Trading deforestation - Why the legality of forest-risk commodities is insufficient

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Abstract

Consumer countries and blocs, including the UK and the EU, are defining legal measures to tackle deforestation linked to commodity imports, potentially requiring imported goods to comply with the relevant producer countries' land-use laws. Nonetheless, this measure is insufficient to address global deforestation. Using Brazil's example of a key exporter of forest-risk commodities, here we show that it has ~3.25 Mha of natural habitat (~152.8 million tons of CO_2) at a high risk of legal deforestation until 2025. Additionally, the country's legal framework is going through modifications to legalize agricultural production in illegally deforested areas. What was illegal may become legal shortly. Hence, a legality criterion adopted by consumer countries is insufficient to protect forests and other ecosystems and may worsen deforestation and conversion risks by incentivizing the weakening of social-environmental protection by producer countries.

1. The Trade Of Forest-risk Commodities

The way we use the land to produce, trade, and consume food is directly connected to social-environmental issues like deforestation, biodiversity loss, human rights violations, climate change, and pandemics [1–3]. The production of agricultural commodities is a key driver of deforestation across the globe [3]. However, deforestation embedded in global supply chains is especially acute in the trade routes between commodity-producing countries in the Global South and commodity-importing countries in the Global North. Recognizing their roles as importers and consumer countries, the United Kingdom and the European Union are considering policy measures to address imported deforestation [4]. In the context of distant connections in food supply chains [1], it is crucial to account for GHG emissions, biodiversity loss, and traditional communities' rights embedded in food imports, taking appropriate mitigation measures.

Over the last decade, a wave of voluntary commitments from the private sector and nations (e.g., the Consumer Goods Forum or via the Amsterdam Declarations Partnership) have fallen short in making progress towards deforestation-free supply chains [5]. Hence, at present, there is growing momentum for bolder actions from both government and private companies. Many discussions are in place on what policies could most efficiently halt the environmental degradation driven by agricultural imports [4]. Part of this debate favors mandatory due diligence by importing countries to verify compliance with legal criteria from exporting countries [4,6]. It is essential to highlight that any legislation to tackle deforestation via a legality-based approach is dependent on the efficacy of local governments and legislation and, ultimately, its alignment with downstream deforestation-free objectives.

Considering Brazil as an example of a key agricultural exporter; the country produced around 118 million tons of soybeans in 2018 alone, representing 36% of global soy production [7]. 57% of Brazil's production in 2018 was exported to China and 11% to Europe, including the UK [8]. The soy-deforestation risk of this Brazilian soy, which includes deforestation and native vegetation loss in the previous five years that became soy up to 2018, was about 61.4 thousand hectares, emitting slightly over 10 million tons of CO_2

[8]. About 6.3 thousand hectares of this native vegetation loss (~10%) and ~1.1 million tons of emitted CO_2 (~11%) belong to the EU, including the UK. These volumes refer only to 2018 soybean production, with impacts even higher in previous years [8].

Despite global climate and biodiversity crises, Brazil's current environmental legislation authorizes significant amounts of vegetation loss [9]. This destruction is not necessary from a land-resource standpoint. Brazil has sufficient suitable lands for expanding production without clearing additional hectares of native vegetation [10]. Moreover, deforestation jeopardizes overall agricultural production and income due to disruptions in local rainfall patterns driven by deforestation [11]. Not even the existing legal requirements are adequately enforced. Roughly 20% of Brazil's soy and at least 17% of beef exports to the EU, produced on the Amazon and Cerrado biomes, may be contaminated by illegal deforestation [9]. Previous studies have shown the limits of Brazil's legislation to tackle illegal deforestation [12], and the actual and potential increases in deforestation stemming from bailouts and revisions in the Forest Code[13,14].

2. Natural Habitat At High Risk Of Legal Deforestation

Here we build upon and go beyond Rajao et al.'s (2020) study. We estimate the potential legal deforestation and carbon emissions in Brazil that may take place shortly (until 2025). For this, we combine several spatially explicit databases and a spatial model that estimates the probability that native vegetation will remain until 2025 in the face of several drivers of land use change (*See Methods*).

We identify 1,114,693 rural establishments holding ~69.2 million hectares of unprotected native vegetation (*i.e.*, that can be legally deforested), storing ~5.8 billion tons of CO_2 (Tables 1 and S1). Out of these, ~3.25 million hectares storing ~152.8 million tons of CO_2 are at high risk of deforestation and native vegetation conversion until 2025. Another ~26.8 Mha storing 1.1 billion tons of CO_2 are at medium risk (Tables 1, S1, Figures 1, S1, and S2). This is a plausible extent of short-term future deforestation risk. In 2020 alone, Brazil's Amazon and Cerrado biomes together lost 1.8 Mha [15].

Table 1 – Native vegetation and potential carbon dioxide stocks that can be legally cleared and emitted in Brazil until 2025.

Risk of Loss	Number of Rural Establishments	Unprotected Native Vegetation (ha)	Unprotected Carbon (tonnes of CO_2)
1 High Risk	104,145	3,251,961	152,816,882
2 Medium Risk	464,162	26,777,911	1,107,194,477
3 Low Risk	319,808	29,037,483	3,796,246,697
4 No Risk	226,578	10,186,942	782,194,659
Total	1,114,693	69,254,298	5,838,452,715

3. The Legal Basis Of Deforestation In Brazil

The legislative framework built to protect native vegetation in Brazil comprises two main instruments: protected areas in public lands and mandatory conservation in private properties. Protected areas include conservation units – such as national parks and forests – and traditional peoples lands – such as indigenous communities. On the other hand, mandatory protection in private property is mainly regulated by the Forest Code, introduced in 1934 and revised in 2012. The Brazilian Forest Code, unlike most European forest laws, was designed within the paradigm of an open agricultural frontier, granting rural owners the subjective right to convert forest land into agricultural areas as long as certain limits are respected. These limits are legally defined as Permanent Preservation Areas (natural vegetation in riverbanks, for instance, PPAs) and Legal Reserve (LR), a portion of a given property set aside for conservation or sustainable management [9].

In the forestlands of the Amazon biome, 80% of any medium-to-large private property is overall considered Legal Reserve (LR). However, this general rule is an exception since special conditions allow Amazon states and municipalities to reduce this LR area to 50% [14]. This level of protection is often used as an example of ambitious legislation, but it also means that 20-50% of these medium-to-large properties can be lawfully deforested. Considering that properties in the Amazon can be as large as 20-thousand hectares, the areas open for legal deforestation according to Brazilian law are far from insignificant. Additionally, elsewhere in Brazil, the Legal Reserve areas range from 20% to 35% in equally important biomes such as the Cerrado savanna and the Pantanal wetlands. The Atlantic Forest is an exception because the *Mata Atlântica* protection law forbids any additional clearing. Therefore any deforestation within this biome is undeniably illegal. These biomes are critical carbon sinks. Their conservation is crucial for tackling climate change and the CO_2 emissions driven by land use change [9].

All in all, the Forest Code defines at least ~101 Mha of Brazil's biomes as areas open for legal deforestation [16]. This area is about four times the territory of the United Kingdom. The clear-cut of such regions would mean extra emissions of at least 12.48 billion tons of CO_2 – all of which potentially authorized by the current Brazilian legislation [16]. This amount is almost 34 times the UK's total greenhouse gas (GHG) emissions in 2018 alone [17]. In alignment with our short-term modelled estimates (*See Methods*), this area is what we consider as the *total* amount of possible legal deforestation. Whilst not all of this is likely to be cleared in the near term due to political, biophysical, and infrastructural constraints for deforestation, some areas in Brazil are likely to be at particularly high risk (Figure 1).

4. Changing Legislation Over Time

As stated above, Brazil's legislation is permissive enough to allow for a substantial amount of legal CO_2 emissions via land use change. Yet, the legal framework to protect native vegetation has been changing in the recent years to allow more legal deforestation and legalize economic activities carried out in former forests and natural habitat that was illegally cleared. The 2012 Forest Code is a stark example of this situation. From the 1990s, Brazilian environmental agencies ensured that law enforcement was more stringent than before, and thousands of non-compliant rural producers were fined. This generated political pressure to revise the law, passed in 2012, with several amnesties for illegal deforestation carried out before 2008 [13], thus effectively legalizing previously illegal deforestation. With the changes in 2012 alone, about 41 Mha of deforested and converted lands that should otherwise have been restored to native habitat were granted amnesty [18]. Another ~1 Mha is estimated to have been deforested between 2012 and 2017 due to the incentives provided by the revisions to law [13].

The Forest Code is not an isolated case. Several bills in Parliament are on the verge of being approved that are likely to bring more amnesties and open additional space for legal deforestation (*See the SI, List of Brazilian Congress Bills*). These bills are part of an overarching movement by the current Bolsonaro administration to re-shape the socio-environmental legal framework in Brazil, incentivizing further legal destruction of natural habitat and carbon emissions and the legalization of agricultural activities that are currently unlawful.

5. Ways Forward

To effectively implement a legality-based sustainability policy, legal deforestation activity should be monitored by producer-country authorities or otherwise by the supply chain itself. To be considered legal, any land use change from native vegetation to agricultural cover in Brazil must be subject to approval by the State Environmental Department before it takes place. The State Environmental Department must assess cases and issue land clearing permits if the requests comply with all legal requirements. Authorizations must identify the geospatial location of the clearance. Nevertheless, most states in Brazil lack any tracking system for these authorizations, which means there is effectively no monitoring of whether the authorized deforestation is being carried out lawfully. Currently, Brazilian agencies lack the technical capacity and political willingness to monitor, verify, enforce and report land use regulation.

Without such local information, in the context of the global supply chains in which soy is embedded, it is virtually impossible to attest if deforestation has been carried out legally or not [19]. Companies point out technical difficulties in monitoring and verifying legal deforestation to challenge regulation and enforcement by consumer countries [20]. An ideal scenario would be one where buyers could request the legal permits of clearings and production operations from their upstream suppliers (*i.e.,* farmers). However, this is complicated by technical issues related to Brazilian authorities' incapacity or unwillingness to monitor, verify, enforce, and report legal compliance.

In comparison, there are several methods to trace and verify *gross* (i.e. rather than just legal) zero-deforestation and natural habitat conversion in export supply chains[21–23]. Platforms such as Trase[8] and Mapbiomas[24] are examples of publicly available supply chain and land use data that companies can use. Ultimately, companies can – and do – have mechanisms to audit and verify whether their supply chains are deforestation-free via supplier engagement processes. A missing link to ensure a level playing field and promote industry-wide action is a requirement for precise cut-off dates, past, present, or future, to mark when no conversion will be allowed in the supply chains[5].

Since companies and supply chain actors have been failing to define commitments and cut-off dates voluntarily[5], clear and stringent mandatory regulation demanding zero gross deforestation and natural habitat conversion by consumer-country authorities appears to be an effective measure. While the introduction of downstream legislation covering all forms of deforestation may appear politically infeasible in the short term [4], it should not be dismissed as an ultimate goal. Nor should other potential policy mechanisms which have the potential to encompass broader protections be de-prioritized.

In sum, in addition to being insufficient to prevent deforestation activity in all forms, regulation based solely on the criterion of legality carries the risk that it may be detrimental to the protection of forests. In countries where legislation can be easily modified, as is demonstrably the case for Brazil, increased demand for products with legal origins can increase pressure for legislative changes that aim to legalize agricultural activities located in illegally deforested areas. These legislative changes, in turn, also pave the way for more legal deforestation. Therefore, while welcoming the steps made by governments to introduce regulation to respond to the global threat of deforestation, we urge consumer-nation policymakers to consider zero-*gross* deforestation and zero native vegetation conversion criteria in their initiatives to address imported deforestation, GHG emissions, and biodiversity loss, considering that this is technically viable and potentially effective despite the short-term political hurdles that would need to be overcome to implement these advanced measures.

6. Methods And Data

First, we use a property-level boundaries dataset, which includes the amounts of Legal Reserves (LR), Permanent Preservation Areas (PPAs), and the surplus of LRs (i.e., that can be legally cleared) [16]. Second, we use an aboveground carbon density map at 50m pixel resolution for Brazil [25]. Third, we use projections of unprotected native vegetation in private lands, considering rural establishments that can conduct legal clearings [16]. Fourth, we employ a modelling approach that estimates the probability of the existence of native vegetation until 2025 [26]. This model considers topography, soil properties, climate data, distance to transportation corridors, and legally protected areas, including indigenous lands. This unprecedented combination of datasets allows us to estimate the potential future legal deforestation with different levels of risk.

We took a conservative approach, excluding from this analysis the areas that Freitas et al. (2018)[16] projected as potential private properties to fill spatial gaps in the Brazilian territory. We only considered the rural establishments officially registered and identified at Brazilian land databases. Therefore, while Freitas et al. (2018)[16] estimated ~101 Mha of unprotected native vegetation within private lands, we only considered ~69.2 Mha. We used Fendrich et al.'s (2020)[26] land cover model to classify these unprotected areas according to their risk of conversion. Ours is a conservative estimate because we only considered properties with accurate land registries in the land database constructed by [16] and updated by [14], *i.e.*, we excluded properties modelled to fill spatial registry gaps.

The land tenure database presented in Freitas et al. (2018) [16] and updated by Freitas et al. (2018) [14] was used as starting point for the analysis presented here. This database comprises public and private properties in Brazil such as Indigenous Lands, Conservation Units, Quilombola Territories, and private rural properties from the Rural Environmental Registry (Portuguese acronym CAR) and the georeferenced properties of the National Agrarian Reform Institute (Portuguese acronym SIGEF). The database also includes information on the compliance of these rural properties with the Brazilian Forest Code. It has information related to the area of native vegetation and the amount of aboveground carbon stock within each rural property [16,25]. With the existent variables, it is also possible to identify the part of the native vegetation (or its carbon stocks) that is both legally protected or has the potential to be legally deforested (the latter called hereafter as unprotected native vegetation or unprotected carbon stocks). It is essential to highlight that our land tenure map differs from [14,16] because we only considered properties with accurate land registries in the land database constructed by [16] and updated by [14], *i.e.*, we excluded properties that were modelled to fill spatial registry gaps.

Fendrich et al. (2020) [26] presented maps of the probability of the existence of native vegetation in a given pixel for the years 2017 and 2025. The probabilities are calculated based on a spatially explicit regression model that explores the relation of land cover maps of the Mapbiomas project (2019)[24] and spatial variables (drivers of land cover change), such as topography, soil properties, climate data, distance to transportation corridors and legally protected areas, including indigenous lands. The land cover maps were reclassified to four classes in the model, namely, native vegetation, pasture, agriculture, and other uses. The existence of these four land cover classes was analyzed for every pixel in the entire period (from 1985 to 2017). The model captured the relation of the land cover classes and the spatial variables. Based on alternative future climate and policy scenarios (aggressive, business as usual, and conservative scenarios), Fendrich et al. [26] estimated the probability of the existence of native vegetation, agriculture, and pasture in Brazil for the year 2025.

Here we used the business as usual scenario to generate a map of the variation of native vegetation probability (VNVP map) between 2017 and 2025, where positive values represent pixels with an increase in the probability of native vegetation existence until 2025. In contrast, negative values represent pixels with a decrease in the probability of native vegetation existence until 2025. Further, we have combined the rural properties with unprotected native vegetation and the VNVP map to extract the average probability for each of these properties. Fig. S1 expresses the distribution of the average probabilities within rural properties.

The distribution of the VNVP shows that 99.6% of the properties with unprotected native vegetation have VNVP between -5% and +5%, with the majority of the properties (79,2 % of the total) presenting negative values (Fig. 2). Based on the distribution of the VNVP, we defined four classes of risk of unprotected native vegetation to be deforested:

- Properties with VNVP lower than -3% = High risk
- Properties with VNVP between -3% and -1%= Medium risk
- Properties with VNVP between -1% and 0% = Low risk
- Properties with VNVP higher or equal than 0% = No risk

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Figures

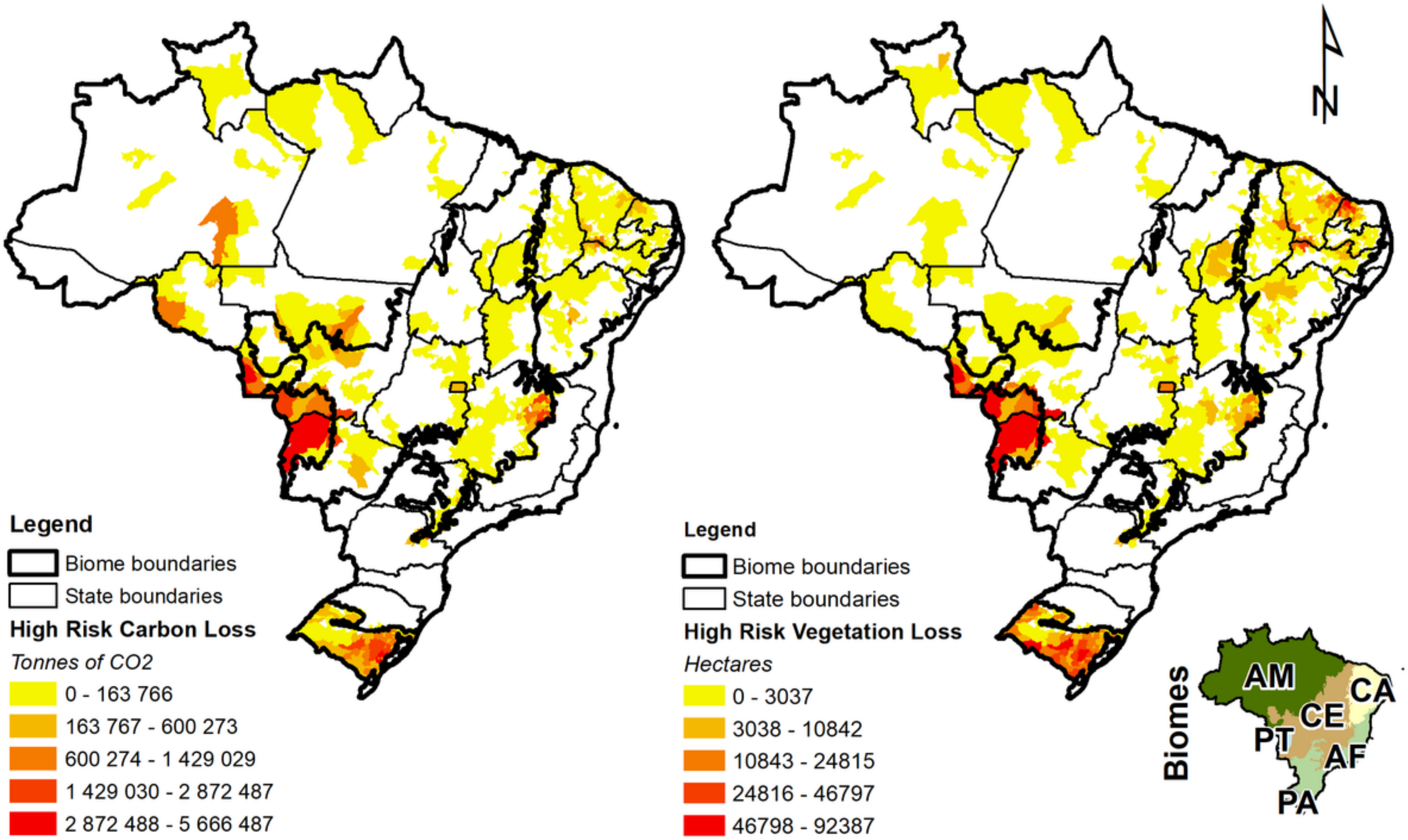

Figure 1

Maps showing the largest CO2 stocks (in tonnes) and native vegetation areas (in ha) at high risk of legal conversion in Brazil until 2025.

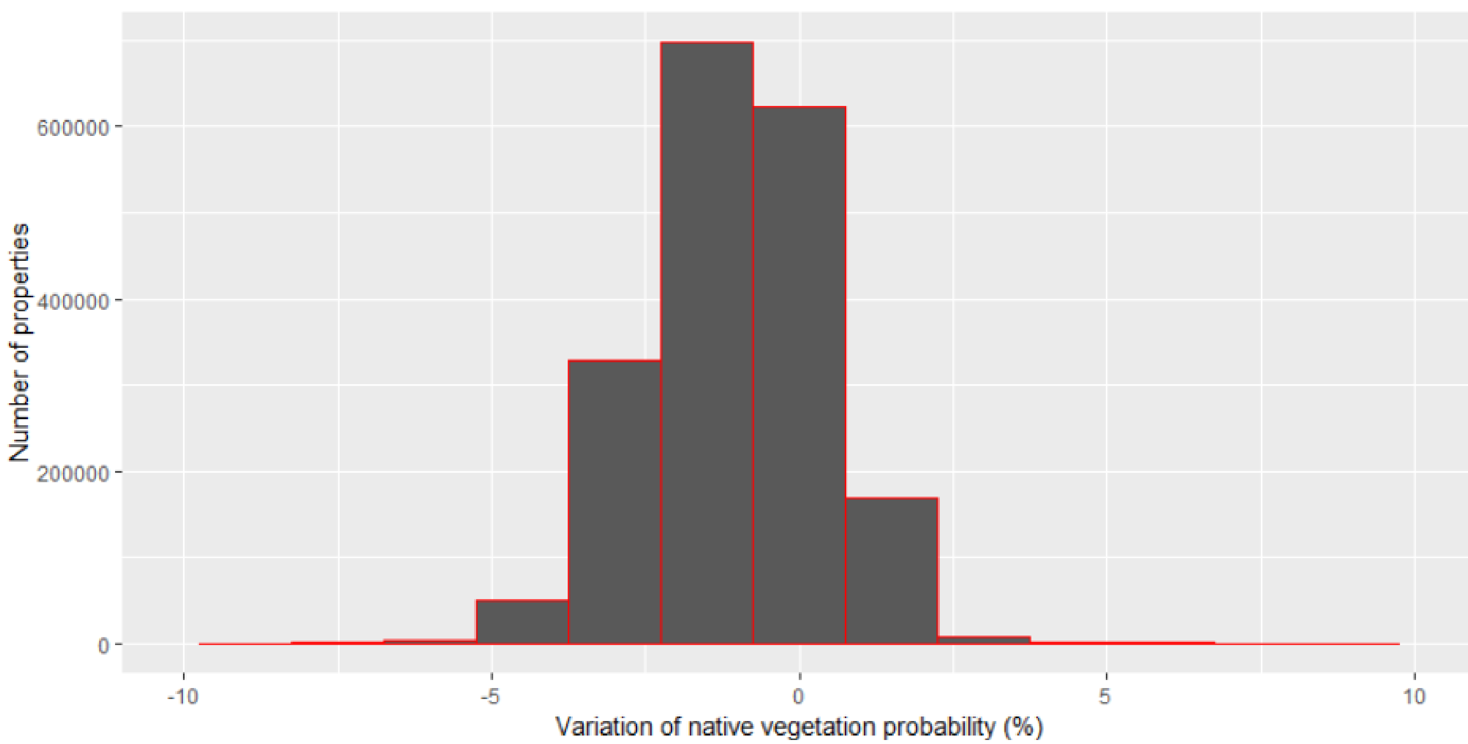

Figure 2

Distribution of the average probabilities of native vegetation variation between 2017 and 2025 within rural properties with unprotected native vegetation. Positive values represent pixels with increase in the probability of native vegetation existence until 2025 whereas negative values represent pixels with decrease in the probability of native vegetation existence until 2025.

Supplementary Files

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