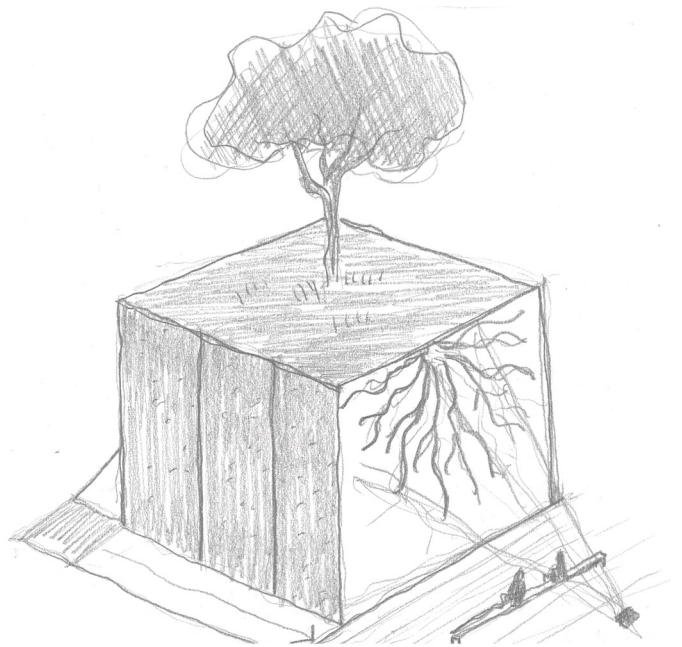
The Cerrado's Memorial





This site functions as a museum. Inside the building, the Cerrado Garden allows visitors to circulate the garden. The garden serves as an exhibition space, providing educational information about the ecological importance of the cerrado that is hidden underground: the roots. The aim is for visitors to understand the integration of Cerrado's trees and the soil and recognize the importance of this biome.





The Ecological and Productive corridor

To design the green corridor, a selection of trees with significant economic value, ecological importance, and cultural uses was made. According to information based on guides for biome restoration, these species have been successful in direct seeding techniques for reforestation of degraded areas⁽¹⁾. The time of growth and when they start their production phase are relevant factors taken into account in the next steps of the research.

(1) Information available at: <https://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/1042015/1/RestauracaosemeaduradiretacerradoPDFWEB.pdf>

Fragment of the green corridor

The green corridor in the basin scale

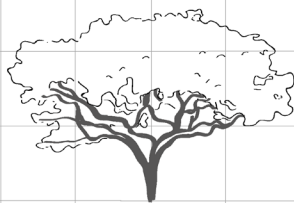




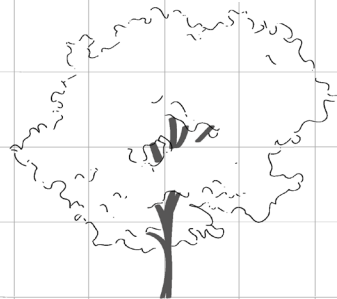
Cagaita
Eugenia dysenterica



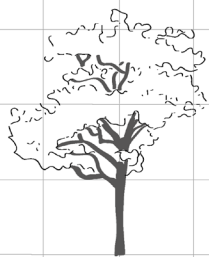
Jatoba
Hymenaea stigonocarpa



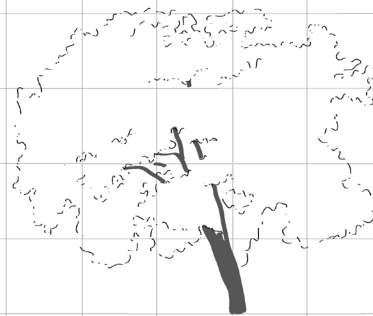
Pequi
Caryocar brasiliense



Baru
Dipteryx alata



Peroba do cerrado
Aspidosperma tomentosum



Copaiba
Copaifera langsdorffii



5m

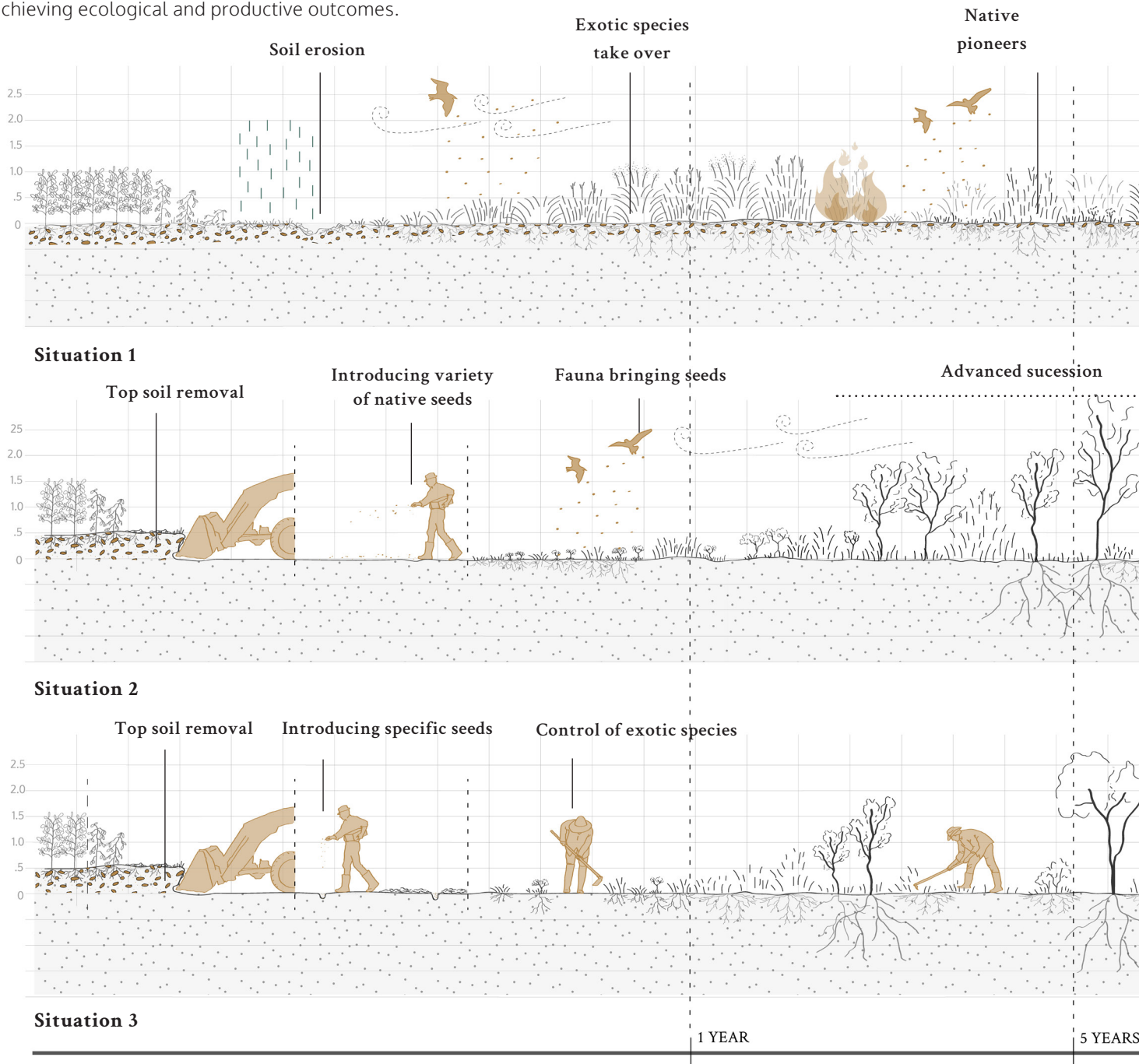


Time and natural processes

The Drawing time exercise illustrates the natural succession of the Cerrado in agricultural areas. This sections explores three different future options for a monoculture crop and how human intervention can support biome restoration and estimates the timeframe for achieving ecological and productive outcomes.

Option 1

No human intervention. Natural succession begins slowly, highly dependent on soil condition and proximity to native vegetation. A mature ecosystem resembling the original Cerrado may take up to 50 years.

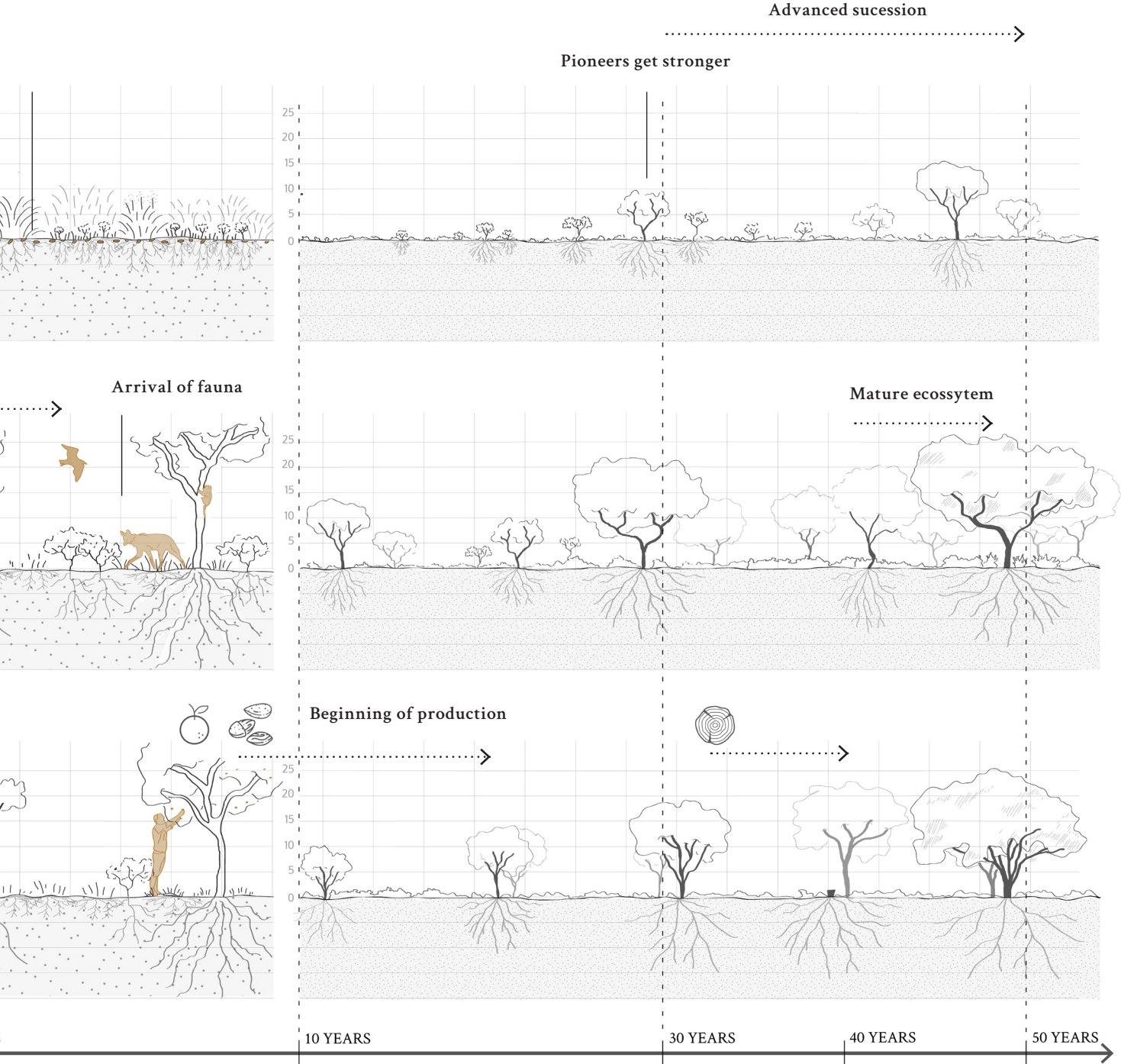


Option 2

Soil preparation involves removing topsoil to reduce nutrients, creating conditions unfavorable to invasive species. Direct seeding with a mix of native species—especially groundcover and pioneers—initiates natural succession and accelerates restoration.

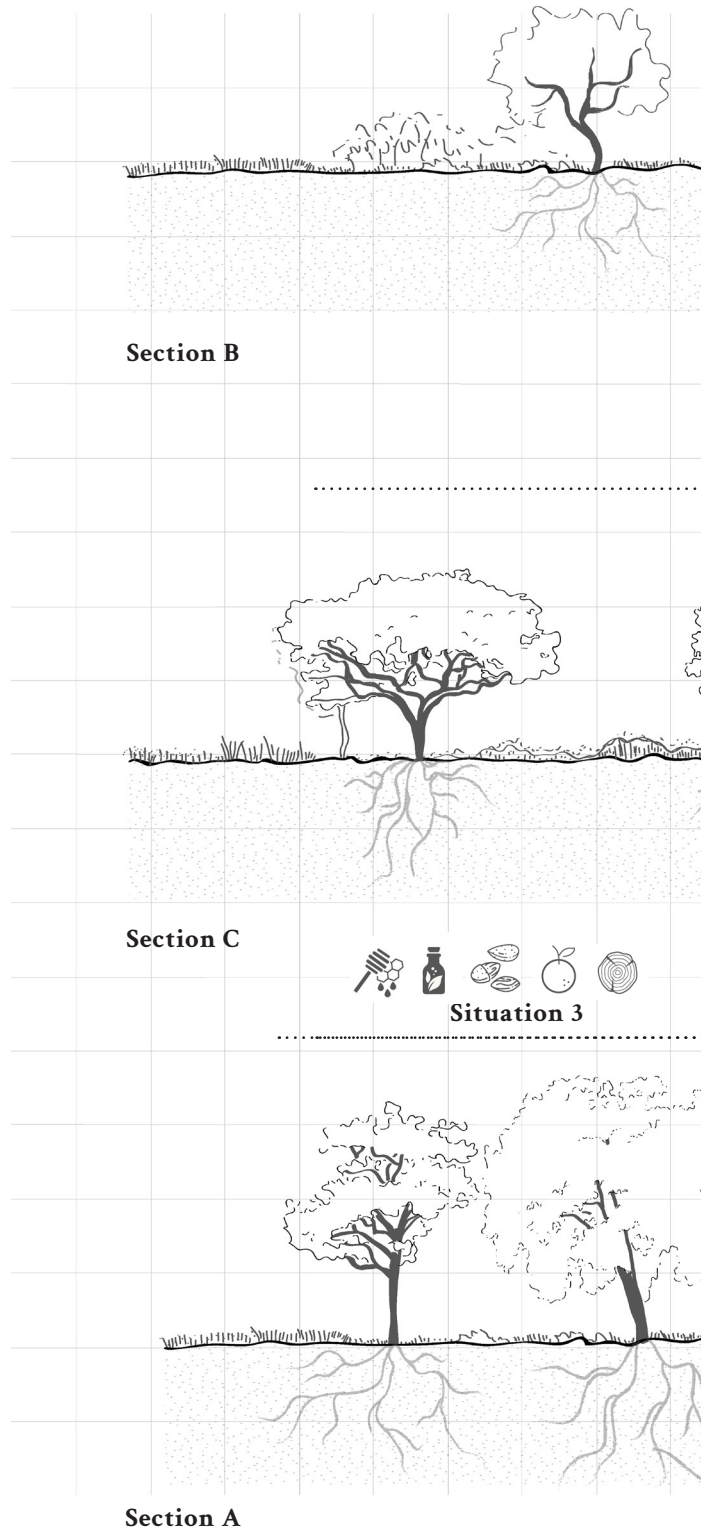
Option 3

Similar to Option 2, but seeds are introduced in specific spatial arrangements with selected productive species. This approach combines ecological restoration with production goals, involving more active human management.

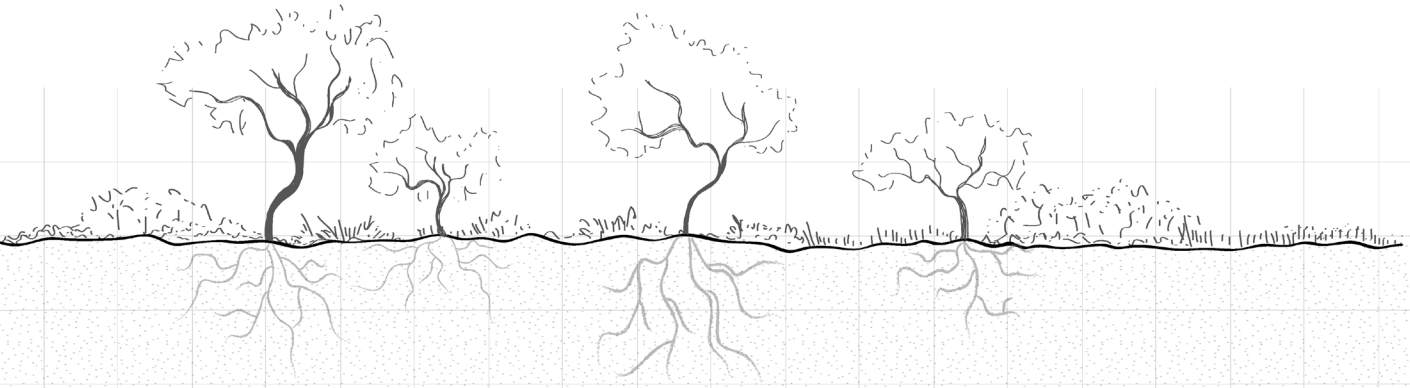


Spatial variations of the Ecological corridor

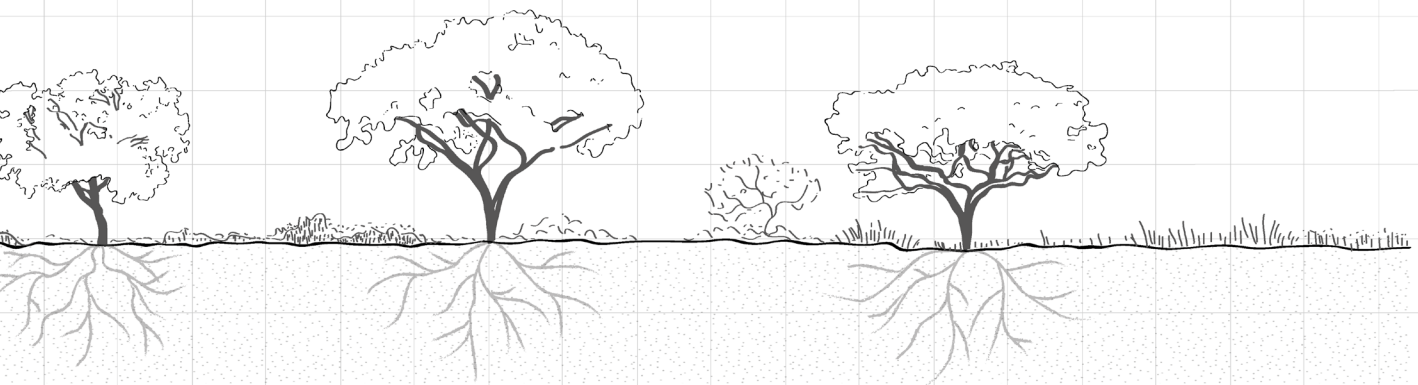
The ecological corridor within the Botanical Garden applies the techniques explored in the drawing-time research across three distinct spatial conditions, combining elements of Situations 2 and 3 described earlier, and the Maned Wolf's habitat (pages 76 and 77). In this way, the corridor serves as a model for large-scale ecological connectors that integrate biome restoration with productive landscapes. At the same time, it offers visitors the opportunity to engage with ecological processes and discover the potential of the Cerrado as both a resilient ecosystem and a productive environment.



Situation 2



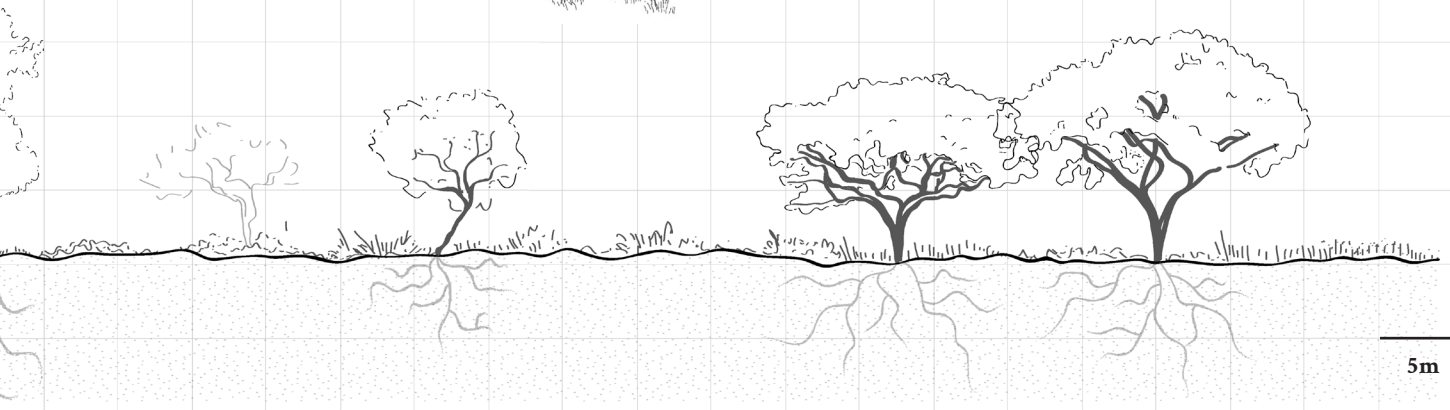
Situation 3



Situation 2



Situation 3



5m

A network in Janeiro River Basin

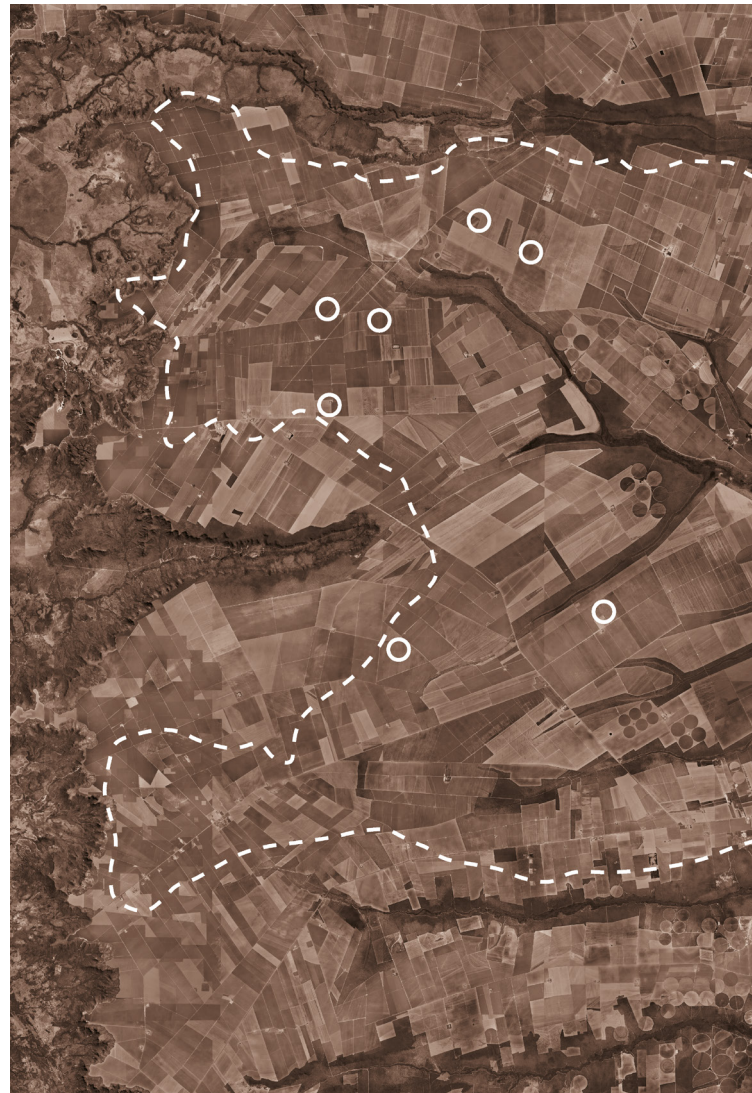
If the design and proposed vision were implemented in the Janeiro River Basin, what sectors of society would become involved?

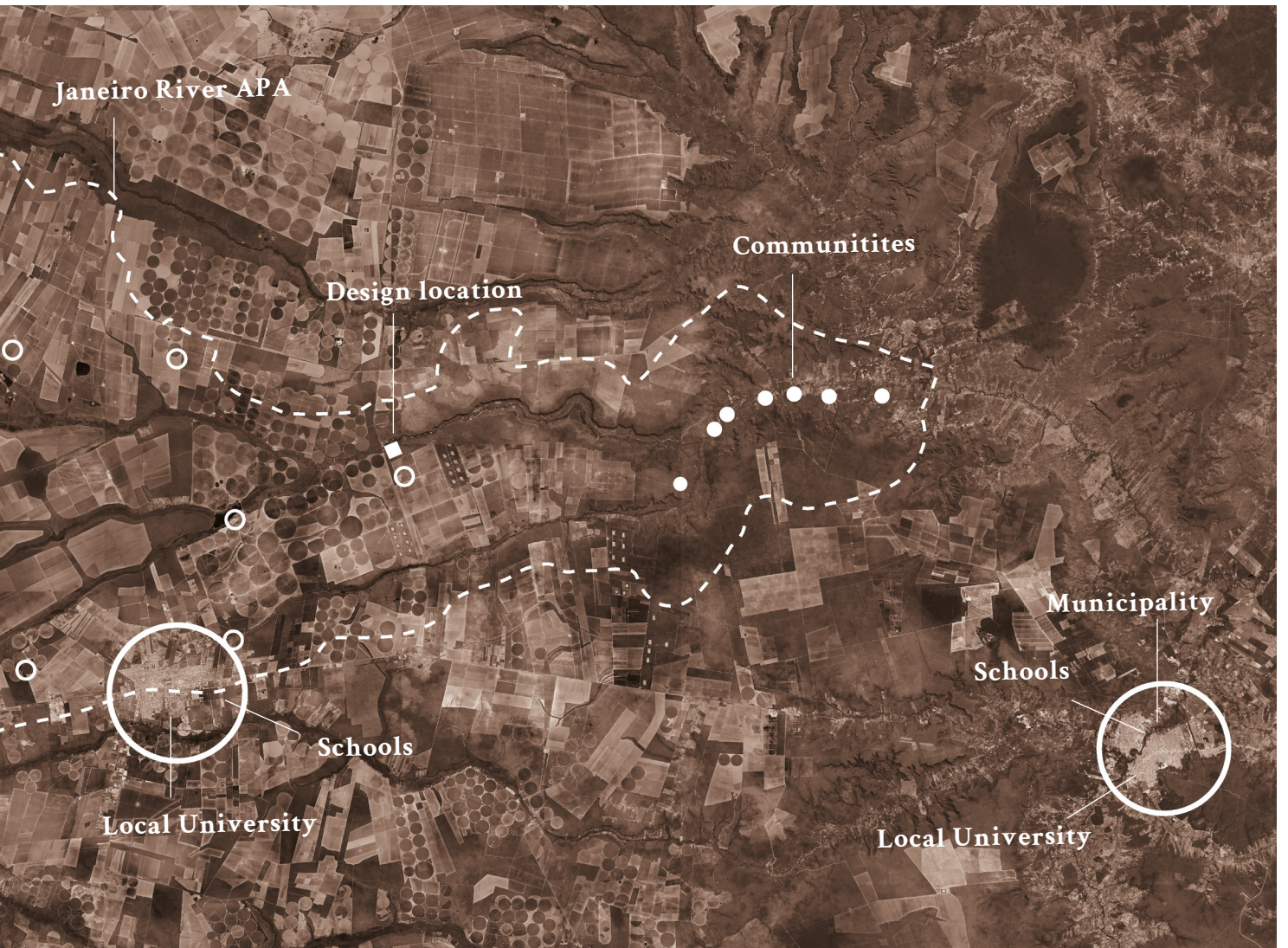
The project considers it an urgent need to include the private sector, especially large-scale farms, in the responsibility for restoring and reintegrating natural vegetation areas. These large properties, currently dominated by monoculture agriculture and the exportation of commodities, are among the main drivers of vegetation loss and fragmentation in the Cerrado, particularly in the Janeiro River Basin, the western region of Bahia, and across the biome as a whole.

Local universities and schools are also essential partners in this process. While producing research, Universities have the potential to extend knowledge into society, as well as to understand and transform the local reality.

The resulting network also includes the schools, given their capacity to provide socio-environmental education and raise awareness about the importance of the biome among younger generations.

Ultimately, the project places great value on and effectively integrates the traditional knowledge and social practices of local communities. Their understanding of the Cerrado and their sustainable interaction with it offers possibilities for socio-economic integration that respects cultural aspects and possibilities for new relationships with the biome.





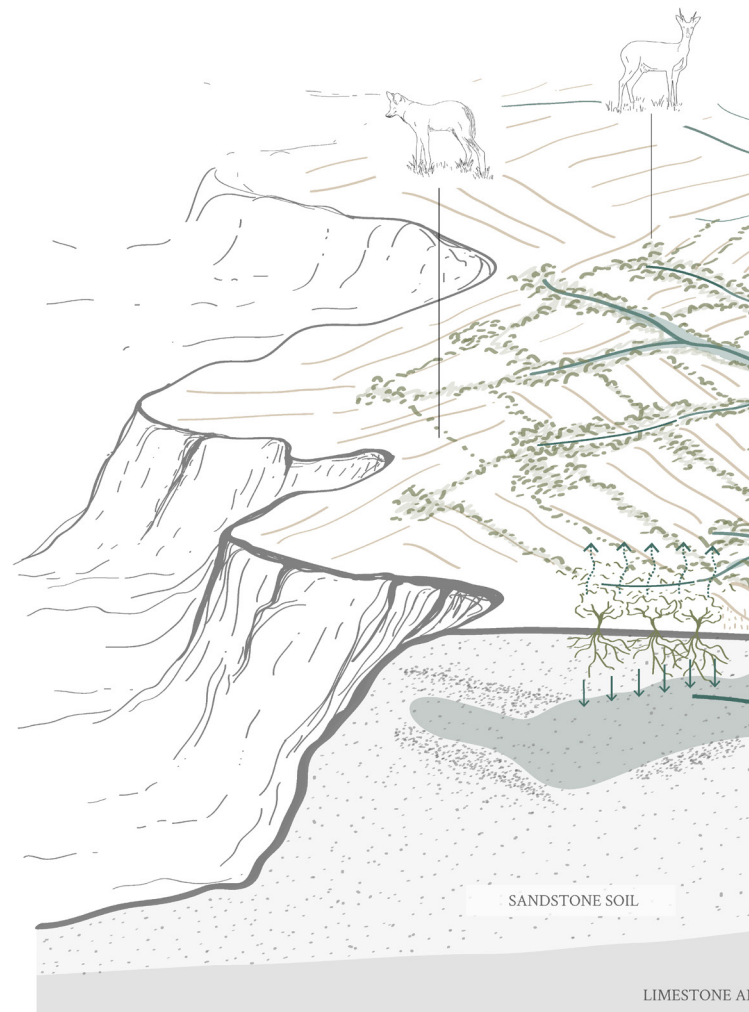
Conclusion

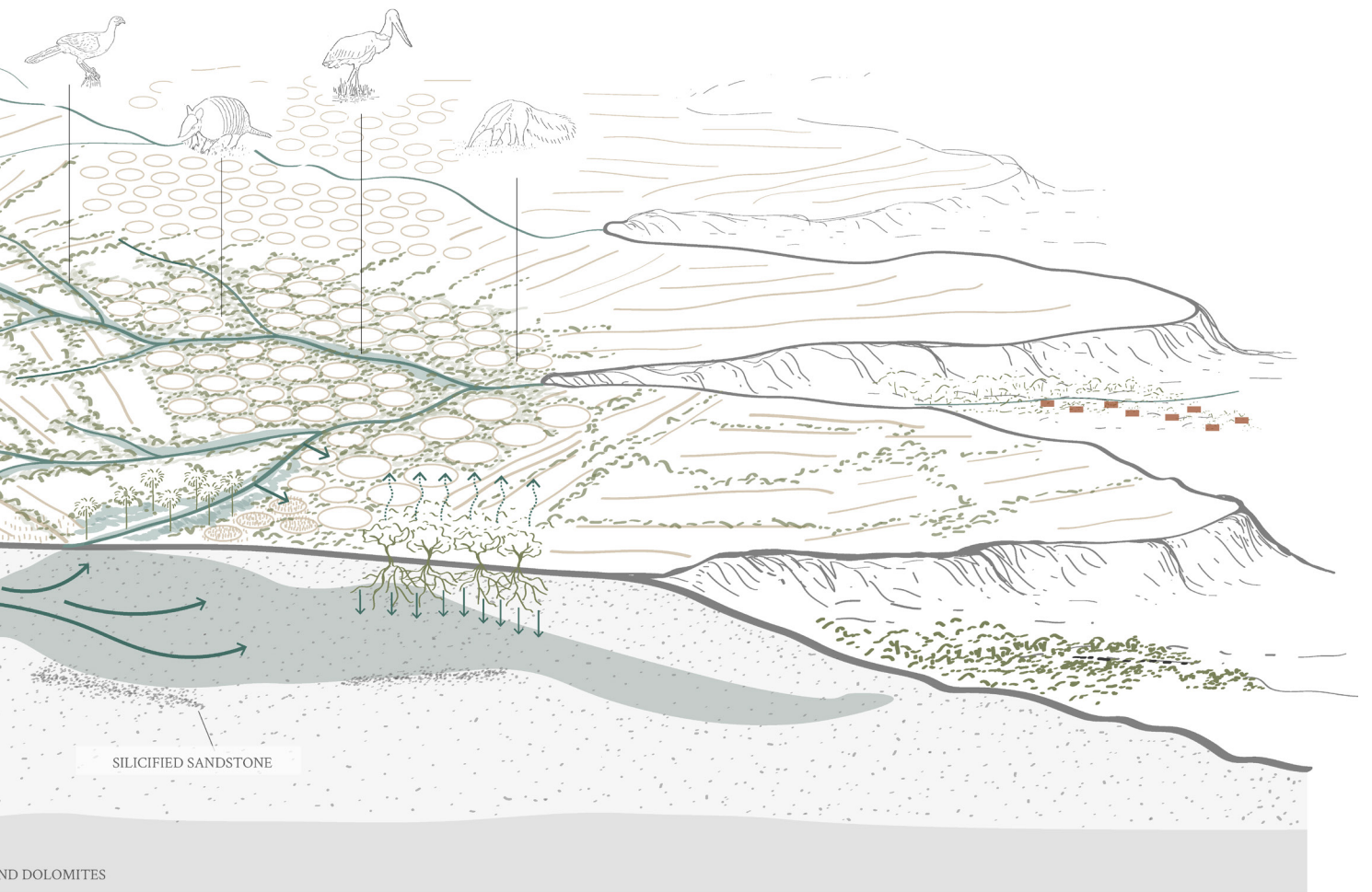
A seed for Local and Global changes

Today, Western Bahia is a major grain-exporting region, and as a result, it also exports vast amounts of water embedded in agricultural commodities. The region also encompasses the critical Urucuia Aquifer, whose protection is vital to the sustainability of the biome and requires urgent attention.

The seed planted by the project in the Janeiro River Basin holds the potential to initiate change across several dimensions, such as scientific research, ecological restoration, and landscape aesthetics. The study and resulting design of this thesis demonstrate that, on the one hand, Western Bahia has undergone significant transformations over decades of large-scale, extractive land use. On the other, it now holds the opportunity to redefine what a productive landscape can be. This redefinition could involve a transition from monoculture toward more integrated, socially and environmentally balanced agricultural systems.

Offering a new perception of Cerrado's landscape, and a diverse and integrated program, the design highlights the enormous, still-emerging potential of native species, particularly in the fields of food production and medicinal use. It brings that potential to light and envisions this region as a transition from a commodity-based export economy to one grounded in a new local and global logic centered on ecological value and social inclusion, repositioning itself as a worldwide reference for productive and socially integrated landscapes rooted in the native socio-biodiversity.





Reflection

A Utopian design

The design's concept works on a potential scale of transformation. However, regarding the context of Brazil's current political, economic, and social reality, its implementation and the broader impact it envisions may be seen as a utopian concept. As an example, the depletion of water resources by agriculture is a fact that could be addressed by strict regulations, which in Brazil's context is a measure that is far away from being achieved due to the overwhelming influence of agribusiness in the country's politics.

This same reality is also reflected in the marginal role that Landscape Architecture and urbanism play in Brazil, particularly in the design of public spaces. The private sector, which includes large-scale farms, exerts disproportionate power and influence, often at the expense of social, environmental, and public interest priorities.

Reflecting on the role of Landscape Architecture

Reflecting on the role of landscape architecture in such a complex context also presented an opportunity to question what the discipline can contribute and how it might mitigate, propose, or even reinvent the relationship between humans and the natural environment. Landscape Architecture alone has little influence on such political context. However, considering the discipline and profession as a mediator between other areas, landscape design can integrate other fields and,

as a result, bring together a wide range of stakeholders and societal groups. Reflecting on this potential and considering that a landscape design can influence and shift people's perception and awareness, the discipline can become a powerful tool to address complex solutions.

An unexpected outcome

The starting point of the thesis was my interest in the Cerrado biome in central Brazil. Recognizing the importance of the biome in terms of hydrology, I joined the Traditional Water Stories Lab, driven by the water aspect and motivated to design a water system. However, the design was taken in another direction. It was led by the research process, which revealed the location, defined the scales, and assigned the design.

I began the research, trusting that I would find an intriguing enough design area to explore. However, this path was laborious and often overwhelming. Several topic ideas and potential design assignments came to mind. And finally, I was forced to be open to the unknown, accept losing control over my initial expectations, and allow the thesis to shape itself. In a way, I became a facilitator for the in-between turns and the path it was taking.

Reflecting on the role of landscape architecture

Exploring the role of landscape architecture in such a complex context was also an opportunity to question what the discipline can contribute, how it might mitigate,

propose, or even reinvent the relationship between humans and the natural environment.

I realized that landscape architecture can serve as a mediator between disciplines such as architecture, geography, ecology, and botany. However, this also raises the challenge of combining all this knowledge in a meaningful way without becoming too generic when operating across multiple disciplines.

Being drowned in data

It was a fortunate discovery that the topic is much more widely discussed than I had imagined. However, I also became overwhelmed by the volume of data and the abundance of recent content, which was, on the one hand, extremely enriching but, on the other, exhausting.

While working on the thesis, I realized that trying to combine too much knowledge can prevent you from going deep into any one aspect. Considering when, why, and how to seek specific content that could influence design strategies and decisions became important.

For example, I could have spent months researching the biome's ecological aspects. How do we deal with so much information? When I needed concrete tools to think strategically at a regional scale, ecological knowledge, particularly about the local fauna, proved a great means of spatializing strategies and applying them to a broader vision.

Scale continuum: a challenging yet fascinating aspect

As I started with a considerably large area, Cerrado corresponds to about 40% of the European Union, finding a design location was particularly challenging. While the topic was narrowed down and refined, discovering connections from local to global scales was fascinating, which implied deepness and opened up the scale continuum aspect that became central to the design approach. Working through scale adds complexity: it's laborious, but it also enriches the design. I hope I have reached a satisfactory outcome within the scale continuum perspective.

Reference list

Ambrósio Moreira, P., Levis, C., Junqueira, A., Cassino, M., Lins, J., & Clement, C. (2021). Domesticação de plantas e de paisagens.

Beer, F., Munhoz, C. B. R., Couwenberg, J., Horák-Terra, I., Fonseca, L. M. G., Bijos, N. R., Da Cunha, C. N., & Wantzen, K. M. (2024). Peatlands in the Brazilian Cerrado: Insights into knowledge, status and research needs. *Perspectives in Ecology and Conservation*, 22(3), 260–269. <https://doi.org/10.1016/j.pecon.2024.07.003>

Berleant, A. (1997). *Living in the landscape: Toward an aesthetics of environment*. Oxford University Press. <https://academic.oup.com/jaac/article/56/3/302/6341938>

Berleant, A., & Carlson, A. (2007). *The aesthetics of human environments*. Broadview Press. <https://ci.nii.ac.jp/ncid/BA85830112>

Boelens, R., Vos, J., & Perreault, T. (2018). Introduction: The multiple challenges and layers of water justice struggles. In *Cambridge University Press eBooks* (pp. 1–32). <https://doi.org/10.1017/9781316831847.001>

Bustamante, M. M. da C. (2016). Entrevista. *Revista Darcy*, (21), 38–45.

Donahue, J. M., & Johnston, B. R. (1998). Water, culture, and power: Local struggles in a global context. *Choice Reviews Online*, 35(11), 35–6458. <https://doi.org/10.5860/choice.35-6458>

Durigan, G., Munhoz, C. B., Zakia, M. J. B., Oliveira, R. S., Pilon, N. A., Valle, R. S. T. D., Walter, B. M., Honda, E. A., & Pott, A. (2022). Cerrado wetlands: Multiple ecosystems deserving legal protection as a unique and irreplaceable treasure. *Perspectives in Ecology and Conservation*, 20(3), 185–196. <https://doi.org/10.1016/j.pecon.2022.06.002>

Gaspar, M. T. P., & Campos, J. (2007). O Sistema Aquífero Urucuia. *Revista Brasileira de Geociências*, 37(3), 216–226.

Gobster, P. H., Nassauer, J. I., Daniel, T. C., & Fry, G. (2007). The shared landscape: What does aesthetics have to do with ecology? *Landscape Ecology*, 22(7), 959–972. <https://doi.org/10.1007/s10980-007-9110-x>

Holanda, S. B. de. (1936). *Raízes do Brasil*. Rio de Janeiro: José Olympio Editora.

Lúcio, S. L. B. (2019). *Foice, machado, fogo e enxada: Práticas de cultivo e sucessão secundária em matas de galeria inundáveis do Cerrado após agricultura itinerante* (Tese de doutorado, Universidade de Brasília).

Martins, R. A., Laranja, R. E. de P., Santos, E. V. dos, Ferreira, I. M., & Lima, J. D. (2017). O (des)caminho das águas: Alteração no subsistema de vereda provocado por reservatório destinado ao abastecimento de pivô central. *Caminhos de Geografia*, 18(61), 83–102. <https://doi.org/10.14393/rcg186106>

Motta-Junior, J. C., & Martins, K. (2002). The frugivorous diet of the maned wolf, *Chrysocyon brachyurus*, in Brazil: Ecology and conservation. In D. J. Levey, W. R. Silva, & M. Galetti (Eds.)

Munárriz, L. Á. (2011). The category of cultural landscape. *AIBR Revista De Antropologia Iberoamericana*, 06(01). <https://doi.org/10.11156/aibr.060104e>

Nassauer, J. I. (1995). Culture and changing landscape structure. *Landscape Ecology*, 10(4), 229–237. <https://doi.org/10.1007/bf00129257>

Oliveira, A. (2023). *A grilagem de terras na formação territorial brasileira*. <https://doi.org/10.11606/9786587621326>

Reis, S. C. dos, Dias, J. H. P., Sousa, L. O., Chiarello, A. G., Sá, M. E., & Ramos, I. P. (2023). Germination of fruits eaten by the maned wolf *Chrysocyon brachyurus* (Illiger, 1815) (Carnivora, Canidae). *Biota Neotropica*, 23(3), 1–9. <https://doi.org/10.1590/1676-0611-BN-2022-1413>

Ribeiro, R. F. (2002). O Eldorado do Brasil central: História ambiental e convivência sustentável com o Cerrado. CLACSO Repository. <https://biblioteca-repositorio.clacso.edu.ar/handle/CLACSO/11715>

Salmona, Y. B., Matricardi, E. A. T., Skole, D. L., Silva, J. F. A., De Araújo Coelho Filho, O., Pedlowski, M. A., Sampaio, J. M., Castrillón, L. C. R., Brandão, R. A., Da Silva, A. L., & De Souza, S. A. (2023). A worrying future for river flows in the Brazilian Cerrado provoked by land use and climate changes. *Sustainability*, 15(5), 4251. <https://doi.org/10.3390/su15054251>

Santos, D. E., & Pinho, S. A. (2001). Breve histórico de ocupação da Bahia em três grandes áreas. In *Dinâmica sociodemográfica da Bahia: 1980–2002* (Vol. 2, pp. 69–79). Salvador: SEI.

Souza, C. L. F., De Oliveira, R. B., Mustafé, D. N., Nunes, K. A. C., & De Moraes, E. M. B. (2019). O Cerrado como o “berço das águas”: Potencialidades para a educação geográfica. *Revista Cerrados*, 17(1), 86–113. <https://doi.org/10.22238/rc244826922019170186113>

Viana, D., & Souza, N. F. da S. (2021). Aspectos ecológicos e potencial econômico do buriti (*Mauritia flexuosa*). *Agrarian Academy*, 8(2). https://doi.org/10.18677/agrarian_academy_2018a52

Vos, J., & Boelens, R. (2018). Neoliberal water governmentalities, virtual water trade, and contestations. In *Cambridge University Press eBooks* (pp. 283–301). <https://doi.org/10.1017/9781316831847.019>

Table of Images

Image 1.0 - Landscape at my grandparents farm.
Source: Author, 2012

Image 1.1 - Community 'Fecho de pasto' in Western Bahia. Source: Gui Gomes. Available at <https://especial.reporterbrasil.org.br/comunidadestradicionais/fundo-e-fecho-de-pasto-da-bahia/>. Accessed in April, 2025

Image 1.2 - Cartography of Brazil in 1519. Source: Atlas Miller (1519). Available at <https://catalogue.nla.gov.au/catalog/4508170>. Accessed in April, 2025.

Image 1.3 - Landscape of Cerrado. Source: Roberto Murta. Available at <https://ecoa.org.br/inventario-do-cerrado/>. Accessed in April, 2025

Image 1.4 - Contrast between native vegetation of Cerrado and monoculture crop. Source: Adriano Gambarini/ WWF-Brasil. Available at https://wwf.panda.org/wwf_news/?209892/Deforestation-spikes-in-Brazil-over-last-year

Image 1.5 - Public Hearing that marks the beginning of the articulations at the federal level for the approval of the Constitutional Amendment Project which transforms Caatinga and Cerrado into national heritage protected by the Federal Constitution. Source: Campanha Cerrado. Available at <https://www.campanhacerrado.org.br/noticias/441-audiencia-publica-pec-504>. Accessed in April, 2025

Image 1.6 - The 3rd National Meeting of Voices

and Practices of Women of the Cerrado. 70 women from traditional communities from different parts of the Brazilian Cerrado gathered to strengthen the sociobiodiversity of the Biome. Available at <https://www.brasildefato.com.br/2023/10/26/somos-a-sociobiodiversidade-do-cerrado-afirmam-mulheres-em-encontro-nacional-realizado-no-norte-de-minas/>. Accessed in April, 2025.

Image 2.0 - 'Estrondo' farm, Formosa do Rio Preto, Western Bahia. Source: Marcio Sanches/WWF-Brasil. Available at <https://oeco.org.br/reportagens/entre-a-cruz-e-a-espada-ha-alternativa-eleitoral-em-2022-que-garanta-a-protecao-do-cerrado-baiano/> Accessed in April, 2025.

Image 2.1 - Landscape of cerrado during the wet season (top image) and dry season (bottom image). Source: Jardins do Cerrado project. Available at: <https://www.jardinsdecerrado.com/chuva-e-seca>. Accessed in April 2025.

Image 2.3 - Abstract section that illustrates the variety of typologies within the Cerrado Biome. Adapted from: Walter, Bruno & Sevilha, Anderson. (2019). A agonia de um Bioma. In: DARCY - Revista de Jornalismo Científico e Cultural da Universidade de Brasília UnB (ISSN: 2176-638X). 21. 06.

Image 2.4 - Group of Images from the traditional peoples of Cerrado. Source: Reporter Brasil.

Available at: <https://especial.reporterbrasil.org.br/comunidadestradicionais/fundo-e-fecho-de-pasto-da-bahia/>. Accessed in June 2025.

Image 3.1 Local farmer on a dry canal in Brejo Verde, a rural village in western Bahia. Photo from Dado Galdieri. Available at: <https://e360.yale.edu/features/with-traditional-farms-withering-why-is-brazil-running-dry>. Accessed on April 2025

Image 3.2 Pumps taking water from the Arrojado River to the irrigation system of Rio Claro farm in Wester Bahia. Photo from Dado Galdieri. Available at: <https://e360.yale.edu/features/with-traditional-farms-withering-why-is-brazil-running-dry>. Accessed on April 2025

Image 4.7 - Images from "Restaura Cerrado" project. Photos from Mariana Siqueira. Source: Jardins do Cerrado Project. Available at: <https://www.jardinsdecerrado.com/blog>. Accessed on April, 2025

Image 4.8 Images showing the work from the association Cerrado de Pé that focuses on seed collection and biome restoration. Photos from Márcio Sanches. Source: WWF-Brasil. Available at: <https://www.wwf.org.br/?84660/restauracao-do-cerrado-tem-protagonismo-de-coletoras-de-sementes>. Accessed in June 2025.

Image 4.9 Images from Silvopastoral Systems in Cerrado. Source: Silvopastoral Systems (SPS) guide. Available at: <http://www.alice.cnptia.embrapa.br/alice/handle/doc/1132245>. Accessed in June 2025.

