

Environmental Compliance related to Soy Production in the Amazon and Cerrado Biomes

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Executive Summary

This study assesses the level of compliance of soy production in the Amazon and Cerrado biomes with key elements of the Forest Code, based on the analysis of **27 million hectares of soy cultivated in 2024¹ across approximately 134 thousand rural properties.**

The analysis occurs within a context of regulatory and market transformation: the implementation of the European Union Deforestation Regulation (EUDR), which requires zero deforestation after 2020 and compliance with the legislation of the country of origin; the erosion of the Soy Moratorium, which since 2006 prevented the purchase of soy from deforested areas in the Amazon after July 2008; and signs of restructuring in Chinese demand, that could reduce soy imports up to 21% by 2035.

The analyses developed by the Center for Territorial Intelligence (CIT), Federal University of Minas Gerais (UFMG), Instituto Centro de Vida (ICV), and Trase with contributions from Renmin University of China, were based on official deforestation data for the Amazon and Cerrado, rural property boundaries contained in the National Rural Environmental Registry System (SICAR), and deforestation authorizations and enforcement actions from federal and state environmental agencies. The results are organized into two dimensions – deforestation with non-compliance issues and authorized deforestation – providing insights and recommendations for traders, financiers, and policymakers in directing due diligence, regularization, and market access actions.

- 1. Deforestation with non-compliance issues:** The results show that **31% (8.4 million hectares)** of the soy cultivated in 2024 was on properties with either unauthorized deforestation between August 2008 and July 2024 or enforcement records. This percentage considers deforestation both at the cultivation site and in other areas of the same property. Of the just over **24 thousand properties with deforestation with non-compliance issues, 77%** have evidence of a lack of native vegetation within the farm as required by the Legal Reserves requirements or enforcement records. The remaining **23%**, despite meeting the Legal Reserve or even having a vegetation surplus, also recorded deforestation without authorization.

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- 1.** The boundaries of rural properties used in this analysis are based on CAR records, without any spatial adjustment for overlapping polygons. Consequently, the total reported area of soybeans may be overestimated due to overlapping property boundaries.

2. **Authorized Deforestation:** Authorized deforestation occurred on only **3%** of soy farms, corresponding to **7%** of the total area cultivated with the crop (**1.9 million hectares**).

The end of the Soy Moratorium will put at risk **412 thousand hectares of Legal Reserve surplus** that could be legally cleared inside soy farms, in addition to **11 million hectares of native vegetation that need to be conserved as legal reserves**, but are now more exposed to illegal deforestation due to the lack of a robust, sector-wide and collective mechanism such as the Moratorium.

Efforts to advance environmental compliance in the soy value chain depend in large part on re-establishing sectoral zero-deforestation agreements expanded to the Cerrado, accelerating environmental regularization and increasing transparency through the integration of public databases, and strengthening international technical cooperation to promote global deforestation-free chains.

Introduction

Brazil is the world's largest producer and exporter of soy, with an estimated planted area of 48.6 million hectares in the 2025/2026 harvest and a production of 180 million metric tons². Soy is the main product of the Brazilian agricultural export agenda and accounts for approximately 40% of global soy production³.

Approximately 60% of the country's soy-cultivated area is located within the Amazon and Cerrado⁴. These biomes account for most of the recent agricultural expansion, as well as the disputes between production and environmental conservation and social conflicts. Because these regions house Brazil's largest remaining areas of native vegetation and play a vital role in regulating climate, water cycles, and biodiversity conservation, the soy supply chain faces growing pressure to ensure environmental compliance and implement effective mechanisms to eliminate deforestation from production.

Consumer markets have been tightening their access requirements. The European Union Deforestation Regulation (EUDR), approved in 2023 and set to take effect at the end of 2026, requires soy and other commodity importers to demonstrate that their products do not originate from areas deforested after December 31, 2020, and were produced in compliance with the relevant legislation of the country of origin – including, in Brazil, the Forest Code (Law No. 12,651/2012⁵). The regulation imposes due diligence obligations on operators, including the collection of georeferenced information on supplying properties, risk assessment, and the adoption of mitigation measures. The UK government also recently announced plans to introduce similar measures for British companies to verify that their supply chains do not contribute to illegal deforestation⁶.

China is the world's largest soy importer and the main destination for Brazilian exports – Brazil accounts for more than 60% of Chinese soy imports⁷. However, China has signaled important structural transformations. In 2023, President Lula and President Xi committed to collaborating in the fight

2. National Food Supply Company (CONAB). (2026). Agricultural Information Portal. <https://portaldeinformacoes.conab.gov.br/produtos-360.html>

3. Brazilian Agricultural Research Corporation (Embrapa). (2026). Agro em Dados: Soy. <https://www.embrapa.br/agropensa/agro-em-dados/agricultura/soja>

4. MapBiomass. (2026). MapBiomass User Toolkit (Collection 10.1). <https://plataforma.brasil.mapbiomas.org/>

5. https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm

6. Department for Environment, Food & Rural Affairs (23 June 2026). Government steps up action to tackle illegal deforestation. GOV.UK. <https://www.gov.uk/government/news/government-steps-up-action-to-tackle-illegal-deforestation>

7. Sistemiq. (2026). China's Food Future. <https://www.systemiq.earth/resource-category/chinas-food-future-consultation-paper/>

against illegal deforestation, and in 2025 the two countries signed a cooperation agreement for the restoration of native vegetation⁸. In July 2026 the China Chamber of Commerce for Import and Export of Foodstuffs, Native Produce and Animal By-Products (CFNA) published guidelines for importers to check for the presence of illegal deforestation that occurred after 2008 and potential overlaps with indigenous lands and protected areas, in line with Brazil's Prosecutor's Office (MPF) legality protocols⁹.

The introduction of these emerging concerns takes place while the Market Analysis and Early Warning Team from the Chinese Ministry of Agriculture and Rural Affairs projects a reduction of soybeans imports by 21% by 2035 compared to 2025¹⁰, with an expected 7% reduction already in 2026/27 based on the previous year¹¹. Meanwhile the central government identified soybeans as a strategic crop in the 15th Five-Year Plan (2026–2030), aiming to raise domestic production and diversify imports as measures to reduce import dependence and strengthen supply resilience. It was not the first time China signaled that it intends to reduce soy or at least stabilize soy imports, but past projections have not been realized due to external events such as the swine flu, COVID-19, and the war in Ukraine. This time, however, the outlook may be different. China's population has entered a period of demographic decline, while per capita pork consumption is expected to peak soon. Furthermore, there has been a stronger signal from the central government with the implementation of import quotas for beef.

Contrary to global signs of tightening legality requirements and zero deforestation/conversion, state legislators and production sector organizations in Brazil led a movement that resulted in the erosion of the Soy Moratorium – a landmark and globally recognized voluntary commitment signed by soybean traders and civil society organizations in 2006 that prevented the purchase of soy grown in deforested areas in the Amazon after July 2008. Estimates indicate that the end of the main voluntary instrument for controlling deforestation associated with soy in the Amazon could put at risk up to 13 million hectares of native vegetation in the biome¹², precisely at a time when importing markets are pointing toward a scenario with higher requirements for traceability and environmental compliance.

Given the weakening of private deforestation control mechanisms, the entry into force of the EUDR, and signs of future contraction of the Chinese market, an updated analysis of the level of environmental compliance of Brazilian soy production in these biomes is urgent. This study presents estimates related to compliance with essential elements of the Forest Code, serving as input to evaluate the exposure of consumer markets such as the EU and China. Finally, it makes recommendations for different actors to advance environmental compliance in the soy supply chain.

8. Trase. (2026). The Beijing-Brasilia effect: A new paradigm for sustainable commodity trade. https://resources.trase.earth/documents/Reports/The_Beijing-Brasilia_effect_A_new_paradigm_for_sustainable_commodity_trade_BR-PT.pdf

9. The 17th Major Grain and Oil Industry Conference was successfully held, jointly promoting the grain and oil industry towards a low-carbon and sustainable future. <https://wri.org.cn/xinwen/The-Release-Ceremony-of-the-Guidelines-on-China-Brazil-Soybean-Sustainable-Supply-Chain>

10. Fu Ya, https://scs.moa.gov.cn/gzdt/202604/t20260429_6483787.htm

11. Fu Ya, https://scs.moa.gov.cn/gzdt/202604/t20260429_6483787.htm

12. Rajão, R., Valdiones, A. P., Bernasconi, P., Nunes, F., Assis, D., & Lisboa, F. (2026). End of the Soy Moratorium puts 13 million hectares in the Amazon at risk. ICV/UFGM. <https://www.icv.org.br/wp-content/uploads/2026/03/moratoria-soja-final-en.pdf>

Environmental Compliance and Methodological Approach

Deforestation in Brazil is primarily driven by the expansion of agricultural frontiers and land speculation, often associated with weak land governance and enforcement of environmental legislation. The Forest Code (Law 12.651/2012) is the main Brazilian environmental legislation regulating land use on rural properties, reconciling agricultural production with environmental conservation. The law establishes two central mechanisms for protecting native vegetation: the Legal Reserve (LR) and the Permanent Preservation Area (APP).

The Legal Reserve requires every rural property to maintain a minimum percentage of native vegetation within its total area. This percentage varies by biome: in the Amazon, properties in forest areas must preserve between 50% and 80% depending on certain conditions, while in the Cerrado, the proportion is 35% in areas within the Legal Amazon or 20% in other regions of Brazil. Permanent Preservation Areas protect specific strips of territory – riverbanks, hill-tops, slopes, and other environmentally sensitive areas.

Furthermore, the Forest Code determines that any significant suppression of native vegetation must be previously authorized by the competent environmental agency. Deforestation without authorization constitutes a legal infraction, subject to fines and embargoes, depending on each situation.

For compliance verification purposes, the main instrument provided by law is the Rural Environmental Registry (CAR), a mandatory public registry that integrates information on property boundaries and conservation areas. Although it is self-declared, the CAR provides the basis for environmental monitoring at the property level and for applying other mechanisms of the law, such as the Environmental Regularization Program (PRA).

For rural property boundaries, we used the SICAR database¹³ (which provides spatially explicit CAR registries), which totaled just over 2 million registries for the Amazon and Cerrado biomes, excluding canceled, duplicated, or overlapping registries with Protected Areas. The overlaps between the records were not removed. This information was cross-checked with the soy area contained in Collection 10 of MapBiomas, identifying as a soy property any farm that had at least 6.25 hectares of soy¹⁴.

To evaluate compliance with LR and APP requirements on soy properties, we used the approach developed by Rajão et al. (2020)¹⁵. For vegetation suppression authorizations, we used the database produced by ICV and Trase¹⁶, as well as embargoes¹⁷. The environmental infraction data were obtained from Ibama and filtered to select only those pertaining to damage to native vegetation¹⁸. To assess deforestation, we used the Prodes database from 2009 to 2024¹⁹. Deforestation was classified as authorized if there was a vegetation suppression authorization overlapping with the rural property. Deforestation with non-compliance issues was assessed based on the property's compliance with Forest Code requirements and available enforcement data, supporting a risk gradient analysis. Three categories were used:

13. Rural Environmental Registry (CAR) Public Consultation System (February/2025). Government of Brazil. <https://consultapublica.car.gov.br/publico/imoveis/index>

14. The area of 6.25 hectares was used as a proxy to maintain the minimum mappable area standard of the PRODES Amazon program.

15. Rajão, R. et al. (2020). The rotten apples of Brazil's agribusiness. *Science*, 369(6501), 246-248. <https://doi.org/10.1126/science.aba6646>

16. ICV and Trase. (2026). New analysis reveals extent of unauthorised deforestation in Brazil. Trase Insights. <https://trase.earth/insights/new-analysis-reveals-extent-of-unauthorised-deforestation-in-brazil>

17. Embargo is an administrative sanction applied to a specific area where an environmental violation has occurred. It prohibits any economic activity or land use (such as soy crop) within that perimeter to prevent further environmental damage and allow for the recovery of native vegetation.

18. Open Data Portal, IBAMA. Accessed December 2025. <https://dadosabertos.ibama.gov.br/dataset/fiscalizacao-auto-de-infracao>

19. National Institute for Spatial Research (INPE). (2026). TerraBrasilis Data Download Portal. Government of Brazil. <https://terrabrasilis.dpi.inpe.br/downloads/>

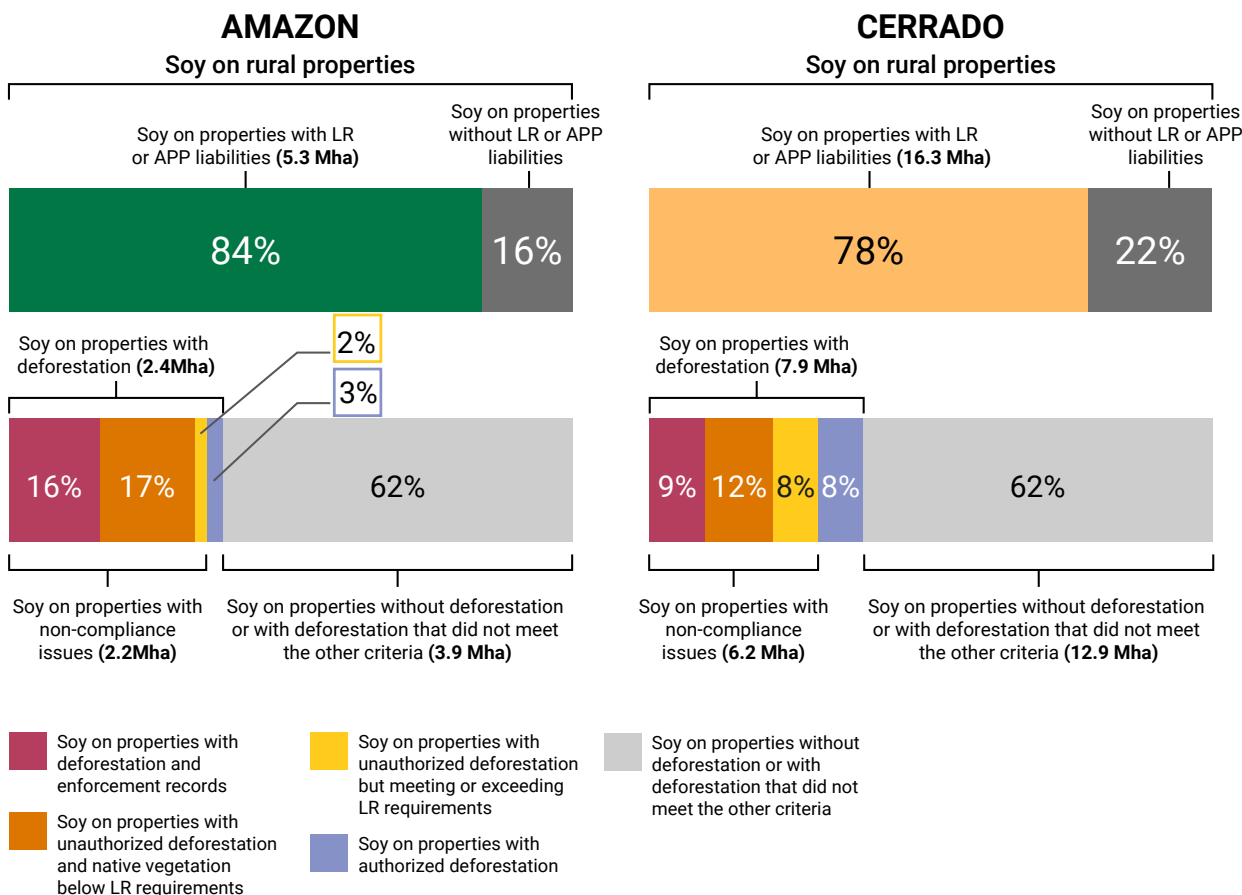
- Unauthorized deforestation in properties with a Legal Reserve surplus relative to the minimum required by law
- Unauthorized deforestation in properties with a lack of native vegetation within the farm as required by the Legal Reserve, but with no administrative measures.
- Deforestation in properties with an embargo or notices of violation related to damage to native vegetation.

It is important to note that the deforestation authorization databases used have limitations regarding data completeness. Regarding other methodological limitations, this analysis relies on the CAR database as of February 2025, which may not reflect the most recent property-level boundary changes. The 6.25-hectare minimum mapping threshold, adopted to avoid indications of non-compliance arising from simple overlaps between property boundaries and PRODES polygons, may fail to detect smaller clearings, potentially underestimating total unauthorized deforestation. Legal Reserve compliance is assessed on-property only, without accounting for off-property compensation mechanisms admitted by Law 12,651/2012 due to SICAR database limitations. Additionally, the hydrographic baseline used to assess Permanent Preservation Area compliance may underestimate the actual extent of these areas, affecting the accuracy of APP-related liability estimates.

Results

We identified **27 million hectares of soy cultivated** on approximately **134 thousand registered properties in the Amazon and Cerrado in 2024**. Of this total area, **84% and 78% of the soy area in the Amazon and Cerrado**, respectively, were on farms with evidence of on-property vegetation limits below Forest Code requirements – either for LR or APP. There are approximately **67 thousand rural properties** with evidence of lack of native vegetation according to the law, with an estimated LR liability of **6.5 million hectares**, which, under the Forest Code, must be compensated or restored depending on each property's situation. While some of these farms may have already compensated their Legal Reserve obligations in other farms or through other compensation mechanisms, the lack of comprehensive public databases and the slow process of CAR validation make it difficult to assess the prevalence of this situation. Nevertheless, the data demonstrates that the absence of native vegetation in the percentages indicated by the Forest Code remains a common situation in both biomes (**Figure 1**), highlighting the need to advance the implementation of the PRA in both the Amazon and the Cerrado. Furthermore, given the widespread evidence of Legal Reserve deficits, new native vegetation clearings are very likely to be illegal, as in-farm forest reserve surpluses is a basic requirement for obtaining clearing authorizations.

FIGURE 1. Soy area cultivated in the Amazon and Cerrado in million hectares (Mha) in 2024. We found 8.4 Mha (31%) of soy planted on rural properties where deforestation with non-compliance issues occurred between August 2008 and July 2024.

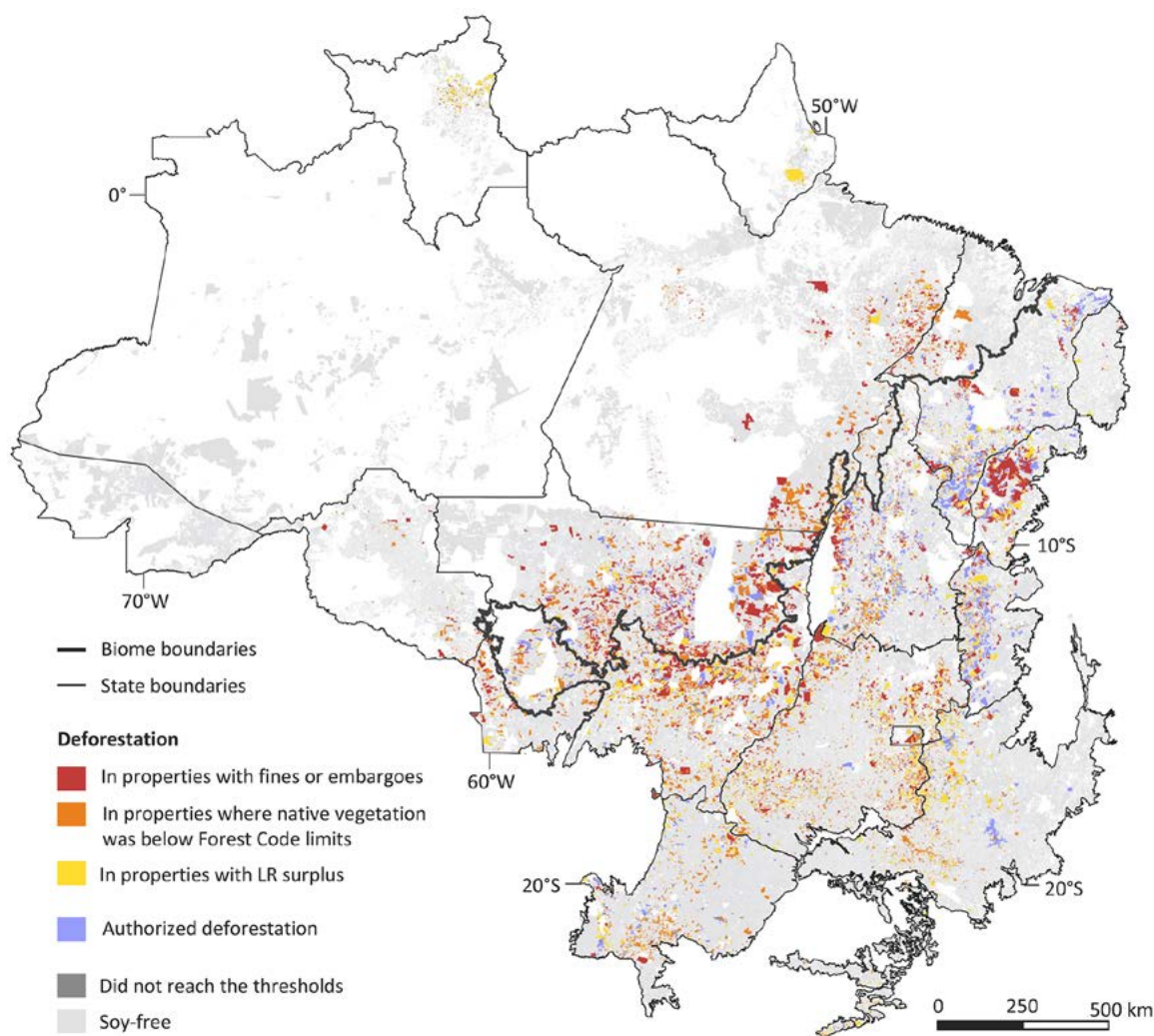


Based on this analysis of remaining vegetation on soy properties, we checked whether deforestation had occurred after July 2008, seeking to identify if it occurred on properties that already have a native vegetation area lower than that established in the Forest Code.

In total, **5.7 million hectares of deforested areas** were mapped on rural properties with soy cultivation. These farms with deforestation – considering both the cultivated area and other portions of the property – represent about **10.6 million hectares (39%)** of the 2024 cultivation.

Deforestation with non-compliance issues represents **73% of the total deforestation on soy properties**. Of the **24,151 properties** with deforestation with non-compliance issues, totaling **8.4 million hectares of soy** (2.2 Mha in the Amazon and 6.2 in the Cerrado), **77%** have evidence of vegetation limits below on-property Legal Reserves requirements or possess environmental embargo and/or infraction notices related to damage to native vegetation, signaling strong evidence of illegality. In the remaining **23%**, although the properties presented an LR surplus, no authorizations issued by the competent agencies were identified.

FIGURE 2. Distribution of deforestation between August 2008 and July 2024 on soy properties, by deforestation category. Most soybean production associated with deforestation takes place on land with non-compliance markers – either deforestation without authorization or with enforcement records.

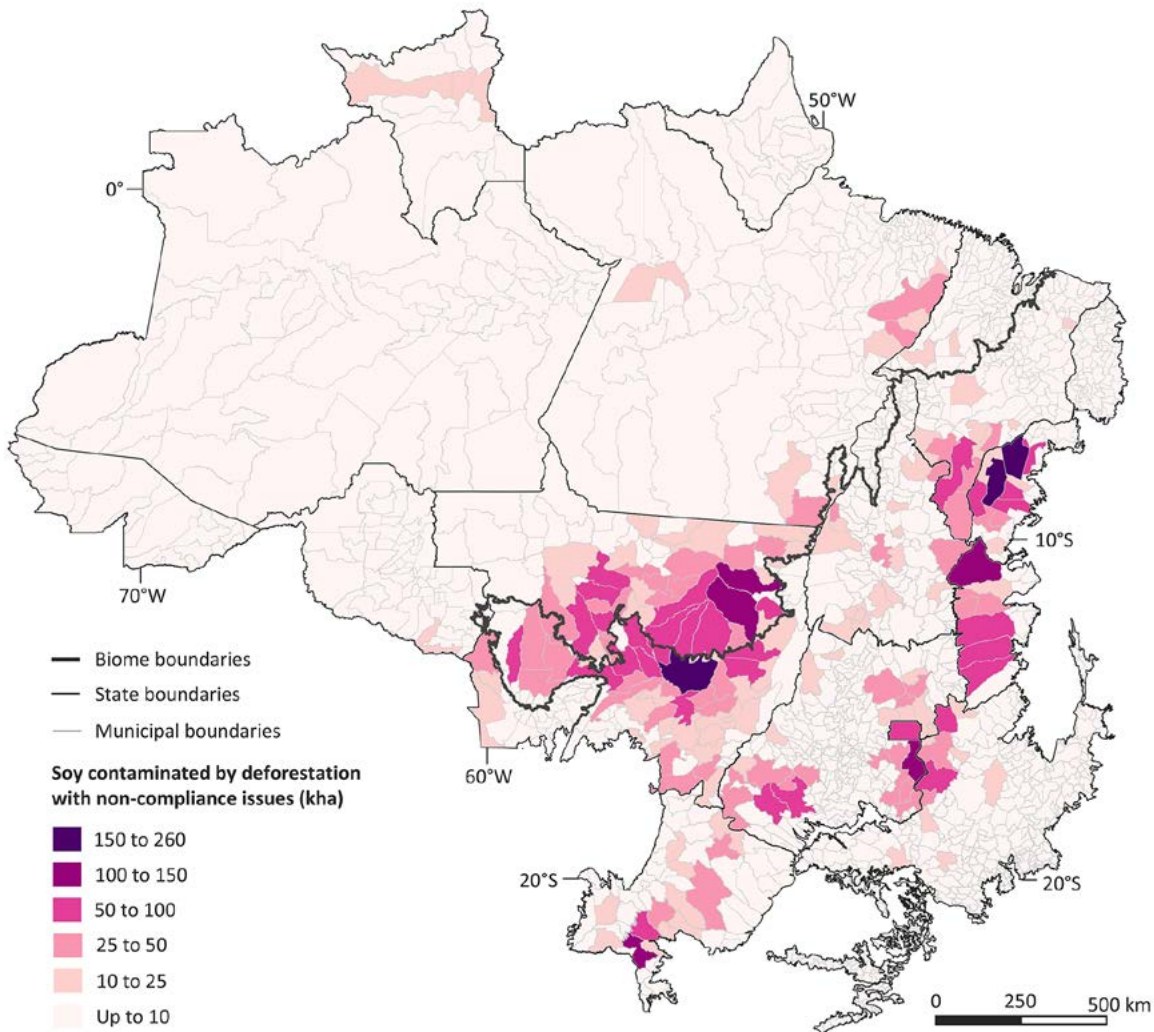


Authorized deforestation occurred on only **3%** of soy farms, corresponding to **3% and 8%** of the total cultivated area in the Amazon and Cerrado, respectively. On the positive side, **61%** of the soy area in the Amazon and Cerrado is deforestation-free, based on cut-off data from 2008.

Despite differences in the relative proportions of each type of deforestation between biomes, potentially illegal deforestation (with fines/embargoes or in properties with LR/APP liabilities) is dominant in both cases, revealing that clear-cutting affects areas that should be destined for native vegetation conservation.

We found a high concentration of deforestation with non-compliance issues in a small number of municipalities (**75**), which account for approximately **61%** of the soy cultivated on properties with this type of problem in the two biomes (**Figure 3**). The state of **Mato Grosso** had the largest areas of soy on properties with unauthorized deforestation: **3.35 Mha** of soy in properties with **1.15 Mha** of deforestation with non-compliance issues.

FIGURE 3. Rural properties with soy and deforestation with non-compliance issues are found throughout the Amazon and Cerrado, but are highly concentrated in a few municipalities.



This geographic concentration of risk related to deforestation with non-compliance issues allows traders, financiers, and processors to direct their verification efforts toward the most critical municipalities. In practice, this enables a tiered approach: more intensive and detailed verifications in jurisdictions with a higher incidence of unauthorized deforestation or with embargoes and fines, combined with simplified procedures for other municipalities.

EU and China Exposure to Soy Originating from Farms with Unauthorized Deforestation

Analysis of export data from Trase²⁰ reveals that in 2022, 27% and 44% of the soy traded from the Amazon and Cerrado, respectively, was destined for China, while 18% and 7% went to the European Union. Among the 10 municipalities with the highest levels of soy production contaminated by deforestation with non-compliance issues, 4 of them are among the main origins of soy exported to China – **Nova Mutum (MT), Cristalina (GO), Paranatinga (MT) and Ponta**

20. <https://trase.earth/>

Porã (MS) and 3 of them for soy exported to the EU – Formosa do Rio Preto (BA), Querência (MT), and Nova Ubiratã (MT).

Considering criteria such as overlap with Protected Areas, embargoes, unauthorized deforestation after July 2008, and post-2020 deforestation, it is estimated that **36% of the soy area** in both the Amazon and Cerrado would likely be **non-compliant with the EUDR**. Although this is just over **one third** of production, the volume of soy destined for the EU is relatively small, meaning the compliant portion is sufficient to supply the European market. Nevertheless, the EUDR as a regulatory signal may induce broader changes, especially regarding supply chain traceability and physical segregation between compliant and non-compliant products.

Although the Chinese market may be seen as a destination for soy rejected by the EU – as it does not impose equivalent requirements – this dynamic is already being challenged by signs of change, including the CFNA guidelines for buyers and high-level policy decisions. This context indicates that the window for importing soy with deforestation risk is likely to narrow, conferring more relevance to environmental compliance in production also within the scope of exports to China. Furthermore, governmental traceability and compliance monitoring platforms, such as SeloVerde and Consulta CAR, are likely to become more relevant for exports to both the EU and China, providing a strategic advantage to jurisdictions with lower deforestation rates and higher transparency levels.

Final Considerations and Recommendations

The identification of 8.4 million hectares of soy cultivated on farms with post-2008 deforestation with non-compliance issues reveals that the expansion of the agricultural frontier continues to disregard legality thresholds. This scenario is particularly concerning given the convergence of two opposing trends: on one hand, the tightening of markets like the European Union and the UK, and new discussions with the Chinese market; on the other, voluntary mechanisms such as the Soy Moratorium are being weakened. In this context, environmental compliance needs to be recognized as a minimum requirement for economic viability and market access for Brazilian soy.

The data also indicates that while over 60% of the soy produced in the Amazon and Cerrado is deforestation-free, the majority is associated with properties with evidence of environmental liabilities, presenting native vegetation below the limits established by the Forest Code. Four out of every five hectares cultivated in 2024 were on farms with insufficient remaining on-property native vegetation compared to what is established in the legislation. Legal Reserves and Permanent Preservation Areas perform essential ecological functions for maintaining ecosystem services that sustain agricultural productivity as well as biodiversity conservation. Efforts aimed at regularizing LR and APP liabilities are not only a legal requirement, but also a necessity for maintaining agricultural activities, especially in a scenario of intensifying climate change.

Importantly, this challenge is solvable. Just 75 municipalities account for approximately 60% of all deforestation with non-compliance issues on soy properties across both biomes. This concentration means that targeted action, such as intensive due diligence, environmental regularization and enforcement focused on a defined set of municipalities, can deliver outsized results across the whole supply chain.

We present the following recommendations for different actors in the soy supply chain to advance environmental compliance:

Production Sector and Exporters

- Re-establish multi-sectoral zero-deforestation agreement, modeled after the Soy Moratorium, with a criteria for legality proof and zero-deforestation soybean production and supply chains. These agreements should establish monitoring, reporting systems, and a member withdrawal mechanism, and be expanded to the Cerrado biome to prevent the worsening of native vegetation conversion in the coming years.
- Adopt due diligence protocols for both legality and deforestation and conversion-free (DCF) sourcing, prioritizing municipalities with a high concentration of deforestation.
- Use existing governmental compliance monitoring platforms, such as Sel-oVerde and Agro Brasil + Sustentável, to reduce risk of illegalities and implement voluntary DCF pledges.
- Direct agricultural expansion onto already-converted land: approximately 80 million hectares of degraded pasture are available in Brazil, enabling production growth without additional native vegetation conversion.

Financial Institutions

- Condition access to finance on robust environmental compliance, the absence of deforestation (authorized or unauthorized), and the implementation of regularization plans to restore environmental liabilities.
- Expand environmental criteria already established for agricultural loans also for private finance and barter.
- Create specific financing lines for forest restoration and Legal Reserve compensation, aiming to mitigate the identified 6.5 million-hectare liability and to make environmental regularisation economically viable for producers.

Brazilian Universities, Civil Society and Scientific Research Organizations

- Strengthen research on the environmental and social impacts of soybean development.
- Explore environmentally friendly, poverty-alleviating and sustainable agricultural models.
- Conduct oversight over banks and the alliance of soybean producers and exporters, and publish corporate social and environmental responsibility reports on major enterprises.

Brazilian National and Subnational Governments

- Accelerate CAR validation and the effective implementation of the PRA, promoting the environmental regularization of rural properties.
- Integrate databases of vegetation suppression authorizations and state and federal embargoes with the CAR database in transparent compliance monitoring platforms, ensuring the qualification of deforestation on the property and the identification of environmental infractions.
- Strengthen enforcement actions against unauthorized deforestation.
- Develop governmental traceability and compliance monitoring that is universal in scope (integrate data on all farms) leveraging GEO and AI technologies.
- Based on sanitary and timber regulations, develop a regulation that establishes a mandatory environmental compliance declaration for exports of agricultural commodities.

International Consumer Markets (EU and China)

- Support the implementation of traceability governmental platforms that allow compliant production to be distinguished from that associated with deforestation.
- Adopt risk-based inspections, enabling National Competent Authorities to prioritise scrutiny in higher-risk areas.
- Coordinate due diligence standards with the major importing markets, including China, to prevent the displacement of non-compliant volumes rather than their elimination from trade.