AGRICULTURAL POLICIES IN DEBATE

Soy expansion and emergent challenges for the sustainability governance between Europe and Brazil

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Summary

1. Introduction

Global climate and biodiversity crises have brought attention to problems of deforestation and conversion of native vegetation. Tropical biomes are particularly relevant in this regard, as they function as vital carbon sinks and biodiversity hotspots, but simultaneously also concentrate the largest rates of deforestation. Confronting drivers of tropical forest loss has therefore become essential to efforts directed at climate mitigation and ecosystem preservation. Currently, a few products, commonly known as forest-risk commodities (FRCs) account for a large share of global deforestation. Soybeans hold a key significance in this regard, as soy expansion, mainly in South America, has been associated with large rates of deforestation in recent decades. As the world's largest soy producer and exporter, Brazil stands in a crucial position. While a large domestic market for soy products exists in Brazil, the main driver of Brazilian soy expansion has been European and Chinese demand. Past experiences both show how dynamic global demand and accelerated domestic agro-industrial expansion can lead to elevated rates of soy-driven deforestation and conversion rates. However, Brazil also provides important lessons of how well-coordinated governance efforts, encompassing public actors, private companies and civil society can lead to substantial drops in soy-driven deforestation, and in some cases even spur a decoupling between production increases and native vegetation loss. Such experiences become particularly important in the context of a developing country, in which the need to curtail global ecological crises will have to be reconciled with pressures to raise outputs and generate export earnings. Moreover, when efforts to confront socio-environmental problems related to soft-commodity production are driven by buyers in the Global North, sustainability demands and initiatives often face staunch resistance from producers in the Global South, who feel that costs are passed on without corresponding compensation. In the soy sector, a large number of private chain-based initiatives have therefore struggled to gain scale and effect. More recent efforts to create publicly mandated environmental and social due diligence requirements could have a more profound effect within soy markets, and therefore need to receive thorough scrutiny.

In this report, we analyze the soy trade between Brazil and the EU, - with special emphasis on Germany - and its relation to Brazilian deforestation. We seek to understand how existing and evolving public and private governance initiatives and regulatory

arrangements affect deforestation, with an eye to past experiences and likely future developments. While we recognize that poorly governed soy expansion also has been associated with social problems, in this paper, we apply a more specific focus on deforestation to delve more deeply into this specific phenomenon. As part of the Agricultural Policy Dialogue paper series, the current report is structured as a companion piece to Sellare & Borner (2022), who provide an important overview of this thematic from the European side. This report mainly engages with this issue from the Brazilian side of the soy chain, although some necessary references to developments in Europe and Germany are made.

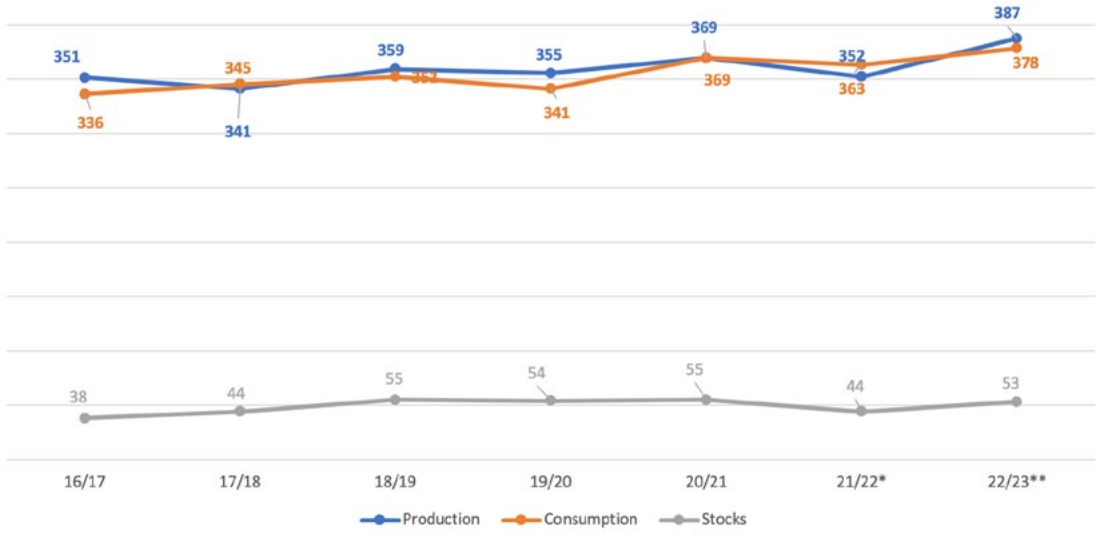
The report is structured into four overarching sections. Section 1 outlines key trends in the soy trade between Brazil, and the EU and Germany, as well as the interconnections of the animal protein complex on both sides of the Atlantic. Section 2 examines the environmental challenges associated with soy expansion in Brazil, with particular emphasis on how European demand drives deforestation in the country. In section 3, we analyze how existing governance experiences have been able to confront environmental problems within the Brazilian soy sector, and zero-in on which future challenges remain. Finally, in section 4, we focus on evolving regulatory initiatives in the form of due diligence requirements under development in the European Union, on how they are likely to affect sustainability issues in Brazil, and which dilemmas they raise.

2. Soy production and consumption trends in Germany and the EU

2.1. Recent evolution of trade flows

Due to the high protein content of soybean products and the bans on animal meal in the beginning of the millennium, their main application is as feedstuff for chickens, pork or cattle. In this context soy is strongly integrated within international commodity markets, as about 42% of the production is traded internationally. According to estimates by the International Grains Council (IGC), global soybean production in the 2022/23 crop is projected to reach 387 million tons. Expectations of a record harvest are based on the prospect of a large soybean supply in Ukraine, although forecasts for this region should be viewed with caution due to the ongoing war.

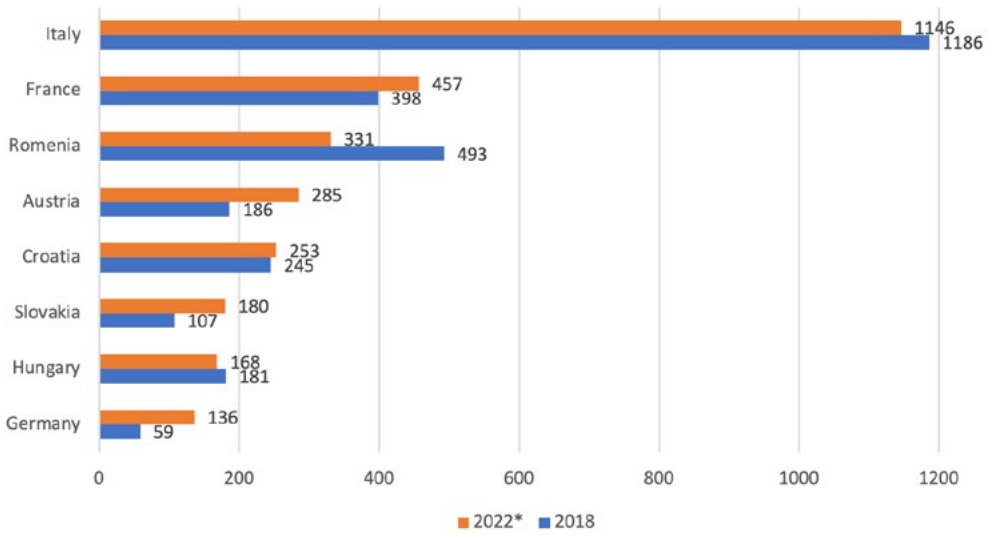
Figure 1. Global supply balance of soybeans (Millions of tons)



Source: IGC, AMI (2022). Notes: *provisionally; ** estimated

The estimated global soy consumption is 378 million tons (Ufop, 2022). Soy production in the EU-27 was around 2.7 million tonnes in 2020/21. Soybean cultivation is gaining ground in the EU-27 and will cross the million mark (1.04 million hectares) for the first time in the 2022 harvest (BMEL, 2022). The cultivated area in Germany has more than tripled since 2016 and is expected to reach a volume around 136,000 tonnes in 2022 (See Figure 2). Driven by massive public subsidies, soybean cultivation has increased sharply, especially in southern Germany. According to the preliminary results of the main land use survey, around 51,400 hectares were planted with soybeans this year (BMEL, 2022).

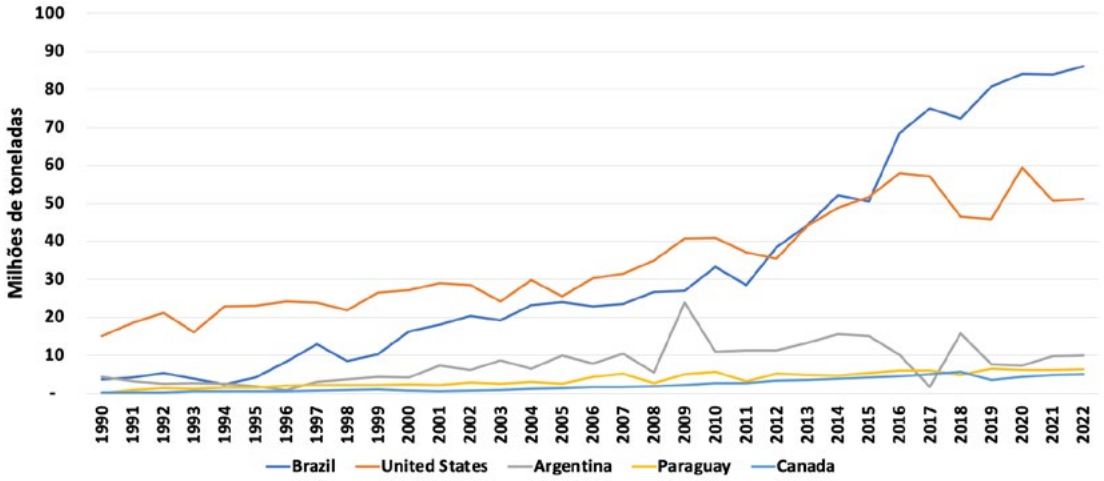
Figure 2. Soybean production in EU-27 in thousand tons (in 2018 and 2022)



Source: EU-commission (2022) * estimated

European soy is uncompetitive on world markets and domestic demand far exceeds supply. The world's largest soybean producers are the US, Brazil and Argentina (see Figure 3). These countries represent almost 82% of production and more than 90% of export volumes. Brazil is the largest producer, with 149 million tons, and also the largest exporter, with a volume of 86 million tons, and a market share of 51% (Statista, 2022).

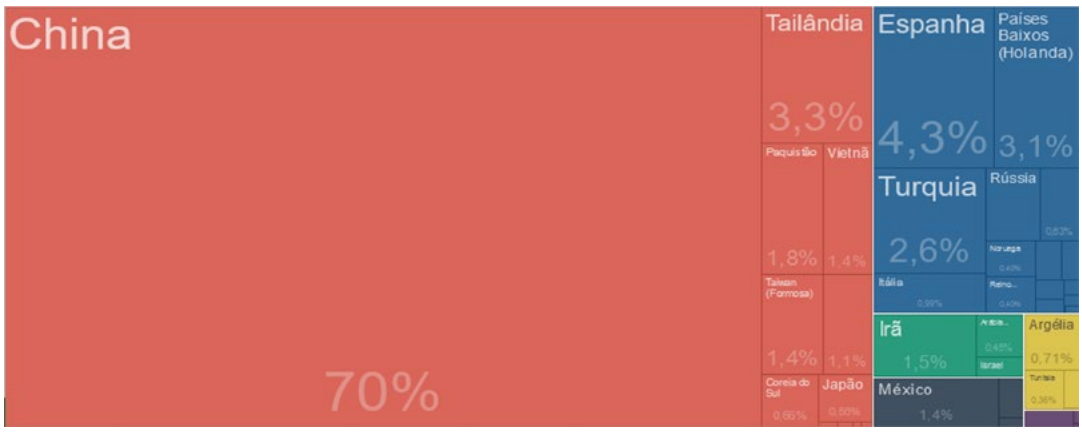
Figure 3. Major soybean exporters in the international soy market (Millions of tons).



Source: authors elaboration based on OECD-FAO (2022)

China is the main global soy importer with 96.52 million t., followed by the EU-27 and Mexico. The EU has historically been an important client of Brazilian soybean products, but its share in value has dropped in recent decades, from 65,6% in 2000 to 16.4% in 2020. Even so, from the EU's point of view, Brazil is still the main supplier; in 2020, 45% of the total value imported from the soy complex by the EU originated in Brazil. Concerns about sustainability issues in soy supply chains – especially from Brazil – are on the rise in Europe (Sellare et al., 2022). Today, China has become the predominant destination for Brazilian soy exports, accounting for as much as 70%.

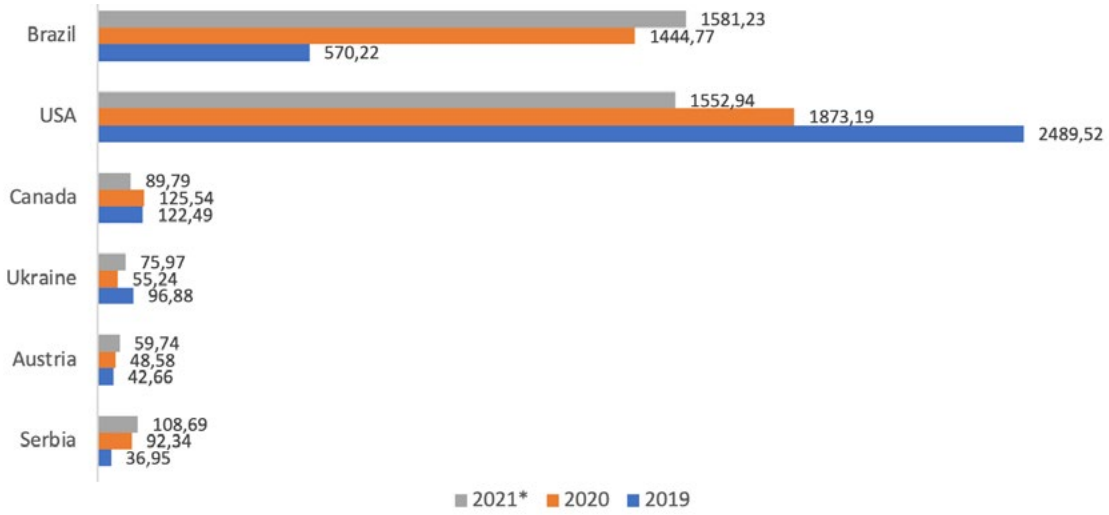
Figure 4. Main export destinations for Brazilian soy in 2021.



Source: ComexStat (2022).

Germany is largely dependent on soy imports. The country's import volume in 2021 was 3.59 million tons, with about 1.58 million tons coming from Brazil (Statista, 2022).

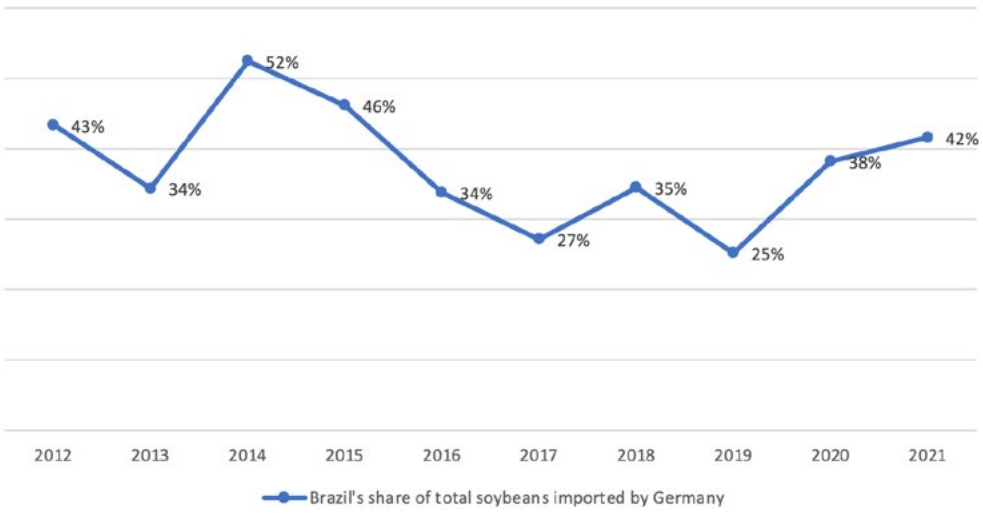
Figure 5. Most important supplier countries of soybean imports to Germany by import volume from 2019 to 2021 (in 1,000 tons).



Source: authors elaboration based on OECD-FAO (2022)

On the average, during the last decade Brazil's share in the total value of soybean imported by Germany was 37.6%, which highlights the importance of Brazil's participation in the German soy chain, as can be seen in Figure 6.

Figure 6. Percentage of value imported from Brazil in the total value of soybean complex* imported by Germany in the last 10 years (2012-2021)



Source: authors based on UN COMTRADE (2022). Note: *including soybean, soybean meal and soybean oil.

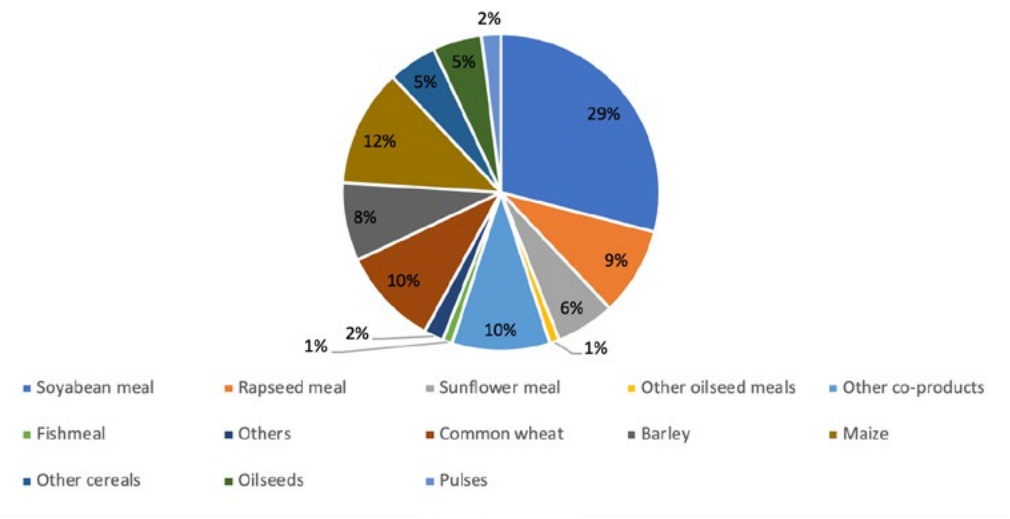
Despite the low European share of international soy markets compared to Asia, and especially China, quality requirements in the European market are dictated by retailers and depend on the specific processing purpose. The latter must therefore be considered when concluding contracts or comparing prices. For this reason, oil factories that produce soybean oil have different requirements than feed or food manufacturers. Soybean meal, on the other hand, is traded as a more standardized international commodity (Unsleber et al., 2018).

2.2 European meat production and the Brazil-UE "protein complex

Due to the high protein content of soybean products and the bans on animal meal in the beginning of the millennium, their main application is as feedstuff for chickens, pork or cattle. In this context soy is strongly integrated within international commodity markets, as about 42% of the production is traded internationally. According to estimates by the International Grains Council (IGC), global soybean production in the 2022/23 crop is projected to reach 387 million tons. Expectations of a record harvest are based on the prospect of a large soybean supply in Ukraine, although forecasts for this region should be viewed with caution due to the ongoing war.

Soybean meal plays an important role as an ingredient in the formulation of compound feeds, mainly due to its higher protein content compared to other crops, as well as its amino acid composition and year-round availability (based on dry matter). Soybean meal has become the single most important source of protein in the EU-27, providing 29% of crude protein for food use in 2020/21 (see Figure 7).

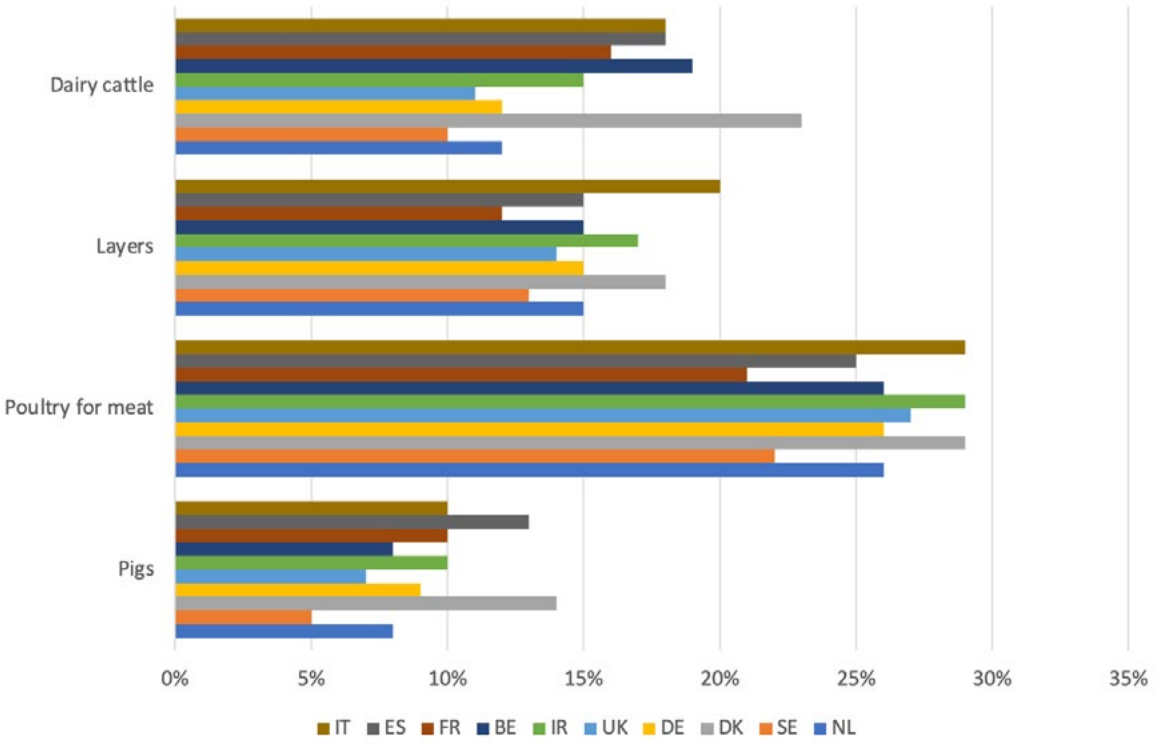
Figure 7. Sources of proteins for feed use in the EU27 in 2020/21.



Source: Authors based on FEFAC (2021).

However, the protein self-sufficiency rate of soybean meal is low, with EU production covering only 3% of demand in 2019/20 (Kuepper et al., 2022), resulting in a heavy dependence on soybean imports. Soybean meal is mostly used as a source of high quality vegetable protein in compound feedstuffs, as well as smaller volumes that are added to the homemade mixture on the farm. The participation of soybean meal in compound feeds differs between European countries (see Figure 8).

Figure 8: Estimated soybean meal content in animal feed.



Source: authors based on Hoste (2016)[1]

In 2020, the estimated per capita consumption of soy – considering a variety of linked products – was 61 kg, with animal products representing 90% of this total. Despite EU exports of pork, with around 30% of production exported, and powdered milk with an export share of around 25%, domestic consumption generally accounts for the largest share. This shows that most of the soy incorporated into animal products produced in the EU is consumed domestically (Kuepper et al., 2022).

A trend that can be observed in recent years is that a growing number of people in Germany have been trying to avoid meat in their daily diet. Among the different

[1] According to Hoste (2016), the data for soy contents were based on local references, as well as derived from national statistics, and the assumptions were based on numerous sources and expert judgment.

reasons, increasing awareness of climate change and environmental sustainability are key. The food industry and retailers have been reacting to this trend by offering an increasing array of vegetarian and vegan products. Innovations have been presented, especially in the segment of meat substitutes, which increases the demand for soy and other leguminous products. However, the main consumption of soy continues to be for animal feed. With a per capita meat consumption of around 60 kilos per year, - that is, an average meat consumption of more than one kilo per week, - consumption is still above the value recommended by the German Nutrition Society, which is a weekly portion. between 300 and 600 grams (Statista, 2022). Despite domestic consumption being stagnant, exports continue to grow, meaning that meat production in Germany continues to increase. For poultry and swine, the value has doubled in the last ten years (HDI, 2021).

Box 1: Non-genetically modified soybean

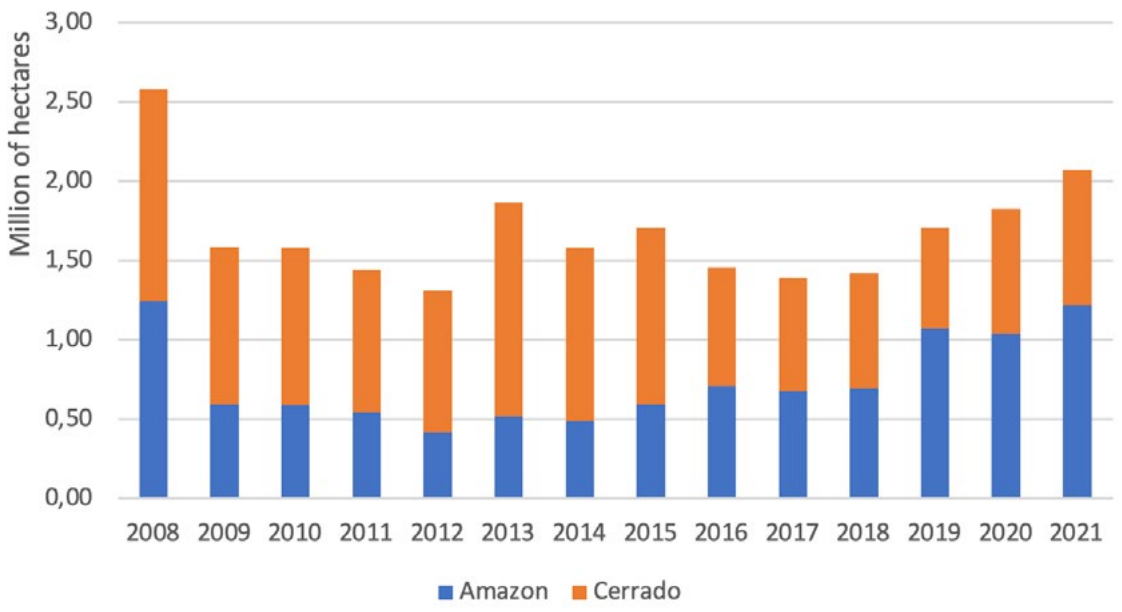
Another important growing consumer trend in Germany is the consumption of GMO-free products. Ohne Gentechnik is the label for food of animal origin that has been produced without GMO feedstuffs, which is almost a standard for dairy products, eggs, and poultry. However, non-GMO soy is scarce on the world market (Tillie et al., 2015). Small amounts are grown in Europe, namely in Germany. What is imported from North and South America is largely genetically modified. Brazil is the only non-European producer that offers large amounts of "GMO-free" soy. With the proportion of GM soy increasing for years - currently occupying 96% of Brazil's acreage - it has become increasingly complex and therefore also more expensive to grow "GM-free" soy and to supply Europe. Production difficulties mark the entire production chain - from seed to cultivation, harvesting, and properly separating along the entire transport chain. The accidental blending of GM soy cannot be completely avoided in open natural conditions, but this content must not exceed the threshold value of 0.9%, which is decisive for labeling. However, apart from the expected additional premium on conventional varieties, demand for non-GMO soybeans from Germany and other EU countries is negligible compared to the strong increase in demand for GM soy in Asia in recent years. As result, the production of non-GMO soy in Brazil has dropped significantly in recent years, from 5.5 million tons in 2018/19 to just 2.75 million tons in 2020/21 (Kuepper et al., 2022). The only alternative is therefore often to produce in Europe, and this is currently the most important reason for experiments with soybean cultivation in Germany (Deutscher Sojaförderring e.V., 2022). There are no reliable data on the amount of certified soy imported into Germany. According to the German government's response to a parliamentary request ("kleine Anfrage") from the Green Party in late 2020, around 0.8 million tons were certified to sustainability standards in 2018 (European Soy Monitor). Since these do not always include "GMO-free", the amount of soy certified as GMO-free is likely to be lower.

3. Brazilian soy expansion, environmental challenges

3.1 A quantitative overview of soy expansion in Brazil and crucial land-use trends

Agricultural and livestock frontiers in the Amazon and Cerrado biomes are important deforestation hotspots in Brazil. In the late 20th and the early 21st Centuries, deforestation rates in both biomes reached very elevated levels. As we shall see in following sections, efforts to halt soy expansion on recently deforested land in the Amazon led to a relatively successful decoupling of soy from clearances of native vegetation in this biome. The Cerrado nonetheless continues to be marked by significant levels of clearances of native vegetation due to soy expansion. As can be seen from Figure 9, total Amazon deforestation reached a low point of 4,571 km^2 in 2012, whereafter it surged to a high point of 13,038 km^2 in 2021. Cerrado deforestation reached a low point of 6,319 km^2 later, in 2019, but rose again to 8,531 km^2 by 2021.

Figure 9: Deforestation trends in the Cerrado and the Amazon biomes



Source: authors' elaboration based on Prodes data (INPE, 2022). Note: data refer to the annual deforestation increase detected by satellite images. For the full methodology see Câmara et al. (2006).

Since the development of soybeans varieties adapted to tropical conditions, and of techniques to correct soil acidity in the Brazilian Cerrado, the area dedicated to soy cultivation has seen a significant increase, both in absolute terms and as a share of the total cultivated area. Between 1976 and 2022, soybean production grew from roughly 7 million hectares to nearly 41,5 million hectares, resulting in the production volume increasing from 12 million tons to 126 million tons (Conab, 2022). While the planted area rose six-fold in this period, production underwent a ten-fold increase. Yet, the magnitude of the expansion of soy production has also raised environmental concerns, concerned with land use and deforestation.

State-led initiatives to integrate remote regions within the Amazon through infrastructure provision have also facilitated the growth of agriculture within these territories (Chaddad, 2016; Sauer, 2018). The competitive advantages created led private actors to incorporate areas of the biome into the soy complex. Other drivers of deforestation are also evident, namely cattle ranching, but also illegal mining and land grabbing. By 2021, 17,7% of the vegetation in the Amazon biome had already been deforested (INPE, 2022). Historically, deforestation has been concentrated in the Southern and Southeastern fringes of the biome, comprising the states of Pará and Mato Grosso (MT), although in 2021, the state of Amazonas overtook the second place from the state of Mato Grosso, - the largest soybean producing state in Brazil, accounting for 27% of outputs (Conab, 2022). Roughly half of the MT territory is part of the Cerrado biome, which also is where most of the soy expansion has occurred. The northernmost part is originally covered by the Amazon Forest.

Between the 2005/06 and 2018/19 crop seasons, the cultivated area of soybean in the Amazon biome has increased from 1.14 to 5 million hectares. However, only slightly more than 1% has come from newly deforested areas in the period, given the effect of the Amazon Soy Moratorium, which we discuss in section 3.2 (Greenpeace, 2020). The Soy Moratorium implied the commitment by traders not to buy soy from areas in the Amazon biome deforested after June of 2006 (later 2008). In the period between 2008 and 2020, 1.9% of soy was planted in areas in non-conformity with the moratorium. In the 2020/21 crop season, this share had risen to 2.5% of the total cultivated area in the Amazon biome. The Moratorium did not curb the expansion of soy in the biome, but it has been successful in directing production to previously deforested areas, encouraging the intensification of land use (Abiove & Agrosatélite, 2022). A study of the Soy Moratorium's effectiveness estimated that the initiative prevented deforestation of approximately 1,8 million hectares of forest between 2006 and 2016 (Heilmayr et al., 2020). In the crop season 2020/21, the area planted with soybean in Amazon biome reached 5,9 million hectares, representing 52% of the harvested agricultural area in the

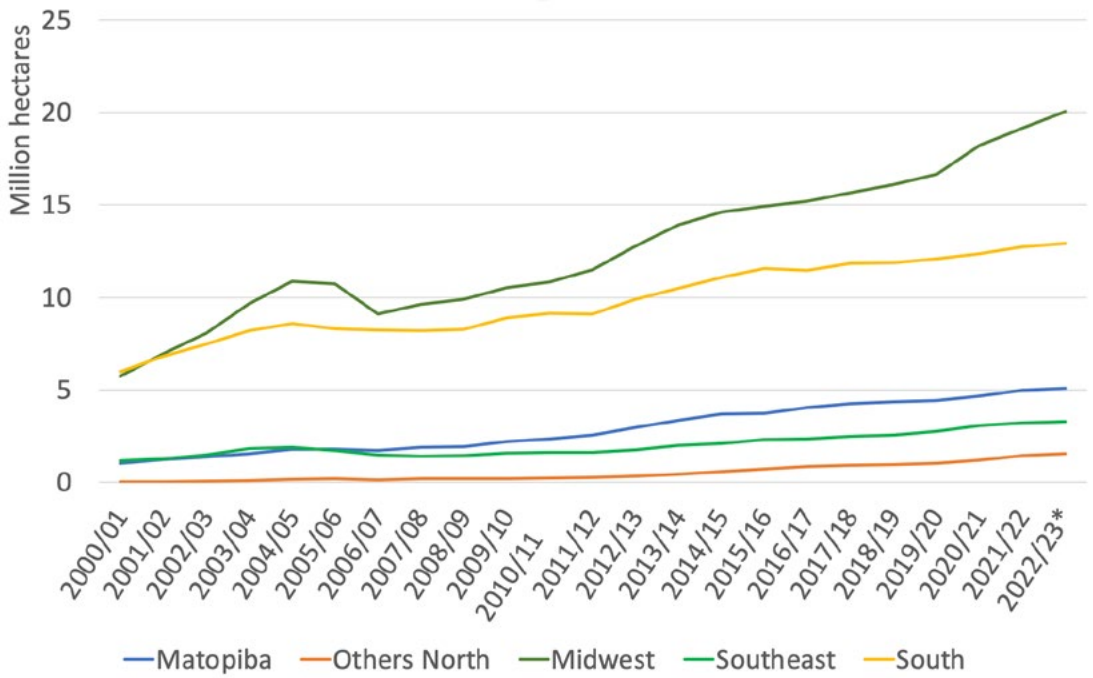
biome and 44% of the gross value of agricultural production. This area also represents 16% of the total soybean area planted in the country (Serigati & Possamai, 2021).

The bulk of the incorporation of native areas for Brazilian soybean production took place within the inland Cerrado biome, where large-scale agricultural production underwent significant productivity increases (Gasques et al., 2004; Rada, 2013). The Cerrado encompasses 52% of the area dedicated to soy cultivation in Brazil. The productive area of soy in this biome increased by about 170% between 2000/01 and 2020/21, from 7.5 million hectares to 20 million in 2020/21 (Abiove & Agrosatélite, 2021). The soybean area occupies around 10% of the biome (Abiove & Agrosatélite, 2021; Mapbiomas, 2022).

In the Cerrado, Matopiba2 stands out as the main region for grain expansion, and it is considered as the most important Brazilian agricultural frontier. The Matopiba is also the area where the expansion of soybeans is most closely associated with conversion of native vegetation, given that the region accounts for two thirds of the total deforestation in the Cerrado. In the period from 2013/14 to 2020/21, the soybean area in the Cerrado grew with some 4.4 million hectares. In Matopiba, 0.26 million hectares expanded over pastures, while 0.50 million hectares expanded with deforestation (Abiove & Agrosatelite, 2021). Between the 2000/01 and 2021/22 harvests, the planted area in the region increased from 1.0 million to 5.0 million hectares (Conab, 2022) (see Figure 10). In the more consolidated production regions of the Cerrado, the soybean area increased from 6.6 million hectares in 2000/01 to 15.3 in 2020/21 (Abiove & Agrosatelite, 2021). This region covers part of the states of Mato Grosso and Mato Grosso do Sul, the Federal District and Goiás in its entirety, as well as parts of Minas Gerais and São Paulo, and a small portion of Paraná. There, the amounts of cleared land suitable for soy agriculture are large, with opportunities for expansion through intensification of land use without further deforestation. Of the expansion of 4.4 million hectares of soybeans in the period from 2013/14 to 2020/21 in the consolidated part of the Cerrado, 1.5 million hectares expanded over pastures and 0.12 million hectares expanded with deforestation. This highlights the much more deforestation-intensive character of soy expansion in Matopiba compared to more consolidated areas of the Cerrado. As a driver of the growth in production outputs, agricultural intensification via the occupation of pastures surpasses deforestation, accounting for 40% of the expansion. Deforestation represented 14% and the another 46% occurred over crops that were fallow in the 2013/14 harvest (Abiove & Agrosatelite, 2021).

[2] Matopiba is an acronym naming the region that extends across territories comprising the Cerrado biome of the Brazilian states of Maranhão, Tocantins, Piauí, and Bahia.

Figure 10: Soybean cultivation expansion by region (in millions of hectares)



Source: Conab (2022) * estimated

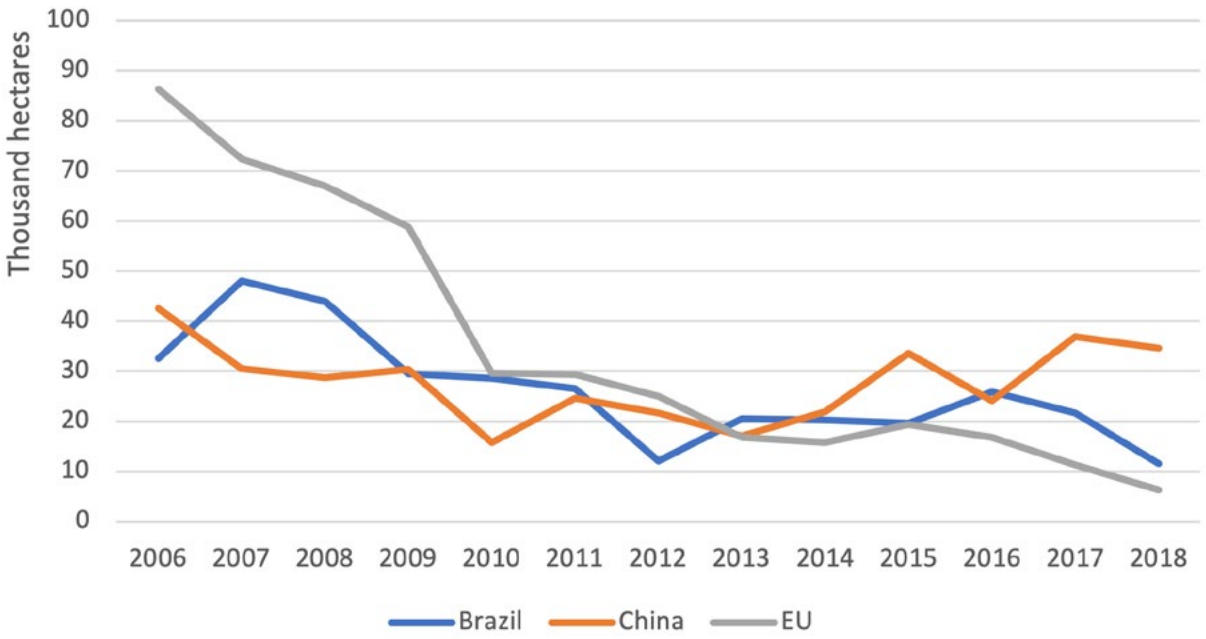
Land use in Brazil has intensified as this asset has increased in value. In the harvest season 2001/2002, 14% of the Brazilian territory planted with grains was double-cropped, a number which over a 20-year period increased to almost 30%. Considering specifically the corn crop in the Midwest, this number reaches 97% (Conab, 2022). Another example of intensification of land use in Brazil is the Crop-Livestock-Forest Integration (CLFi) system which grew from 1.9 million hectares in 2005 to an estimated area of 18.6 million hectares in 2021 (Polidoro et al., 2020). Brazil has almost 90 million pastures with some degree of degradation (Lapig, 2022), whose conversion into cultivated areas is likely to be the driver of production expansion, - as it was the case with 90% of the area incorporated into agricultural production in the Midwest region over the past decade. These areas are predominantly pastures with a high degree of suitability for agricultural production (Soendergaard et al. 2021). This conversion also has the potential to promote economic gains and, in addition to the land-saving effect, reduce GHG emissions by 463.7 Mt CO_2eq/year (Carlos et al., 2022).

3.2 Soy and export-driven sustainability challenges

Due to its contribution to deforestation, much attention has been directed towards the drivers of soy expansion, which in the case of Brazil are strongly related to international demand. The three major destinations for Brazilian soy are China, Brazil, and the EU.

The embodied deforestation3 in European soy consumption has declined noticeably from 2006 to 2018. For comparison, the embodied deforestation in Brazilian soy exports to China has remained relatively stable throughout this period, while some decline can be observed with respect to domestic consumption (see Figure 11). However, the numbers for embodied deforestation should be viewed in a context in which Chinese imports of Brazilian soy have grown exponentially in the period examined, while those of the EU have declined. These numbers should nonetheless be taken with some degree of caution, as the Trase (2018) data on which they rely only count deforestation as soy-driven in areas where it was planted within a period of five years after native vegetation had been cleared. Methodologies relying on a more "distant" cut-off date, will therefore encompass much more soy-driven deforestation. The significant drop in embodied deforestation of soy imports to the EU does nonetheless suggest that European buyers have been sourcing from areas with less recent deforestation, as well as the fact that Cerrado deforestation reached its peaks closer to the turn of the millennium.

Figure 11: Embodied deforestation risk in Brazilian soy destined for different countries and regions in thousand hectares.

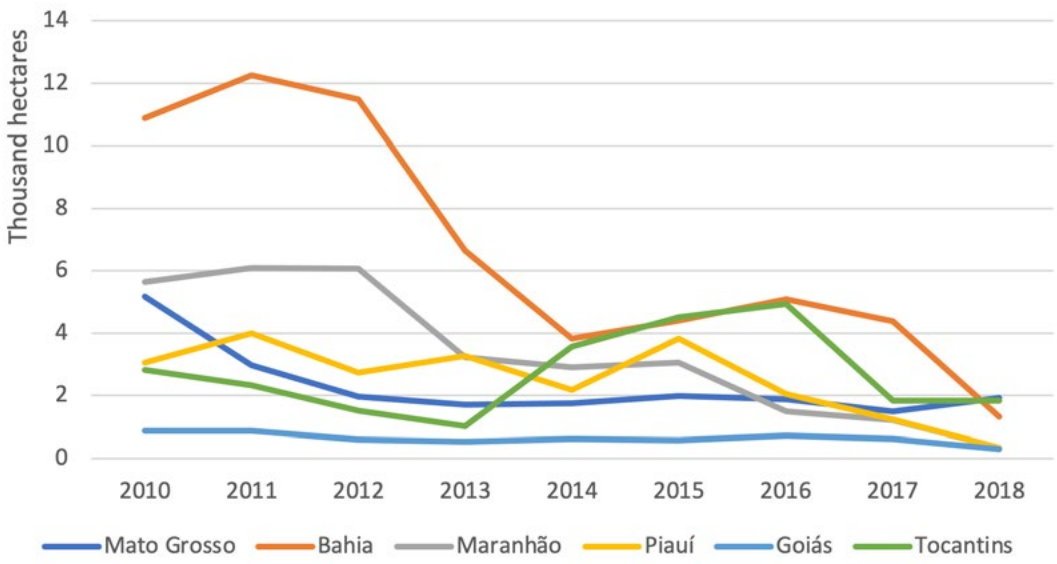


Source: Trase (2018)

[3] Embodied deforestation refers to the approximate amount of native vegetation loss associated with the production of soy volumes

As noted in section 3.1, deforestation in the Cerrado caused by soy expansion has increasingly been concentrated in the Matopiba agricultural frontier region (Gibbs et al. 2015). This is also reflected in the numbers for embodied deforestation risk of EU soy imports from different states in the entire Cerrado region (see Figure 12). Thus, amongst the six states with the largest deforestation footprint in their soy exports to the EU by 2018, were all of the four Matopiba states.

Figure 12: Embodied deforestation risk from soy imported by the EU distributed in different producer states (in thousand hectares).



Source: Trase (2018)

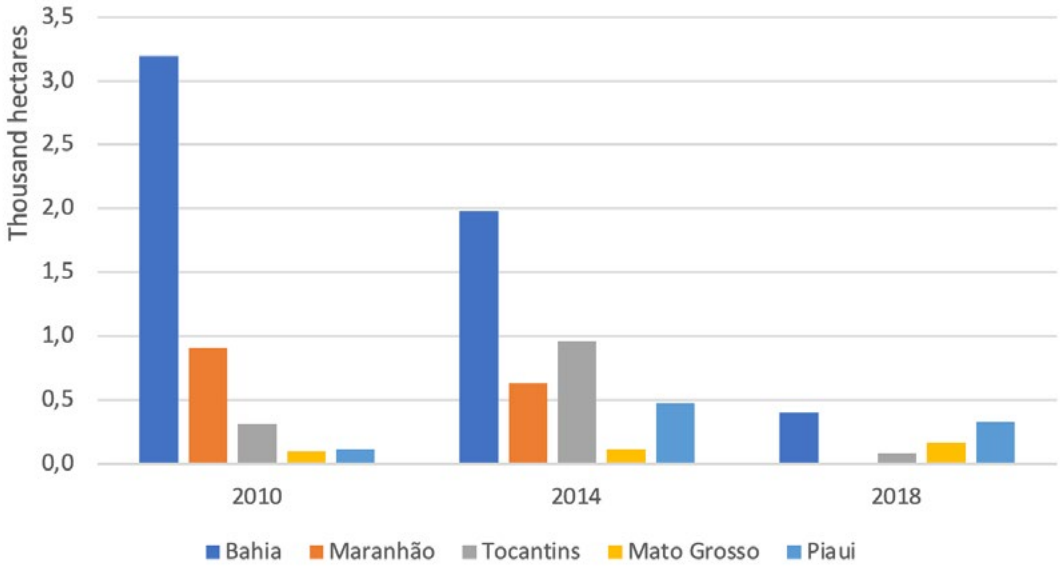
German soy imports and embodied deforestation

As a large livestock producer, Germany imports significant amounts of protein-rich feedstuffs for animal production. In a recent study (West et al., 2022) provides important information on the embodied deforestation in German soy imports. In the period from 2016-2018, direct German soy imports thus contained 16,200 hectares of embodied deforestation. However, a consumption-based perspective points to a higher number of 23.600 hectares in the same period. The brunt of this deforestation risk embodied in German soy imports (71.7-76.4%) came from Brazil. Also from a consumption perspective, embodied deforestation risk in German soy imports for the period 2014-2018 of 47,400 ha surpasses that of other large EU consumers, such as France, Spain, and Italy (West et al., 2022).

A regional perspective of the embodied deforestation in German soy imports from Brazil points to a certain degree of geographical concentration and decline over time. As can be seen in Figure 13, the state of Bahia alone represents a large share of embodied

deforestation, followed by varying share distributed on different Matopiba states and Mato Grosso.

Figure 13: Embodied deforestation in German soy imports from Brazil distributed in different states, in thousand hectares in 2010, 2014, and 2018.



Source: Trase (2018)

It is noteworthy that the deforestation embodied in German soy imports is so concentrated, that a state-wide perspective does not even capture this situation with sufficient granularity; focus therefore needs to be directed at the municipal level. Hence, 61.6% of all imported embodied soy-driven deforestation in Germany from Brazil was thereby concentrated in only three municipalities in Matopiba; Rio Preto, Alto Parnaíba and Urucui (West et al., 2022).

3.3 Soy production and other central sustainability challenges

High emissions of CO_2 have been attributed to Brazilian soybean production, although with a large spatial variability across producing areas. In line with the deforestation trends, the largest carbon footprints are associated with MATOPIBA municipalities and Pará, where soy is most directly linked to natural vegetation loss (Escobar et al., 2020). Despite the need to decouple production from deforestation, which is the main challenge to reach a more sustainable soy production, other aspects related to GHG mitigation potential should also be considered. Some Brazilian producers have adopted a range of tropical agricultural technologies that contribute to raising the sustainable character of the soybean production system, mainly, - though not exclusively - by decreasing GHG emissions (Nepomuceno et. al, 2021). Notable examples are No-Tillage Systems

(NTS), Biological Nitrogen Fixation (BNF), Crop-Livestock-Forest Integration (CLFi), contour plowing, biological inputs in partial substitution to chemical inputs, and the integrated management of pests, diseases, and weeds. In addition to the mitigation component, these technologies also increase yield, production stability, and rational use of inputs and land, which improves economic performance and relieves the pressure on new areas (Telhado & Capdeville, 2021).

In 2022, Brazil completes 50 years of NT with its wide adoption on about 35 million hectares - that is, more than 60% of the area planted with grains (Fuentes-Llanillo, 2021). NT can reduce emissions both through less soil disturbance, as well as through less use of machinery and fossil fuels. It is also beneficial for soil quality as this technique retains moisture, prevents erosion, and improves soil microbiota, thereby also helping with soil adaptation of agriculture to climate change. Moreover, when combined with increased crop frequency and the inclusion of cover crops, no-tillage can promote soil carbon sequestration (Nicoloso & Rice, 2021). The so-called "no-tillage system" (NTS) raises the efficiency of no-tilling by increasing soil organic matters, and can lower CO_2 emissions by 0,5-0,6 ton/CO_2/year/hectare.

Biological nitrogen fixation (BNF) is the use of inoculated seeds in which the plant acquires nitrogen through association with bacteria in the roots that fix the N2 present in the atmosphere, transforming it into forms that can be assimilated by plants. BNF is the main source of nitrogen (N) for the soybean crop and can provide all the necessary N needs. In Brazil, widespread BNF adoption saves billions of dollars on fertilizers substitution with lower GHG emissions and pollution of water reservoirs (Hungria & Mendes, 2015). Crop-livestock-forest integration (CLFi) positively affects soil by increasing carbon and nitrogen contents, supports nutrient retention and recycling, water retention, and reduces erosion soil losses (Torralba et al. 2016; Zomer et al. 2016). The trees provide thermal comfort for the animals and improve economic diversification, yielding environmental, social and economic benefits. Soybeans grown in integrated systems can thereby lead to significantly lower carbon footprints.

Besides decarbonization, preserving biodiversity is also key to achieving more resilient environments. The encouragement of harmonious coexistence between soybean farmers and beekeepers is also one of the challenges for the sake of more sustainable production systems. While, on one hand, soybean blooms can be used as bee forage, on the other hand, pollination increases soybean production by about 13%. In this sense, joint actions related to good agricultural and beekeeping practices within important soybean production have been undertaken with success (Embrapa, 2022a).

A set of metrics to measure the sustainability aspects of the Brazilian soybeans, employing qualitative and quantitative measurements still need to be better developed, but researchers from different centers are focused on this issue. Some evidence collected by Embrapa in a pilot carbon farming initiative identified an average carbon footprint of 783 kg CO_2 eq per ton of soybeans amongst a group of producers who adopted low-carbon agricultural practices. The number represents a reduction of up to 80% compared to the average of the main international databases (Embrapa, 2022b).

4. The governance dimension

4.1 Brazilian public regulation and the Forest Code as an important regulatory baseline

Three major revisions of legislation for native vegetation protection have been made in Brazil, in 1934, 1965 and 2012, respectively. Between the 1965 version and the most recent, the legislation had been amended several times, always in a more restrictive manner, raising complaints from rural producers. In 2012, an updated version was passed, the Native Vegetation Protection Law (No. 12,651/2012), also known as the Forest Code (FC). The FC is a crucial instrument to promote Brazil's efforts in conserving and restoring its natural cover. Landowners are required to set aside a percentage of their property under native vegetation, depending on the biome. This so-called Legal Reserve amounts to 80% in the Amazon biome; 35% in the northern Cerrados, and 20% in other areas. The law limits the expansion of production in Permanent Preservation Areas (APPs in its Brazilian acronym) and Legal Forest Reserves4 and creates incentives for farmers to invest in modern and sustainable technologies and in practices conducive to productivity gains.

In line with the FC, it is mandatory for all rural properties to be mapped and registered through the Rural Environmental Registry (Cadastro Ambiental Rural, CAR, in its Brazilian acronym). The CAR is a national electronic public register, based on self-declaration, with the purpose of integrating the environmental information of rural

[4]APP is a protected area, covered or not by native vegetation, with the environmental function of preserving water resources, the landscape, geological stability and biodiversity, facilitating the gene flow of fauna and flora, protecting the soil and ensuring well-being of human populations. Legal Reserve is an area located inside a rural property or possession, with the function of ensuring the sustainable economic use of the natural resources of the rural property, assisting the conservation and rehabilitation of ecological processes and promoting the conservation of biodiversity, as well as shelter and the protection of wild fauna and native flora.

properties related to the APPs, legal reserves, areas of restricted use, forest remnants, and other forms of native vegetation, and of consolidated areas. The CAR comprises a database for control, monitoring, environmental and economic planning for the purpose of combating deforestation. It is the first step in the process of ensuring a property's environmental regularity, by meeting the FC obligations. This includes: data from the owner; data on proof of ownership and/or possession documents, and georeferenced information on the property's perimeter with information on different types of land use.

Enforcing the FC has proved to be difficult and remains a challenge. Legal uncertainty has had a negative impact on its implementation. Between 2012 and 2018, there were lawsuits pending decisions by the Supreme Federal Court or the Superior Court of Justice on controversial issues and its implementation. In 2019, the decisions of the Supreme Court entered into force. Despite some progress made since then, the FC is far from being effectively implemented across all Brazilian states. The registration analysis and validation stage has begun in most states, though it remains the primary bottleneck in implementing the FC; 25% of the registries have been passed through an incomplete analysis, representing 38% of the registered area. Only 0,5% of the registries have already been validated, representing 2.2% of the total registered area5 (Serviço Florestal Brasileiro, 2022).

Although the FC is a federal law, its implementation is a subnational attribution. State regulations follow the general rules of the FC, but each state introduces its own innovations. A group of states lag behind in terms of implementation for a number of reasons; they lack legislation to support the implementation; have not advanced in the analysis stage; lack cartography databases and personnel for implementing dynamic analyses; and are not covered by technical and financial cooperation agreements. The CAR has been used in other public policies as well, such as environmental licensing, access to rural credit, and land tenure regularization. As such, advancing the analysis and validation stages of the CAR must be a top priority for state governments (Chiavari et al., 2021).

Unintended, the CAR has also been used in attempts to legitimize land ownership, thus increasing the possibilities for real estate speculation. Therefore, in the implementation of the FC, broad efforts to analyze and validate the data declared in CAR are crucial, as is the implementation of the Environmental Regularization Programs (PRA), which relate to the set of actions that must be taken by rural property owners to ensure the environmental regularization of their lands. Both are urgent measures to combat de-

[5]According to data from Serviço Florestal Brasileiro on 1st of September, 2022.

forestation and illegality, as well as strengthening surveillance and fines related to legal reserves compliance, - especially when considering that in the Amazon and Matopiba, around 95% of deforestation is illegal (Valdiones et al., 2021).

The comparison between the number of properties inscribed in the CAR, - close to 6.7 million, - with the number of rural properties counted by the last Brazilian Agricultural and Livestock Survey of 2017, - approximately 5.1 million - underscore the importance of validating registration data. The difference is attributed to multiple registries unduly overlapping Indigenous Lands, Conservation Units and undesignated lands that have no clear land rights. Brazil has over 65 Mha of undesignated public forests in the Amazon (Stabile et al., 2020). From 2019 to 2021, public lands accounted for 51% of deforestation in the Amazon, and around 30% took place on non-designated public lands (Alencar et al., 2022). In this sense, an important additional public policy to the FC, to eliminate land grabbing and land speculation, is the designation of public forests. This could limit the pool of land available for uncontrolled expansion of agriculture (Stabile et al., 2020).

Although the FC of 2012 had reduced restoration requirements in relation to its previous version, it introduced new mechanisms to address fire management, forest carbon storage, and payments for environmental services, which could reduce deforestation and provide environmental benefits. An important mechanism is the Environmental Reserve Quota, CRA (Portuguese acronym to Cota de Reserva Ambiental), a tradable legal title to areas with intact or regenerating native vegetation exceeding the FC requirements. The CRA (surplus) on one property may be used to offset a vegetation reserve deficit on another within the same biome and, preferably, the same state (Soares-Filho et al., 2014). The mechanism is in full operation in the state of Mato Grosso do Sul (MS) which spans across the Cerrado and Pantanal biomes and accounted for 9% of the soybean produced in Brazil in 2021 (Conab, 2022). The MS state agency has already approved the issuance of CRAs, and several contracts for the purchase and sale have already been signed (Chiavari at al., 2021). Given the high costs of restoration CRAs, contracting could become a cost-effective way to comply within the FC while protecting vegetation surplus that might otherwise be legally deforested.

From the landowner's perspective, compliance with the FC still offers few economic benefits. In addition to stricter supervision, it could be mixed with market mechanisms that create lasting incentives for sustainable land-use practices and other complementary legislation. The FC itself comprises provisions (Article 41) meant to facilitate Payments for Environmental Services (PES). Although it has not yet been regulated, in 2021, Brazil enacted a National Payment Policy for Environmental Services (Law 14,119). In

order to encourage synergies between agricultural production and the conservation and recovery of natural resources, the regulation of the law in question and the provisions provided for in the FC must be prioritized by the elected government of Brazil.

Box 2 – Status of legal reserves in APPs, Brazil, and the Amazon and Cerrado biomes

Analysis of the individual areas of the rural properties registered in the CAR and their areas of native and consolidated vegetation identified the existence of legal reserve surpluses in an area much larger than the areas with reserve deficit. On the other hand, a liability was identified regarding the areas of APPs according to the following table (in millions of hectares):

	Brasil	Amazon	Cerrado
Legal reserve surplus	86	12	33
Legal reserve deficit	16	9	4
APP deficit	3	1	0,7

Source: Observatório do Código Florestal (2022)

The lack of clear land tenure rights over a significant part of the Brazilian territory is a strong driver of deforestation and should be addressed alongside with the FC. The feeling that the rules can change at any moment due to constant flexibilization and several intentions to alter the time frames encourages land grabbing. Legislative proposals under the justification of debureaucratization land governance could help avoid conflicts, provide legal security, and offer economic inclusion to rural producers. Nonetheless, to avoid incentivizing further illegal land grabbing it would need to meet criteria to only regulate legitimate occupations that have been waiting for titles for decades (Pinto et al., 2022).

4.2 The potential and limitations of Moratoriums in the Amazon and the Cerrado

The Amazon Soy Moratorium

Initiatives to improve the sustainability performance of the Brazilian soy sector, and in particular, to decouple soy production from deforestation, gained momentum in the 2000s. As soy cultivation expanded towards the fringes of the Amazon, this caught both

domestic and international attention. The Greenpeace (2006) report, "Eating up the Amazon" made this issue even more salient, and helped fuel actions from stakeholders in relation to the Brazilian soy sector. This eventually led to the creation of the Amazon soy Moratorium from 2006, signed between entities within the Brazilian soy industry and civil society. The Moratorium determined that within the Amazon biome, traders would only purchase soy from areas deforested before 2006 (later 2008), and a series of monitoring mechanisms were created for this purpose. The combined market power of the ABCD traders (Archer Daniel Midlands, Bunge, Cargill, and Louis Dreyfus) meant that in practice, only soy cultivated in conformity with the moratorium could be effectively marketed. The moratorium was effective in decoupling the direct link between Amazon deforestation and soy expansion (Heilmayr, et al. 2020; Seymor & Harris, 2019). Thus, while before the Moratorium, close to 30% of soy expansion in the Amazon took place on recently deforested areas, by 2014, less than 1% of soy expansion in this region occurred on native vegetation (Gibbs et al. 2015). As earlier mentioned, this number has risen to approximately 2,5% in the 2020/21 crop season (Abiove & Agrosatelite, 2022). While this increase does not represent a drastic development thus far, it does raise some concerns about the continued decoupling of soy expansion from Amazon deforestation.

Despite the Moratorium's success in breaking the direct link between soy expansion and deforestation, challenges remain. Studies from the Amazon part of the soy-producing state of Mato Grosso from 2015 thereby show that while 82% of producers are in compliance with the Soy Moratorium, 65% of these are in non-compliance with the Brazilian FC, which suggests that illegal deforestation has occurred in areas of the property not producing soy (Azevedo et al. 2015). In spite of monitoring efforts by traders to avoid purchases of soy in non-compliance with the moratorium, a share of producers have sought alternative means to market their product. One example of these efforts is triangulation, whereby, for example embargoed properties sell their product to compliant properties which then ship it on to traders, or simply register sales in the name of other farmers (Rausch et al. 2016). More recently, traders have sought to advance more detailed monitoring systems that confront this loophole. The proportion of traders not adhering to the soy moratorium – a voluntary agreement – that are present in the region has nonetheless grown in recent years. This has left more channels for shipping non-compliant soy, which appears to have been growing in recent years (Søndergaard et al. 2020). Findings also suggest that soy production in areas in accordance with the moratorium appears to frequently have been displacing cattle ranching into recently deforested areas (Gollnow et al. 2018). The moratorium also appears to have been displacing part of soy production in the Amazon to the Cerrado, thereby increasing expansion pressures in the latter region (Noojipaddy et al. 2017). Finally, independently of its compliance with the soy moratorium, rapid expansion of

cultivation in this region has also been associated with land conflicts and other socio-environmental problems (Sauer, 2018).

Despite its loopholes and continued challenges, the Amazon Soy Moratorium nonetheless stands as a significant achievement which unquestionably has served to mitigate the ecological pressures of soy production in large areas of Brazil. So, while it has not proven to be a silver bullet, absent the soy moratorium, sustainability challenges in the Amazon would likely have been much more significant. Confronting remaining obstacles appears to be strongly dependent on broader efforts to ensure legal adherence by producers in the Amazon region, - a task that would depend on strong engagement by Federal authorities.

A soy moratorium for the Cerrado

With the relative success of the Amazon Soy Moratorium, voices began arguing for a similar arrangement to decouple soy expansion in the Cerrado from deforestation. The Cerrado is a highly biodiverse landscape of 2 million km^2, which nonetheless has been strongly affected by rapid expansion of agricultural and livestock activities in recent decades, - not least soy. Lower mandatory requirements for native vegetation preservation in the Cerrado within private rural properties (varying from 20-35%) means that this biome could be in serious risk of further degradation (Lima et al. 2019). Estimates thus suggest that the Cerrado has lost approximately 46% of its original native vegetation, while only 19,8% of areas are unaffected by anthropogenic activities. Moreover, 40% of remaining native vegetation could legally be deforested, meaning that business-as-usual projections suggest that 31-34% of the remaining Cerrado would be lost by 2050 (Strassburg et al. 2017).

The prospects of further loss of the Cerrado have spurred discussions within academia, the agricultural sector, and civil society about how arrangements akin to those of the Amazon Soy Moratorium could be implemented. Importantly, eventual solutions would have to both contemplate conservation, livelihoods, as well as the interests in further expansion of soy production within the region. This was the goal for the Cerrado Working Group, established in 2017 with participation from civil society and the soy industry. More efficient production methods, including crop and livestock integration have thus been highlighted as an important part of plans for a Soy Moratorium in the Cerrado, as this would reduce pressures for soy expansion. Estimates have found that the implementation of a Soy Moratorium in the Cerrado from 2008-2014 could have averted the conversion of 700.000 hectares (Nepstad et al. 2019). Expansion on degraded and low-productivity pastures is crucial for efforts to decouple soy from loss of native vegetation. The 76 million hectares of pastures in the Cerrado reach only 35% of their maximum sustainable production capacity. Raising this number to 61%

would increase meat production by 49%, leave room for the projected demands for soy expansion, and even free up 6.38 million hectares for restoration projects, equivalent to the FC deficit in the Cerrado (Strassburg et al. 2017). Other estimates suggest that a Soy Moratorium in the Cerrado could avert the conversion of 3.6 million hectares of native vegetation towards 2050, and the general effects of such a measure only would limit the total Brazilian soy production area with approximately 2% compared to business as usual (Soterroni et al. 2019).

Notwithstanding what appears as a clear technical potential to decouple soy expansion from native vegetation conversion in the Cerrado, thus far, governance efforts have fallen short of this objective. By 2020, the Cerrado Working Group stalled, as important actors from the Brazilian soy industry withdrew from the initiative. A crucial point of disagreement related to the issue of potential compensatory payments for producers who would absorb the opportunity costs associated with refraining from expanding into areas of native vegetation, which could otherwise be legally deforested. Different accounts exist of the failure of this initiative. From the industry side, critique has been directed at actors further downstream in soy chains, due to their alleged lack of willingness to provide the necessary compensation payments (Economist, 2020). Conversely, food processing companies downstream appear to have been distrustful of Brazilian soy producers' commitment to the moratorium, given that a large share does not even comply with existing Brazilian legislation. Finally, parts of the Brazilian soy sector also appear to have felt empowered by the election of the radical right-wing Jair Bolsonaro as president in 2018, which made them put less emphasis on sustainability engagement (Schilling-Vacaflor & Lenchow, 2021). Whatever the reason for the failure of the plans for a Cerrado Soy Moratorium, the current situation is that beyond the Brazilian FC, - suffering both from a lack of scope and mainly, from poor implementation - no comprehensive governance framework exists to decouple soy expansion from deforestation of the Cerrado.

4.3 Private sustainability governance within soy chains an certification initiatives

In recent years, different types of private regulation have gained momentum in order to confront contemporary sustainability problems more broadly, and more specifically also those related to forest-risk commodities, such as soy. Multistakeholder initiatives relying on certification have been part of these efforts. Different certification initiatives have thus targeted Brazilian soy production, of which the most prominent is the Roundtable for Responsible Soy (RTRS). The RTRS joined different stakeholders, from civil society, the soy industry, and global retailers around attempts to establish specific sustainability criteria which would define responsible soy production, such as good

production practices as well as a zero-deforestation criteria. Since its inception in 2006, the initiative also counted on participation from different Brazilian agribusiness entities, although some have later left (Schouten and Glasbergen, 2012, p. 70). While the RTRS has managed to define criteria for improvements of the sustainability performance of soy producers through generally inclusive deliberations, RTRS certification today only covers a minor share of Brazilian soy production (Søndergaard et al. 2021).

Another dynamic worthy of attention regards the degree to which financial markets and investors have, - and most importantly, will – treat deforestation risks within their strategic decisions. Recently, Environment, Sustainability, and Governance (ESG) related matters have gained increasing financial materiality, spurring a rise in the number of financial companies that regularly report on these parameters (Freiberg et al. 2020). Some estimates suggest that the total number of assets under management in the United States that could be classified under some kind of ESG label has reached 33%, or around US$ 17 trillion (Nason, 2020). Companies exposed to deforestation are thereby increasingly facing portfolio-wide risks, encompassing loss of reputation, consumer boycotts, and legal sanction (CERES, 2020; Slob et al. 2020). Yet, while the volume of capital cited in estimates of ESG assets is noteworthy, concrete results are more nebulous, as is the future potential to bring about sustainable change through investor demands.

Voluntary initiatives have also been undertaken at the sectoral level by groups of companies adopting different kinds of zero-deforestation commitments (ZDCs). Amongst the most notable arrangements are the Soft Commodity Forum (SCF), the Soy Transparency Coalition (STC), Accountability Framework Initiative (AFI), The Consumer Goods Forum (CGF)'s Forest Positive Coalition of Action, and the Retail Soy Group (RSG). Common for these initiatives is that they generally encompass a diverse array of stakeholders from civil society and business, and in different ways target sustainability problems associated with soy production. Although some of these initiatives comprise commodity traders, most members can be found further downstream in the soy chain, such as food processors and retailers. Their general aim is to ensure the decoupling of soy production from deforestation – apart from other socio-environmental key performance indicators – and most rely on chain-based transmission of sustainability demands to actors upstream, through different monitoring, traceability, and certification instruments. However, this chain-based approach to private sustainability governance, which to a large extent relies on the market power of lead-firms in the downstream part of commodity chains, has shown a series of weaknesses. Resistance to adopt sustainability demands without corresponding compensation amongst actors upstream has provided significant obstacles (Søndergaard & Mendes, forthcoming). The aforementioned difficulties associated with the efforts to

establish a soy moratorium in the Cerrado serve as an example of this.

Soy traders operating in Brazil have, nonetheless, also adopted certain sustainability commitments, and in some cases also time-bound ZDCs. Thus, while some traders, such as Bunge and Cargill have set concrete goals to reach deforestation-free supply chains by 2025 and 2030, respectively, others have made more limited commitments - restricted, for example, to specific jurisdictions.

Similar disagreements to those that mark relations between traders and retailers and processors have also become evident in relations between traders and soy farmers in Brazil. Consequently, the former have often not been able to convey sustainability demands to the latter, especially when buyers with less restrictive sustainability demands are present in producer regions. This is reflected in the very limited effectiveness which private zero-deforestation criteria for sourcing of soy in the Cerrado have had until today (Ermgassen et al. 2019). In sum, apart from the Amazon Soy Moratorium, which did prove to be efficient in decoupling soy expansion from deforestation in this biome, private voluntary initiatives have not been very effective in confronting immediate sustainability problems caused by soy expansion in other parts of the country. This has led to calls for alternative and more comprehensive hard-law approaches.

At the COP 27 in Egypt, a group of global commodity traders, including the main soy traders in Brazil, presented the Agriculture Sector Roadmap to 1.5°C centered in 3 pillars: (i) to accelerate supply chain action to reduce emissions from land use change; (ii) drive transformation of commodity producing landscapes, and (iii) support forest positive sector transformation. With specific regards to soy, this Roadmap presented the target date of 2025 for the removal of deforestation from these companies' supply chains in the Amazon and Cerrado biomes (Roadmap, 2022). Although the document states the aim to protect over 14 million hectares of land beyond that already protected by the Brazilian Forest Code, the specific targets, cutoff dates, and definitions presented within the Roadmap to the soy sector have nonetheless been subjected to criticism from environmental organizations. This is not least the case with the deforestation definitions, which allegedly could lead to continued high levels of clearings of native vegetation in the Cerrado. Brazilian soy sector, on the other hand, have raised complaints related to demands that reach beyond the requirement of the Brazilian Forest Code, arguing that this step would impede soy expansion in large areas of the Cerrado. Moreover, this group has also highlighted how this would amount to a significant de-facto trade barrier, which could compromise Brazilian agricultural products' global market access (Tosi, 2022). In general, although the Roadmap has not been seen as rapid enough or broad enough, moving toward greater transparency and disclosure using credible metrics and platforms, as well as implementation mechanisms, such as traceability and monitoring systems could provide for improved sustainability outcomes.

5. Global due diligence and the soy trade

5.1 Global trends for due diligence of FRCs

Despite growing global pressures towards market leaders to decouple agricultural commodities from deforestation, progress has thus far been slow (Haupt et al. 2020; Lambin et al. 2018; Rogerson 2017). From 2010, a series of initiatives with different degrees of involvement from public actors were taken to confront commodity-driven deforestation and spur afforestation efforts. With support from 61 governments worldwide, in 2011, the Bonn Challenge established the goal of restoring 150 million/ha of degraded land by 2020 and 350 million/ha by 2030. The 150 million/ha pledge was reached as early as in 2017 (Bonn Challenge, 2021). With the goal of decoupling production of FRCs such as soy, palm oil, beef and paper by 2020, the New York Declaration on Forests, signed in 2014 was supported by more than 200 national and local governments, companies, and civil society entities, who pledged to "cut natural forest loss in half by 2020, and strive to end it by 2030" (NYDF, 2014). Yet, despite this ambition, the declaration lacked a binding character and did not go beyond a general appeal for private actors to adopt zero-deforestation commitments. The absence of legally binding instruments also marked the Amsterdam Declaration (AD), signed by different European countries in 2015, and which reiterated NYDF objectives (AD, 2015). The 2014 IPCC report also underscored the risks which can be found in the nexus between agricultural expansion and native vegetation loss. It also pointed to serious ecological tipping points which could be surpassed with continued tropical deforestation (IPCC, 2014). The 2021 IPCC report also emphasized the link between soft commodity production and tropical deforestation, and stressed the role of forest loss as one of the principle human-induced drivers of climate change (IPCC, 2021). Finally, calls to end deforestation were also made in the Forest Agreement signed at the COP26 in 2021. States that together represented 85% of global forest cover committed to "working collectively to halt and reverse forest loss and land degradation by 2030" (UN, 2021). The agreement did not specify any particular instruments to reach this goal, but the time-bound objective was a hitherto unprecedented achievement.

5.2 European due diligence initiatives

Commitments signed at the multilateral level have accelerated efforts to install mandatory mechanisms to confront environmental impacts abroad caused by domestically consumed products. Laws aiming to oblige companies to address human rights problems and environmental degradation within their global supply chains have

been passed in France and Germany, and are under elaboration in the United States and the United Kingdom. The EU has also taken significant steps to install due diligence mechanisms that specifically would address FRC commodities. The Union already applied a mix of instruments to confront deforestation in third countries, such as the European Union Timber Regulation (EUTR), and through bilateral agreements (Henn 2021, p.343). The EUTR, however, only partially addresses deforestation through bans on illegally imported wood products (Bager et al. 2021, p.290). These measures were supplemented by the adoption of the UN General Principles on Business and Human Rights, as well as a revision of the OECD Guidelines on Multinational Enterprises. However, towards the late 2010s, efforts to create due diligence mechanisms gained momentum. In early 2018, the EU Feasibility study on options to step up EU action against deforestation was published in the form of two reports, 'Background analysis and setting the scene: scale and trends of global deforestation and assessment of EU contribution' and 'A potential EU initiative on deforestation: possible interventions' (EU, 2018). This was followed up by a roadmap to reduce imported deforestation & comments, also in 2018, and public consultations in 2019 and 2020. (Schilling-Vacaflor & Lenschow, 2021)

In October 2020, the European Parliament voted in favor of legislation that would address the socio-environmental impacts of imported FRCs. The European Commission (EC) was in charge of specifying this proposal. In 2021, the Commission presented the Draft 2021/0366 (COD), which demanded that a range of FRCs, such as beef, palm oil, soy, cocoa and coffee complied with three key criteria, according to which they would need to be, a) **deforestation-free,** meaning that the latest permitted conversion of native vegetation on areas in which they were produced was December 31, 2020, b) were **compliant with legislation** in producer countries, and c) were **covered by due diligence statements** (EC, 2021). After the EC had presented its proposal, treatment of the draft went on to the European Council, which modified the definitions of forest degradation to refer to structural changes to forest cover. Finally, the Council further emphasized the aspects related to human rights, incorporating important elements of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Finally, in September 2022, the European Parliament (EP) approved the updated version of the draft with 453 votes in favor and 57 against, with 123 abstentions. The new version of the draft contained forest definitions which included the Brazilian Cerrado, but not other ecosystems, such as peatlands and grasslands. The law will thereafter pass on to be implemented by national legislative assemblies.

On the European side, the proposal was supported by civil society organizations, and also generally reflects demands from EU citizens, of which 80% declare support for a law that limits the entry of products associated with deforestation or human rights

violations (CE, 2022). On the other hand, the European feed industry adopted a more critical stance, voicing its concerns about the specific demands for monitoring systems relying on geolocation coordinates, which have been characterized as highly demanding (Basquill, 2022). Brazilian diplomacy during Bolsonaro´s government has also been highly critical of the law, which it has claimed could significantly affect the country's agricultural exports to the EU. Brazilian attempts during that period to influence the formulation of the legal proposal do nonetheless appear to have been unsuccessful.

5.3 Key dilemmas concerning mandatory due diligence

The prospects of forthcoming EU due diligence regulations for FRCs raises many questions regarding the soy trade with Brazil, which relate to impacts, efficiency, legitimacy and equity. The impact on the soy trade between Brazil and the EU has surely become more significant as the Brazilian Cerrado was included in the draft's forest definition. Irrespective of whether they are legally or illegally deforested, soy grown in Cerrado areas cleared after the cut-off date inscribed in the draft will not be able to enter the EU market. In this regard, the effects of the legislation will become more significant with time. Ideally, this regulation could help accelerate a movement already in course, whereby soy expansion is directed towards degraded pastures rather than native vegetation. However, the most significant immediate impact of the legislation would be to exclude soy producers in non-conformity with Brazilian environmental legislation from European market access. Rajão et al. (2020) thus suggest that approximately 20% of Brazilian soy exports to the EU from the Cerrado and Amazon biomes could be contaminated with illegal deforestation, meaning that areas have been cleared after 2008 without license on these properties. While 20% of Brazilian soy exports to the EU by itself only represents a modest share of total Brazilian production, the legislation could have broader multiplier effects. These would become evident if traders chose not to establish parallel supply chains for the European markets, but instead accelerate efforts to reach zero-deforestation supply chains for all of their operations. If EU regulations thereby indirectly became extended to soy supply chains directed at other export markets, - notably, China, - this could have a significant additional effect (Partiti, 2021). Moreover, considering that the EU historically has been an important norm entrepreneur within the field of environmental politics, adoption of similar regulations by other international clients could also strongly affect the international marketing conditions for Brazilian soy (Schilling-Vacaflor & Lenschow 2021, p.13).

Another central question with regards to due diligence regulations concerns their effect, seen as their capacity to bring about the desired sustainability outcomes. In this regard, Sellare et al. (2020) present six key priorities which become necessary to ensure effective due diligence regulations:

- **Impact assessments:** in form of prior estimates of social and environmental impacts of due diligence measures before their implementation.
- **Compliance measurements:** through adequate and cost-effective monitoring instruments, aimed at ensuring confidence related to the compliant origin of products.
- **Theory framework development:** to establish clear and verifiable hypotheses concerning the impacts of the purported sustainability measures.
- **Evaluating policy interactions:** by paying attention to the outcomes shaped by overlapping and interconnected legal frameworks with which due diligence regulations interact.
- **Support for equity:** to provide for equitable outcomes for the diverse set of actors along the supply chains subjected to due diligence regulation.
- **Confronting root causes:** with special emphasis on the systemic problems of global trade and the need for proper legal frameworks and enforcement in producer countries.

These key points highlight that the efficiency of due diligence regulations cannot be presumed a priori. Rather, equitable and sustainable outcomes rely on a wide array of contextual factors in relation to which regulations and their modes of implementation will need to be sensitive. Finally, an important aspect with regards to efficiency concerns the potential for transmission of sustainability demands along global supply chains. The assumption that actors downstream in food chains can pass on sustainability demands to upstream producers, and on which many theories of change rely, has increasingly come under critical scrutiny (Baines 2014; Daugverne 2017). However, thus far, within soy markets these demands have been driven by private actors assuming voluntary commitments, and as we have seen in previous sections, have only had a limited effect. It thereby remains to be seen how mandatory sustainability demands covering entire import regions, - as would be the consequence of the EU due diligence law, - will play out in practice[6].

Another central question with respect to due diligence regulations concerns legitimacy. In a strict sense, reference to multilateral obligations, - such as the Paris Agreement,

[6] A possible implication of the draft as it stands concerns the part of the document that proposes to classify countries or regions as low, medium or high risk. In this case, the detailed process of documenting high-risk locations (country or region) would, by itself, act as a disincentive to imports by European buyers. In this case, it could equally penalize compliant producers that are located in the same region/country.

extraterritorial carbon sink impacts, as well as reliance on compliance with national legislation in producer countries means that the due diligence legislation, as it stands, could be deemed in compliance with international trade law (Henn, 2021). An important point in this regard is to avoid double standards in terms of sustainability frameworks, which is prohibited by the World Trade Organization (WTO). In a broader sense, the notion of legitimacy also concerns social and public acceptance beyond its strictly legal aspects. In this regard, it is noteworthy that few Brazilian entities were part of designing the roadmap for the new legislation. Inclusion of actors from countries affected by the legislation thus appears as an important concern to ensure that it produces the desired outcomes (Schilling-Vacaflor & Lenschow 2021, p.11).

A final, but nonetheless important point concerns equity and fairness in terms of outcomes of the EU due diligence law. In relation to the Brazilian soy sector, the question about who would eventually absorb segregation costs across the chain through the logistical flow to the shipping point, thus far stands unanswered. Studies have shown that sustainability demands can serve as a strategy for profit maximization and for gaining competitive advantages (Daugverne & Lister's 2013). "Sustainability supplier squeezes" as actors downstream exercise market power in relation to suppliers upstream can thereby transfer benefits, such as price premiums to the former, while the latter assume costs of implementing these changes (Ponte 2019a & 2019b). In relation to this risk, Partiti (2021, p.149) highlights that "Supply-chain management must therefore be properly leveraged by public authority. If left unhindered, it enables powerful chain leaders to exploit sustainability-related claims, transferring value from suppliers to chain leaders". While assessments of the specific means to ensure that positive environmental outcomes of future due diligence regulations are combined with social equity is beyond the scope of this paper, this dimension nonetheless becomes important to evaluate by public policy makers. Sellare et al. (2020, p.861) thus underscore that while ideally, actors downstream should provide the means for sustainability improvements amongst upstream suppliers, frequently, they opt for the "easiest" alternative, which is market exclusion. Abrupt disarticulation of commodity producing regions from global markets can lead to severe socio-economic consequences in producer regions. Being mindful of such risks thereby constitutes an essential task in the course of the implementation and monitoring of the effects of European due diligence regulations.

6. Final remarks: key points

- In conclusion to this report, we present a range of key points which we hope can help inform policymakers and practitioners in their efforts to support inclusive and more sustainable soy chains.
- Although China has overtaken the EU as the most important client of Brazilian soy, the European animal protein production complex is still strongly dependent on soy imports from Brazil, - a situation which is unlikely to change fundamentally in the immediate future.
- Despite changing consumer trends away from animal-source products, as well as the growing salience of problems related to commodity-driven deforestation, Germany still imports substantial amounts of Brazilian soybeans. With exports totaling 1.58 million tons in 2021, Brazil overtook the United States as the most important supplier of soy to Germany in 2021.
- Although deforestation rates in the Brazilian Amazon and Cerrado biomes underwent a decline until 2012, these numbers have risen in recent years, leading to heightened international concerns and potential market access risks for Brazilian soy products.
- Embodied deforestation in Brazilian soy exports to the EU has dropped significantly since 2006. A more moderate fall can be observed with regards to domestic consumption, while some increase mark exports to China, although total volumes of soy exports to this Asian country has grown as a much higher proportion in recent years.
- Embodied deforestation in Brazilian soy exports to the EU is strongly concentrated in the MATOPIBA region and the state of Mato Grosso. With specific regards to German soy imports, from 2010-2018 the largest share of embodied deforestation derived from soy imports originating from the state of Bahia.
- Important measures to confront the sustainability challenges associated with Brazilian soy production can also be found in the form of No-Tillage Systems (NTS), Biological Nitrogen Fixation (BNF), Crop-Livestock-Forest Integration (CLFi), contour plowing, some degree of substitution from chemical inputs to biological ones, and the integrated management of pests, diseases, and weeds.
- The Brazilian Forest Code contains a range of important regulatory instruments to curb illegal deforestation. Consistent implementation of this law is crucial in order to decouple soy expansion from deforestation.

- The Amazon Soy Moratorium constitutes an important step to decouple soy expansion from Amazon deforestation. It should nonetheless be monitored closely, as new challenges that could threaten this decoupling have arisen in recent years.
- A Soy Moratorium in the Cerrado could provide substantial conservation benefits and if combined with sustainable intensification of agriculture and livestock production, could be reconciled with substantial increases in production outputs. Thus far, disagreements between different actors in the soy chain, concerning who will assume conservation costs have hindered an agreement.
- Different voluntary multistakeholder initiatives advanced by actors downstream, such as retailers and food processors together with NGOs, have sought to address soy-driven deforestation in Brazil through chain-based transmission of sustainability demands and certifications. Thus far, though, they do not appear to have had much effect.
- Building on increasingly tangible multilateral commitments to address FRC-driven deforestation, mandatory due diligence requirements targeting deforestation and social transgressions in producer regions have been developed in a range of buyer countries.
- Due diligence regulations under development in the EU could have a significant impact on soy imports from Brazil. The degree to which they would provide an incentive for compliance amongst producers would largely depend on the degree to which these regulations disseminate beyond supply chains targeting the EU to cover commodity traders' entire supply networks, and mainly, if similar regulations are adopted by other international buyers.
- Despite multistakeholder initiatives and commitments to address FRC-driven deforestation, as well as the increasingly evident concretization of due diligence regulation, there is still no coordinated and robust action in the Brazilian soy sector to confront or adapt to this situation.
- While due diligence regulations have been devised with the goal of producing positive sustainability outcomes in producer regions, it becomes important to evaluate their broader impact across global supply networks with specific attention directed towards issues related to impacts, efficiency, legitimacy and equity.

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