

Moment of truth for the Cerrado hotspot

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Despite projections of a severe extinction event, a window of opportunity is now open for a mix of policies to avoid biodiversity collapse in the Cerrado hotspot.

Brazil's success in lowering Amazon deforestation rates by 70% from 2005 to 2013 risks becoming overshadowed by rapid clearance of the adjacent Cerrado biome. As we report here, across these 200 million hectares (Mha) of tropical savanna, a perfect storm of agribusiness expansion, infrastructure development, low legal protection and limited conservation incentives is set to trigger an extinction episode of global significance. This dismal scenario, however, can be averted. Large yield gaps in converted lands mean food production could still be greatly increased even while reducing the footprint of farming¹. Legal frameworks, policy instruments and multi-stakeholder agreements that largely account for the remarkable events in the Amazon are slowly being applied in the Cerrado, but must be scaled-up². Many pivotal decisions will be made in the coming months (Fig. 1 and Supplementary Table 1). We urge national policymakers and international stakeholders in positions to do so to rescue the Cerrado from the brink, and deliver a step change in Brazil's progress towards sustainable development.

A hotspot under threat

With over 4,800 plant and vertebrate species found nowhere else, the Cerrado is a global biodiversity hotspot. It also spans three of the largest watersheds in South America, contributing 43% of Brazil's surface water outside the Amazon. Despite its enormous importance for species conservation and the provision of ecosystem services, the Cerrado has lost 88 Mha (46%) of its native vegetation cover, and as little as 19.8% remains undisturbed. Between 2002 and 2011, deforestation rates in the Cerrado (1% per year) were 2.5 times higher than in the Amazon.

Current protection remains weak. Public protected areas cover only 7.5% of the biome (compared with 46% of the Amazon), and under Brazil's Forest Code, only 20% (compared with 80% in the Amazon) of private lands are required to be set aside for conservation. As a result, 40% of remaining natural vegetation can now be legally converted³. The country's Soy Moratorium, a key element in preventing almost all direct conversion of the Amazon to soy cultivation⁴, does not apply to the Cerrado. Of the remaining Cerrado, 88.4% is suitable for growing soybeans, and 68.7% for sugarcane, crops for which demand is predicted to rise steeply in coming decades¹. Moreover, potential funding for conservation from climate change mitigation funding bodies is currently limited. Despite warnings that REDD+ payments ('Reducing Emissions from Deforestation and Degradation', a mechanism under the UN Convention on Climate Change) might undermine conservation in biodiversity-rich but relatively carbon-poor regions⁵ and even though the Cerrado accounts for 26% of Brazilian emissions from land-use change⁶, the current rules of Brazil's main climate funding stream — the Amazon Fund — preclude conservation investments (except in monitoring) outside the Amazon.

We combined recent data from Brazil's most comprehensive assessment of its species threat status to date (Brazil's 2014 Red List) with two state-of-the-art projections of land-use change for the Cerrado^{7,8}. The picture we found is sombre. In this 'business-as usual' (BAU) scenario, the combination of limited protection and marked pressure from agricultural expansion explains the projections that 31–34% of the remaining Cerrado is likely to be cleared by 2050⁷ (Fig. 1a,b). Our calculations based on the species–area

relationship suggest that this projected deforestation will drive ~480 endemic plant species to extinction — over three times all documented plant extinctions since the year 1500 (Fig. 1d, see also Supplementary Information). This will in turn have profound consequences for Brazil's environmental standing and damaging repercussions for its agribusiness sector. Our species-by-species assessments using a continuous model for extinction risk⁹ indicate extinctions will be pronounced among those 397 threatened endemic plant species whose distributions have been individually mapped (Fig. 1e and Supplementary Information). Global losses will also be accompanied by local extinctions, potentially changing the functioning of ecosystems and their ability to provide services to local and regional communities. In addition, the anticipated conversion will emit up to 8.5 Pg CO₂e (petagrams of CO₂ equivalent) — over 2.5 times all the emissions reductions achieved in the Amazon between 2005 and 2013.

Sustainable scenario within reach

Nonetheless, this scenario is entirely avoidable without compromising agricultural growth (Fig. 1c). Our 'Greener Cerrado' scenario illustrates a possible alternative in which a policy mix is put in place to reconcile agricultural expansion, conservation of the remaining Cerrado and restoration of critical habitat for endangered species. Deployment of policies already in place or under revision could enable achievement of all of the region's projected increase in crop and beef production without further conversion of original vegetation, and even allow for targeted restoration. The growth of soybean and sugarcane production — projected to increase by 13.4

and 1.9 Mha, respectively, by 2050 — could be accommodated within agronomically suitable areas currently under pasture (and near current crop production centres and infrastructure) (Fig. 1c). As in the Amazon, the soybean industry thus has the potential to lead the transition towards sustainability by expanding its moratorium on converting natural vegetation to the Cerrado.

Changes in the region's livestock production to make space for this crop expansion without increasing conversion of the Cerrado to new pastures are also essential. Planted pasturelands account for 76 Mha of the Cerrado. Yet stocking rates (livestock per hectare) average only 35% of carrying capacity¹ (Fig. 1b). In a Greener Cerrado scenario, increasing productivity to 61% of sustainable potential until 2050 would spare all the land needed

for cropland expansion, increase beef production by 49% and still spare 6.38 Mha for restoration, equivalent to the current Forest Code deficit in the Cerrado (Fig. 1c). Such a land-sparing strategy carries the risk of a 'rebound effect' (when increased productivity leads to increased profits, which in turn spurs more expansion), but when coupled with complementary conservation measures, as proposed here, these risks are minimized¹⁰. Furthermore, there is evidence this is already happening in the south and southeast regions of Brazil¹, where the expansion of croplands is compensated by even greater reduction in pasturelands, without compromising livestock production. The choice facing the cattle industry and its partners is thus between being the main driver of the collapse of biodiversity and ecosystems (Fig. 1a,d,e) or being

a central player in a more sustainable future. Choosing the latter option requires alignment of public and private policies: the Brazilian government expanding its low-carbon agriculture plan, and the beef supply chain and its partners banning further conversion of natural vegetation.

Greater direct support for conservation is also needed, on both public and private land. It is vital that Brazilian society supports proposals to extend the Cerrado network of public protected areas, and that this expansion be strategically planned to take into account biodiversity, deforestation threat, and the need to safeguard endemic-rich areas potentially capable of acting as refugia under climate change. In parallel, regulation of the nascent market for Forest Code deficit offsets could help conserve key biodiversity areas on private lands by fostering, for example, payments for ecosystem services and private conservation areas. A set of policies aimed specifically at threatened species should be expanded and used to inform all other policies discussed here.

Restoration is key

Complementing conservation of remaining original vegetation by targeting restoration to critical areas, as recommended in the recent National Restoration Plan¹¹, could help conserve >650 threatened endemic plant and vertebrate species we estimate to be undergoing an extinction process due to past deforestation (Fig. 1d–f, Supplementary Tables 2,3). Indeed, the restoration included in the Greener Cerrado scenario, which would be a consequence of enforcing the Forest Code, could avert up to 83% of projected extinctions if directed towards critical areas such as ecological corridors (Supplementary Table 4).

Climate finance — through expanding the Amazon Fund coverage to the Cerrado, as currently under discussion by the fund's managers and donors, and channelling additional resources from the new Green Climate Fund — could play a major role in supporting these activities, commensurate with the importance of Cerrado conservation and restoration in climate change mitigation. This case is likely to be even stronger when climate change adaptation is considered, given the strategic relevance of Cerrado watersheds for Brazil's water and energy security¹². The National REDD+ Strategy¹³ is a crucial policy in this context. It already includes a focus on biodiversity safeguards, which could be expanded to incentivize biodiversity co-benefits that could make carbon storage more resilient. A key policy that has the potential to integrate many of the above is the PPCerrado Action Plan¹⁴, currently planning its third phase (2016–2020).

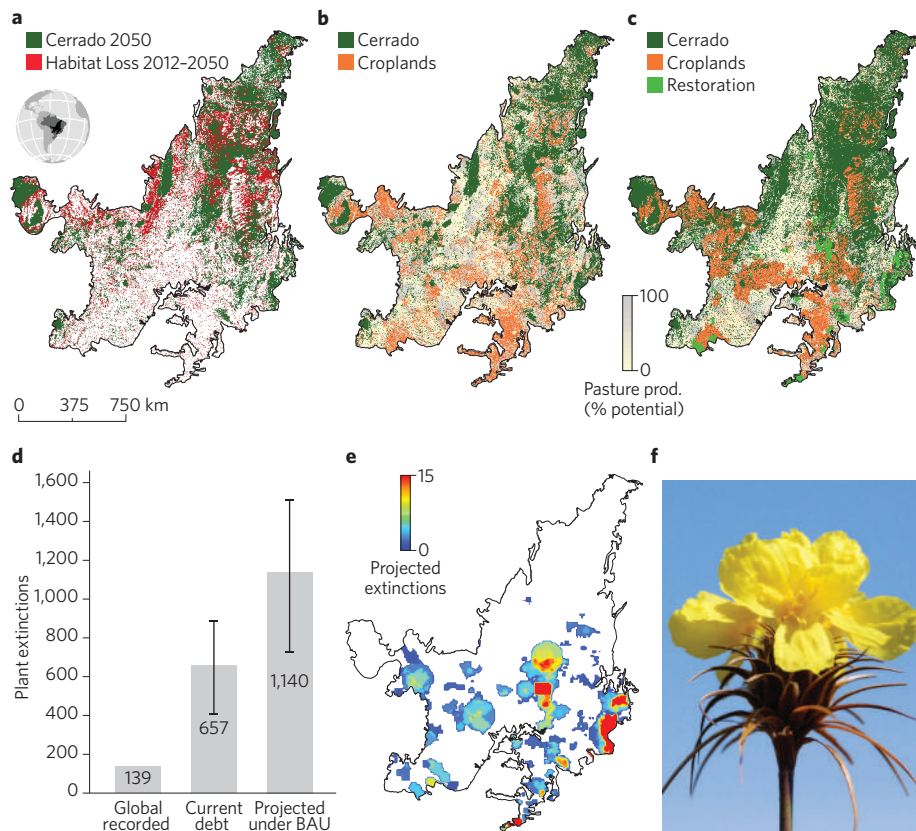


Figure 1 | Land use, deforestation and extinctions in the Cerrado. **a**, Projected deforestation (2012–2050) and Cerrado remnants in 2050, based on a business-as-usual (BAU) scenario. **b**, Land use in 2050 under BAU, and stocking rates as per cent of sustainable carrying capacity assuming continuation of the current yield gap in pasturelands. **c**, Land use in 2050 under a Greener Cerrado scenario based on narrowing the yield gap in pasturelands and restoring 6.4 Mha. **d**, Comparison of global recorded plant extinctions to date, the estimated current extinction debt among threatened endemic Cerrado plants given past deforestation (based on $z = 0.25$; see Supplementary Information), and the projected extinction debt by 2050 under BAU. Upper and lower error bars show extinction debts based on $z = 0.35$ and 0.15 , respectively. **e**, Projected extinctions among 397 endemic plant species based on BAU habitat loss until 2050. **f**, *Xyris uninervis*, a threatened endemic Cerrado species predicted to lose its entire global range under BAU, and to regain ~100,000 ha under a Greener Cerrado scenario. Panel **f** reproduced with permission from Maria das Graças L. Wanderley.

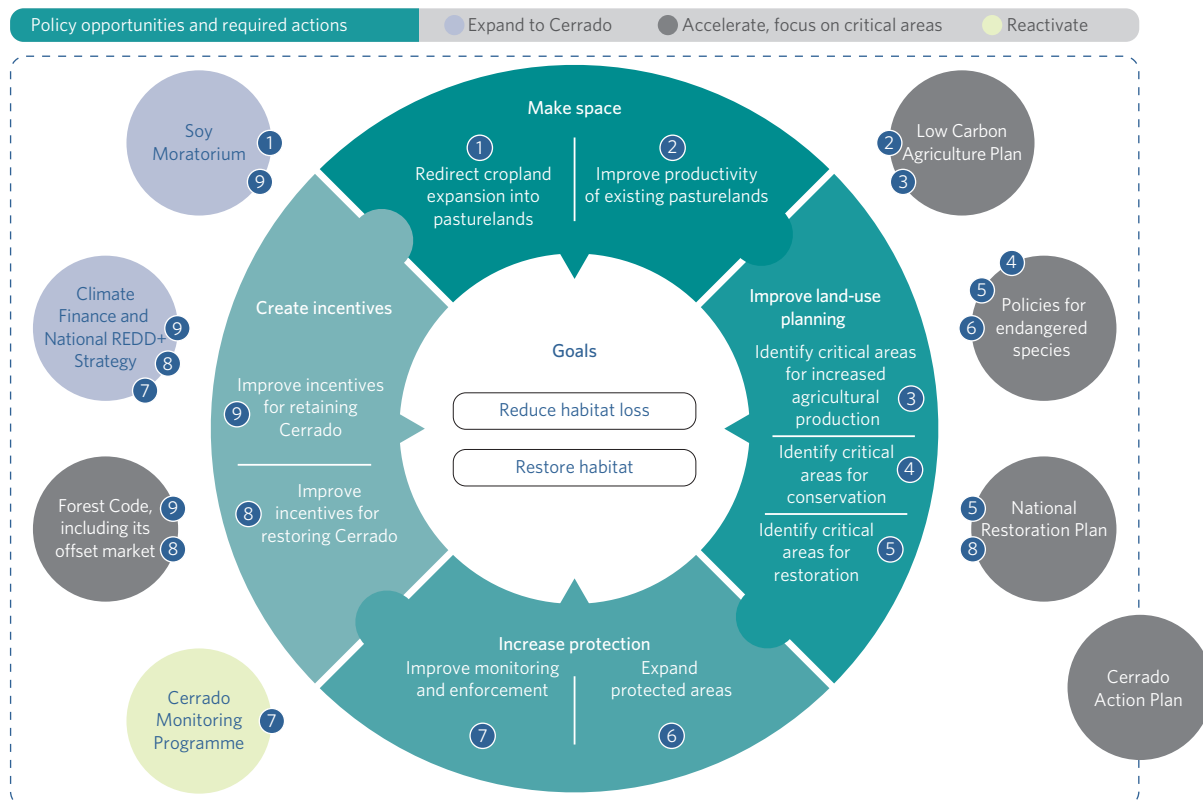


Figure 2 | The main public and private policies needed to retain and restore key Cerrado habitats while enabling agricultural expansion. To make space for deforestation-free agricultural expansion, increasing pasture productivity needs to be coupled with incentives to direct agricultural expansion to already converted lands, from increased climate finance and an expansion of the Soy Moratorium to Cerrado, to sugarcane and to beef. Increased protection would safeguard critical habitats and reinforce pressure for farm expansion into already converted lands. Improved land-use planning is vital to ensure efforts are focused in the most appropriate areas for reconciling agricultural expansion, conservation and restoration.

Each of these policies is already in place in some form in Brazil. What is now required is a concerted effort from all stakeholders — governments, supply chain actors, financial agents, NGOs and individuals — to prevent the Cerrado's environmental collapse. Brazil has done it before, providing environmental leadership and positioning its agricultural sector at the vanguard of post-2020 clean supply-chain and low-carbon development markets. This great strategic advantage, however, is now at risk of being compromised by a deforestation surge which would precipitate plant extinctions of catastrophic proportions. Not only is there a moral imperative, it is also in all these stakeholders' interests to take the substantial but demonstrably achievable steps needed to avert this crisis. □

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Additional information

Supplementary information is available for this paper.

Competing interests

The authors declare no competing financial interests.