

BRAZIL'S COFFEE EQUATION: RICH LANDS, FOREST DEBT

NATURAL ADVANTAGES BUILT A COFFEE POWERHOUSE — BUT EXPANSION CAME AT AN ECOLOGICAL PRICE

A. NATURE'S PERFECT BLEND: BRAZIL'S COFFEE ADVANTAGE FLOWS FROM GEOGRAPHIC ENDOWMENTS IN THE SOUTHEAST



Brazil's dominance in global coffee isn't just about scale or investment. It reflects a rare geographic endowment uniquely suited to coffee — optimal elevation, historically aligned rainfall patterns, and fertile soils across a vast continuous landscape. This perfect blend of inherited natural advantage is concentrated most strongly in the Southeast.

ALTITUDE: COFFEE'S SWEET SPOT

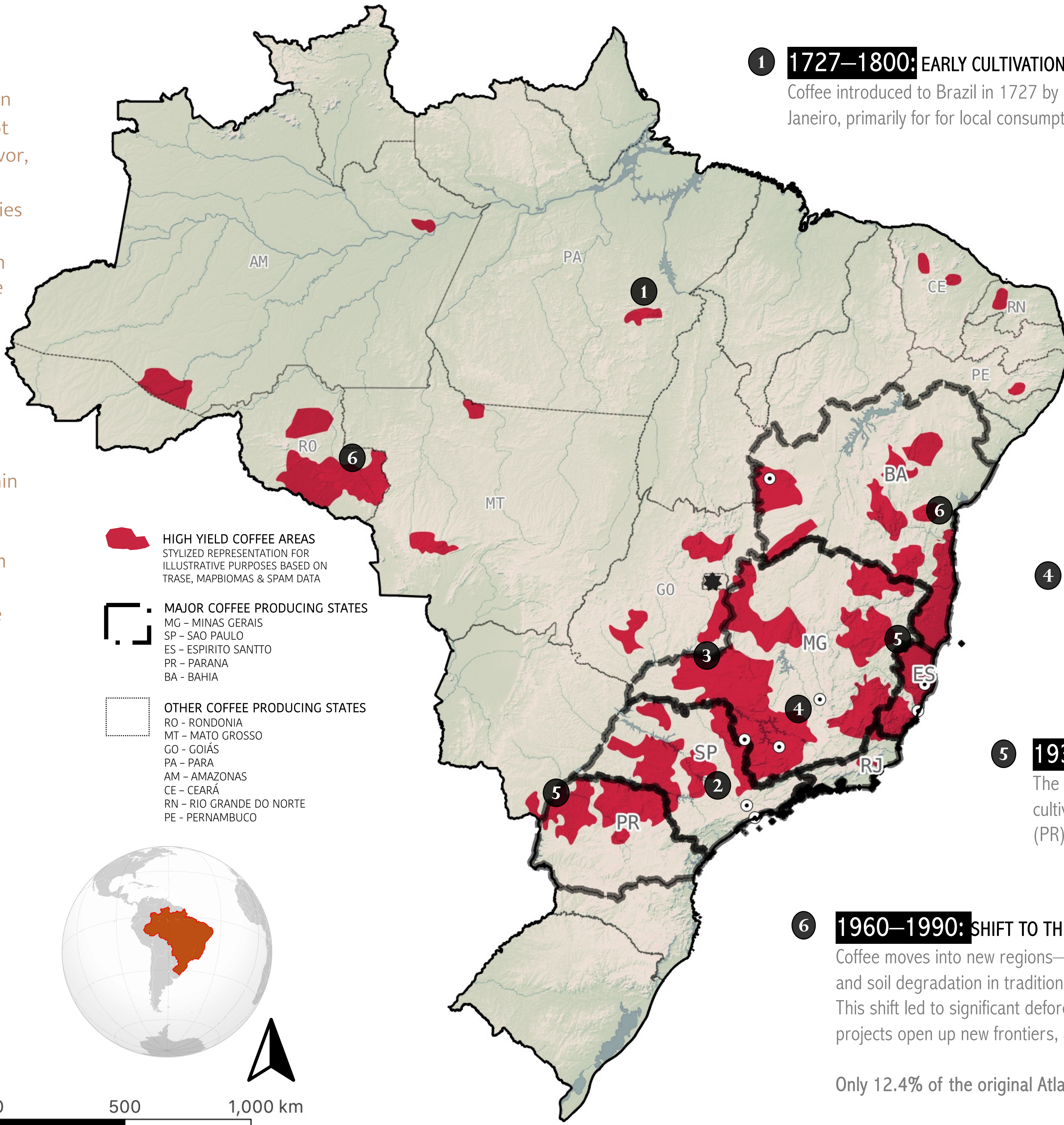
Brazil's Southeast highlands sit between **800–1,200m** — the global sweet spot for Arabica. Cool enough to deepen flavor, warm enough for yields, with average temps of **18–22°C**. While most countries find this altitude in scattered hillsides, Brazil delivers it at scale: over 1.5 million hectares of contiguous highland coffee lands.

RAINFALL: HISTORICALLY RELIABLE PARTNER

Coffee needs a dry spell, then steady rain to flower and fruit. Brazil's Southeast historically delivered exactly that: **1,200–1,600 mm/year**, mostly from October to March — perfectly synced with coffee's growth cycle. This climate rhythm helped turn Brazil into a coffee giant.

SOIL: VOLCANIC LEGACY IN EVERY SIP

Southeast Brazil's soils are iron-rich, humus-packed, and slightly acidic with **pH between 4.5 to 6.0** — coffee's ideal recipe. They echo Ethiopia's Arabica birthplace, but Brazil offers it at scale: a vast, connected coffee belt unlike anywhere else on Earth.



1 1727–1800: EARLY CULTIVATION IN PARÁ

Coffee introduced to Brazil in 1727 by Francisco de Melo Palheta - smuggled from French Guiana and initially cultivated in Pará (PA). By 1770, coffee reached Rio de Janeiro, primarily for for local consumption and remained a minor crop until the early 19th century.

2 1800–1850: EXPANSION INTO SOUTHEAST

Booming global demand drove rapid growth across the Paraíba Valley in Rio de Janeiro (RJ) and São Paulo (SP). Brazil became the top global producer by the 1840s, clearing vast tracts of Atlantic Forest with heavy reliance on slave labor.

3 1850–1900: SHIFT TO WESTERN SÃO PAULO AND MINAS GERAIS

Production moved west as soils depleted. By 1900, São Paulo (SP) held over 500 million coffee trees. This boom resulted in the conversion of vast tracts of the Atlantic Forest into agricultural land. Railroads like Mogiana drove deeper deforestation across western SP and southern MG.

4 1900–1930: OVERPRODUCTION AND EXPANSION INTO MINAS GERAIS

Brazil produced 80% of global coffee by the 1920s. The 1906 Taubaté Agreement incentivized further expansion, especially in MG and exacerbating Atlantic Forest deforestation. The 1930s crash burned millions of bags, but cleared land remained in production. The “coffee cycle” ends, but coffee remains a key export.

5 1930–1960: DIVERSIFICATION AND MECHANIZATION

The global economic downturn led to a decline in coffee prices and a push for economic diversification. Despite this, coffee cultivation persisted, with mechanization increasing efficiency and enabling expansion into new areas, including parts of Paraná (PR) and Espírito Santo (ES). Mechanization and sun-grown methods increased yields but intensified environmental impacts.

6 1960–1990: SHIFT TO THE AMAZON AND ENVIRONMENTAL IMPACT

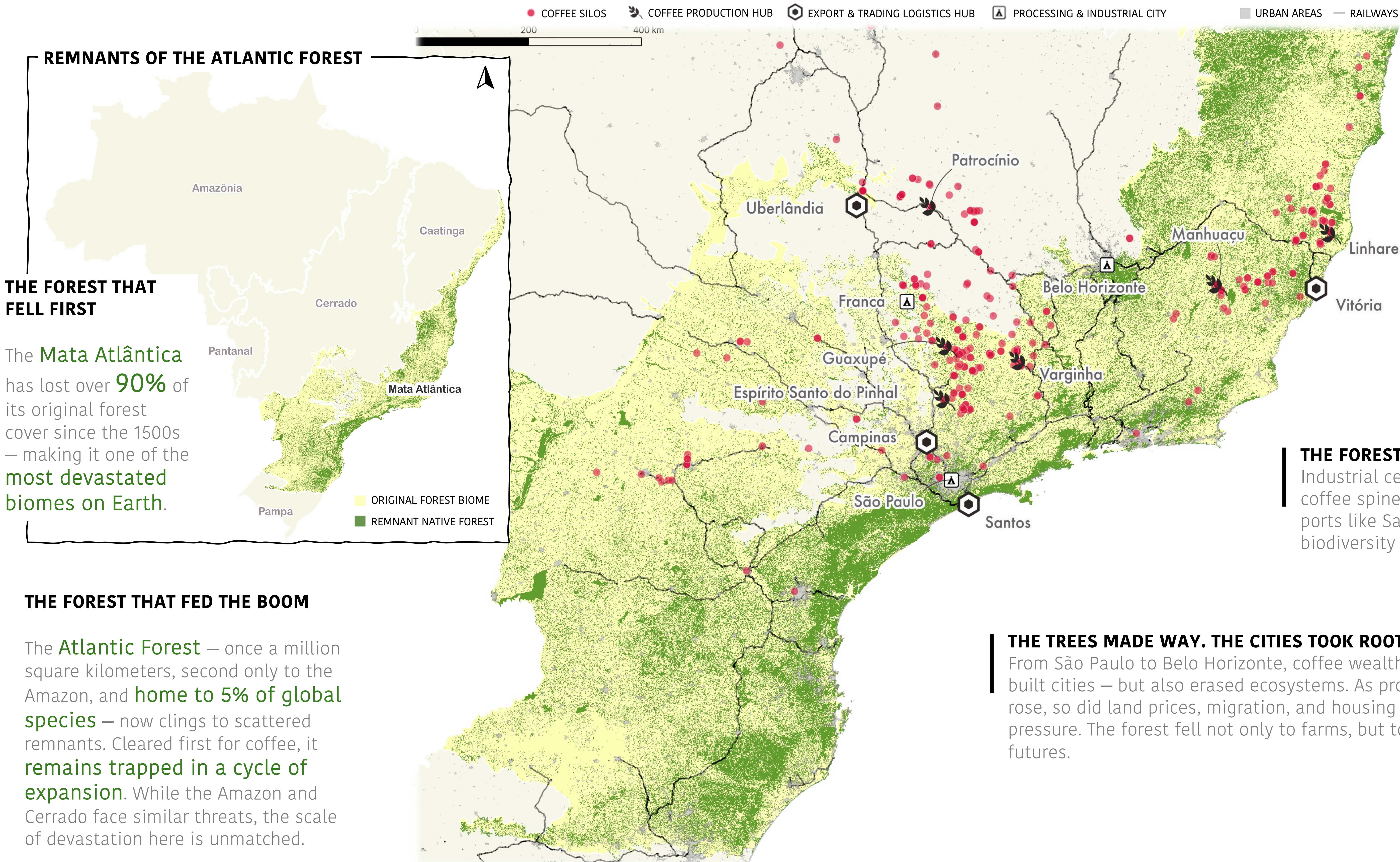
Coffee moves into new regions— Espírito Santo (ES), Paraná (PR), and later Bahia (BA) —as older lands degrade. In the 1970s, severe frosts and soil degradation in traditional coffee-growing areas prompted the relocation of coffee cultivation to the Amazon, particularly in Rondônia (RO). This shift led to significant deforestation in the Amazon region, as forests were cleared to make way for coffee plantations. Major infrastructure projects open up new frontiers, accelerating deforestation, especially in the Cerrado and Atlantic Forest.

Only 12.4% of the original Atlantic Forest remained by now, down from about one million km², with coffee as a major cause.

B. BREWED ON BORROWED LAND: COFFEE BOOM ETCHED A FOREST DEBT INTO BRAZIL'S LANDSCAPES



Coffee didn't just replace the forest. It replaced the logic of the landscape. What began with colonial coffee booms grew into a system of extraction, infrastructure, and expansion — one that still defines the Atlantic Forest's geography today.



THE FOREST THAT FELL FIRST

The **Mata Atlântica** has lost over **90%** of its original forest cover since the 1500s — making it one of the **most devastated biomes on Earth**.

THE FOREST THAT FED THE BOOM

The **Atlantic Forest** — once a million square kilometers, second only to the Amazon, and **home to 5% of global species** — now clings to scattered remnants. Cleared first for coffee, it **remains trapped in a cycle of expansion**. While the Amazon and Cerrado face similar threats, the scale of devastation here is unmatched.

THE FOREST FELL. THE SILOS ROSE.

Hundreds of silos now punctuate this landscape — silent markers of a biome colonized and transformed. The red dots tell their own story: Where dense forests once stood, steel domes now dominate, locking the region into an extractive geography that began with the coffee boom. These silos are not mere infrastructure; they are monuments to a centuries-long shift — from canopy to commodity.

THE FOREST NETWORK BROKE. THE FREIGHT NETWORK GREW.

Industrial centres like Franca, Varginha, and Guaxupé form Brazil's coffee spine — fed by railroads and ringed by silos. The rail links to ports like Santos didn't just move beans; they carved through biodiversity corridors, replacing forest flows with freight flows.

THE TREES MADE WAY. THE CITIES TOOK ROOT.

From São Paulo to Belo Horizonte, coffee wealth built cities — but also erased ecosystems. As profits rose, so did land prices, migration, and housing pressure. The forest fell not only to farms, but to futures.

CLEARED FAST, LASTING LOSS

Coffee production in Brazil has grown more than 300-fold since 1820 — from just over 200,000 bags to a projected 66 million in 2024. Each surge in production demanded more land, more labor, and more logistics. It carved new frontiers, displaced forest, and cemented a legacy of extraction. The expansion of sun-grown coffee — engineered for maximum sunlight and faster yields — has only sharpened the industry's hunger for land. These high-intensity systems thrive best on cleared forest, strip the soil of nutrients, and often render landscapes exhausted within years. The Atlantic Forest was the first to fall. Its loss became the quiet collateral of Brazil's coffee empire — and forest loss continues unabated.

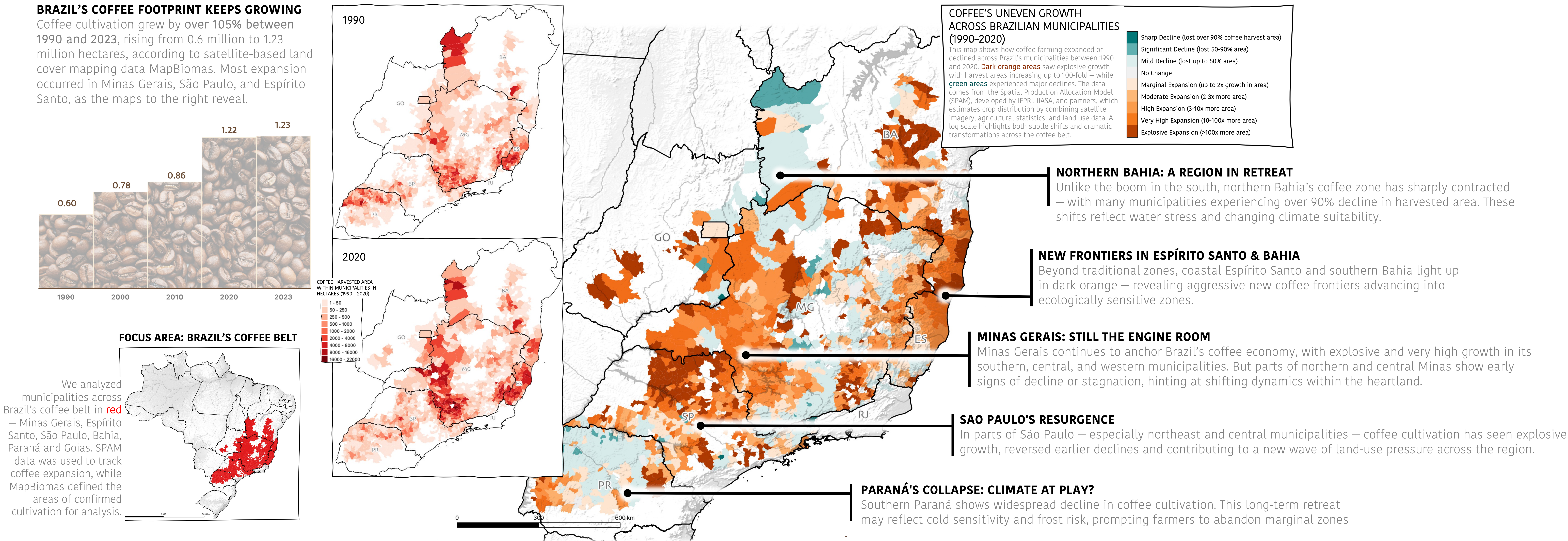
THE PRICE OF GROWTH: COFFEE'S LAND HUNGER IS STILL CLAIMING FORESTS

COFFEE'S ADVANCE KEEPS CARVING INTO FORESTS — EVEN IN FRAGILE BIOMES ALREADY STRIPPED BARE

A. BOOM WITHOUT BRAKES: COFFEE KEEPS PUSHING PAST OLD FRONTIERS



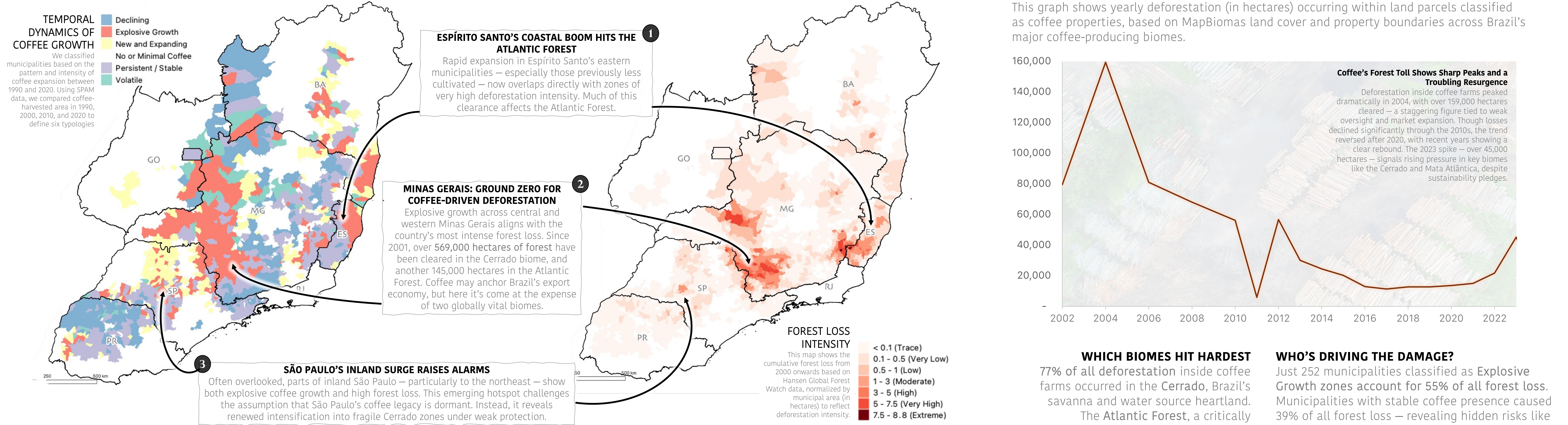
Brazil's coffee footprint continues to grow — doubling since 1990 and still expanding fast. As cultivation deepens in the Minas Gerais heartland, new frontiers are rising across Espírito Santo, Bahia and São Paulo. Explosive growth has overtaken new biomes, while stable zones mask hidden churn. Coffee's advance is both vast and volatile — redrawing the geography of Brazil's coffee economy.



B. COST OF THE BOOM: COFFEE'S FOOTPRINT SPREADS, FORESTS SHRINK FURTHER



Coffee farm's expansion continues to exact a steep ecological price — clearing over 700,000 hectares since 2000 in the coffee belt. Explosive growth hotspots in Minas, Espírito and São Paulo now overlap with zones of intense deforestation — with 77% of cumulative forest loss striking the savanna-rich Cerrado and 20% hitting the endangered Atlantic Forest.



C. THE HIDDEN FOOTPRINT: INDIRECT DEFORESTATION



In Southeast Minas Gerais, the spread of coffee plantations triggers far more than direct clearance. These satellite maps show how coffee reshapes entire landscapes — not just by replacing forests, but by displacing cattle, pushing roads into remote areas, and inflating land speculation. Much of the surrounding forest loss occurs near, but not within, coffee plots — exposing an indirect footprint that is larger, deeper, and harder to trace. This is deforestation laundering in action: coffee moves in after forests fall, profiting from prior destruction while sidestepping accountability.



EXPANDING FOOTPRINT, SHRINKING FORESTS

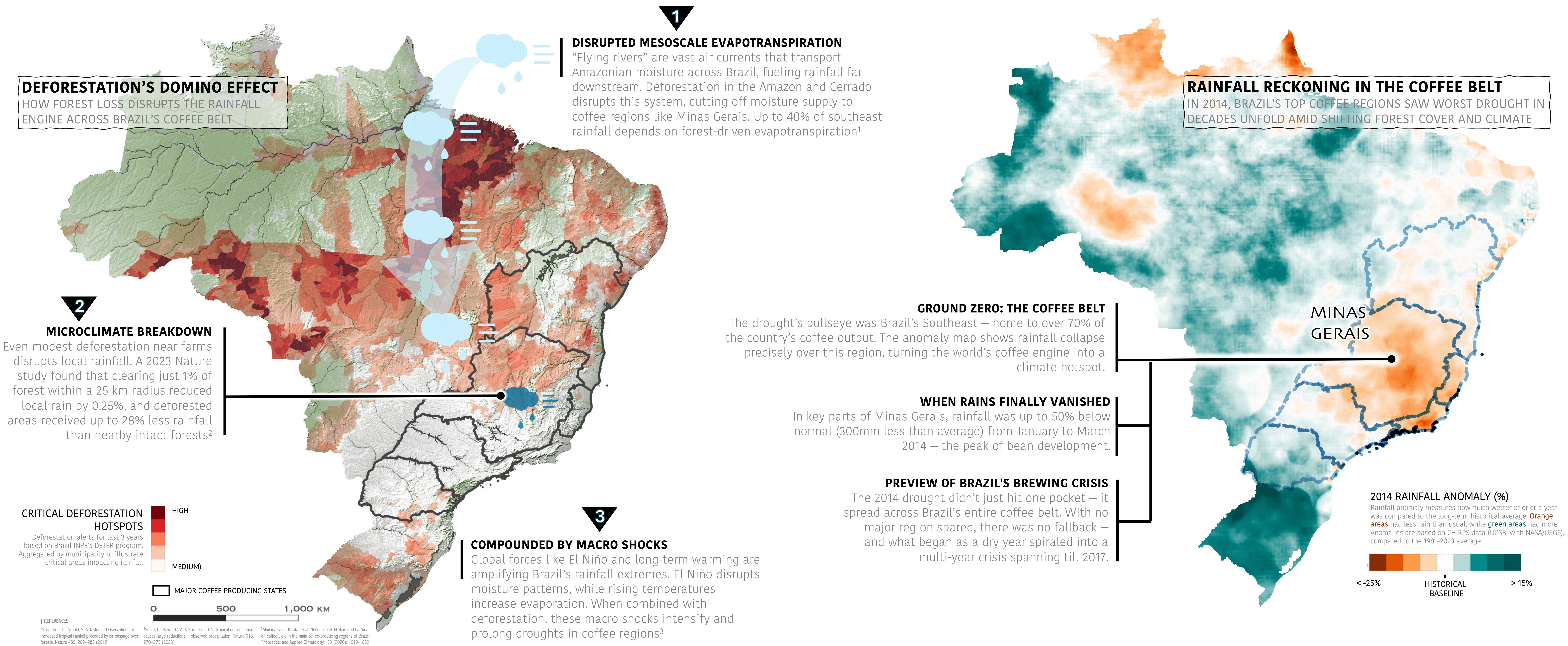
Across Brazil's coffee belt, plantations are redrawing the map. What begins as direct expansion soon cascades into wider forest loss — both within and beyond farm boundaries. Forests and savannas give way to monoculture; roads and land speculation follow. But this transformation comes at a growing cost: as tree cover disappears, the climate begins to turn — drier, harsher, and far less forgiving.

3 BRAZIL'S FAILING RAIN ENGINE: FROM RELIABLE RAINS TO RELENTLESS DEFICITS

STEADY RAINFALL RHYTHMS ARE UNRAVELING AS DEFORESTATION WEAKENS BOTH SOURCE AND SHIELD OF MOISTURE

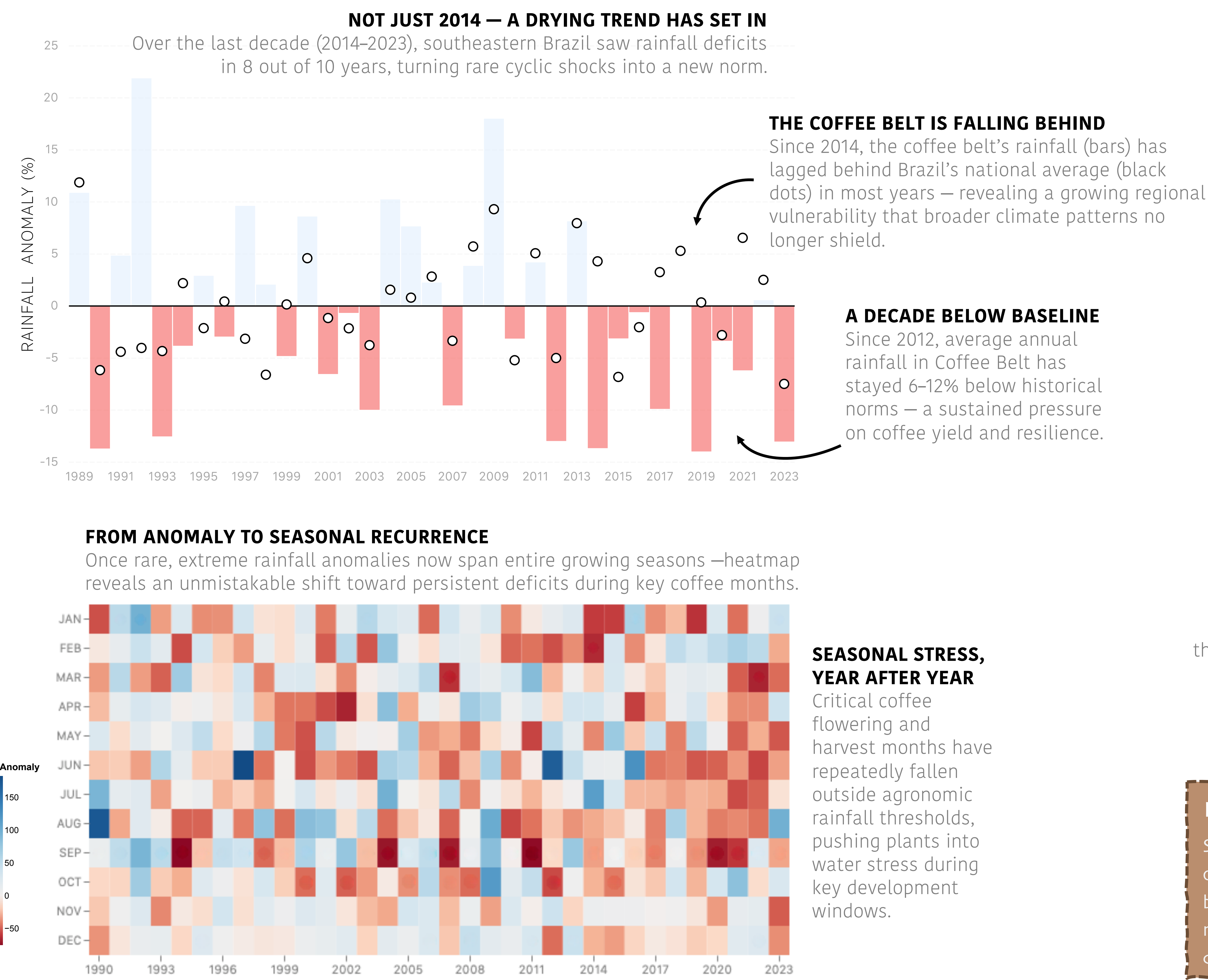
A. BREWING INTO COLLAPSE: FORESTS FELL, THE RAINS SHIFTED, COFFEE PAYING THE PRICE

Once sustained by forest-fed rain systems, Brazil's southeastern highlands now sit at the heart of a deepening rainfall crisis. Deforestation across the Amazon, Cerrado, and Atlantic Forest has disrupted local and regional moisture cycles — with the 2014 drought marking a turning point where coffee began to feel the climate cost of its own landscape transformation.



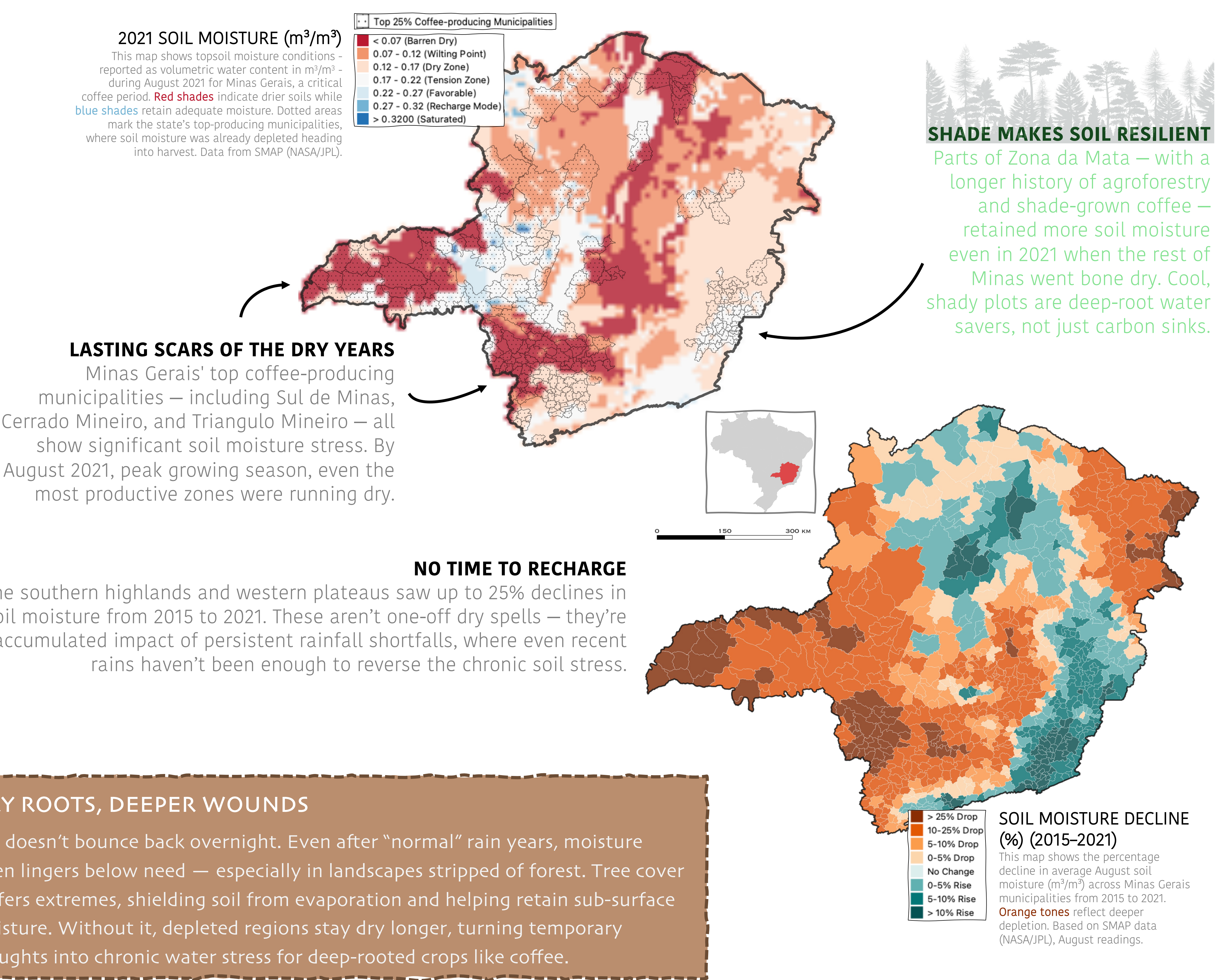
B. PARCHED GROUNDS: RAIN DEFICITS ARE NOW ROUTINE IN THE COFFEE BELT

What was once seen as an occasional drought has become a recurring pattern. From 2014 onward, southeastern Brazil's coffee belt has experienced near-annual rainfall shortfalls — with prolonged deficits increasingly clustering during the crop's most vulnerable months.



C. DEFICIT TO DEPLETION: WITHOUT FORESTS, RAIN RUNS OFF, ROOTS DRY OUT

Years of disrupted rainfall have taken a toll on the land itself. By 2021, large parts of Minas Gerais — Brazil's most important coffee state — showed stark signs of soil moisture collapse, particularly in high-yield regions. These maps reveal the lingering footprint of a decade of drying.



4 CRISIS IN EVERY CUP: COFFEE'S MARKET CHAOS ROOTED IN ECOLOGICAL COLLAPSE

ONLY AGROFORESTRY CAN BREAK THE SELF-DEFEATING CYCLE BEFORE CLIMATE MAKES IT PERMANENT

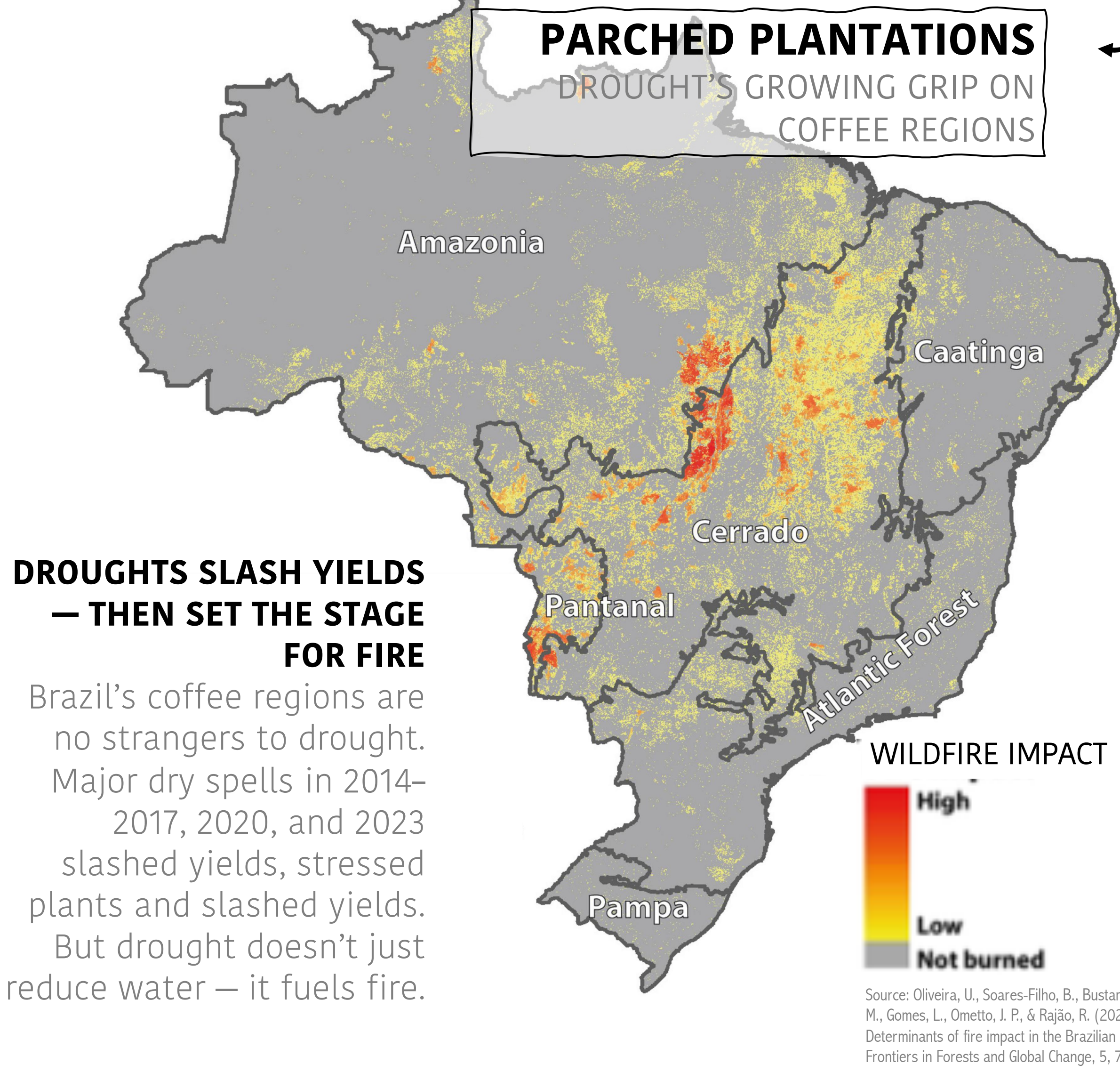
A. BREWING VOLATILITY: ECOLOGICAL LOSS AND SPECULATION BEHIND COFFEE'S PRICE SPIKES

Coffee prices have surged time and again — driven by a growing mix of extreme droughts, biodiversity collapse fuelling pest outbreaks, and frost events. As these shocks become more frequent and compound, speculative market behaviour is amplifying volatility in ways never seen before.



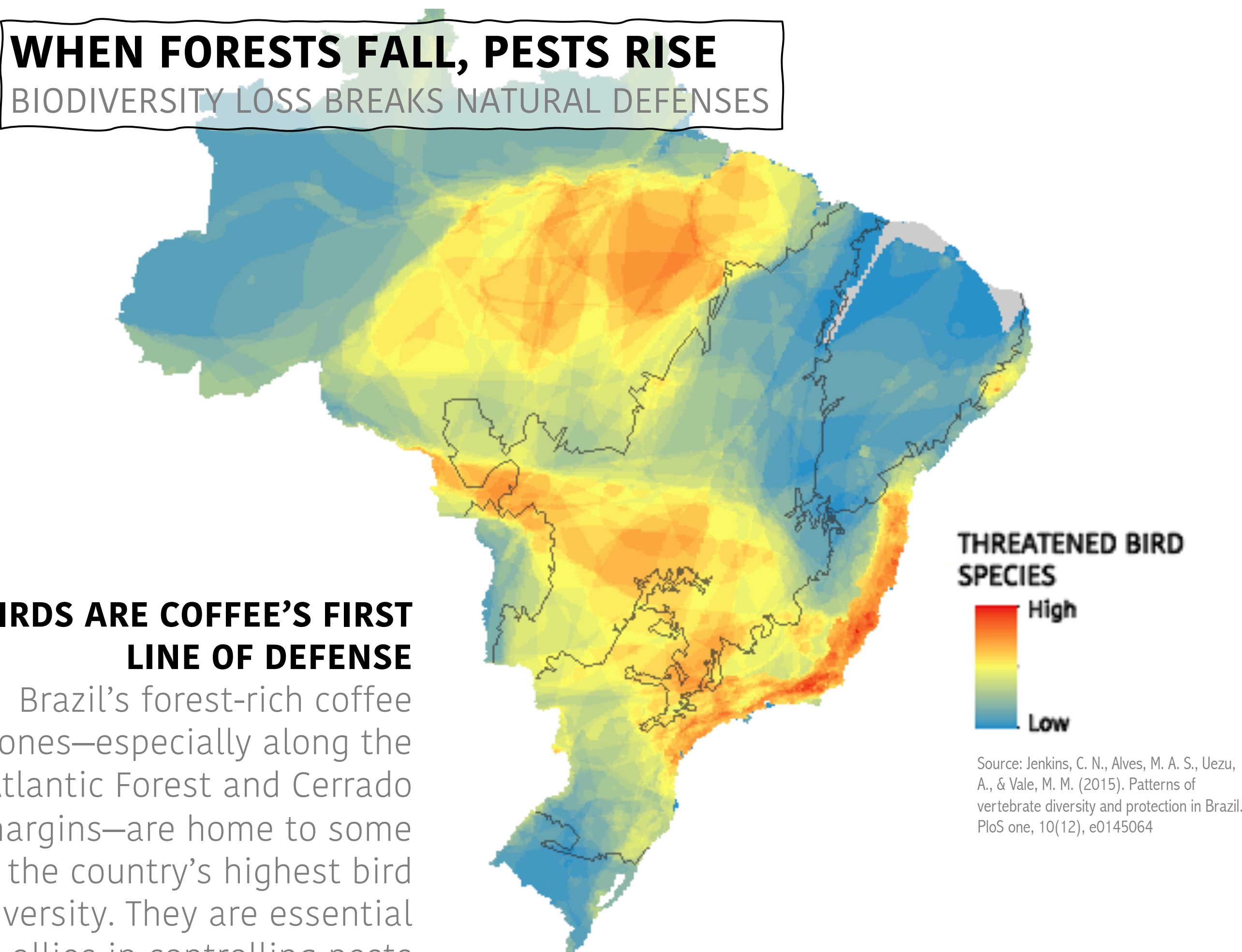
ROASTING THE MARKET: HOW INCREASING EXTREME EVENTS FUEL SPECULATION LOOPS

The frequency and intensity of shocks to Brazil's coffee system — from ecological to climatic — have increased over the past couple of decades. Market speculation now acts as an accelerant: each extreme event doesn't just strain production, it fuels cycles of fear, hoarding, and price volatility across global markets. More recently (2023–2024), Brazil's coffee industry faced a mix of pest pressure, drought, and erratic weather. These have collectively contributed to a tight global supply and historically high prices (e.g. price surges of 50–100% over 2024–2025)



WHEN FORESTS FALL, PESTS RISE BIODIVERSITY LOSS BREAKS NATURAL DEFENSES

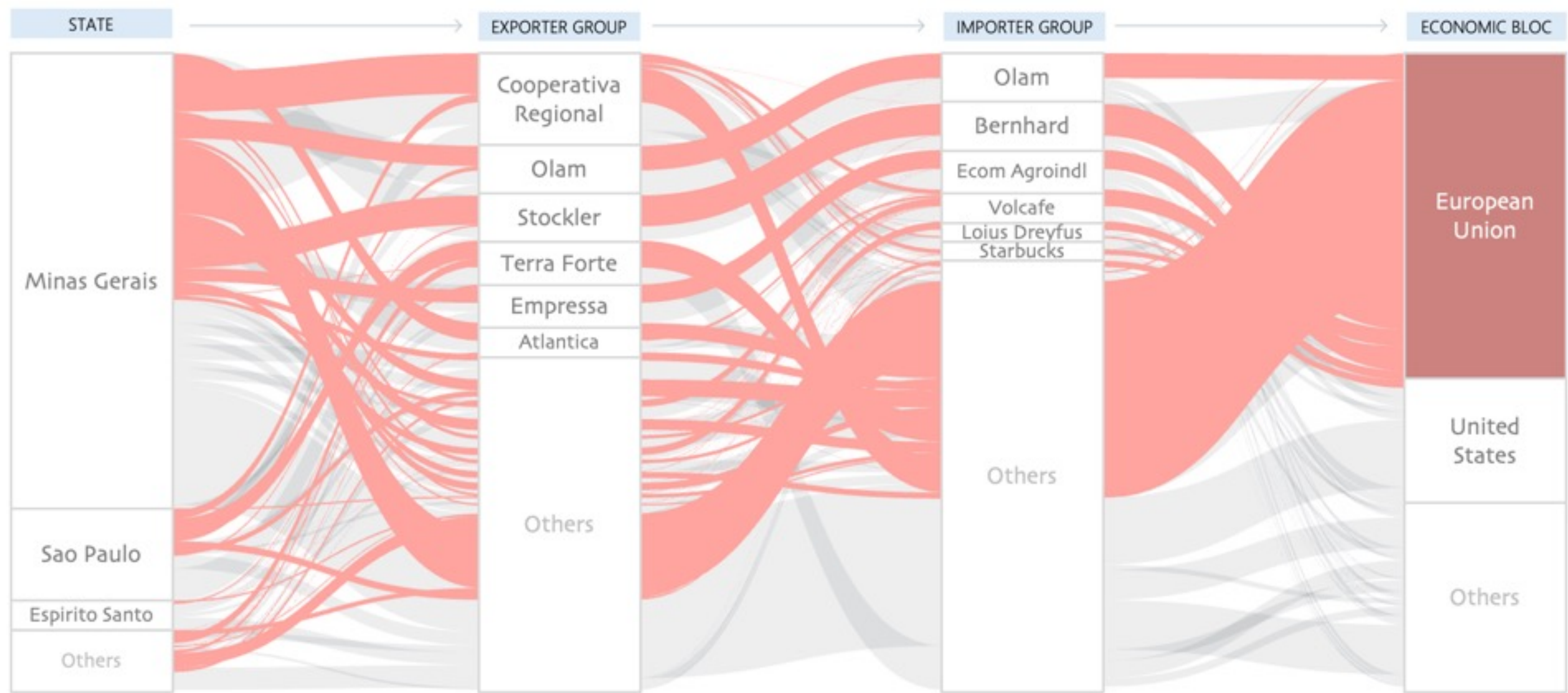
BIRDS ARE COFFEE'S FIRST LINE OF DEFENSE
Brazil's forest-rich coffee zones—especially along the Atlantic Forest and Cerrado margins—are home to some of the country's highest bird diversity. They are essential allies in controlling pests like the coffee berry borer.



BIRDS DISAPPEAR, PESTS TAKE OVER
But as deforestation expands, bird populations collapse—most drastically among endemic and threatened species. The result: pest outbreaks grow more frequent and severe, as seen during the 2001–2002 borer crisis and the 2013–2014 leaf miner surge. Less biodiversity means more pesticide dependence, weaker resilience, and rising risk across the coffee belt.

B. THE FINAL FILTER: EUDR RISKS BLOCKING HALF OF BRAZIL'S COFFEE TRADE

As ecological risks mount, EU regulations threaten billions in exposed supply chains — and exporters may soon face a bitter reckoning.

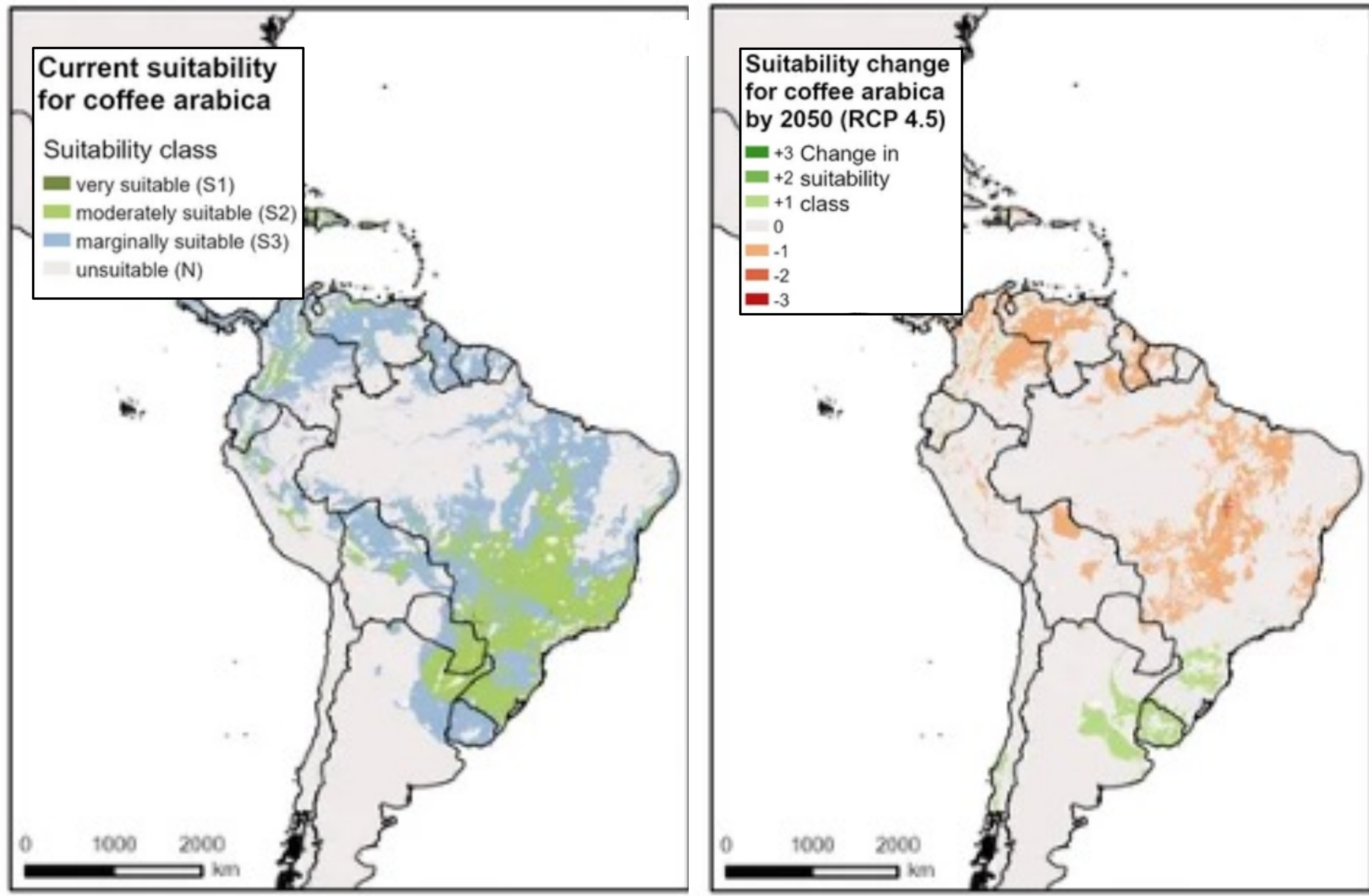


BILLIONS AT THE BRINK

Over \$2.4 billion in Brazilian coffee exports — more than 52% of national trade — flows into the EU, now subject to strict deforestation-free requirements under the 2026 EUDR. With supply chains still largely unmapped, even compliant producers risk being caught in the regulatory crossfire — putting entire export flows in jeopardy.

C. THE CLIMATE CLIFF: COFFEE BELT ARE RUNNING OUT OF TIME

Rising heat and shifting rain are eroding coffee suitability—but agroforestry could help turn the tide.



Climate change is set to land the final blow on Brazil's coffee belt. As shown in the map, much of today's prime-growing zones will lose suitability by 2050—even under moderate emissions (RCP 4.5)

With rising heat, erratic rain, and compounding droughts, Arabica yields in key regions are already down 20%, and projections suggest Brazil could lose up to two-thirds of its suitable coffee land by 2050. In this climate, every shock hits harder and market volatility deepens.

But there's still a path forward: agroforestry—by restoring shade, cooling microclimates, and boosting resilience—may be coffee's best chance at weathering the storm. The time to scale it isn't tomorrow. It's now.

D. NO SHADE, NO COFFEE: AGROFORESTRY IS THE LAST DEFENSE

Agroforestry is not just a sustainable alternative—it may be coffee's last lifeline.

It's a natural shield against nearly every climate and ecological stressor discussed so far. By reintroducing tree cover, agroforestry buffers against drought, improves soil moisture retention, restores bird habitats that control pests, cools overheated plantations and even reduces the severity of frost events.

Yet despite its transformative potential, adoption remains far too limited. As the map shows, agroforestry has expanded in parts of Brazil—but mostly in non-coffee regions and for other crops. In key coffee-growing zones, uptake is still below 1% of area, leaving plantations exposed to escalating shocks. For a sector facing compounding threats from heat, biodiversity loss, and market volatility, scaling agroforestry in coffee isn't optional—it's urgent.

