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Deforestation and Agricultural Expansion in Brazil's Amazon and Cerrado Biomes

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DEFORESTATION AND AGRICULTURAL EXPANSION IN BRAZIL'S AMAZON AND CERRADO BIOMES

The Amazon and Cerrado biomes, which together cover nearly two-thirds of Brazil, are critical to global ecological stability but face significant deforestation pressures driven by agriculture and livestock expansion. While the Cerrado, with its savanna-like vegetation, and the dense forests of the Amazon have distinct ecological characteristics, both have been similarly impacted by Brazil's rapid agricultural and infrastructural development. Historically, these biomes were sparsely occupied until the 20th century, when large-scale projects such as the Belém-Brasília and Trans-Amazonian highways facilitated settlement and land conversion.

During the 1980s, agricultural frontiers expanded rapidly, especially in the Cerrado. Research by Embrapa introduced advanced soil management techniques and crop adaptation strategies, enabling efficient tropical agriculture and converting native vegetation into productive farmland for crops like soy and corn. In the Amazon, where soils are less fertile, large-scale cattle ranching dominated, leading to the establishment of the infamous "arc of deforestation" along major transport routes.

Recognizing the alarming rates of deforestation, the federal government launched the Satellite Monitoring Program of Deforestation in the Legal Amazon (PRODES) in the late 1980s. This program uses satellite imagery to generate official deforestation statistics for the Amazon. While instrumental in tracking deforestation rates, PRODES initially lacked tools to analyze land-use conversion dynamics, limiting its utility in guiding public policies. To address this gap, the government launched TerraClass Amazon in 2010, which qualified deforested areas based on land use. In 2013, this initiative was extended to the Cerrado biome, and by 2018, the Cerrado was also incorporated into PRODES monitoring.

Technological advancements in the 1990s further transformed Brazil's agricultural landscape. Improved crop varieties and land-saving techniques boosted productivity, turning the country into a global leader in food production. For instance, cattle herds expanded despite reduced pasture areas, thanks to more intensive and sustainable management practices. However, these gains in productivity have not entirely curbed deforestation, as the expansion of agricultural production continues to drive land clearing and environmental degradation.

Brazil's governance model for the Amazon and Cerrado relies on the concept of "attributed lands," where areas are designated for specific conservation purposes. These include protected areas such as conservation units and Indigenous territories, safeguarded by federal agencies like IBAMA and the Federal Police. Protected areas are integral to long-term ecological preservation, aligning with the IUCN definition that emphasizes the conservation of natural ecosystems, cultural values, and ecosystem services. In the Amazon, protected areas span approximately 1.9 million square kilometers, while in the Cerrado, they cover about 160,000 square kilometers.

Despite the large proportion of smallholders, who account for 92% of agricultural establishments in the Amazon and 86% in the Cerrado, land ownership remains heavily concentrated in large estates. In the Amazon, these estates occupy nearly 70% of the land, leaving only 20% for smallholders. In the Cerrado, the distribution is slightly more equitable, with large estates controlling just over half of the land, while medium-sized properties account for a more substantial share. This imbalance highlights the challenges of aligning agricultural development with conservation objectives.

In the early 2000s, deforestation in the Amazon surged, peaking at nearly 30,000 km² in 2004 (Figure 1). To address this crisis, the government introduced the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm), which outlined 12 strategic objectives and 194 action lines aimed at eradicating illegal deforestation by 2030. The plan also promoted sustainable forest management. Following its success in reducing deforestation in the Amazon, the program was extended to the Cerrado in 2010, significantly lowering annual deforestation rates from over 15,000 km² to less than 10,000 km² in subsequent years (Figures 2 and 3).

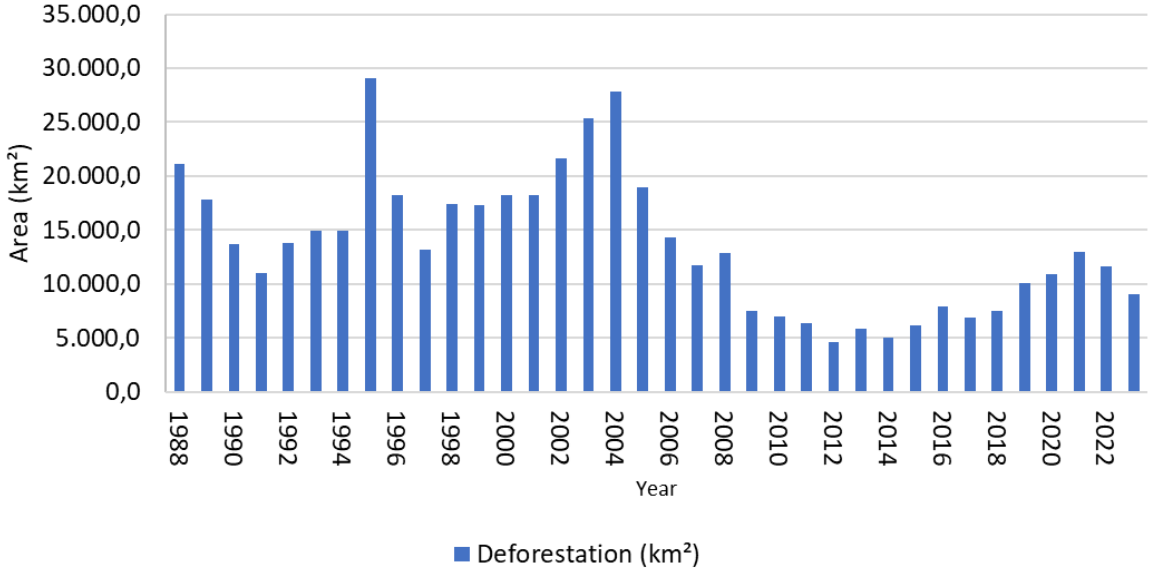
A critical legislative measure in this context is Brazil's new Forest Code (Law 12.651/2012), which sets comprehensive guidelines for protecting native vegetation. The law covers Permanent Preservation Areas (PPAs), Legal Reserves, and Restricted Use zones, regulating forest exploitation, origin tracking of forest products, fire control, and introducing financial mechanisms to support conservation. The Rural Environmental Registry (CAR), a central feature of the law, consolidates rural property data into a national electronic database, facilitating environmental monitoring and deforestation control.

Under the Forest Code, Permanent Preservation Areas protect vital resources like water, soil, and biodiversity while promoting ecological connectivity for flora and fauna. Legal Reserves within rural properties aim to balance sustainable economic activities with biodiversity conservation, with the size of these reserves varying based on property location.

Another critical initiative is Brazil’s National Program for the Conversion of Degraded Pastures, which transforms low-productivity pastures into highly productive and sustainable areas through systems like Crop-Livestock Integration (CLI) and Crop-Livestock-Forest Integration (CLFI). This program not only sequesters carbon but also reduces the pressure to clear new land by intensifying the use of already deforested areas.

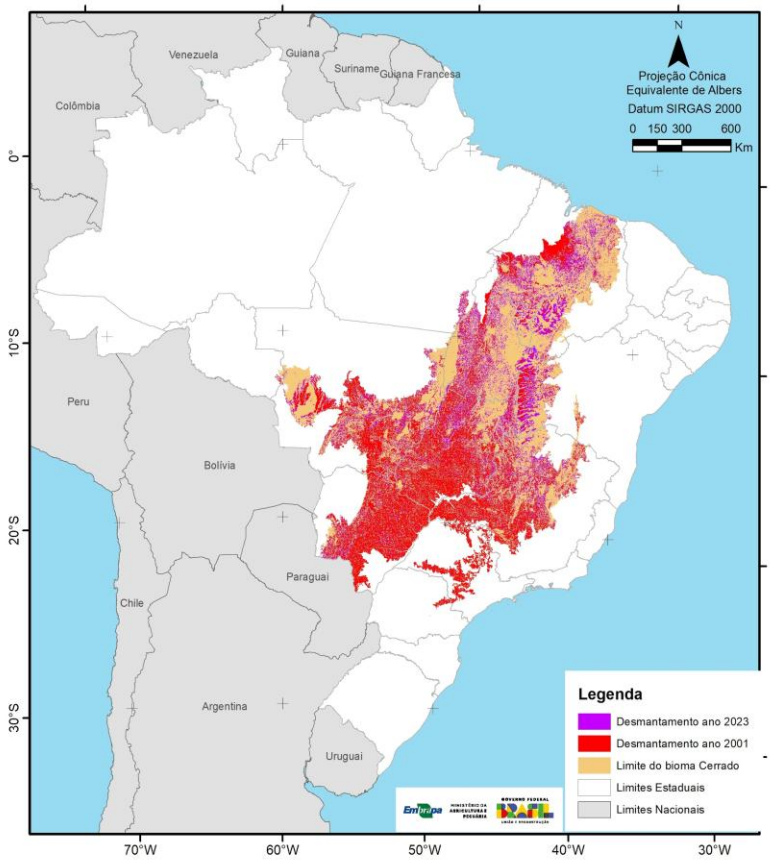
Finally, consumer-driven sustainability pressures have reshaped supply chains, with initiatives like the Soy Moratorium setting benchmarks. The agreement, forged between the Brazilian Association of Vegetable Oil Industries (ABIOVE), the National Association of Grain Exporters (ANEC), and NGOs such as Greenpeace and WWF, bans the export of soy grown in deforested areas of the Amazon after July 2008 (Figure 4). Although soy production in the Amazon has increased by over 300% since the moratorium, 95% of this growth occurred on lands cleared before 2008, primarily through the conversion of pasturelands.

Figure 1 - Annual deforestation in the Legal Amazon region



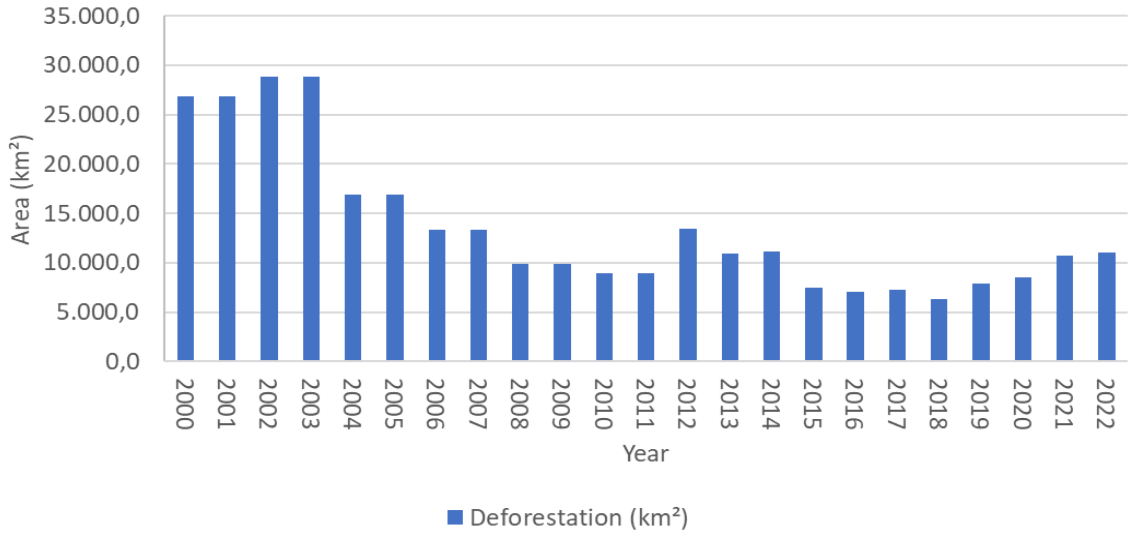
Data source: INPE (2024a)

Figure 2 - Deforestation in the Cerrado biome 2001 and 2023



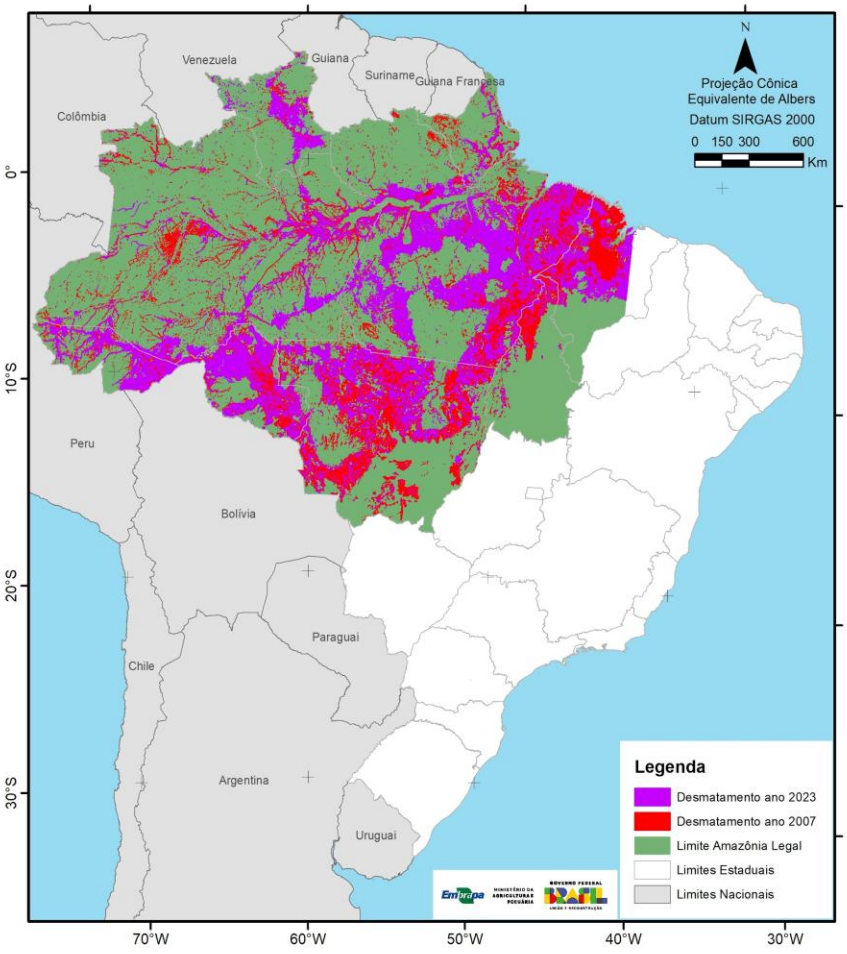
Data Source: INPE (2024b)

Figure 3 - Annual deforestation in the Cerrado biome



Data Source: INPE (2024b)

Figure 4 - Deforestation in the Legal Amazon region 2007 and 2023



Data source: INPE (2024a)

CONCLUSIONS

Despite the progress achieved in recent decades — such as the strengthening of environmental legislation, the use of more efficient agricultural technologies, and the development of new monitoring mechanisms — major challenges remain for Brazil. The high demand for economic and social development continues to place pressure on the Amazon and Cerrado biomes, requiring not only the expansion of sustainable agricultural production but also the continuous improvement of environmental enforcement and governance. Continuing along this path is uncertain in an increasingly volatile world marked by the weakening of international agreements and norms, yet it will be decisive in reconciling food security with environmental conservation.

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