UNIVERSITÄT BONN

zef
Center for
Development Research
University of Bonn

ZEF POLICY BRIEF NO. 55

PATH TO ZERO DEFORESTATION? MITIGATING CATTLE-DRIVEN DEFORESTATION IN THE BRAZILIAN AMAZON

BY CONSTANZE VOM HOFF, THAO DAO, DOMINIK SURI

February 2025

KEY MESSAGES

Despite efforts such as the G4 Cattle Agreement and the Deferred Prosecution Agreement (TAC), cattle-driven deforestation in the Brazilian Amazon, which accounts for over 70% of forest loss, remains a critical challenge. Limited enforcement mechanisms, a lack of accountability throughout the supply chain, and the varying ability of stakeholders to implement and comply with deforestation commitments hinder the effectiveness of these Cattle Agreements in mitigating deforestation, leaving their full potential unrealized. Addressing these challenges requires i) **increasing supply chain transparency**, ii) **expanding the scope of zero-deforestation commitments**, and iii) **strengthening farmer capacity** (see Figure 1).

The following solutions should be prioritized in the **short term**:

i. **Leverage traceability platforms:** Promote initiatives such as *Trase*, *Do Pasto ao Prato* and *SeloVerde* to increase consumer awareness through improved labeling and accessible data.
ii. **Expand coverage of zero-deforestation commitments:** Expand coverage of Cattle Agreements to include more regions and stakeholders. Introduce enforceable penalties for non-compliance, while gradually increasing the number of signatories to the Cattle Agreements and implementing cooperative measures in structured phases to increase compliance on farms. Strengthen coordination among federal, state, and local enforcement agencies.
i. **Integrate monitoring systems:** Fully implement the Rural Environmental Registry (Cadastro Ambiental Rural, CAR) nationwide and link it to the Animal Transit Permit System (Guia de Trânsito Animal, GTA). Incorporate advanced monitoring tools such as electronic identification of cattle.

In the **long term**, the following measures are essential and should be implemented gradually in phases:

i. **Establish a coordinating body:** Create a "network broker" to align and facilitate the activities of supply chain stakeholders.
iii. **Improve farmer capacity building:** Simplify compliance processes and provide farmers with tools and training for sustainable cattle farming.

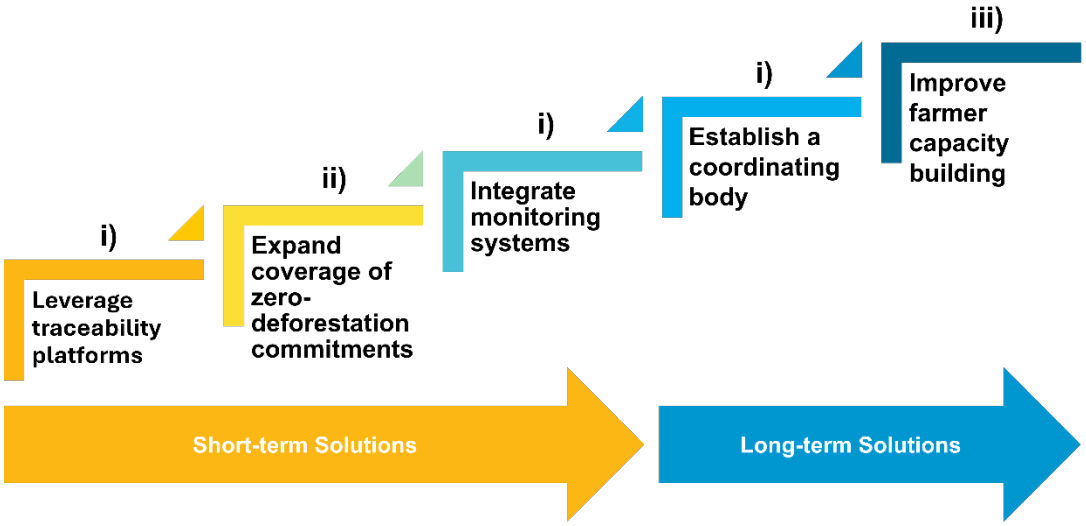

Figure 1: Solutions for cattle-driven deforestation in the Brazilian Amazon. *The measures are related to: i) increasing supply chain transparency, ii) expanding coverage of zero-deforestation commitments and iii) enhancing capacity building for farmers.*

THE BRAZILIAN CATTLE AGREEMENT: A SUCCESSFUL APPROACH TO ENVIRONMENTAL SUSTAINABILITY?

Deforestation for cultivating and producing agricultural commodities such as beef is a major driver of biodiversity loss, greenhouse gas emissions, and land conflicts (Russo Lopes and co-authors, 2021), particularly in the Brazilian Amazon (Amazônia, see Figure 2), where cattle ranching accounts for over 70% of deforestation (Levy and co-authors, 2023). To address this problem, Brazil is using a mix of command-and-control regulations and voluntary environmental agreements.

Voluntary environmental agreements in Brazilian cattle ranching include the Deferred Prosecution Agreement (Termos de Ajustamento de Conduta, TAC) and the G4 Cattle Agreement (G4). Both aim to decouple beef production from deforestation. Because of their common goals and overlapping requirements, we refer to them collectively as the Cattle Agreement.

The Cattle Agreement incentivizes slaughterhouses in the Brazilian Amazon to monitor and disclose cattle suppliers, and requires them to stop buying from non-compliant ranchers operating on illegally deforested land. However, its effectiveness has been mixed and its implementation faces significant challenges. These include the complexity of the cattle supply chain, inequities and inefficiencies in its implementation, a narrow focus on selected target regions leading to leakage, and limited engagement of key stakeholders.

Deferred Prosecution Agreement (TAC)
A voluntary environmental agreement between the federal government, slaughterhouses and ranchers that incentivizes slaughterhouses to monitor the environmental practices of ranchers in the Brazilian Amazon.

G4 Cattle Agreement (G4)
Beef processors (Bertin, JBS, Marfrig, and Minerva) must demonstrate that they have not purchased animals from farms that have engaged in any deforestation since October 2009.

Cattle Agreements (CA)
Voluntary environmental agreements aimed at reducing deforestation by targeting the cattle supply chain, which includes both G4 and TAC.

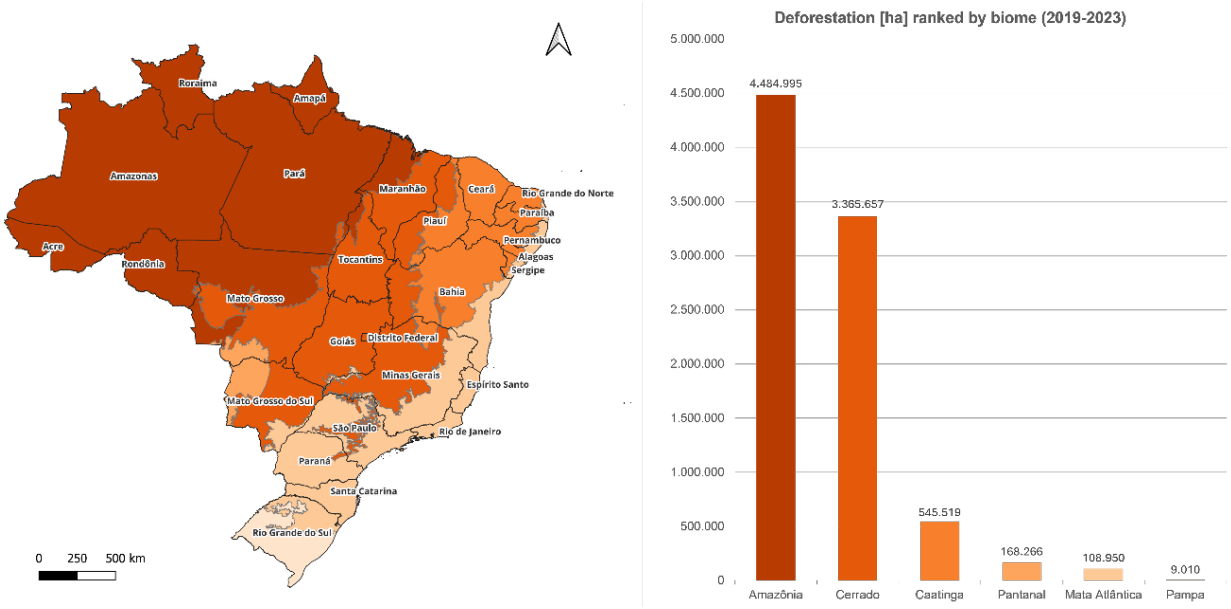

Figure 2: Deforestation in Brazil (2019–2023). *The map shows the spatial distribution of deforestation in ha by biome across Brazil, with darker orange indicating higher levels. Notably, the* ***Amazon biome*** *experienced the highest deforestation (4.48 million ha) from 2019 till 2023, followed by the* ***Cerrado*** *(3.37 million ha). Data were retrieved from MapBiomas in December 2024.*

ENFORCEMENT CHALLENGES OF THE BRAZILIAN CATTLE AGREEMENT

Complex cattle supply chain

The beef production cycle consists of several stages, from breeding to fattening before cattle are sent to slaughterhouses (see Figure 3). Indirect suppliers breed and raise calves and sell them to feedlots, while direct suppliers fatten cattle and sell them to slaughterhouses. Only some suppliers manage the entire production cycle (Miranda & Oliveira, 2023). During this process, cattle can be moved from non-compliant farms to compliant farms before reaching slaughterhouses, a practice known as "cattle laundering," which complicates efforts to track illegal activity (Carvalho and co-authors, 2019; Skidmore and co-authors, 2021). Ranchers can also circumvent TAC agreements by registering only the "deforestation-free" parts of their farms in the Rural Environmental Registry (Cadastro Ambiental Rural, CAR) (Carvalho and co-authors, 2019).

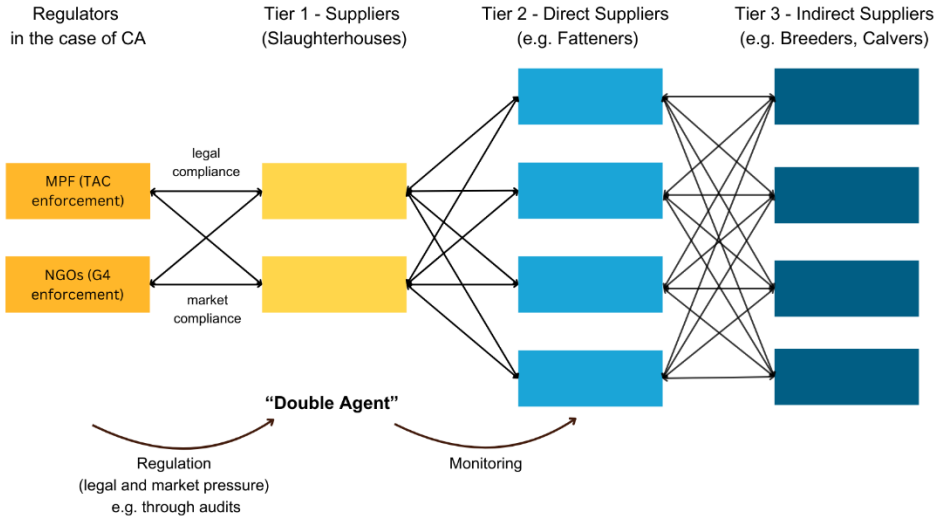

Figure 3: Complex multi-tier cattle supply chain under the Cattle Agreement (CA).
The left side shows two regulatory forces: The Federal Public Prosecutor's Office (Ministério Público Federal, MPF) enforces TAC compliance through legal means, and NGOs such as Greenpeace enforce G4 compliance through market-driven zero deforestation commitments. Slaughterhouses act as "double agents," ensuring compliance with the TAC while monitoring second- and third-tier suppliers (feeders, breeders, and calves). Challenges in monitoring indirect suppliers arise from transparency issues, which are common to both agreements. This figure is based on Cammelli and co-authors (2022).

Equity and effectiveness in the cattle supply chain

Reduced deforestation is enforced through legally binding measures through TAC and through market-driven compliance through G4. Despite their different approaches, both agreements rely on cooperation throughout the cattle supply chain (Cammelli and co-authors, 2022; Skidmore and co-authors, 2021). However, while the CA is collaborative at the slaughterhouse level, there is no evidence of collaboration in enforcement upstream at the feedlot or calving stage. The involvement of indirect suppliers further complicates enforcement. The CA places the burden of proof on the farmer, which creates challenges in ensuring compliance throughout the supply chain. This approach raises equity concerns, fosters mistrust, and leads to farmer resistance. Ultimately, it fails to address a key driver of deforestation: insufficient support for farmers to transition to sustainable practices (Cammelli and co-authors, 2022; Skidmore and co-authors, 2021).

Selective target regions: Limited scope and leakage in the CA

Enforcing the CA requires decisions about how to deal with noncompliance, with ultimate success depending on producers adjusting their behavior. However, policy failure often occurs when ranchers shift harmful practices to less regulated areas, known as leakage or spillover effects. An example of this is the increase in deforestation in the Cerrado biome following the implementation of zero-deforestation commitments in the Amazônia biome between 2009 and 2013 (Dou and co-authors, 2018). The Cerrado experienced such spillover and leakage effects due to limited policy coverage (Grabs and co-authors, 2021; Levy and co-authors, 2023; Miranda and Oliveira, 2023).

Limited coverage of target stakeholders

Ranchers involved in illegal deforestation in the Brazilian Amazon can still sell cattle to slaughterhouses that have not signed the CA. This is because the current monitoring system focuses only on direct suppliers, leaving indirect suppliers unmonitored. As a result, deforestation is three times more likely to occur on land outside the policy's reach (Skidmore and co-authors, 2021).

By 2017, eight years after the introduction of the TAC, 63 meatpackers (48%) operating in the Amazônia biome had signed the agreement. Together, they slaughter about 70% of the cattle produced in the biome (Carvalho and co-authors, 2019). Meanwhile, non-signatory slaughterhouses avoid enforcement costs and face little market pressure or penalties, especially since many international markets, including China, do not require origin standards. This undermines the efforts of compliant slaughterhouses (Carvalho and co-authors, 2019).

The central role of market share dynamics

The effectiveness of CA in the Brazilian cattle industry is influenced not only by coverage, but also by the high market concentration of participating firms. Levy and co-authors (2023) highlight that widespread adoption of zero-deforestation commitment signatories can significantly reduce deforestation. The adoption of G4 by major industry players has already led to significant reductions in deforestation in key Brazilian states such as Pará, Mato Grosso and Rondônia, emphasizing the critical role of market dominance in reinforcing CA's self-enforcing nature (Levy and co-authors, 2023; Miranda and Oliveira 2023).

While market concentration helps ensure compliance by making it more difficult for farmers to circumvent CA and sell non-compliant products in alternative markets, careful regulation is essential. Excessive concentration could lead to oligopsony or even monopsony, distorting market dynamics and creating inequitable outcomes for suppliers (Levy and co-authors, 2023).

Potential drawbacks of TAC

Due to the complexity of the cattle supply chain, TAC may have unintended negative impacts if not implemented carefully. Miranda and Oliveira (2023) show evidence of increased deforestation coinciding with increased access to rural credit in communities where a slaughterhouse signed a TAC agreement. One possible explanation for this is that although slaughterhouses sign the TAC agreement, they may indirectly benefit suppliers, such as cattle ranchers, by facilitating their access to cheap bank credit. This is because the agreement is often seen as a sign of "good behavior" throughout the supply chain. However, it is difficult to ensure that these organizations fully comply with the terms of the TAC. If non-compliant companies continue to receive financing, this could inadvertently contribute to deforestation.

POLICY RECOMMENDATIONS

Despite efforts like the G4 and TAC, deforestation in the Brazilian Amazon remains a complex and significant challenge. Moving forward, practical solutions must bridge the gaps between supply chain issues and enforcement, as well as the challenges faced by farmers. The following recommendations offer a path forward to mitigate cattle-driven deforestation in the Brazilian Amazon.

Increasing Supply Chain Transparency

- **Supply chain transparency** can be strengthened by promoting and implementing projects such as *Trase* database and *Do Pasto ao Prato*, which provide consumers, companies and governments with information about the origin of agricultural commodities, as well as platforms like *SeloVerde*, which facilitate environmental compliance.
- Animal laundering **can be reduced by fully implementing the Rural Environmental Registry (Cadastro Ambiental Rural, CAR) and integrating it with the Animal Transit Permit Program (Guia de Trânsito Animal, GTA)** (Carvalho and co-authors, 2019). Full implementation requires the registration of all rural properties, a deadline that has been repeatedly postponed due to political and resource constraints. Integrating the CAR with the GTA, especially if the permit is fully digital and publicly accessible, will improve the traceability of cattle throughout the production cycle.
- **Transparency can be improved through the use of technologies such as electronic identification of cattle, such as tags and microchips (Carvalho and co-authors, 2019).** These identification systems, similar to an "animal passport," record details of origin and vaccinations, making it easier to trace cattle and build trust in the food industry.
- **A network intermediary organization should be established to reduce information asymmetries and promote cooperation between direct and indirect suppliers.** This intermediary role, possibly led by the Federal Prosecutor's Office, could coordinate activities among government agencies, civil society, and stakeholders, thereby improving transparency and accountability in the supply chain (Cammelli and co-authors, 2022; Grabs and co-authors, 2022).

Expanding Coverage and Enforcing Zero-Deforestation Commitments

- **Expanding the Cattle Agreement (CA) across regions and stakeholders**, with enforceable penalties for violations, can reduce cattle-driven deforestation by 51% if all companies adopt zero-deforestation commitments (Levy and co-authors, 2023). Governments should coordinate with both public and private actors to improve policy inclusiveness and complementarity (Grabs and co-authors, 2022). Expanding the scope of the CA, including beyond the Amazon, would help reduce deforestation in other areas. The gradual increase in the number of TAC signatories by the Federal Prosecutor's Office is beneficial for smaller companies, allowing them to meet their commitments over time. The focus should be on expanding TAC, not just on extending control and enforcement (Cammelli and coauthors, 2022; Grabs and coauthors, 2022; Levy and coauthors, 2023).
- **Integrating enforcement systems across federal, state, and local levels** prevents producers with embargoed land from selling cattle elsewhere, improves data sharing, and supports stricter implementation through measures such as fines for noncompliance (Carvalho and co-authors, 2019).

Enhancing Capacity Building for Farmers

- **Capacity building involves educating farmers, raising awareness and providing tools to help them comply with CA regulations**. This should minimize compliance barriers through targeted, localized interventions and simplify compliance with zero-deforestation requirements. Value chains, including supermarkets, producers, governments and consumers, play a key role in supporting this process (Grabs and co-authors, 2022).

REFERENCES

Cammelli and co-authors. “Effectiveness-Equity Tradeoffs in Enforcing Exclusionary Supply Chain Policies: Lessons from the Amazonian Cattle Sector.” *Journal of Cleaner Production* 332 (2022): 130031. https://doi.org/10.1016/j.jclepro.2021.130031

Carvalho and co-authors. “Deforestation Control in the Brazilian Amazon: A Conservation Struggle Being Lost as Agreements and Regulations Are Subverted and Bypassed.” *Perspectives in Ecology and Conservation* 17, no. 3 (2019): 122–30. https://doi.org/10.1016/j.pecon.2019.06.002

Dou and co-authors. "Spillover effect offsets the conservation effort in the Amazon." Journal of Geographical Sciences 28 (2018): 1715–1732. https://doi.org/10.1007/s11442-018-1539-0

Grabs and co-authors. “Designing Effective and Equitable Zero-Deforestation Supply Chain Policies.” *Global Environmental Change* 70 (2021): 102357. https://doi.org/10.1016/j.gloenvcha.2021.102357

Levy and co-authors. “Deforestation in the Brazilian Amazon Could Be Halved by Scaling up the Implementation of Zero-Deforestation Cattle Commitments.” *Global Environmental Change* 80 (2023): 102671. https://doi.org/10.1016/j.gloenvcha.2023.102671

Miranda and co-authors. “Assessing the Performance of Voluntary Environmental Agreements under High Monitoring Costs: Evidence from the Brazilian Amazon.” *Ecological Economics* 214 (2023): 107982. https://doi.org/10.1016/j.ecolecon.2023.107982

Skidmore and co-authors. "Cattle ranchers and deforestation in the Brazilian Amazon: Production, Location, and Policies." *Global Environmental Change* 68 (2021): 102280. https://doi.org/10.1016/j.gloenvcha.2021.102280

CONTACT

Constanze vom Hoff (Faculty of Agricultural, Nutritional and Engineering Sciences, University of Bonn): constanze.vomhoff@gmx.de

Thao Dao (Faculty of Agricultural, Nutritional and Engineering Sciences, University of Bonn): daothithuthao3001@gmail.com

Dominik Suri (Institute for Food and Resource Economics, University of Bonn): dsuri@uni-bonn.de

We acknowledge support from the European Union’s Horizon Europe research and innovation program CLEVER (grant agreement number 101060765).

IMPRINT

Center for Development Research (ZEF) University of Bonn
Genscherallee 3
53113 Bonn I Germany
Presse.zef@uni-bonn.de
+49 (0) 228 / 73 6124

Layout: Yesim Pacal / ZEF PR

zef.de