Title: The Rise and Fall of Brazil's Soy Moratorium

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Abstract: For the last two decades, a widely adopted commitment by soybean traders to avoid sourcing from farms in the Brazilian Amazon with recent deforestation has contributed to reducing deforestation across the biome. Recently, legal and political challenges to this commitment have led to its likely demise. We review the evolution of the Amazon Soy Moratorium (ASM) policy context and present estimates of the area of forest at risk with the end of the policy. Ending the ASM will lead to increased deforestation in the Amazon and could discourage the adoption of policies against deforestation by other private sector actors more broadly.

Main Text:

Brazil's Amazon Soy Moratorium (ASM) is a voluntary multisectoral zero-deforestation pact, in which soy traders agreed to not source or finance soy on Amazon lands deforested after July 2008.[1] When the ASM began in 2006, soy was a major driver of Amazon deforestation and nearly one third of soy expanded directly through deforestation (1, 2). After the ASM was implemented by the buyers of 90% of the Amazon's soybeans, deforestation to create new soy fields fell to nearly zero (1).

The ASM's clear and uniformly implemented rules encouraged high levels of compliance, without the need for complex traceability systems, and incentivized soy expansion onto the large "bank" of 9.7-15 Mha of land that was deforested prior to the Moratorium cut-off date, which allowed the Amazon's soy area to nearly triple under the ASM (1, 3). In doing so, the ASM reduced deforestation by 35% (1.8 Mha) in areas at risk for soy expansion, including outside of soy properties (4). By reducing overall pressure on forests, the ASM complemented improvements to public policy implementation over the same time period (4) and helped to drive deforestation rates down to record lows by 2012, making it the most impactful voluntary supply chain policy ever implemented.

Despite these remarkable outcomes, the majority of traders unilaterally terminated their commitments under the ASM in early 2026, effectively ending it, amidst a series of legislative and administrative challenges. Among these were the passage of laws by Mato Grosso and other leading soy producing states that removed subsidies and tax benefits for investments in new facilities from traders implementing any environmental commitment like the ASM that limits production on areas that could be legally used under Brazilian legislation, and an investigation by Brazil's anti-trust agency, CADE, into an accusation that ASM traders acted as a cartel in implementing their ASM commitments. A group of Brazilian political parties and several civil society organizations (CSOs) have acted to defend the ASM, including petitioning the country's Supreme Court, STF, to intervene (Table S1).

CSOs used scientific studies to show how the ASM enables improved implementation of Brazil's own environmental regulations, alongside legal arguments that by penalizing companies for setting ambitious environmental standards for sourcing, laws like Mato Grosso's violate key principles of free competition and environmental protection that are enshrined in the Brazilian constitution (Table S1). To address anti-trust allegations, CSOs have proposed amendments to ASM governance and information handling systems that address anti-trust concerns. A final decision from the Supreme Court regarding the constitutionality of state laws, and which could affect the eventual ruling by CADE, is still pending. The decision may ultimately come too late to save the ASM, but the prospects for an effective replacement and the future of private sector policies that aim to end deforestation and conversion of native ecosystems linked to supply chains hang in the balance.

The costs of ending the Soy Moratorium

We foresee high costs for both forests and the soy sector with the end of the ASM.

[1] The cut-off date in the original agreement was July 24, 2006, which was eventually updated to July 22, 2008 to align with a key cut-off date in Brazil's federal Forest Code.

Based on the size of the ASM's effect on deforestation rates identified in our previous research (4), we estimate that ending the ASM would result in at least 1.4 Mha of additional deforestation over the next 10 years, compared to a counterfactual in which the ASM persists (SM1). This is equivalent to an increase of 14% over historic deforestation rates in the Amazon, and would result in 843 MtCO2e, equivalent to the annual emissions of Canada.

This surge in deforestation is expected because under the ASM, the highest paying buyers of land were deterred from buying newly deforested areas, and the value of deforestation and overall pressure on forests was greatly reduced (4). Without the ASM in place, pressure for direct conversion of forests for soy will return along with the role of soy expansion in fueling speculative clearing (4).

However, there are 10s of millions of hectares of forests on soy suitable land across the Amazon that could be at risk over the long term, in the absence of sufficient safeguards against deforestation (3). This includes 9.1 Mha (SM2) on private properties that still could be legally cleared under the Forest Code, and as much as 28.7 Mha on undesignated forests that are particularly vulnerable to illegal conversion (S2; Fig. 1). While improved implementation of the Forest Code, through public and private sector policies is critical, market commitments like the ASM that limit conversion of even legally clearable areas will be needed for Brazil to meet its climate commitments (6).

The loss of the ASM goes beyond impacts on forests. It will create material risks for Brazil's soy sector and the companies acting in the region. While some studies have suggested that firms may avoid regions with more restrictive regulatory environments (7), signatory companies to the ASM increased their presence in the Amazon over the course of the agreement (SM3). Indeed, companies agreed to the ASM, at least in part, because they saw that it was in their economic interest to do so (8). Without the ASM, companies may need to implement more complex due diligence requirements for soy exported from this region to maintain access to certain markets and to ensure that they meet Scope 3 emissions targets. Long-term trading relationships could be disrupted, and companies could face significant reputational risks that could even affect their valuation (9). The continued viability of soy production in the Amazon could also be at risk if deforestation exceeds certain thresholds locally or regionally (10).

Despite claims of the economic hardships imposed by the Moratorium, the end of the agreement brings few tangible benefits for soy farmers. The ASM alone did not constrain soy expansion on soy properties because most deforestation cleared after the 2008 cutoff date violated the Forest Code. The ASM also had no impact on farmgate prices, which means the end of the commitment is unlikely to increase farmer earnings (SM4). Under the ASM, soy farmers had enough eligible land on their own farms to increase the area of soy planted in the Amazon by nearly 20% (1.7 Mha), without additional deforestation (3). The end of the ASM frees up only around 739,000 ha of area that is suitable for soy production and that was cleared legally under the Forest Code since 2008, largely on properties where soy is not currently produced (SM5). The relatively low costs of the ASM for Amazon soy producers, in terms of land availability, combined with evidence that its forest conservation occurred outside of soy properties suggest that opposition to the ASM may have been largely driven by speculative interest in expansion into new areas instead of by hardships faced by soy producers (3, 4).

The way forward

There is still a chance to avoid the worst repercussions from the loss of the ASM. Swift implementation of a new policy scenario that retains a uniform monitoring system and a 2008 cut-off date for deforestation could be a win-win for the sector and the environment. This could be achieved by formalizing monitoring under the purview of an independent body led or overseen by a coalition of civil society organizations or by establishing a public monitoring platform and the publication of a list of compliant producers on a so-called "green" list that could be consulted individually by soy traders or any other company during their procurement decisions. Indeed, a platform like this that simply publicly identifies properties without deforestation after 2008, independent of the activity conducted on the farm, could support the expansion of deforestation-free sourcing to other critical biomes like the Cerrado and the coverage of crops like corn, which are expanding rapidly in the Amazon, as well as improving implementation of key policies in the cattle sector, like the Beef TAC. Given the proximity of the Amazonian forests to reaching critical tipping points (11), and the urgent need to strengthen the resilience of Brazil's ecosystems more broadly, wider adoption and implementation of deforestation-free sourcing should be supported instead of backtracking on the forest conservation gains of a successful policy like the ASM.

Other potential paths forward are less likely to preserve the ASM's forest conservation benefits. For example, without a uniform monitoring system or protocols across the sector, individual company commitments to deforestation-free sourcing could lead to uneven and inconsistent implementation and increase the costs for companies to administer them. Attrition from deforestation-free sourcing commitments would segregate the sector, with existing deforestation-free soy areas supplying companies that retain their commitments, while increasing market-share of non-committed companies would increase the marketability of soy from recently deforested areas and erode the forest saving power of the remaining commitments (12). Another pathway is a shift to emphasize improved enforcement of the Forest Code in the place of deforestation-free sourcing. Improved Forest Code enforcement is needed in the soy sector, as as many as a quarter of soy properties have illegal deforestation. However, Forest Code compliance alone does not devalue deforestation the way the ASM did, in part because non-compliance with the Forest Code can be mitigated while deforestation after the ASM's cut-off date remained inadmissible indefinitely (13).

Finally, it is critical that the outcomes of the legal and administrative cases under consideration at the STF and CADE, respectively, do not discourage or limit sectoral or individual commitments by companies to adopt and implement environmental sourcing criteria. Instead, strong decisions by these bodies that emphasize the value of environmental conservation in business practices and reaffirm the rights of companies to take measures to improve their environmental performance will help create and improve enabling policy conditions for private sector engagement.

The ASM in context

The end of the ASM is just the latest in a series of defeats for environmental protections in Brazil. Agricultural lobbies are currently so powerful in Brazil's National Congress that they recently have overturned presidential vetoes on a bill that dismantles the country's environmental licensing system. In addition, these groups have been trying to approve an amendment to the

Constitution that would impose a "temporal framework" that limits indigenous land rights to lands directly occupied by them as of 1988, ignoring centuries of displacement and land grabbing, and ignoring a previous decision from the Brazilian Supreme Court on the matter. This trend is not unique to Brazil; environmental issues and the climate crisis are quickly being supplanted by other political priorities around the world (14).

However, deforestation and environmental criteria continue to be priorities in the context of global trade and markets. The European Union Deforestation Regulation (EUDR), though weakened and delayed, continues to be an important bellwether of changing standards for commodity production. Similar policies have advanced or are under consideration in the United Kingdom and the United States, and China has signaled increasing interest in increasing sustainability criteria for the products it imports. Most companies that left the ASM have public commitments to end deforestation in their supply chains, in some cases in line with their commitments through global multi-stakeholder initiatives like the Consumer Goods Forum (14), and there is likewise increasing pressure from the investment community on companies to reduce their exposure to deforestation in their supply chains. Exiting the ASM will greatly complicate these companies' efforts to attend to these commercial and reputational demands.

Voluntary, market-based instruments like the ASM have repeatedly proven to be important backstops and stop gaps for the implementation of public policy, which can be slow and complex (12). The unique role that the ASM has played in reducing the value of deforestation extended beyond soy properties, reaching even the speculative frontier, which made it an indispensable tool in creating more favorable conditions for Brazil to implement its laws and public policies.

The increase in pressure on forests that will come with the end of the ASM will be nearly impossible to reverse, jeopardizing Brazil's recent progress towards meeting national targets such zero-deforestation by 2030, elimination of greenhouse gas emissions by 2050, and eliminating the loss of biodiversity by 2030 (6, 15). To avoid this, what is urgently needed is a renewed commitment to deforestation-free sourcing not only by soy sector in the Amazon, but extended to the Cerrado and other biomes, and to other key sectors like the cattle sector, along with a formalized and universal property-level monitoring system for deforestation to streamline and facilitate implementation of these commitments. Ending the ASM before these measures are in place will risk Brazil's position as the world's most reliable sustainable soy producer, as well as creating material risks for the sector, risks to Brazil's climate agenda, and risks for Brazilian society overall.

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Conceptualization: LR, HKG, TR, CM

Methodology: LR, HKG, TR, MB, MS

Writing – original draft: LR, HKG, TR, CM

Writing – review & editing: LR, HKG, TR, CM, MB, MS.

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Data, code, and materials availability: All data are available in the main text or the supplementary materials, except for the Rudorff et al soy suitability map, which will be posted in a public repository.

Supplementary Materials

Materials and Methods

Figs. S1 to S4

Tables S1 to S4

References (16-29)

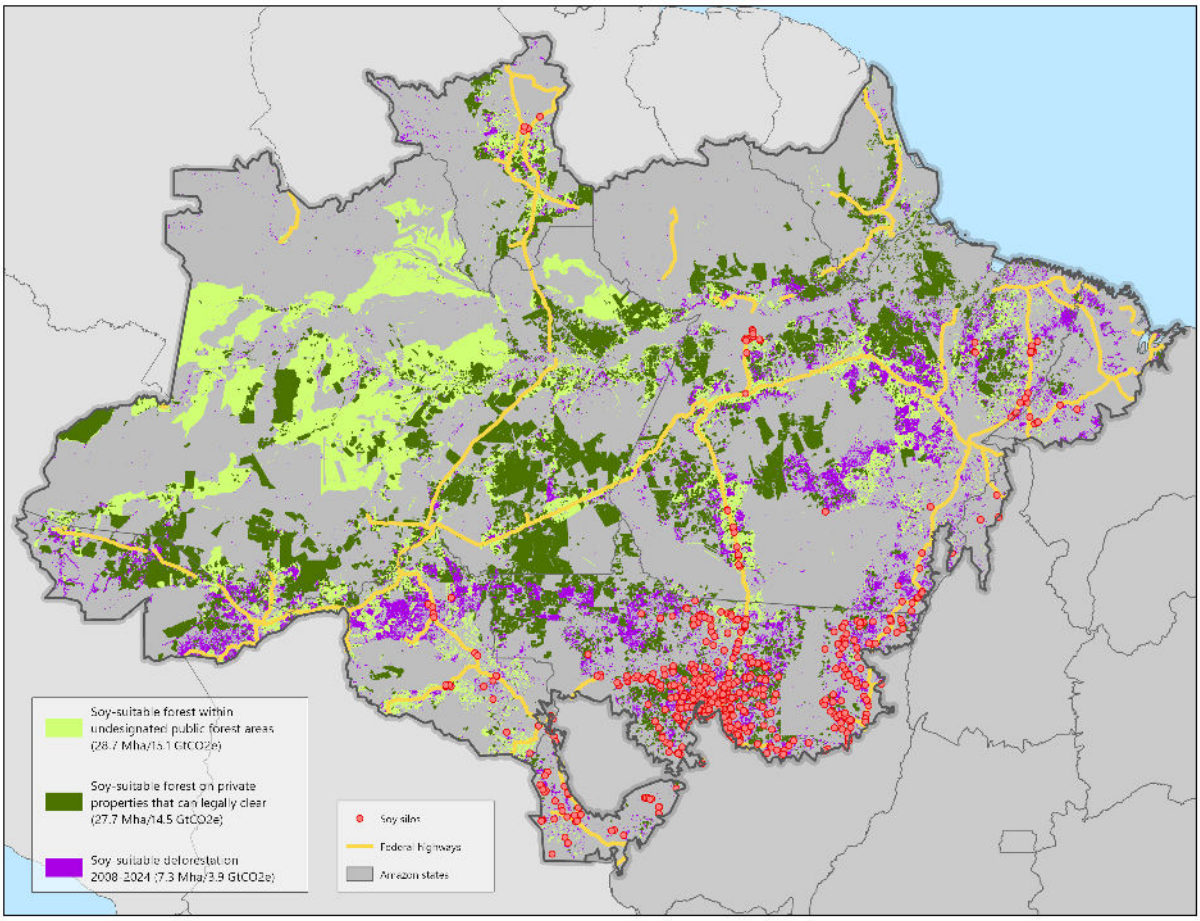

Fig. 1. Map of soy-suitable areas in the Amazon biome where soy is most likely to expand following the end of the ASM. Areas near installed soy infrastructure (silos) may see the most immediate expansion, as these are areas where soy production is already consolidated. Only 9.1 Mha of the soy-suitable forest on private properties (dark green areas on the map) could be legally cleared under Brazil's federal Forest Code.

Supplementary Materials:

Materials and Methods

Figs. S1 to S4

Tables S1 to S4

References (16-29)

SM1 - *Estimating deforestation and carbon emissions expected with the end of the ASM*

To create a simple estimate of the increase in deforestation that can be expected due to the end of the ASM, we used the size of the effect of the ASM on decreasing Amazon deforestation estimated in (4), applied to predicted deforestation rates for 2025-2035 based on deforestation during the 2014-2024 period.

The ASM effect size from (4) was estimated based on the deforestation rates on soy suitable areas within 300 km of the Amazon biome border and was equivalent to a decrease in deforestation rates of 0.66%.

We replicated the parameters of (4) to estimate baseline deforestation rates in for scenario in which the ASM continued until 2035 as a counterfactual to the end of the ASM in 2026 based on historical deforestation rates during the most recent 10-year period for which deforestation data was available (2014-2024) in soy suitable areas within 300 km of the Amazon Biome border. Soy suitable forested areas were identified by selecting areas remaining within the PRODES forest mask as of 2024 that overlapped with areas classified as having medium suitability for soy production (>40) according to (16) and that were considered suitable (>0) for mechanized agriculture according to (17) and deforestation was based on PRODES' Amazon Biome annual deforestation increment and non-forest increment layers (18, Fig. S1). We estimated an average deforestation rate for 2014-2024 of 0.653% for soy suitable forested areas within 300 km of the Amazon biome border.

We applied this deforestation rate 10 times to the area of soy suitable forests (determined as vegetation areas remaining in the PRODES mask as of 2024) remaining in our study area, to estimate the forests that will be lost over the next 10 years if average deforestation rates continue unchanged. This yielded an estimate of 1.6 Mha of deforestation that could be expected in our study area between 2025 - 2035 with the ASM remaining in place.

Next, we applied the baseline predicted deforestation rate of 0.653% + inverse of the ASM forest protection rate of 0.66% to remaining forests in our study area to estimate the amount of forest that could be lost with the end of the ASM between 2025-2035. For 2025, when the ASM was still in place, we only applied the baseline rate. For the remaining 9 years, we applied the full estimation deforestation rate of 1.2935%. This resulted in an estimated loss of 3 Mha of forests in the study area by 2035 (Table S2).

Subtracting the forests estimated to be lost even with the ASM in place (1.6 Mha) from estimate for forest loss without the ASM (3.0 Mha) results in a total of 1.4 Mha of forests that can be expected to be lost from the end of the ASM.

To determine the emissions that would result from the loss of these 1.4 Mha, we applied a factor of 526 tCO2e, resulting in a total of 843 MtCO2 in potential emissions (19).

SM2 - *Estimating forests at risk with the end of the ASM*

Although illegal clearing is rampant in the Brazilian Amazon, and the impacts of the end of the ASM will result in increased pressure on all forests, including those that are protected under the Forest Code, the pool of forests that are most directly at risk with the end of the ASM include those on areas that are suitable for soy production and that exceed the Legal Reserve requirements for private properties under the Forest Code, and those that are suitable for soy production and located on Federal Undesignated Forests, which are areas without an official land tenure designation and are particularly vulnerable to land speculation and deforestation (20).

We estimated the area of soy-suitable forests that exceed Legal Reserve requirements on private properties by overlaying a map of CAR properties downloaded from Brazil's SiCAR portal (21) with forest remaining in the forest mask from PRODES and the soy suitability map produced by (22, see also 23). For properties for which more than 80% of the property was still forested, generally indicating that the property can legally clear some forest, we estimated the area of forest in excess of 80% of the total property area. On properties with excess forested area *and* with forested area that overlapped with the soy suitability layer that was equal or in excess of the excess forest area, we considered the excess forested area to be suitable for soy and included this area in our estimate. On properties with excess forested area but with total forested area overlapping with the soy suitability map less than the excess forested area, we considered the total soy suitable forested area on the property in our estimate. Soy-suitable, legally clearable forests were identified on 31,998 CAR properties (out of a total of 711,938 CAR properties), including 155 soy-producing properties (24).

Soy suitable forests in Federal Undesignated Forests areas were estimated by overlaying the PRODES forest mask, the soy suitability layer, and a map of Undesignated Forests (Type B) (25; Table S3).

SM3 - *Soy trader entry into the Amazon under the ASM*

We evaluated how the presence of soy trading firms in Amazon municipalities evolved under the Amazon Soy Moratorium (ASM). The central outcome was the number of distinct trading firms sourcing soy from a municipality in a given year. We tracked the number of active traders because market-exclusion commitments can change not only which farms can sell to which buyers, but also whether – and ultimately how many – buyers choose to operate in a region.

We used transaction-based supply-chain data from Trase, which links export shipments to subnational sourcing origins and identifies the trading firm involved (26). We aggregated the data to the municipality-year level and counted the number of unique firms sourcing soy in a

given municipality and in a given year for 2004-2022. Trase identifies which firms are ASM signatories, allowing us to distinguish between the number of signatory and non-signatory firms.

Firm activity increased within the Amazon overall during the study period, but this rise was concentrated among ASM signatory firms. Fig. S2 shows a sustained upward shift in the number of ASM signatory firms sourcing from Amazon municipalities. In contrast, non-signatory firm presence remained largely stagnant.

The signatory/non-signatory contrast is important for the interpretation of our results. Over the period we study, soy production expanded into the Amazon. If this expansion were the source of additional firm activity, we would expect rising numbers of both ASM and non-ASM firms sourcing from the Amazon. Instead, the increase is specific to signatories.

A plausible interpretation is that the ASM improved the attractiveness operating in the Amazon for signatory firms. It is possible that, by signing the ASM, soy traders were able to attract or maintain demand from consumer markets with stricter environmental standards. The ASM therefore may have provided signatories access to more downstream markets and/or improved the perceived stability of the trading environment.

SM4 - *Evaluating farmgate soy price trends*

A concern raised by critics of the ASM is that exclusion of soy produced in violation of the agreement could depress prices paid to farmers by increasing buyer market power. To explore this concern, we examined trends in farmgate prices before and during the ASM.

We measured farmgate soy prices using Brazil's municipal agricultural statistics (Produção Agrícola Municipal - PAM) (27). PAM reports soy production and the value of production at the municipality-year level. We constructed an average farmgate price as value divided by quantity. This municipality-level measure captures average price movements but cannot distinguish prices received by compliant versus non-compliant farms within the municipality.

The ASM applied to municipalities in the Amazon biome, but not the nearby Cerrado biome. To establish a comparison, we restricted attention to municipalities within 300 km of the Amazon biome boundary, as displayed in Fig. S3. We then tracked the evolution of farmgate soy prices in the selected municipalities, separately for each biome.

As Fig. S4 shows, farmgate prices were highly similar throughout the period, both in levels and trends. The absence of noticeable average price differences is consistent with two possibilities that are not separable with municipality-level price data: (i) prices did not change significantly for both compliant and non-compliant producers, or (ii) heterogeneous effects offset in the mean (for example, downward pressure on excluded/non-compliant suppliers alongside upward pressure for compliant suppliers if higher-earning signatories expand sourcing and increase competition for eligible soy). These equilibrium channels and presents evidence on trader earnings and entry consistent with the second mechanism are discussed further in (28).

SM5 - *Estimating areas cleared legally after 2008*

To estimate the areas that were ineligible for soy production under the ASM but cleared legally under the Forest Code, we overlaid deforestation polygons mapped by PRODES (annual deforestation increment and annual deforestation increment for non-forest for Amazon Biome) with dates after the ASM's cut-off date in July 2008 with CAR properties. Most properties in the Amazon biome can only clear legally if they have more than 80% forest cover, so we summed the area of the PRODES polygons that fell on a soy suitable area on a property with >80% forest cover at the time of the deforestation. We then estimated how much of this area that may have been legally cleared fell on a property that produced soy by overlaying properties with 2024 soy areas identified by Mapbiomas (24, Table S4). Soy-suitable areas cleared legally after 2008 but not used for soy were identified on 13,876 properties, only 114 of which produced soy on other parts of the property. We also identified 139 properties that cleared legally after 2008 and planted soy on those cleared areas.

We identified 4,783 soy-producing properties with <80% forest cover and that had deforestation >July 2008 (23% of all soy properties, n = 20,226). Deforestation on any Amazon biome property with <80% forest cover is a likely violation of the Forest Code due to clearing beyond the legal limits prescribed by the law. According to official ASM reporting, as well as published research, violations of the ASM were uncommon (1,29). Properties could violate the Forest Code without violating the ASM by not planting soy on areas deforested after 2008.

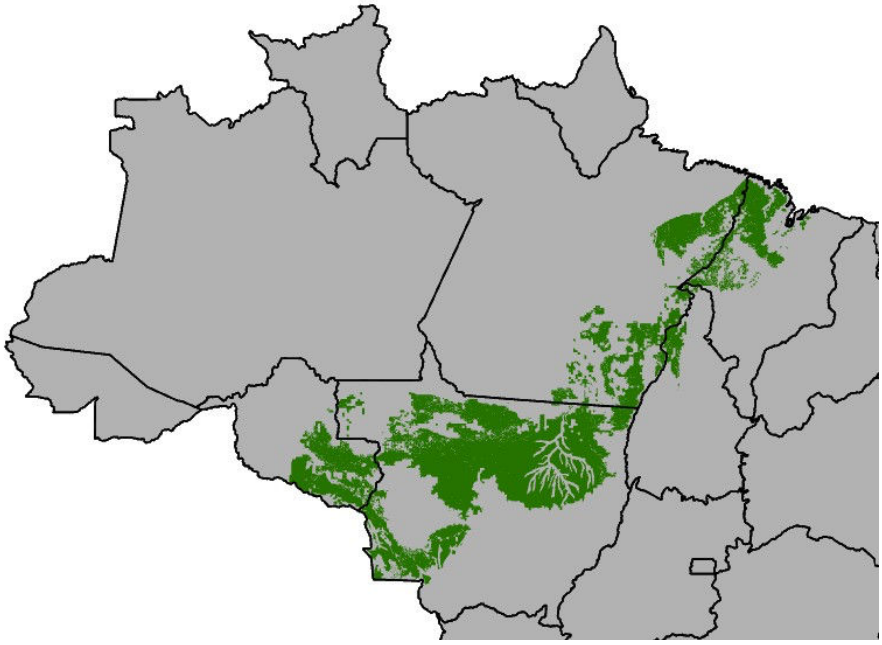

Fig. S1: Soy suitable forested areas within 300km of the Amazon biome boundary.

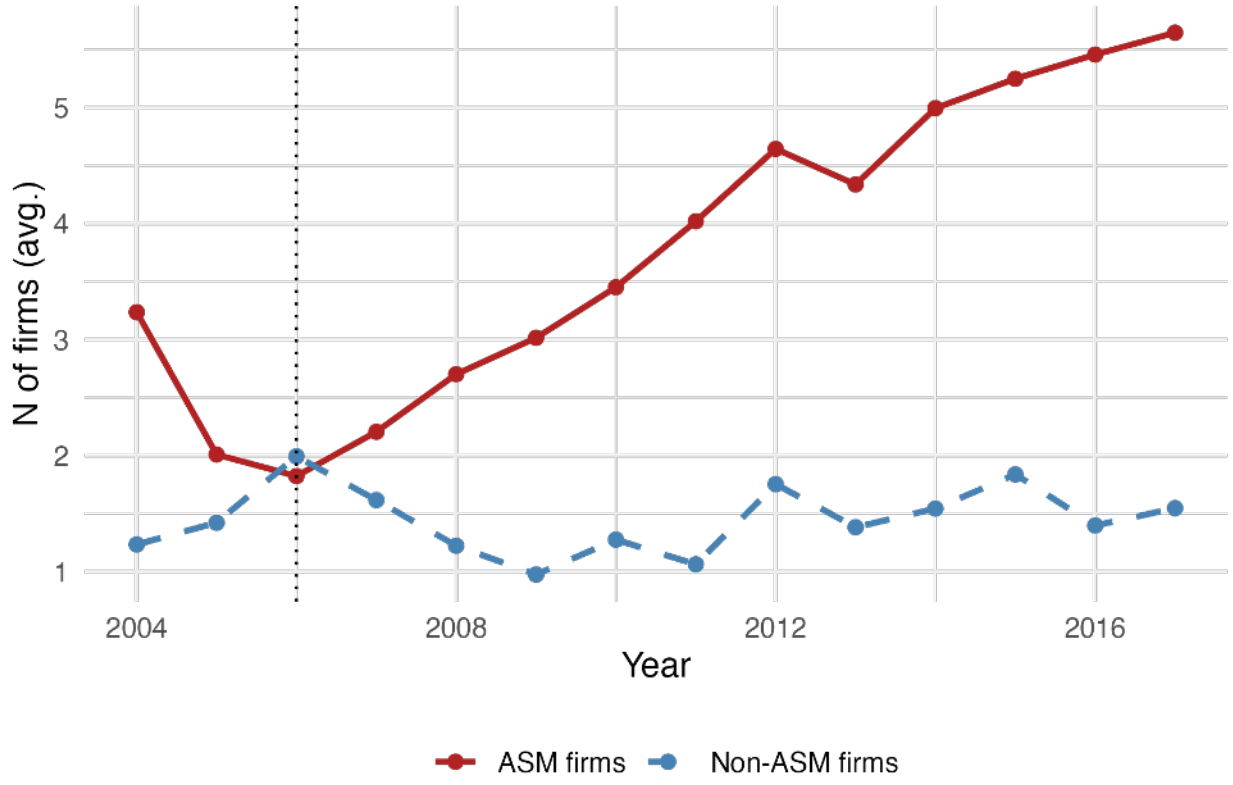

Fig. S2 - ASM and non-ASM entry patterns in the Amazon. The figure plots trends in the number of firms procuring soy on average per municipality in the Amazon, distinguishing between firms that signed the ASM and those that did not. The dotted line points to the beginning of the ASM in 2006.

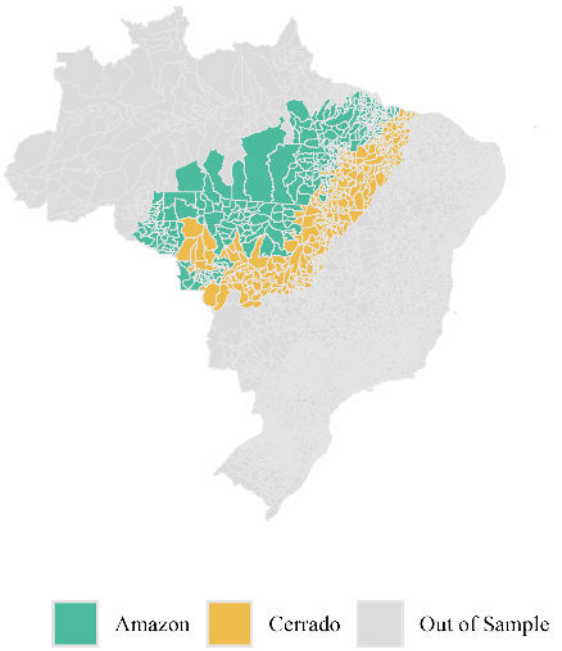

Fig. S3 - Study Sample for evaluation of soy farm-gate prices over time.

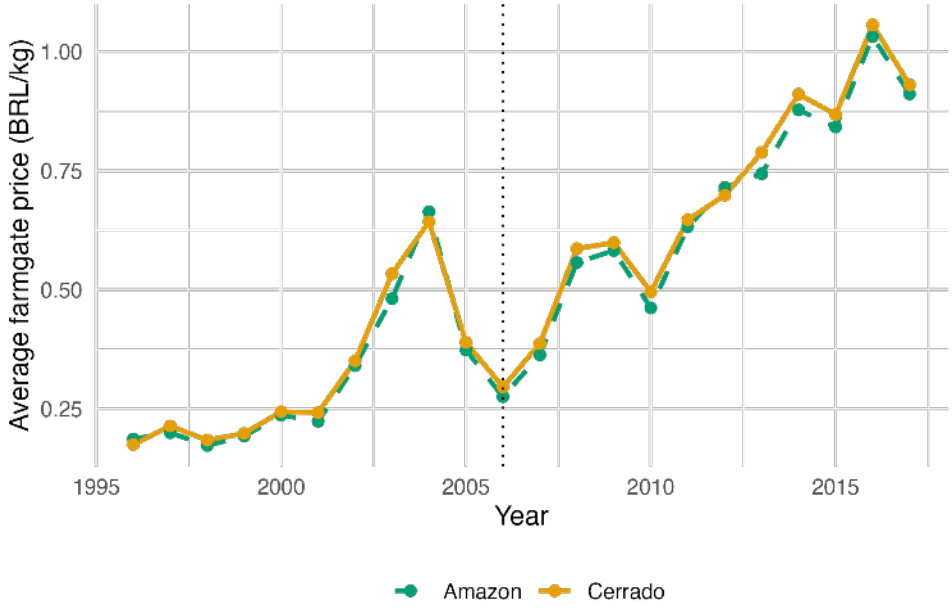

Fig. S4 - Soy farmgate price trends in the Amazon and Cerrado within study sample.

Type of filing	Petitioning Parties	Link
Direct Action for the Declaration of Unconstitutionality and Petition for Injunctive Relief	Communist Party of Brazil (PCdoB), Socialism and Liberty Party (PSOL), Green Party, and Sustainability Network	https://redir.stf.jus.br/paginadorpub/paginador.jsp?docTP=TP&docID=783321786&prcID=7134359
Direct Action for the Declaration of Unconstitutionality and Request for Admission as *amicus curiae*	Greenpeace Brazil, WWF-Brazil	https://redir.stf.jus.br/paginadorpub/paginador.jsp?docTP=TP&docID=783322483&prcID=7134487
Direct Action for the Declaration of Unconstitutionality	Climate Observatory Laboratory, Greenpeace Brazil, WWF-Brazil	https://redir.stf.jus.br/paginadorpub/paginador.jsp?docTP=TP&docID=789614041&prcID=7345330#
Direct Action for the Declaration of Unconstitutionality	Climate Observatory Laboratory, Greenpeace Brazil, WWF-Brazil	https://redir.stf.jus.br/paginadorpub/paginador.jsp?docTP=TP&docID=790737912&prcID=7377929#

Table S1: Key filings to Brazil's Supreme Court (STF) in support of the ASM

Year	Deforested area (ha) (includes forest and non-forest areas)	forest + non-forest at beginning of year (ha)	Defor rate (average rate 2015-2024 + .66%)
2025	149,700	23,568,800	0.6353%
2026	303,300	23,419,000	1.2953%
2027	299,400	23,115,700	1.2953%
2028	295,500	22,816,300	1.2953%
2029	291,700	22,520,700	1.2953%
2030	287,900	22,229,000	1.2953%
2031	284,200	21,941,100	1.2953%
2032	280,500	21,656,900	1.2953%
2033	276,900	21,376,400	1.2953%
2034	273,300	21,099,500	1.2953%
2035	269,800	20,826,200	1.2953%
Total area deforested 2025-2035	**3,012,400**		

Table S2: Study area deforestation estimates for 2025-2035 based on the end of the ASM in 2026

State	Soy suitable surplus forest on CAR properties in the Amazon Biome (ha)	Soy suitable forest in Undesignated Public Forests (CNFP), Type B
AC	472,017	298,258
AM	4,973,622	24,321,804
AP	158,568	122,199
MA	25,059	11,331
MT	875,632	137,768
PA	2,145,243	2,242,064
RO	136,024	602,769
RR	328,775	917,820
TO	437	862
Total	**9,115,375**	**28,654,875**

Table S3: Soy suitable surplus forest on CAR properties and in Undesignated Public Forests, by state. “Surplus forest” means that the area exceeds the required area for Legal Reserve on a private property and could be deforested legally assuming a proper permit were acquired.

	Non-soy properties	Soy-Properties	Total
Area (ha)	719,563	19,580	739,143

Table S4: Soy suitable areas non-compliant with the ASM but cleared legally under the Forest Code.

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