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The challenge of commodity-centric governance in sacrifice frontiers: Evidence from the Brazilian Cerrado's soy sector

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ABSTRACT

Conservation governance is increasingly globalized, particularly supply chain polices implemented by multinational corporations. However, the ways that local elite narratives and power networks influence the design and implementation of policies is poorly understood. We examine the role that local agribusiness narratives have on producers' resistance to supply chain policies through the concept of the "sacrifice frontier". We theorize sacrifice frontiers are regions where reinforcing perceptions that conversion of native vegetation has high economic potential and low conservation importance combine with rapid processes of wealth and power consolidation by agribusiness interests. We posit that these dimensions of a sacrifice frontier make rapid land use change and ongoing social and ecological harm especially probable as they reinforce constraints on sustainability governance. Here, we build on existing theories of environmental sacrifice through the case of the Cerrado biome, Brazil's most active deforestation frontier. We argue that in the Cerrado, and other sacrifice frontiers like it, interventions that seek to reduce native vegetation loss cannot rely on supply-chain led policies, but instead need to foster more territorial multi-sectoral and multi-stakeholder discussions to alter the narrative of sociocultural and biodiversity sacrifice locally. We suggest this can be achieved by paying attention to local needs in a manner that is inclusive to all land users present within a targeted landscape.

1. Introduction

Global demand for agricultural commodities such as soybeans, cattle, palm oil, and cocoa continues to threaten natural ecosystems across the tropics, where global biodiversity and forest carbon stocks are concentrated (Curtis et al., 2018; Pendrill et al., 2022, 2019). Preventing commodity-driven native vegetation conversion has been repeatedly identified as a necessary step to avert irreversible climate change by both scientists and policy makers (e.g., Amsterdam Declaration, 2015; European Parliament, 2023; Rockström et al., 2009). This was reaffirmed at COP26 through commitments made to halt deforestation by 141 countries and 10 of the largest agricultural commodity companies (UNFCCC, 2021a, 2021b). Projections indicate that between 81 and 147 million hectares of new agricultural areas will be needed by 2030 compared to 2000 (Lambin et al., 2013). Avoiding major agricultural frontier expansion and the associated socioecological tradeoffs requires policies that can prevent agricultural expansion in regions where public policy provisions and civil society attention have historically been weak, such as tropical savannas, dry forests, shrublands, and wetlands (Budiharta et al., 2014; Lahsen et al., 2016; le Polain de Waroux et al., 2016).

Regions where governance remains weak despite high levels of land use change have been described as "sacrifice zones" (Brannstrom, 2009; Chaves et al., 2023; Oliveira and Hecht, 2016; Pires, 2020). The concept of the sacrifice zone was first applied to pollution studies (e.g., Fox, 1999; Lerner, 2012) to articulate the environmental and human costs accrued by specific geographies in the name of economic development, as well as the stigmatization and undervaluing that occurs to these regions (de Souza, 2021; Holifield and Day, 2017). The notion captures the idea that some places or peoples are "sacrificed", bearing the brunt of negative impacts to achieve the goal of broader economic development (Lerner, 2012; Ofstehage et al., 2022). The concept has been applied to phenomena including large-scale mining projects (Shade, 2015), shale fracking (Holifield and Day, 2017), and agricultural frontiers (Brannstrom, 2009). Previous applications in agricultural frontiers focused on

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environmental sacrificeability, yet recent studies have also described sacrifice zones as places of social sacrifice, where the wellbeing of certain communities is sacrificed to facilitate corporate consolidation (Heaberlin and Shattuck, 2023).

To better understand the challenges public and private governance interventions face when combatting commodity-driven land use change and its negative environmental and social harms, we revisit the concept of the sacrifice zone and incorporate it into land use frontier theory by abductively building on previous work on frontiers, sacrifice zones, and agricultural commodities. In doing so, we build a clarified and expanded theory of agricultural sacrifice zones, which we refer to as "sacrifice frontiers". We define a sacrifice frontier as *a land use frontier where the conversion of native vegetation has a high perceived economic value and low perceived conservation value, particularly relative to neighboring regions*. Importantly, the presence of such perceptions may be generated by the actions of powerful actors and vested interests, such as corporations, local elites, and agricultural lobbies (Hecht, 2005). We view sacrifice frontiers as a specific type of frontier where powerful actors' perceptions of a region's economic potential makes effective conservation policy adoption especially challenging. The idea of perceived conservation value is inclusive of multiple values that merit safeguarding, including sociocultural and biological diversity. In the act of sacrificing native vegetation for a narrow view of development, it is not just vegetation that is sacrificed, but also livelihoods and cultures that do not fit with the dominant value paradigms (Bastos Lima and Persson, 2020; Pereira and Pauli, 2016).

We argue that sacrifice frontiers are likely to exhibit less tractable challenges than other types of frontiers to international and domestic efforts to halt native vegetation loss. As such, a clearer characterization of sacrifice frontiers is important to facilitate the implementation of effective and equitable conservation policies in these regions where policy legitmacy is currently low.. This work also responds to a broader call in the study of transnational governance to better examine how local power and contestation contexts influence transnational policy design and implementation (Graz, 2021). It also responds to recent work that suggests that conservation is embedded within frontier processes in the way that land is prioritized and considered for conversion (Buchadas et al., 2022).

We expound our theorical model using observations from the Brazilian Cerrado biome. The Cerrado is the world's most biodiverse savanna ecosystem, comprised of mosaics of forest, shrub, and grassland formations (Rodrigues et al., 2022). The Cerrado is a vitally important biodiversity hotspot and the source for many of South America's most important rivers (Lahsen et al., 2016). Half of the Cerrado has already been cleared and only 19 % of undisturbed native vegetation persists. Ecological protections are low and development of remaining areas for conversion to agricultural commodities, particularly soy and cattle is still being actively promoted (Rausch et al., 2019; Russo Lopes et al., 2021; Strassburg et al., 2017).

Over a decade ago, Brannstrom (2009) posed the question of whether local governance processes in the Cerrado of Western Bahia better resemble the notion of a sacrifice zone (characterized as territories where unrestricted land use change is facilitated by agricultural lobbies) or a conservation opportunity (where global forces cause farmers to collaborate with the state and comply with environmental policies) (Hecht, 2005; Nepstad et al., 2008). Brannstrom found attributes of both models to be present in the Cerrado and identified nonstate actors (e.g., farming cooperatives and producer organizations) as promising regional conservation actors able to influence producer behavior (Brannstrom, 2009).

Since Brannstrom's designation of the Cerrado as a sacrifice zone there have also been significant advances in our understanding of the Cerrado. Native vegetation in the Cerrado has continued to be cleared and is now more threatened than ever before due to low legal restrictions and high potential profits from converting Cerrado vegetation for soybean production (Lahsen et al., 2016; Rausch et al., 2019). There has also been an increasing focus on the failures of sustainability governance in the region (Bastos Lima and Persson, 2020; Lahsen et al., 2016; Russo Lopes et al., 2021). Despite increasing global action to eliminate native ecosystem conversion from food supply chains, conversations about how to implement companies' zero-deforestation commitments (ZDCs) in the Cerrado have stalled (Bastos Lima and Persson, 2020; Chaves et al., 2023). Nonstate actors are increasingly hostile to punitive conservation approaches to completely ban soy-driven ecosystem conversion in the Cerrado, yet alternative approaches to incentivize conservation are lacking (Garrett et al., 2022). Critiques against market-based initiatives have gained renewed attention in global conservation governance debates. Political ecology and critical geography scholars continue to question the neoliberal governance assumption that the companies who indirectly drive negative vegetation loss can be expected to stop ongoing clearing simply by helping channel more finance and incentives toward increased productivity on already cleared areas (Baletti, 2014; Delabre et al., 2020; Panwar et al., 2023). Delabre et al. (2020), for example, questions whether corporations are truly willing to forgo the financial benefits native vegetation loss brings. In light of this expanding literature on sustainability narratives, land system dynamics, and the future of environmental governance in the Cerrado, Brannstrom's question about the nature of the Cerrado in conservation policy debates requires revisiting.

The Cerrado may also be a parable for non-forest ecosystems around the world that are increasingly threatened with sacrifice for industrial agriculture, including South America's Llanos, Gran Chaco, and Chiquitania (Etter et al., 2010; le Polain de Waroux et al., 2016; Song et al., 2021; Zak et al., 2004), the Great Plains of North America (Wright and Wimberly, 2013), Australia's downs and savannas (Forbes, 2022; Stokes et al., 2006) and Africa's dry forests, savannas, and grasslands (Gardner et al., 2016; Gasparri et al., 2016; Phalan et al., 2013). There is a growing literature on the resistance of agricultural actors to environmental governance in many non-forest ecosystems that is highly similar to that seen in the Cerrado (Henderson et al., 2021; le Polain de Waroux et al., 2016; Zak et al., 2004).

Here, we expand existing theorization of land use change in frontiers by abductively building a conceptual framework that outlines the characteristics of sacrifice zones in land use frontiers, as well as the expected land use and policy implications of this characterization. We investigate existing land use and policy narratives present in the Cerrado biome to show the ways a sacrifice frontier manifests in public and individual narratives of the Cerrado. We ask: to what extent do agricultural value chain actors present the Cerrado as a sacrifice frontier? We examine this question using both semi-structured interview data and a review of existing evidence on agricultural frontiers and soy, land use change, and development in the Cerrado. We then examine how identified narratives of sacrificeability influence potential policy pathways to curb deforestation, especially private-sector approaches. Through this we provide a clear and applicable theory of the sacrifice frontier, expound it through a critical case, the Cerrado biome, and explore its applications for sustainability governance. Because the Amazon and Cerrado collectively constitute a large remaining agricultural frontier in the agricultural development plans and trajectories of Brazil, our work often relies on comparing decisions and policies taken in the Amazon and how they contrast to those in the Cerrado. In this way the sacrificeability of the Cerrado is framed in terms that are relative to the sacrificeability of the Amazon.

2. Theoretical framework

In the context of land use change, for native vegetation to be sacrificeable it is necessary that it is portrayed as having high promise for economic development as well as relatively low conservation value (Oliveira and Hecht, 2016). A frontier is generally considered to be a region or collection of adjoining regions with rapid and extensive native

vegetation conversion, with the minimum region determined as the smallest level at which political decisions on land use are made, such as the county or municipality level (Pacheco, 2012; Rodrigues et al., 2009). The frontier nature of a region entails not only a rapid process of vegetation conversion, but also a rapid accumulation of wealth and power for a narrow subset of the population due to the presence of high rents and limited governance, further increasing the leverage of these elites to shape societal narratives (le Polain de Waroux et al., 2018).

We view the sacrifice frontier as a unique type of frontier, highly appealing to corporations and highly resistant to environmental governance. Sacrifice frontiers are related to neoliberal and corporatist frontiers identified previously (Browder and Godfrey, 1997; le Polain de Waroux et al., 2018; Pacheco, 2012). However, the sacrifice frontier is distinct in actors' heightened ability to resist environmental governance locally due to the logic of national or regional development brought through environmental sacrifice. Sacrifice frontiers are therefore particularly vulnerable to rapid land use change. By downplaying their conservation value relative to other regions, the conversion of sacrifice frontiers for anthropogenic use may even be characterized as a "win–win" for development and the environment by land use actors and policy makers (Andersson, 2021; Buchadas et al., 2022).

We expect that sacrifice frontiers can occur anywhere where there is extensive native vegetation that could be converted and a political desire for economic development. Likewise, sacrifice frontiers could be driven by any sector, including mining or waste disposal, that is sufficiently widespread to generate rapid and extensive native vegetation conversion at the county level or higher. Agribusiness is a major driver of economic growth and land use change globally. However as these trends are especially pronouced in the tropics, we expect sacrifice zones to be most common in tropical and subtropical agricultural frontiers (Cervantes-Godoy and Dewbre, 2010; Pendrill et al., 2022).

As decisions on land use policy often occur at the national or regional level, sacrifice frontiers are often defined in relative terms – i.e., to meet food security or economic development goals, those regions most acceptable/beneficial for conversion are those most likely to be sacrificed. This same process can occur through focused attempts to conserve specific regions, leading to neighboring landscapes being systematically undervalued as worthy of conservation. Olivera & Hecht (2016) argue that in South America, civil society campaigns to protect the Amazon failed to include neighboring regions to the south and east, including the Chaco and Cerrado biomes, thereby helping to redirect agriculture to these places. It is expected that due to "forest bias" (the overemphasis on above ground biomass in conservation), this sacrificeability will be stronger for sparsely wooded or non-forested ecoregions that neighbor densely forested biomes (Bonanomi et al., 2019; Sawyer, 2008). Indeed, there is strong evidence that the world's grasslands, wetlands, and dry forests are highly threatened and highly undervalued globally (Lehmann, 2010; Parr et al., 2014). The dry forests of the Gran Chaco, the grasslands of Australia, North America, China, Southern Africa and India, and the spiney forests of Madagascar all have the high levels of land use change and low conservation attention that are characteristic of sacrifice frontiers (Chang et al., 2022; Gardner et al., 2016; Gasparri et al., 2016; Henderson et al., 2021; Kumar et al., 2020; Stokes et al., 2006; Wright and Wimberly, 2013).

Who does this undervaluing is also significant. Local and regional elites often play an outsized role in activating and expanding frontiers (German et al., 2014; le Polain de Waroux, 2019; McCarthy, 2010). To support elite benefit capture, these groups often promote and disseminate narratives that resist governance and promote their role in regional development (Adams, 2015; Taravella and Arnauld de Sartre, 2012). Within a sacrifice frontier, marginalized groups such as Indigenous Peoples or traditional communities may value the region very highly, but unless they are able to alter the dominant narrative of those driving land use change it is unlikely to prevent the region undergoing large-scale losses of native vegetation. While marginalized groups have successfully contested land use change discourses in several regions (e.g., Hope, 2021; Schwartzman and Zimmerman, 2005), most frequently they are unable to alter agricultural development narratives or frontier expansion (e.g., Bastos Lima and Persson, 2020; Eloy et al., 2016). Therefore, due to the key role that elites have on frontier expansion, we expect that elite narratives play an especially critical role in sacrifice frontier expansion.

While elites are likely to capture much of the benefits of land use change and participate heavily in the narratives used to motivate this conversion, non-elites are especially likely to bare the negative impacts of a sacrifice frontier. Frontier regions are never empty and contain a range of communities, cultures, and economies that do not fit well with the neoliberal economic paradigm promoted in sacrifice zones. As a result, territorial sacrifice necessarily results in sociocultural sacrifice for marginalized groups in these frontiers. Often these groups are Indigenous and traditional communities for whom the native vegetation provides key ecosystem services, ranging from provision of foodstuffs and building material to cultural and spiritual services (Pert et al., 2015; Sangha et al., 2018). Dominant narratives of sacrifice used to justify land grabs will likely lead to the degradation of these ecosystem services (Pereira and Pauli, 2016), polluting water sources and other vital resources (Hooks and Smith, 2004). These processes will likely cause maldevelopment, where frontier expansion in the name of economic development harms rather than helps Indigenous and traditional communities (Russo Lopes et al., 2021).

2.1. *Expected pathways to land use change in sacrifice frontiers*

Frontier expansion occurs when conditions change so that land that was not previously financially, socially, or politically feasible for production becomes viable (e.g., via changes to accessibility, policy frameworks, development narratives, demographics, agricultural technologies, commodity prices, or production/trade incentives) and there are actors present locally with the desire and ability to capture the land rents available (le Polain de Waroux, 2019; le Polain de Waroux et al., 2018; Meyfroidt et al., 2018; Pacheco, 2012). Frontier expansion often occurs extremely rapidly due to the presence of abnormal rents, a disequilibrium between economic rent (land's economic value) and bid rent (the price that actors are willing to pay for land) that allows for very high returns, until increased competition and investment causes bid and economic rent to converge (di Tella, 1982).

Despite the presence of some or all of these factors, frontier expansion can slow due to unexpected challenges and changing conditions or be intentionally stopped due to policy interventions (García et al., 2021; Gibbs et al., 2015). Actors who seek to take advantage of abnormal rent in frontiers are exposed to higher risk than in consolidated regions, contributing to the disequilibrium between bid rent and economic rent. However, in a sacrifice frontier the risks individuals are exposed to are expected to be considerably lower than in other types of frontiers. Due to the low perceived conservation value, the threat of a future conservation policy closing the frontier is likely reduced. The high agricultural potential, whether actual or perceived, increases both producers and other agribusiness actors' robustness to unexpected challenges or setbacks, due to a strong belief that abnormal rents will be realized (le Polain de Waroux et al., 2018). This reduced risk facilitates more rapid investment and agglomeration in sacrifice frontiers than other frontiers, resulting in an influx of well-capitalized actors and especially rapid and widespread conversion of native vegetation (Garrett et al., 2013). Agglomeration is where firms cluster in close proximity to one another, resulting in positive externalities such as knowledge transfer and reduced infrastructure costs, helping to increase the intensity of frontier expansion agriculture (Garrett et al., 2013). The disequilibrium between bid rent and economic rent is therefore expected to be shorter lived, making sacrifice frontiers an especially competitive frontier where we expect less risk-tolerant actors to be willing to engage in frontier expansion than would be found elsewhere. Such sustained investment likely reduces the risk of a "bust" following the initial frontier "boom", likely further

enhancing agglomeration (Barlow, 2023).

This is compounded by a propensity for political consolidation by pro-development institutions, particularly through an increased influence on local, regional, and national policy and policymakers. Pro-development institutions in agricultural frontiers include commodity industry associations, agricultural lobbies, and producer groups. In competitive, agglomeration-prone frontiers which lack a strong environmental narrative locally, both the actors and incentives are present to build or reinforce pro-development institutions (Brannstrom, 2009). Likewise, we expect weak pro-conservation entities locally, reducing the presence of a counterbalance to development narratives (Brannstrom, 2009; Hecht, 2005). In sacrifice frontiers that exist in part due to high levels of conservation pressure in neighboring regions, this effect is compounded by an ability for land users and pro-development institutions to observe the effects of policies implemented in regions targeted for conservation (Bastos Lima and Persson, 2020). Conservation polices observed in neighboring regions can provide concrete examples for pro-development or pro-agriculture groups to rally around, likely leading to increased political importance of such organizations regionally (Holmes, 2007; Mammadova et al., 2020). Indeed, unlike the classical portrayal of a frontier as a region characterized by high uncertainty that is challenging for expansion, pro-development institutions may portray the sacrifice frontier as an opportunity that cannot be lost (Ioris, 2016; Meyfroidt et al., 2018). Together, the lower risk of frontier collapse and higher ability to resist conservation policies creates an extremely robust setting for rapid and sustained frontier expansion (Fig. 1.1). Conversely, previous work on the Amazon by Garrett et al. (2013) has found that presence of strong conservation policy at the onset of frontier formation can help arrest frontier positive feedback loops, discourage business investment and power accumulation, leading to worsening conditions for agribusiness and lower agricultural expansion.

2.2. *Expected policy implications of a sacrifice frontier*

The risk of rapid and extensive frontier expansion in sacrifice frontiers is compounded by unfavorable conditions for strong public or private conservation policy development. The perception of both high economic potential and low conservation value increases the entitlement of local land users regarding their right to open land for economic development (Garrett et al., 2022). This occurs both via a belief in the importance of frontier expansion locally for economic development and food security (le Polain de Waroux et al., 2021; McDonald, 2003) and an "attitude of unconcern" regarding natural vegetation (Geist and Lambin, 2002). This, in tandem with the political consolidation of pro-development institutions, is likely to create extremely hostile conditions for public policy creation in sacrifice frontiers. Within such regions we expect there to be a highly motivated and organized population that are opposed to increases in conservation governance locally (Hecht,

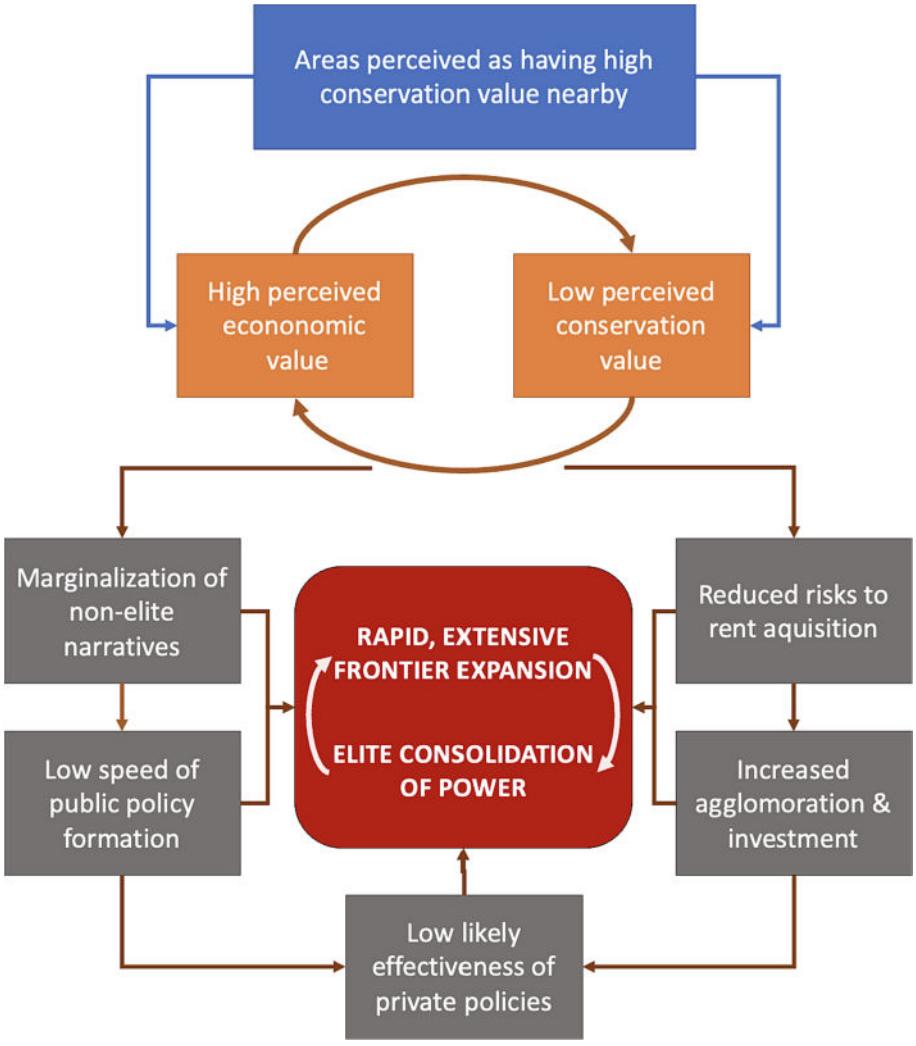

Fig. 1.1. Diagram representing the processes driving frontier expansion and elite consolidation of power in a sacrifice frontier. Necessary conditions of a sacrifice frontier are shown in orange, reinforcing features are shown in blue, resultant drivers of land use change are shown in grey, and land use outcomes are shown in red.

2005). We therefore expect that the formation of public policies conducive to conservation to be slower in sacrifice frontiers than other types of frontiers and the likelihood of antagonistic policies to be higher (Fig. 1.1). This may also reinforce tendencies for maldevelopment, economic development that worsens the conditions of many stakeholders, particularly those who are excluded from policy processes (Russo Lopes et al., 2021).

As private sustainability policies made by agricultural commodity companies exist outside of the legal framework, they can be adopted even during periods or in locations where there is insufficient political will for public conservation policies (Lambin et al., 2018). Uptake of private initiatives can be rapid, but to go beyond "greenwashing" and have impacts on the ground they require monitoring and enforcement mechanisms, which often necessitates public policy support (Austin et al., 2021; Garrett et al., 2019). Because private policies are primarily adopted voluntarily in response to public pressure, sacrifice frontiers may present a challenge for their effectiveness since such public sentiment is often relatively weak or lacking.

High market coverage and sticky (i.e., stable and consistent) trade relationships are associated with effective supply chain conservation policies (Levy et al., 2023; dos Reis et al., 2020). Sacrifice frontiers, due to their rapid agglomeration and competitive dynamics, are unlikely to maintain either high market coverage or sticky trade relationships. This is because the high expectations of frontier expansion and increased production is likely to incentivize new traders to enter the commodity sector, including those without sustainability policies. Such new actors present additional opportunities for trade relationships for producers who wish to open new areas (Abeygunawardane et al., 2022). Sacrifice frontiers therefore tend to lack conducive conditions for effective public or private conservation policies. However, these same conditions also imply that in sacrifice frontiers the potential for high additionality if enough companies could fully implement zero-deforestation policies.

3. Methods & case study context

3.1. Case study context

The Cerrado is the world's most biodiverse savanna, containing an estimated 5 % of the planet's species (Green et al., 2019) and an estimated above ground carbon stock of 12 billion tons (Freitas et al., 2018). The Cerrado is also home to numerous Indigenous Peoples and traditional communities including quilombolas, geraizeiros, sertanejos, vazanteiros, and riberinhos for whom the Cerrado's native vegetation is of fundamental importance to their livelihoods and cultures and who play a key role in ecosystem management in the region (Ferreira et al., 2022; Lahsen et al., 2016). However the ecological, cultural, and climatic importance of the ecoregion are widely underappreciated, even by those living in urban centers within the biome (Bizerril, 2004). Native vegetation in the biome varies from dry forest to wooded savanna and open grassland (Ratter et al., 1997). This has contributed to the Cerrado being overshadowed by the dense tropical forests of the Amazon biome for national and international conservation efforts (Lahsen et al., 2016; O'Riordan, 2016).

The Cerrado is considered highly suitable for largescale soy production, as the region is characterized by an abundance of flat plateau, soil types and hydrographic networks that are conducive to mechanized crop agriculture (Rausch et al., 2019; Soares-Filho et al., 2014). However, these conditions were only realized after a series of technological advances to generate crop varieties and soil management practices suitable for Cerrado (Alves, 2016; Hosono and Hongo, 2016; Lopes, 1996), coupled with social and political shifts to present the biome as highly suitable for agriculture and important for national development (Da Silva, 2019; Da Silva and De Majo, 2023; Russo Lopes et al., 2021). Through this process, often described as a "miracle", the Cerrado went from being considered inhospitable for industrial agriculture to one of the world's key breadbaskets (Rada, 2013; The Economist, 2010).

Half of the biome has already been cleared for agricultural use, primarily soy production and cattle ranching (Project MapBiomas, 2020). Soy expansion alone was responsible for the clearing of 14 Mha of Cerrado vegetation between 2003 and 2017 (zu Ermgassen et al., 2020). The majority of remaining Cerrado vegetation is in the north of the biome, known as Matopiba. This region encompasses 73 Mha and 337 municipalities in the states of Maranhão, Tocantins, Piauí and Bahia, whose initials give the region its name (Fig. 1.2). In recent years, Matopiba has seen a rapid expansion in crop production, often at the expense of natural vegetation (de Araújo et al., 2019). This has occurred due to low land prices, the development of suitable seed varieties, and political support (Russo Lopes et al., 2021). Soy expansion in Matopiba has been linked to major ecosystem losses, carbon emissions, land grabbing, and social conflict (Calmon, 2020; Eloy et al., 2016; Strassburg et al., 2017), as well as GDP growth and infrastructure development (Carneiro and Costa, 2016). These land use and socioeconomic changes are associated with lower air quality, higher exposure to diseases, and a loss of traditional livelihood options, all of which threaten the diversity and wellbeing of those residing in the biome (Rekow, 2019; Russo Lopes et al., 2021; Silva et al., 2023).

Despite being one of the world's biodiversity hotspots, the Cerrado is weakly protected (Klink and Machado, 2005). Just 7.5 % of the biome is within protected areas (Fig. 1.2), one of the lowest rates for any Brazilian biome (Rausch et al., 2019) and the Brazilian Native Vegetation Protection Law, colloquially known as the "Forest Code" (Law 12.651/2012), only requires 20–35 % of rural properties to be protected within the Cerrado, far less than the 80 % required in the neighboring Amazon biome. PRODES and DETER, Brazil's public deforestation monitoring platforms only expanded to the Cerrado in 2016, despite PRODES having been present in the Amazon biome since the 1970s and DETER since 2004 (Parente et al., 2021). Likewise, implementation, inter-ministerial coordination, and efficacy of the Brazilian government's Deforestation and Control plan in the Cerrado (PPCerrado) has been weaker than the PPCDAm, the equivalent policy in the Amazon biome (Hochstetler and Keck, 2007; Lahsen et al., 2016). Policies antagonistic to conservation are also present in the region with Matopiba being designated and targeted for investment through a Federal Government Agricultural Development Plan (*PDA-Matopiba*) (Government of Brazil, 2015). This was accompanied by technical reports from Embrapa, the state-owned Brazilian Agricultural Research Corporation, arguing Matopiba to be the region of Brazil with the highest potential for the expansion of arable land in Brazil (de Miranda et al., 2014). Although the new government under Luiz Inácio Lula da Silva is seeking to strengthen environmental governance across Brazil, including via a decree to strengthen the PPCerrado (Presidência da República, 2023), President da Silva's inaugural decrees and inaugural speech heavily focused on the Amazon biome (da Silva, 2023).

Private policy coverage has been increasing in the region and several of the largest companies sourcing from the Cerrado have adopted market exclusion ZDCs. 46.5 % of soy exported from the Cerrado was traded by companies with a zero-deforestation policy in 2017, a dramatic increase from 0 % in 2013 (zu Ermgassen et al., 2020). These policies were adopted individually, and each has differing rules, rigor, and implementation timelines, which creates the potential for gaps and misalignment that may reduce their effectiveness. In general, the global or Cerrado-specific commitments present in the region are vague and lacking in clear implementation timelines (zu Ermgassen et al., 2020). Likely as a result, existing research indicates that ZDCs have not had a statistically significant effect on deforestation in the Cerrado (Gollnow et al., 2022; Leijten et al., 2022). Recent collective agreements, such as the NYDF (2014), the Cerrado Manifesto (2017), and the Soft Commodities Forum (2019) may increase pressure on producers in coming years. However, these agreements currently do not require signatories to exclude non-compliant producers. A recent study by Gollnow et al. (2022) suggests that avoided soy-driven deforestation could be substantial in the Cerrado, should existing global zero-deforestation

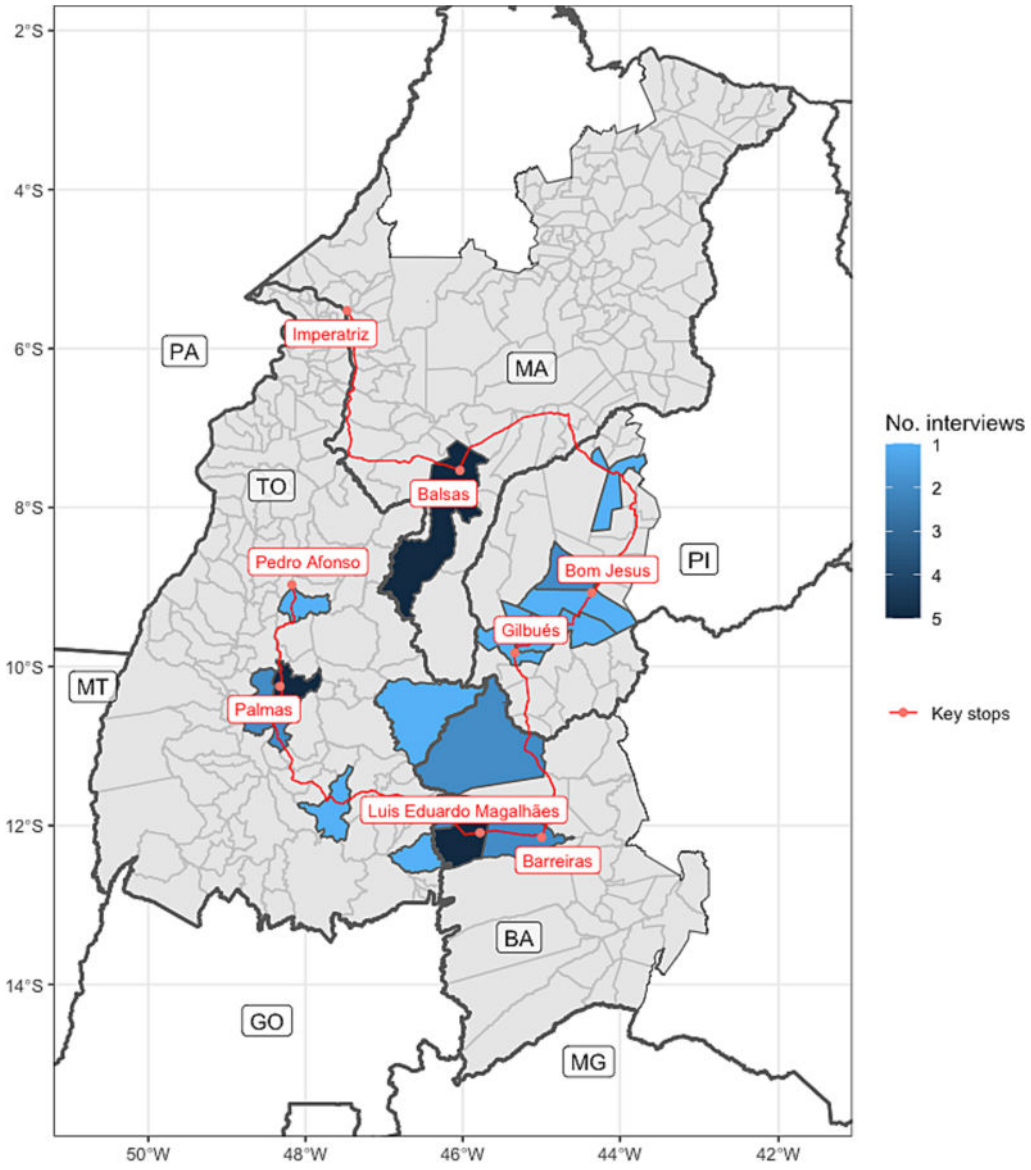

Fig. 1.2. Location of interviews and route taken during fieldwork, including key stops. A key stop is defined as any location where a considerable number of interviews took place (i.e., where we met with producers from surrounding regions) as well as the start and end point of the route taken across Matopiba. Municipalities within Matopiba where no interview took place are indicated in grey.

commitments related to soy be implemented through a strict market exclusion approach equivalent to that of the Amazon's Soy Moratorium, even considering the limited market coverage of such commitments regionally.

3.2. Methods

To assess how agricultural supply chain actors characterized the Cerrado in conservation and development debates we focused on the region of Matopiba, the most active soy frontier in the Cerrado. We executed detailed semi-structured interviews in 16 municipalities, spread across all four states of the Matopiba Region (Fig. 1.2). This was supported by a review of the existing scientific and grey literature on soy land use and governance in the Cerrado (in English and Portuguese). In total, we conducted 27 interviews with 32 stakeholders, including 22 producers and 16 experts, all of whom were interviewed in May and June 2018 (Table 1.1). In addition to the information below, further details regarding the interviewees and the positionality of the fieldwork executors can be found in the Supplementary Information.

3.2.1. Sampling strategy

As the purpose of our fieldwork was to understand the perceptions driving land use change in frontier regions of the Cerrado, municipalities were selected based on three criteria: (i) soy production was high or rapidly increasing (IBGE, 2021), (ii) soy production was present on land converted from native vegetation within the previous five years (Project MapBiomas, 2020), and (iii) firms with ZDCs sourced from these municipalities (Trase, 2020). These criteria were used to ensure that we captured areas that were active soy frontiers, in line with our definition of a frontier as a municipality with rapid and extensive native vegetation conversion and to ensure we captured both private and public governance measures in the region. 31 % of these municipalities were subsequently selected as part of the 25 Cerrado priority municipalities by the Soft Commodities Forum in 2019, rising to 61 % of the newly expanded 2021 list (SCF, 2021, 2019).

We sought to interview as wide a range of stakeholders as possible. Participants included soy growers, producer organizations, government officials, civil society organizations, agribusiness representatives, researchers, agricultural input vendors, and farmers producing goods

Table 1.1
Breakdown of types of stakeholders interviewed by state and municipality. In the case of producers, municipality reflects location of their primary farm, not the location of interview. Numbers indicate the number of interviews, not interviewees.

States	Municipality	Stakeholders interviewed
Maranhão (5)	Balsas (5)	Soy producer | Other producer | Researcher | Supply chain actor | Civil society organization
Tocantins (7)	Palmas (4)	Researcher | NGO | State government | Producer organization
	Porto Nacional (1)	Other producer
	Pedro Afonso (1)	Producer organization
	Natividade (1)	Soy Producer
Piauí (7)	Gilbués (1)	Soy producer
	Monte Alegre do Piauí (1)	Other producer
	Redenção do Gurguéia (1)	Soy producer
	Currais (2)	Soy producer | Other producer
	Bom Jesus (1)	Civil society
	Sebastião Leal (1)	Soy producer
Bahia (8)	Luiz Eduardo Magalhães (4)	Soy producer | Producer organization | Soy buyer (2)
	Barreiras (2)	Soy producer | Civil society organization
	Formoso do Rio Preto (2)	Soy producer | Other producer

other than soy, including smallholders. We included non-soy producers to understand how soy-driven sacrifice frontiers are affecting individuals in the broader landscape and to identify whether other actors' narratives contrasted those of soy actors. We did this as the negative effects of soy expansion are often felt by marginal individuals such as smallholders, who often do not produce soy themselves (Eloy et al., 2016; Russo Lopes et al., 2021). Additionally, we attempted contacting the local agricultural workers' representatives (e.g., the *sindicato dos trabalhadores e trabalhadoras rurais*), but were unable to reach them by telephone or at their local offices. Due to local legal and ethical restrictions, we could not interview members of indigenous or traditional communities (e.g., *quilombola* communities), marginalized groups that are also often adversely affected by soy development (Eloy et al., 2016). These restrictions include obtaining consent from Indigenous leaders, the National Indigenous Peoples Foundation (FUNAI), the National Historical and Artistic Heritage Institute (IPHAN), the National Council for Scientific and Technological Development (CNPq), and the National Health Council (CONEP) (CEP/UFCAT, 2016).

In the key municipalities identified we conducted purposeful sampling of important gatekeepers such as producer organizations and well-connected value chain actors (e.g., agricultural input vendors or local researchers). We then used a snowball sampling approach alongside cold calling of producers and experts to identify additional participants (Patton, 2014; Silverman, 2013). These techniques were used as a strategy to ensure we were able to reach as wide a range of actors as possible. Soy farms in Matopiba are often gated and owned by individuals that live some distance from the property (Eloy et al., 2016). This makes them hard to reach without first contacting gatekeepers. Cold calling was conducted to ensure the participation of more marginal producers who are less well connected to the gatekeepers identified and thus less likely to be identified through our snowball approach. This method yielded a rich qualitative dataset of 27 interviews with 34 stakeholders, including 13 producer and 14 expert interviews with 18 and 16 participants respectively (Table 1.1). The distribution of interviews was 34 % in Tocantins, 28 % in Bahia, 22 % in Piauí and 16 % in Maranhão.

3.2.2. Interviews

Semi-structured interviews were conducted in Portuguese by two of the co-authors on farms or in agribusiness/producer organization offices and guided by a set of open-ended questions (see Supplementary Information S4) that was approved by IRB/Human Subjects (Protocol #4543X). Question guides differed for producers local experts (e.g., agribusiness representatives, policy makers, NGO representatives), but all participants were prompted to talk about their perception of several key themes*:* (i) *the development and impacts of soy in the region;* (ii) *the public and private policy context of soy production;* and (iii) *the quality/availability of soy buyers locally*. Additional questions, including the interviewees background, household, production system, credit access, group membership, as well as their general concerns and challenges, were also asked. All participants were asked basic personal information, but otherwise questions were guided by participants responses to our questionnaire (Adams, 2010). So far as we were able, participants were sought out until thematic saturation was achieved for each topic in all four Matopiba states and for both producers and experts (Saunders et al., 2018). Both soy buyers across the region and soy producers in Maranhão were underrepresented due to difficulty in gaining consent for their participation limiting our ability to assess state-level saturation in that state. However, those responses gained in Maranhão were consistent with those in other Matopiba states. Due to the political sensitivity of land use management and commodity-driven native vegetation conversion in Brazil we did not record interviews digitally and ensured full anonymity for all participants.

Interviews were always conducted by two researchers, who both took notes during the interviews and combined, compared, and organized these as soon as possible after each interview. This was done to ensure recording was as full and accurate as possible in each case. Responses were then sorted into the main themes of the questionnaire. When indicating participants' perspectives in the results, the farmer or expert who supported the result is listed in parentheses. Participants' identities are anonymized and replaced with a numeric code (e.g., Farmer 1; Expert 8). A full table of the codes attributed to each individual and some basic, non-identifying characteristics are provided in the Supplementary Information. To ensure issues are portrayed in the stakeholders' own words where possible we make use of quotations, provided as paraphrased translations from the original language. Additionally, some proportions are provided to indicate agreement amongst the sample. However, as sampling is not representative of the entire study region, these figures should not be interpreted as representative of the views of the soy value chain population in the Cerrado, but rather are indicative of agreement amongst the sample.

3.2.3. Participant characteristics

There were two groups of participants in this study: *agricultural producers* and *local experts*. Some participants met the criteria for both agricultural producers and local experts, for instance due to them owning a farm and holding leadership positions in local agricultural associations. In these cases, we asked questions from both interview guides and treated them as local experts for the purpose of classification. Respondent's farm sizes varied from 24 ha to 26,000 (median 941) but our sample was overall biased towards larger, more capitalized farmers. The mean property size of our interviewees (3484 ha) was roughly twice that of the mean soy farm size within the Matopiba in 2017 (1645 ha) (IBGE, 2020). 57 % of the producers interviewed were soy growers, half of whom also raised cattle, either alongside their crops or in an integrated system. The non-soy producers all produced cattle, in some cases alongside vegetables and non-soy crops. Only one producer stated that agriculture was not their primary income source, although 46 % also had off-farm income. The median age was 57 and 92 % were male. A majority of the interviewed soy producers had migrated from the South of Brazil, where there is a long history of annual crop production. Non-soy producers were mixed, coming from the Northeast (43 %), the South (29 %) and the Southeast (14 %). Data from these interviews are also

reported in Garrett et al. (2022) to assess the potential implications of using payments for environmental services versus market exclusion mechanisms to implement ZDCs in the Cerrado. The same producer coding is used in both works to aid clarity of understanding.

4. Results: The Cerrado as a sacrifice frontier

In the following section, we examine and expound our sacrifice frontier theory through the case of the Cerrado biome. We integrate regional evidence from fieldwork with local stakeholders in Matopiba, the existing literature, and available information on agribusiness activities and land use change in the region to deepen our theoretical model and explore how sacrifice frontiers function on the ground.

4.1. High perceived economic potential and frontier rent opportunities

The economic potential of the Cerrado has been identified by academics (Soares-Filho et al., 2014), soy industry organizations (Rudorff et al., 2015), Embrapa (de Miranda et al., 2014), the Brazilian federal government (Government of Brazil, 2015), the United States Department of Agriculture (USDA, 2012), and international media agencies (The Economist, 2010; The New York Times, 2007). The Cerrado contains the majority of non-utilized land suitable for soy in Brazil, the most important agricultural export nationally (Rausch et al., 2019; Soares-Filho et al., 2014). The region has been promoted as having "promising growth expectancy" for soy due to the soil characteristics, favorable rainfall regime, and especially, the low price and availability of land (Carneiro and Costa, 2016; Costa et al., 2021). The potential to expand on already cleared pastures is an often highlighted narrative, despite regional differences in the availability of suitable pastureland (Romeiro et al., 2018).

The economic importance and favorable conditions for industrial agriculture present in the Cerrado were also identified by all participants interviewed, several of whom emphasized the relative economic importance of the Cerrado versus the Amazon (Farmer 13; Expert 7, 10). Expert 10 typified this sentiment by saying that "Matopiba is good for agribusiness because there is still a lot of potential land to open…and lots of flat plains which are good for planting grains." Although participants broadly agreed with the importance of the Cerrado for soybean cultivation (Expert 1, 5, 7, 10, 12, 13), several participants reflected that available cleared land currently used for pasture were on highly undulated terrain, unsuitable for largescale crop agriculture such as soybeans (Expert 2, 8) and that future expansion in Matopiba would need to be at the expense of native vegetation (Expert 10).

The prevailing sentiment amongst participants was that Matopiba remains both a frontier and an opportunity for rent acquisition (Farmer 12; Expert 2, 4, 9, 11, 12, 14), a sentiment also held amongst academics, civil society, and policy makers (Bezerra and Gonzaga, 2019a; Calmon, 2020; Pires, 2020; Romeiro et al., 2018). Surveying of soy producers in West Bahia by the Soft Commodities Forum found 60 % of farmers wanted to expand their soy area, with 54 % viewing the conversion of native vegetation as the most cost effective solution to achieve this (SCF, 2021). Likewise, our interviews identified several farmers stating that they had recently or were actively trying to open new areas for agriculture (Farmer 4, 8). Despite the perception that the region remains a frontier, producers generally did not perceive the Cerrado as a high risk environment for agriculture as is normal in agricultural frontiers (Jepson, 2006). Three of the farmers interviewed felt that their farms faced no risk to security of income (Farm 10, 11, 14). For those who identified risks, the primary concerns identified were primarily not related to the frontier status of the region, but rather focused on the local climate (Farm 1, 2, 4, 5, 6, 7, 8, 11, 12; Expert 1, 2, 3, 4, 5, 7, 9, 10, 11, 13). While frontier expansion and local climate change are linked (Aragão et al., 2008; Rodrigues et al., 2022), this was not the perception of interviewees.

4.2. Low perceived conservation threat from rent-seeking activities

In line with previous work, we found that the importance of conserving the Cerrado, for biodiversity, carbon stocks, or for use by traditional or indigenous communities was undervalued in industry and political dialogues regarding the Cerrado (Bezerra and Gonzaga, 2019b; Bonanomi et al., 2019; Lahsen et al., 2016). We found that Aprosoja, the major soy producers' association in Brazil, downplayed any conservation threats in the region, explicitly stating in an open letter to international actors, "The Brazilian Cerrado is not threatened with extinction and soy is not a relevant factor in deforestation…the soybean area in the Cerrado of MATOPIBA can double without threatening the preservation of the biome, contrary to what is said by Europeans and their NGOs" (Aprosoja Brasil, 2019).

Although several participants reflected that conserving the Cerrado was important, particularly for protecting water supply (Farmer 5, 11; Expert 9, 11, 14), it was also reflected that the conservation value of the Cerrado was low, especially relative to the Cerrado's economic potential and also to the neighboring Amazon biome's conservation value (Farmer 1, 6, 8; Expert 3, 13). Expert 13 argued, "The economic interests in the Cerrado are not present in the Amazon and everyone has an eye on the Amazon. People care a lot about it, so it is bad politically and economically for Brazil to continue expanding soy there." This reflects a pragmatic position on agricultural expansion in the Cerrado, grounded in the region's potential for rent acquisition and a perception that the Cerrado is lower on the conservation agenda than the Amazon.

4.3. Rapid agglomeration & political consolidation of pro-agriculture institutions

Despite the region being identified as an active frontier, numerous signs were identified that reflect the rapid emergence of an agglomeration economy that not only enhanced the profitability of soy production in the biome, but also helped consolidate agricultural interests. The region has received major private and public investment in transport infrastructure, grain storage, and export capacity (Pereira et al., 2018; Russo Lopes et al., 2021). Several research participants argued that despite some shortcomings, infrastructure, business links and credit access had improved significantly while available land for agricultural expansion remained abundant (Farmer 1, 7, 9, 11 Expert 1; 4; 10). Participants felt that access to industry, land prices and agricultural productivity have all increased (Farmer 2, 6, 8, 9; Expert 1, 3, 8) with one farmer stating they produced "one sack of soy per hectare in the 1980s, now its 60" (Farmer 2). Although it was still felt that large areas remained for potential soy expansion, some participants also felt consolidation was also occurring, particularly in flat areas of West Bahia (Farmer 6, Expert 2, 3, 4, 7, 14).

Further signs for rapid agglomeration and investment come from the abundance of soy buyers available to producers. New soy buyers are rapidly entering the Cerrado, particularly Matopiba, and are building silos and crushing plants to support their endeavors (Pereira et al., 2018; Trase, 2018). There was a consensus between farmers and experts, including all soy buyers interviewed, that the Matopiba region is a sellers' market where despite demand outstripping supply, new traders are beginning operations (Farmer 1, Expert 1, 4, 9). All soy producers described themselves as having numerous options of who to sell to and, when asked, described soy as very easy to sell. Several producers mentioned that they were currently or considering selling to traders that had begun operations in Matopiba more recently, such as Agrex and CHS (Farmer 1, 8, 12). Neither of these firms were operating in the region prior to 2010, nor have they signed ZDCs as of publication (zu Ermgassen et al., 2020). It was highly challenging to obtain agreement from representatives of trader companies to participate in this study, but among the three representatives that participated, all of whose companies had ZDCs, it was universally felt that it was challenging to procure the quantity of soy they had the capacity to process or store. One

zero-deforestation committed buyer said, “The market here for soy is highly competitive – at the moment we get what we need but it’s hard” (Expert 6).

Numerous nonstate pro-agricultural development institutions are present in the Cerrado, operating extensively both regionally and on the national and international stage. National organizations such as the Brazilian Association of Soy Producers (Aprosoja) has a strong presence in each state in the biome (Aprosoja, 2021). Producer cooperatives and syndicates are also widespread (Jepson, 2006). Regional organizations, such as Bahian Association of Farmers and Irrigators (AIBA), have successfully organized resistance against private policies, in particular the expansion of the Soy Moratorium to the Cerrado. In 2019, an open letter from six producer organizations in Bahia, including AIBA, was sent to the Director of Sustainability at Cargill stressing that producers in the region should not be hindered from exercising their legal right to opening new areas and capture the rent associated with this (AIBA, 2019). In response, Cargill issuing a statement that they are against the presence of a soy moratorium in the Cerrado, reflecting the political influence of such organizations (Noticias Agricolas, 2019).

4.4. Sacrificeability constrains private and public conservation interventions in the Cerrado

Our results clearly show that elite supply chain actors’ narratives characterize the Cerrado as a place of high economic value, rapid expansion potential, and low conservation value, conforming to the idea of a sacrifice frontier. This in turn appears to be linked to strong resistance against the need for additional public or private regulations. Despite growing pressure to conserve the Cerrado and the presence of clear threats to native vegetation from soy expansion (Cerrado Manifesto, 2017; Strassburg et al., 2017), agribusiness industry institutions consistently try to brand soy production as sustainable. In an open letter to the international community, Aprosoja presented an explicit counterattack to what they called “the recent offensive of NGOs and members of the European soybean import network” (Aprosoja Brasil, 2019). The letter argues Brazilian production is the most sustainable in the world “bearing the cost of the entire society, without losing competitiveness”, that production of soy in Matopiba can double its area without threatening native vegetation, and that “soy producers do not negotiate with Non-Governmental Organizations.” (Aprosoja Brasil, 2019).

Instead of market exclusion supply chain policies, producers and pro-agriculture institutions in the Cerrado advocate for sustainable, responsible, and eco-certified soy that offers producers positive incentives (Bastos Lima and Persson, 2020; Sawyer and Lahsen, 2016). The Cerrado, and Matopiba in particular, has a major concentration of certified soy globally. There were over 3 million tons of Roundtable on Responsible Soy (RTRS) certified production produced in the Cerrado in 2018, with over 30 % of total production in Maranhão and 16 % in Piauí certified by RTRS (Freitas and Buosi, 2018; RTRS, 2021). Only one of the soy farmers who participated in this study were certified, through both the RTRS and Soja Plus. Although RTRS certification requires zero-deforestation, the farmer who had achieved certification did not view certification as challenging to obtain, but simply costly (Farmer 6). Previous work considers soy certification unlikely to achieve biome-level conservation or address associated socio-economic issues (e.g., Bastos Lima and Persson, 2020; Garrett et al., 2016; Schilling-Vacaflor et al., 2021). Such certification may, therefore, simply serve to greenwash soy production in the sector, further strengthening the region as a sacrifice frontier.

We found that research participants had high awareness of public and private environmental policies in the neighboring Amazon and a strong stance against rules expanding beyond the current legal framework. Most producers and experts interviewed were aware of the Soy Moratorium in the Amazon, with a large minority aware of discussions to expand the Moratorium to the Cerrado (Farmer 6, 7, 11; Expert 1, 3, 6, 7, 9, 10, 13). In all cases, even amongst the participant who was RTRS certified and therefore required to observe zero-deforestation on their property, participants were highly negative towards the expansion of the Moratorium to the Cerrado. It was felt to be unfair to “limit a farmer who follows the Forest Code” (Expert 9). This sentiment was also reflected publicly by several leading West Bahian producer organizations in an open letter to Cargill to prevent the expansion of the companies zero-deforestation commitments to the Cerrado (AIBA, 2019). Additionally, it was argued that a moratorium would stymie development in “an area far more disposed to grain production than the Amazon” (Expert 6).

Although most of the producers who participated in this study supplied soy firms who had nominally committed to zero-deforestation, we were unable to identify an impact of these policies on producer behavior, likely indicating their conservation capability is at present limited. 67 % of the farmers who participated in this study sold goods to companies who had signed zero-deforestation agreements. However, all participants reported that there was no difference in documentation or deforestation requirements between buyers with or without a private policy. Participants generally agreed that to sell soy, registration in CAR and being free from illegal deforestation was all that was required. This means that irrespective of whether farmers were within a ZDC supply chain, they were able to legally deforest between 65 and 80 % of their properties. Farmers broadly felt that suppliers monitored them to ensure compliance with zero-illegality and that CAR was required before preliminary negotiation could begin (Farmer 1, 2, 6, 7; Expert 1, 3, 4, 6, 8, 10, 13). However, several stated that it was possible to sell soy without having to provide CAR (Farmer 9; Expert 1), the primary tool buyers reported using to check for deforestation. All farmers stated that neither deforestation requirements nor documentation were a consideration when choosing a buyer and were far more concerned by price (Farmer 1, 2, 7, 9, 12; Expert 4), personal relationship (Farmer 6; Expert 4, 5, 7), and the offering of secure contracts (Farmer 1). While firms have adopted or updated ZDCs since fieldwork was conducted in 2018 (see Supplementary Information S3), and future changes are planned, including the EU due diligence directive (European Commission, 2022), we do not expect on-the-ground conditions in the Cerrado to differ significantly now or in the near future from conditions when fieldwork was conducted.

5. Discussion

In this paper we revisited the concept of the sacrifice zone and integrated it into frontier theory. We then explored the applicability of the resulting concept of a sacrifice frontier through the case of the Brazilian Cerrado. Finally, we examined how the depiction of the Cerrado as a region worthy of economic development and not worthy for conservation was linked to narratives of low support for conservation policies. This narrative was even clearer in light of farmer and industry comparisons to the neighboring Amazon biome, which is perceived to be the priority for conservation. We found that producers, both in our interviews and in public dialogues, were advocating for their continued right to clear native vegetation up to the limit allowed by the Brazilian Forest Code. Several indicated their regret that they couldn’t clear above these legal limits. The sacrificeability identified for soy expansion was bolstered by well-organized producers’ organizations that opposed the expansion of punitive deforestation controls, high opportunity costs to move from zero illegal to zero gross deforestation, and large sunk investments in the region. The Cerrado also appears to be a seller’s market where ZDC companies, despite not having implemented their commitments, are already competing for production with traders that do not have any sustainability policies. Our results further suggest that these characteristics strengthen entitlements to convert native Cerrado vegetation and impair efforts to increase both public and private deforestation regulations. This loss of native vegetation likely impacts carbon stocks, biodiversity, and Indigenous and traditional community ways of life in the Cerrado.

5.1. Sacrifice frontiers illustrate how local industry flexes their power to preempt regulation

Scholars of transnational governance have focused on how global value chain actors exercise their heretofore unprecedented power "to write their own rules and avoid binding state regulation" (Bartley, 2021). In the Brazilian soy sector, a large focus has been placed on neo-extractivism embodied by such supply chain policies, with scholars arguing "these programs have questionable environmental benefits at best and at worst work to reenforce the hegemony of international environmental organizations, to green the image of agri-business" (Baletti, 2014). Here, we suggest that the making of sacrifice frontiers can be conceptualized as an effort of producing regions to write their own rules to avoid more stringent supply chain regulations imposed upon them by multinational companies. This conceptualization is in line with how Hecht (2005; 2017) and Brannstrom (2008) originally described sacrifice zones in land use frontiers, but it has not received sufficient attention within the broader transnational environmental governance literature, despite calls to better ground that literature in the realities of local context (Graz, 2021).

These discussions about the power of global value chain actors are of particular importance in the context of sacrifice frontiers, and other complex socio-ecological systems where positive feedback loops lead to rapid, non-linear growth in environmental and social harms. These abrupt and large-scale changes in the socio-ecological systems necessitate rapid and ambitious policy responses. Yet, due to the structural reinforcing effects of the harm-causing behaviors in helping to consolidate the power and narratives of the harm-makers, generating ambitious actions becomes harder and hard over time.

The case of the Cerrado shows how farmers' unions and agribusiness institutions help undersell the conservation value and upsell the production value of their region as an effective barrier to further regulation. Evidence of the success of this underselling can be seen in multinational companies' limited attempts to implement global soy ZDCs through market exclusion approaches in the region (Garrett et al., 2022). Our study reveals how value chain actors are often active participants in sacrifice narratives that exacerbate frontier formation and expansion, rather than just receivers of broader development narratives. As such they can also be an active force in counteracting these narratives.

What remains unclear is whether supply chain policy implementers, such as soy traders, welcome this contestation of supply chain governance efforts as a legitimate reason to delay taking any costly action. For example, recent research on oil palm deforestation governance in Indonesia suggests that some companies use implementation challenges to justify a lack of progress in eliminating palm-driven deforestation in their supply chains (Grabs and Garrett, 2023). If this is the case then the risk of greenwashing is particularly high in sacrifice frontiers, as companies are able to support conservation policies while simultaneously washing their hands of their ability to enact change.

Narratives of corporate inability to enact change are likely reinforced by the focus on opportunity costs in conservation practice and research. Anywhere there is a high opportunity cost to avoid agribusiness development are presented as low conservation priority in regional and global planning and mapping processes (Strassburg et al., 2020). Sacrifice frontiers, as spaces that are perceived as possessing low conservation value and high agricultural potential, are inherently locations characterized as possessing high opportunity costs for conservation. But what our work emphasizes is how opportunity costs are constructed by society when they decide to prioritize agricultural development and thereby amplify only the values of certain actors.

5.2. Co-creation of the Cerrado sacrifice frontier & Amazon conservation narratives

The perceived unimportance of the Cerrado for biological or socio-cultural conservation described by interviewees was often discussed alongside the ecological importance of the Amazon biome. Theoretically, we described the presence of nearby areas with high perceived conservation value as a reinforcing feature of sacrifice frontiers. However, the co-creation of public narratives of sacrifice in the Cerrado and conservation in the Amazon, makes this claim unverifiable in practice. Historic shifts in the Amazon biome from narratives of colonization, expansion, and development to conservation and preservation occurred alongside the creation of the "miracle" of the Cerrado wherein the viability and suitability of the Cerrado for agriculture was promoted (Garrett et al., 2021; Rada, 2013). Globally, forests are considered both more valuable for conservation and less attractive for human habitation than savannas (Bonanomi et al., 2019; Falk and Balling, 2010; Rathmann et al., 2022). This combination of "forest bias" and "savanna preference" present in the two Brazilian biomes likely facilitated the co-creation of these two opposing narratives. This trend is exacerbated by the seemingly larger focus on Indigenous Peoples in international tropical forest conservation dialogues (e.g., Ministério das Relações Exteriores (2023)), while Indigenous and traditional peoples are scarcely mentioned in dialogues about the Cerrado (e.g., Cerrado Manifesto (2017)).

This co-creation of contrasting narratives for tropical forests and non-forest ecosystems such as savannas means that sacrifice frontier formation can be thought of as a form of "narrative leakage"; as governance stringency increases and becomes accepted in one location, narratives in less protected regions harden against conservation and in favor of agricultural expansion (le Polain de Waroux et al., 2017). Certainly, similar trends to the Cerrado can be found in the Paraguayan Chaco, another sacrifice frontier where agricultural expansion increased dramatically following the creation of a public moratorium on deforestation in the nearby Paraguayan Atlantic Forest (Henderson et al., 2021). However, for highly forested countries that lack either native non-forest ecosystems or large-scale degraded landscapes such as Gabon, the lack of areas considered sacrificeable by the international community and commodity argued to hinder development and worsen international inequities (Lyons-White et al., 2020).

5.3. The presence of sacrifice frontiers globally

While further research will be needed to definitively indicate the presence of sacrifice frontier conditions in regions beyond the Cerrado, based on our findings we are able to review existing evidence and identify several regions that appear to possess narratives of high economic potential and low conservation importance. We find evidence of sustained native vegetation loss without the emergence of major conservation policies in regions across the world. These include South America's Llanos, Gran Chaco, and Chiquitania (Etter et al., 2010; le Polain de Waroux et al., 2016; Song et al., 2021), the Great Plains of North America (Wright and Wimberly, 2013), Australia's downs and savannas (Forbes, 2022; Stokes et al., 2006), Madagascar's spiney forests (Gardner et al., 2016), and Africa's savannas and grasslands (Gasparri et al., 2016; Phalan et al., 2013). In some cases, these regions neighbor regions are considered to be of greater conservation value or lower economic potential, such as Australia's northeastern rainforests, and central Africa's Congo basin. In South America, the conservation movements focus on South America has been argued to facilitate the sacrifice of all other native biomes in the continent (de Oliveira and Hecht, 2017). Initial evidence to support this claim comes from the discrepancy in international conservation funding directed to the Amazon relative to other South American regions (Qin et al., 2023). It is also important to note that all potential sacrifice zones we identify are grasslands, savannas, or dry forests. These regions lack the bias for conservation observed in dense tropical forests and possess the preference for development identified in savannas and open woodlands, making them especially vulnerable to sacrifice (Brannstrom, 2009; Falk and Balling, 2010; Rathmann et al., 2022).

5.4. Broadening land use governance in sacrifice frontiers

The political narratives and reinforcing perceptions of a sacrifice frontier alter what can be expected of both public and private conservation policies in such frontiers, particularly private policies that lack a legal basis, such as ZDCs. The legitimacy of such policies is likely to be low and resistance to their implementation is expected to be high and well organized. This does not mean that private conservation interventions are not worthwhile in sacrifice frontiers, particularly if they represent a public and committed shift in supply chain companies' participation in sacrifice frontier narratives.

While supply chain policies can be improved within the existing unfavorable context, our results underscore that preventing native vegetation loss in a sacrifice frontier will likely require going beyond corporate supply chain policies. The presence of strong industry narratives regarding the importance of economic development and low conservation value limit the formation and acceptance of private policies.. Greater efforts are needed to engage with the diverse array of narratives and perspectives of groups that contest the portrayal of sacrifice in regions like the Cerrado, such as Indigenous Peoples and traditional communities.

This is especially important as local communities in frontiers often contest narratives of sacrifice and participate in regional and international movements to conserve sacrifice frontiers and alter narratives that devalue these landscapes (Cons and Eilenberg, 2019; Peluso and Lund, 2011). Supporting attempts to reinvent and contest frontier expansion through territorialization, the establishment or re-establishment of systems of control, governance and their spatial representations could be a powerful way to resist sacrifice frontier narratives (Rasmussen and Lund, 2018; Tsing, 2005). While we expect development narratives to be especially dominant and robust in sacrifice frontiers, resistance to these narratives is also present. This is the case in the Cerrado where groups including the Landless Workers' Movement, Indigenous and traditional peoples, and conservation actors actively resist frontier expansion and seek to protect remaining vegetation, especially those managed and claimed by local communities (Chaves et al., 2023; Sawyer and Lahsen, 2016; Wittman, 2005).

Nonetheless, supply chain actors are highly important in agricultural frontiers. Should corporations go beyond relying solely on individual company commodity-centric exclusion mechanisms and actively participate in the processes of territorialization that already exist amongst many marginalized communities in frontier regions, this may play an especially powerful role in altering narratives of sacrifice. Such interventions will likely need to include engagement with nonstate actors like producer organizations and syndicates currently opposed to market exclusion measures as well as conservation actors, Indigenous Peoples, and local communities.

6. Conclusion

Sacrifice frontiers present a wicked problem for efforts to prevent native vegetation loss. Unlike other frontiers, which are usually presented as high-risk challenges to be undertaken by enterprising pioneers, sacrifice frontiers are portrayed as economic opportunities that may be lost if pro-conservation institutions have their way. As such, these frontiers represent spaces where farmers and pro-agribusiness institutions are willing to publicly and vocally organize against conservation efforts. This is particularly the case for efforts that might penalize producers or portray frontier expansion as unsustainable or environmentally challenging. In the Cerrado this has manifested through strong and sustained campaigning against the expansion of the Amazon Soy Moratorium to the Cerrado and a shifting of the narrative towards policies that reward producers, such as eco-certified production. Participants, even those who vocalized pro-environmental sentiments and/or were eco-certified, were vocally opposed to the expansion of public or private measures that would penalize expansion.

The presence of sacrifice frontiers represents a major barrier to efforts to use voluntary environmental governance to reduce environmental harms. Transnational companies have less legitimacy and leverage to curb polluting and degrading activities in such regions, especially if the activities they are trying to prevent are legally permitted. Companies also risk pushback and loss of market position should they implement strict penalties for environmental harms without additional actions or broader support. Interventions are needed that can overcome the strong expansionist narrative in sacrifice frontiers and assert the importance of conservation locally. Strategies to prevent rapid frontier expansion in sacrifice frontiers like the Cerrado will likely be most effective with broad coalitions of actors, including supply chain companies, but also actors who already resist narratives of sacrifice and frontier expansion, such as Indigenous Peoples and local communities.

Better understanding of sacrifice frontiers is also highly relevant for emerging due diligence policies and zero-deforestation mandates by importing regions, which have already passed in the EU and UK and being discussed in USA (European Parliament, 2023; Schatz, 2021; UK Government, 2020). Zero-deforestation mandates focus on classifying areas according to deforestation risk and requiring companies to take additional efforts to make sure they aren't sourcing deforestation-linked products in these areas. ZDCs also form the centerpiece of the global conservation agreement signed by 141 nations at COP26 in Glasgow (UNFCCC, 2021a, 2021b). Zero-deforestation import mandates present an important leverage point to help conserve native ecosystems, but how this will be implemented remains uncertain. Should efforts to downplay the negative impacts of native vegetation loss in sacrifice frontiers prevail, there is potential for no conversion mandates to further exacerbate the inequalities in conservation efforts across the world. This is especially likely if non-forest ecosystems remain outside of the scope of national import policies, allowing for vegetation loss to continue in these landscapes. Currently the EU's deforestation regulation only covers imports that are linked to deforestation, rather than the conversion of grasslands, savannas, wetlands, or shrublands (Trase and Greens/EFA, 2022). Preventing rapid frontier expansion and the environmental and human impacts that this will bring requires corporations and governments to reassess the value of undervalued ecosystems and help change perceptions of local elites in regions such as the Cerrado.

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CRediT authorship contribution statement

Samuel A. Levy: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Anna Victoria Nogueira Garik:** . **Rachael D. Garrett:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.geoforum.2024.103972.

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