



A transcalar landscape system

Corn: A multiscalar agent for the spatial regeneration & ecological protection of the Andean Mountain Forest in Colombia

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CORN PATH

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Corn: A multiscalar agent for the spatial regeneration &
ecological protection of the Andean Mountain Forest in
Colombia

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Abstract

Corn: an agent able to redefine the spatial territorial order within a multisystemic network

Andean Mountain Forest (AMF) is part of the Tropical Andes global biodiversity hotspot¹ and covers 25 % of its total area. It represents a high level of turnover in the altitudinal gradient due to its **hinge character** between the high mountain ecosystems —cloud forest and paramo— and the successional ecosystems below —tropical rainforest and dry tropical forest—. However, it is the most vulnerable forest today² in **Colombia** due to the **Agricultural Frontier (AF)**³: the boundary of rural land where all agriculture extractive forms can be undertaken in the country. These two actors embody a conflict that grows increasingly due to the periodic expansion of the border, leading to a dramatic and total swallowing from the AF to the AMF. A dynamic that has spatially formed an arbitrary and critical **overexploited corridor** —called **transect** for this research— that makes evident the **disruptive role** Andean Mountain Forest is undertaking today in the ecological fluxes; scenario that calls urgently for a recalibrating action: involving **regenerative** and **protection agency**.

The hypothesis states **corn as an agent able to retrace the spatial organization of the transect, aimed to recover its Andean Mountain Forest**. The main objective is to display the **multidimensional-functional quality of corn**: its skill of influence diverse actors while reweaving the territory in a complex network.

The thesis methodology is developed through an **atlas of maps** by combining data analysis techniques with interpretative and empirical observations. A trans-scalar territorial lecture that follows the method “research by design”⁴. And, secondly, the ultimately **landscape design proposal** that defines a National Agricultural Park (the first of this typology in Colombia) where corn agency—the genius loci of the territory—is depicted in practical landscaping interventions.

This thesis **concludes** that corn acts as a holistic-multidimensional agent in the altitudinal and horizontal spatial dialogue between and in the transect, able to **restoring indigenous presence across the territory, redefining the management of the Agricultural Frontier under a more restricted model, and ultimately transitioning the region's KBAs from their current threatened status to one of safety and ecological succession**.

Furthermore, it **discusses** the need to adapt landscaping approaches to consider the inter-scalar territorial lectures of the discipline into a systemic⁵ logic that goes from global to cellular scales, as Alexander Von Humboldt stated so fiercely when implying the *interconnectedness of the whole*⁶. Since landscape scale interventions are rarely above the 1_30000 scale, a systemic lecture would automatically place each studio case into a **‘scale-free’ web**⁷ allowing to zoom in and out and make connections with nodes in a broader spatial transformation and temporal span; as nature itself claims, recognizing it is one unique body in constant motion-transformation, but also the current global climate and eco-social crisis we are facing today.

KEYWORDS: Andean Mountain Forest, Indigenous Peoples, Key Biodiversity Hotspots, Agricultural Frontier, Corn (*Zea mays*), Transcalar system.

1 This hotspot has a crucial role as it is the host of the greatest biological richness on the planet: It is home to more than 34,000 species of plants and animals, half of which are endemic, which is why it has been recognized as the biological reserve of humanity. Besides, it converges more than 40 Indigenous groups, which frames it under an exceptional cultural diversity too. These communities play a critical role in economic activities, politics and land use. As such, they are important allies in biodiversity conservation. Moreover, lands owned or reserved for Indigenous peoples and communities represent more than 52 percent of the hotspot's land area. (Critical Ecosystem Partnership Fund n.d.)

2 “Only 4% of the original Andean forest remains in Colombia, being one of the greatest ecosystem losses in the country. The Andean region is the most populated and economically active, which has fragmented its forests and today they only represent 20% of the initial coverage” [...] Deforestation due to illicit crops, expansion of the agricultural frontier, extensive livestock farming and mining activities, development of infrastructure projects (reservoirs, roads, etc.) are their most visible threats”. (Ministerio de Ambiente y Desarrollo Sostenible s.f.)

3 (Unidad de Planificación Rural Agropecuaria (UPRA) 2018)

4 “Drawing is presented as an essential tool for interpreting, visualizing, communicating, and understanding. [...] This approach is grounded in a process of observation, review, and reinterpretation of the territory, contributing spatial reflections that are both tangible and intangible, measurable, qualitative, and quantitative, through cartographic and iconographic representations. (Fiallo 2024)

5 (López 1993)

6 (Wulf 2015)

7 “Network theory has transformed the way we understand the world [...] It has revolutionized how we think about relationships between people as much as relationships between plants and fungi [...] Fungi and plants are individual life forms with their own disposition and agency [...] active contributors to the whole by being the transmission cables connecting the threads to the network [...] scale-free allow us to appreciate these forms in ways we were incapable of doing before” (Bridle 2022)

Introduction

The Andean Mountain Forest is the most vulnerable ecosystem in Colombia. Read through an interscalar approach — one that moves between the global and the local — three facts emerge that must be named clearly, because together they explain why this territory is a keystone actor in the quest for a planetary ecological balance. First, it belongs to the global **Tropical Andes Hotspot**, which places it within one of the most fragile and irreplaceable biological frames on Earth. Second, the recovery and conservation of this ecosystem are not possible — nor legitimate — without **indigenous communities at the center of its management**. Third, when the Andean Mountain Forest is confronted with the Agricultural Frontier — the force exerting the greatest anthropic pressure on it — an anomaly appears. This spatial disruption is not incidental; it is revealing. For this research, it is named the **transect**: a line that becomes a window onto the full complexity of the territory, where all actors — destructive and generative alike — share a common point of encounter.

That point is corn. **Corn** is the **landscape keystone**: an agent capable of holding together a multiscalar and multidimensional system that regenerates, protects, and conserves the **Andean Mountain Forest**. Its role crosses boundaries that at first appear unrelated — ecological, cultural, productive, political — and precisely because of this it becomes the operative thread of the entire research.

The research is unfolded in two parts.

The first develops a **research-by-drawing** methodology with a free-scale approach, tracing a continuous argument from the global to the local. It is expressed through a cartography interwoven with data analysis, spatial analysis, and literature — together describing the dynamics between the Andean Mountain Forest and all the forces that have driven it toward its current state of degradation. Within this system, corn emerges as a multifunctional actor: that is present across all sectors and responds to pressures that superficially seem unrelated, connecting it all in a very complex multisystem.

The second part is the **Landscape Project**: a multi-point, multi-purpose intervention in the territory at the scale of a National Park. Its design ensures a transcalar effect — operating simultaneously from the microscale to the cosmic, in the tradition that Alexander von Humboldt first formalized when he understood nature as an indivisible whole.

Together, both parts fulfil the three non-negotiable actions this research is committed to: restoring indigenous territorial presence; redefining the management of the Agricultural Frontier under a more ecologically restricted model; and transitioning the region's Key Biodiversity Areas of the Global Hotspot from their current threatened status toward safety, recovery, and ecological succession.





Motivation

Every time life brings me back to that place where the big, deep questions of the discipline surface — how to choose where to look, how to define the zoom, the scale, the central subject — I realize that these questions are, in themselves, the bulk of a landscape architect's work. This is precisely what a landscape architect can determine with their skills: the WHERE to land in order to see, to listen, to bring to light the indistinct voices of a piece of land in its most tacit power.

But it is not that simple. Every person carries a personal landscape in their memory — one that defines, quietly and permanently, the place of an entire life. It is always at the base of any search or project one sets out to trace, sometimes surfacing very clearly, other times very shyly.

In my case, that landscape has always been the MOUNTAIN. I spent most of my life in the rural area of a small town called Sopó, at 2,650 m above sea level, in the eastern range of the Colombian Andes — with the mountain in the foreground behind my house, and another mountain as a backdrop in front of it. Everything the mountain has been able to recreate has been my place, my landscape, always.

Perhaps this is why I feel so deeply identified with Alexander von Humboldt. His way of reading and understanding territory resonates in me profoundly, and I sense this is not coincidental — it is the product of his own personal landscape: the mountain. The mountain called to Humboldt vividly and invited him to walk it repeatedly. He lived with an overflowing desire to be in it, always desperate to climb the most magnificent ranges in the world — the Andes, the Himalayas, the Altai. And over the course of his life, the mountain taught him that its form is literally the throne that makes possible the INTERCONNECTEDNESS OF THE WHOLE. Through it, he found the soul of ecology — because he was able to translate into drawing how the mountain, in itself, demands to be read in relation to everything, from micro to macro.

Perhaps this explains my own stubborn fascination and instinctive need to read territory by always searching to encompass it all — the human race and every other form of life on earth. I am still learning how to depict and translate

into drawings all that the mountain shows me. That is why I want to close this introduction with a passage by Andrea Wulf, which describes a way of reading territory that has always moved through me — and which I finally see someone else performed so genuinely through drawing:

“Humboldt showed Darwin how to investigate the natural world not from the claustrophobic angle of a geologist or zoologist, but from within and without. Both had the rare ability to focus in on the smallest detail — from a fleck of lichen to a tiny beetle — and then pull back to examine global and comparative patterns. This flexibility of perspectives allowed them both to understand the world in a completely new way. It was telescopic and microscopic, sweepingly panoramic and down to cellular levels, moving through time from the distant geological past to the future economy of native populations.” — p. 226

So, returning to the questions with which I began — how to define where to start, how to choose the place, the zoom, the scale, the central subject — and recognizing that I am a landscape architect marked by the presence of a mountain, I find myself with the need to answer them through the Humboldtian methodology: the interscalarity of territory, from micro to macro and vice versa. From the Tropical Andes' global Biodiversity Hotspot to a small corn seed, and back again.

My motivations are defined through two aspects:

- **Personal origin:** being born in the mountain.
- **Professional motivation:** finding a methodology capable of unveiling what is invisible in territories, within the codes of science and practice.





PART I: Research and Theoretical Framework

CHAPTER 1: Who is the Andean Mountain Forest in Colombia

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“The Andean Mountain Forest in Colombia is not a passive backdrop — it is an active, multidimensional force.”

The Andean Mountain Forest in Colombia is not a passive backdrop — it is an active, multidimensional force shaping Colombia's landscape, climate, and culture. Its fragile status today holds such a complex scenario that it is necessary to read and reread it countless times and from a multidisciplinary field because only by doing so it will fully grasp its systemic network and come with meaningful and truly recovery strategies at place. This study contributes to this aim by doing a lecture from a Landscape point of view and make visible possible the recovery.

Andean Mountain Forest — is the country's most fragile ecosystem, of which only 4% remains. It is in the most populated and economically active region of the country, and therefore its forests have been relentlessly fragmented, retaining just 20% of their original coverage. The primary drivers of this loss are deforestation from illicit crops, agricultural frontier expansion, extensive livestock farming, mining, and infrastructure development.

Yet despite its vulnerability, this ecosystem is a critical actor permeating at a high extent in a trans-scalar scenario — from the microscale to the cosmic, as Alexander von Humboldt understood. Reason why this research aims to navigate this complex and interwoven system very carefully to grow solid strategies for its regeneration, recovery, and protection.

However, before diving into this inter-scalar approach, it is essential to first establish a clear reading of what Andean Mountain Forest fundamentally is — understanding its role across biological, environmental, social, economic, and cultural dimensions simultaneously.

1.1 The Orographic

Foundation: Why Colombia's Andes Are Exceptional

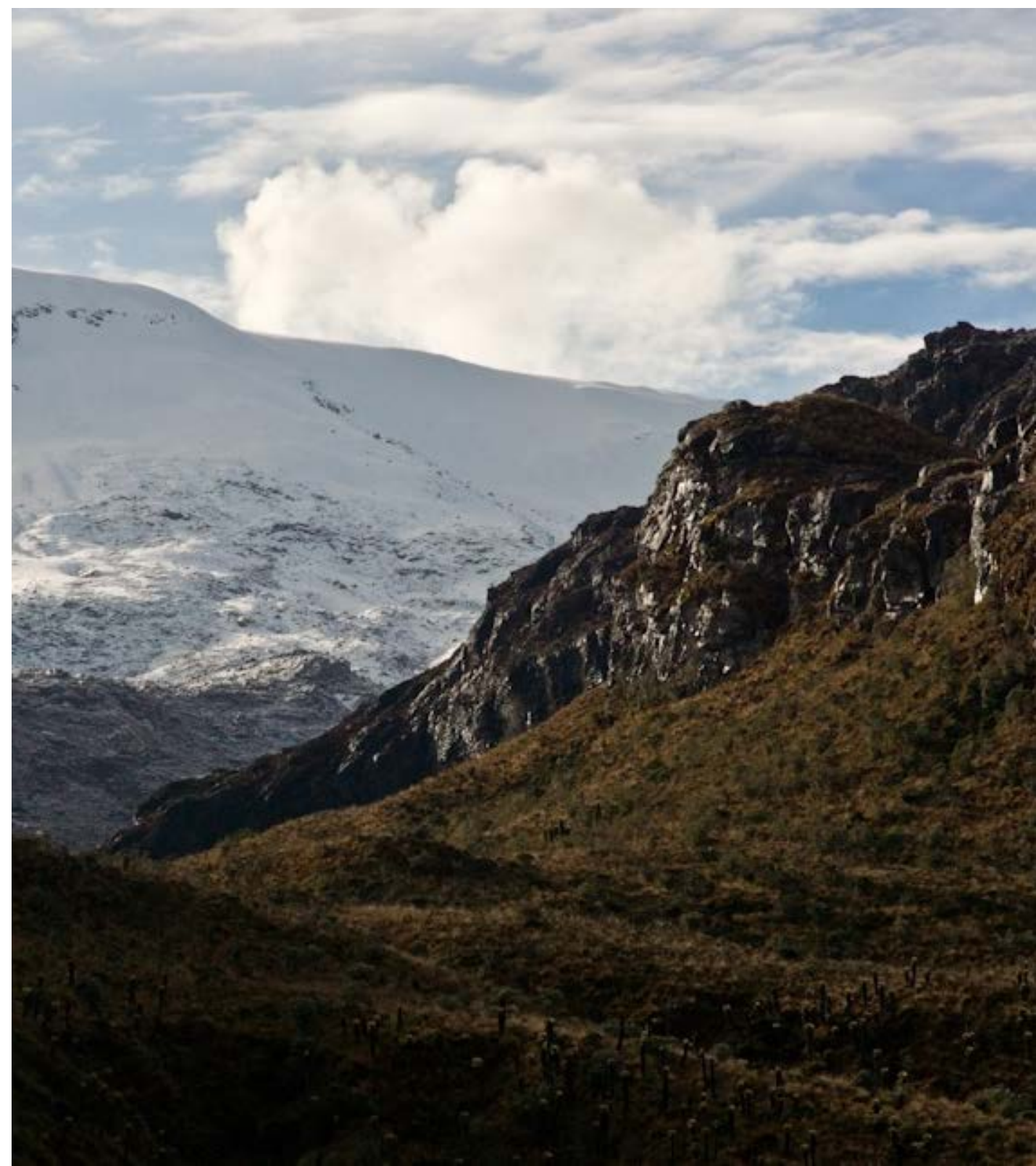
Any serious engagement with the Andean Mountain Forest must begin with the landscape property that makes it singular among the world's ecosystems — and that constitutes the most fundamental driver of this research: the orography of the Andes as it unfolds across Colombian territory.

The Andes are the longest mountain range in the world and the highest outside of Asia — a continuous cordillera stretching approximately 7,000 km along the western edge of South America, between 200 and 700 km wide, with an average elevation of 4,000 m. Formed by the colossal collision of the Nazca and South American tectonic plates, the range performs one of the continent's most critical ecological functions: the capture and redistribution of water. Meltwater from peaks exceeding 6,000 m feeds river systems flowing toward both the Pacific and Atlantic Oceans, regulating hydrological cycles at a continental scale. Spanning seven countries — Venezuela, Colombia, Ecuador, Peru, Bolivia, Argentina, and Chile — the range is divided into three subregions (north, central, and south), each shaped by distinct geological origins and atmospheric circulation patterns, producing highly differentiated ecosystems with exceptional levels of endemism.

Yet among all these extraordinary characteristics, one stands apart — and it is uniquely Colombian: the Andes do not traverse Colombia as a single cordillera. Upon entering Colombian territory, the range trifurcates into three distinct mountain chains — the Western, Central, and Eastern Cordilleras — separated by deep intervening valleys. This is not me-

rely a geographical curiosity. This orographic partition is the structural condition that makes Colombia one of the world's seventeen megadiverse countries, hosting nearly 10% of the planet's total biodiversity — a concentration further amplified by the country's position within the equatorial zone.

What appears at first glance as a simple geographical fact carries profound ecological consequences. The trifurcation of the Andes generates an intricate mosaic of altitudinal gradients, microclimates, and isolated valleys — each functioning as an independent evolutionary theatre, within which the Andean Mountain Forest distinguish strongly because draws a hierarchical pattern of ecological complexity that cascades across all three cordilleras and sits at the very heart of this research.

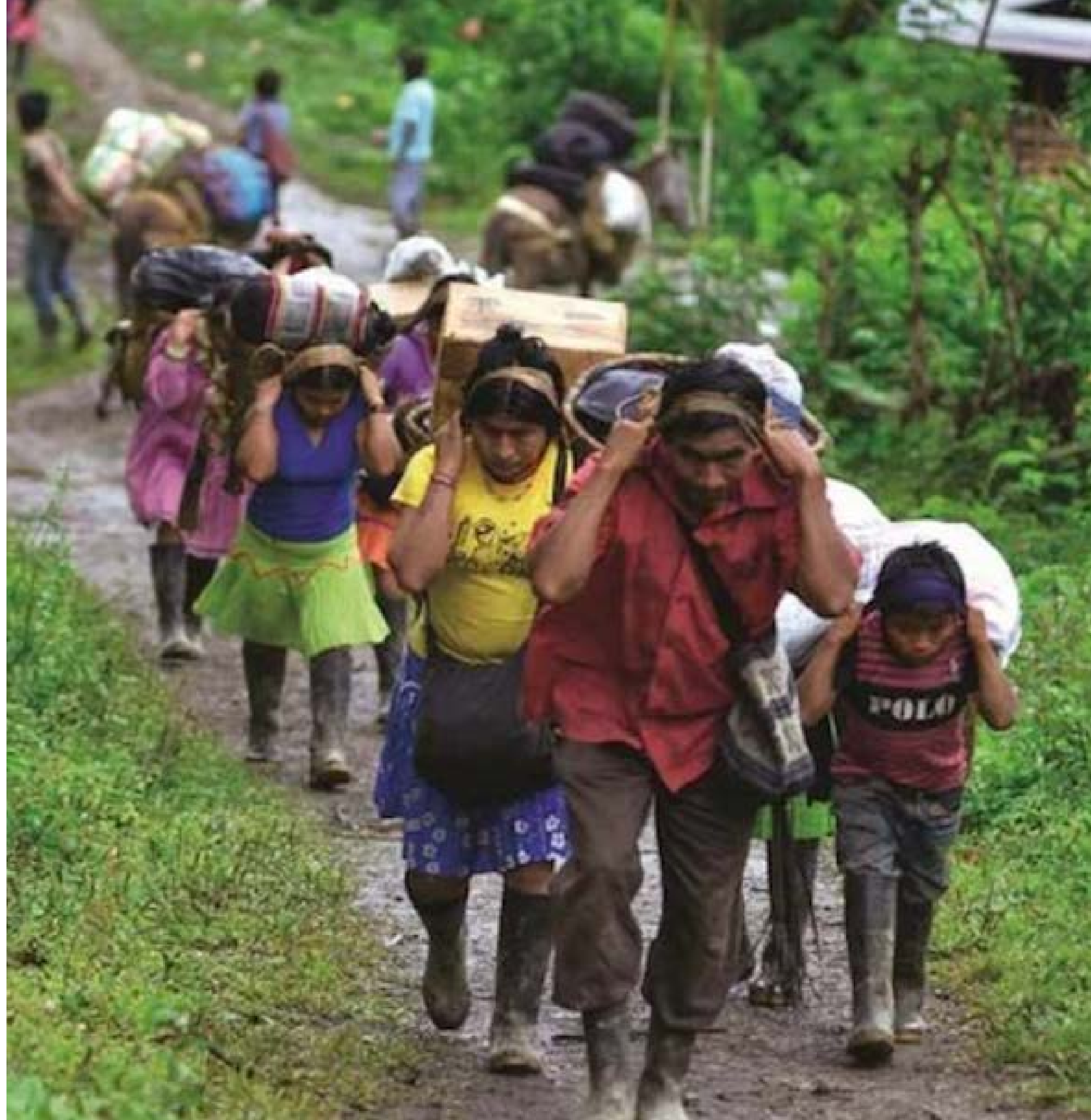


1.2 The multifunctionality of the Andean Mountain Forest

Ecologically, it is the Amazon's water tower — sourcing over 60% of its basin — and one of the planet's most significant carbon reservoirs, with high-altitude páramo soils storing up to 1,400 tons of carbon per hectare. Its forests also regulate water flow, prevent landslides, and sustain the hydrological balance of an entire continent. It represents a high level of turnover in the altitudinal gradient due to its transitional character in the altitudinal dynamic, as it is among the high mountain ecosystems —cloud forest and paramo— and the other successional ecosystems below —tropical rainforest and dry tropical forest—.

Socially and economically, some 40 million people across seven countries depend on its environmental services. It supplies fresh water to nearly 60 million people, powers roughly half the region's hydroelectric energy, irrigates vast agricultural lands, and is one of the world's major centers of origin for cultivated plants. Specialty coffee, cacao, and eco-tourism all depend directly on its health.

Culturally, for the 10 million indigenous people who inhabit it, this forest is an ancestral heartland — inseparable from their identity, knowledge, and worldview.



Chapter’s bibliography

- *Amenazas & Soluciones. Proteger los bosques andinos - Andean Forests. Produced by Conversations du Monde. © 2026 Andean Forests.*

CHAPTER 2: Interscalar Approach | Stage 1

Key actors in the vulnerability of the Andean Mountain Forest,
the most threatened ecosystem in Colombia today.

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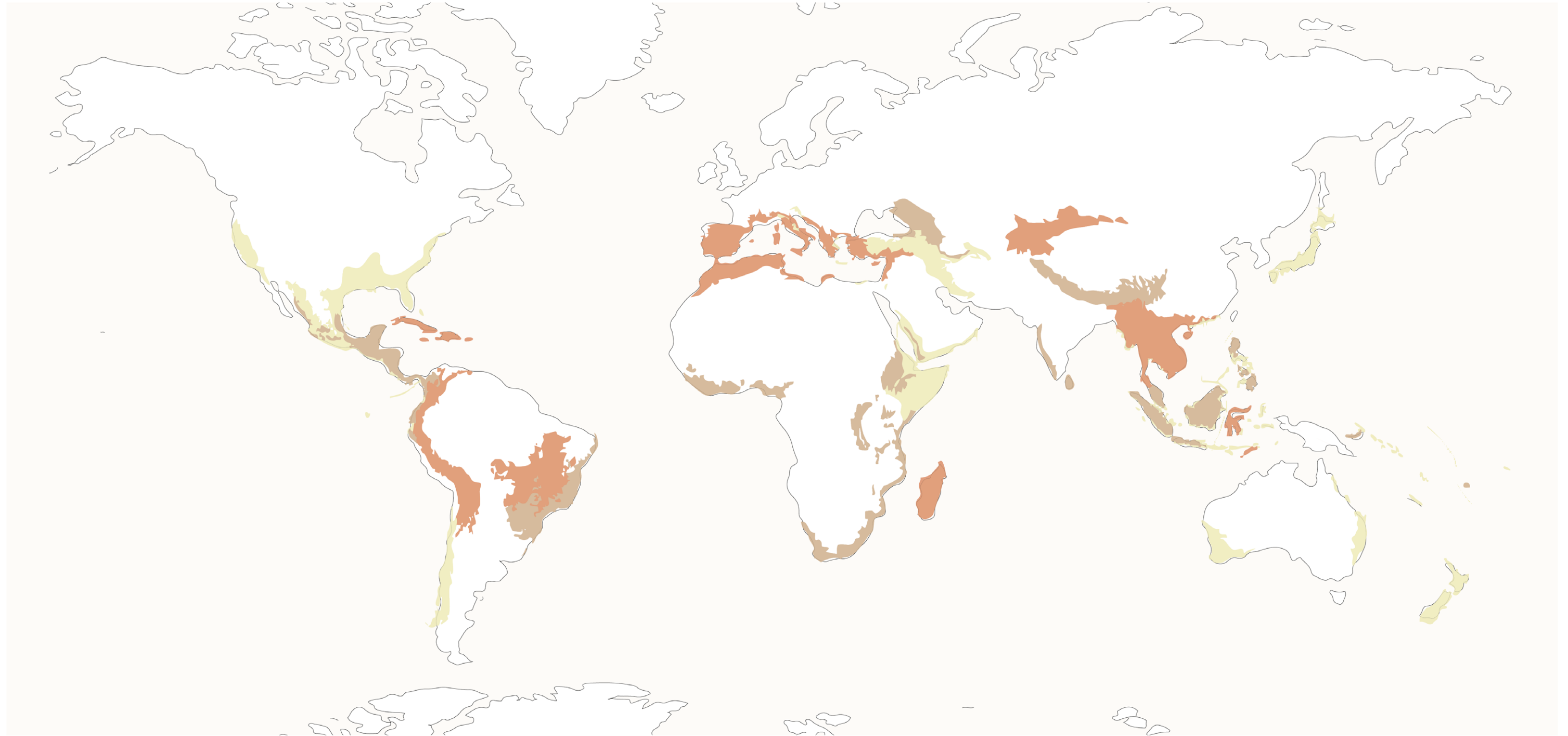
Scalar goal: *To analyse the key actors in the Andean Mountain Forest hotspot
to recognize their level of influence in the vulnerability of the forest.*

This chapter explores the Andean Mountain Forest across three scales — global, continental, and Colombian — each one revealing a key actor playing a significant role in the ecosystem’s current vulnerability.

“It is in section — cutting
transversally through the
cordilleras — that the true depth
and violence of this corridor
become legible.”

2.1 Global scale: Earth Planet

KEY ACTOR: Tropical Andes Hotspot



Global Biodiversity Hotspots are 36 regions of extraordinary biological value and critical importance to global climate stability — yet among the most threatened on Earth. Identified and safeguarded primarily through the Critical Ecosystem Partnership Fund (CEPF) — a joint initiative of Conservation International, L'Agence Française de Développement, the European Union, the Global Environment Facility, the Government of Japan, and the World Bank — this program exists for one core purpose: to concentrate limited conservation resources where they will have the greatest impact in preventing global extinctions.

Within all these hotspots there is the Tropical Andes one, the most biodiverse hotspot on the planet in which rest my home country too, Colombia. While the other 35 global hotspots cover only 2.3% of the Earth's land surface, they harbor half of all plants and 77% of terrestrial vertebrates; the Tropical Andes alone contains:

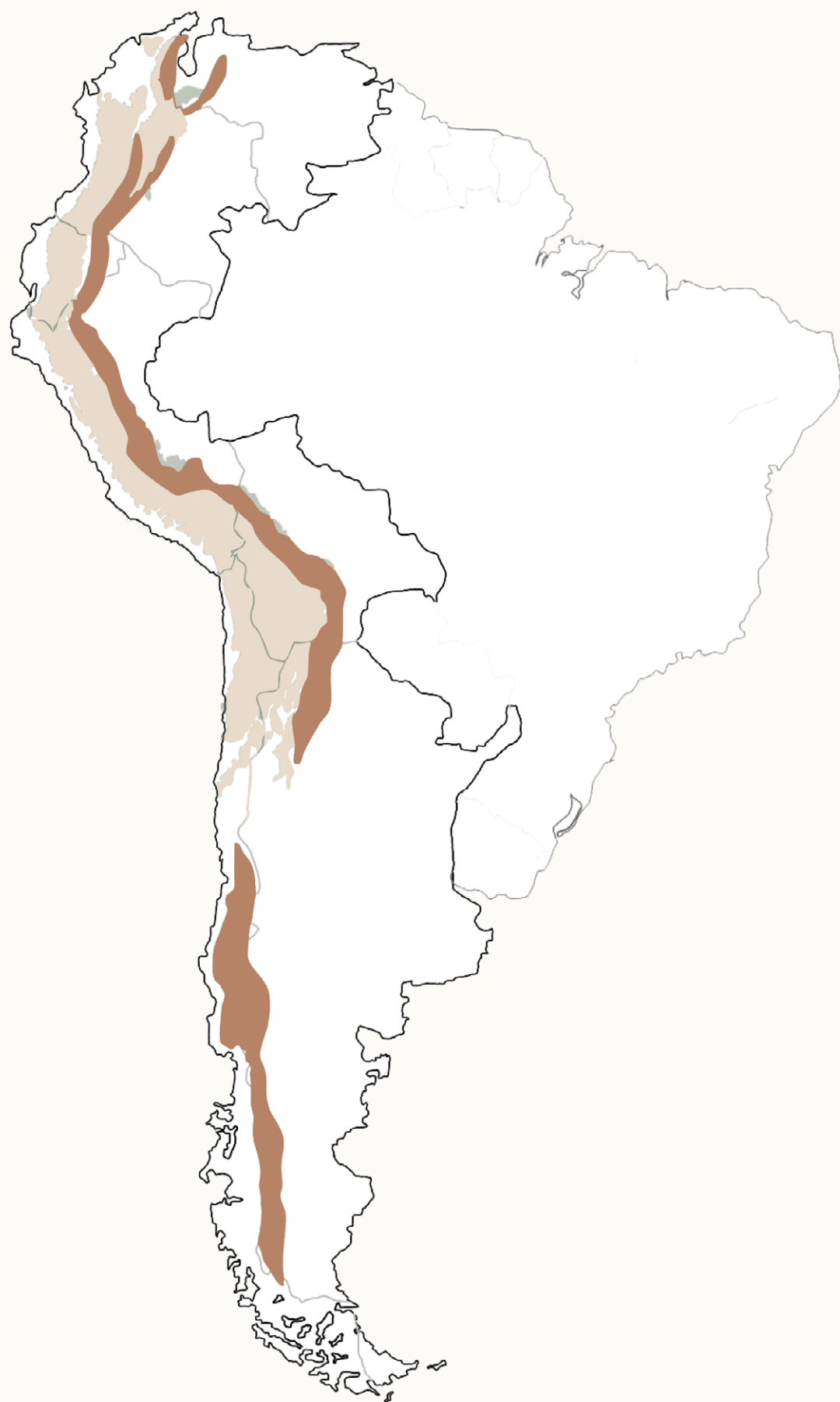
34,000 species of plants and animals, half of which are endemic (found nowhere else).

The world's highest diversity of plants, birds, mammals, and amphibians. 1,451 globally threatened species, representing one of the highest concentrations of at-risk life on Earth.

This fact positions automatically the Andean Mountain Forest not merely as a Colombian forest but as a biological reserve of humanity — critical to both regional survival and global ecological balance, as it covers 25% of its land surface.

2.2 Continental scale: South America

KEY ACTOR: Indigenous people



Recognizing that the Andean Mountain Forest belongs to the Tropical Andes — the most biodiverse hotspot on the planet — immediately situates us at the continental scale of South America: a continent distinguished by its extraordinary richness in indigenous peoples. The Critical Ecosystem Partnership Fund (CEPF) has identified these communities as the most strategic allies for the regeneration and preservation of this threatened hotspot, given their important demographic presence across the territory, their ancestral connection to the land, and their proven effectiveness in stewarding some of the world's most biodiverse ecosystems.

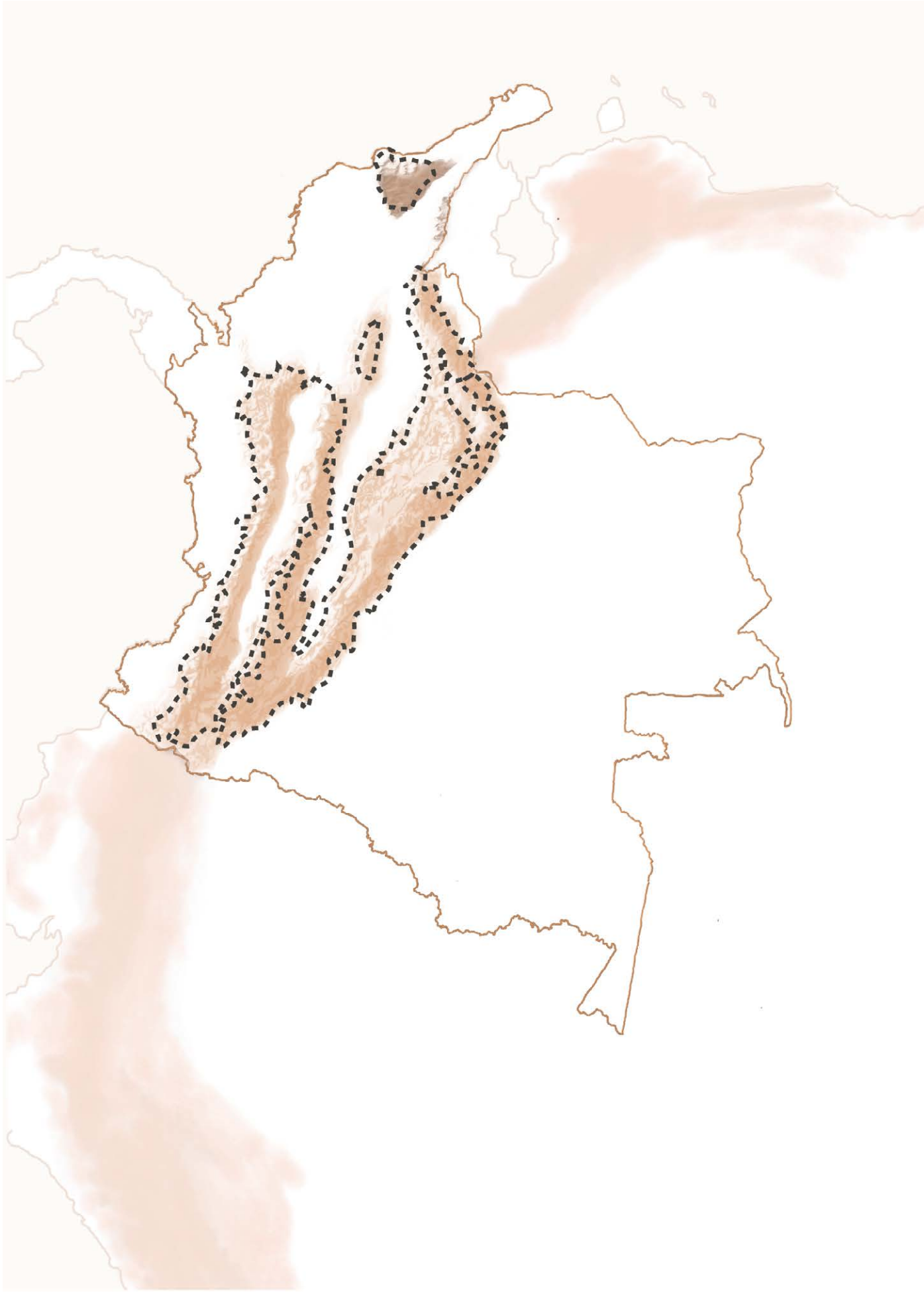
Approximately 10 million indigenous people from more than 50 ethnic groups inhabit at least 21 percent of the hotspot's surface area, which includes several Key Biodiversity Areas (KBAs). This widespread presence makes them the primary stewards of the region's remaining natural habitats. Their territories consistently demonstrate lower deforestation rates than lands without communal administrative structures — a pattern rooted in their cosmogonies as they position nature and humanity as mutually dependent, binding cultural identity and mythological frameworks to the stewardship of the land.

This effectiveness is reflected at multiple scales. Within the hotspot, protected areas across several countries overlap with indigenous territories, evidencing successful co-management models. At the national level, indigenous organizations have taken direct leadership in large-scale conservation: in Bolivia, for instance, the Tsimané Masetene Regional Council led the revision of a national protected area management plan. Beyond governance, indigenous communities frequently drive bio-enterprises —

conservation-aligned ventures in coffee, cacao, and ecotourism — that tie local livelihoods directly to forest health. These initiatives are not merely economic instruments; they are essential mechanisms for enabling communities to manage their territories according to their own cosmovision while simultaneously safeguarding biodiversity.

Despite their central role in conservation, indigenous actors face extreme risks in defending their territories against extractive industries. Indigenous leaders are subject to severe persecution and assassination — particularly in Colombia, the country this research focuses on, which recorded the highest number of environmental defenders killed worldwide in 2019. Compounding this, land tenure ambiguity and insecurity remain the most significant structural obstacle: secure land rights are an essential precondition for any meaningful and long-term conservation engagement.

2.3 Colombia scale: Administrative Colombia boundaries
KEY ACTOR: Agricultural Frontier



The Agricultural Frontier: The Spatial Logic of Degradation in Colombia
Zooming into Colombia, a critical spatial pattern emerges that fundamentally defines the degree of the Andean Mountain Forest degradation at the national scale: the Agricultural Frontier. Officially, this is the boundary of rural land that separates areas where agricultural and extractive activities are permitted from those where they are restricted or prohibited — demarcating conditioned zones, protected areas, ecologically significant landscapes, and territories legally excluded from agricultural use.

The Agricultural Frontier is not a neutral line. When overlapped with the Andean Mountain Forest, its weight becomes immediately legible: nearly the entirety of the forest surface falls within its reach, making it the primary structural force governing whether these ecosystems are exploited, degraded, or preserved. It is organized into two categories:

- 1. Conditioned Areas
Zones where agricultural activities may be permitted, restricted, or prohibited depending on legally defined conditions: Ethnic conditions: Indigenous reserves hold territorial autonomy, meaning that any decisions regarding agricultural use within their boundaries require prior consultation with communities, or must align with their life plans (planes de vida).
Environmental conditions: Certain environmental planning categories allow sustainable-use regimes that permit agricultural activities, subject to their environmental zoning process or management plan.
Risk management conditions: Areas subject to very high threat from mass movements or high volcanic activity, where land use is conditioned by safety and

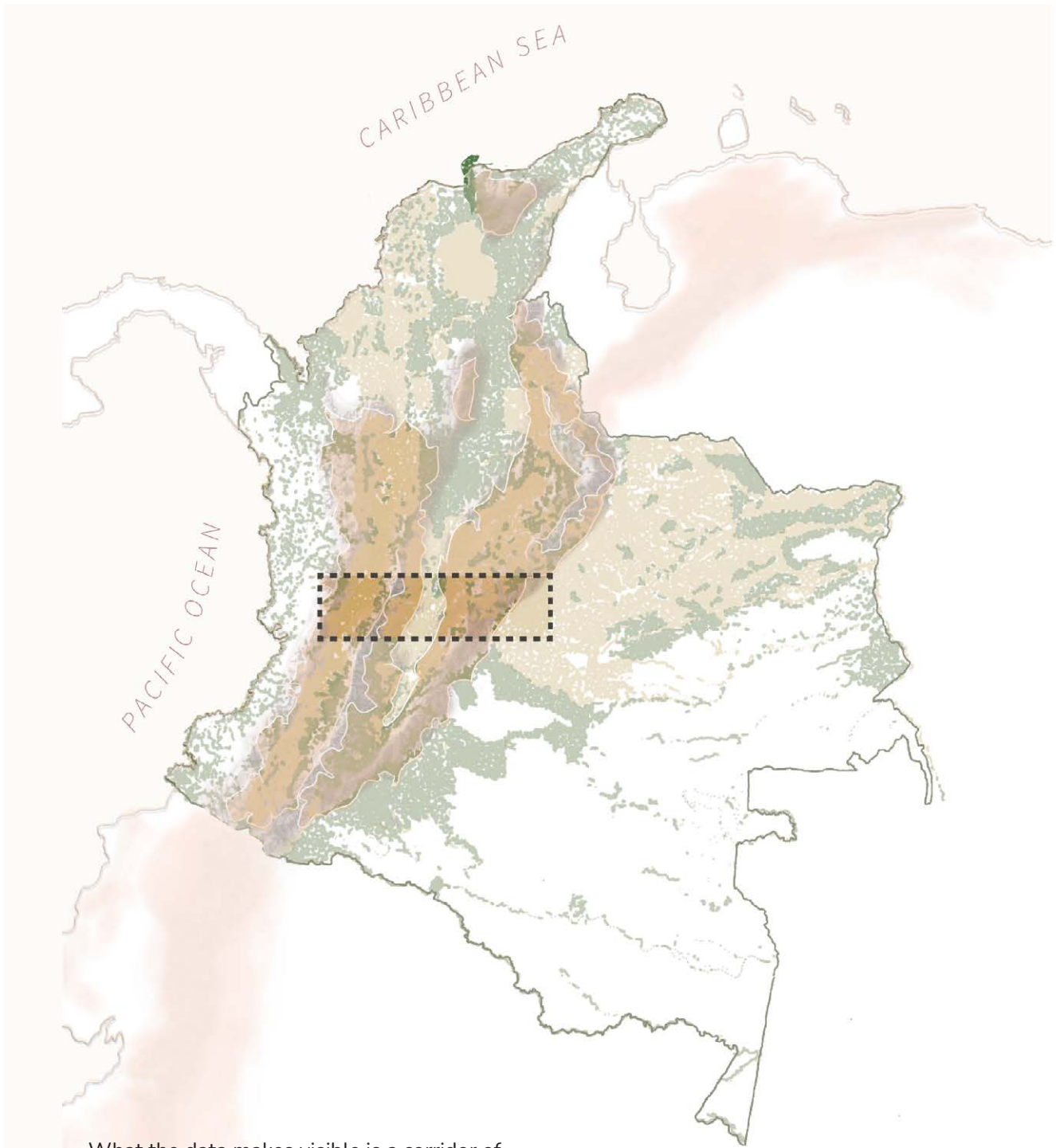
stability criteria.

- 2. Non-Conditioned Areas
The unrestricted playing field of the agricultural sector — the surface where all forms of extraction and land use can be developed without legal prohibition. This is where frontier expansion operates with the least resistance, and where deforestation pressure is highest.

Exclusion Areas (a distinct sub-category)
Zones where agricultural activities are prohibited by law, typically on the grounds of environmental importance or archaeological heritage. These represent the legal outer boundary of protection — though their enforcement remains a critical and contested issue.

(map – ANDEAN MOUNTAIN FOREST print – Indigenous absence highlighted)

This first stage of the interscalar approach identifies three actors in profound structural relationship with the Andean Mountain Forest: the Tropical Andes Hotspot, indigenous peoples, and the Agricultural Frontier. But a closer reading of the overlap between the non-conditioned areas of the Agricultural Frontier and the forest surface reveals something more alarming — an emergent and unplanned dynamic that no single actor consciously designed.



What the data makes visible is a corridor of overexploitation threading through all three Andean cordilleras. This is not a planned intervention but an atypical pattern that has crystallized through the cumulative and unrestricted spatial expansion of the Agricultural Frontier — a slow, relentless advance that has reached such a degree of intensity at the country's core that it is now capable of tracing a near-continuous line of degradation across three mountain chains, disregarding entirely the hyper-complex ecological systems that underlie them.

The full weight of this condition, however, cannot be grasped in plan. It is in section — cutting transversally through the cordilleras — that the true depth and violence of this corridor become legible, which is called transect for this research.

Not conditioned
Restricted

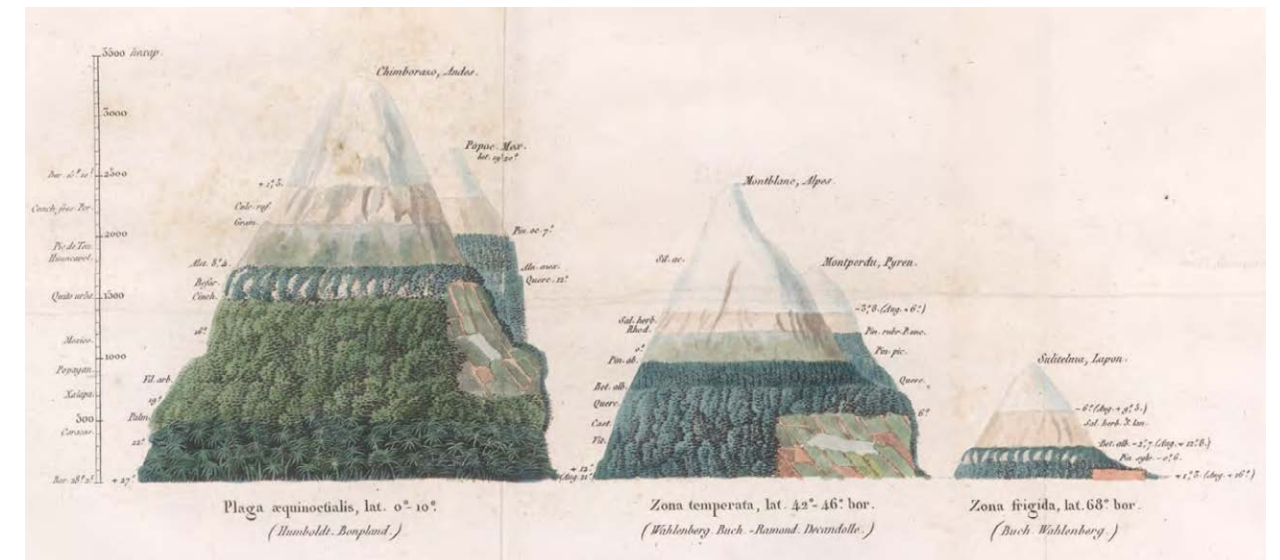
Chapter's bibliography

- *About Conservation International* | Conservation International. Arlington, VA: Conservation International. © 2025–2026.
- *Portada - Hotspot Andes Tropicales*. Operated by the Regional Implementation Team (RIT) for the Tropical Andes Biodiversity Hotspot (PROFONANPE, ACEAA, Patrimonio Natural, and Fundación Futuro Latinoamericano) with funding from the Critical Ecosystem Partnership Fund (CEPF). 2026.
- *Pronaturaleza – Fundación Peruana por la Conservación de la Naturaleza, et al. Ecosystem Profile: Biodiversity Hotspot of the Tropical Andes, 2021 Update*. Arlington, VA: Critical Ecosystem Partnership Fund (CEPF). June 2021.
- *Unidad de Planificación Rural Agropecuaria (UPRA). Metodología para la identificación general de la frontera agrícola en Colombia*. Authors: Luis Alfonso Sierra Castro, César Augusto Rey Ángel, Claudia María Córdoba García, Gustavo Guarín, and Adiel Rocío Botia Sánchez. Bogotá D.C., Colombia: Ministerio de Agricultura y Desarrollo Rural. 2018. ISBN: 978-958-5552-34-0

CHAPTER 3: The transect: A Transcalar Hub Connecting Every Scale of Action

“They are not three separate problems to be solved in sequence — they are three expressions of the same structural condition, each reinforcing the others.”

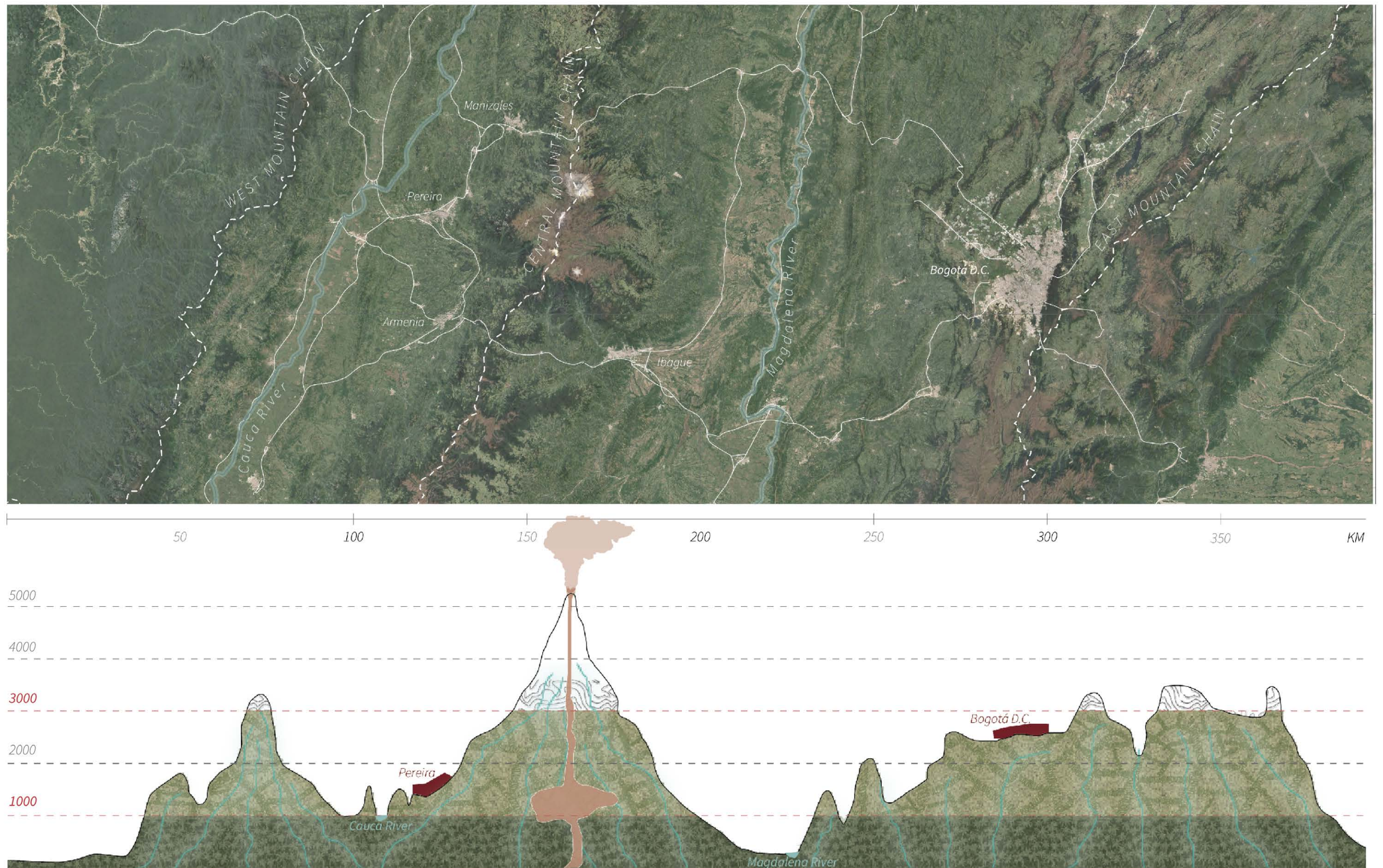
Scalar goal: To identify the actors — both those that threaten and those that hold regenerative potential — whose presence are key for weaving a systemic landscape capable of producing a transcalar impact: starting at a local scale and reverberating outward to the global.



As introduced in the previous chapter, the transect is drawn through an arbitrary path — yet one that captures a deeply complex dynamic. Essentially, it offers a landscape framework that reveals non-conventional actors and links between resources and allies which, once connected, could enable a realistic recovery effort within the Andean Mountain Forest. Technically, it constitutes a line of 400km long.

This framework finds its grounding in Humboldt's thinking: the mountain as the keystone landscape element — the one capable of surfacing dynamics that

would otherwise remain hidden, and capable of offering a holistic reading of the territory no other framework could provide. Here, the Andean range's division into three chains is not treated as mere geographic fact, it is the greatest resource of study for this research: the instrument through which territory in full can be studied and analysed critically and reaches the interconnection of everything — the very wholeness Humboldt so powerfully proclaimed.



The research draws inspiration from Humboldt's intricate thematic mapping, and specifically from one exceptional illustration depicting three mountains — Chimborazo, Mont Blanc, and Sulitelma — featured in his 1817 work *De distributione geographica plantarum*. Humboldt placed these three mountains side by side to demonstrate a key insight: vegetation patterns shift with latitude in much the same way they shift with altitude. Each mountain represents a distinct latitudinal zone:

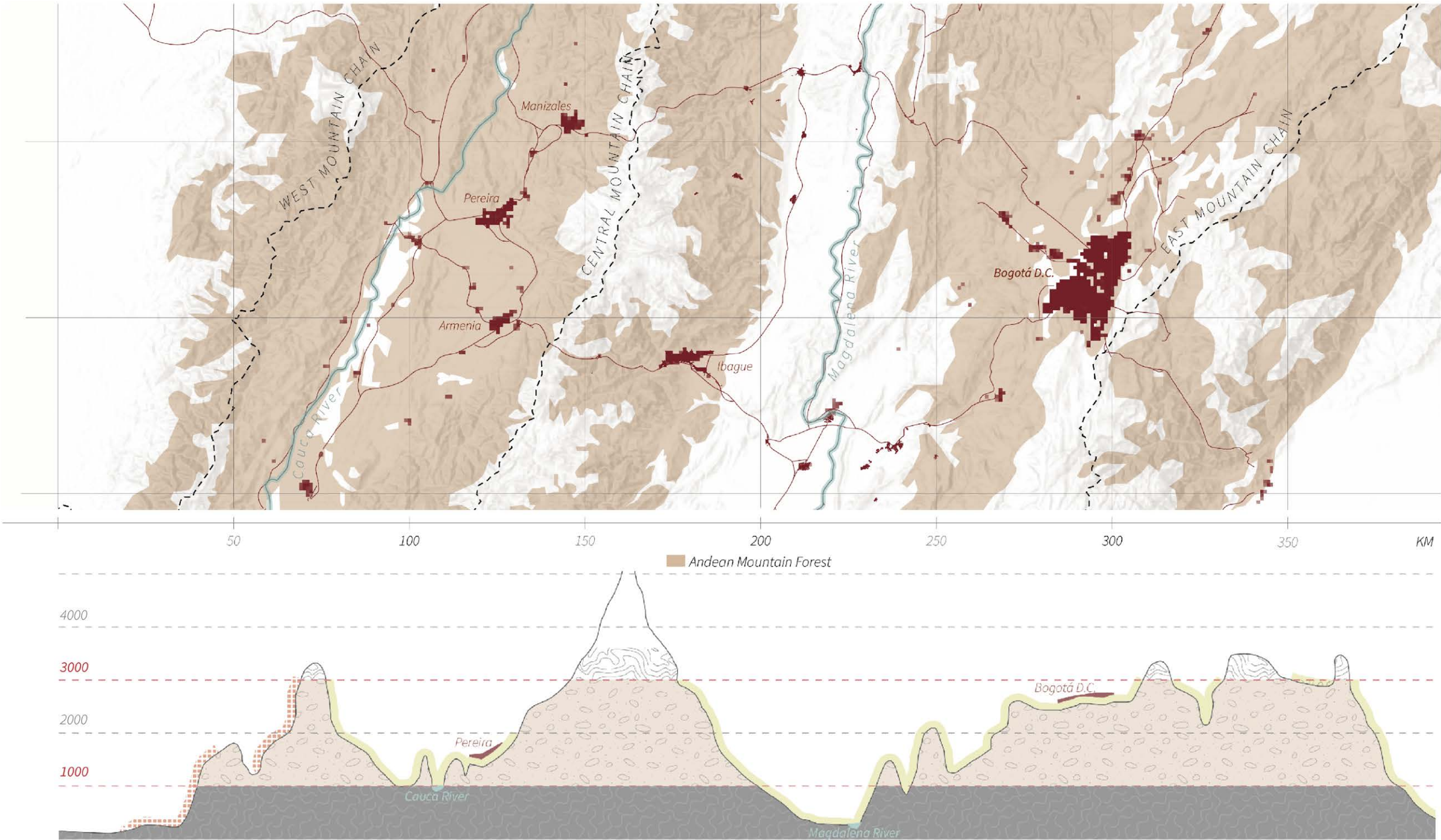
- Chimborazo (Equatorial) — positioned on the left of the illustration, with Popocatepetl behind it, representing the tropical and equatorial regions.
- Mont Blanc (Temperate) — positioned at the center, with Mont Perdu behind it, representing the temperate regions of Europe.
- Sulitelma (Frigid) — positioned on

the right, representing an almost arctic, "frigid" climate.

This research adopts the same comparative logic, applying it to the three Andean chains crossed by the 400 km transect. However, the inversion is necessary here: it is the altitudinal measure, rather than the horizontal one, that must be treated as a conceptual reference rather than a literal scale. Given the considerable length of the transect, representing elevation at a literal, proportional scale would render the altitudinal differences between the three chains nearly imperceptible — the mountains would flatten into a barely distinguishable line, and the very dynamics the analysis seeks to reveal would be lost. By conceptually exaggerating the altitudinal dimension, the transect section makes these patterns and interconnections legible, allowing the relationships between the three chains to be read and analysed clearly.

This cartographic key governs the reading of the analysis presented throughout the chapter. It establishes a consistent visual logic: the plan view is positioned above, while the corresponding section is shown below it. Unlike the altitudinal measure — which, as discussed, is conceptually exaggerated — the 400 km horizontal length is maintained as a literal, proportional measure across both representations.

The transect: An overexploited corridor



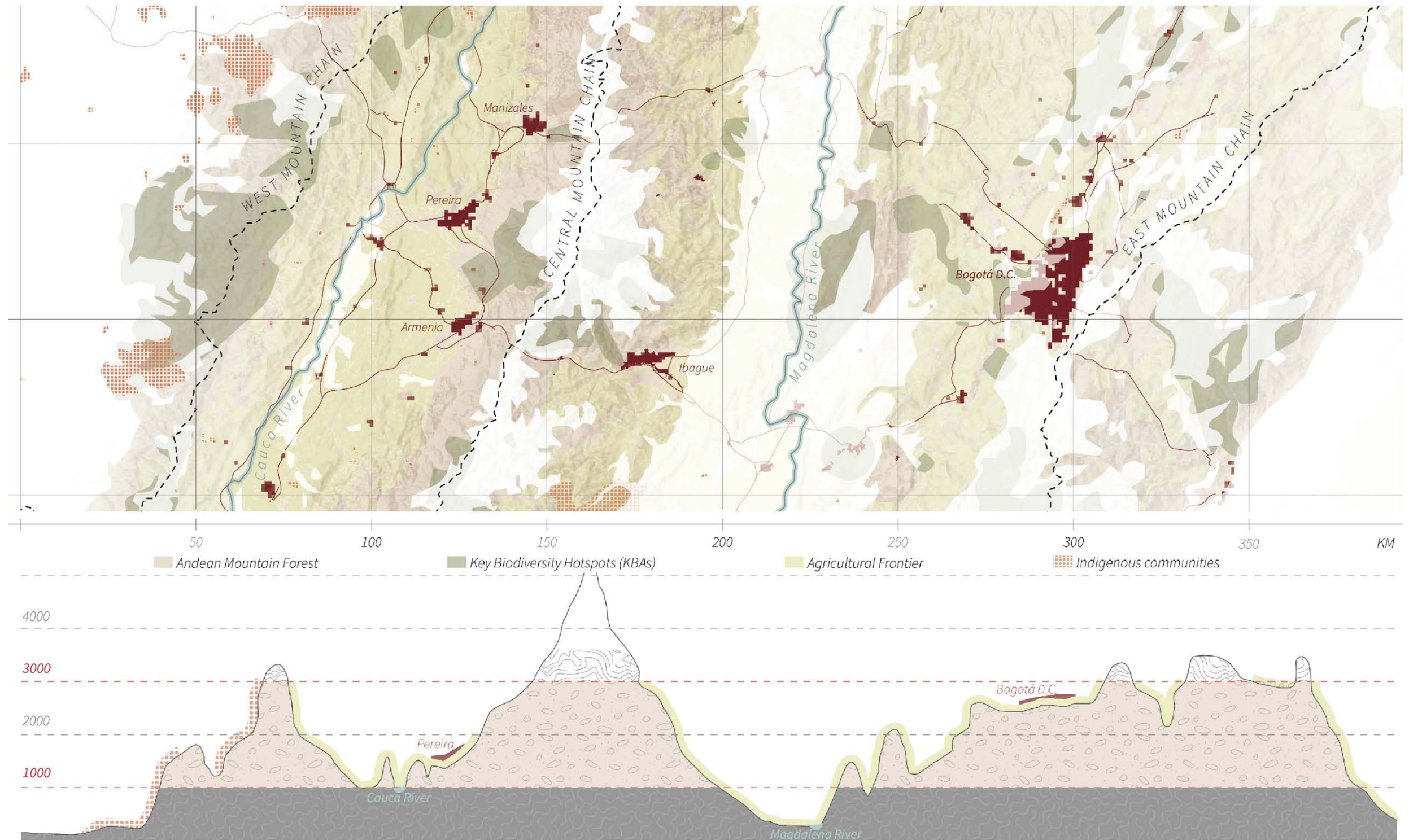
When having a simple view of the transect alone, it is quite evident that it hosts a group of the most important cities in the Colombia: Bogotá, Ibagué, Armenia, Pereira y Manizales; a condition that by itself could throw the assumption of the transect concentrating the highest density population of the country. And indeed, as Bogotá just alone has today “11.8 million in 2025, constituting approximately 22.1% of the total urban population of the country”¹, while Pereira has an estimate of 602.831 inhabitants, Ibagué 494.316, Manizales 440.407 and Armenia 319.234 inhabitants². This lecture contributes to the understanding of why here the transect line is taking place.

1 (World Health Organization, s.f.)
2 (Worldometer, s.f.)

The transect read through the three key actors (1 stage interscalar approach)

When reading the Andean Mountain Forest layer with the three main actors's highlighted in the 1 stage interscalar approach — Tropical Andes Hotspot, Indigenous peoples, Agricultural Frontier— there are gold insights already that start to interweave and reveal the complex system and dynamic behind this arbitrary corridor at the core of Colombia.

(PLAN+SECTION –TRAN-
SECT: All 3 main actors
together)



The Transect Read Through the Tropical Andes Global Hotspot’s influence

On one hand, the tropical Andes Hotspots reveals some Key Biodiversity Areas (KBAs) in the area. These are the sites that the Critical Ecosystem Partnership Fund (CEPF) identify for each global hotspot as the most significant for the contribution to the global persistence of biodiversity. They are identified using a global standard that provides a set of quantitative criteria and thresholds based on:

- **Threatened biodiversity:** Presence of species at high risk of extinction.
- **Geographically restricted biodiversity:** Presence of species found in only a few places.
- **Ecological integrity:** High-quality, intact ecosystems.
- **Biological processes:** Areas critical to specific life stages of species (e.g., breeding or migratory stopovers).
- **Irreplaceability:** Sites that are essential for the survival of certain species or ecosystems.

The Tropical Andes Hotspot currently comprises 474 identified Key Biodiversity Areas (KBAs)—423 confirmed and 51 proposed. Of these, 119 are located in Colombia, the highest number of any country in the hotspot, with the greatest concentration found in the Cordillera Central, followed by the Cordillera Occidental.

To facilitate analysis and management, these KBAs are organized into corridors. The transect under study spans three such corridors, each corresponding to one of the three Andean Chains, hosting the following KBAs:

WEST ANDEAN CHAIN: Corridor Paraguas-Munchique-Bosques Montanos del Sur de Antioquia

COL74: Parque Nacional Natural Tatamá
COL106: Serranía de los Paraguas

CENTRAL ANDEAN CHAIN: Corridor Northeast of Quindio

COL10: Bosques del Oriente de Risaralda
COL14: Cañón del Río Barbas y Bremen
COL37: Finca la Betulia Reserva la Patasola
COL32: Cuenca del Río Toche
COL15: Cañón del Río Combeima
COL87: Reserva Natural Ibanasca
COL52: Lagunas Bombona y Vancouver
COL38: Finca Paraguay
COL6: Alto Quindío
COL117: Vereda el Llano
COL30: Cuenca del Río Jiménez
COL84: Reserva Hidrográfica, Forestal y Parque Ecológico de Río Blanco

EAST CENTRAL CHAIN: Corridor Bogotá Eastern Cordillera

COL33: Cuenca Hidrográfica del Río San Francisco y sus alrededores
COL42: Hacienda La Victoria, Cordillera Oriental
COL127: Paraíso de Aves del Tabor y Magdalena
COL9: Bosques de Tolemaida, Piscilago y alrededores
COL55: Municipio de Pandi
COL8: Bosques de la Falla del Tequendama
COL72: Parque Nacional Natural Sumapaz
COL120: Villavicencio
COL16: Cañón del Río Guatiquía
COL61: Parque Nacional Natural Chingaza y alrededores
COL44: Humedales de la Sabana de Bogotá
COL41: Gravilleras del Valle del Río Siecha
COL23: Cerros Occidentales de Tabio y Tenjo
COL126: Mejue
COL136: Rocas de Suesca
COL25: Complejo Lacustre de Fúquene, Cucunubá y Palacio
COL19: Carretera Ramiriqui-Zetaquira

A reading of the Relative Biodiversity Values (RBV) across all KBAs in the transect surfaces a pivotal insight: the Northeast of Quindío Corridor holds the highest RBV scores in the entire transect, ranging from 0.45 to 0.53—and remarkably, the highest at the national scale as well. In other words, the most biodiverse areas of the Colombian portion of the Tropical Andes Hotspot are concentrated precisely here, within this single corridor.

This finding establishes the first structural challenge the research must confront: how to mitigate and reverse the threatened condition of the hotspot’s most biodiverse territory in Colombia, while being directly weakened by two deeply concerning factors. First, this is a territory where indigenous presence is virtually absent. Second, it is a territory subject to intense anthropic pressure, driven by the Agricultural Frontier’s indiscriminate presence here under the non-conditioned policy category. These two conditions are examined in detail in what follows.

The Transect Read Through Indigenous Knowledge's influence

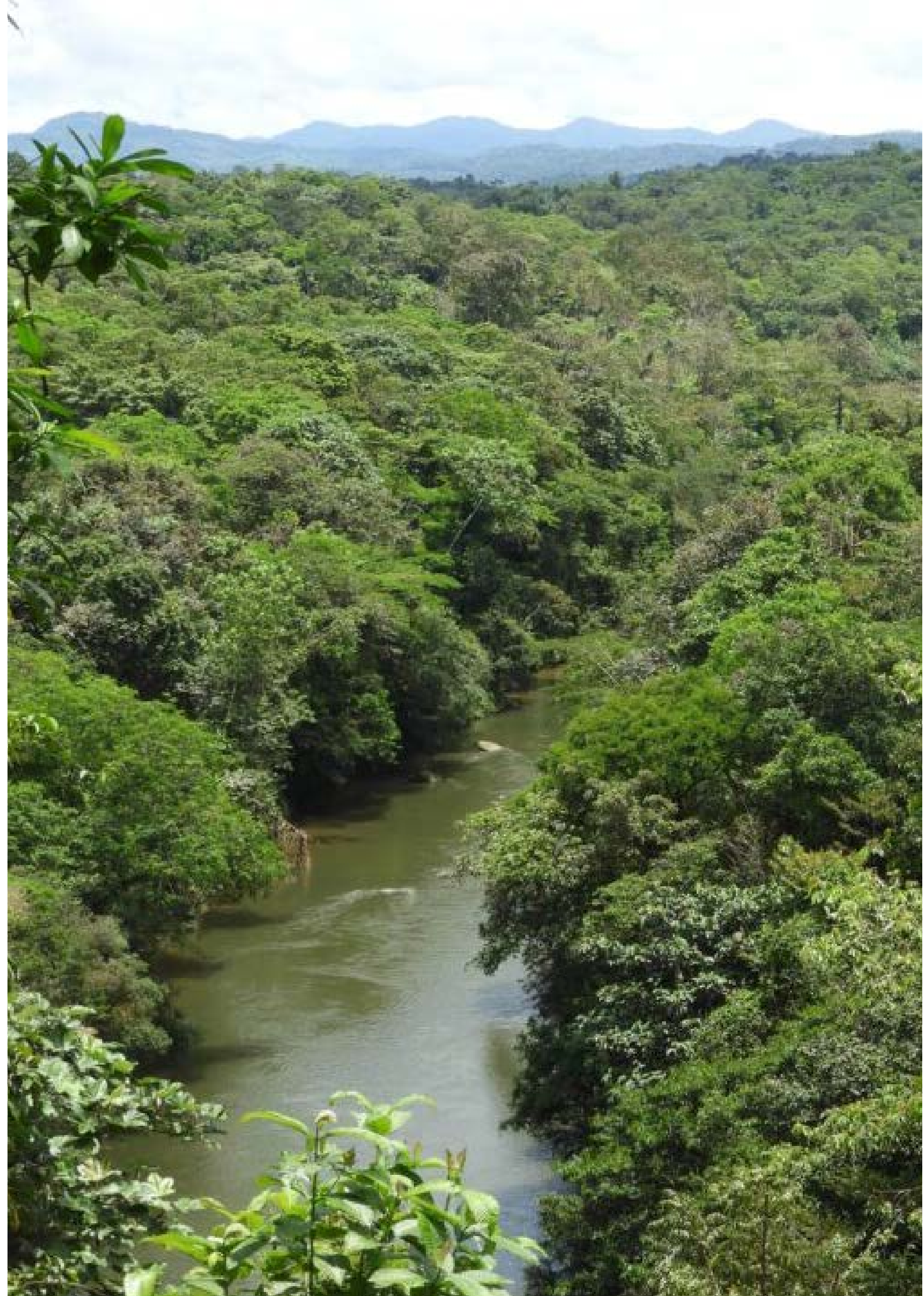
Regarding indigenous peoples, the spatial reading of the transect reveals an unavoidable and revealing gap: their presence is strikingly weak, represented only by a single hatch pattern marking a concentration in the Western Andean Chain.

This finding raises an immediate concern and calls for a closer examination of this population's condition within the transect. The near-absence is particularly contradictory given that, according to CEPF, Colombia's portion of the Tropical Andes Hotspot is widely considered the "indigenous heartland of South America," home to approximately 2.2 million indigenous people, many of whom inhabit the 35 million hectares of national territory that fall within the hotspot.

Cross-referencing CEPF records with the transect confirms this imbalance: only the Western Andean Chain corridor—Paraguas-Munchique-Bosques Montanos del Sur de Antioquia—shows documented presence and alliances with indigenous peoples. The sources explicitly identify the Embera and Nevera Drua as key actors in this corridor. The Embera community, in particular, plays an active role in territorial management, having developed Planes de Vida (life plans) to govern their lands and protect biodiversity. Afro-descendant communities are also present in this area, notably within Parque Nacional Natural Tatamá, where they engage in artisanal gold mining and subsistence agriculture.

By contrast, the Eastern and Central Andean Chains corridors: Northeast of Quindío and the Bogotá Eastern Cordillera, show a markedly different governance pattern. Here, the sources point to management by local civil society organizations, regional autonomous corporations (CARs), and municipal governments, with no specific indigenous nations identified as administering these sites.

This is a foundational insight for the research as a whole, as it surfaces the first structural challenge the project must confront: how to meaningfully incorporate indigenous presence and agency into the central and eastern corridors. Without this, any intervention aimed at restoring the Andean Mountain Forest at a transcalar level risks and breaths in an unrealistic and ultimately unsustainable scenario, as we just have learned their crucial role on the recovery and conservation of the hotspot.



The Transect Read Through Indigenous Knowledge's influence

The Agricultural Frontier emerges as a deeply disturbing and invasive pattern across the Andean Mountain Forest, standing as the primary driver of its deforestation and the leading factor threatening the Tropical Andes Hotspot within Colombia's boundaries.

The spatial reading makes this threat unmistakable: the Andean Mountain Forest appears nearly swallowed by the Agricultural Frontier under its non-conditioned category, a condition that makes its devastating effect faster, easier, and more difficult to reverse.

What is most alarming is that the only barrier preventing the Agricultural Frontier from forming a single, solid, unbroken line across the entire transect are the peaks of the three Andean Chains. It is precisely on these peaks that the national parks safeguarding the region's most biodiverse areas are located—yet they remain extremely fragile, as no meaningful buffer zone protects their perimeters. On the contrary, the Agricultural Frontier presses directly against their edges, exerting a constant pressure.

This leads to a second, equally critical insight for the research—one that, in fact, converges with the first. If the absence of indigenous presence in the core of the transect constitutes the project's first structural challenge, the unbroken, solid line of the Agricultural Frontier constitutes its second: how to soften this line that currently gives shape and definition to the entire transect, and how to translate that softening into concrete spatial interventions that could play under the restricted category of the Agricultural Frontier—or, more ambitiously, into a comprehensive special management strategy for the transect as a whole.

The Convergence Point: Indigenous Presence as the Foundation

It is at this point that the three insights interweave and reveal their deeper, interdependent connection. The absence of indigenous presence across the transect, the unrelenting advance of the Agricultural Frontier as a solid and unconditioned line, and the threatened condition of the hotspot's most biodiverse territory in Colombia are not three separate problems to be solved in sequence—they are three expressions of the same structural condition, each reinforcing the others. The lack of indigenous gover-

nance leaves the Agricultural Frontier unchecked; the unchecked Agricultural Frontier intensifies the pressure on the most biodiverse territory; and the absence of an alternative model in precisely that territory deprives it of the very tool that could mitigate and reverse its threatened status.

Read together, the facts suggest that the spatial management model this transect urgently needs does not have to be invented from scratch: it could be rooted in indigenous presence itself. As seen in the Planes de Vida of the Embera community in the Western Andean Chain, indigenous territorial governance offers an alternative management model fundamentally distinct from the extractive logic driving the Agricultural Frontier. In this light, restoring indigenous presence across the transect is not merely a matter of representation or reparative justice; it becomes a strategic, structural response capable of addressing all three challenges at once—softening the Agricultural Frontier's advance, and, in doing so, mitigating and reversing the threatened condition of the hotspot's most biodiverse territory in Colombia. Indigenous governance thus emerges not as one possible intervention among others, but as the potential foundation upon which the spatial intervention the project seeks to define can be built.

3.1 The transect: What, Who, Why? SWOT Analysis

The reading of the transect undertaken so far has already defined, with clarity and purpose, half of this project's aim. It is now an established fact that recovering the Andean Mountain Forest in Colombia is unnegotiable without three concurrent actions: restoring indigenous presence across the territory, redefining the management of the Agricultural Frontier under a more restricted model, and ultimately transitioning the region's KBAs from their current threatened status to one of safety and ecological succession.

These three statements form the umbrella under which this research will develop. As the study continues, it will dig deeper into the territory, uncovering new actors, new anomalies, and new layers of complexity. Yet at every turn, it will look back to this umbrella as its guiding compass, weaving each new finding into a coherent and consistent understanding

of the intricate system underlying the transect.

To organize the new actors playing a crucial role in the complex system behind the transect, a SWOT analysis was developed to categorize them, making their understanding and impact easier to grasp.

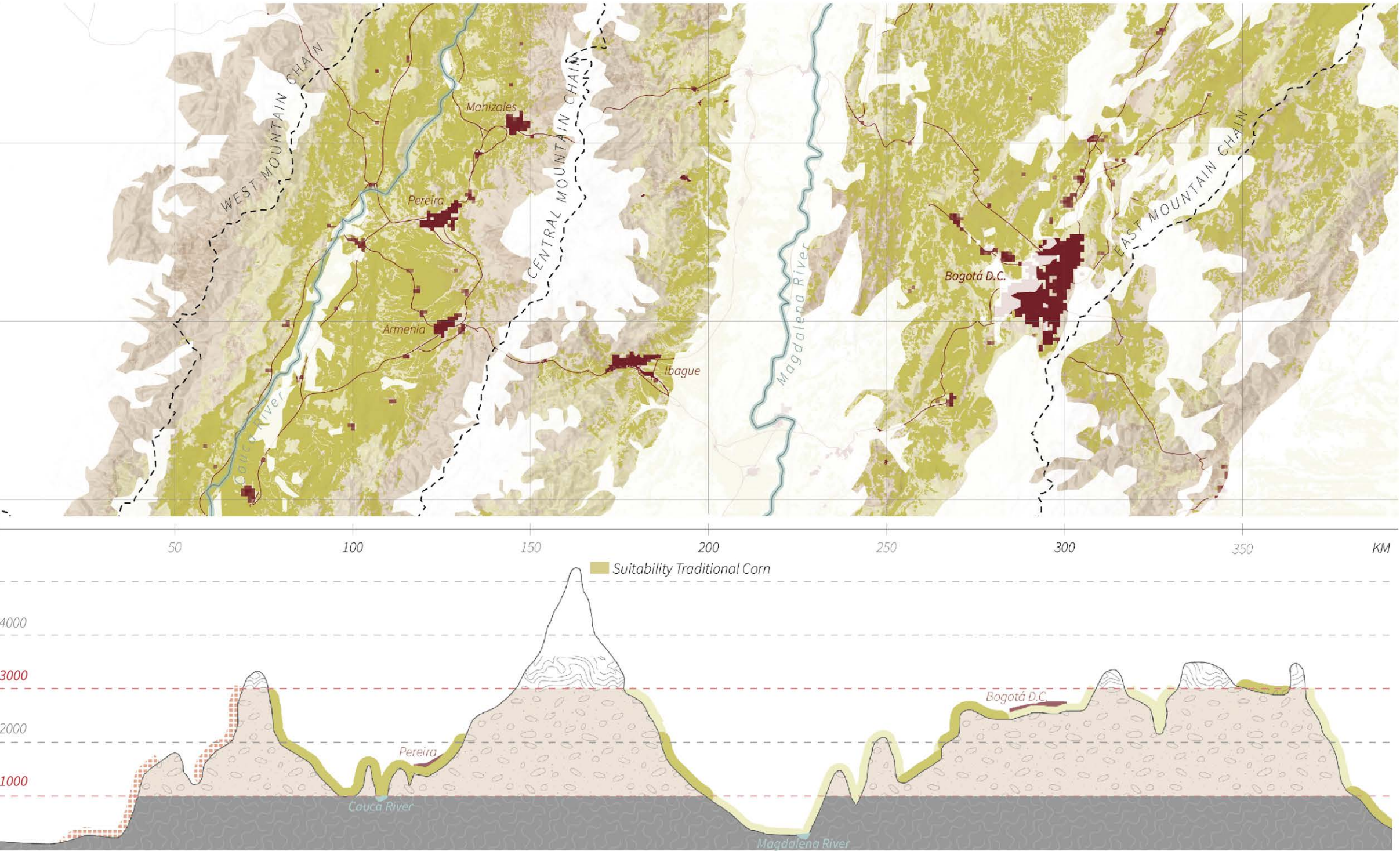
3.1.1 Strenghts

Among all the potentialities this territory has to offer, this research identifies one element that although it is not present significantly in the transect today, it has very worthy chance to be present very aloud and visible, and to have a potential impact as it naturally emerges as multifunctional—capable of taking substantial action toward each of the three challenges that form this research’s umbrella. This element is deeply linked to biodiversity, indigenous communities, and the Agricultural Frontier alike: CORN.

This research therefore puts forward its central hypothesis: that corn can act as an agent capable of retracing the spatial organization of the transect, within a plan that recovers, protects and conserves the Andean Mountain Forest while effectuating a transcalar impact across the territory, from micro to global.

There is crucial to highlight that this strength is framed by referring to the TRADITIONAL CORN and not the INDUSTRIAL one, and in the following we will see in detail how it is deeply connected to the three challenges that form this research’s umbrella: biodiversity, indigenous

communities, and the Agricultural Frontier, putting a more detailed emphasis and on the link regarding the indigenous, as it is deeply strong.



3.1.1 Strenghts

Positioning maize as a strength is not an arbitrary choice — it is a precise and grounded stance, rooted in its demonstrable role as a keystone element of biodiversity when cultivated under indigenous management systems. This relationship is not coincidental. Across Andean indigenous communities, maize is cultivated through remarkably convergent practices that translate a shared cosmogony — one that frames nature as a living, generative mother — into a concrete way of inhabiting and organizing the territory framed under a practice called Chagra. What from a Western scientific perspective can be read as an agroecological model is, for these communities, a sacred ritual: a daily and cyclical act that integrates biological diversity, technical ecological knowledge, and spiritual belief into a coherent system for community survival and environmental conservation.

The Chagra: Structure and Logic



This model is most known as the Chagra (or Conuco), and its foundation is a triadic plant association: maize, beans, and tubers (primarily potato and cassava). It operates as a migratory cultivation system structured around a 20-year cycle, organized in parcels of approximately 5 hectares, and deliberately designed around periods of rest that allow the soil to recover its fertility. The system inte-

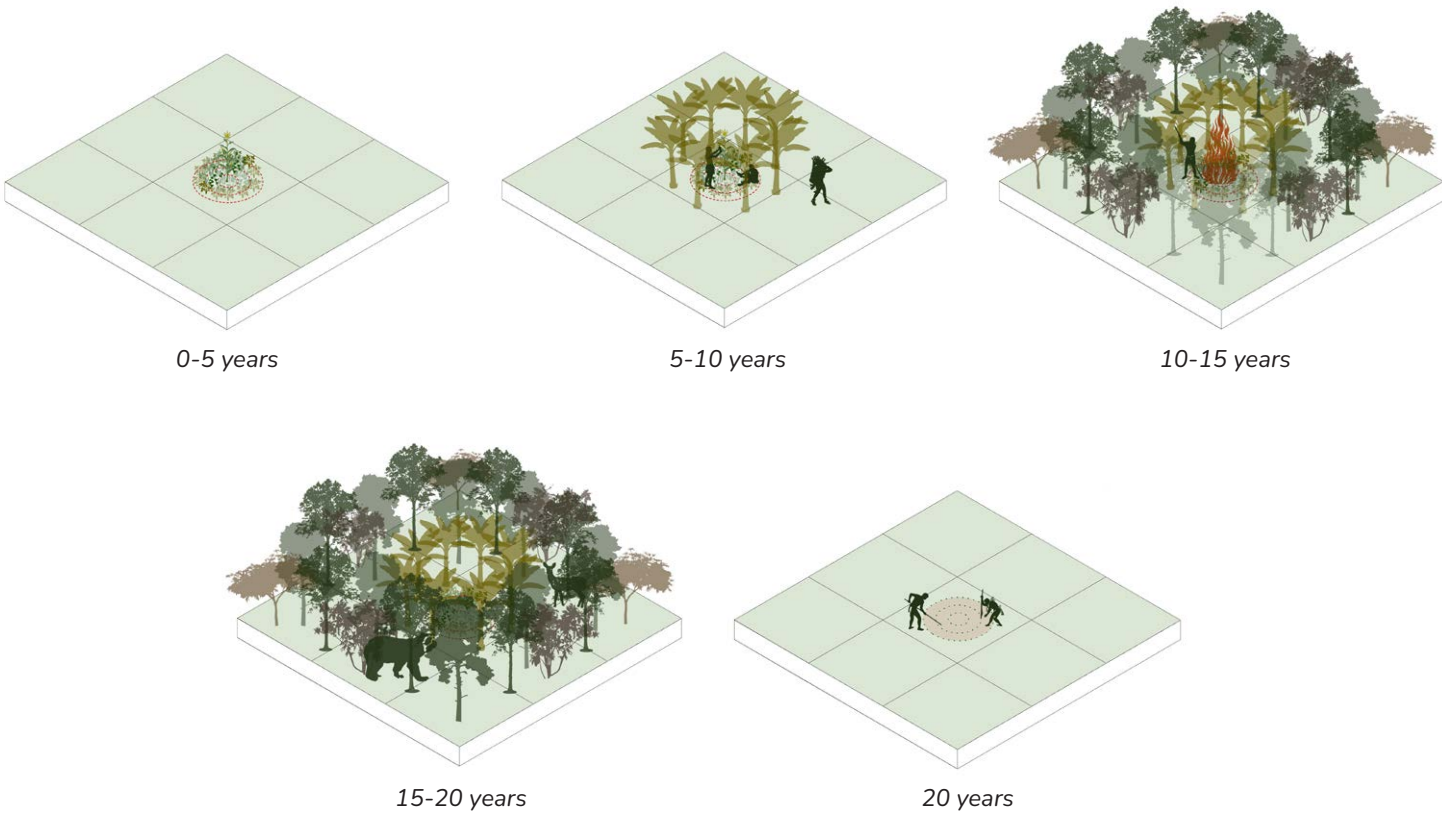
grates multiple vertical layers of vegetation — low, mid, and high forest strata — producing a landscape that evolves through clearly defined phases that closes with the total recovery of the forest in a healthy and stable way, as it mimics natural forest processes:

Ecological Performance

The Chagra is not merely productive — it is systemically functional. By maintaining a continuous supply of organic matter and activating efficient nutrient cycling, it sustains soil fertility across successive phases. Simultaneously, it regulates pest populations, stabilizes local microclimates, and governs hydrological processes

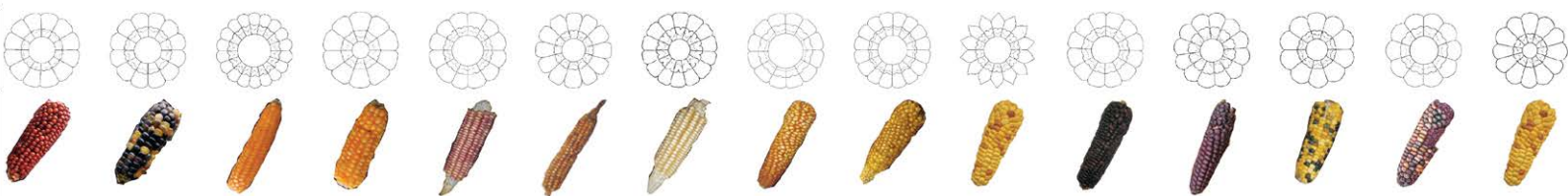
— operating, in effect, as a self-regulating ecological system. This synchronization reveals the deeper coherence of the system: ecological knowledge and cosmological reading of the world are not separate domains — they are a single, integrated framework for managing living landscapes.

Phase	Years	Landscape Condition
Sowing	0	Maize planted with beans and tubers; plot used for 2–3 sowing cycles
Forest Garden	5	Triadic crops intercropped with fast-yielding fruit trees
Food Forest	10	Forest garden enriched with slow-yielding fruit trees
Hardwood Forest	15	Food forest matures into dense hardwood canopy
Renewal	20	Forest is burned; Chagra cycle restarts



B. CORN & INDIGENOUS PEOPLE
Maize in Colombia: A General Framework

The Indigenous-Maize Bond



The relationship between indigenous peoples and maize in Colombia is ancestral, profound, and multidimensional. Maize has historically occupied the center of indigenous history, culture, economy, and daily diet, while simultaneously playing a central role in cosmogony: various indigenous groups explain the origin of maize through sacred myths, employ it as a medium for communicating with the spiritual world, and offered it in burial rituals—as confirmed by extensive archaeological evidence of carbonized primitive maize cobs found in pre-Hispanic funerary contexts across the country.

A Millennia of Evolution

This bond is rooted in thousands of years of co-evolution between people and plant. The domestication of maize began approximately 60,000 years ago, transforming a wild plant into one of the most important food crops in the Western Hemisphere—a status it retains to this day. This exceptional progression was driven by two primary forces:

Introgression from Wild Relatives

Maize evolved through the natural exchange of genetic material with its wild relatives, principally Teosinte and Tripsacum:

- **Teosinte:** Although not native to Colombia, Teosinte’s influence is widespread through races introduced from Mexico and Central America. The Mexican race Tuxpeño, which carries Teosinte germplasm, was introduced to northeastern Colombia and crossed with the local Clavo race to produce the Puya and Puya Grande varieties. Evidence from chromosome knobs confirms that most modern Colombian varieties carry Teosinte or Tripsacum intervention.
- **Tripsacum:** Unlike Teosinte, Tripsacum is native to Colombia and present across various altitudes. The Chococéño race displays distinct “tripsacoid” characteristics derived from natural hybridization, as maize and Tripsacum frequently grow and flower simultaneously in the humid Chocó region—endowing the plant with a unique rusticity and resilience to extreme rainfall.

Geographic Isolation and Topography

Colombia’s rugged topography—defined by the trifurcation of the Andes into three independent cordilleras and deep inter-Andean valleys—functioned as a natural laboratory for maize evolution:

- **Biological barriers:** Mountain ranges created isolated population nuclei, both human and botanical, that were geographically proximate yet biologically separate. This isolation allowed distinct maize populations to develop independent genetic identities—what are today recognized as races—without constant intermixing.
- **Altitude-based adaptation:** Maize races in Colombia are highly sensitive to altitude, producing sharp climatic differentiation. Races adapted to warm climates (0–800 metres) show extreme maladaptation above 1,800 metres, while cold-climate races (1,800–3,000 metres) rarely produce seed below 1,000 metres.
- **Environmental diversity:** The range of environments—from sea level to over 3,000 metres—fostered a degree of biological variation likely unmatched by any other country in the world.

Colombia’s Native Maize Races

Recent research has significantly updated the understanding of Colombia’s maize diversity. While it was long believed the country held only 23 native races, a comprehensive 15-year study by the Universidad Nacional de Colombia (UNAL) Palmira and the Colombian Agricultural Institute (ICA) identified 42 distinct races. These are organized into three categories:

Primitive Races — considered potential links to prehistoric wild maize, characterized by small ears and seeds:

- **Pollo:** Likely the most primitive race in Colombia, with a restricted distribution on the eastern slopes of the Cordillera Oriental in Boyacá and Cundinamarca.
- **Pira:** A primitive white popcorn variety cultivated mainly in Cundinamarca, with smaller populations in Tolima and Huila.

Probably Introduced Races — thought to have arrived in Colombia from other regions in ancient or more recent times:

- **Pira Naranja:** An orange popcorn variety found exclusively in Nariño.
- **Clavo:** A progenitor race for many others, now rare in its pure form, known for its long, thin, flexible cobs.
- **Güirua:** Located near the Sierra Nevada de Santa Marta, characterized by long, soft glumes.
- **Maíz Dulce:** Scarce in Colombia, likely introduced from Ecuador or Peru.
- **Maíz Harinoso Dentado:** Floury and dented; infrequently found.
- **Cariaco:** Adapted to low altitudes (0–400 metres), notable for its exceptionally varied grain colors.
- **Andaquí:** Localized on the eastern slopes of the eastern cordillera system in the southern Caquetá region.
- **Imbricado:** A high-altitude race with curved, overlapping grains.
- **Sabanero:** The most widely cultivated race at high altitudes in the Colombian Andes, encompassing two dominant local varieties—Arroz (hard, crystalline) and Porva (floury, large-grained).

Colombian Hybrid Races — originating within the country through natural or intentional crossbreeding:

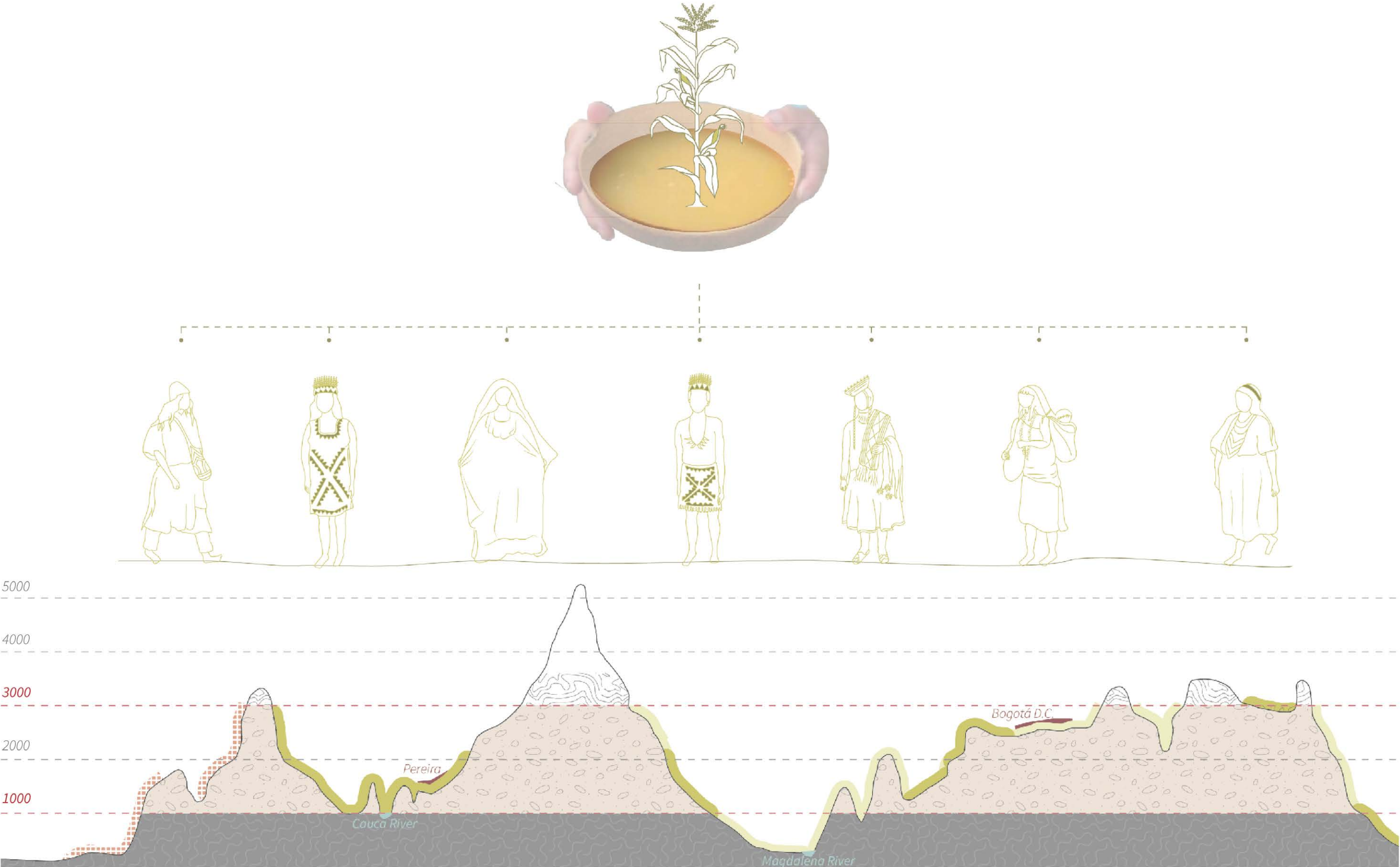
- **Cabuya:** A long, flexible-cobbed race conserved at high altitudes in Cundinamarca, Boyacá, and Santander.
- **Montaña:** The principal race of the Central Cordillera and a progenitor for several important hybrid races.
- **Capio:** Closely related to Montaña, distinguished by its floury endosperm.
- **Amagaceño:** One of the most widely distributed races in Colombia, cultivated across all three cordilleras.
- **Común:** A hybrid of Costeño and Amagaceño, and the most widely cultivated native race in temperate zones.
- **Yucatán:** Adapted to low and intermediate elevations (500–1,000 metres) in the Upper Magdalena Valley.
- **Cacao:** A floury race concentrated in Cundinamarca and Boyacá.
- **Costeño:** Dominant in low-altitude regions, it has significantly influenced many

- warm-climate races.
- **Negrito:** Closely related to Costeño, cultivated specifically for its blue aleurone, used in making bollo bread.
- **Puya:** A long, thin-cobbed dented maize concentrated in the northern regions east of the Magdalena River.
- **Puya Grande:** A larger variant of the Puya race.
- **Chococéño:** A rustic, tripsacoid race unique to the high-rainfall Pacific coast of the Chocó region.

Maize & Indigenous people in the transect

It is noticeable that most of the Colombia’s known native maize races are present within the transect, and that their distribution is deeply tied to indigenous peoples, as basically, it serves as the backbone of their identity within which there is a pattern among all the indigenous groups of the transect, all of them share a hierarchical symbolic meaning towards a beverage called Chicha (maize beer): a sacred beverage that maintains the equilibrium between “hot” and “cold,” symbolizing the balance between man and woman, or the sun and the moon, whose preparation is a central communal activity, the “centre of encounter”. However, indigenous presence is currently uneven across the three Andean Chains: it is concentrated in the Western Chain, while the Central and Eastern Chains show a precarious or entirely absent indigenous presence—and with it, a corresponding absence of native maize

cultivation. This distinction shapes how the corn-indigenous relationship will be examined across the transect. For the Western Chain, the analysis reflects an active and living bond. For the Central and Eastern Chains, it necessarily turns to the indigenous groups that once inhabited these territories and were displaced from them—primarily as a consequence of colonization and armed conflict. These are historical processes whose causes and dynamics fall outside the scope of this research, but whose spatial and cultural legacy is central to it: restoring indigenous presence in these territories is precisely one of the practical aims the project seeks to advance.

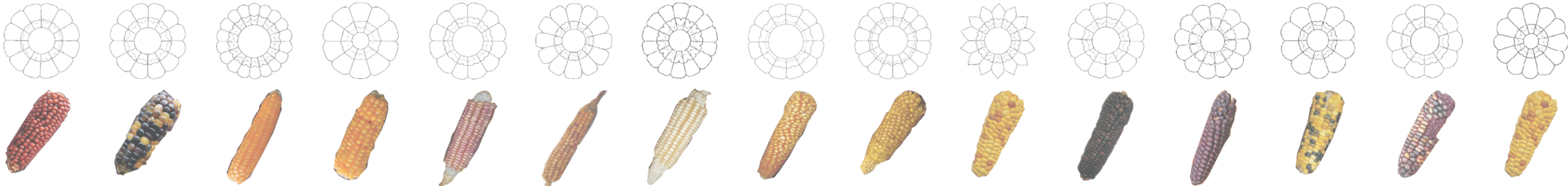


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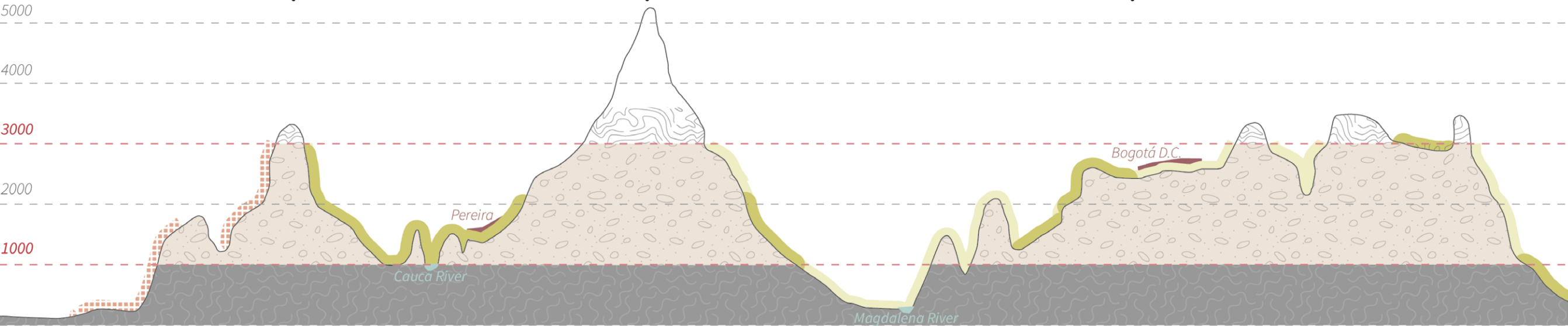
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NATIVE MAIZ
23 SPECIES
(Today 42)

- | | | | | |
|---------------|--------------|--------------------------|------------|-----------------|
| 1. Cariaco | 6. Montaña | 1. Pira naranja | 1. Pollo | 6. Sabanero |
| 2. Maiz dulce | 7. Capio | 2. Clavo | 2. Pira | 7. Negrito |
| 3. Chococeño | 8. Amagaceño | 3. Guirua | 3. Cabuya | 8. Imbricado |
| | 9. Común | 4. Maiz Dentoso Harinado | 4. Cacao | 9. Puya |
| | 10. Costeño | 5. Yucatan | 5. Andoquí | 10. Puya grande |



To examine the relationship between indigenous peoples and maize across each Andean Chain of the transect, this study focuses on one community per chain—selected on the basis of population size and territorial significance—in order to trace, with clarity and depth, the bond each has woven with maize across the territory.

WESTERN ANDEAN CHAIN: Emberá & Maize: An Identity, Spiritual, and Biological Bond

The connection between maize and the Emberá indigenous community—the only one present in the transect today—runs deep across two interlocking dimensions: identity and spirituality, and biological.

Spiritual and Identity Dimension

Maize sits at the core of Emberá cosmology, understood as the source of the “essence of being” for the people. This relationship is embodied in the chokó, a ceramic pitcher used for fermenting maize into chicha (maize beer), which is symbolically equated with a woman’s womb. Just as a woman gives life, the chicha held within the chokó reproduces and sustains Emberá-Chamí culture across generations.

Biological Dimension

The Emberá are also the creators of the Chococéño race (also known as Chococito or Maíz Chamí), a maize variety shaped by centuries of indigenous stewardship and recognized as the principal race of the Chocó region in western Colombia. It is uniquely adapted to the Pacific coast’s extremely high rainfall, thriving at elevations between 0 and 200 metres. The race is distinguished by its rustic character and “tripsacoid” traits, believed to result from natural hybridization with *Tripsacum*—a wild maize relative that grows alongside it in the humid Chocó.

Other Maize Races with Western Presence

Beyond the Chococéño, two additional races shape the maize landscape of western Colombia:

- **Clavo:** Rare in its pure form today, though specimens have historically been collected across Chocó, Nariño,

and Caldas. Recognized for its long, thin, flexible cobs, Clavo is considered a progenitor of several other races, including Puya and Montaña.

- **Común:** A highly successful and widely cultivated race in Colombia’s temperate zones (800–1,400 metres), particularly in the Cauca Valley bordered by the Western Cordillera. Común is itself a hybrid, born from the coastal Costeño and the mountain-adapted Amagaceño races.

CENTRAL ANDEAN CHAIN: Pijaos & Maize: An Identity, Spiritual, and Biological Bond

The connection between maize and the Pijaos—the indigenous community that historically inhabited the Central Andean Chain within the transect’s area—was foundational. Long before the Spanish conquest, maize was the undisputed basis of Pijao nutrition, and archaeological excavations consistently reveal this grain alongside their ceramics and goldwork, with evidence dating back to approximately 860 AD. Together, these findings confirm a sedentary agricultural lifestyle in which maize occupied a central role.

Today, the Pijao population has been dramatically reduced, with a small minority surviving in an area just south of the transect—a direct consequence of the displacement processes discussed earlier. Yet their agricultural legacy persists in the departments of Tolima and Huila, indigenous and peasant communities have preserved a remarkable diversity of native maize varieties to this day, including the primitive Pira popcorn race and the high-yielding Andaquí. This continuity carries particular significance for the research, as Tolima’s territory encompasses half of the Central Chain framed within the transect—making it a landmark reference for understanding the maize-indigenous relationship in this corridor and for the project’s aim of restoring it.

Spiritual and Identity Dimension

Maize holds a central role in Pijao spiritual life, serving as the primary medium through which the mohán (shaman) communicates with the spiritual world. This connection is expressed through a rigorous eight-day fast, during which the Mohan consumes only a handful of maize and chicha (maize beer) in order

to seek revelations. The visions received are then confirmed through ritual: maize buns (bollos) are placed on a sacred fire, and their condition is read as an omen—if the buns remain whole and the ash turns white, the sign is favourable; if they break or the ash turns red, the fast must be repeated.

For the remaining Pijao communities, maize continues to be understood as the “root of life”—the primary expression of their ancestral work and cultural continuity.

Biological Dimension

The Pijaos developed and preserved a distinctive set of native maize races through generations of indigenous stewardship:

- **Clavo:** A highly valued, high-yielding variety characterized by a thin cob and a high grain count.
- **Guacamayo:** Prized for its exceptional flavour and notably large ears, reaching up to 27 cm in length.
- **Chucula and Bavario:** Traditional varieties maintained across generations as expressions of Pijao agricultural knowledge.
- **Sabanero:** Most widely cultivated at the high altitudes of the Cordillera Oriental, though collections have also been documented along the Cordillera Central.

Beyond these races, the Pijaos also played a significant role in the evolution of Pira—one of only two primitive maize races identified in Colombia and a potential link to the country’s prehistoric maize heritage.

EASTERN ANDEAN CHAIN: Muiscas & Maize: An Identity, Spiritual, and Biological Bond

The connection between maize and the Muiscas—the indigenous community that historically inhabited the Eastern Andean Chain within the transect’s area and today survives as a minority—carries a singular distinction within this research: it is the Muisca territory that preserves Colombia’s only two primitive maize races, Pollo and Pira, considered the country’s most direct links to prehistoric wild maize. Of these, Pollo is likely the most primitive race in Colombia and is believed to have been the staple crop of the cave cultures that preceded the Muisca civilization itself.

Spiritual and Identity Dimension

For the Muiscas and their descendants, maize is not merely a crop—it is a sacred gift from the gods and a cornerstone of their cosmogony. According to their myth of origin (Sue), an indigenous man buried grains of gold that sprouted into the first maize plants, a divine offering to humanity. This sacred status is confirmed archaeologically: Muisca tombs in Sogamoso and Pasca consistently contain carbonized cobs of primitive Pollo and Pira maize, placed within ceramic vessels decorated with human faces and geometric patterns—offerings that speak to maize’s role as a bridge between the living and the ancestral world. This belief system has not been lost to time. To this day, it remains common practice among Muisca descendants to hang hembra (female) maize ears behind house doors to ward off scarcity—a living expression of an ancestral relationship that persists, quietly but powerfully, into the present.

Biological Dimension

The Eastern Andean Chain—specifically the departments of Cundinamarca and Boyacá—holds a singular place in Colombia’s maize heritage as the primary home of the country’s two primitive races, both considered potential links to prehistoric wild maize:

- **Pollo:** Likely the most primitive maize race in Colombia, with a distribution strictly limited to the eastern slopes of the Cordillera Oriental in Boyacá and Cundinamarca.
- **Pira:** A primitive popcorn variety cultivated mainly in Cundinamarca, with smaller populations found in Tolima and Huila. Carbonized cobs of this race have been recovered from Muisca funerary urns, confirming its deep ancestral roots.

The Muisca legacy also extends to the Sabanero race—named after the Sabana de Bogotá and today the most widely cultivated high-altitude maize in the Colombian Andes. Its influence reaches far beyond national borders, having served as a progenitor for numerous races in Colombia and as far as Mexico and Guatemala. Within this race, two local varieties are commonly distinguished:

- **Arroz (or Roita):** A white, hard, crystalline variety, highly valued for its yield and ease of shelling.
- **Porva:** A floury, yellow variety appreciated for its large grain size and widespread use as choclo (tender corn).

Other Maize Races with Eastern Presence

- **Cabuya:** Conserved at high altitudes across Cundinamarca, Boyacá, and Santander. Distinguished by long,

thin, flexible cobs with a reduced number of grain rows.

- **Cacao:** A hybrid race—a cross between Costeño and Sabanero—concentrated in Cundinamarca and Boyacá at intermediate altitudes between 800 and 1,800 metres.
- **Andaquí:** Although its broader distribution includes the southern Intendencia del Caquetá, it is specifically localized on the eastern slope of the eastern mountain system.

C. CORN & AGRICULTURAL FRONTIER

Territorial Suitability: Traditional Corn Within the Agricultural Frontier

A significant and concrete opportunity emerges when traditional maize cultivation is examined against the current extent of the Agricultural Frontier — the boundary actively encroaching upon the Andean Mountain Forest. According to the UPRA (Unidad de Planificación Rural Agropecuaria — the Rural Agricultural Planning Unit attached to the Colombian Ministry of Agriculture and Rural Development, responsible for guiding public policy on rural land management, agricultural suitability, and land adaptation), traditional maize (Zea mays L.) presents substantial cultivation suitability across Colombia at the national scale.

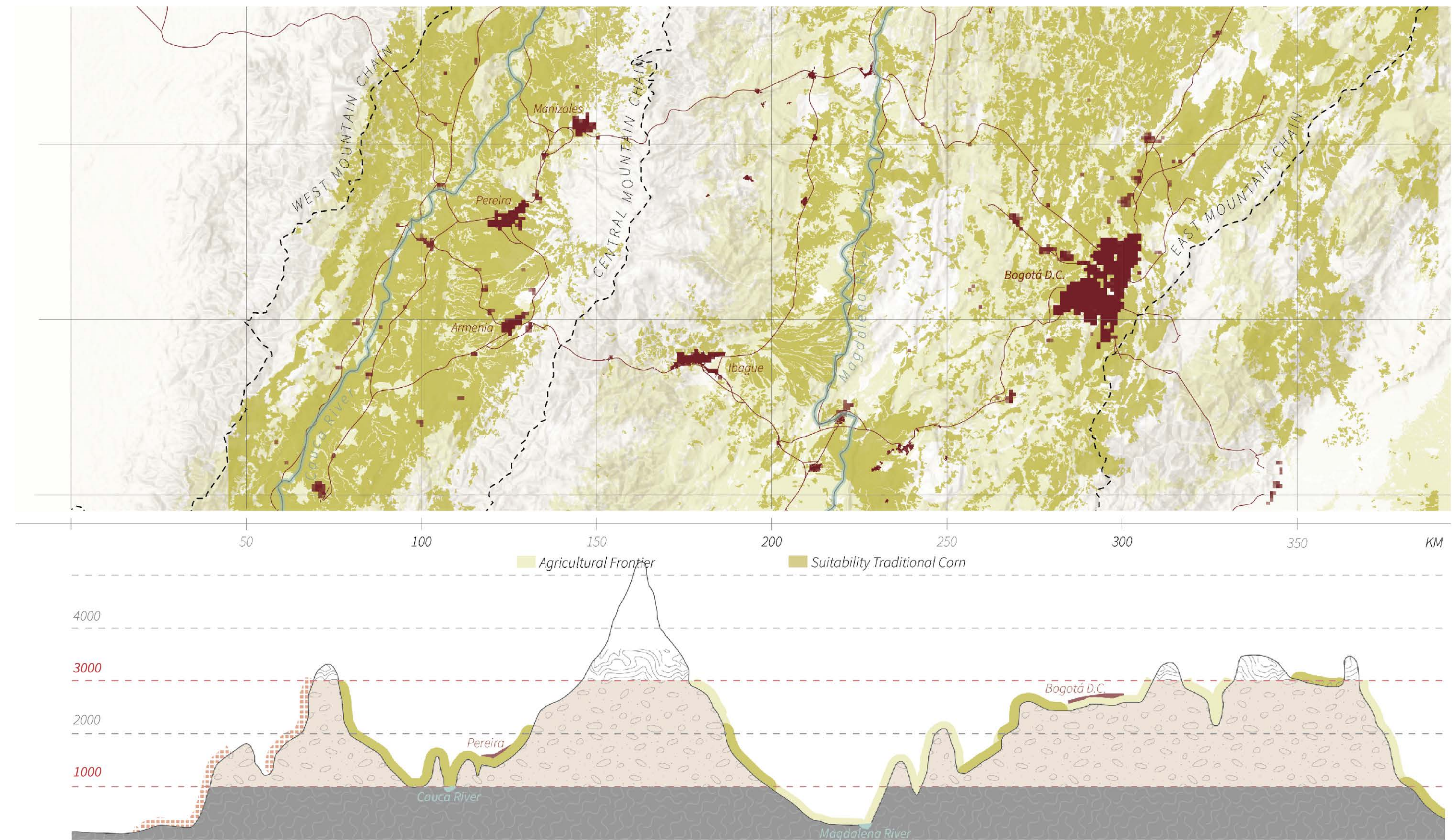
National Suitability Data

Based on UPRA’s national zoning map at 1:100,000 scale, traditional maize is suitable across 29,719,325 hectares — equivalent to 75.7% of Colombia’s total Agricultural Frontier area. This area is distributed across three aptitude categories:

Aptitude Category	Share of Frontier	Area (ha)
A1 — High Aptitude	25.2%	9,918,399
A2 — Medium Aptitude	26.2%	10,269,847
A3 — Low Aptitude	24.3%	9,531,079
Total Suitable Area	75.7%	29,719,325

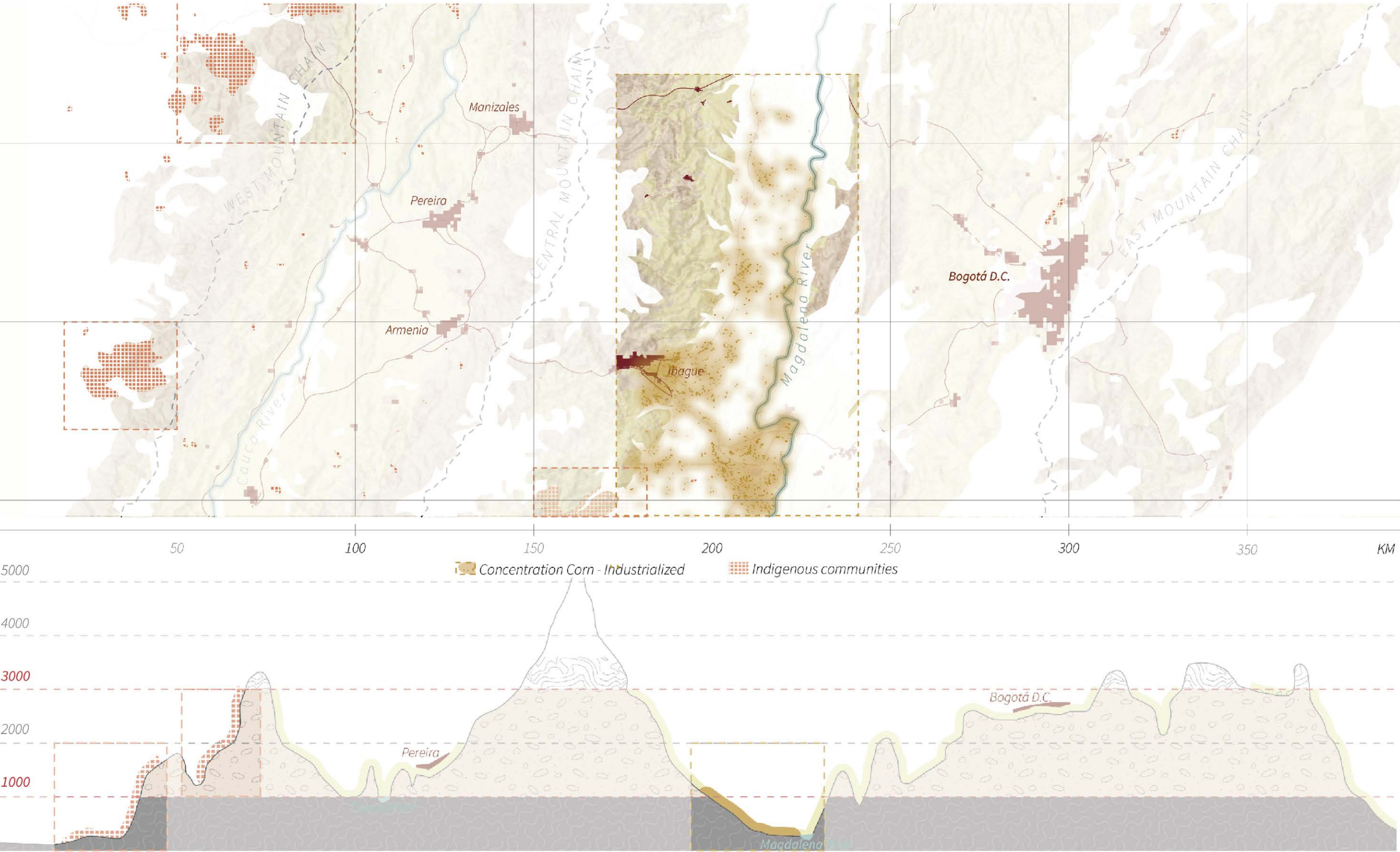
Spatial Relevance to the Transect

When this national suitability data is cross-referenced with the mapping focus area of the transect, a significant spatial overlap emerges — confirming that the intervention zone is not an exception but a representative and strategically relevant portion of this broader territorial condition.



3.1.2 Weaknesses

Maize as Weakness: The Industrial Contradiction



The very element identified as the transect's greatest strength simultaneously constitutes one of its most critical vulnerabilities. At first glance, this appears paradoxical—yet it becomes entirely coherent once a key fact is acknowledged: the transect contains a department that leads the country in industrial maize production. Tolima ranks first in technified yellow maize production and second in white maize production nationally; by 2016, its industrial maize output alone accounted for approximately 17% of the national total, yielding around 162,000 tonnes from 34,500 hectares.

Located on the eastern slope of the Central Andean Chain within the transect, this industrial dominance generates a set of complex and compounding dynamics that simultaneously challenge and reinforce the urgency of restoring native maize to the Andean Mountain Forest. Four interconnected dimensions define this contradiction:

1. The Industrial Seed Model and the Erosion of Food Sovereignty

Industrial maize production in Colombia operates under a model built on hybrid seed varieties—the result of strategic crosses between two distinct maize lines—designed to achieve heterosis, or hybrid vigor, expressed in higher yields per hectare, greater grain uniformity, and improved pest resistance.

In terms of yellow maize, more than 90% of Colombia's technified production consists of Genetically Modified (GM) varieties—hybrids further enhanced with genes for pest resistance or herbicide tolerance. In terms of white maize, numerous hybrid varieties have been developed since the 1930s, including Diacol H 104, ICA H 154, and ICA H 207, tailored to specific regional conditions.

This model carries a structural consequence: it privatizes the seed. Because hybrid seeds do not reproduce true to type, farmers cannot practice seed saving—the millennia-old process of selecting and preserving seed from previous harvests—without suffering significant yield losses. As a result, peasant and indigenous communities are compelled to purchase new seeds each season, systematically undermining their agricultural autonomy and food sovereignty.

2. Import Dependency and the Threat to Genetic Diversity

Colombia's industrial maize system is sustained not by domestic production alone, but by a massive and growing import dependency. The country currently meets only 12.7% of its hybrid yellow maize demand domestically and 50% of its white maize demand—with the remainder supplied almost entirely by imports from the United States. This dependency shows no sign of reversing; on the contrary, demand for yellow maize—used primarily for animal feed in a rapidly expanding livestock chain—continues to grow at an accelerating pace.

The consequences of this dynamic extend far beyond economics. The dominance

of industrial varieties displaces the processes of natural selection and genetic improvement that indigenous peoples have cultivated over millennia. It places native maize genetic diversity at direct risk of erosion and, with it, endangers the indigenous cultures whose cosmogonies, identity, and food security are inseparably bound to their native seed varieties—as examined in the preceding sections.

3. The Spatial Displacement of Maize from the Mountain

Industrial maize production in Tolima is concentrated in the lowest elevations of the eastern slope of the Central Andean Chain—predominantly along the banks of the Magdalena River in the valley floor. This spatial dynamic removes maize cultivation from the mountain, and critically, from the altitude range of the Andean Mountain Forest, displacing an ancestral agricultural practice that has historically been one of the forest's most important management tools.

This displacement is further compounded by severe water stress: today, 68% of Tolima's municipalities face high or very high water-use indices, creating intense pressure on irrigation resources concentrated in the valley. This condition reinforces a pattern in which agricultural activity migrates downward, away from the forest zones where its recovery potential is greatest.

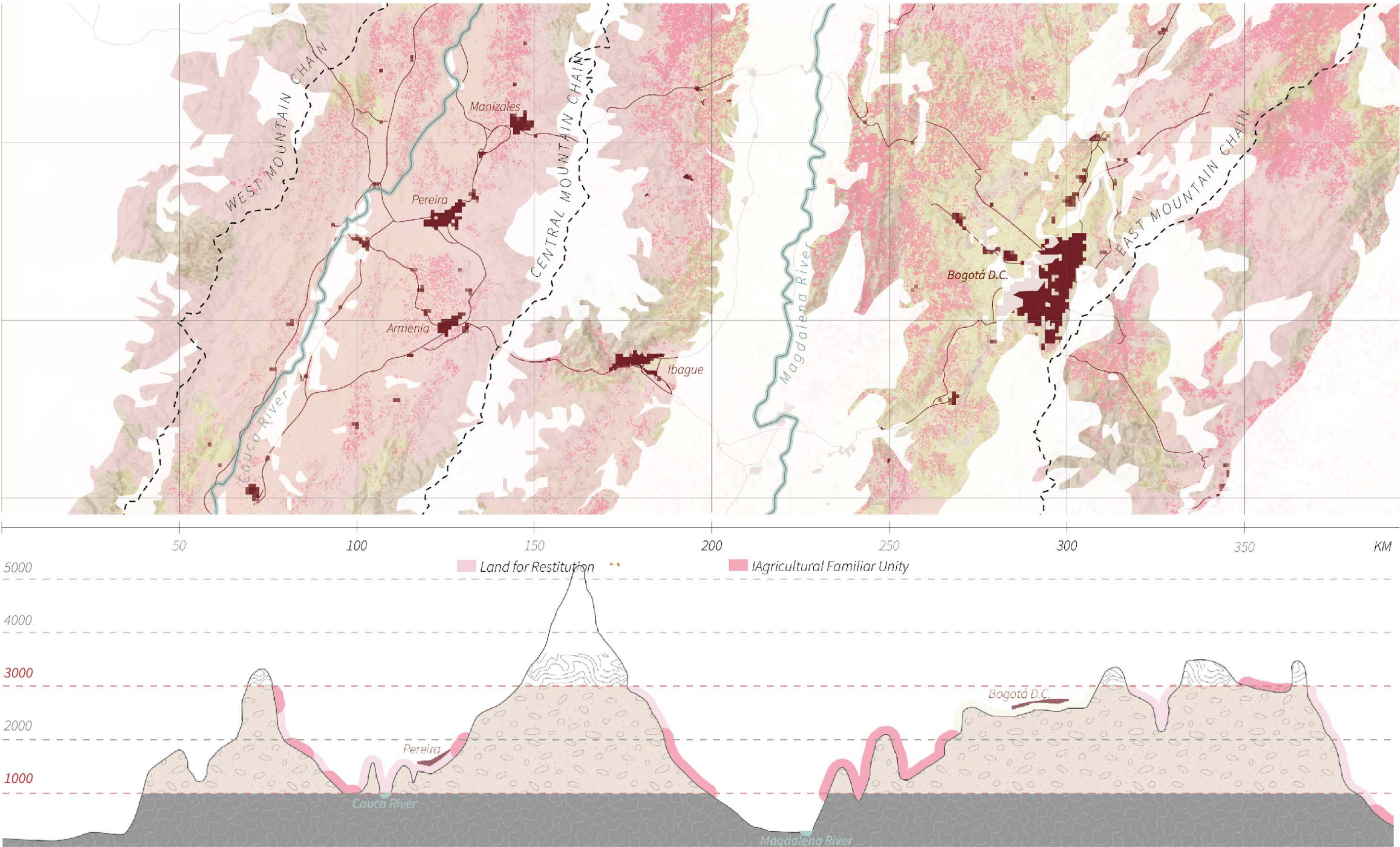
4. Genetic Erosion of Native Races

The cumulative effect of industrial monoculture expansion and the introduction of transgenic maize in nearby lowlands is placing Colombia's native maize races under significant threat of genetic erosion. The diversity painstakingly developed over thousands of years through indigenous stewardship, geographic isolation, and natural selection—described in the preceding framework—faces direct and accelerating pressure from a system fundamentally incompatible with its preservation.

Taken together, these four dynamics do not merely represent agricultural or economic challenges: they constitute a structural threat to the very foundation upon which the project's hypothesis rests. The industrial maize model, as it operates today in the transect, actively undermines the conditions necessary for restoring indigenous presence, recovering the Andean Mountain Forest, and achieving the transcalar impact this research seeks to define.

3.1.3 Opportunities

A. Governmental Frameworks as Territorial Enablers



The dual nature of maize — simultaneously the thesis’s central strength and its most critical vulnerability, given the opposition between traditional and industrial cultivation — brings two specific institutional actors into focus. These actors do not merely complement the argument: they constitute the realistic and policy-grounded mechanism through which the three foundational actions of this study -the umbrella- can be operationalized across the transect.

These two actors are Land Restitution policy and the Familiar Agricultural Unit (UAF). Both actors operate exclusively within governmental policy frameworks, and both carry concrete spatial and legal instruments capable of bringing indigenous communities back to the land — and with them the forest, through the agroecological knowledge systems that CORN requires as its operational foundation.

Land Restitution: Spatial Reclamation of the Territory

The Land Restitution Unit (Unidad de Restitución de Tierras) operates on the territory through a system of defined Microzones — geographically bounded areas of intervention that meet a precise set of preconditions: guarantees for safe return, verified security conditions, and a sufficient density of documented land abandonment and dispossession cases. These Microzones serve as the operational framework for the gradual and progressive implementation of the Registry of Dispossessed and Forcibly Abandoned Lands (Registro de Tierras Despojadas y Abandonadas Forzosamente).

When mapped against the transect, the spatial extent of these Microzones covers a significant portion of the Andean Mountain Forest — establishing a direct and legally actionable overlap between the zones of historical dispossession and the ecological territory this study seeks to regenerate. The return of indigenous communities to these lands is therefore not a speculative proposition: it is a process already inscribed within an active national legal and spatial framework.

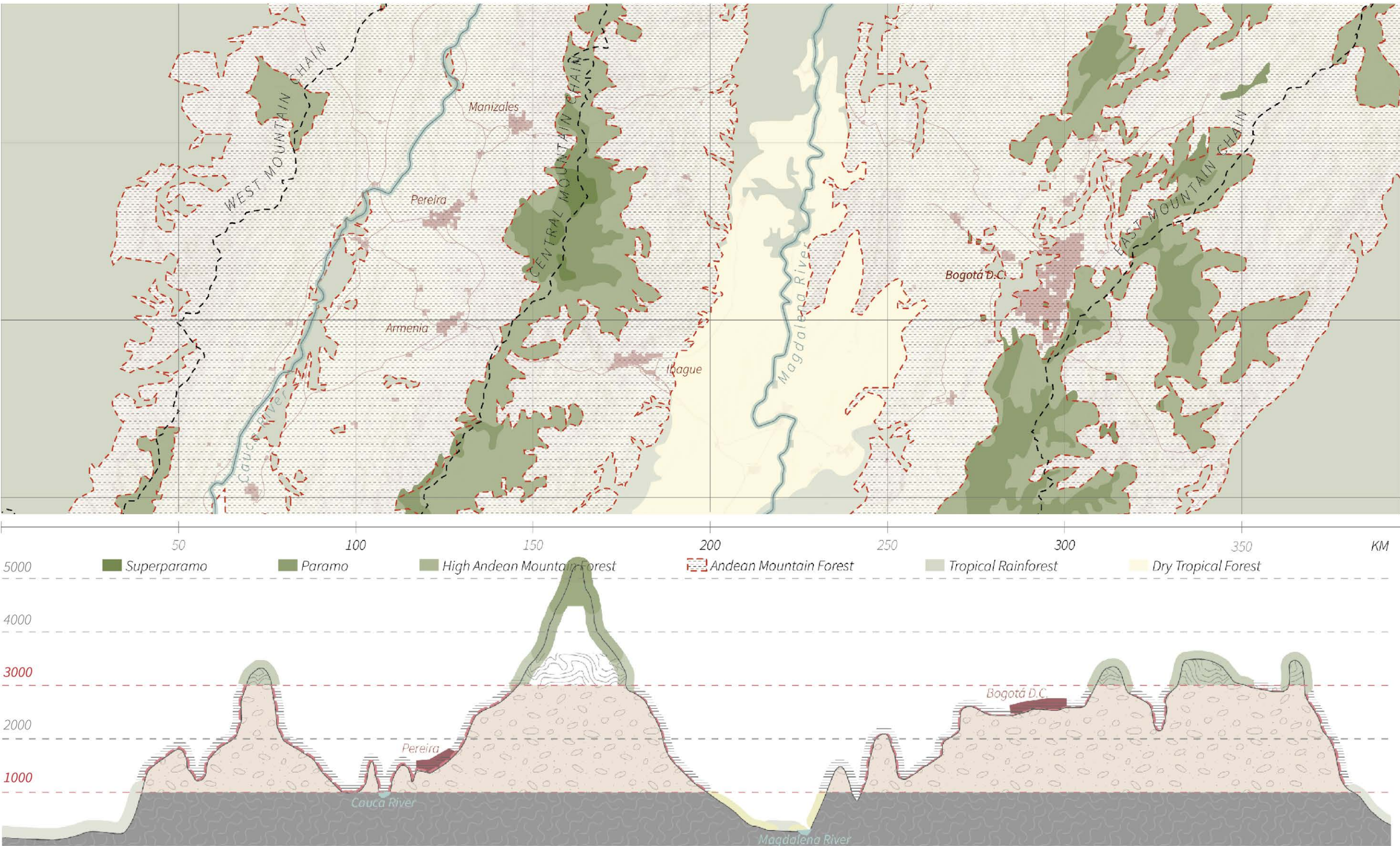
The Familiar Agricultural Unit (UAF): Defining the Viable Productive Cell

The Familiar Agricultural Unit (Unidad Agrícola Familiar — UAF), as defined by the National Land Agency (Agencia Nacional de Tierras — ANT), constitutes the foundational productive unit for agricultural, livestock, aquaculture, or forestry activity in rural Colombia. Its definition is structured around four key principles:

Dimension	Definition
Productive Extension	Physical size is determined by the agroecological conditions of the specific area and the application of appropriate technology
Economic Viability	Extension must be sufficient to allow a peasant family to remunerate their labour and generate a capitalisable surplus to consolidate family patrimony
Labour Structure	Under normal conditions, a UAF requires only the work of the owner and their nuclear family, with additional labour permitted when the production system demands it
Territorial Calibration	Viable productive areas are defined through portfolios of production systems matched to Physical Homogeneous Units (Unidades Físicas Homogéneas — UFH) across the national territory

For the purposes of this study, only parcels of 5 hectares or smaller were mapped within the transect — a deliberate threshold that aligns directly with the operational scale of the Chagra agroecological system described in the previous section. This spatial filter identifies the realistic and precise points across the territory where traditional maize cultivation can be reintroduced under the Chagra model.

B. Altitudinal Biodiversity Gradient: An Ecological Treasure



B. Altitudinal Biodiversity Gradient: An Ecological Treasure

A second major opportunity embedded within the transect is of purely ecological order — and its significance is difficult to overstate. Across its altitudinal span, the transect encompasses 6 of the 8 ecoregions that define the entirety of Colombian territory:

#Ecoregion

- 1 Tropical Rainforests
- 2 Andean Mountain Forests
- 3 Tropical Savannas
- 4 Tropical Dry Forests
- 5 High Mountain Ecosystems
- 6 Wetlands and Bodies of Water

This concentration of ecoregions within a single transect is not merely a cartographic coincidence — it is the expression of an exceptional altitudinal gradient, one that makes this territory one of the most ecologically complex and biodiverse corridors in the country.

The Andean Mountain Forest as Ecological Pivot

Within this gradient, the Andean Mountain Forest occupies a structurally critical position. It operates as the transitional and connective ecosystem between the high mountain ecosystems above — cloud forest and páramo — and the successional ecosystems below — tropical rainforest and dry tropical forest. This intermediary role is not passive: the ecological succession of the Andean Mountain Forest directly conditions and enables the succession of the ecosystems both upward and downward along the altitudinal gradient. Its integrity is, in effect, a systemic prerequisite for the stability of the entire ecoregional sequence.

Three Major Páramo Complexes: A Singular Convergence

This transitional dynamic acquires further significance when considered alongside a remarkable finding: the transect contains, at the summit of each of the three Andean mountain chains, one of Colombia’s most important páramo complexes:

Andean Chain	Páramo Complex
Eastern	Complejo Páramo de Sumapaz
Central	Complejo Páramo Los Nevados
Western	Complejo Páramo de Tatamá

(Instituto Alexander Von Humboldt, 2012)

The páramo is one of the rarest ecosystems on Earth, present in only four countries of the Andean mountain range. Colombia holds a disproportionate share of global responsibility for this biome: more than half of the world’s páramos are found within its borders. Their strategic importance is well established — they regulate and supply approximately 70% of the country’s freshwater resources,

store significant quantities of atmospheric carbon in their soils, and harbour exceptionally high levels of endemic species (Instituto Alexander Von Humboldt, 2020).

Ecological Implications for the Intervention

The presence of three páramo complexes — each anchoring one Andean chain within the transect — reframes the intervention territory not as a degraded agricultural frontier alone, but as a living altitudinal system whose regeneration carries consequences far beyond its own boundaries. Restoring the Andean Mountain Forest within this gradient means restoring the connective tissue between these high-altitude water and carbon reservoirs and the lowland ecosystems they sustain. In this sense, the altitudinal biodiversity gradient is not merely an ecological backdrop to the thesis — it is one of its most powerful arguments for urgency and spatial precision.

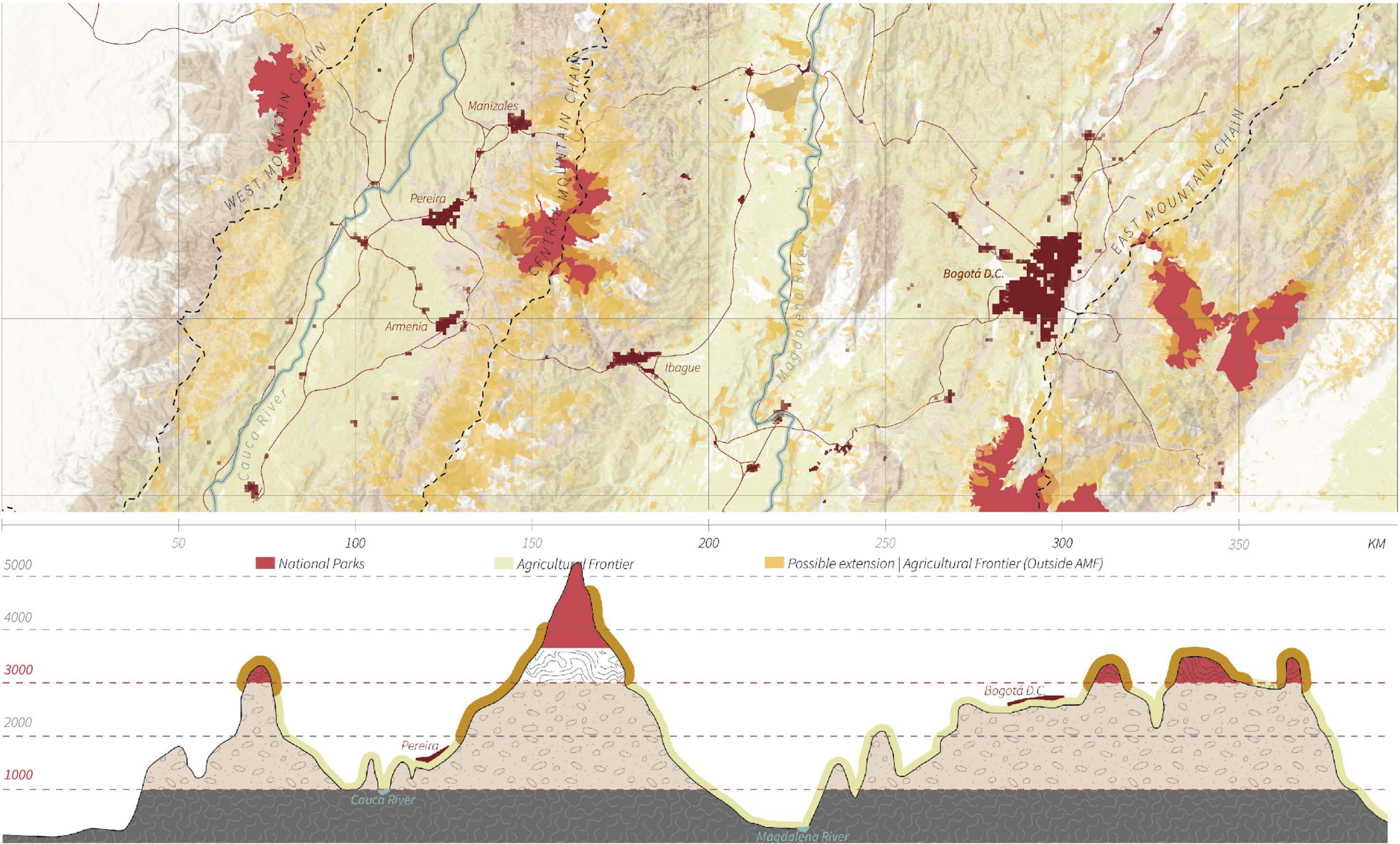
CORN as the Agent of Transformation

Together, these two institutional frameworks — Land Restitution Microzones and UAF-calibrated parcels — plus the altitudinal biodiversity gradient, do not operate as independent instruments. Read spatially and systemically, they converge to define the conditions under which CORN can be back and positioned as the active agent of reorganizing the territory, under a multifunctional, multidimensional system capable of simultaneously addressing ecological regeneration, indigenous territorial restitution, and the restructuring of the Agricultural Frontier. This convergence is not incidental. It is the spatial and institutional foundation upon which the transcalar intervention of this thesis is built.

3.1.4 Threats

Four conditions represent the most critical challenges to achieving the goals of this research: the expansion of the Agricultural Frontier, precarious forest cover, mining, and coffee monoculture. Together, they do not operate as isolated pressures but as a compounding system of forces acting simultaneously on the most fragile ecosystem of a global biodiversity hotspot.

The Expansion of the Agricultural Frontier

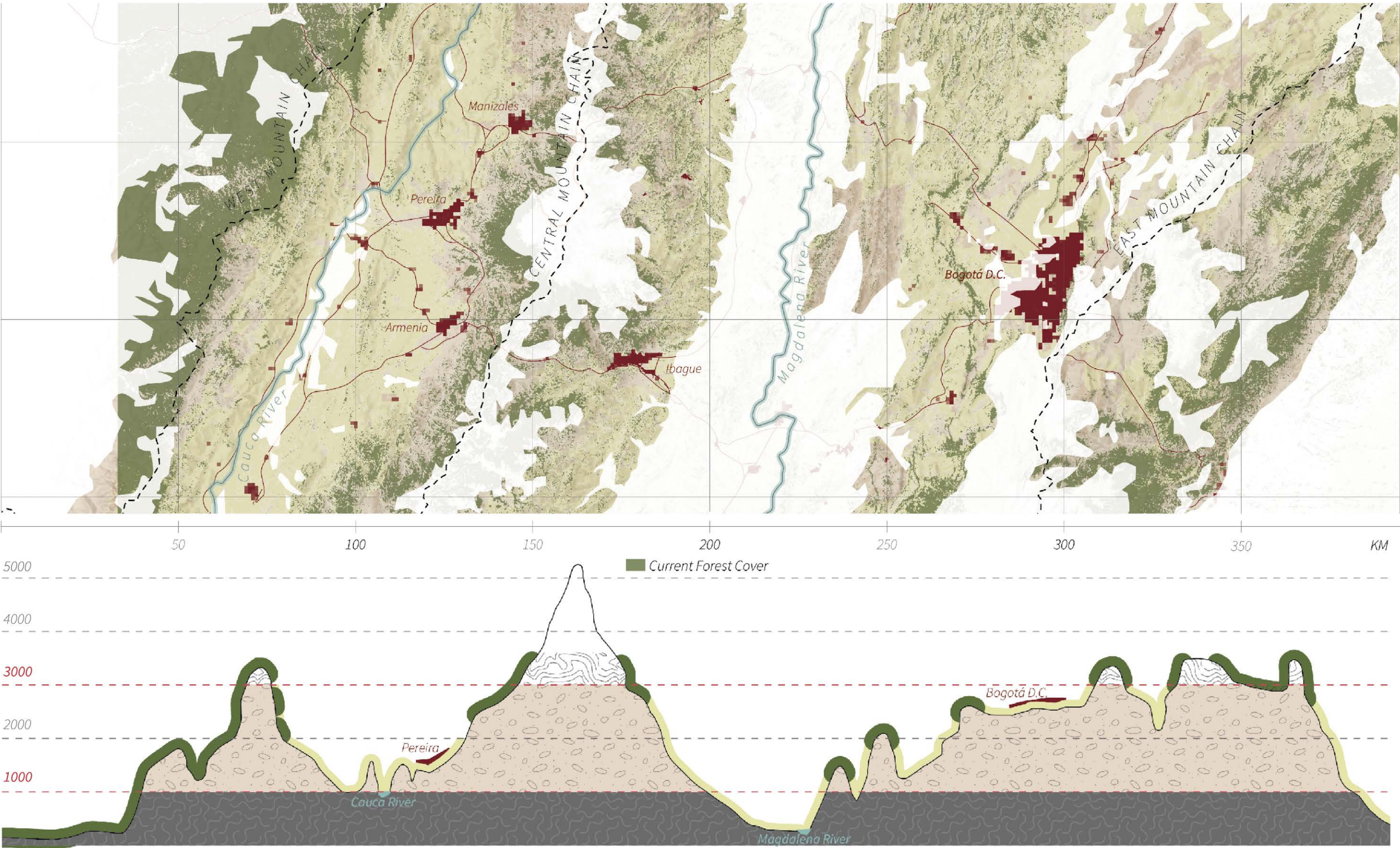


The primary danger of this expansion within the transect is not simply the loss of land — it is the consolidation of an already overexploited corridor into a continuous, unbroken line of anthropic pressure. Read on the transect's section, this dynamic reveals a critical consequence: the protected areas situated above the Andean Mountain Forest level, where the páramo hotspots are concentrated, would become entirely exposed to the forces operating along the Agricultural Frontier, with no buffer remaining between extraction and the most biodiverse and climatically sensitive zones of the territory.

The effects of this expansion are threefold. Environmentally, it drives systematic deforestation and the replacement of natural vegetation with crops and pasture. Socially, it disrupts existing communities and deepens the fracture between land use and cultural identity. Legally, it generates territorial conflict and insecurity, particularly in areas where land tenure is already contested.

“The protected areas situated above the Andean Mountain Forest level, where the páramo hotspots are concentrated, would become entirely exposed to the forces operating along the Agricultural Frontier, with no buffer remaining between extraction and the most biodiverse and climatically sensitive zones of the territory”

Precarious Forest Cover



If there is one condition that translates most tacitly and most powerfully the central problem this thesis addresses, it is the state of forest cover in the transect. The data reveals a territory profoundly fragmented: what remains of the Andean Mountain Forest is concentrated at the edges of the highest altitudinal perimeter, or scattered in isolated patches in the uppermost areas. The forest no longer forms a continuous body. It survives in pieces.

Presenting this condition in the most fragile ecosystem of a global hotspot is not merely an environmental concern — it is a destabilization of the essential ecological and social systems that sustain both local life and global stability. According to the Critical Ecosystem Partnership Fund (CEPF), the consequences unfold across five interconnected dimensions. The first is the breakdown of connectivity and the acceleration of species extinction. Fragmentation destroys the functional connectivity required for species to survive and maintain genetic diversity. Isolated patches cannot support viable populations of wide-ranging species such as the spectacled bear or the mountain tapir, and as the climate shifts, the fragmented landscape acts as a barrier preventing species from moving to higher altitudes — dramatically increasing extinction risk.

The second is the destabilization of water security. The Andean forests function as the continent's water towers, absorbing rainfall and releasing it steadily throughout the year. Fragmentation reduces this capacity, leading to prolonged droughts and water scarcity. Where livestock has replaced forest, soil compaction further diminishes the land's

ability to filter and store water.

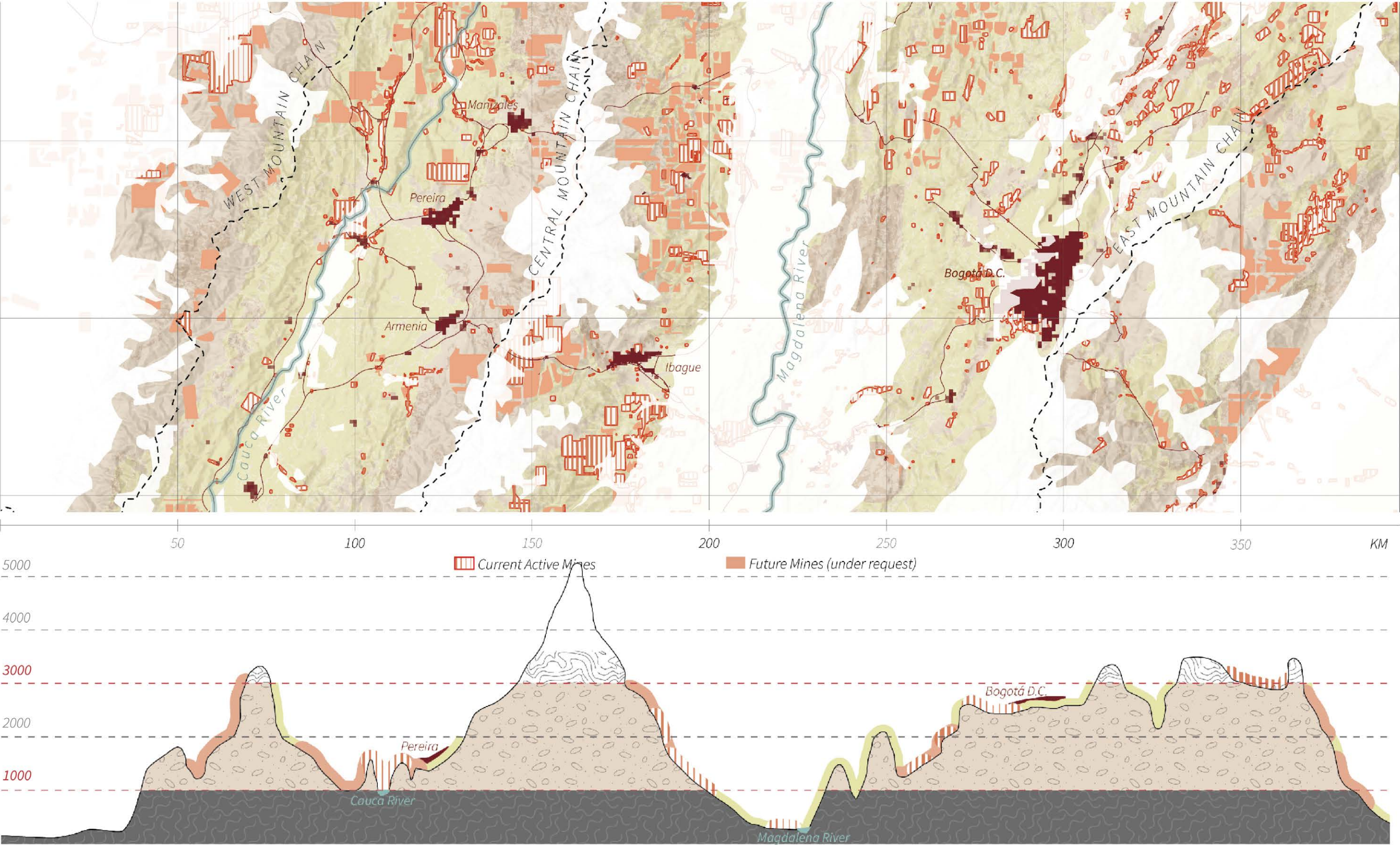
The third is the massive release of stored carbon. The Tropical Andes is the second most important hotspot globally for irrecoverable carbon. Land-use change — particularly the conversion of forest to pasture — can cause the loss of between 20% and 100% of organic carbon stored in high-altitude soils. Critically, if these carbon stocks are lost, they cannot be restored by 2050, effectively accelerating the global climate crisis beyond the point of mitigation.

The fourth is the increased risk of natural disasters. The natural vegetation on the steep Andean slopes performs the essential service of retaining soil. Without it, landslides, floods, and avalanches become more frequent and more severe, with disastrous consequences for high-altitude populations. Rainfall that once filtered gently through forest cover now strikes bare soil with full force, eroding the fertile upper layers and undermining agricultural productivity in the same areas that deforestation was meant to serve.

The fifth is socioeconomic crisis and forced migration. Ecosystem degradation leads to the loss of the services that local communities depend on for food and medicine — currently, one in three mountain inhabitants in developing nations suffers from food insecurity. This insecurity drives migration to urban centers, which in turn accelerates the loss of ancestral knowledge and the further marginalization of the most vulnerable, particularly women who remain behind to manage degraded land without adequate resources.

“The data reveals a territory profoundly fragmented: what remains of the Andean Mountain Forest is concentrated at the edges of the highest altitudinal perimeter, or scattered in isolated patches in the uppermost areas. The forest no longer forms a continuous body. It survives in pieces.”

Mining



Mining is one of the most critical threats to the Andean Mountain Forest in Colombia, exerting pressure through direct habitat destruction, environmental contamination, and severe social conflict. Its impact is driven by both legal concessions and widespread illegal activity, often intensified by global economic shifts. Within the transect, mining is distributed across all three Andean mountain chains in roughly proportional measure — but when future concession requests are mapped, a hierarchical concentration emerges along the eastern slope of the Central Chain, precisely where ecological sensitivity is highest.

The direct effects on the forest are severe and, in many cases, irreversible. The Serranía de San Lucas KBA has lost over 61,000 hectares of forest to the combined impact of mining, illicit crops, and agricultural expansion. The Reserva Regional Bajo Cauca Nechí suffers one of the highest concentrations of illegal gold mining in the country, with 15,142 hectares of forest lost as a result. Beyond the immediate footprint of extraction, the construction of access roads catalyzes further transformation — facilitating uncontrolled colonization and opening previously inaccessible forest to additional deforestation.

The scale of legal pressure is equally alarming. Several Key Biodiversity Areas show a high degree of overlap with active mining concessions: Páramo de Rabanal at 81.8%, Cuenca del Río Toche at 59.4%, and Cañón del Río Combeima at 37.7%. In the Paraguas-Munchique Corridor alone, the state has granted 93 mining titles to private companies, with another 106 applications pending that intersect at least 27 different KBAs. These figures reveal a structural misalignment between extractive policy and conservation commitments — one in which mining titles are granted by the

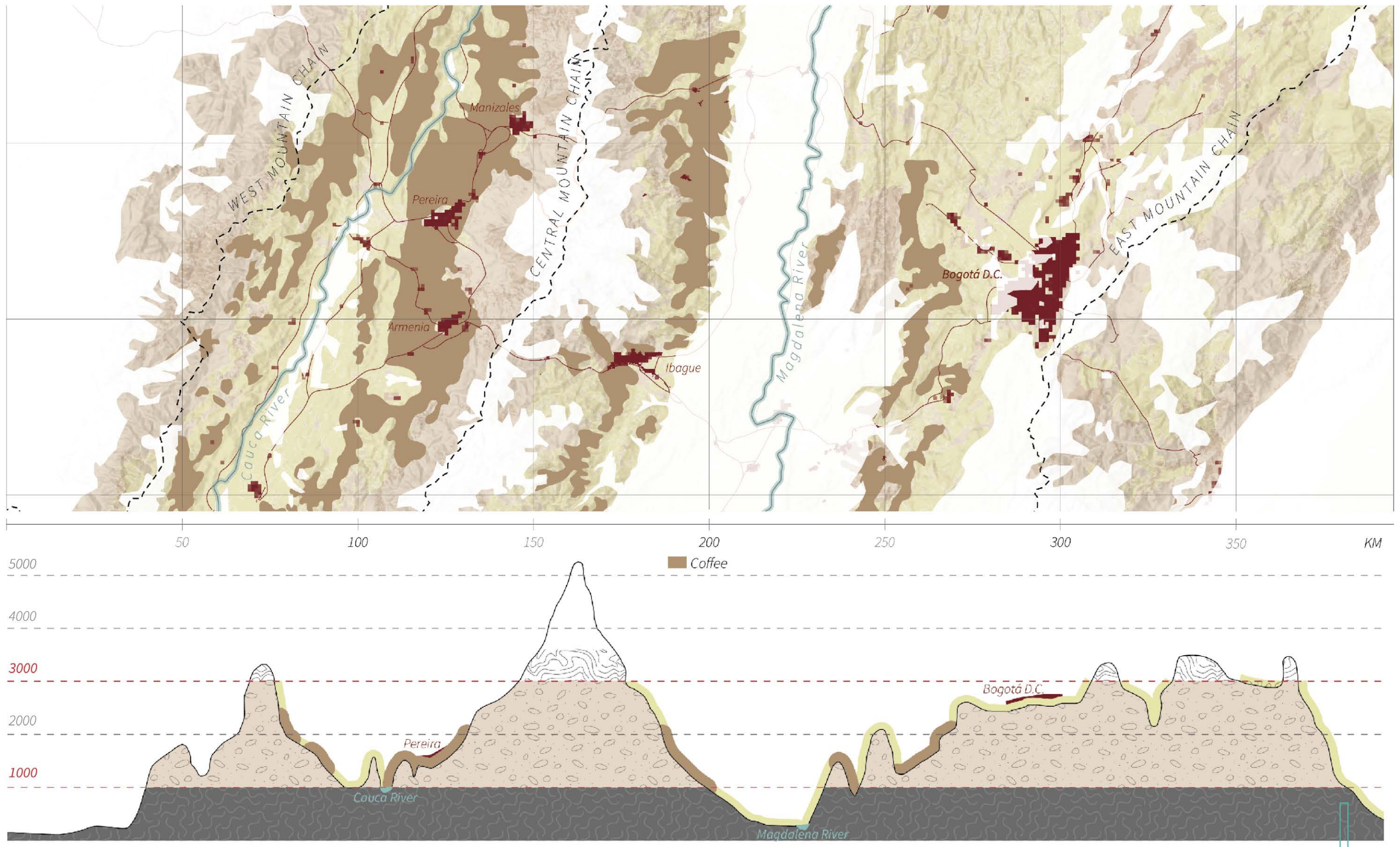
Ministry of Mines and Energy without adequate coordination with environmental authorities.

The contamination legacy of illegal mining compounds the damage. Mercury, used widely in artisanal gold extraction, poisons water sources and aquifers with consequences that extend far beyond the extraction site itself, particularly in the sensitive riparian ecosystems of the Chocó bioregion. During the COVID-19 pandemic, when gold prices exceeded US\$2,000 per ounce and state oversight was reduced, illegal mining activity intensified dramatically in remote areas — a pattern that reveals how directly global economic forces translate into local ecological destruction.

The social costs are equally grave. In 2019, Colombia recorded the highest number of assassinations of environmental defenders in the world, with 64 leaders killed that year alone — many of them indigenous and community leaders resisting extractive encroachment on their territories. Between 2010 and 2013, at least 226 socio-environmental conflicts related to extractive industries were identified in indigenous territories, underscoring the profound tension between national extractive ambitions and the rights and survival of the communities whose lives are rooted in the land being destroyed.

“Within the transect, mining is distributed across all three Andean mountain chains in roughly proportional measure — but when future concession requests are mapped, a hierarchical concentration emerges along the eastern slope of the Central Chain, precisely where ecological sensitivity is highest.”

Coffee Monoculture



Coffee is central to Colombia's economy and cultural identity — and within the transect, its presence is not incidental but defining. The departments leading national coffee production are concentrated precisely here: Caldas, Risaralda, and Quindío, alongside northwestern Tolima, northern and eastern Valle del Cauca, and southwestern Antioquia. It is no coincidence that this area is known across Colombia as the Eje Cafetero — the Coffee Axis — and that the UNESCO Cultural Coffee Landscape rests on the western slope of the Central Chain within it. Coffee here is not merely an agricultural crop; it is a territorial identity. This makes its ecological impact both more significant and more complex to address. The expansion of coffee cultivation affects the Andean Mountain Forest through several compounding mechanisms. The most direct is deforestation: the clearing of natural forest to establish plantations, particularly as many farmers have transitioned from diverse agroforestry — shade-grown coffee, which maintains canopy cover — to full-sun monocultures, which the data explicitly links to significant levels of deforestation. Where forest once formed a continuous fabric, coffee plantations now contribute to the agricultural mosaic that fragments it, destroying the functional connectivity that wildlife and ecological systems depend on.

The chemical footprint of monoculture intensifies the damage. Agrochemical runoff contaminates the water sources that flow from the Andean Mountain Forest into the valleys and communities below — the same water towers whose regulation capacity is already under threat from forest fragmentation. The use of uncontrolled burning to clear land for new cultivation adds a further layer of risk, with fires capable of escaping into adjacent forests and causing damage far beyond the intended clearing.

Specific KBAs bear the clearest marks of this pressure: the Alto Quindío and Cañón del Río Combeima in the Coffee Axis, the Serranía de las Minas and Parque Nacional Natural Puracé in Huila — the department with the largest coffee-growing surface in the country — and the evocatively named Cafetales de Támesis, where coffee and conservation share the same ground.

Yet within this threat lies a possibility. A growing movement toward sustainable bio-enterprise — bird-friendly and shade-grown coffee, agroforestry systems that link livelihoods directly to forest preservation rather than its destruction — points toward a different relationship between coffee and the mountain. This possibility is not peripheral to the research; it is one of the threads the landscape project seeks to weave.

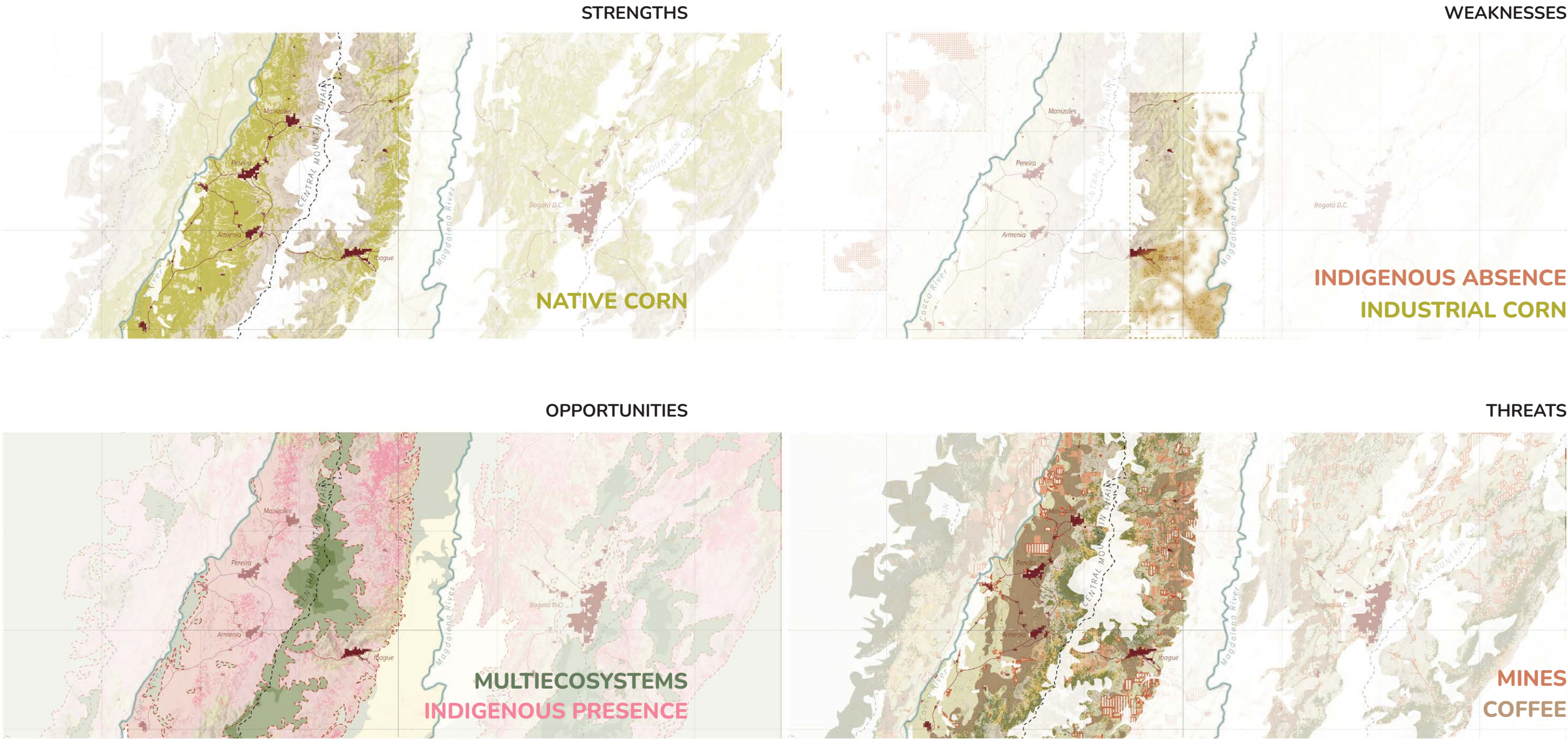
“Coffee is central to Colombia’s economy and cultural identity — and within the transect, its presence is not incidental but defining.”

“It is no coincidence that this area is known across Colombia as the Eje Cafetero — the Coffee Axis — and that the UNESCO Cultural Coffee Landscape rests on the western slope of the Central Chain within it. Coffee here is not merely an agricultural crop; it is a territorial identity.”

3.1.5 Swot results

The Fragile Spine: How the Most Vulnerable Chain Rules the Transect

Where the highest intensity of all complexities collide



The Central Andean Chain as the Strategic Territorial Anchor

Reading the SWOT as a whole reveals a pattern: the Central Andean Chain is where every actor, pressure, and opportunity converges at peak intensity. This convergence makes it simultaneously the most vulnerable and the most potent element of the transect — the spine through which the system's viability must be addressed, and the entry point for the next interscalar approach.

The Central Andean Chain is the strategic landscape element best positioned to advance the study's core goal: the regeneration, protection, and conservation of the Andean Mountain Forest. Two conditions justify this choice.

First condition: physical complexity.

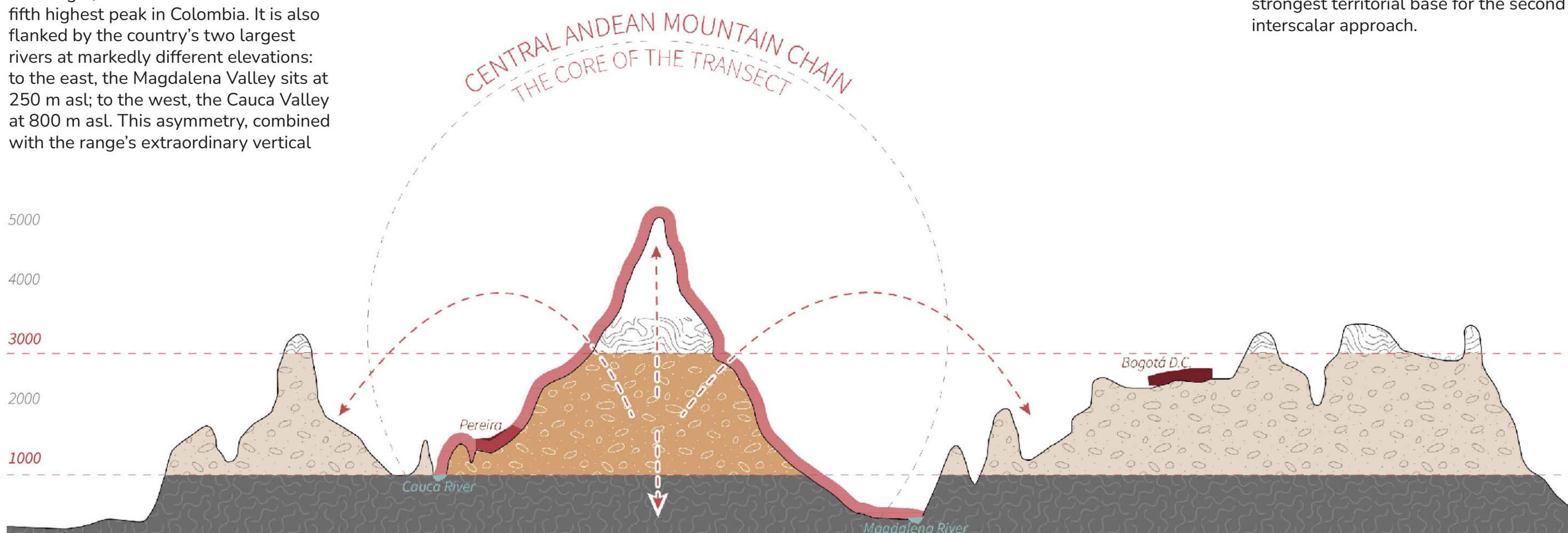
Among the three mountain ranges of the transect, the Central Chain holds the most diverse altitudinal gradient, reaching 5,389 m above sea level — the fifth highest peak in Colombia. It is also flanked by the country's two largest rivers at markedly different elevations: to the east, the Magdalena Valley sits at 250 m asl; to the west, the Cauca Valley at 800 m asl. This asymmetry, combined with the range's extraordinary vertical

span, makes the Central Chain the most physically complex mountain in the transect.

Second condition: the water-in-oil effect. Within the transect's dynamic, the three Andean chains function like oil — and the Central Chain acts as water moving through them, generating disturbance. As the most degraded, overexploited, and pressured of the three ranges, it becomes the primary source of ecological disruption: severing connectivity, interrupting fluxes, and producing a multiscalar, multidimensional disconnection driven by the deteriorated state of its Andean Mountain Forest. This effect is not only horizontal — operating across the three ranges — but also altitudinal: since the Andean Mountain Forest

(spanning roughly 1,000–3,000 m asl) appears across all three chains, it simultaneously acts as water in oil between the ecosystems above and below it.

Yet this same fragility holds the greatest strategic opportunity. Precisely because the Central Chain concentrates and amplifies disturbance, intervening here carries the highest potential for systemic reverberation. A project designed to act as the lubricant — restoring connectivity where the water-in-oil dynamic generates the most friction — could propagate its regenerative effect across the entire transect and beyond, in a transcalar way. In sum, identifying the water-in-oil effect performed by the Central Andean Chain horizontally, and by the Andean Mountain Forest altitudinally, also reveals their potential to act as the lubricant of the system. This dual role — most critical disruption, highest regenerative leverage — makes the Central Andean Chain the strongest territorial base for the second interscalar approach.



Chapter's bibliography

Official Reports and Technical Manuals

- Agencia Nacional de Tierras (ANT). "ANT lanza visor interactivo de Unidades Agrícolas Familiares – UAF para la ciudadanía."
- Echeverri Perico, R., & Rubiano, A. (Coords.). Tolima: Tomo II. Bogotá: Produced with the support of the FIRST program (FAO-UE).
- Gobernación del Tolima & Unidad de Planificación Rural Agropecuaria (UPRA). (2015). Documento diagnóstico del Plan de Ordenamiento Social y Productivo de la Propiedad Rural.
- Rodríguez Romero, A., Aguilar Corrales, D. A., et al. (2023). Cultivo de maíz tradicional: Identificación de zonas aptas en Colombia a escala 1:100.000. Bogotá: Unidad de Planificación Rural Agropecuaria (UPRA).
- Unidad de Planificación Rural Agropecuaria (UPRA). (2019). Frontera agrícola. Bogotá: UPRA.
- Universidad de Ibagué - Instituto de Desarrollo Regional. (2022). Situación de los pueblos indígenas en el Tolima.

Books and Academic Chapters

- Acevedo Osorio, Á. (2016). "La multifuncionalidad de los sistemas tradicionales de producción de agricultores familiares en el Sur del Tolima." In Á. Acevedo-Osorio & J. Martínez-Collazos (Comps.), *La agricultura familiar en Colombia: Estudios de caso desde la multifuncionalidad y su aporte a la paz* (pp. 185-210). Bogotá: Ediciones Universidad Cooperativa de Colombia - Corporación Universitaria Minuto de Dios - Agrosolidaria.
- Jaramillo B., E., & Rojas, A. (Eds.). (2019). *Antropología hecha en Colombia* (Tomo III). Cali: Editorial Universidad Icesi.
- Roberts, L. M., Grant, U. J., Ramírez, R., Hatheway, W. H., & Smith, D. L. (1957). *Razas de Maíz en Colombia*. Bogotá: Ministerio de Agricultura de Colombia - Oficina de Investigaciones Especiales (Boletín Técnico No. 2).
- Ashworth, William B., Jr. (2022, September 14). "Alexander von Humboldt." *Scientist of the Day*. Linda Hall Library. This article provides historical context on Humboldt's influence on the field of plant geography and his development of novel scientific graphics.
- Linda Hall Library. "De distributione geographica plantarum secundum coeli temperiem et altitudinem montium: prolegomena / auctore Alexandro de Humboldt..." Digital collection and catalog entry

Indigenous Rights and Global Reports

- International Work Group for Indigenous Affairs (IWGIA). "The Indigenous World 2025: Colombia."
- Progressive International. "National Indigenous Minga reached important agreements with the government."
- Survival International. "60% of Colombian tribes at 'risk of extinction'."

Community and Cultural Resources

- Fundación Swissaid. (2018). *Cartilla Maíz Chamí*. Risaralda: Semillero de Investigación Intercultural Institución Educativa San Antonio del Chamí.
- Organización Nacional Indígena de Colombia (ONIC). "Comunicados a la opinión pública."

Other Noted Studies within Sources

- Lucena, M. "Datos Antropológicos sobre los Pijao."
- Ministerio de Cultura. *Caracterización de los pueblos indígenas de Colombia: Pueblo Pijao*.

CHAPTER 4: Interscalar Approach | Stage 2

Key dynamics at highest intensity trace the most strategical territorial areas for reorganizing the territory

.....

“A strong horizontal belt emerges from the dense overlapping of actors concentrated along the lower edge of the Andean Mountain Forest.”

Scalar goal: To spatially analyse the dynamic between the first stage’s interscalar approach and the transect’s actors, in order to identify and acupuncture the most strategic territorial areas for reorganizing the system.

This chapter examines the spatial interaction between all actors identified in the previous chapter and the three keystones of the research — Key Biodiversity Hotspots, Indigenous Peoples, and Agricultural Frontier — across three consecutive scales that progressively zoom into the transect —Central Andean Chain, Eastern Slope, Territorial Interstice—. Among these three scales, the first and last one will serve mainly to point out a territory; while the second one will be the one displaying the whole dynamic confronting two maps under the following analytical method:

Analytical Method

The spatial analysis distills all information gathered so far into two fundamental categories — anthropic forces and natural forces — each rendered as a dedicated representative map.

Anthropic Forces include the following layers:
Mining · Coffee · Traditional Corn's Highest Soil Suitability · Family Agricultural Units · Industrial Corn · Grey Infrastructure

Natural Forces include the following layers:
Multiecosystems · Protected Areas · Tropical Andes Key Biodiversity Areas (KBAs) · Econevedos: Territorial Landscape Plan

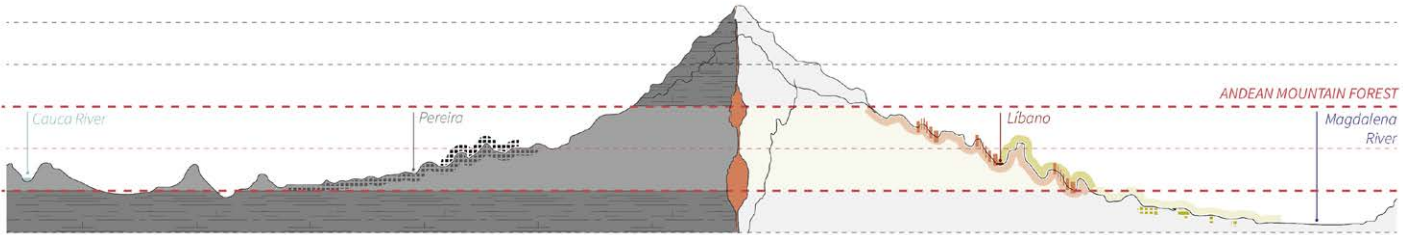
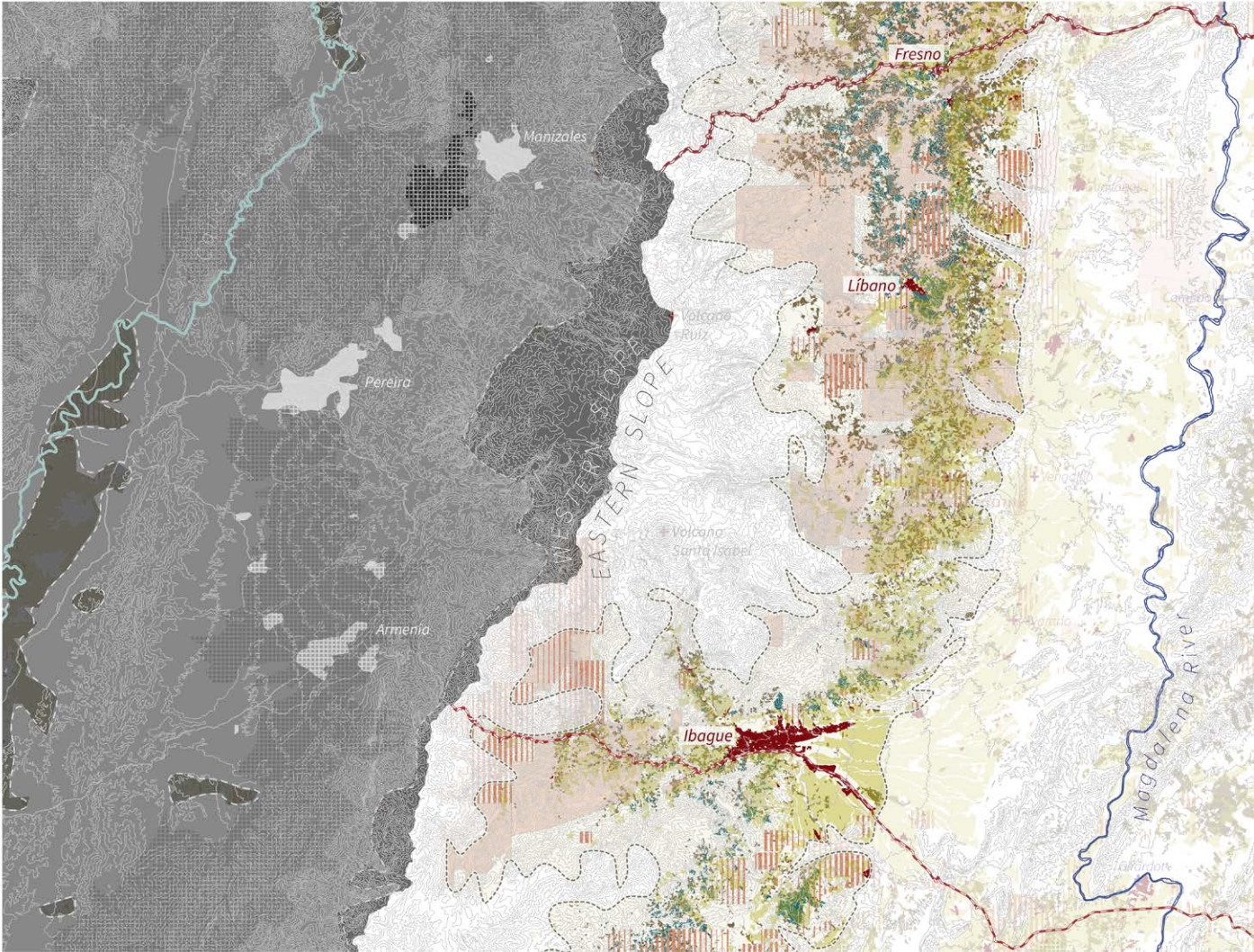
It is important to highlight that as this 2 stage's interscalar approach descends to the Central Andean Chain scale, the analysis begins to reveal finer territorial detail. These are not new key actors, but branches of the primary ones — subsidiary layers that are nonetheless essential for reading the spatial dynamics with accuracy, such as the protected areas and the Econevedos plan.

Reading Convention

As established also in the transect mapping, maps drawn here will carry the Andean Mountain Forest's footprint — rendered as perimeter, line, and hatch — to serve as lens of the focus study area: the ruling spatial reference that frames and governs the entire reading.

- Andean Mountain Forest (1000-3000m osl)
- Current mines
- Future mines
- Current corn
- Coffee monoculture
- Agricultural Familiar Units (UAF)
- High suitability corn
- Prehispanic ancient paths
- Vial infrastructure
- Water line - 1° Largest territorial river
- Settlements

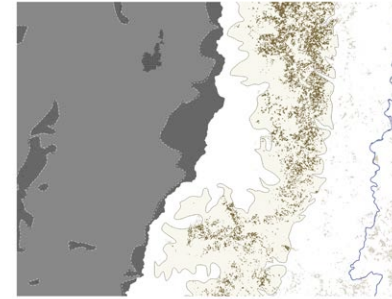
4.1 Anthropic forces
KEY DYNAMIC: A potential horizontal belt



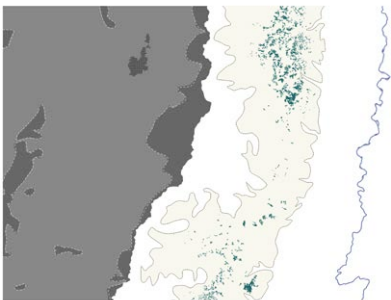
When read as a whole, the anthropic forces map reveals a striking pattern: a strong horizontal belt emerges from the dense overlapping of actors concentrated along the lower edge of the Andean Mountain Forest. Read individually, each actor sharpens the picture:



Coffee: Current coffee plantation parcels are heavily concentrated around Líbano and the northern section of the slope, gradually fading southward — tracing a gradient of agricultural occupation that mirrors the belt's directionality.



Industrial Corn: Entirely concentrated in the Magdalena River's interandean valley, spatially disconnected from the Andean Mountain Forest. Its logic is structural: industrial corn demands flat terrain, placing it categorically outside the mountain's domain.



Traditional Corn - Highest Soil Suitability: The actor that most precisely and forcefully draws the horizontal belt. Its distribution marks the lower boundary of the Andean Mountain Forest with the greatest definition and continuity of all forces mapped



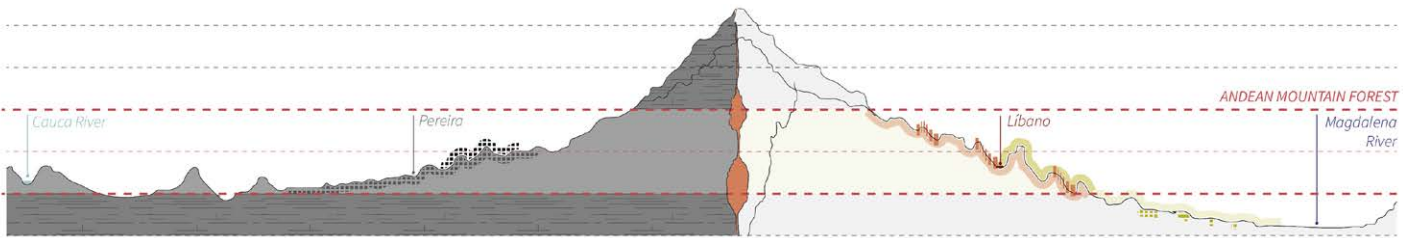
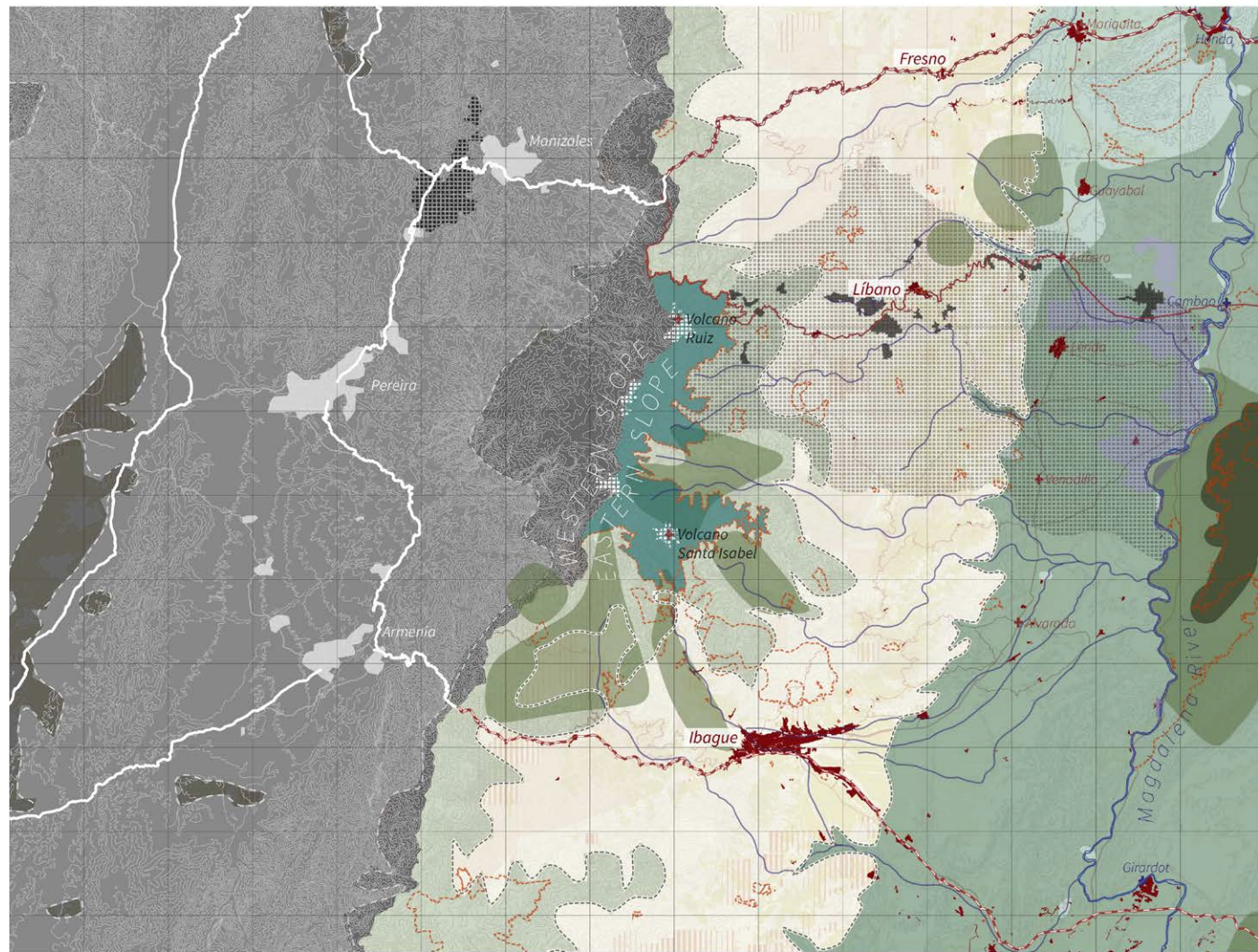
Grey Infrastructure: The slope is bracketed — to the north and south — by two primary national mobility corridors. These are not isolated lines: they are connected by a regional horizontal axis linking the territory's second-order urban nodes, effectively enclosing the slope within an infrastructural frame.



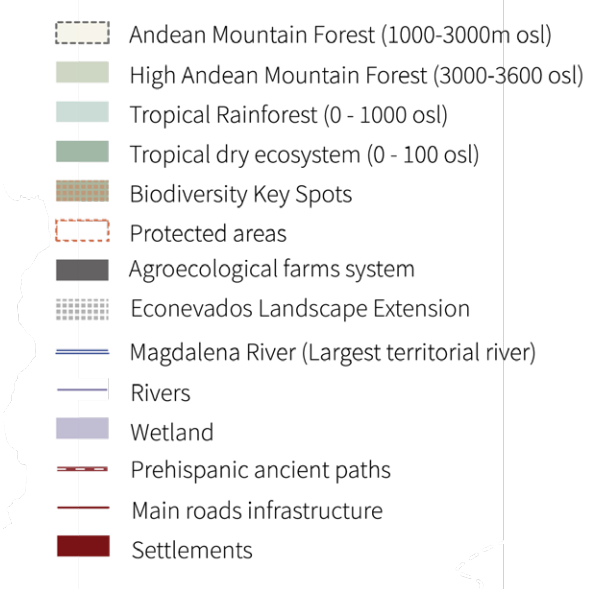
Family Agricultural Units: Microcells dispersed transversally across the entire slope, layered over the corn's land surface — registering the human scale of agricultural occupation woven through the belt.

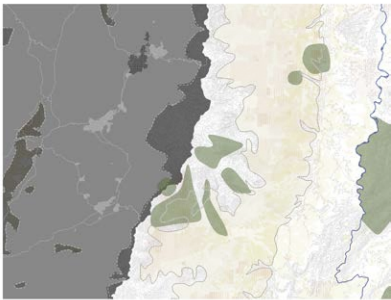
4.2 Natural forces

KEY DYNAMIC: A potential altitudinal axis

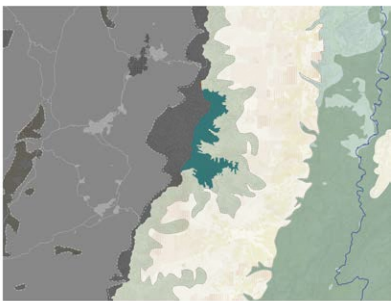


When read as a whole, the natural forces map reveals a striking backbone: a strong altitudinal axis interweaved by the spatial presence of relevant, and diverse iconical actions taking place along it. It is the only one in the focus area connecting the territory regionally in an altitudinal way, it links a diversity of helmets that have a remarkable collective memory and identity in the region and nation -Armero, Libano, Murillo-. Furthermore, it constitutes the backbone of the existing landscape plan Econevas. When read all actors individually, the picture is sharpened:

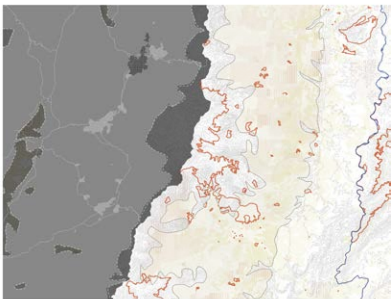




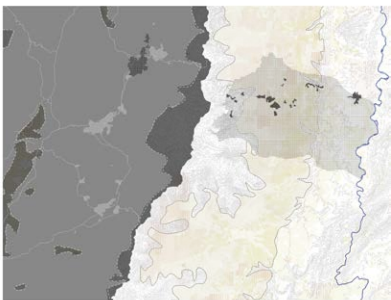
Tropical Andes Key Biodiversity Areas (BKAs): There are two nodes concentrating...



Multiecosystems: There are two nodes concentrating



Protected Areas: There are two nodes concentrating



Ecoregions: Territorial Landscape Plan: There are two nodes concentrating

Chapter’s bibliography

- *The Inquisitive Biologist.* (2025, February 11). Book review – *The Invention of Nature: The Adventures of Alexander Von Humboldt, the Lost Hero of Science.*
- *Yellowstone to Yukon Conservation Initiative (Y2Y).* (2026). *Establishing Wildlife Corridors & Habitat Protections in US & CA.*
- *How Wolves Saved Yellowstone.* (n.d.). [Audio/Video Transcript]



PART II: Landscape Project

CHAPTER 5: The threshold

Conceptual framework

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“Traditional maize is currently facing extinction — and with it, the Andean Mountain Forest is collapsing, triggering in chain the deterioration of the broader Tropical Andes hotspot.”

5.1 The Yellowstone to Yukon Conservation Initiative reference

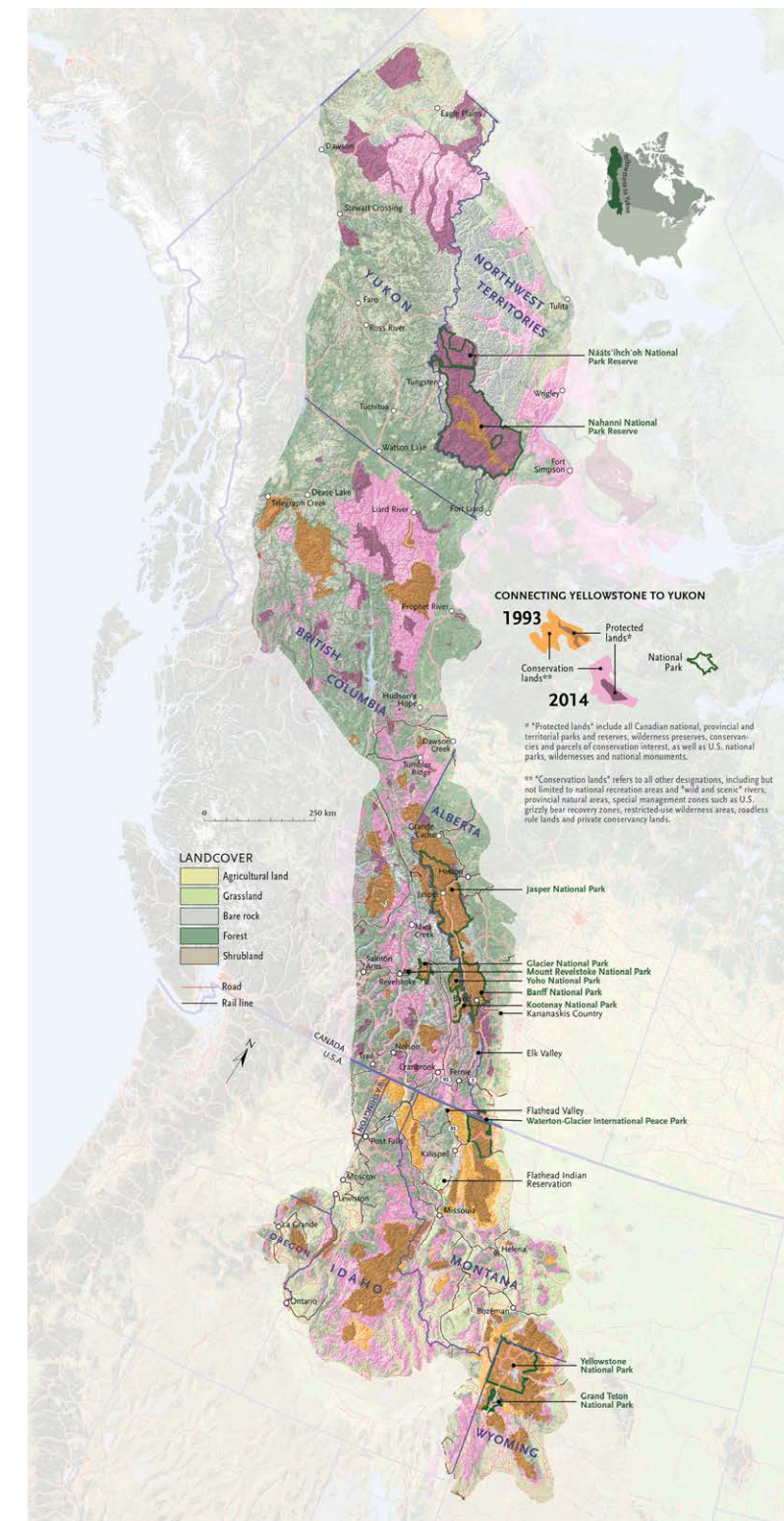
To go in detail with the project design, it is necessary to point out that any point-scale intervention pursued by this research must be embedded within a long-term management framework capable of reverberating transscalarly — one that can objectively contribute to the conservation of the Tropical Andes global biodiversity hotspot, where the Andean Mountain Forest stands as Colombia's most vulnerable ecosystem, recognizing and dealing with the complexities the study pointed out. This premise orients the second part of the research toward the voices of three foundational figures in environmental thought and action: George Perkins Marsh, Henry David Thoreau, and John Muir. Their significance lies not only in their ideas, but in their capacity to translate critical ecological awareness into concrete political and legal protections for nature — processes in which the figure of the National Park played a decisive role.

George Perkins Marsh argued relentlessly for forest protection, a legacy crystallized in his seminal work *Man and Nature*. He refused to limit environmental concern to isolated cases — no longer just a degraded patch in southern France, an arid region in Egypt, or an overfished

lake in Vermont. His argument was planetary in scope. Rather than cataloguing local occurrences, Marsh elevated environmental concern to an unprecedented and urgent scale, demonstrating that the whole Earth itself was at risk.

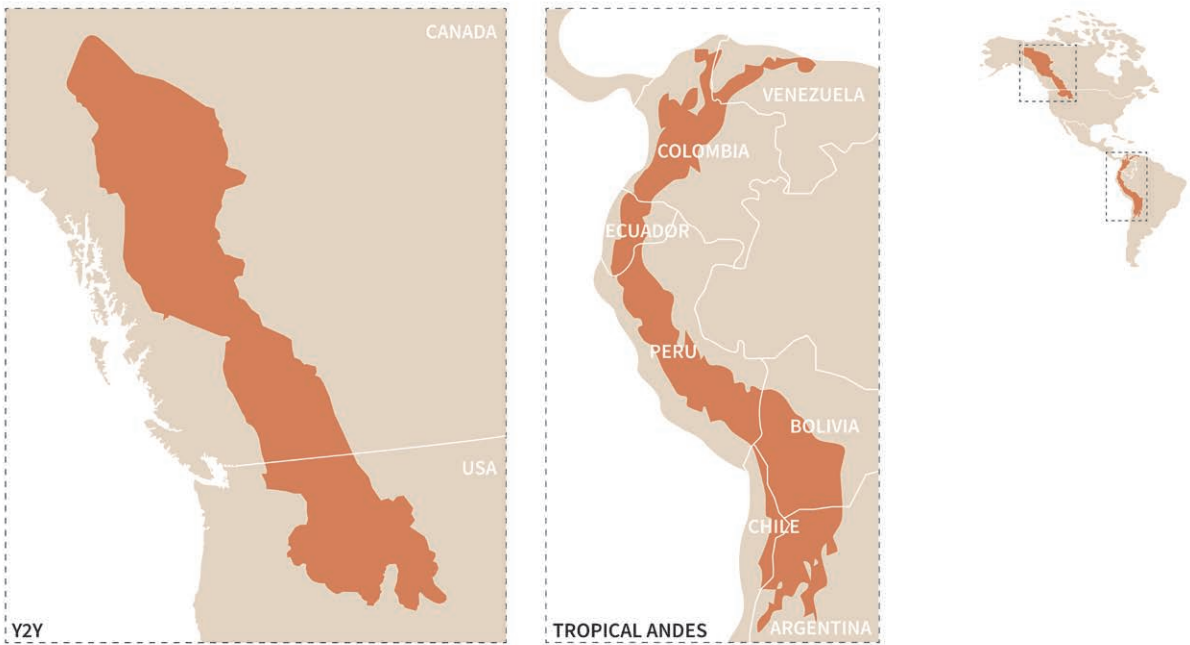
John Muir understood that only governmental structures could provide nature with lasting protection. Through hundreds of articles and dozens of books, he established himself as one of America's most influential environmental advocates. His sustained campaign for the protection of Yosemite ultimately drew the attention of President Theodore Roosevelt — who, after sharing a camping trip with Muir in Yosemite, committed to creating the national park.

These precedents converge on a clear design directive: the landscape intervention proposed by this research must operate within an institutional framework — whether designated as a park, protected area, reserve, or equivalent figure — capable of sustaining the long-term management model required to achieve transcalar impact on the Tropical Andes hotspot.



Building on the key precedents established in the previous section, this research adopts the Yellowstone to Yukon Conservation Initiative (Y2Y) as its primary strategic reference. The Y2Y project operates at a scale and engages actors whose logic closely mirrors those at play in the Tropical Andes — making it a reliable compass for formulating the project's conservation and design strategies.

Structural Resemblances Between Y2Y and the Tropical Andes Hotspot



Together, these six structural parallels confirm that the Y2Y initiative offers not merely an inspirational model, but a directly transferable strategic framework — one whose organizational logic, territorial scale, and conservation priorities align closely enough with the Tropical Andes to meaningfully guide the project’s design approach.

5.2 The Threshold

The Y2Y reference allows this research to reinforce and spatially articulate the transcalar system it is weaving together. While the practical project of this study is concentrated on one precise area of the Tropical Andes Hotspot: The Eastern slope of the Central Andean chain— comparable in role and scale to Yellowstone National Park within the Y2Y — it functions as a critical window that demonstrates how strategies developed at this scale can be expanded and replicated across the entire system.

Accordingly, the landscape design project frames its purpose within a national park figure and deploys the conceptual notion of the threshold as its spatial framework. To do so, it tracks the movement of the system’s keystone species — the organism whose presence or absence determines the ecological fate of the whole.

The Keystone Species as Spatial Logic
-The Wolf in Y2Y

Within Yellowstone National Park, the wolf operates as the keystone species of the entire Y2Y region. Its seasonal migration from south to north produces cascading effects across the system — most critically, maintaining the predator-prey balance that sustains the ecological integrity of the whole corridor. As a direct consequence, wolf migration paths became the primary cartographic resource defining the wildlife corridors that structure the Y2Y design. This was made evident by the wolf’s near-extinction in 1926, a period during which the entire Yellowstone ecosystem began to collapse. When wolves were reintroduced in 1995, they triggered a trophic cascade — the restoration of the entire food web through the return of a single apex predator.



	Yellowstone to Yukon (Y2Y)	Tropical Andes Hotspot
Scale	3,400 km corridor, from the Greater Yellowstone Ecosystem to the Yukon Territory	4,200 km span across northwestern South America
Structural Spine	Defined by the Rocky Mountains range	Defined by the Andean Mountain Range
Critical Patches	Core wildlife habitats distributed across the corridor	Key Biodiversity Areas (KBAs) distributed across the hotspot
Ecological Integrity	Recognized as the largest intact mountain system on Earth; boundaries designed to keep the system wild	Recognized as the planet’s greatest biological hub; boundaries designed to restore, protect, and conserve its threatened ecosystems
Indigenous & Political Geography	Overlaps 75+ Indigenous territories; spans 5 U.S. states, 2 Canadian provinces, and 2 territories	52% of its surface inhabited by indigenous peoples; spans 7 countries: Venezuela, Colombia, Ecuador, Peru, Bolivia, and the tropical portions of Argentina and Chile
Wildlife & Species Priority	Provides continuous space for wide-ranging species — grizzly bears, wolves, elk, caribou, and wolverines — to roam, feed, and reproduce	Urgently aims to restore critical habitat to prevent the extinction of 183 endemic priority species: 82 amphibians, 32 birds, 11 mammals, 10 reptiles, 41 plants, and 7 fish

-Traditional Maize in the Tropical Andes



In the context of this project, the research identifies traditional maize as the equivalent keystone species of the Andean Mountain Forest system. Among the very few species capable of moving across the full the region, maize holds the same systemic role the wolf holds in Y2Y: it is an agent capable of recovering, sustaining, and conserving the ecological balance of the whole system.

Just as wolf migration paths defined the spatial logic of Y2Y, the soil suitability of traditional maize within the Andean Mountain Forest becomes the primary cartographic resource defining the threshold of this landscape design project.

The Parallel and Its Implication

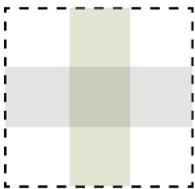
	Y2Y — Yellowstone	Tropical Andes — This Project
Keystone species	Wolf	Traditional Maize
Systemic role	Predator-prey balancer	Soil-ecosystem balancer
Crisis moment	Near-extinction, 1926	Ongoing extinction pressure
Absence consequence	Ecosystem-wide collapse	Andean Mountain Forest collapse > Tropical Andes collapse
Restoration mechanism	Reintroduction > trophic cascade	Reintroduction > restoration in cascade
Spatial cartography resource	Wolf migration paths > wildlife corridors	Maize highest soil suitability > design threshold

Both species demonstrate the same principle: their absence triggers systemic collapse; their presence restores systemic balance.

This research assumes that traditional maize is currently facing extinction — and that with it, the Andean Mountain Forest is collapsing, triggering in chain the deterioration of the broader Tropical Andes hotspot. It follows, by direct analogy, that the reintroduction of traditional maize holds the potential to activate a comparable restoration cascade — becoming both the ecological and spatial foundation of the project's design purpose.

The Threshold Site

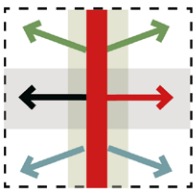
The location of the threshold is defined through three sequential steps:



REGIONAL PAK AREA



THRESHOLD



CONNECTION

1. Defining the Park's Area

The park's perimeter is established by overlapping the two ruling dynamics identified in Chapter 4:

- A horizontal dynamic — converging the most intense anthropic forces across the territory
- An altitudinal dynamic — linking the most significant natural forces along the altitudinal gradient

The junction between these two dynamics produces a primary influence area, whose boundary directly traces the park's perimeter.

2. Placing the Threshold

Within the park's perimeter, the threshold is positioned as a strategic belt at the centre of the park's area structured in two layers:

- An outer layer that spatially encompasses the zone of highest anthropic pressure along the horizontal dynamic
- A core corridor at its centre — a parallel band matching the area of highest traditional maize soil suitability within the park

This positioning ensures that the threshold sits at the heart of the park's perimeter, allowing its ecological and spatial impact to propagate proportionally across the entire park area.

3. Multiscale Connection

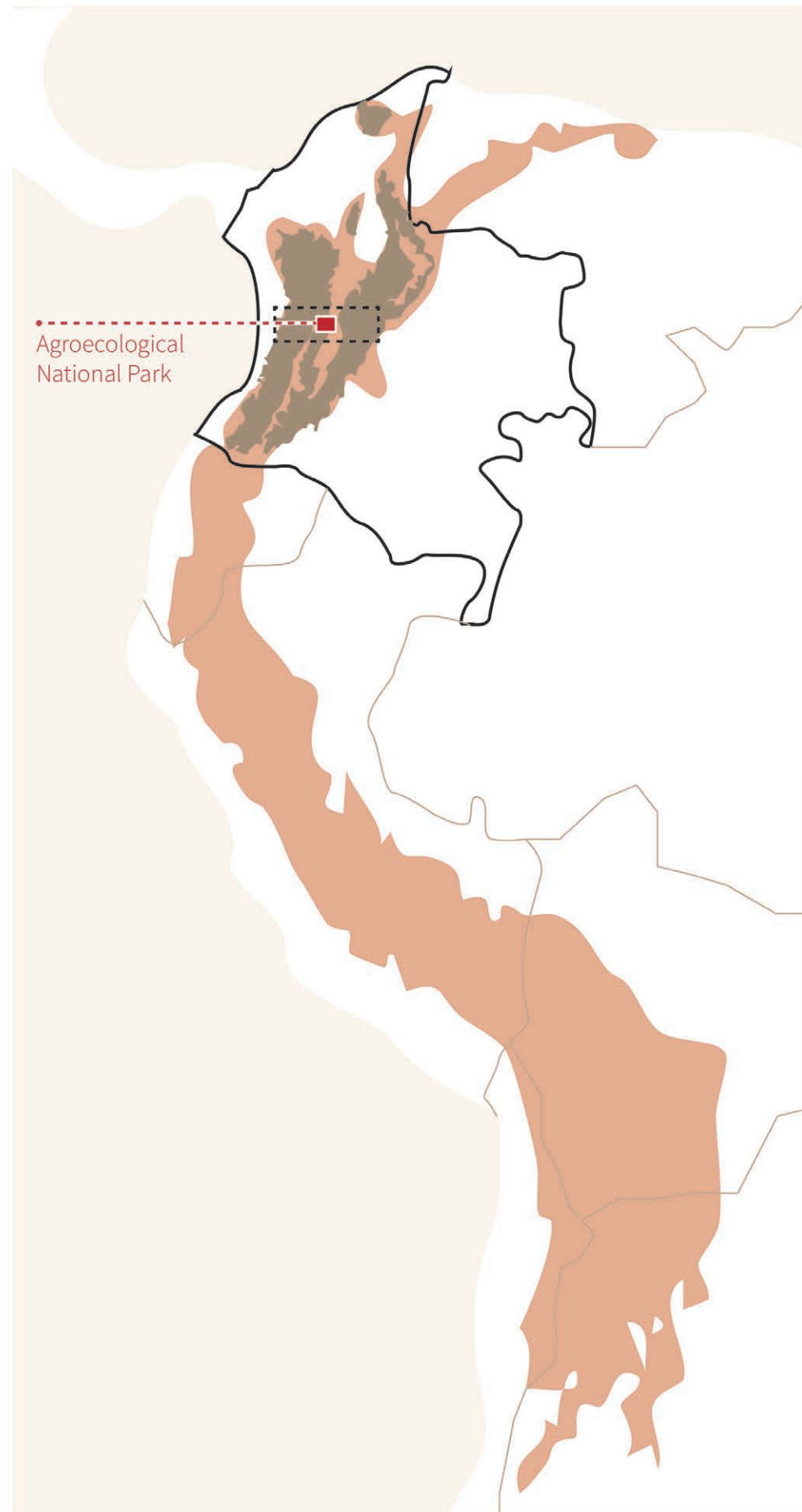
The threshold is spatially bounded by two primary national roads and permeated by a multimodal mobility infrastructure — integrating blue (water), green (ecological), and grey (built) networks. This layered connectivity ensures the threshold's potential effects reverberate across multiple scales and externalities of the whole system.

CHAPTER 6: Corn cultural landscape

An agroecological National Park

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“By saving native maize from extinction, this project does not merely preserve a crop — it recovers a culture.”



According to Carl Sauer, a cultural landscape emerges when a cultural group — acting as the agent — transforms a natural area over time through their shared learning, habits, skills, and preferences. In this framework, culture, not the individual, is the true geographic agent shaping the land.

Translated into our research, maize becomes that agent: its presence has interweaved a culture that historically defined the habits, skills, and identity of human populations across this territory. By saving native maize from extinction, this project does not merely preserve a crop — it recovers a culture: the very force capable of regenerating, protecting, and conserving the Andean Mountain Forest.

The national park proposed by this research will give form to a Corn Cultural Landscape. As the return of native maize takes hold over the coming years, this landscape will become the living record of a potent culture — one cultivated for millennia within our ancestral territory yet increasingly buried under accumulating layers of erasure.

To give maize the agency in the territory in order that it is able to recover the culture, and with it the forest, the spatial design defines its first lines translating the conceptual framework:

1. PARK DELIMITATION

Cardinal limitators are keystones:
North-South: Primary national infrastructure
East: Largest national river
North: Tallest national mountain

2. MAIZE THRESHOLD

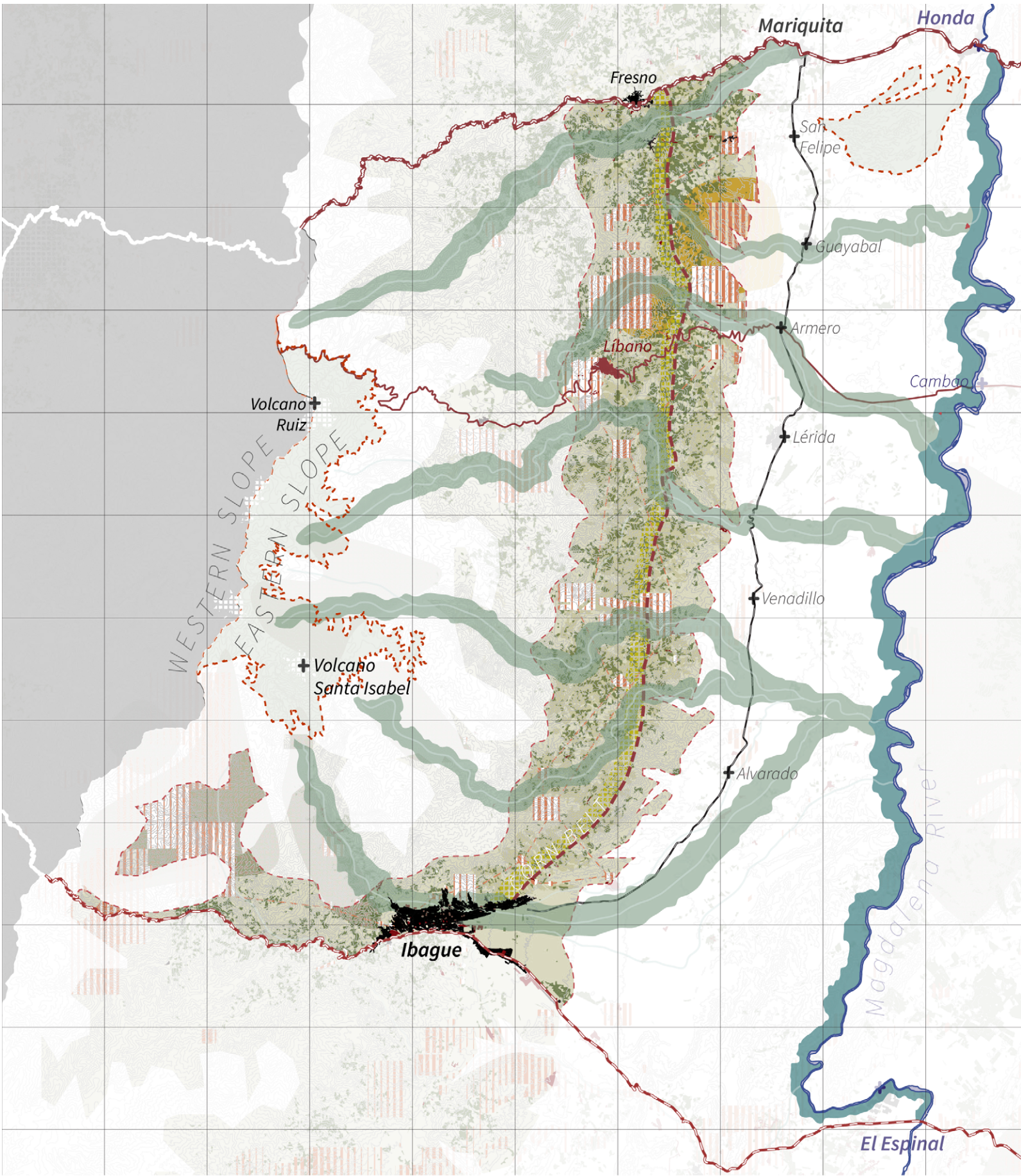
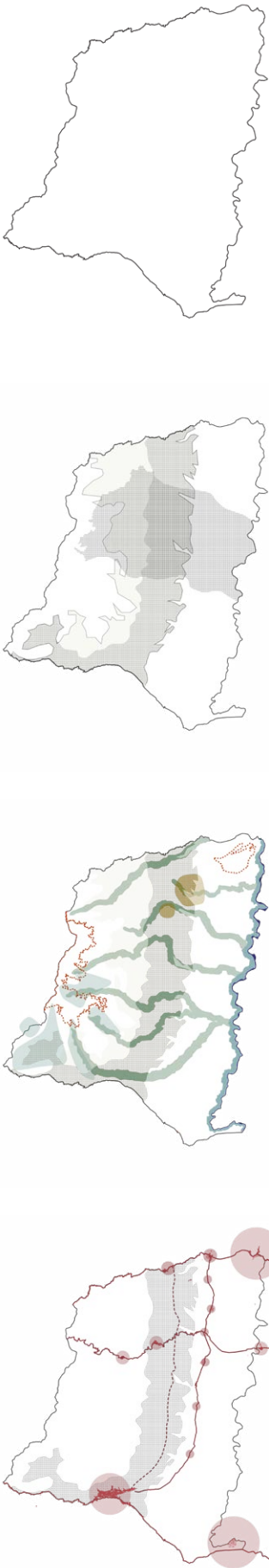
An strategical intermedium element (park core) that
balances, improves, potentiates the whole area

3. ECOLOGICAL NETWORK & HOTSPOT

A rich natural system permeating the threshold:
Green/Blue corridors
Two Key Biodiversity Hotspots

4. SYSTEM MOBILITY CONNECTION

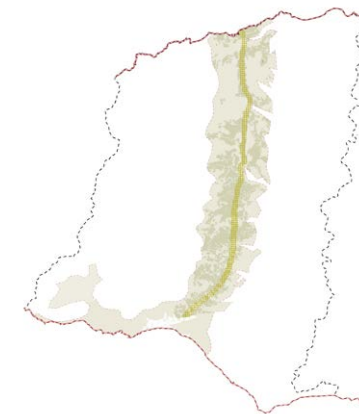
Three lines interweaving all key antropogenic actors:
Altitudinal axis: multiscalar & multiecosystemic connector
Lower horizontal line: microlocal actors connector
Threshold line: A new line for corn facilities connection
& managment



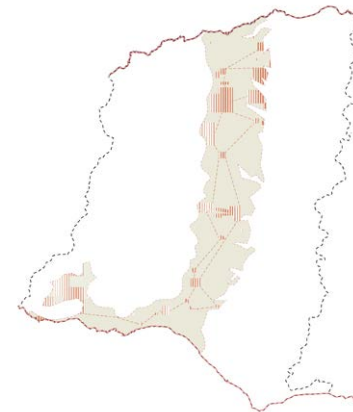
It is essential to clarify that by having the boundaries of the national park carefully defined by national landscape elements of significant ecological, social, and cultural value, the corn threshold is well contained and protected. It is the park's backbone where the practical design perse is landed and executed—the projectual corridor where design interventions are grounded through a system of acupuncture strategies, able to influence and extend their impact transcalarly.

6.1 The corn threshold: A restorative belt reorganizing the territory

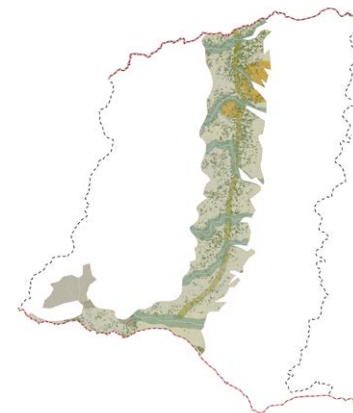
The threshold has 15 km wide and 90 km long. It operates as a strategic belt at the centre of the park, structured around four acupuncture strategies that together form a system of multidimensional regeneration, protection, and conservation; its influence ratio effectively has a restorative effect on the potential externalities of the whole park. Each strategy is defined by a specific role and presence of maize — its motion through the territory becomes the organizing principle that connects all key actors identified by the research in previous chapters.



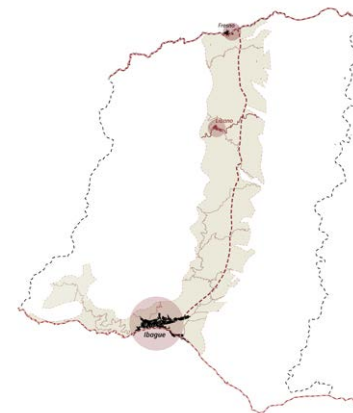
1. NATIVE CORN BELT



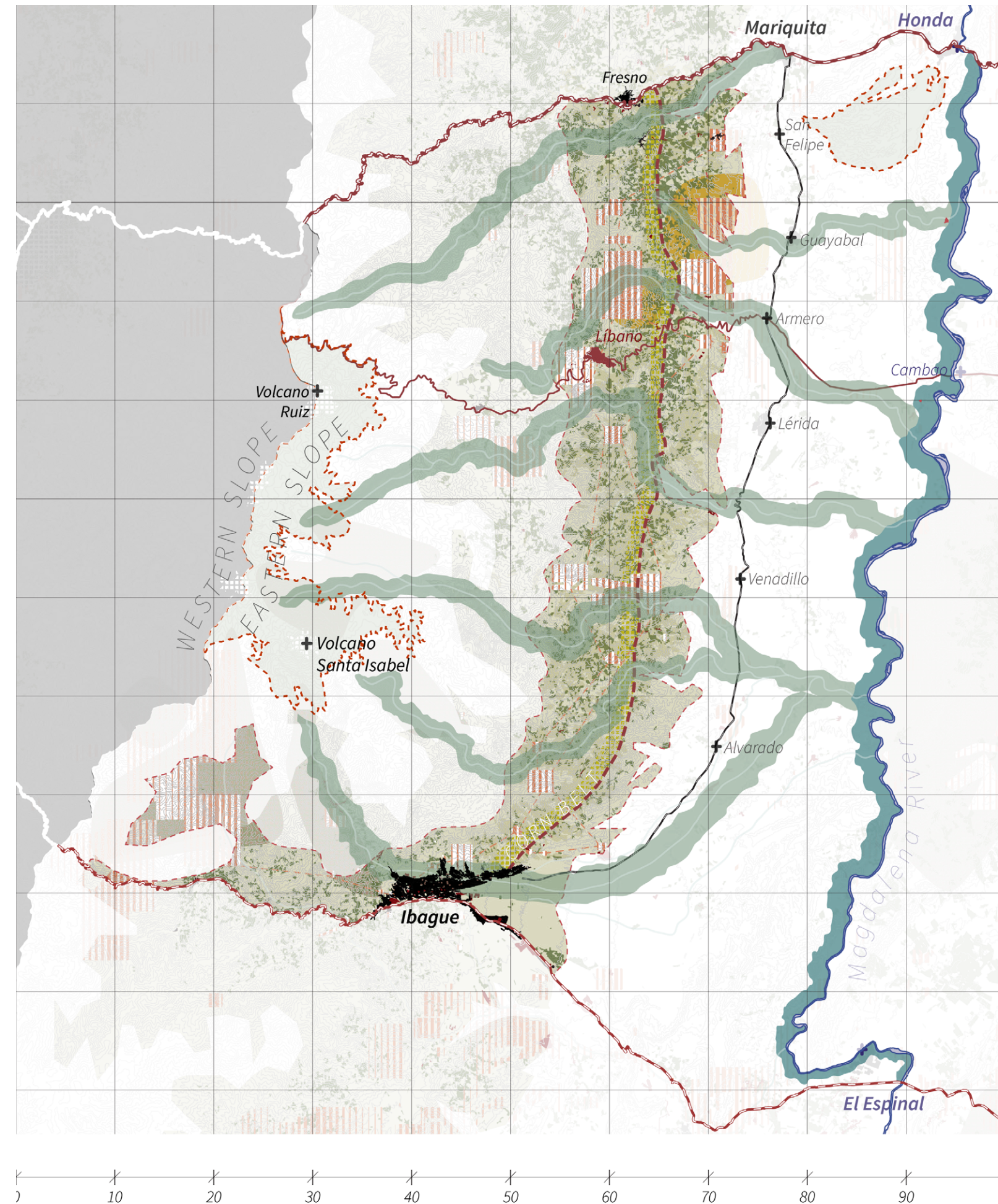
2. RECLAMATION EPICENTERS



3. LANDSCAPE REFORESTATION HUBS



4. MULTIMODAL MOBILITY SYSTEM



Four acupuncture strategies:

1. **Native Corn Belt:** This is the core in which the constant maize presence will be perform. Designed as a national hub for native maize evolution, it revives the ancestral Chagra practice — cultivating seed diversity through natural selection. The belt's boundaries are determined by tracking the highest soil suitability for maize cultivation, which naturally forms a continuous horizontal band across and at the centre of the threshold.
2. **Reclamation Epicentres:** The active mines enclosed within the threshold are its most strategically significant actors. By already being subject to public and private discussions among national and international entities, they represent the most viable sites for a transitional indigenous land restitution model — legally, socially, and ecologically.

The strategy begins within the active mining context itself: indigenous communities will be invited to heal mining tailings through maize. Here, the Chagra is not for self-consumption but dedicated to heavy metal uptake and a community-owned gold phytomining process. This establishes the legal and cultural framework through which indigenous peoples begin to reappropriate the territory.

Maize presence here is therefore temporal: once the land is remediated, it yields entirely to forest regeneration.

3. **Landscape reforestation hubs:** These are existing landscape elements within the threshold, organized under two categories:

Human-free zones — Blue-green corridors and Key Biodiversity Areas (KBAs) within the threshold are dedicated entirely to wildlife. Drawing on E.O. Wilson's theory of island biogeography — which holds that even well-protected natural parks inevitably lose species unless reserves expand in size — these zones are designated as strictly human-free natural reserves, allowing species number and diversity to increase.

Agroecological zones — Existing coffee plantations and Family Agricultural Units (UAFs) within the threshold become entry points for dialogue with the existing Econevedos project, gradually integrating them into its expanding agroecological network, with the aim of bringing the entire threshold under this model.

In both categories, maize presence follows an intermittent dynamic: the Chagra is introduced first to restore soil and invite the forest back. Once the forest is established, maize appears only sporadically — mimicking natural forest disturbances through clearings — to enrich the soil and create space for species diversity and food forest systems to thrive.

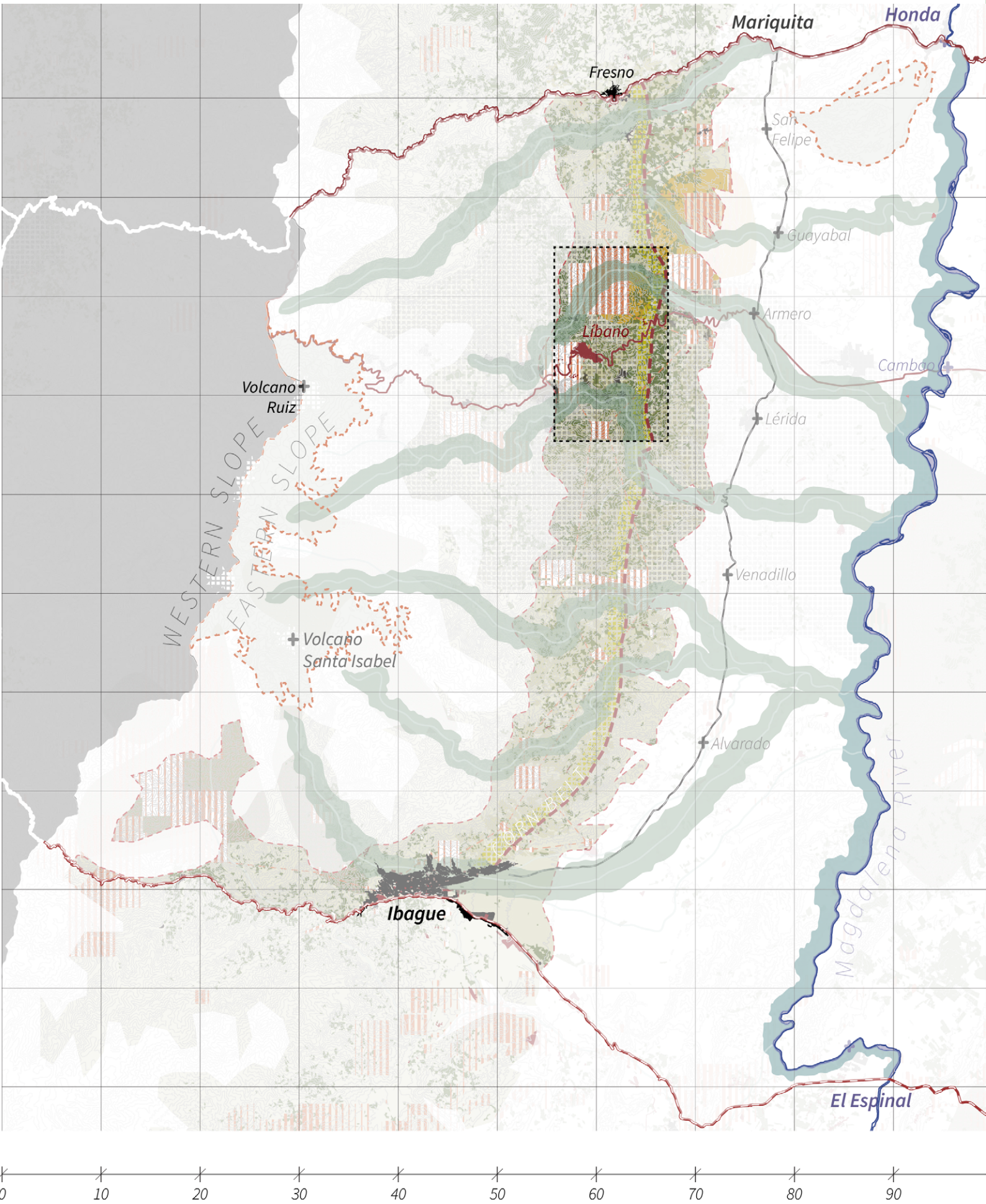
4. **Multimodal mobility system:** The threshold serves as a national reference for maize identity and living culture and must therefore be legibly connected to the wider park, who itself has a transcalar link. Two main mobility lines structure this connection:

Regional line — Following the existing altitudinal axis, this route crosses the park's full range of ecological complexity, linking the eastern and western boundaries and ensuring regional-scale connectivity.

Local line — A multimodal route tracing existing paths along and parallel to the Corn Belt, connecting all micro-local actors within the threshold and across the park's area.

Maize holds an omnipresent role along this infrastructure, permeating the core of the threshold and reinforcing its identity as the connective tissue of the entire system.

6.2 The junction: A neurological point to land the pilot project



To understand the threshold's strategies in greater depth, the proposal shifts scale — zooming into the junction where the two main mobility lines of the infrastructure converge. This junction is not arbitrary: it is the point where the regional altitudinal axis and the local multimodal line meet, making it the most interconnected and representative site within the threshold.

This change of scale serves a precise purpose. Rather than reading the four acupuncture strategies as abstract bands across a territorial map, the zoom-in allows each strategy to be understood in its spatial and operational detail — how it is designed, how it functions on the

ground, and how the different actors, ecologies, and maize presences interact within a tangible, defined area.

In this sense, the junction acts as a microcosm of the whole: a site where the Native Corn Belt, the Reclamation Epicentres, the Reforestation Hubs, and the Mobility System are all simultaneously legible and materially present. What the territorial scale establishes as a system, this scale reveals as a lived landscape — one where the return of maize, the restoration of land, and the reappropriation of culture can be seen, measured, and experienced.

Chapter’s bibliography

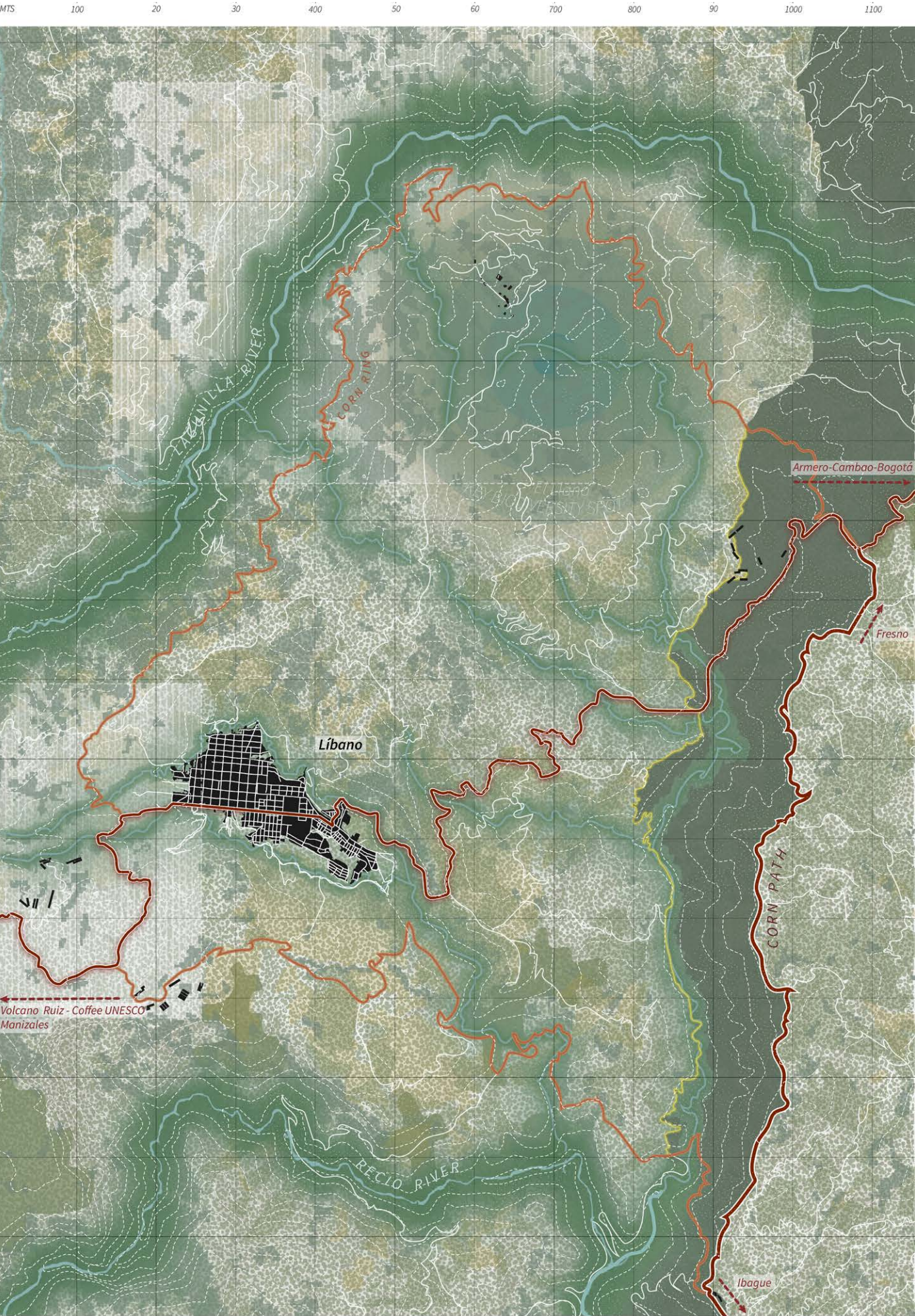
- Castro Herrera, G., & Urquijo Torres, P. (Eds.). (2025). *Carl O. Sauer: una antología desde nuestra América*. Panamá: Centro de Investigación, Formación y Emprendimiento (CIFEm). ISBN: 978-9962-8601-0-5
- McHarg, I. L. (1969). *Design with Nature*. New York, NY: The Natural History Press
- Sabaté Bel, J. (n.d.). *Parc Agrari del Baix Llobregat / Parc Agricole du Baix Llobregat*. (Excerpted from *Quaderns d'arquitectura i urbanisme*), pp. 196–197

CHAPTER 7: Strategical plan

A fractal to read the territorial system

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“The Market gives the Corn Belt
an economy; the Seed Bank
gives it a scientific memory;
the Reserve Centre gives it
institutional sovereignty; the
Biofuel Hub gives it energetic
autonomy.”



The strategic plan operates at the scale of the junction — the point where the two main mobility lines of the threshold infrastructure converge. This site is not chosen arbitrarily. It is the most interconnected node within the 15 km × 90 km threshold: the place where the regional altitudinal axis meets the local multi-modal route, where all four acupuncture strategies are simultaneously present, and where every actor traced by the research — from global policy frameworks to microlocal land uses — converges into a single, legible territory. In this sense, the junction functions as a microcosm of the whole threshold, and

by extension, of the park itself. What is established at territorial scale as a system of four strategies, this plan reveals at ground level as a lived landscape — one where the return of native maize, the restoration of degraded land, and the reappropriation of indigenous culture become spatially measurable and experientially present. Because the junction contains all four strategies in their full complexity, it can be read fractally: the logic that governs this small area is the same logic that will govern the entire park. To understand the junction is to understand how the project behaves at every scale.

- Primary Green-Blue Corridors
- Secondary Green-Blue Corridors
- Key Biodiversity Spot
- Econevedos agroecological farms
- Coffee agroforestry
- FAU Agroforestry
- Agroforestry expansion
- Corn Belt
- Axis - multimodal line
- Corn - multimodal line
- Ring line
- Valley line path
- Mines-Epicenters
- Settlements

7.1 A 50-year execution timeline



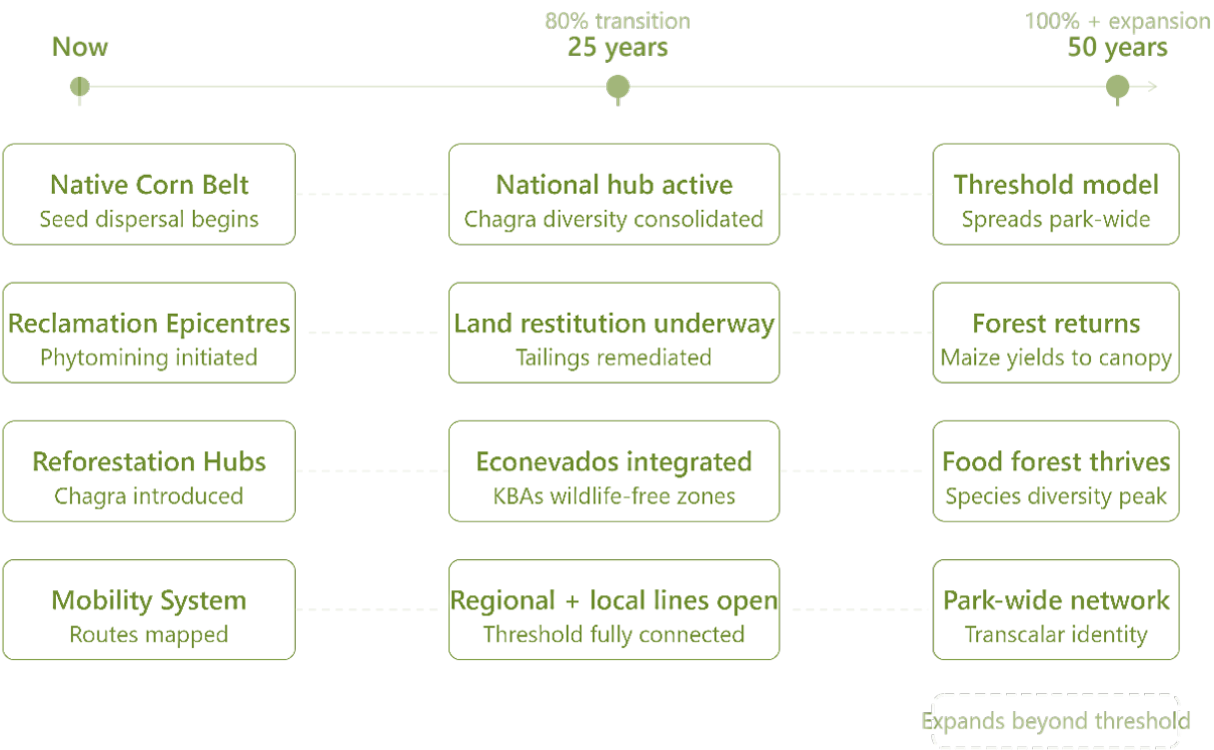
For the threshold to reach its full restorative potential — becoming a protected, conserved, and self-sustaining agroecological system — the strategic plan is structured across a 50-year implementation horizon.

This timeframe reflects the actual pace of ecological recovery primary under maize agency, and also of institutional negotiation, and of cultural transition. Each of the actors identified by the research — active mines, land restitution for indigenous communities, coffee farmers, blue-green corridors, KBAs, UAFs, and mobility infrastructure — occupies a distinct starting condition and requires a distinct transition path. The 50-year arc gives each actor the time it needs to move from its current state into its assigned role within the agroecological system.

The timeline is structured around two spans:
At 25 years, all actors are expected to have completed at least 80% of their transition. The Native Corn Belt is fully consolidated as a functioning national hub for native maize diversity. The Reclamation Epicentres have completed their phytomining cycles and are yielding to forest regeneration. The Reforestation Hubs — both the human-free wildlife corridors and the agroecological UAF zones — are integrated into the expanding Ecorevados network. The mobility system is adopted to operate at both regional and local scales.

At 50 years, the transition reaches 100% across all actors within the threshold. More significantly, the restorative logic of the threshold begins to extend outward — into land uses and territories that were not the primary subject of this research but that share ecological and cultural adjacency with the park. The threshold, by that point, no longer functions only as a defined intervention zone: it functions as a model, a precedent, and a seed for a wider territorial transformation.

This is the transcalar ambition of the strategic plan. The junction proves the logic; the threshold embeds it; the park and its surrounding territories absorb it over time.

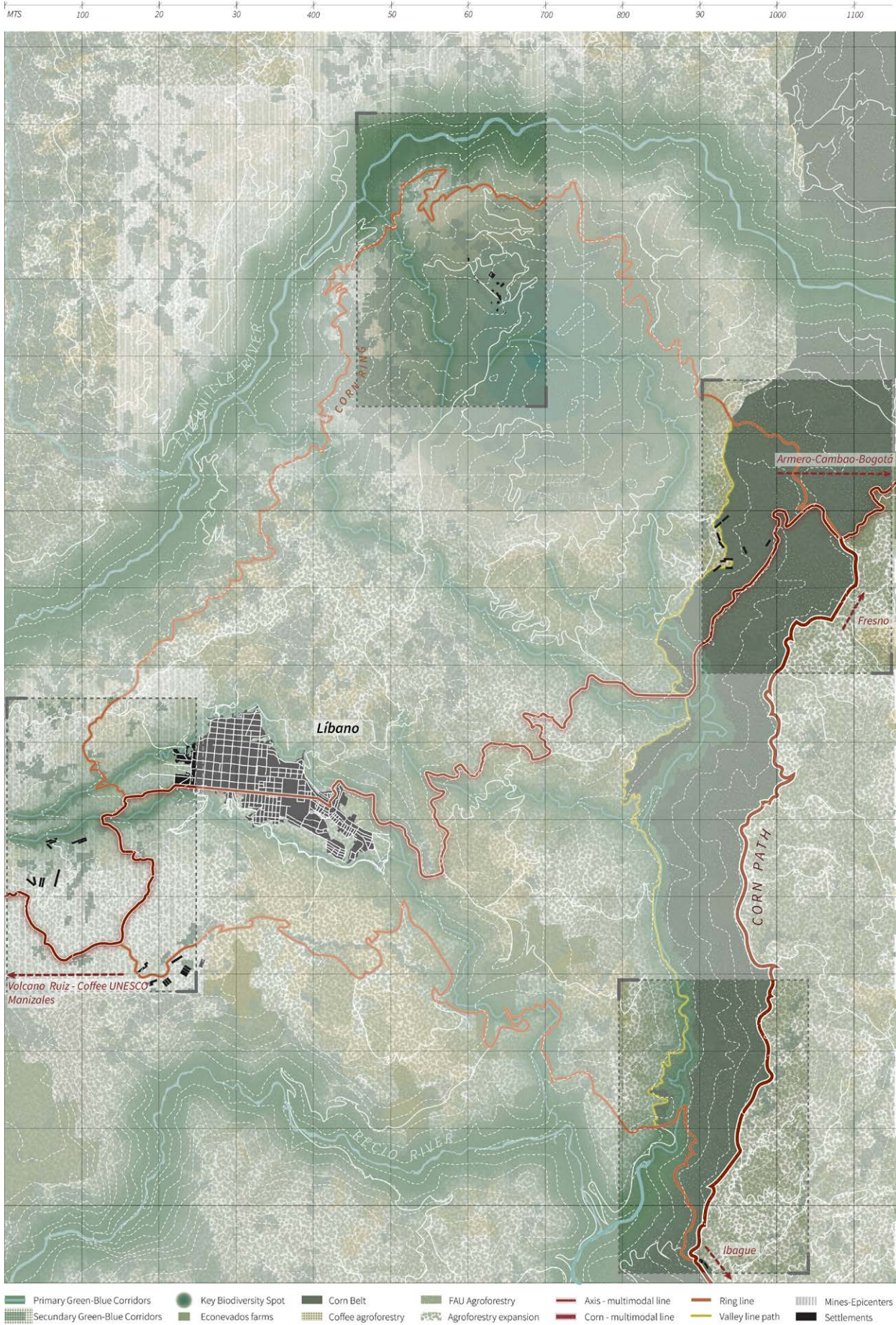


7.2 Isotropic system
A non-hierarchical network of four maize programs

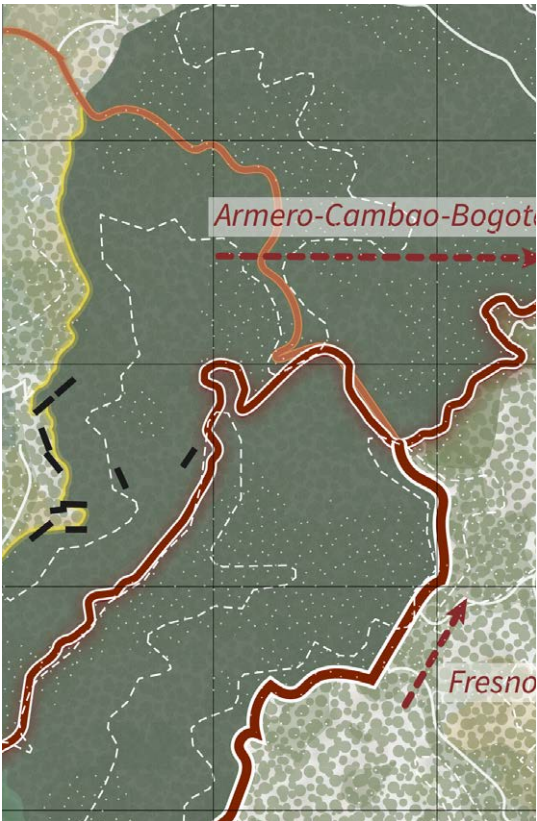
The isotropic system is a network structured around horizontal hierarchies: four territorial actors, each assigned a distinct maize program, each equally indispensable to the functioning of the whole. The term isotropic is used here in its precise sense — a system that exerts equal force in all directions, with no single node subordinate to another. No program leads; none follows. Together they form the operational and cultural backbone of the Corn Cultural Landscape, sustaining it economically, socially, ecologically, and institutionally across generations.

Each of the four actors is located where it is for specific territorial reasons — soil conditions, existing infrastructure, proximity to settlement nuclei, mine activity, mobility access — and each is designed to perform a role that no other actor in the system can replace. Their interdependence is what makes the system resilient.

Collectively, the isotropic system is the mechanism through which native maize achieves its fullest expression: not as a crop, not as a symbol, but as the organising principle of a living cultural landscape with the capacity to become a national reference and an international model for agroecological territorial governance.



1. Regional Organic Maize Market

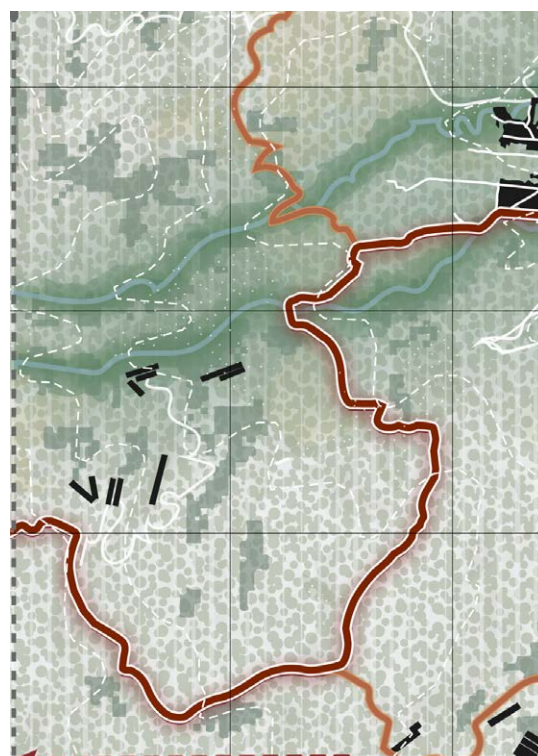


The first actor in the isotropic system is dedicated to the economic and cultural representation of native maize in all its dimensions of human consumption — above all, food. It functions as a regional market through which the diversity of native varieties cultivated across the Corn Belt reaches producers, communities, and visitors, consolidating a local and regional economy rooted in the grain's cultural identity.

This program is located at the junction where the Native Corn Belt is crossed by the threshold's two main mobility lines — the regional altitudinal axis and

the local multimodal route — as well as two additional local logistical lines that structure the energy and material flows of the strategic plan. This convergence of infrastructure makes the junction the most viable and most visible site for a market of regional reach. The presence of an existing settlement nucleus and associated industrial infrastructure in this area further reinforces its suitability, offering built allies — storage, processing, distribution — that the market program can integrate rather than replace.

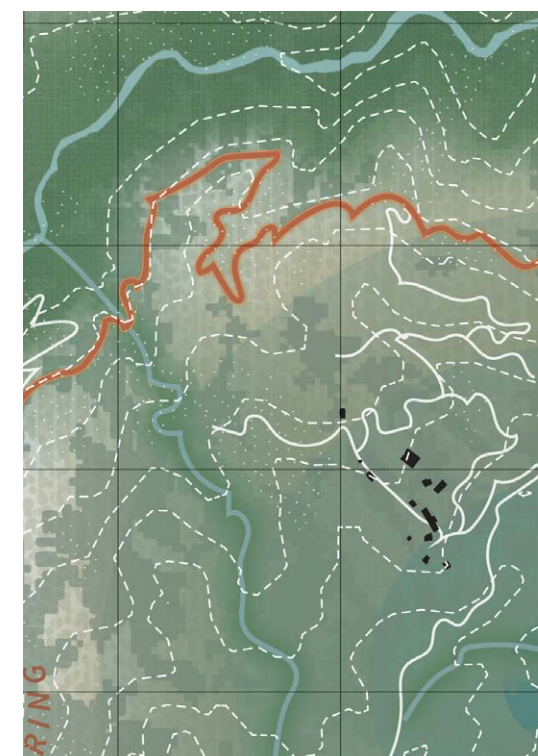
2. National Maize Seed Bank



The second actor is a scientific research centre and living seed bank dedicated to recording, preserving, and tracing the transformation that native maize has exerted on this territory across millennia — and to projecting the agency it can recover if its diversity is restored. Drawing on the model of the Banco de Germoplasma del Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT) in Mexico — one of the most significant germplasm conservation institutions in the world — this program operates as both archive and laboratory: a place where seed diversity is not only stored but actively studied, cultivated, and reintroduced into the Chagra practice across the threshold.

This actor is located on the surface area belonging to the active mine closest to Líbano, the largest settlement nucleus in the park. This proximity is strategically significant on two levels. First, it opens a concrete basis for dialogue around the mine's transition toward a new land use — positioning the seed bank as the cultural and scientific successor to an extractive economy. Second, Líbano's scale and logistical capacity — its position along the park's main altitudinal axis, its existing infrastructure and institutional networks — gives this program the viability it needs to operate at national reach.

3. Regional Indigenous Resguardo

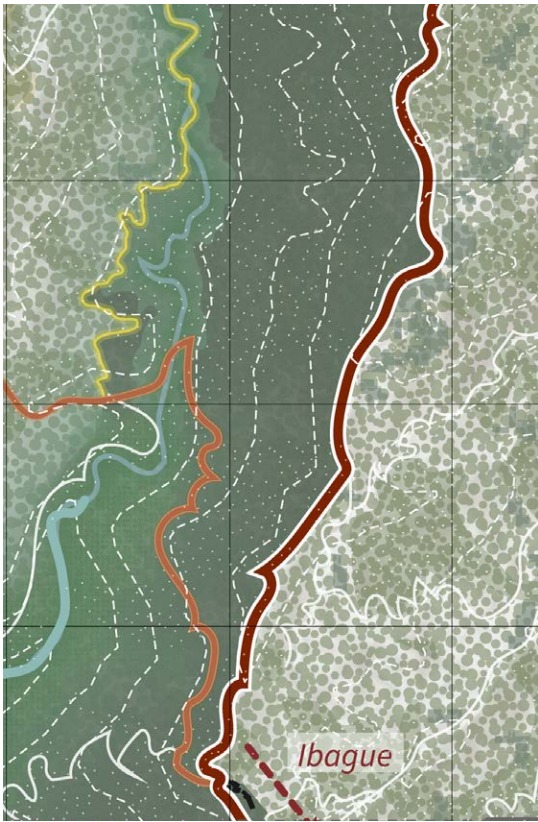


The third actor is dedicated to hosting the administrative and operational centre of the regional indigenous resguardo — the institutional node through which all processes of land restitution within the threshold are managed, coordinated, and put into practice.

This program is located at the site of the largest and most ecologically conflicted active mine in the entire park: a mine whose scale and spatial overlap with the threshold's most significant Key Biodiversity Areas (KBAs) make it the most urgent and most consequential site of intervention in the strategic plan. Its existing infrastructure and facilities — built for extraction — are conceived here as the future physical substrate of collective indigenous ownership. Under a land restitution framework, these structures become the headquarters from which indigenous communities lead the management of the threshold as a whole: defining its conservation protocols, overseeing phytomining and ecological recovery processes, and holding the legal and cultural authority over a territory that has historically been taken from them.

This is not only an ecological act. It is a political one. Placing the reserve centre here — at the epicentre of the park's most damaging extractive presence — is a deliberate statement about who the threshold belongs to, and who is best positioned to care for it.

4. Biofuel production hub



The fourth actor is dedicated to the transformation of maize agricultural waste — stalks, husks, cobs — into biofuel, supplying the energy needed to sustain the operational logistics of the park. By using what the Corn Belt's cultivation produces as byproduct, this program introduces a closed-loop energy model that eliminates competition between food production and fuel production, and that roots the park's energy sovereignty in the same agroecological cycle that defines its identity.

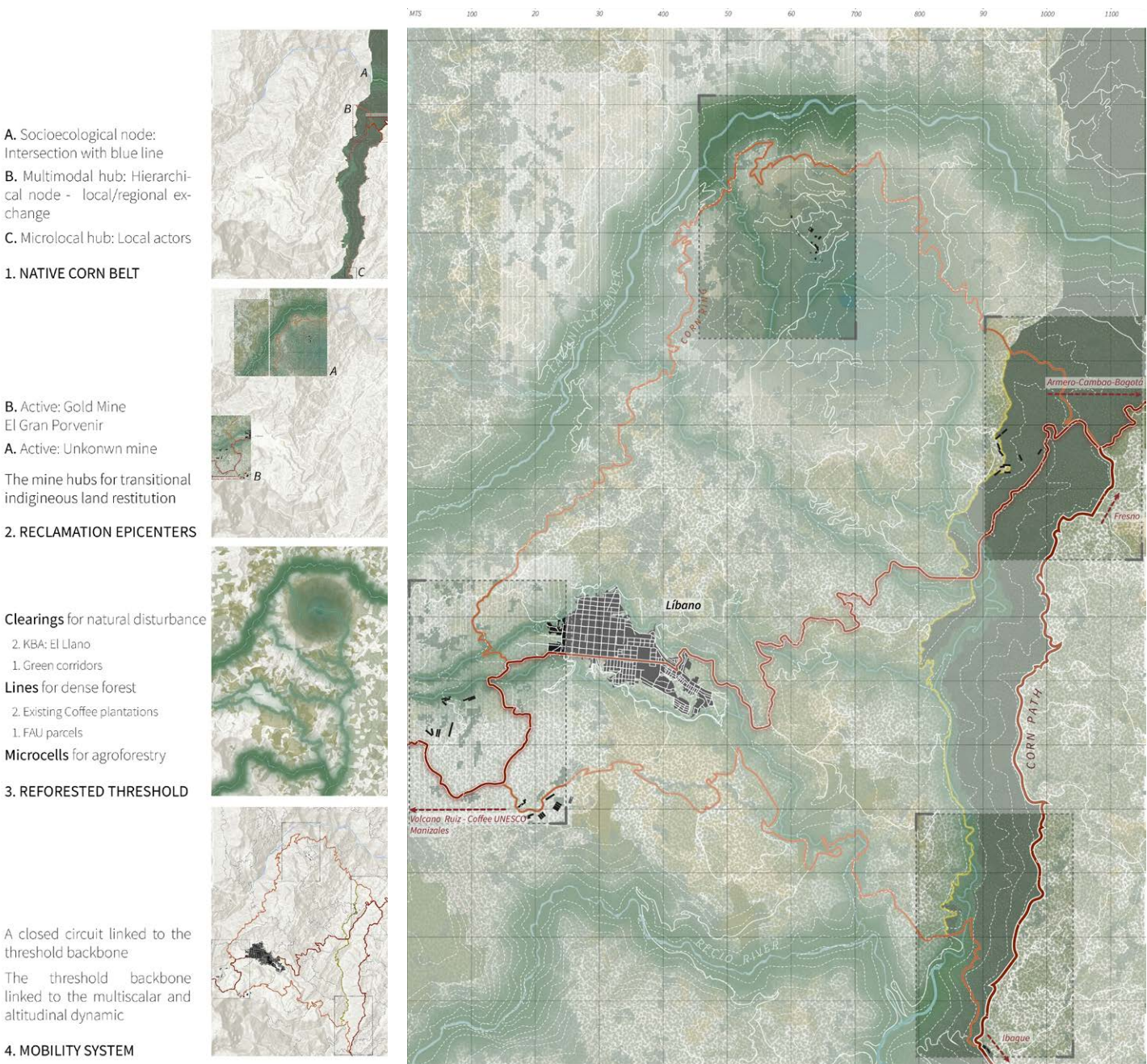
This hub is located at Tierradentro, the most remote settlement nucleus in the park. That remoteness is precisely the rationale. A strategic plan that does not reach its most peripheral nodes risks reproducing the same spatial hierarchies it seeks to dismantle. By assigning Tierradentro a founding role in the isotropic system — one that responds directly to its geographic conditions and serves the entire park's infrastructure — the plan ensures that no part of the territory is invisible, and that the benefits and responsibilities of the Corn Cultural Landscape are distributed across its full extent.

The four actors of the isotropic system do not operate in sequence. They operate simultaneously, each reinforcing the others: the Market gives the Corn Belt an economy; the Seed Bank gives it a scientific memory; the Reserve Centre gives it institutional sovereignty; the Biofuel Hub gives it energetic autonomy. Together, they are the conditions under which a Corn Cultural Landscape becomes not only possible, but inheritable.

7.3 Maize multifunctional agency: Key restorative actions

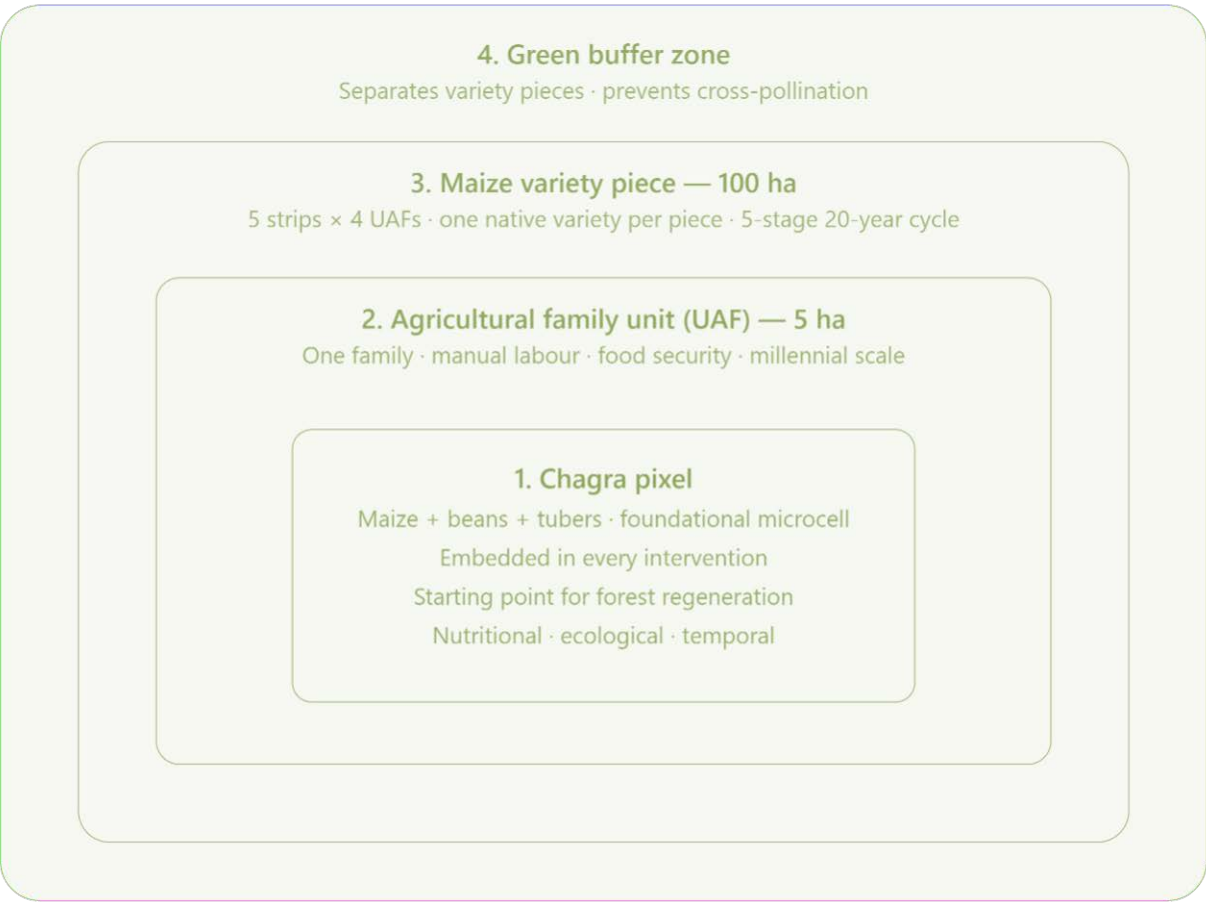
Diving into the four acupuncture strategies

This subchapter elaborates in more detail how the four acupuncture strategies defining the threshold system, by looking at them through the fractal the strategical plan performs.

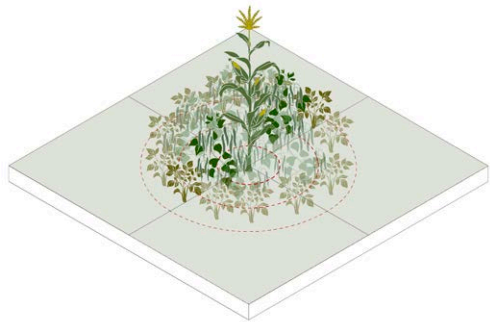


Native Corn Belthe

The Native Corn Belt strategy is built on four nested, interdependent elements — each one a prerequisite for the next — that together form a system for regenerating the Andean Mountain Forest through indigenous agroecological knowledge



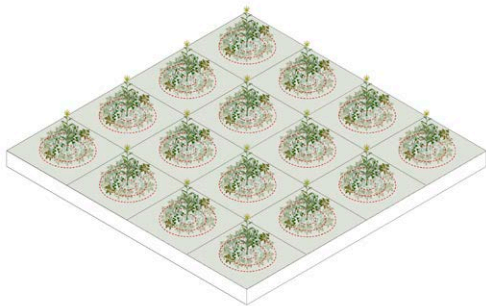
1. CHAGRA PIXEL: The foundational microcell of maize, beans, tubers.



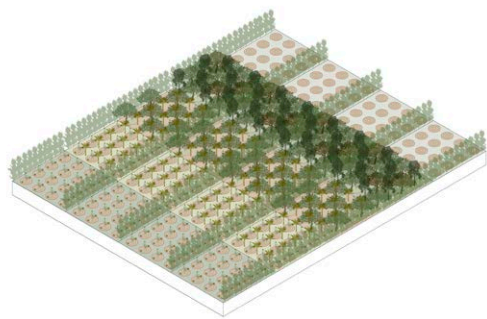
The Chagra Pixel is the irreducible unit of the entire strategy. Rooted in indigenous cultivation practice, it places the maize plant at the centre of a polyculture of beans and tubers — replicating the ecological logic that Andean communities have applied for millennia. This microcell is embedded in every intervention across the belt, regardless of scale. Without it, there is no forest regeneration. It provides the nutritional, ecological, and temporal foundations the project depends on: food production, soil enrichment, biodiversity support, and the gradual succession toward forest cover.

2. AGRICULTURAL FAMILIAR UNIT (UAF): Parcels 5Ha size

The UAF is the territorial unit that organises the belt. The strategy redistributes and normalises land into 5-hectare parcels, using existing UAF-designated plots (identified in the research) as anchors, then adapting adjacent land uses to the same size. This scale has proven optimal over centuries: it sustains high productivity under traditional farming without industrial investment, and is managed by a single family through manual labour — ensuring household food security and autonomy.



3. Maize variety piece: Parcels 100Ha size



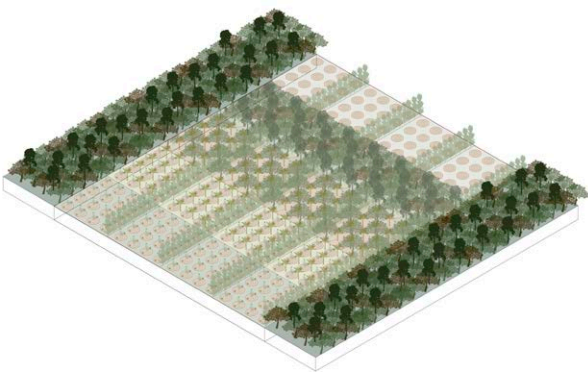
Twenty UAF parcels are grouped into a Maize Variety Piece of 100 hectares. The grouping follows a clear logic: every four UAFs form a strip, and five strips are assembled to form the piece. Each strip corresponds to one of the five stages of the chagra's 20-year cycle:

- Stage 1 — Sowing
- Stage 2 — Forest garden formation
- Stage 3 — Food forest
- Stage 4 — Hardwood forest
- Stage 5 — Renewal / fallow

Each Maize Variety Piece is dedicated to the cultivation of one specific native maize variety, ensuring that genetic and ecological diversity is preserved at the territorial scale.

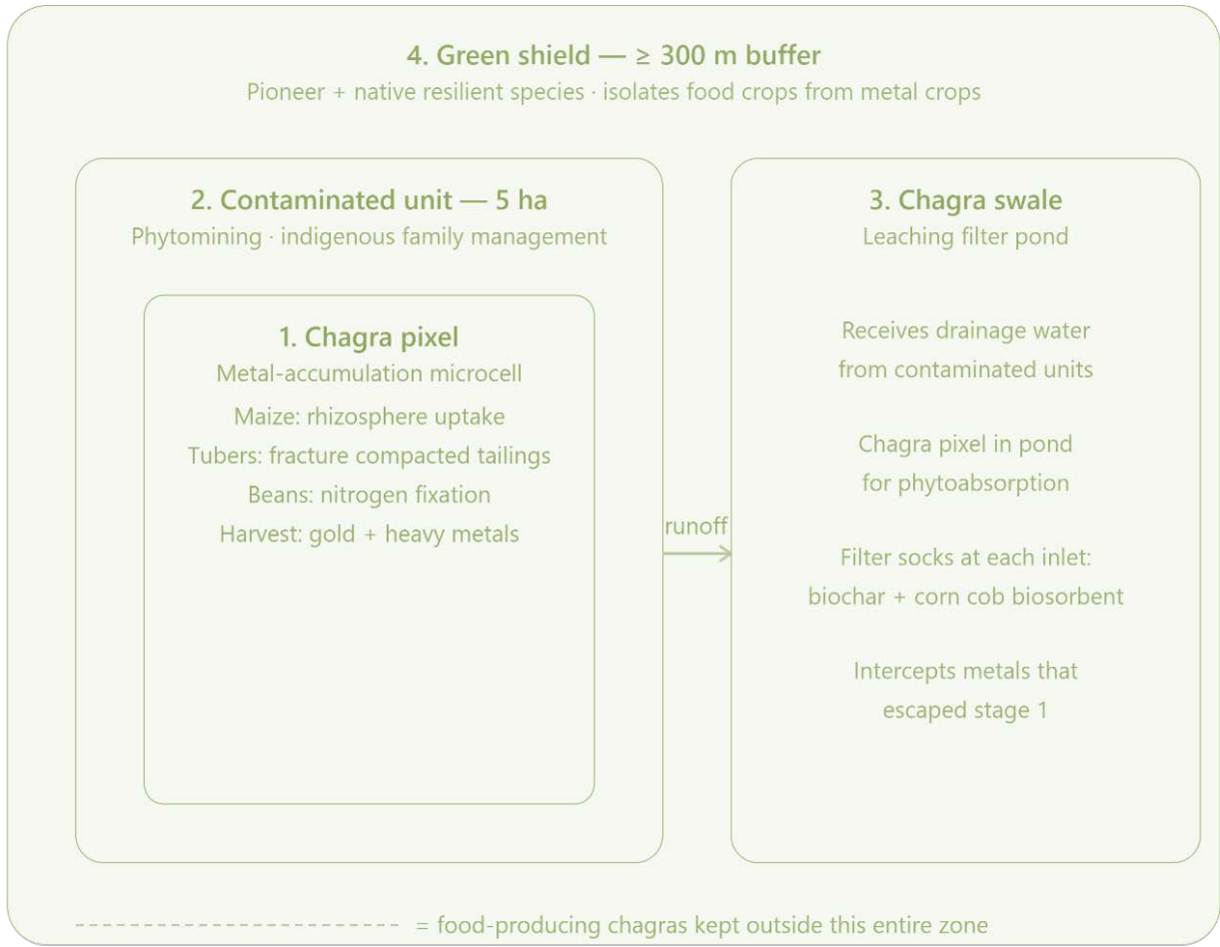
4. Green buffers: Varietal separation zones

Because each Maize Variety Piece cultivates a distinct native variety, buffer zones are placed between pieces to prevent cross-pollination and preserve each variety's independent evolutionary trajectory. This practice mirrors the spatial logic indigenous communities have maintained for millennia — keeping varieties separate so each one can develop singularly, true to its own lineage.

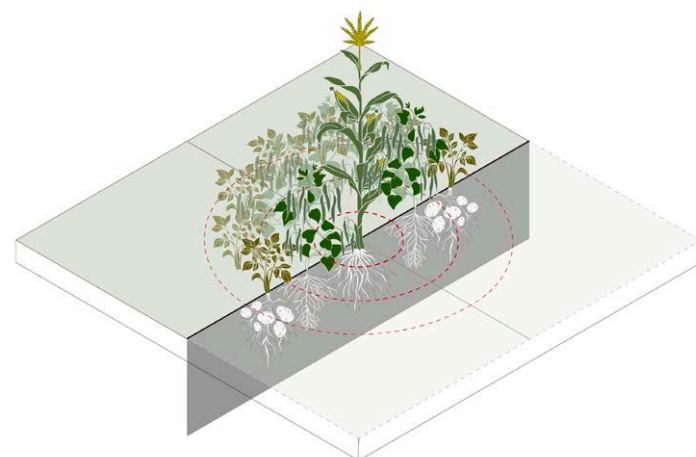


Reclamation Epicenters

The Reclamation Epicenters strategy applies the logic of the Chagra Pixel to a radically different purpose: healing the mining tailings that scar this territory. These are among the most damaging yet least visible wounds in the system — contamination that operates underground, out of sight, silently leaching heavy metals into soil and water. The strategy is built on four nested elements that together form a complete remediation system rooted in indigenous agroecological practice.



1. CHAGRA PIXEL: The phytoremediation microcell

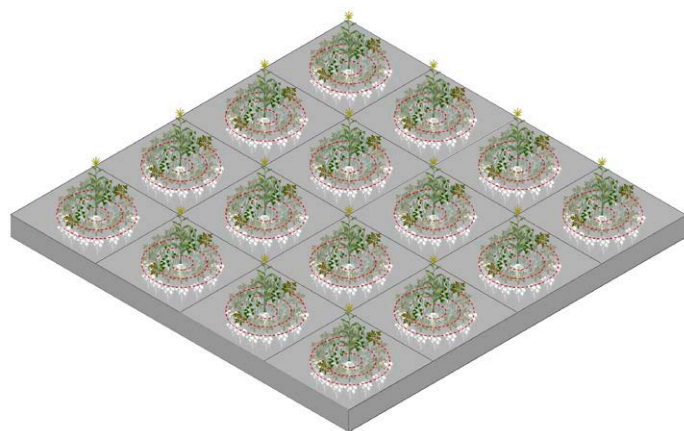


Here the Chagra Pixel shifts its role from feeding people to detoxifying land. Maize is a proven accumulator of heavy metals, primarily through rhizosphere interactions: its root exudates and associated soil microorganisms accelerate the stabilisation of metals such as cadmium and lead, converting them from mobile, environmentally harmful exchangeable forms into more stable organic or residual compounds.

Metal accumulation concentrates predominantly in the roots.

The polyculture logic amplifies this capacity in two complementary ways: tubers mechanically fracture the compacted tailing material, increasing metal bioavailability and making uptake more effective; beans fix atmospheric nitrogen into the exhausted tailing soil, creating the conditions in which maize can establish and survive at all. Neither plant alone achieves what the three achieve together.

2. CONTAMINATED UNIT: Phytomining at 5 ha



The contaminated units mirror the scale and structure of the UAF parcels in the Corn Belt:

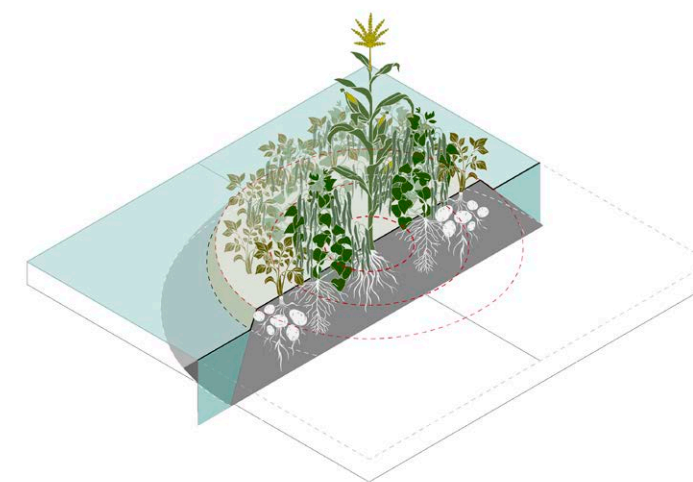
5-hectare plots managed by one indigenous family. This parallel is deliberate. It allows indigenous communities to operate within a familiar territorial and management logic — same scale, same rhythm — as they begin to re-appropriate land that was extracted from them.

The re-appropriation, however, is not only physical but legal. The gold phytomined from each unit is assigned directly to the family that works it. Under Colombian law, the formal transfer of mine-

ral wealth found on a parcel constitutes a basis for strengthening territorial claims — meaning that by handing the harvested gold to indigenous families, the strategy creates a legal pathway toward land ownership that runs parallel to the ecological one. Remediation and territorial restitution become a single act.

The harvest itself is not food but metal. Gold is the primary extraction mineral in this area, and the biomass accumulated by the chagra — the metal-laden plant material — must be carefully processed to recover it without causing secondary contamination. This handling protocol is therefore both an ecological requirement and a legal one: the integrity of the recovered gold is what makes the ownership claim possible.

3. CHAGRA SWALE: the leaching filter pond

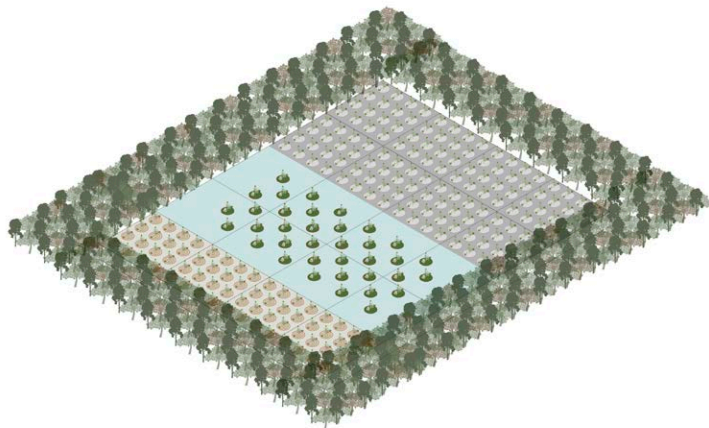


Placed downstream of the contaminated units, the Chagra Swale is a constructed wetland pond that functions as a second stage of interception. It receives the runoff and drainage water from the contaminated units — water that still carries metals not fully taken up in the first stage — and

filters it before it can re-enter the wider environment. The Chagra Pixel operates here too, now in an aquatic context: plants grow swale islands for repeating the phytoremediation, and not directly in the water as maize stress in aquatic environments. Besides, at each water inlet, filter socks are installed composed of biochar and corn cobs; corn cobs are

a particularly effective biosorbent due to their lignocellulosic biomass, which binds dissolved heavy metals before the water passes through. The swale thus closes the loop on contamination that escapes the first stage.

4. GREEN SHIELD: Isolation buffer of ≥ 300 m



Every remediation area must be enclosed by a buffer zone of at minimum 300 metres. This separation is essential for two reasons. First, it prevents the metal-laden chagras from contaminating food-producing ones through cross-pollination — the same varietal integrity logic that drives the green buffers in the

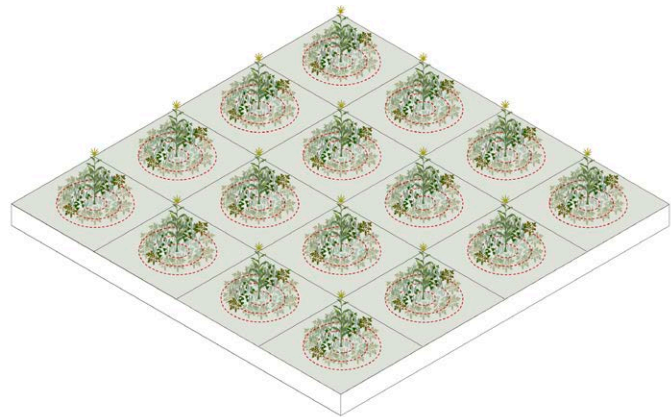
Corn Belt, here applied as a biosafety measure. Second, the buffer itself must be ecologically functional: it should be composed of pioneer species and those native varieties with the greatest resilience under degraded and transitional conditions, so that it not only isolates but actively begins the ecological recovery of the surrounding land.

Landscape reforestation hubs



The Landscape Reforestation Hubs apply the same Chagra cycle that underlies the Corn Belt, but with one significant adaptation: stage three diverges depending on the ecological and land-use category of the area being intervened. As before, the strategy operates across two distinct categories — human-free zones (existing water bodies and Key Biodiversity Areas) and agroecological zones (existing coffee plantations and UAFs) identified across the Strategic Plan area. The first three stages run in parallel across both categories; it is only at stage three that their paths diverge, and this difference carries through into stage four.

1. CHAGRA UNIT: 5 ha, 2–3 harvesting periods rotation



The Chagra Unit is identical in scale and logic to the UAF of the Corn Belt: a 5-hectare parcel owned and managed by one family. Its operation follows the same traditional rhythm. What changes here is the territory it colonises. Beyond the coffee plantations and UAF parcels already identified within the agroecological

zones, the Chagra Unit also extends into the human-free zones: the riparian extension of watercourses, and the land surfaces defined as Key Biodiversity Areas. This expansion means the Chagra Unit is the common entry point for ecological recovery across the full spectrum of land types in the hub — productive and protected alike.

2. FOOD GARDEN: native fruit species, mixed canopy layer rotation



This is the stage at which the two categories part ways. In the human-free zones, human management withdraws and the area is surrendered to the natural ecological succession of the Andean Mountain Forest. The food garden gives way to a self-organising hardwood forest, with succession driven by wildlife dispersal, seed banks, and the structural complexity already established in the

previous stages. In the agroecological zones, active management continues. The forest garden is maintained as a productive agroforestry system: native species tolerant of shade are cultivated beneath the canopy, generating yield while the forest structure matures. This model sustains the economic engagement of the indigenous family with the land while accelerating forest cover.

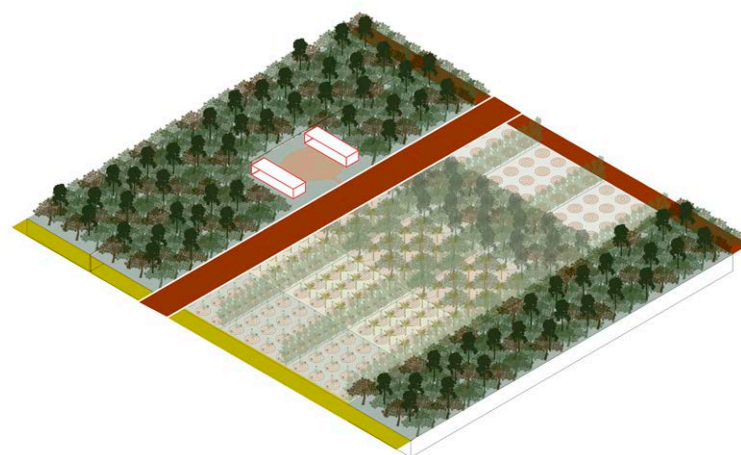
3. FOOD HARDWOOD FOREST: Two implementation models



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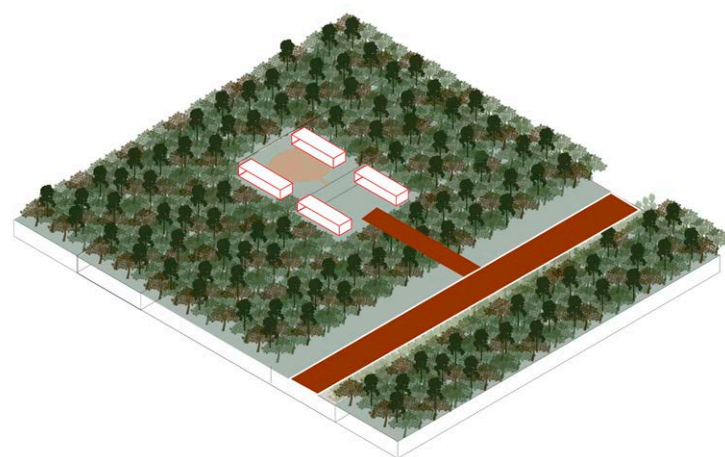
1. 1.Crossing Roads Vortex — the primary axis: regional connection and main network intersection



The primary road is the altitudinal axial line — the urban backbone of the Strategic Plan. It runs vertically through the territory, connecting the fractal upward to the national park and outward to the regional and national road network. Within the plan, it traverses two of the four isotropic zones. At its eastern passage, it crosses

the Regional Maize Organic Market — the most dynamically charged intersection in the entire network. This is the point where all five lines of the mobility system converge simultaneously, creating a vortex of flows: logistics, commerce, local movement, and tourism. Its multimodal nature makes it the primary hotspot for human activity in the plan, with the highest density and diversity of potential users.

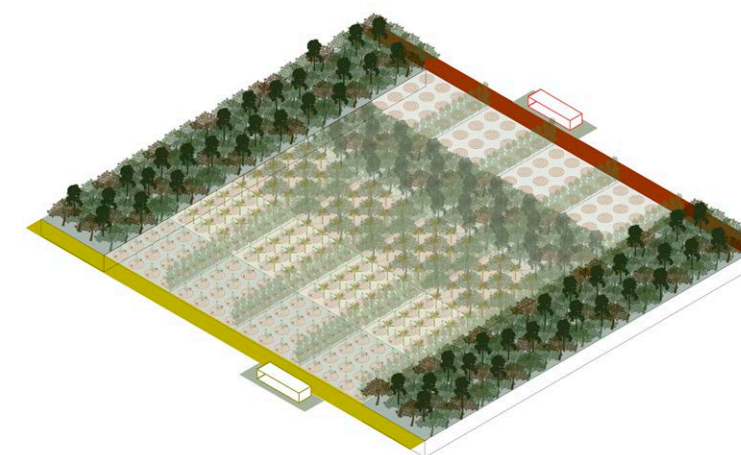
2. Crossing Between Two Potential Facilities — the primary axis: institutional corridor



At its western passage, the same primary road crosses the second isotropic zone: the Maize Seed National Bank. Here the axis road runs between two large pre-existing built structures belonging to an active mine — a spatial condition that concentrates infrastructure on both sides of the path, lending it an institutional character distinct from the market vortex to the east.

Together, these two crossings along the primary axis — the market junction and the seed bank corridor — provide a complementary range of uses that can serve the full spectrum of citizens: local farmers, researchers, institutional visitors, and tourists passing through.

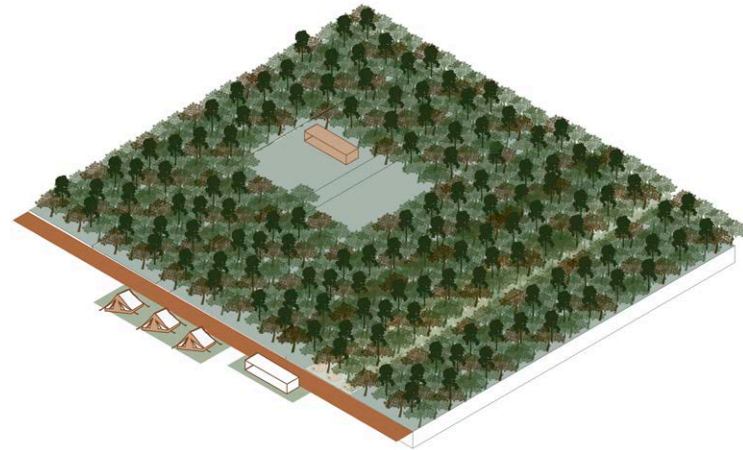
3. Maize Belt Paths — two slow local logistics lines



Running along the length of the Corn Belt are two dedicated slow-movement paths, each serving a distinct logistical function and restricted to local use. The upper path, at the eastern ridge of the belt, is devoted entirely to the productive logistics of the Maize Variety Pieces. Along it, new buildings for seed reserves are strategically placed — each positioned at junctions with other

network lines to maximise local accessibility and ease of reach for the families working each variety piece. The lower path, at the western edge of the belt, serves the biofuel centre and its supply chain. Along this route, facilities are placed to function as collection and storage depots for the organic matter awaiting transformation into energy — forming the material backbone of the belt's energy cycle.

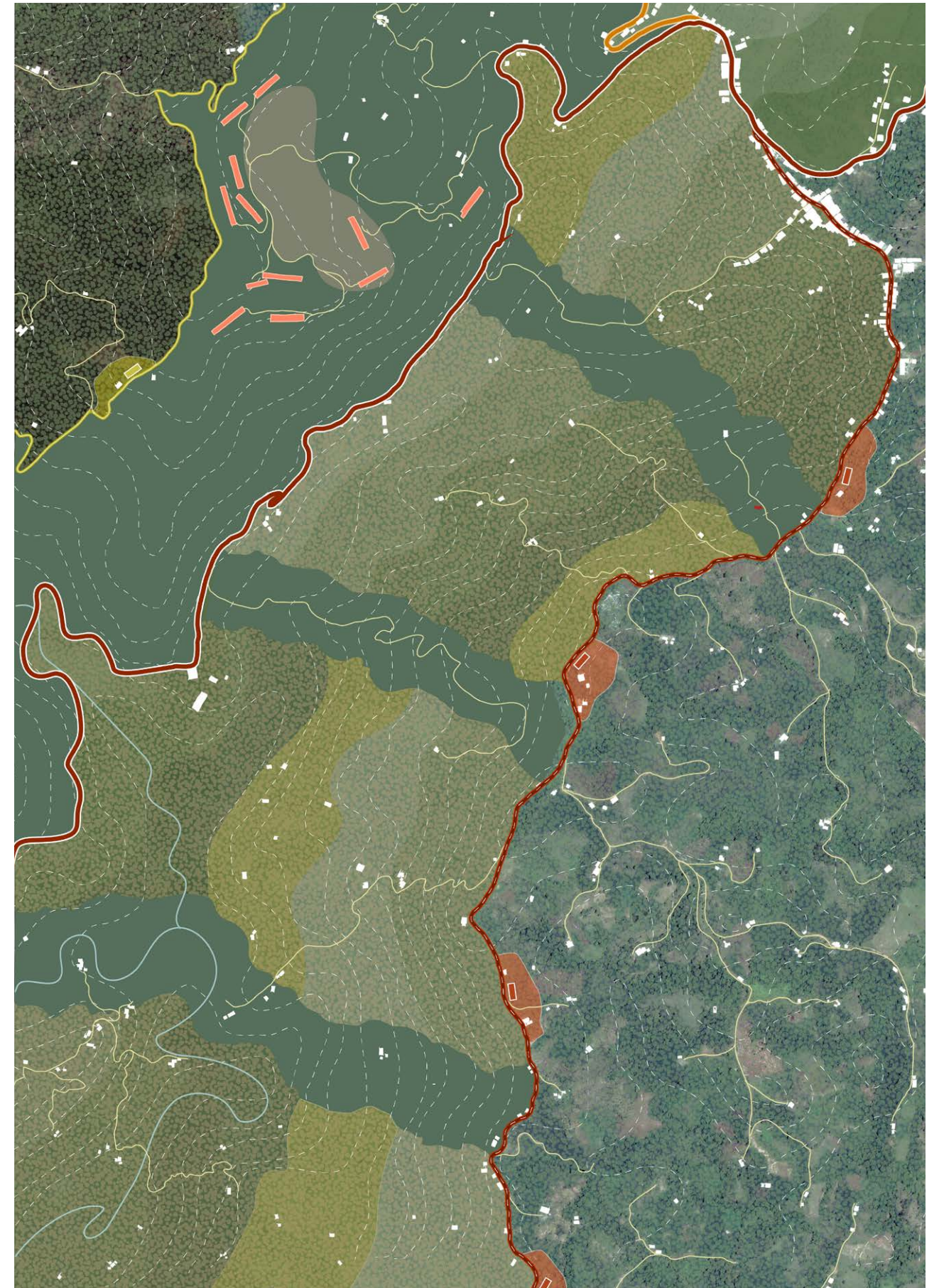
3. Maize Belt Paths — two slow local logistics lines



The tourism line was not designed from scratch but assembled: existing local paths were meticulously traced and joined to form a continuous ring that connects and permeates all the uses and dynamics the fractal offers. It reaches the most remote farms in the territory, threading through landscapes and productive systems that no other line in the network accesses: the only line that deli-

berately crosses all zones and uses. This line is dedicated to slow, pedagogical ecotourism — a mode of movement that allows visitors to read the territory and its agroecological logic at a human pace. Camping infrastructure placed along the ring reinforces its potential as a self-sustaining economic circuit, generating a direct income stream for the park and the communities within it.

7.4 The pixel: The Isotropy of transcalar connection



Among the components of the isotropic system, this research selects the Regional Organic Maize Market for closer examination. The choice is deliberate: the market's transcalar potential — its ability to connect and operate across scales, from the plot to the region — makes it an ideal analytical device. It provides

an opportunity to show how a single pixel, the minimal unit of the territory, can serve as a lens onto the threshold multisystem as a whole, revealing how maize acts as an agent that reorganizes territorial structure.

Chapter's bibliography

- Jiménez-Machuca, A. S., Bautista-Terán, R. J., Licapa-Redolfo, G. S., Fajardo-Flores, R. K., Farfán Chilicaus, G. C., Castillo Chung, A. R., & Licapa-Redolfo, R. (2023). *Zuro de Zea Mays: an alternative in the removal of heavy metals (Zuro de Zea Mays: una alternativa en remoción de metales pesados)*. Presented at the 21° Multiconferencia Internacional LACCEI de Ingeniería, Educación y Tecnología: "Liderazgo en Educación e Innovación en Ingeniería en el Marco de las Transformaciones Globales: Integración y Alianzas para el Desarrollo Integral", Buenos Aires, Argentina,,. ISBN: 978-628-95207-4-3. DOI: 10.18687/LACCEI2023.1.1.303.
- Mojiri, A. (2011). *The Potential of Corn (Zea mays) for Phytoremediation of Soil Contaminated with Cadmium and Lead*. *Journal of Biological and Environmental Sciences*, 5(13), 17-22.
- Carbotecnia. (2004). *El carbón activado en el tratamiento de aguas residuales*. Boletín técnico AR-001. Zapopan, Jal, México: Carbotecnia S.A. De C.V..

Conclusions

The research presented in these sources culminates in a vision where maize is not merely a crop, but a transcalar agent of planetary survival. By positioning a single seed at the heart of the Andean Mountain Forest—the most vulnerable ecosystem in Colombia—this project demonstrates how micro-scale interventions can ripple outward to safeguard the Tropical Andes Global Biodiversity Hotspot.

The Power of the Seed: From Microscale to Global Impact

Maize serves as the landscape keystone, acting as the "genius loci" that binds together ecological, cultural, and political dimensions. Just as the reintroduction of the wolf triggered a "trophic cascade" that restored the Yellowstone ecosystem, the return of native maize to the Colombian Andes is designed to trigger a restorative cascade. At the microscale, the Chagra Pixel—a polyculture of maize, beans, and tubers—restores soil fertility and mimics natural forest succession. At the global scale, this systemic regeneration protects "irrecoverable carbon" reservoirs and preserves half of the world's plant species found within these hotspots, proving that the interconnectedness of the whole begins at the cellular level.

Implementation: From Discussion to Reality

To transition from research to implementation, the project must be discussed as a National Agricultural Park, the first typology of its kind in Colombia. Implementation is not viewed as a singular event but as a 50-year execution timeline that balances ecological recovery with institutional and cultural transition. Discussion for implementation should start through three primary avenues:

The Pilot Junction: The project identifies a specific "neurological point" or junction where mobility lines and ecological dynamics converge. This site acts as a microcosm where the project's logic can be proven at a manageable scale before being expanded.

Policy Integration: Implementation relies on existing governmental frameworks, specifically Land Restitution microzones and Family Agricultural Units (UAF). By aligning with national land-tenure policies, the project transforms from a speculative design into a legally actionable strategy for indigenous territorial restitution.

Strategic Alliances: Implementation requires dialogue between the state, private

mining entities (for phytomining and land healing), and existing landscape plans like Econevas.

A Multitude of Triggered Projects

This research does not propose a static plan but a "scale-free" web of interventions that trigger a wide array of sub-projects across the territory. These include: Reclamation Epicentres: Projects dedicated to healing mining scars through maize-based phytoremediation, turning contaminated tailings into sites of indigenous land reclamation.

The Isotropic System: Four distinct but interdependent programs: a Regional Organic Maize Market for economic sovereignty; a National Maize Seed Bank for scientific memory; a Regional Indigenous Resguardo for political autonomy; and a Biofuel Production Hub for energy sovereignty.

Landscape Reforestation Hubs: Efforts to integrate coffee monocultures into diverse agroforestry systems and create "human-free" wildlife corridors.

Multimodal Mobility System: A regional and local infrastructure network that facilitates "pedagogical ecotourism" and logistical support for native corn farmers.

Ultimately, the Corn Threshold redefines the spatial order of the Andes, proving that through the ritual of the Chagra and the agency of the seed, we can reconcile human production with the urgent necessity of ecological protection

Acknowledgments

This is a space to thank every single person who, directly or indirectly, helped me bring this journey of my life to its conclusion.

First of all, I want to deeply thank Carolina Fiallo — thank you for trusting in me, for the patience and the care with which you always shared your precise words, your time, your wisdom. Above all, thank you for opening to me a collective space with other women, where conversations were woven together to nourish us mutually, each one from her own way of seeing the world.

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Finally, I thank the water — the dimension that helped me move through the difficulties, teaching me to take deep, long breaths in order to keep going.

The background is a topographic map with a grid overlay. A series of white dots forms a horizontal line across the top and a vertical line down the left side, intersecting at the top-left corner. The map features contour lines, a river labeled 'LAGANILLA RIVER', a path labeled 'CORN RING', and a town labeled 'Líbano'. Other labels include 'Armero-Cambao-Bogotá' and 'Fresno'.

A transcalar landscape system