AGRICULTURAL POLICIES IN DEBATE

German soy imports from Brazil and policy options for more sustainable supply chains

JORGE SELLARE AND JAN BÖRNER

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List of acronyms and abbreviations

ABIOVE | Associação Brasileira das Indústrias de Óleo Vegetal
ADP | Amsterdam Declarations Partnership
APROSOJA | Brazilian Association of Soy Producers
BMEL | Bundesministerium für Ernährung und Landwirtschaft
CAP | Common Agricultural Policy
EC | European Commission
EU | European Union
FEFAC | European Feed Manufacturers' Federation
FONEI | Forum nachhaltigere Eiweißfuttermittel
GHG | Greenhouse Gases
GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit
GMO | Genetically Modified Organism
NGO | Non-Governmental Organization
OVID | Verband der ölsaatenverarbeitenden Industrie in Deutschland
PES | Payment for Ecosystem Services
RSPO | Roundtable for Sustainable Palm Oil
RTRS | Roundtable for Responsible Soy
TRASE | Transparency for Sustainable Economies
USA | United States of America
UK | United Kingdom

Executive summary

Soybeans are one of the most important sources of protein for food and feed and also serve as bioenergy feedstock. However, increasing global demand for soy is putting significant pressure on forestland and other biodiversity rich areas in producing countries. Brazil is the largest producer and exporter of soybeans and, despite significant reductions in deforestation in the Amazon between 2004 and 2012, concerns about sustainability issues related to soy production persist. It has been estimated that between 2001 and 2016 around 4.75 million hectares of natural vegetation were converted to cropland for soy, half of which in the Cerrado, a biodiverse tropical savannah with importance for the provision of ecosystem services in South America.

The debate about negative environmental and social impacts of agricultural expansion in South America gained momentum in the European Union after the 2019 forest fires in the Brazilian Amazon and Pantanal featured prominently in the media. Although Germany and other European countries have been reducing soy imports from Brazil, around one third of German soy imports are still sourced from Brazil, either directly or via re-exports from other European countries. For Brazil, however, the German market only represents 1.5% of the total soy trade value. China is the most important buyer of Brazilian soy (around 70%) and, as such, has the biggest environmental footprint in absolute terms. However, between 2006-2016, European countries had a significantly higher average environmental footprint per ton of imported soy than China, suggesting that Europe sources soy from areas in Brazil that have been actively expanding soy production into forests.

Several proposals exist to improve sustainability governance in soy supply chains. Voluntary zero-deforestation commitments and sustainability standards are among the most frequently proposed measures. The Amazon soy moratorium is regarded as the most effective multi-stakeholder voluntary commitment to date and was estimated to have reduced deforestation rates by 35% between 2006 and 2016. Unilateral company commitments on the other hand are ineffective in halting deforestation at regional scale if they achieve zero deforestation by substituting problematic trade flows with products sourced from consolidated production regions. Sustainability standards are often adopted

as part of such commitments, but global demand for certified products is too low to exert transformative impacts at the landscape scale. The scientific evidence, moreover, suggests that these impacts are highly dependent on contextual factors, such market and value chain structures.

Although there is no single solution to increase sustainability in soy supply chains, there are two principles that should be mainstreamed in German and European initiatives: (1) increased coordination at the EU level and (2) a stronger focus on the desired sustainability outcomes rather than product-specific approaches. A unified European approach is considered a precondition to make South American soy production systems more sustainable. Joint commitments made at the EU level could leverage more binding sustainability commitments among soy producers, traders, and eventually also providers of agricultural inputs and technology packages. These commitments should be coupled with policy instruments to leverage the demand for deforestation-free soy while channelling consumers' willingness to pay for sustainable soy toward initiatives that combat forest loss. Furthermore, we need policies that promote more sustainable consumption patterns in both soy exporting and importing regions as well as R&D for alternative protein sources as partial substitutes for soy-based feed.

1. Introduction

Soybeans play a key role as a source of protein in the global agri-food system. Although soybeans are more often associated with animal feed, they are actually a "hidden commodity," found in thousands of processed foods and even cosmetics (Lenfert & Börner, 2017). The increasing global demand for soy has been an important driver of land use change in producing countries. Despite a reduction in deforestation rates in recent years, it is estimated that 19% of global forest loss between 1990-2008 was linked to soy expansion (European Commission, 2013). In Brazil, the world's biggest producer and exporter of soybeans, the situation is not different. Soy production is directly and indirectly associated with the expansion of cropland into forests. In the Brazilian Amazon, soybean area grew by 3.29 million hectares (Mha) between 2001 and 2016 and directly contributed to 1.67 Mha of forest loss (Song et al., 2021). Although deforestation in Brazil declined between 2004 and 2012[1], deforestation rates are currently on the rise. The 2019 forest fires in the Amazon and Pantanal have spurred reactions from several international actors and intensified the debate on the role of agricultural expansion as one among several causes of the fires (Lopes, 2019).

The European Union (EU) heavily relies on soybean imports to meet internal demand for food and feed, with the United States and Brazil being the two main suppliers (European Commission, 2021). Concerns about sustainability issues in soy supply chains – especially from Brazil – are on the rise in Europe. In 2015, six EU member states signed the Amsterdam Declarations Partnership (ADP)[2], an initiative that recognized the role of agricultural supply chains in global forest loss and aimed to enhance the dialogue between producers and consumers and support private sector-led initiatives to reduce deforestation. The ADP helped facilitate and strengthen several national soy strategies led by the private sector, such as the Danish Alliance on Responsible Soy, the German

1 In 2012, Brazil introduced its latest Forest Code and a new national land registry system, which aimed to halt illegal deforestation by reducing costs of monitoring, enforcement, and compliance. Some studies suggest, however, that, for farmers, the economic benefits of fully complying with the Forest Code is limited (Azevedo et al., 2017).

2 As of January 2021, the ADP has 8 signatories (Denmark, France, Germany, Netherlands, Norway, UK, Italy, Belgium, and Spain), who are responsible for around 62% of all soy imports to Europe.

Forum nachhaltigere Eiweissfuttermittel (FONEI)[3], and the UK Roundtable for Sustainable Soy (for an overview of the main national soy strategies, see Table A1 in the appendix).

Despite the increasing awareness of soy-related sustainability issues, finding effective solutions remains a daunting challenge. In fact, little is known about the direct and indirect impacts of public and private initiatives to reduce soy-driven deforestation. For instance, voluntary commitments by individual private companies lack independent monitoring and oftentimes remain rhetoric: only 21 out of the 251 investors who signed an open letter calling businesses to action against deforestation have their own zero-deforestation policies (Win, 2020). At the EU level, some suggest that the Common Agricultural Policy (CAP) might have indirectly affected soy production in developing countries by creating incentives for European farmers to increase meat and dairy production, while creating disincentives for farmers to meet the EU demand for feed via locally grown protein crops (Gregory & Polsterer, 2017). Even initiatives with clearly defined sustainability goals, such as the EU Green Deal, are not free of criticism (Fuchs et al., 2020), and expectations are mixed about what an EU due diligence law can realistically achieve.

Here we provide an analysis of the status quo of soy imports from Brazil, focusing on demand-side policy measures and on the perspectives of German stakeholders. Our goal is to explore whether German stakeholders and their international partners could more effectively contribute towards reducing the negative sustainability impacts of soy production. Our discussion is based on multiple sources of secondary data, such as reports and position papers from several organizations, research articles, and trade data. Furthermore, we conducted semi-structured interviews with German stakeholders from an industry association, stakeholder dialogue platform, retailing sector, development agencies, and the civil society, to capture their perspectives on the main sustainability challenges in soy supply chains and alternative policy mechanisms. In Table A2 in the appendix, we summarize the main points raised by each stakeholder type during the interviews.

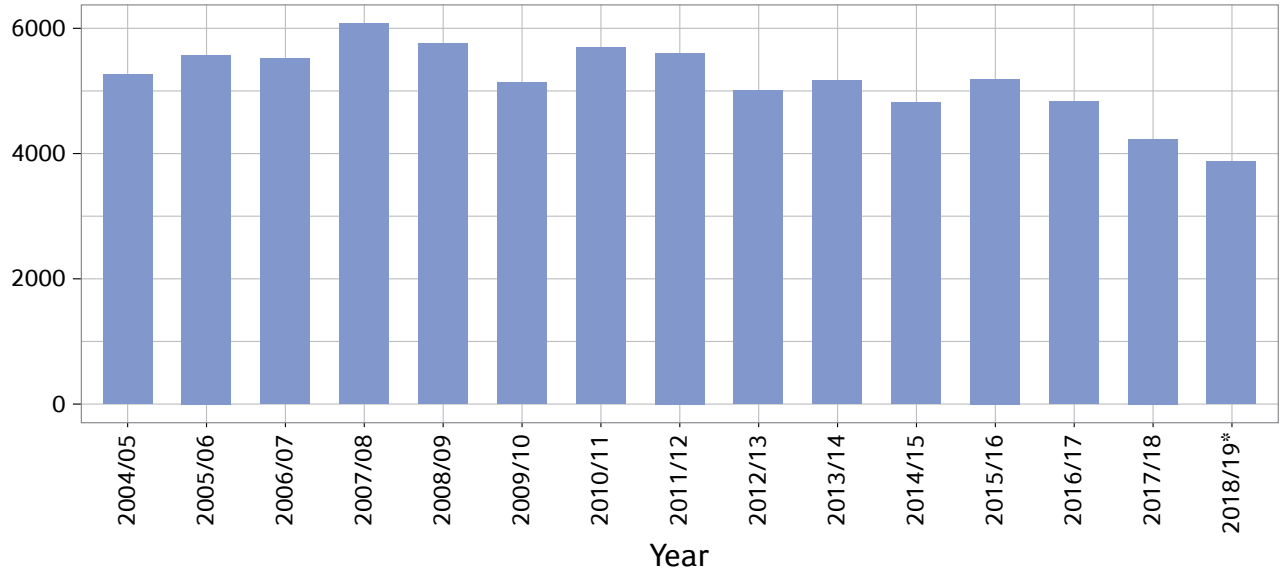
3 The FONEI was created in 2014 and its initial focus was on the promotion of local production of feed and on non-GMO feed. In 2019/2020, the topic of deforestation-free supply chains was introduced and discussed in the forum.

2. Trade and sustainability impacts in soy supply chains

2.1. Soy imports to the EU and Germany

Germany relies on soybean imports mostly to cover its demand for animal feed. Between 2004 and 2019, Germany imported on average 5.18 million soybean-equivalent tonnes per year (Figure 1), making it the second largest importer of soy in Europe (Figure A1 in the appendix). These numbers include not only soybeans, but also soymeal and oil, which represent a substantial amount of total soy imports. In 2018, for example, Germany imported 3.64 million tonnes of soybeans, 2.43 million tonnes of meal, and 62 thousand tonnes of oil, totalling 6.14 million tonnes of soy imports. Around 33% of the soy is re-exported, mostly to other EU countries, and the rest is used for domestic consumption (IDH, 2020).

Figure 1 – Quantity of soy imported to Germany (2004-2019)



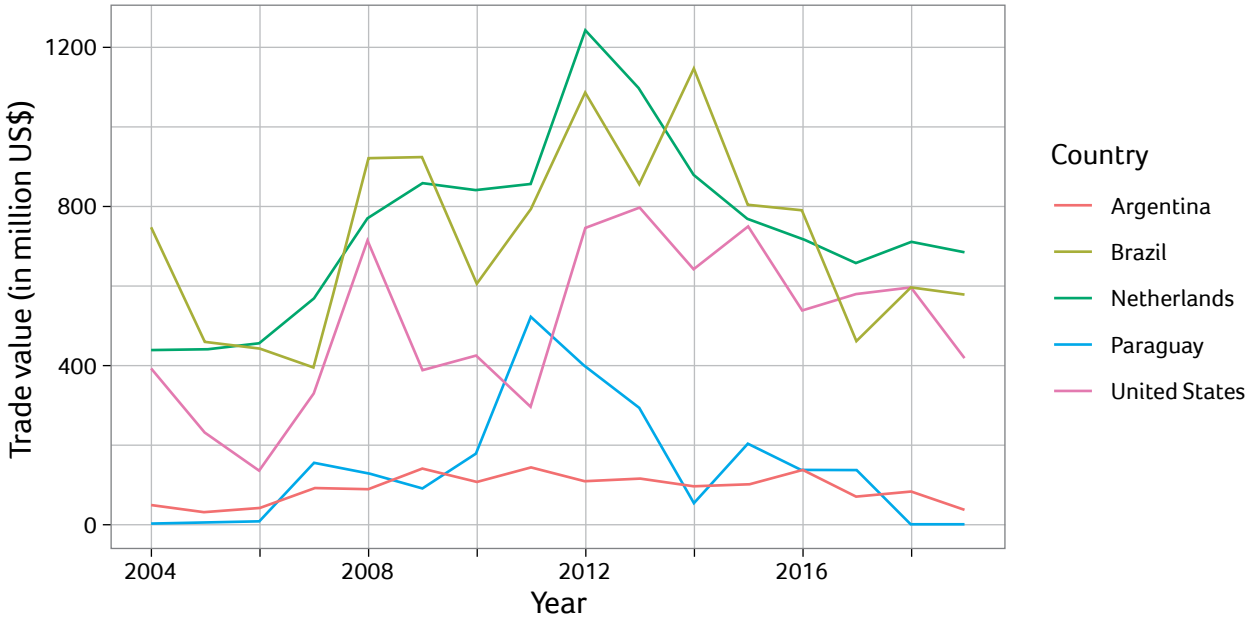
Source: Authors' elaboration based on data from https://dserver.bundestag.de/btd/19/233/1923345.pdf.

* Based on preliminary data for 2018/2019.

Although the total quantities of soy imports have remained fairly stable during the last decade, geographic sourcing patterns varied significantly. Historically, most of the soy imported to Germany comes from Brazil, the United States, or via the Netherlands from similar sources. Until 2006, Brazil accounted for 40% of the market share of German soy imports, but since 2007 the United States has taken over as the country with the biggest market share in terms of trade value. Annual figures fluctuate, for example, due to external macroeconomic factors, such as the Chinese-USA trade war in 2018-2019. In recent years, the trade value of soybean imports from Brazil to Germany fell significantly, accounting for only 10% of the total trade value in 2018 and 3% in 2019 (Figure A2 in the appendix).

However, Germany also imports processed Brazilian soybean meal for use as animal feed. Combining soybeans and meal, Brazil still accounted for 28% of the total trade value of soy imports to Germany in 2019 (Figure 2). As a result, Brazil remains a key sourcing region for German soy imports.

Figure 2 – Trade value of soy imports (soybeans and meal) to Germany (2004-2019)

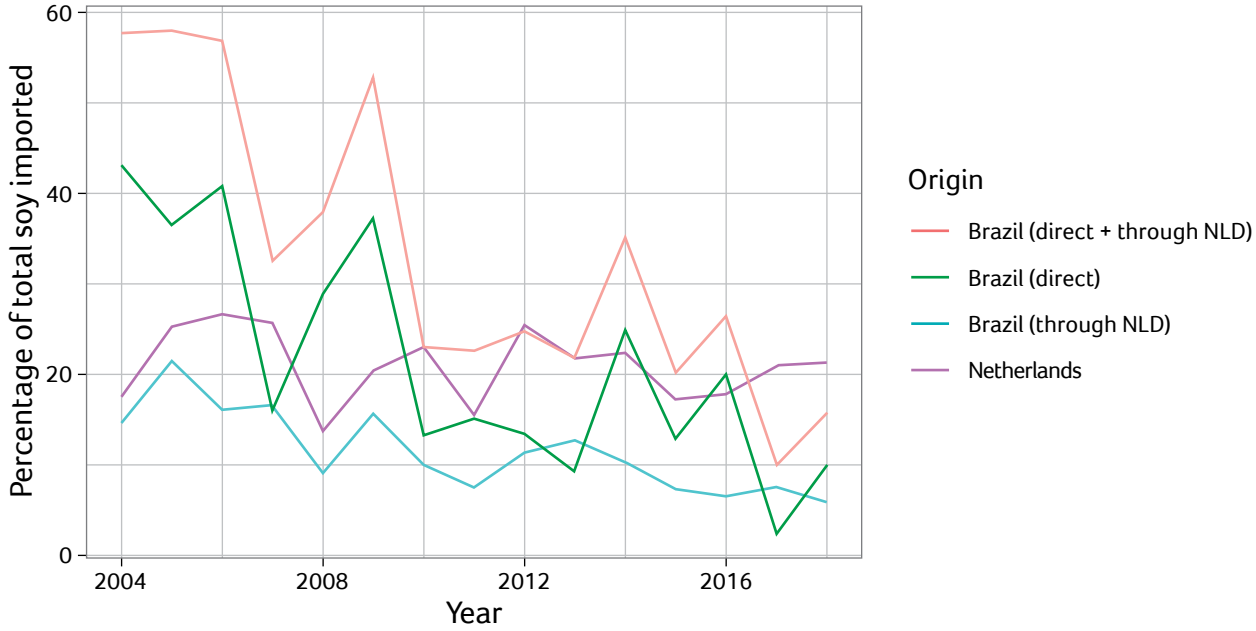


Source: Authors' elaboration based on data from OEC (2021).

A significant share of Europe's soy imports from Brazil arrives in the Netherlands, after which they are re-exported to other EU countries. From 2004 to 2019, Brazil's soybean exports to the Netherlands accounted for 4.7% of its total soy trade value (Figure A3 in the appendix). This is a relatively small market share for the Brazilian economy, but for the Netherlands this represents 51.1% of its soy trade value (Figure A4 in the appendix). Since a substantial amount of the soy imported

to Germany arrive through the Netherlands, we have to consider indirect imports through the Netherlands to arrive at a realistic estimate of how much Brazilian soy arrives in the German market. Doing so suggests that on average 32% of total soy imports to Germany come from Brazil (Figure 3) as opposed to 20% when we only consider direct imports from Brazil.

Figure 3 – Percentage of Germany's soybean imports from Brazil and the Netherlands (2004 – 2018)



Source: Authors' elaboration based on data from OEC (2021).

Note: We estimated that the amount of Brazilian soybeans coming into Germany through the Netherlands is proportional to the share of soybeans that the Netherlands import from Brazil.

2.2. Environmental impacts of soy production

In our interviews with German stakeholders, deforestation was regarded as the most important sustainability issue linked to soy production. Our respondents also mentioned several secondary sustainability issues with varying degrees of emphasis. These include changes in ecosystems and biodiversity loss, pollution due to overuse of agrochemicals, and conflicts over land rights as well as with indigenous and traditional communities. The representatives from the stakeholder dialogue platform pointed out that their members are generally aware of these issues, but that soy-related deforestation has so far dominated the agenda across meetings and discussions.

In the past 15 years, soy production has shifted to the Cerrado biome, and it is estimated that 16.6% of all forest loss in the Cerrado was converted into cropland

to grow soybeans (Table A3 in the appendix) (Song et al., 2021)[4]. Between 2006 and 2017, deforestation for soy in the Cerrado resulted in 210 million tonnes of carbon dioxide equivalent (MtCO2e) emissions, with 68% of this associated with soy for export. In 2017, more than half of all exports from the Cerrado went to China (59%). This exposes China to a total deforestation risk[5] of 460 km^2, which equates to 5.6 MtCO2e. Exports to the EU in the same year represented 17% of all exports from the Cerrado, which can be linked to 150 km^2 of deforestation and 1.7 MtCO2e emissions (Trase, 2018).

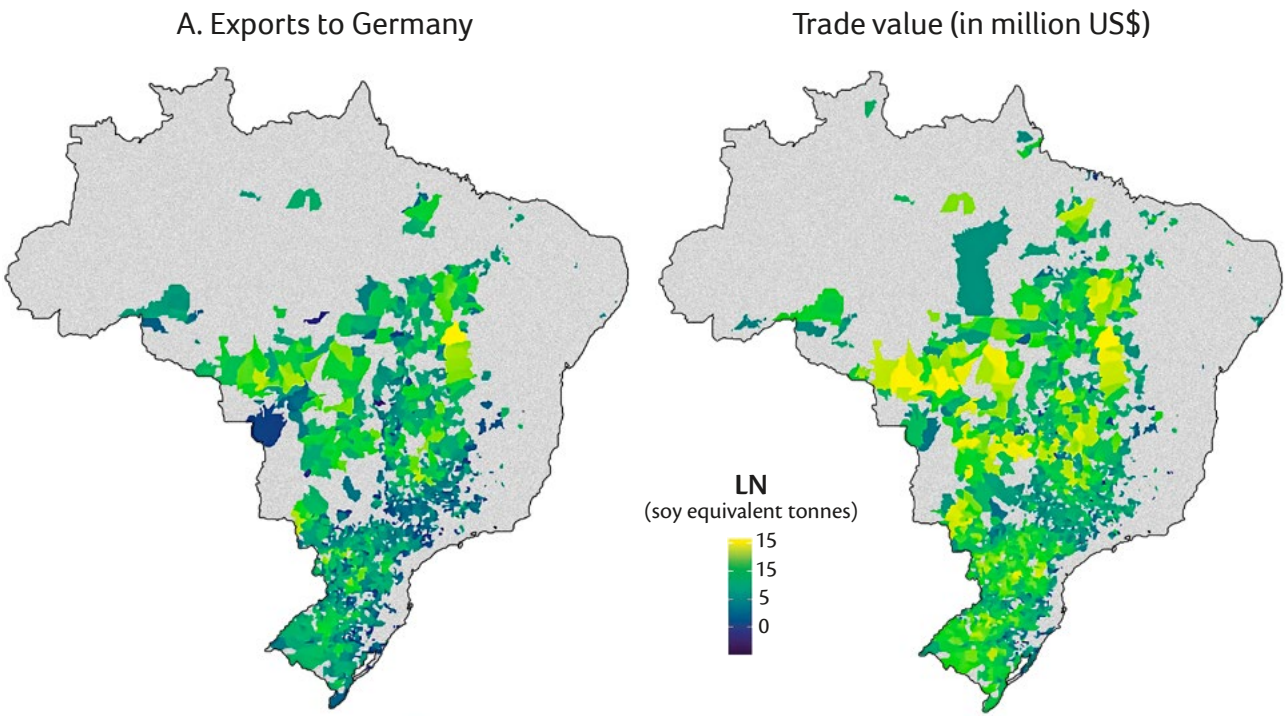
Although China imports from Brazil a significantly larger amount of soy than the EU, European countries are sourcing from areas where the risk deforestation from soy is high. This makes the EU's impact per tonne of soy even higher than China's impact (Figure A5 in the appendix) (Escobar et al., 2020; Trase, 2018)[6]. Among the EU countries, Germany has the second highest relative risk of deforestation, ranking above countries that import larger volumes of soy, such as the Netherlands and Spain. Although there are no major differences between Germany and other EU countries in terms of the municipalities and biomes they source from (Figure 4 and Table 1), Germany seems to import a bigger share of its soy from municipalities at the agricultural frontier, where deforestation is rampant. Figure A6 in the appendix shows the biome of origin and country destinations of soy potentially contaminated with potentially illegal deforestation (Rajão et al., 2020).

4 A study commissioned by ABIOVE (Associação Brasileira das Indústrias de Óleo Vegetal) suggests that, between 2013-2020, only 8% of the soy expansion in the Cerrado occurred in deforested land, while the rest occurred in the already cleared land and on degraded pastures (Agrosatélite, 2021). However, these figures disregard indirect deforestation linked to soy expansion.

5 Trase calculates deforestation risk "using localized data on commodity production, sourcing patterns and deforestation. (…) The total deforestation risk associated with the supply chain of a given buyer is calculated by aggregating the share of commodity-related deforestation in each sourcing region that is proportional to the share of the total soy produced in that region being sourced by that buyer." (Trase, 2018: p. 10)

6 It is noteworthy that sourcing from an area where the risk of deforestation is high does not necessarily equate to sourcing from areas where deforestation actually happened. Some private companies report to be improving their monitoring systems and to be able to trace back most of their direct purchases to single farms (WBCSD, 2021). This allows for better estimates of how much soy was purchased from deforested lands. However, private companies do not make this data publicly available, which forbids independent assessments.

Figure 4 – Total soy exports to Germany and to the EU by municipality (2004 – 2018)



Source: Authors' elaboration based on data from TRASE.

Table 1 – Total soy exports from Brazil by biome (2004 – 2018)

	European Union		Germany	
	Soy-eq. (in 1,000 tonnes)	%	Soy-eq. (in 1,000 tonnes)	%
Amazon	24,549.8	9.9%	1,453.5	5.0%
Atlantic Forest	60,515.8	24.5%	7,805.1	27.1%
Caatinga	87.1	0.0%	21.4	0.1%
Cerrado	122,868.1	49.7%	14,590.1	50.6%
Pampa	8,632.0	3.5%	614.8	2.1%
Pantanal	72.3	0.0%	0.2	0.0%
Unknown biome	30,733.0	12.4%	4,355.1	15.1%
Total	**247,458.1**	**100%**	**28,840.1**	**100%**

Source: Authors' calculations based on data from TRASE.

Looking at trade routes and the geographical locations of producing regions and importing countries can help explain these differences in sourcing patterns. From a logistics standpoint, it makes sense for European countries to source soybeans from the North of Brazil, while China and other Asian countries import from the Southern States and from lower-risk areas in the Cerrado (Figure 5). Changing these patterns would imply higher transportation costs and might be less efficient from a carbon emissions perspective.

Figure 5 – World export routes for Brazilian soybeans

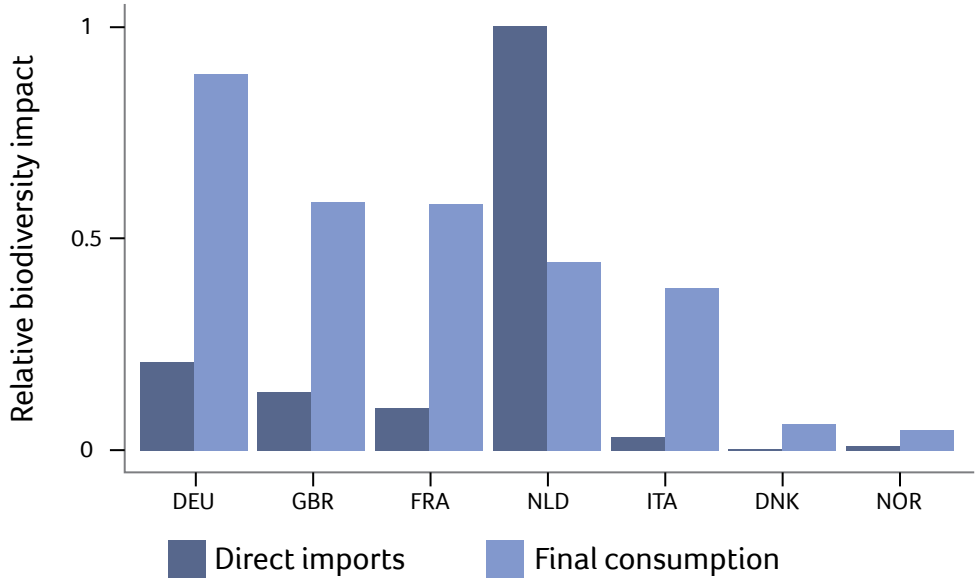
Source: Adapted from Salin (2021).

Although land use change is the main driver of carbon emissions, emissions from other steps in the value chain, such as input use, transportation, and processing are not trivial. While soy from municipalities in the MATOPIBA region (states of Maranhão, Tocantins, Piauí, and Bahia) have a high carbon footprint resulting mostly from land use change, municipalities from the South of the Amazon have high carbon emissions from domestic transport and industrial processing (Figure A7 in the appendix) (Escobar et al., 2020). As soy keeps expanding to more rural remote areas with underdeveloped infrastructure, the lack of efficient networks of transportation and storage is likely to result in higher carbon emissions (Fliehr, 2013).

In addition to deforestation and carbon emissions, the expansion of soy to the Cerrado has been raising concerns about the impacts on ecosystem services and habitat loss in this biodiversity hotspot (Strassburg et al., 2017). Brazil's domestic market alone drives 45% of soy-related impacts on endemic Cerrado species, while its impact per unit of soy consumed is twice as high as that from any other country. This suggests that domestic supply chains source from municipalities with high richness of endemic species (Green et al., 2019). Regarding European markets, Figure 6 shows that the Netherlands boast the largest soy-related impacts on the Cerrado biodiversity when we consider only direct imports. However, most of the soy that arrives at Dutch ports is re-exported to other

European countries, Germany being an important buyer. Therefore, when we consider these re-exports and consumption of soy embedded in other products, Germany comes out as one of the countries with the largest soy-related impacts on the biodiversity.

Figure 6 – Biodiversity impact of direct soy imports and total final consumption for countries signatories of the Amsterdam Declaration



Source: Adapted from Green et al. (2019).

Note: The analysis is based on trade data from 2011, to which the authors attribute biodiversity losses between 2000 and 2011. For more information on the methodology, please refer to the original publication.

Another sustainability issue that was emphasized during our interviews with representatives from the German Association of Oilseeds Crushers (OVID) and the civil society was the use of genetically modified organism (GMO) in soy production. Representatives from OVID emphasized the potential of GMO technology as a key to more sustainable soy production, whereas the civil society representative warned against health and environmental risks linked to agrochemical use and other intensive commercial agricultural practices. In the scientific community, GMOs are also a contentious issue. Some scholars argue that GM crops lead to an increase in the use of agrochemicals, which negatively impacts non-target populations and human health (Kranthi & Stone, 2020). Others challenge these claims and emphasize the economic benefits of GMOs and their importance in meeting future demand for food without expanding agriculture into forestlands (Qaim, 2020).

3. Scientific and stakeholder perspectives on improving sustainability governance in soy supply chains

In this section, we present some of the scientific evidence on the pros and cons of four of the main proposals to improve sustainability in soy supply chains and complement it with the perspective of German stakeholders. A full summary of our semi-structured interviews disaggregated by stakeholder type can be found in Table A2 in the appendix.

3.1. Voluntary commitments

Voluntary commitments were identified by representatives from OVID and the civil society as an important element in strategies to govern soy supply chains towards reducing the negative impacts identified above. Such commitments usually entail the adoption of social or environmental minimum standards linked to production or product quality by individual companies (unilateral) or whole sectors (multilateral). Most our interviewees considered the Brazilian soy moratorium as the single most effective environmental governance strategy implemented so far. The soy moratorium is a voluntary zero-deforestation commitment that operates as a market exclusion policy, as soybean traders agreed not to purchase soy produced on land that was deforested after 2008 (Gibbs et al., 2015). It has been estimated that, between 2006 and 2016, the soy moratorium prevented the loss of 18,000 km^2 of forestland in the Amazon biome, which represents a reduction of 35% in deforestation rates (Heilmayr et al., 2020).

The civil society representative pointed out that the success of the soy moratorium is usually assessed against a single indicator, i.e. deforestation, which limits our understanding of how the initiative affected other important dimensions, such as biodiversity and human welfare. However, recent and yet unpublished studies on the health effects of soy expansion in Brazil suggest potential relationships with birth outcomes and respiratory diseases that merit further research (Damm et al., 2021; Dias et al., 2019).

The soy moratorium is the best-known multi-stakeholder voluntary commitment to halt deforestation, but similar commitments have been made in the cattle sector with encouraging results, such as positive effects on the sector's productivity (Moffette et al., 2021). Often voluntary commitments are made by companies unilaterally, however. Unilateral commitments often vary in how they define forests, what system is used for monitoring, and in terms of transparency and accountability. This was pointed out by the respondents in our semi-structured interviews as a major shortcoming in voluntary commitments[7]. All respondents saw these unilateral commitments as eventually effective in reducing exposure to environmental risks in supply chains, but limited in their potential to halt deforestation at regional scale. A recent study analysed the effect of zero-deforestation commitments of some of the major soy traders in Brazil and did not find evidence of reduced risk of deforestation in the supply chain of these companies after they have signed their commitments (Ermgassen et al., 2020). These commitments have also been criticized for their potential of enhancing inequalities in rural areas when companies do not provide sufficient support for those farmers who might not have enough financial and educational capacity to adapt to new industry requirements (Grabs et al., 2021).

3.2. Sustainability standards

The adoption and certification of sustainability standards (e.g., Rainforest Alliance, Organic, Fairtrade, RSPO, and RTRS) is often linked to voluntary commitments, as companies usually use the share of certified products they commercialize as an indicator for their sustainability performance. Representatives of the stakeholder dialogue platform, GIZ, and retailing emphasized certification under sustainability standards as one among the most frequently discussed demand-side governance strategies. There are currently several certification schemes that are compliant with the guidelines of the European Feed Manufacturer's Federation (FEFAC) (for an overview of the main standards, see

7 For a brief overview of selected unilateral voluntary commitments, see Table A4 in the appendix.

Table A5 in the appendix). According to recent studies by the Thünen-Institute and Profundo, the International Sustainability and Carbon Certificate (ISCC) and the DonauSoja/Europe Soya standards ranked highest in terms of conservation of ecosystems, good agricultural practice, social criteria, traceability and auditing systems (Hargita et al., 2019; Kusumaningtyas & van Gelder, 2019).

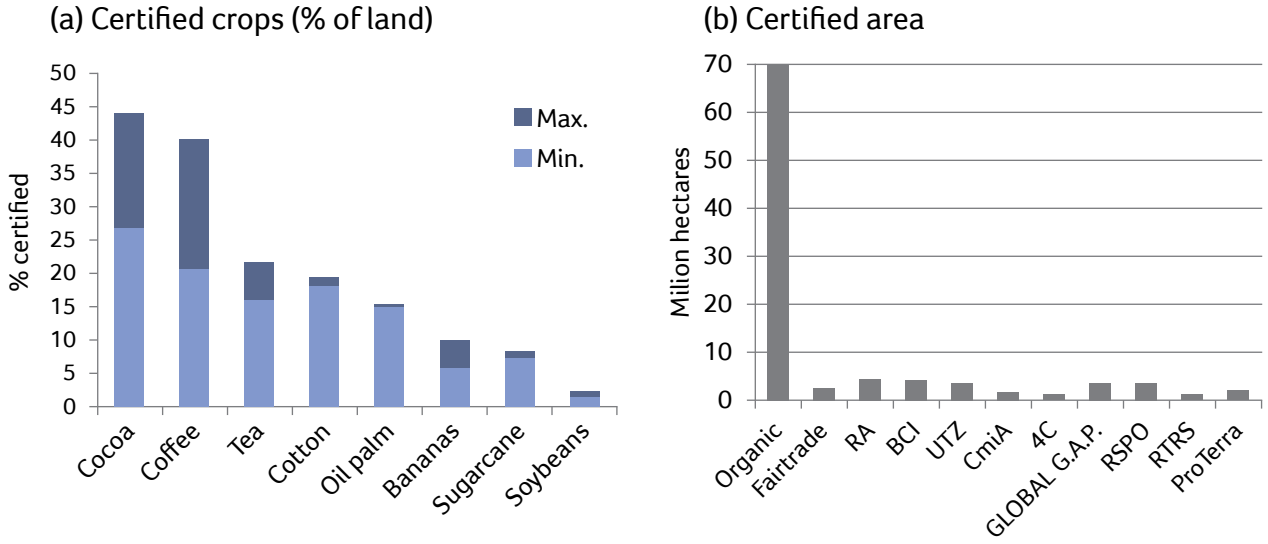
A vast literature analyses whether sustainability standards deliver on their promises. This literature covers many different combinations of countries, crops, and labels (Oya et al., 2018). Although there is not much evidence on soy-specific standards, some studies suggested that the adoption of multi-stakeholder standards, such as RTRS, could have significant benefits in preventing the conversion of native vegetation conversion, especially in regions with less stringent national standards[8] and environmental policies (Garrett et al., 2016). German stakeholders seemed to assume that certification always leads to positive outcomes. However, it is important to note that the scientific evidence on the effects of standards is rather mixed (DeFries et al., 2017). Several recent studies have emphasized that the context matters (Meemken, 2020) and that effects might also vary depending on how well organized second-tier organizations (e.g. cooperatives) are (Sellare et al., 2020).

Our respondents pointed out that companies often adopt certification to signal to consumers that their supply chains are clean. Still, most respondents considered certification a weak instrument, because it is difficult to scale up due to lack of market demand. The current share of certified soy production is too low to have a tangible effect on deforestation rates. These issues are also well-documented in the scientific literature. Only around 2% of all agricultural land in the world is certified (1.6% of the total land used for soy is certified, most of it under RTRS, ProTerra, and Organic standards) (Figure 7) and yet the supply of certified products greatly exceeds demand, thus signalling that the price premium for certified products often exceed the willingness to pay of global consumers (Meemken et al., 2021), even among those who are aware of and engaged in sustainability issues (Isenhour, 2014). Low rates of certification come with the risk that certification remains non-additional, for example, when certified products are preferentially sourced from regions that already comply with social and environmental standards even before the introduction of sustainability standards (Dietz & Grabs, 2021). Furthermore, the independent auditing systems of sustainability standards also have their problems. Fraud

8 National standards led by governments or local business actors have also been criticized for trying to replace standards created by international multistakeholder platforms (e.g., RSPO and RTRS) while being more permissive with large-scale producers. For more on this, see Hospes (2014).

is not uncommon (Lau et al., 2020) and auditors only verify a small sample of certified farms (usually those that are closest to cooperative headquarters and easier to reach), with some certified farmers claiming that they have never been visited by auditors (Ansah et al., 2020; Schilling-Vacaflor et al., 2021).

Figure 7 – Proliferation of sustainably certified soybeans



Source: Adapted from Meemken et al. (2021).

3.3. Due diligence laws

Due diligence laws move beyond voluntary standards and certification schemes by making companies legally liable for non-compliance with defined social and/or environmental minimum standards. As such, due diligence laws can create synergies with the two measures discussed above by creating incentives to adopt third-party verified sustainability standards. In our semi-structured interviews, respondents did not give much emphasis to due diligence laws, however. This is perhaps because the recently approved German due diligence law does not address the most important soy-related environmental issues, despite corresponding demands from the civil society. National due diligence laws were met with criticism by retailers and the processing industry, who often operate in several European countries and fear competitive disadvantages and high transaction costs under a patch-worked legislative landscape. However, all respondents saw benefits of an EU-level due diligence law, as it could harmonize requirements in Europe (including in terms of the standards that should be applied) and could help increase coordination between European companies while sending a strong signal to producing countries and importers in Asia who might be less concerned with sourcing deforestation-free commodities.

We could not identify any scientific study that quantifies the effects of due diligence laws on the purchasing behaviour of firms, nor on socioeconomic and environmental outcomes in producing countries. Existing studies focused on legal aspects of due diligence laws, such as the French Duty of Care Act (Aczel, 2021). However, some researchers argued that an EU due diligence law could help integrate sustainability issues into mainstream corporate governance and that the EU should seek to include criteria beyond human rights violations (Sjåfjell, 2020).

3.4. International transfers for conditional compensation

The idea of implementing a system for international transfers for conditional compensation was prominent in dialogues with the Cerrado Working Group until 2020. However, the representative from the GIZ hypothesised that the idea might have failed for three reasons: 1) there were not enough donors willing to contribute; 2) the implementation structure and the criteria to decide who would be entitled to these transfers were not clear[9]; and 3) the Brazilian Association of Soy producers (APROSOJA) feared the initiative could become a new soy moratorium for the Cerrado. Representatives from OVID and retailers said that this approach is conceptually very appealing, but they were sceptical about the feasibility of establishing a functioning market for these conditional transfers, especially at a large scale.

These challenges identified by German stakeholders are often discussed in the scientific literature on results-based payment systems, such as payments for ecosystem services (PES) and REDD+ projects more broadly. Lack of finance, and questions about what to pay for, to whom and based on what reference levels are considered reasons that prevented results-based payments to effectively function at scale (Angelsen et al., 2018).

In Brazil, some PES pilots were successful in fostering forest regeneration, but these effects materialized reportedly slow and small in magnitude (Ruggiero et al., 2019). This raises questions about how cost-effective PES are in comparison to other conservation policy options. Contextual factors that might be conducive to cost-effective PES schemes, such as well-established property rights and low levels of pre-program compliance are also likely to affect the cost-effectiveness of alternative policy tools (Börner et al., 2020).

9 According to OVID, ABIOVE proposed a clear and transparent, and voluntary structure to provide compensations for farmers. However, they argue that the initiative failed because NGOs and retailers wanted to make it mandatory for farmers to accept the compensations.

Furthermore, different payment designs (e.g., auctions versus fixed payments) and to what extent PES programs align with pre-existing regulatory policies (thus creating an effective policy mix) are important factors that can determine the success or failure of a PES (Börner et al., 2017; Lundberg et al., 2018).

3.5. Other governance options

Beyond the most commonly discussed governance options above some companies and research organizations experiment with offsetting schemes. Offsetting is a common approach to reduce environmental impacts, for example, in terms of carbon emissions or biodiversity loss (Apostolopoulou & Adams, 2017). Instead of certifying product-specific attributes, offsetting usually relies on the certification of investments in impact reducing activities (often in other than the sourcing regions) that compensate for the negative impacts linked to a product of interest[10]. As such, offsetting has the potential to reduce the additionality gap in certification schemes (see section 3.2) by targeting investments to problematic sourcing regions. Recent work, however, suggested that offsetting schemes can also prominently fail to do so (West et al., 2020).

In our interviews, participants also commented on the scenario of an excise tax on soy imports. Excise taxes are a consumption-based taxation levied on domestic consumers or importers. In its simplest form, countries could use a uniform tax rate on imported products based on their average environmental footprint, including tax deductions for third party certified products (Pigato, 2019). As a fundraising mechanism, excise taxes could thus also be combined with offsetting. Most respondents were unfamiliar with the concept and reactions were mixed including supportive and sceptical comments.

3.6. Main challenges and barriers

Regarding the main challenges and barriers for an effective implementation of the proposals discussed above, the lack of coordination between stakeholders was a recurring topic. Our respondents pointed out that voluntary commitments have very limited potential for impact when companies set their commitments individually rather than collectively.

10 The Donau Soja Initiative (https://www.donausoja.org/en/home/), for example, allows retailers to offset the potentially negative effects on tropical forests of soy in their value chains.

According to the civil society representative, the biggest buyers have enough market power to implement a proposal for other biomes akin to the Amazon soy moratorium, if they wished. It has been estimated that such an agreement to prevent the conversion of native vegetation to cropland in the Cerrado would prevent the loss of 3.6 Mha of native vegetation (Soterroni et al., 2019). Representatives from OVID, however, believe that the socioeconomic context in other parts of the country (e.g., population density, environmental regulations, and market structure), would make moratoria for other biomes unfeasible.

More coordination between buyers could also improve transparency and monitoring in their value chains. Some respondents pointed out that supply chains mix across companies and that companies often share storage facilities. Increased coordination could thus help unify industry standards, facilitate information sharing among suppliers, and enable the segregation of supply chains by origin and standards. However, representatives from the dialogue platform emphasized that unified commitments and collective implementation are difficult to achieve. The use of GMOs and gene-editing technologies is often one of the main sources of disagreement and position papers usually only go as far as describing broad guidelines that represent the smallest common denominator[11].

Lack of coordination at the EU level is also seen as a major barrier to increase sustainability in soy supply chains. The OVID representatives pointed out that frequent priority shifts in the European discourse tend to be perceived as inconsistent and erratic from a Brazilian perspective. Because individual European countries account for only small shares of Brazilian soy exports, a unified European approach is considered a precondition to transform South American soy production systems towards more sustainability.

3.7. The role of consumers, NGOs, and alternatives to soy

When questioned about the importance of consumers and NGOs in influencing the purchasing behaviour of German importers, our respondents usually referred to the case of palm oil. Campaigns spearheaded by NGOs and pressure from consumers in developed countries have led several palm oil traders to make zero-deforestation commitments (Lyons-White & Knight, 2018). This has not yet happened to the same extent in the soy sector even though reports of the 2019 Amazon forest fires effectively raised public

11 See, for example, the position paper of the *Forum nachhaltigere Eiweißfuttermittel* (FONEI, 2021).

awareness. Some respondents argued that it is challenging to raise consumer awareness about soy, because it is mostly used as a "hidden" ingredient in animal feed. Nonetheless, all our respondents agreed that the civil society has an important role to play, especially in pushing companies to go beyond initiatives that simply aim to clean their own supply chains.

Regarding alternatives to soy, most respondents agreed that reduced meat consumption represents a potential solution, but drastic changes in food preferences were considered unlikely in the near future. Nevertheless, respondents mentioned that alternative protein sources, such as sunflower seeds, lupine, rapeseed, and peas have an important role to play as partial substitutes for soy-based feed. Representatives from the dialogue platform noted that significant knowledge and technology gaps are still in the way of leveraging the potential of alternative protein sources despite multiple promising pilot initiatives.

4. Conclusions and policy recommendations

We have provided an overview of the status quo of soy imports from Brazil to Germany and how these relate to various sustainability issues, such as deforestation, GHG emissions, and biodiversity loss. Furthermore, we have discussed some of the main proposals to improve governance sustainability in soy supply chains, both from the perspective of the scientific community and from the perspective of German stakeholders.

Although Germany has been reducing its reliance on Brazilian soy since 2010, the Brazilian market is still relatively more important to Germany than the German market is to Brazil. German stakeholders are extremely well informed about the sustainability issues related to soy production and common proposals to increase sustainability in the related supply chains. The experience from dialogue platforms, however, point to limitations of voluntary action when participation is motivated primarily by an interest in reducing exposure to business risk. Individual importers and retailers can, in principle, achieve this goal by sourcing from low-risk regions in Brazil or other soy producing countries without tangible effects on global deforestation rates or other soy-related sustainability issues.

Strategies to further enhance sustainability in German soy supply chains may benefit from mainstreaming two principles, namely: (1) coordinated action at EU level and (2) focus on sustainability outcomes rather than product-specific approaches aimed at reducing sustainability risk exposure. Specifically, we propose the following action points:

Coordination and joint commitments at EU level and beyond

Given the relatively small market share that individual EU countries have in Brazil's soy exports, unilateral approaches from single European countries are unlikely to exert transformative impacts. Increased coordination of action and communication at EU level, for example, based on the EU Farm-to-Fork and Biodiversity Strategies and on the upcoming legislative proposal on forest protection and degradation would coherently

signal producers in Brazil and beyond that access to the European market requires, at the minimum, compliance with national environmental legislation. Furthermore, coordinated pressure from the EU and its international partners (including the civil society) could leverage more binding sustainability commitments among soy producers, traders, and eventually also providers of agricultural inputs and technology packages.

Leveraging demand for deforestation-free soy

Although concerns with sustainability issues in soy supply chains have been increasing, sizeable volumes of unsustainably produced soy still reach the European market. Consumption-based or excise taxes levied at EU level based on average footprints would not only discourage imports of unsustainable soy. Such taxes can also raise funds for results-based payments or offsetting projects and represent incentives for producers to get certified or otherwise invest in more sustainable practices and technologies to reduce impact.

Linking demand for deforestation-free soy to initiatives that combat forest loss

Despite the known caveats of results-based payments and offsetting mechanisms, the current evidence based suggests that they can be at least as effective as conventional command-and-control based forest conservation policies (Wunder et al., 2020). Consumers, traders, and retailers with a genuine interest in reducing deforestation could thus win if their willingness to pay were channelled directly to where the problem occurs, either through offsetting or via direct REDD+ type arrangements, such as the Amazon Fund[12].

Evidence-based experimentation with innovative governance solutions

Despite mounting emphasis on rigorous evaluations of environmental and conservation initiatives, important knowledge gaps remain with respect to what works and what does not on value chain governance. Due diligence laws are particularly under researched (clearly also due to a lack of real-world cases), but evidence gaps also prevail with regard to how and under which conditions digital innovations, such as cloud-based traceability systems and blockchain technology, could revolutionize transparency and accountability in value chains. Public funding for research and innovation action should thus encourage systematic experimentation with institutional and technological innovation across all

12 http://www.amazonfund.gov.br/en/home/

segments of commodity value chains conditional on adherence to rigorous evaluation protocols.

Sustainable bioeconomy leadership

Germany could lead EU level and global efforts to reducing the negative social and environmental impacts associated with commodity trade and soy production in particular. As one of the historically most important international players in international cooperation on the conservation of tropical forests, Germany maintains excellent relationships with relevant public and private stakeholders in soy producing countries and can build on decades of experience on the ground. Such leadership can be informed by a growing domestic bioeconomy and sustainability research landscape and must effectively advocate for a balanced portfolio of governance measures at both the demand and the supply side.

5. References

Aczel, M. R. (2021). Justice without borders: Opportunities from France's 'Duty of Care' Act applied to Uganda. *Energy Research & Social Science*, *75*, 102034. https://doi.org/10.1016/j.erss.2021.102034

ADM. (2021). *Policy to Protect Forests, Biodiversity and Communities*. ADM. https://assets.adm.com/Sustainability/ADM-No-Deforestation-Policy_210323_141338.pdf

ADP. (2019). *Overview European National Soya Initiatives with a Focus on ADP Countries*. Amsterdam Declaration Partnership (ADP). https://ad-partnership.org/wp-content/uploads/2019/10/ADP-Overview-Soya-commitments-and-soya-initiatives-in-European-countries-v2019-0409.pdf

Agrosatélite. (2021). *Cerrado Soy Dynamics with Focus on the 61 Priority Municipalities Updated for Crop Year 2019/20 vs. PRODES 2014-2019*. Agrosatélite. https://wbcsdpublications.org/scf/wp-content/uploads/2021/06/Soy_Dynamic_2019-20_AGROSATELITE_SCF_V1.pdf

Angelsen, A., Martius, C., De Sy, V., Duchelle, A. E., Larson, A. M., & Thuy, P. T. (2018). *Transforming REDD+: Lessons and new directions*. Center for International Forestry Research (CIFOR).

Ansah, E. O., Kaplowitz, M. D., Lupi, F., & Kerr, J. (2020). Smallholder participation and procedural compliance with sustainable cocoa certification programs. *Agroecology and Sustainable Food Systems*, *44*(1), 54–87. https://doi.org/10.1080/21683565.2019.1579776

Apostolopoulou, E., & Adams, W. M. (2017). Biodiversity offsetting and conservation: Reframing nature to save it. *Oryx*, *51*(1), 23–31. https://doi.org/10.1017/S0030605315000782

Azevedo, A. A., Rajão, R., Costa, M. A., Stabile, M. C. C., Macedo, M. N., Reis, T. N. P. dos, Alencar, A., Soares-Filho, B. S., & Pacheco, R. (2017). Limits of Brazil's Forest Code as a means to end illegal deforestation. *Proceedings of the National Academy of Sciences*, *114*(29), 7653–7658. https://doi.org/10.1073/pnas.1604768114

Börner, J., Baylis, K., Corbera, E., Ezzine-de-Blas, D., Honey-Rosés, J., Persson, U. M., & Wunder, S. (2017). The Effectiveness of Payments for Environmental Services. *World Development*, *96*, 359–374. https://doi.org/10.1016/j.worlddev.2017.03.020

Börner, J., Schulz, D., Wunder, S., & Pfaff, A. (2020). The Effectiveness of Forest Conservation Policies and Programs. *Annual Review of Resource Economics*, *12*(1), 45–64. https://doi.org/10.1146/annurev-resource-110119-025703

Bunge. (2021). *Soy from South America: Our 10th Progress Report*. Bunge. https://www.bunge.com/sites/default/files/10th_soy_progress_report.pdf

Damm, Y., Börner, J., & Gerber, N. (2021). *Health Effects of the Amazon Soy Moratorium*. 26th Annual Conference of the European Association of Environmental and Resource Economists, Berlin.

DeFries, R. S., Fanzo, J., Mondal, P., Remans, R., & Wood, S. A. (2017). Is voluntary certification of tropical agricultural commodities achieving sustainability goals for small-scale producers? A review of the evidence. *Environmental Research Letters*, *12*(3), 033001. https://doi.org/10.1088/1748-9326/aa625e

Dias, M., Rocha, R., & Soares, R. R. (2019). *Glyphosate Use in Agriculture and Birth Outcomes of Surrounding Populations* (SSRN Scholarly Paper ID 3390151). Social Science Research Network. https://papers.ssrn.com/abstract=3390151

Dietz, T., & Grabs, J. (2021). Additionality and Implementation Gaps in Voluntary Sustainability Standards. *New Political Economy*, *0*(0), 1–22. https://doi.org/10.1080/13563467.2021.1881473

Ermgassen, E. K. H. J. zu, Ayre, B., Godar, J., Lima, M. G. B., Bauch, S., Garrett, R., Green, J., Lathuillière, M. J., Löfgren, P., MacFarquhar, C., Meyfroidt, P., Suavet, C., West, C., & Gardner, T. (2020). Using supply chain data to monitor zero deforestation commitments: An assessment of progress in the Brazilian soy sector. *Environmental Research Letters*, *15*(3), 035003. https://doi.org/10.1088/1748-9326/ab6497

Escobar, N., Tizado, E. J., zu Ermgassen, E. K. H. J., Löfgren, P., Börner, J., & Godar, J. (2020). Spatially-explicit footprints of agricultural commodities: Mapping carbon emissions embodied in Brazil's soy exports. *Global Environmental Change*, *62*, 102067. https://doi.org/10.1016/j.gloenvcha.2020.102067

European Commission. (2013). *The impact of EU consumption on deforestation: Comprehensive analysis of the impact of EU consumption on deforestation* (No. 063; Technical Report). European Commission. https://ec.europa.eu/environment/forests/pdf/1.%20Report%20analysis%20of%20impact.pdf

European Commission. (2021). *EU Oilseeds and protein crops Trade 2020/21 Marketing Year July—March*. European Commission.

Fliehr, O. (2013). *Analysis of transportation and logistics processes for soybeans in Brazil: A case study of selected production regions* (No. 4; Thünen Working Paper). Thünen Institute. https://www.thuenen.de/media/publikationen/thuenen-workingpaper/ThuenenWorkingPaper_04.pdf

FONEI. (2021). *Positionierung des „Forums nachhaltigere Eiweißfuttermittel" zu nachhaltigeren Eiweißfuttermitteln*. Forum Nachhaltigere Eiweißfuttermittel. https://www.eiweissforum.de/uploads/tx_bleinhaltselemente/Positionspapier_final_Stand_21_04_2021.pdf

Fuchs, R., Brown, C., & Rounsevell, M. (2020). Europe's Green Deal offshores environmental damage to other nations. *Nature*, *586*(7831), 671–673. https://doi.org/10.1038/d41586-020-02991-1

Garrett, R. D., Carlson, K. M., Rueda, X., & Noojipady, P. (2016). Assessing the potential additionality of certification by the Round table on Responsible Soybeans and the Roundtable on Sustainable Palm Oil. *Environmental Research Letters*, *11*(4), 045003. https://doi.org/10.1088/1748-9326/11/4/045003

Gibbs, H. K., Rausch, L., Munger, J., Schelly, I., Morton, D. C., Noojipady, P., Soares-Filho, B., Barreto, P., Micol, L., & Walker, N. F. (2015). Brazil's Soy Moratorium. *Science*, *347*(6220), 377–378. https://doi.org/10.1126/science.aaa0181

Grabs, J., Cammelli, F., Levy, S. A., & Garrett, R. D. (2021). Designing effective and equitable zero-deforestation supply chain policies. *Global Environmental Change*, *70*, 102357. https://doi.org/10.1016/j.gloenvcha.2021.102357

Green, J. M. H., Croft, S. A., Durán, A. P., Balmford, A. P., Burgess, N. D., Fick, S., Gardner, T. A., Godar, J., Suavet, C., Virah-Sawmy, M., Young, L. E., & West, C. D. (2019). Linking global drivers of agricultural trade to on-the-ground impacts on biodiversity. *Proceedings of the National Academy of Sciences*, *116*(46), 23202–23208. https://doi.org/10.1073/pnas.1905618116

Gregory, M., & Polsterer, N. (2017). *Agriculture and deforestation: The EU Common Agricultural Policy, soy, and deforestation*. Fern. https://www.fern.org/fileadmin/uploads/fern/Documents/Fern%20CAP%20SUMMARY%20FINAL_0.pdf

Hargita, Y., Hinkes, C., Bick, U., & Peter, G. (2019). *Entwaldungsfreie Agrarrohstoffe—Analyse relevanter Soja-Zertifizierungssysteme für Futtermittel* (No. 98; Thünen Working Paper). Thünen Institute. https://www.thuenen.de/media/publikationen/thuenen-workingpaper/ThuenenWorkingPaper_98.pdf

Heilmayr, R., Rausch, L. L., Munger, J., & Gibbs, H. K. (2020). Brazil's Amazon Soy Moratorium reduced deforestation. *Nature Food*, *1*(12), 801–810. https://doi.org/10.1038/s43016-020-00194-5

Hospes, O. (2014). Marking the success or end of global multi-stakeholder governance? The rise of national sustainability standards in Indonesia and Brazil for palm oil and soy. *Agriculture and Human Values*, *31*(3), 425–437. https://doi.org/10.1007/s10460-014-9511-9

IDH. (2020). *European Soy Monitor—Insights on European responsible and deforestation-free soy consumption in 2018*. Sustainable Trade Initiative (IDH). https://www.idhsustainabletrade.com/uploaded/2020/05/IDH-European-Soy-Monitor-v2.pdf

Isenhour, C. (2014). Trading Fat for Forests: On Palm Oil, Tropical Forest Conservation, and Rational Consumption. *Conservation and Society*, *12*(3), 257–267.

Kranthi, K. R., & Stone, G. D. (2020). Long-term impacts of Bt cotton in India. *Nature Plants*, *6*(3), 188–196. https://doi.org/10.1038/s41477-020-0615-5

Kusumaningtyas, R., & van Gelder, J. W. (2019). *Setting the bar for deforestation-free soy in Europe: A benchmark to assess the suitability of voluntary standard systems*. Profundo.

Lau, H., Shum, P. K. C., Nakandala, D., Fan, Y., & Lee, C. (2020). A game theoretic decision model for organic food supplier evaluation in the global supply chains. *Journal of Cleaner Production*, *242*, 118536. https://doi.org/10.1016/j.jclepro.2019.118536

Lenfert, Z. M., & Börner, J. (2017). *Soybean certification and tropical deforestation in Brazil: How to move towards zero-net deforestation* (No. 28; ZEF Policy Brief). Center for Development Research (ZEF). https://www.zef.de/uploads/tx_zefportal/Publications/Policy_brief_28_en.pdf

Lopes, M. (2019). Investment funds managing $16 trillion urge companies in Brazil to fight Amazon deforestation. *The Washington Post*. https://www.washingtonpost.com/world/the_americas/investment-funds-managing-16-trillion-urge-companies-in-brazil-to-fight-deforestation/2019/09/19/08174706-dae6-11e9-a1a5-162b8a9c9ca2_story.html

Lundberg, L., Persson, U. M., Alpizar, F., & Lindgren, K. (2018). Context Matters: Exploring the Cost-effectiveness of Fixed Payments and Procurement Auctions for PES. *Ecological Economics*, *146*, 347–358. https://doi.org/10.1016/j.ecolecon.2017.11.021

Lyons-White, J., & Knight, A. T. (2018). Palm oil supply chain complexity impedes implementation of corporate no-deforestation commitments. *Global Environmental Change*, *50*, 303–313. https://doi.org/10.1016/j.gloenvcha.2018.04.012

Meemken, E.-M. (2020). Do smallholder farmers benefit from sustainability standards? A systematic review and meta-analysis. *Global Food Security*, *26*, 100373. https://doi.org/10.1016/j.gfs.2020.100373

Meemken, E.-M., Barrett, C. B., Michelson, H. C., Qaim, M., Reardon, T., & Sellare, J. (2021). Sustainability standards in global agrifood supply chains. *Nature Food*, *2*(10), 758–765. https://doi.org/10.1038/s43016-021-00360-3

Moffette, F., Skidmore, M., & Gibbs, H. K. (2021). Environmental policies that shape productivity: Evidence from cattle ranching in the Amazon. *Journal of Environmental Economics and Management*, *109*, 102490. https://doi.org/10.1016/j.jeem.2021.102490

OEC. (2021). *Soybeans (HS: 1201) Product Trade, Exporters and Importers*. Observatory of Economic Complexity (OEC). https://app-ant.oec.world/en/profile/hs92/soybeans

Oya, C., Schaefer, F., & Skalidou, D. (2018). The effectiveness of agricultural certification in developing countries: A systematic review. *World Development*, *112*, 282–312. https://doi.org/10.1016/j.worlddev.2018.08.001

Pigato, M. A. (2019). *Fiscal Policies for Development and Climate Action* (International Development in Focus). World Bank. https://openknowledge.worldbank.org/bitstream/handle/10986/31051/9781464813580.pdf?sequence=4&isAllowed=y

Qaim, M. (2020). Role of New Plant Breeding Technologies for Food Security and Sustainable Agricultural Development. *Applied Economic Perspectives and Policy*, *42*(2), 129–150. https://doi.org/10.1002/aepp.13044

Rajão, R., Soares-Filho, B., Nunes, F., Börner, J., Machado, L., Assis, D., Oliveira, A., Pinto, L., Ribeiro, V., Rausch, L., Gibbs, H., & Figueira, D. (2020). The rotten apples of Brazil's agribusiness. *Science*, *369*(6501), 246–248. https://doi.org/10.1126/science.aba6646

Ruggiero, P. G. C., Metzger, J. P., Reverberi Tambosi, L., & Nichols, E. (2019). Payment for ecosystem services programs in the Brazilian Atlantic Forest: Effective but not enough. *Land Use Policy*, *82*, 283–291. https://doi.org/10.1016/j.landusepol.2018.11.054

Salin, D. (2021). *Soybean Transportation Guide: Brazil 2020*. U.S. Dept. of Agriculture, Agricultural Marketing Service. http://dx.doi.org/10.9752/TS048.08-2021

Schilling-Vacaflor, A., Lenschow, A., Challies, E., Cotta, B., & Newig, J. (2021). Contextualizing certification and auditing: Soy certification and access of local communities to land and water in Brazil. *World Development*, *140*, 105281. https://doi.org/10.1016/j.worlddev.2020.105281

Sellare, J., Meemken, E.-M., Kouamé, C., & Qaim, M. (2020). Do Sustainability Standards Benefit Smallholder Farmers Also When Accounting For Cooperative Effects? Evidence from Côte d'Ivoire. *American Journal of Agricultural Economics*, *102*(2), 681–695. https://doi.org/10.1002/ajae.12015

Sjåfjell, B. (2020). Sustainable Value Creation Within Planetary Boundaries—Reforming Corporate Purpose and Duties of the Corporate Board. *Sustainability*, *12*(15), 6245. https://doi.org/10.3390/su12156245

Song, X.-P., Hansen, M. C., Potapov, P., Adusei, B., Pickering, J., Adami, M., Lima, A., Zalles, V., Stehman, S. V., Di Bella, C. M., Conde, M. C., Copati, E. J., Fernandes, L. B., Hernandez-Serna, A., Jantz, S. M., Pickens, A. H., Turubanova, S., & Tyukavina, A. (2021). Massive soybean expansion in South America since 2000 and implications for conservation. *Nature Sustainability*, 1–9. https://doi.org/10.1038/s41893-021-00729-z

Soterroni, A. C., Ramos, F. M., Mosnier, A., Fargione, J., Andrade, P. R., Baumgarten, L., Pirker, J., Obersteiner, M., Kraxner, F., Câmara, G., Carvalho, A. X. Y., & Polasky, S. (2019). Expanding the Soy Moratorium to Brazil's Cerrado. *Science Advances*, *5*(7), eaav7336. https://doi.org/10.1126/sciadv.aav7336

Statista. (2020). *Soja und Sojaprodukte*. https://de.statista.com/statistik/studie/id/78393/dokument/soja-und-sojaprodukte/

Strassburg, B. B. N., Brooks, T., Feltran-Barbieri, R., Iribarrem, A., Crouzeilles, R., Loyola, R., Latawiec, A. E., Oliveira Filho, F. J. B., Scaramuzza, C. A. de M., Scarano, F. R., Soares-Filho, B., & Balmford, A. (2017). Moment of truth for the Cerrado hotspot. *Nature Ecology & Evolution*, *1*(4), 1–3. https://doi.org/10.1038/s41559-017-0099

Trase. (2018). *Trase Yearbook 2018, Sustainability in forest-risk supply chains: Spotlight on Brazilian soy*. Transparency for Sustainable Economies, Stockholm Environment Institute and Global Canopy. http://resources.trase.earth/documents/TraseYearbook2018.pdf

WBCSD. (2021). *Soft Commodities Forum progress report: Towards deforestation-free soy.* World Business Council for Sustainable Development. https://www.wbcsd.org/contentwbc/download/12360/184581/1

West, T. A. P., Börner, J., Sills, E. O., & Kontoleon, A. (2020). Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon. *Proceedings of the National Academy of Sciences*. https://doi.org/10.1073/pnas.2004334117

Win, T. L. (2020). Big investors fall short on policies to halt Amazon deforestation. *Reuters*. https://www.reuters.com/article/global-deforestation-brazil-investment-idINL4N2GS1WR

Wunder, S., Börner, J., Ezzine-de-Blas, D., Feder, S., & Pagiola, S. (2020). Payments for Environmental Services: Past Performance and Pending Potentials. *Annual Review of Resource Economics*, *12*(1), 209–234. https://doi.org/10.1146/annurev-resource-100518-094206

6. Appendix

Table A1 – Overview of the main European national soy-related alternatives

Country	Name of the soya initiative	Commitment (statement, cut-off date, target date)	Starting date	Participants (#, estimated share of market)	Role of government	Monitoring (indicators, which standards)
Austria	Donau Soja Association (initiative dominant in Austria)	Donau Soja promotes a sustainable and European protein supply; Cut-off date deforestation: 1 January 2008; Donau Soja generally allows cultivation only on land that is dedicated to agricultural use since minimum 2008.	2012	280 members in 22 countries, no figure of market share available, but list of members: http://www.donausoj a.org/en/become-a-member/presentatio n-of-members/	No official role by governments. 18 ministers signed the Europe Soya declaration	All 3 standards (Donau Soja, Europe Soya and Danube Region Non GM standard) are controlled by independent certification bodies accredited to ISO 17065
Denmark	Working group on responsible soy	No commitment concrete commitments yet. Sub-working group has just been established (January 2019) to look into potential models for further development, incl. potentially a commitment.	2017	Approx. 15 participants, including retailers, business associations, NGOs, ministry of food and environment, etc.	Participating.	RTRS, ProTerra, ISCC.
France	Alliance pour la préservation des forets	'Charte d'engagement' under development	2018	Membership: 8 private companies (Unilever, Nestle, Ferrero, Cerelia, etc) and 2 federations (ANIA, Alliance7)		At least once a year, starting with palm oil and considering extending to other commodities, the Alliance collects from its members information regarding non-deforestation.

Country	Name of the soya initiative	Commitment (statement, cut-off date, target date)	Starting date	Participants (#, estimated share of market)	Role of government	Monitoring (indicators, which standards)
Germany	Dialogforum nachhaltigere Eiweißfuttermittel	Aims to reach 100% certified soya; No agreement yet on which certification systems to accept (all accredited under FEFAC or less).	2014	App. 60 actors from feed and food industry, agriculture, NGOs, retailer, administrations; Market share not known yet.	Funding the forum, participation in steering committee and plenary (no voting right)	Not yet.
Netherlands	Dutch Soy Working Group	Dutch consumption is covered by RTRS.	2010	All supply chain stakeholders	Supporting and convening.	Dutch Soy Barometer: In 2013, 100% RTRS soya for Dutch direct consumption, covers 25% of total import. Rest is FEFAC Soy Sourcing Guidelines.
	Dutch Soy Platform Initiative	Achieve further uptake of responsible deforestation free soy within Dutch use and use of European/ international connections of Dutch based actors.	2018	Retail, feed sector, farmers association, trade initiatives, traders, government, NGOs dairy	Co-hosting and participating: Ministries of Agriculture Nature and Food Security (co-host), and Ministry of Foreign Affairs.	8 million tons of deforestation free soy by 2023 is a symbolic indicator for our influence as this volume enters the Dutch harbors. However, it is not yet possible to certify this as physical soy. Bridge building between different streams of work is an important function of the Dutch Platform. Further actions and indicators of progress to be developed during

Country	Name of the soya initiative	Commitment (statement, cut-off date, target date)	Starting date	Participants (#, estimated share of market)	Role of government	Monitoring (indicators, which standards)
Norway	Norwegian Soy Initiative	Zero deforestation supply chains: "Effective immediately, we pledge our soy supplies originating from South America and any other rainforest country to be deforestation-free as per reputable certification standard such as ProTerra. The zero deforestation pledge applies to rainforests as well as other high conservation ecosystems."	2015	Five major Norwegian food and feed companies		100% ProTerra by the committed companies. Seems to be 80% of total import.
Sweden	The Swedish Soy Dialogue	Members ensure that all soya used directly or indirectly (i.e. "embedded soya" in feed) for which the company can be hold accountable (i.e. private labels), shall be responsibly produced.	2012	Approx. 50 Swedish feed companies, food companies, food retailers, association organisations and NGOs. See: www.sojadialogen.se	First and foremost a business/ company network	Certification standards RTRS or ProTerra. Verification method developed by Swedish Soy Dialogue. The commitment is voluntary and progress towards the commitment is publicly reported on the members' websites and in their sustainability reports.
Switzerland	The Swiss Soy network	The association supports the cultivation, the purchase and use of certified and responsibly produced soy. The aim of the network is for at least 90% of soy for the Swiss market to be responsibly produced		31 members, covering soy buyers, producer associations, label and environmental organizations, manufacturers, and retailers		Network sourced 99% from sustainable sources in 2017. This accounted for 96% of the Swiss market.

Country	Name of the soya initiative	Commitment (statement, cut-off date, target date)	Starting date	Participants (#, estimated share of market)	Role of government	Monitoring (indicators, which standards)
United Kingdom	UK Roundtable on Sustainable Soy	Commitment being formulated. The RT aims to provide a pre-competitive space for companies and industry associations to work together to achieve a shared goal of a secure, resilient, sustainable supply of soy to the UK, with joint progress	2018	See: http://www.efeca.com/the-uk-roundtable-on-sustainable-soya/	UK's Department for Business, Energy and Industrial Strategy alongside DFID and Defra Involved	Annual report

Source: Adapted from ADP (2019).

Table A2 – Summary of the main points raised by respondents in the semi-structured interviews

	OVID	Multi-stakeholder dialogue platform	Civil society	GIZ	Retailer
Main sustainability issues	Deforestation; Land use rights; Conflict with indigenous communities; GMOs (public perspective); Agronomic practices (e.g., pesticides, water use)	Deforestation; Differentiation between legal and illegal deforestation	Deforestation; GMOs and pesticide use (highly intense commercial agriculture); Destruction of natural habitats and loss of biodiversity	Deforestation; Changes in ecosystems; Land rights; Forced displacements; Conflict with indigenous communities	Deforestation; Climate change; Land grabbing; Pesticides; Biodiversity loss
Main proposal to govern soy value chain	Soy moratorium was very successful, but the expansion of a similar moratoria to other biomes is neither feasible nor advisable;	Certification under sustainability standards is the option most often discussed	Soy moratorium was the only effective private sector initiative, but it only uses deforestation as indicator	Certification under sustainability standards is high in the agenda; EU due diligence law is also promising; Upcoming EU regulation on deforestation-free supply chains	For retailers, certification and segregated supply chains are the most effective mechanisms; Retailers can use a mix of product certification and offsetting

	OVID	Multi-stakeholder dialogue platform	Civil society	GIZ	Retailer
Main barriers for the implementation of effective measures	Lack of a unified discourse and priorities in Germany and Europe; "Sustainability" is not well defined in stakeholder discussions; Political priorities change quickly in response to topical issues; Pressure against free trade agreements (e.g. EU-Mercosur)	Private sector calls for more government actions, preferably in terms of support rather than regulation; Lack of information about alternatives to soy; Technological limitations to use alternative proteins in the production of food	Political actors have a low bar in terms how many secondary companies in the chain must comply with regulations; Economic goals always have a bigger weight;	Low demand for certified products makes sustainability standards rather ineffective in protecting ecosystems; In Germany, there is no pressure to increase the share of certified products; Because soy is a hidden commodity, it is difficult to raise consumer awareness; High costs associated with certification and no substantial premium payments; Lack of transparency in soy supply chains	Transparency is the main challenge, especially when we consider second-tier suppliers; Very challenging to trace back the origin of all soy used and segregate value chains according to origin/ standard; Lack of unified standards and cooperation between companies to facilitate sharing information about suppliers;
Pros/cons: voluntary commitments	Easy to achieve by adopting standards and sourcing from low-risk areas; Does not solve problems if only a few companies make such commitments; Commitments with a discriminatory nature against Brazil (e.g. commitments from some retail chains) is counterproductive in fighting deforestation	Members of the Forum make their own commitments individually; Lack of a joint commitment makes the approach less effective; Difficult to set binding commitments	Apart from the soy moratorium, voluntary commitments have failed to meet their own goals; In principle, private actors could make a big contribution because of their market power; Oligopolies can be In theory, these initiatives can be implemented faster and go beyond short-term political interests;	Voluntary commitments often relate to the adoption of sustainability standards; With enough pressure, companies may implement additional measures (e.g., intensive monitoring, public lists of suppliers, mills, etc.); Difficult to objectively evaluate the commitments, monitoring is not independent	Voluntary commitments can include several components, e.g. establishment of standards, risk assessment, promotion of alternatives, participation in dialogue platforms; These commitments help give a signal to the market and hopefully encourage other actors to follow similar strategies, which could then result in significant changes in sustainability outcomes

	OVID	Multi-stakeholder dialogue platform	Civil society	GIZ	Retailer
Pros/cons: sustainability standards	Very limited impact at the landscape scale because of small market share; Willingness to pay for sustainably certified good is lower than the production costs	Some actors wish the Forum would set/support a minimum standard related to deforestation; It is not clear who should bear the costs of certification	Useful to clean particular chains and reduce the footprint of specific companies; No impact on biome conservation, because the volume of certified soy is too small	It is a weak instrument, but has independent audits and includes sustainability aspects other than deforestation; Company-led sustainability standards could also be effective, but lack transparency;	For some products, it is relatively easy to implement and label accordingly (e.g., fresh chicken and eggs); Other products (e.g., pork meat) are more difficult to sell as certified, so an offsetting approach might be preferable
Pros/cons: Due diligence law	If implemented at the EU level, it could have a significant impact; EU wide measures could set a level playing field for all participants; National approaches might increase bureaucracy and impose trade barriers or trade diversion	-	German due diligence law focus exclusively on social criteria; Despite demands from the civil society, the BMEL failed to incorporate environmental aspect	A supply chain law could ensure that companies conduct risk analyses and that there are no sustainability infractions happening upstream; Such a law could recognize specific certification systems and shift the responsibility to companies (responsibility should not be placed on the standard-setting organizations)	A supply chain law at the EU level would be very useful, especially for companies that operate in several EU countries; National due diligence laws make operations in different countries complicated, as they have different requirements; These laws could also help increase coordination between companies
Pros/cons: Excise taxes	Not discussed in detail; Concerns about how to calculate the footprint and using what reference levels	-	-	Carbon border taxes exist for some products (e.g. aluminium) but not for commodities	The idea sounds promising, but in practice they might affect how competitive certain European products are in international markets
Pros/cons: international transfers for conditional compensation	Conceptually appealing, but irrelevant from a firm's perspective, as it is unlikely that such a system can be organized, even less so at a global scale; Needs a well-functioning market for these payments and standardized methodologies to measure externalities	-	-	This proposal was very prominent until 2020 and was discussed with the Cerrado Working Group; The proposal failed for multiple reasons: not enough donors, unclear implementation structure, resistance from APROSOJA	Only discussed inside certain retailers; The political situation in Brazil makes this kind of investment risky and actors are sceptical to support a system of direct transfers

	OVID	Multi-stakeholder dialogue platform	Civil society	GIZ	Retailer
Technological innovations to make soy value chains more sustainable	GMOs and gene-editing technologies; Digitalization as an opportunity to strengthen networks; Satellite-based technologies to improve monitoring	-	Real time monitoring of compliance on private farms (system used in the soy moratorium); Monitoring system used to track cattle movement and for sanitary control	Traceability and monitoring systems using satellite images; There are concerns that satellite data alone can be misinterpreted (might require additional "ground truthing" on site); For it to be an effective monitoring tool, supply chains must be kept segregated	Supplier verification System/Portal would help categorize suppliers not only in terms of price, safety, and quality, in terms of achieving corporate social responsibility; It would allow buyers to assess how attractive are different suppliers to their sustainability strategies.
What can be done to avoid leakage	Even when a firm changes sourcing to less risky areas, it is important to remain engaged in the areas where deforestation occurs; Unilateral measures without international alignment, support, and integration are likely to merely create trade shifts and should be avoided.	The Forum is primarily concerned about what Germany can do to clean its supply chains; Actually reducing deforestation is not the main concern of private sector representatives	Reduction depends on national measures (e.g. use already deforested land for soy production); Experiences in the Amazon could be expanded to other biomes; We should also consider leakage to the USA	There have been recent talks with Chinese actors about sustainability in supply chains, which is a step forward; We need to make it clear to companies that clean supply chains are not enough, the focus should be reducing overall risk of deforestation; We need to support actions in producing countries to ensure that soy is grown through intensification or in already degraded lands; Promotion of national mandatory traceability systems	As a retailer, we can only take concrete measures related to our own demand for soy; Different actors must sit together in committees to issue a joint position about what the group of German companies / retailers are doing to make their supply chains more sustainable; Joint positioning could send a signal to the international feed market, which could then reduce the risk that the sourcing of "dirty" soy simply shifts to a different country

	OVID	Multi-stakeholder dialogue platform	Civil society	GIZ	Retailer
Role of consumers and NGOs in changing soy sourcing patterns	Important and powerful actor to change demand patterns and raise demands for political action; NGO campaigns were very successful in steering public perception; The use of pictures of forest fires in the Amazon were effective in intensifying the debate, but simplifications make it difficult to increase understanding about differentiated and targeted approaches	NGOs have their role in emphasizing the importance of reducing deforestation as opposed to just cleaning German supply chains; Perception of the public is important to companies and they are concerned about improving own image	In the case of palm oil, public opinion shifted priorities of companies to address deforestation (traders are worried about soy becoming the next palm oil); Consumers in Germany do not have much leverage when compared to EU companies, but it can gain momentum and become a significant economic issue for companies	In the palm oil sector, there was effective pressure from consumers and the civil society, but such pressure is still lacking in soy; Pictures of the fires in the Amazon and social media were important to raise awareness in Europe, but it is difficult to derive concrete actions from it;	NGOs were important to push retailers to increase the offer of vegan products; NGOs are changing their strategy from doing campaigns against specific actors to more actively participating in the dialogue; This push from NGOs has also created competition between food retailers. They have started to pay attention to what their competitors are doing as to avoid lagging behind
Alternatives to soy imports	Sunflower seeds, rapeseed, other leguminous (important to note that soybeans are the most efficient protein source per hectare of land); Reduction of meat consumption would be the most effective, but it is unrealistic;	Lupine, rapeseed, pea; Work with farmers on demonstration plots to teach how to grow soy domestically and use other crops for animal feed;	Stop promoting mass meat production; Reduce meat consumption, improve meat quality; Initiatives to grow soy in Europe can reduce reliance on soy from the Americas	More conscious shopping, reduce consumption of meat; Expand soy production in East Europe (Donau soy);	Increase the offer of vegan products; not only the traditional products (e.g. soy milk, almond milk), but also vegan cheese, yogurt, etc

Table A3 – Forest loss, soybean gain, and deforestation driven by soybean cultivation from 2001 to 2016

	Total forest loss (1,000 ha)	Total soybean gain (1,000 ha)	Soybean gain as a direct or latent driver of deforestation (1,000 ha)	Percentage of forest loss converted to soybean (%)
Brazilian Amazon	27,766	3,294	1,674	6.0
Atlantic Forest	6,935	4,689	541	7.8
Caatinga	2,759	7	5	0.2
Cerrado	14,316	7,536	2,378	16.6
Pampas*	1,243	8,669	152	12.2
Pantanal	626	6	1	0.2
Total	**53,645**	**2,4201**	**4,751**	**8.8**

Source: Adapted from Song et al. (2021).

* Includes areas in Brazil, Argentina, Uruguay, and Paraguay.

Table A4 – Zero Deforestation Commitments of four of the largest soy traders assessed against four selected criteria

Criteria	Cargill	Bunge	ADM	Amaggi
C1: include a zero-gross deforestation target	Cargill's 2019 commitment commits to a "deforestation-free" supply chain, suggesting a gross commitment.	Gross	Gross	Gross
C2: have more inclusive forest definitions	Cargill adopts the FAO definition of forest: "Land with tree crown cover of more than 10 % and area of more than 0.5 ha". Their policy also commits to "protect native vegetation beyond forests… This includes the Cerrado, Gran Chaco and Llanos."	No definition given.	FAO definition	"Our commitment… applies to all locations where we operate, in and outside Brazil, including the Cerrado and Amazon biomes."
C3: specify a functional, transparent system of compliance monitoring and verification among direct and indirect suppliers	(…) Cargill's monitoring appears to be focused on zero illegal deforestation, rather than zero deforestation. (…) Compliance is not independently verifiable as these analyses are done by Cargill's own Geographic Information System (GIS) team and Cargill does not publish information about the location of its sourcing (e.g. the location or boundaries of farms). Their 2019 commitment does, however, "commit to publishing regular reports on key metrics, time-bound implementation plans, progress and impacts."	Bunge reports it has 100% traceability to the farm level for direct sourcing of Brazilian soy from Matopiba and Mato Grosso. (…) Compliance is not independently verifiable as these analyses are done by Bunge's own Geographic Information System (GIS) team and Bunge does not publish information about the location of its sourcing.	ADM reports it has collected digital farm boundaries for 100% of direct suppliers in priority municipalities in MATOPIBA. It does not report figures for the level of non-compliance with their policy. Monitoring is done by AGROTOOLS, a Brazilian technology company and ADM does not publish information about the location of its sourcing.	Amaggi sources 8% of soy from farms operated by the company itself. More than 3,000 direct suppliers are monitored (i.e. in total 86% of sourcing) using their 'ORIGINAR' Geospatial System. Amaggi state that 19% of their sourcing comes from their own farms or farms which are audited and certified as deforestation-free. A further 12% is covered by the Soy Moratorium. Amaggi does not publish information about the location of sourcing, beyond production on its own farms.
C10: monitoring and traceability to the point of origin	Cargill reports it is "working to expand the implementation of the CAR [the Brazilian property registry] with our direct and indirect suppliers"6, but data on progress are not available.	Soy sourced from third-parties is not currently included in monitoring efforts, though Bunge reports that in 2018 it began "engaging with third party suppliers".	No details for traceability are published.	Amaggi sources 85% of supply directly from farmers (15% from third-parties). 8% of sourcing comes from Amaggi's own farms.

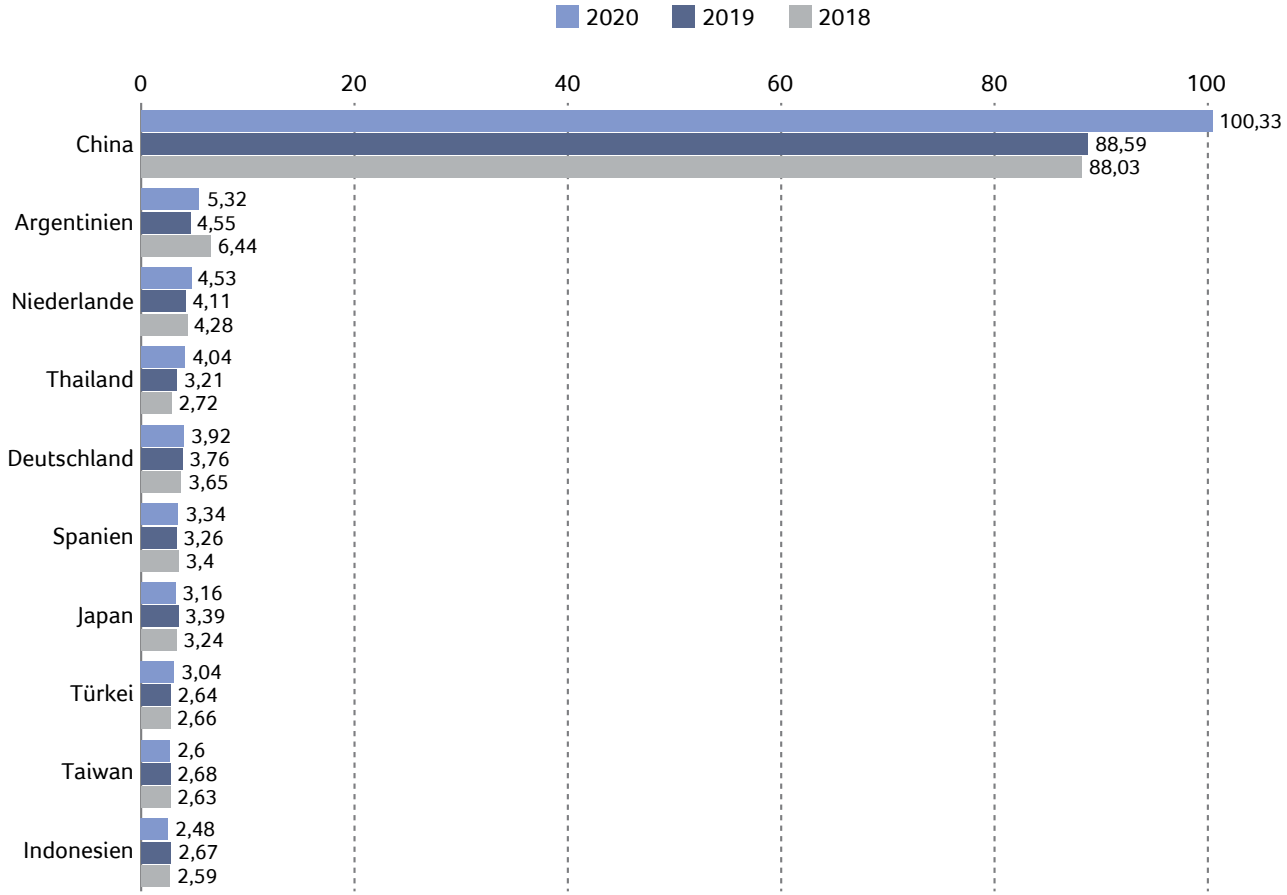
Source: Adapted from Ermgassen et al. (2020). Supplementary information from ADM (2021) and Bunge (2021).

Table A5 – Overview of soy sustainability standards that comply with FEFAC guidelines

Standard	Herausgeber des Standards	Organisationstyp	geogr. Geltungsbereich	Produkte
Agricultura Certificada	Aapresid	Nichtregierungs-organisation (NGO)	Argentinien	verschiedenste landwirtschaftliche Produkte
ADM Responsible Soy Standard	ADM	privatwirtschaftl. Unternehmen	global	Soja (Nahrungs- und Futtermittel)
Amaggi Responsible Soy Standard (ARS)	Amaggi	privatwirtschaftl. Unternehmen	bisher Brasilien	Soja (Nahrungs- und Futtermittel)
Belgian Feed Association (BFA); formerly BEMEFA	Belgian Feed Association (BFA)	Industrieverband	Brasilien, Argentinien	Futtermittel
BUNGE Pro-S	Bunge Ltd-	privatwirtschaftl. Unternehmen	prinzipiell global (bisher Brasilien)	Soja
Cargill Triple S	Cargill	privatwirtschaftl. Unternehmen	Südamerika (Brasilien, Argentinien, Paraguay)	Soja (Nahrungs- und Futtermittel)
Cefetra Certified Responsible Soya (CRS)	Cefetra	privatwirtschaftl. Unternehmen (GroRhandel)	prinzipiell global (bisher Brasilien, Argentinien)	Soja (Nahrungs- und Futtermittel)
COAMO (Programa Coamo de Produção Sustentável da Soja)	COAMO	landwirtschaftlich-industrielle Kooperative	Brasilien	Soja
Donau Soja / Europe Soya	Verein Donau Soja	Multiakteurs-partnerschaft	produziert in der Donau-Region bzw. produziert in Europa	Soja (Nahrungs- und Futtermittel)
Feed Materials Assurance Scheme (FEMAS)	FEMAS Working Group / Agricultural Industries Confederation	Industrieverband	prinzipiell global	verschiedenste landwirtschaftliche Produkte
ISCC EU	International Sustainability and Carbon Certification (ISCC) GmbH	Multiakteurs-partnerschaft	für die Europäische Union	Biokraftstoffe
ISCC PLUS	International Sustainability and Carbon Certification (ISCC) GmbH	Multiakteurs-partnerschaft	auBerhalbderEU	Nahrungsmittel, Futtermittel, biobasierte Produkte, Energie, Biokraftstoffe
ProTerra	ProTerra Foundation	Nichtregierungs-organisation (NGO)	global	alie landwirtschaftlichen Rohstoffe
RTRS	Roundtable on Responsible Soy (RTRS)	Multiakteurs-partnerschaft	global	Soja (Nahrungs- und Futtermittel, Biokraftstoffe)
Sustainable Feed Standard (SFS)	CKade SFS BV	privatwirtschaftl. Unternehmen	prinzipiell global (bisher Brasilien und Argentinien)	Futtermittel
U.S. Soybean Sustainability Assurance Protocol (U.S. SSAP)	U.S. Soybean Export Concil (USSEC)	õffentlich-private Partnerschaft / Plattform	produziert in den USA	Soja (Nahrungs- und Futtermittel)

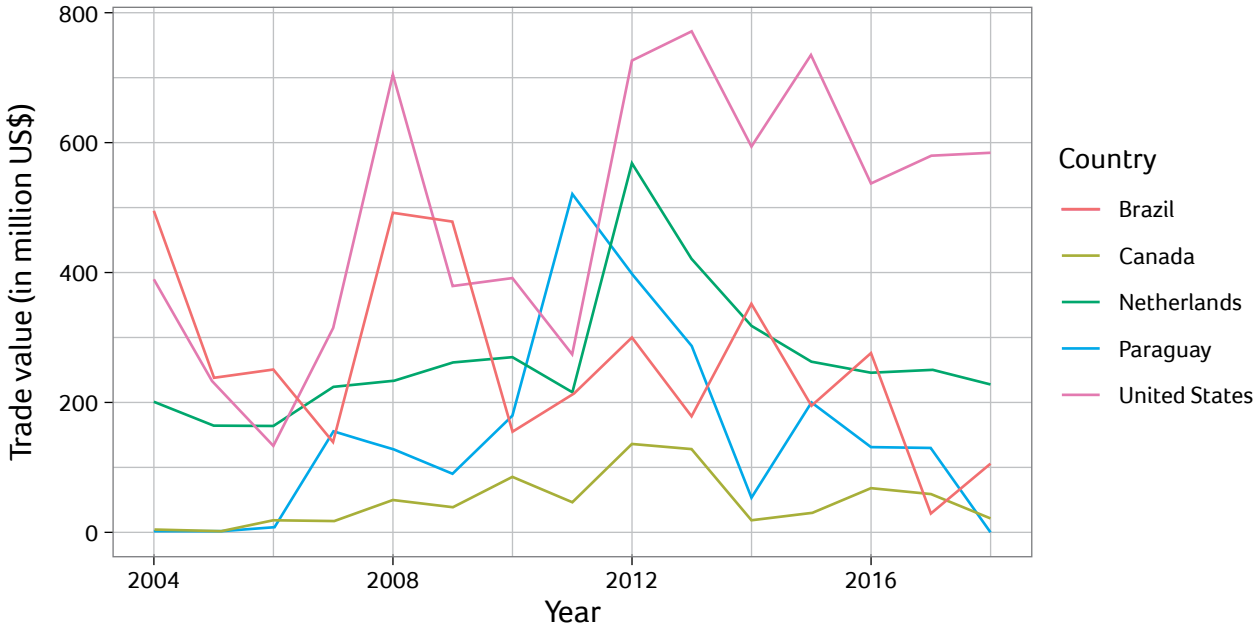
Source: Hargita et al. (2019).

Figure A1 – Leading importing countries of soybeans worldwide by import volume (in million tons)



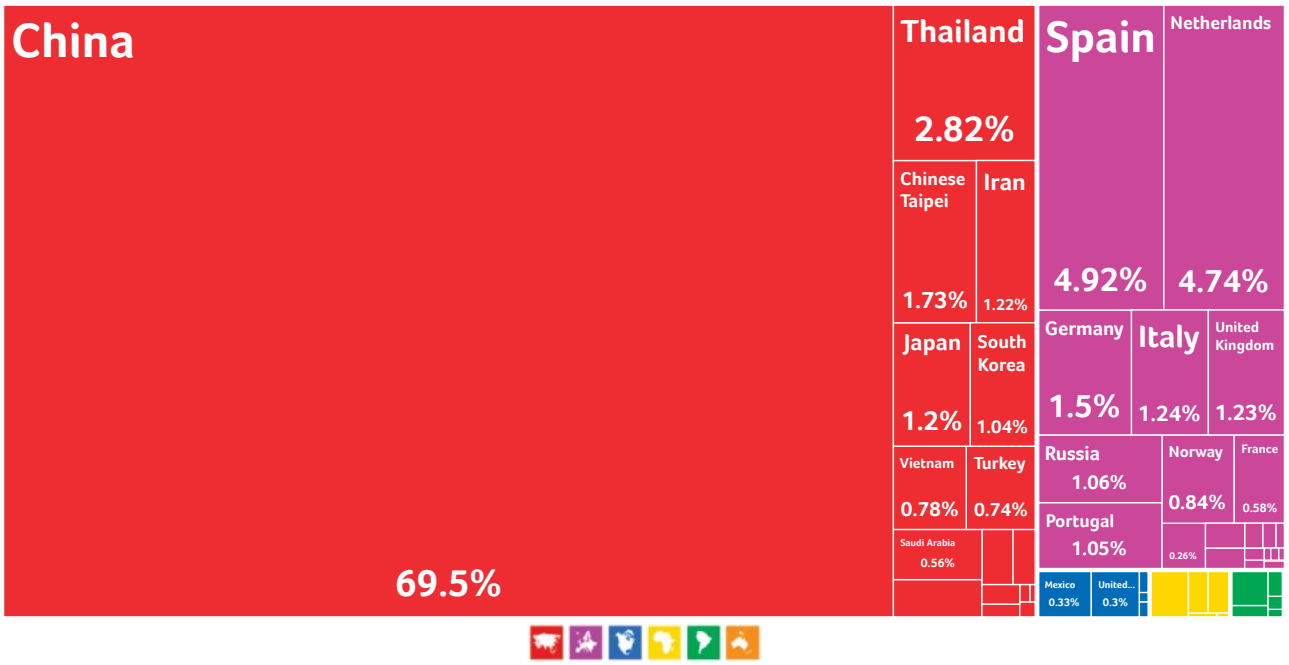
Source: Statista (2020).

Figure A2 – Trade value of soybean imports into Germany (2004-2019)



Source: Authors' elaboration based on data from OEC (2021).

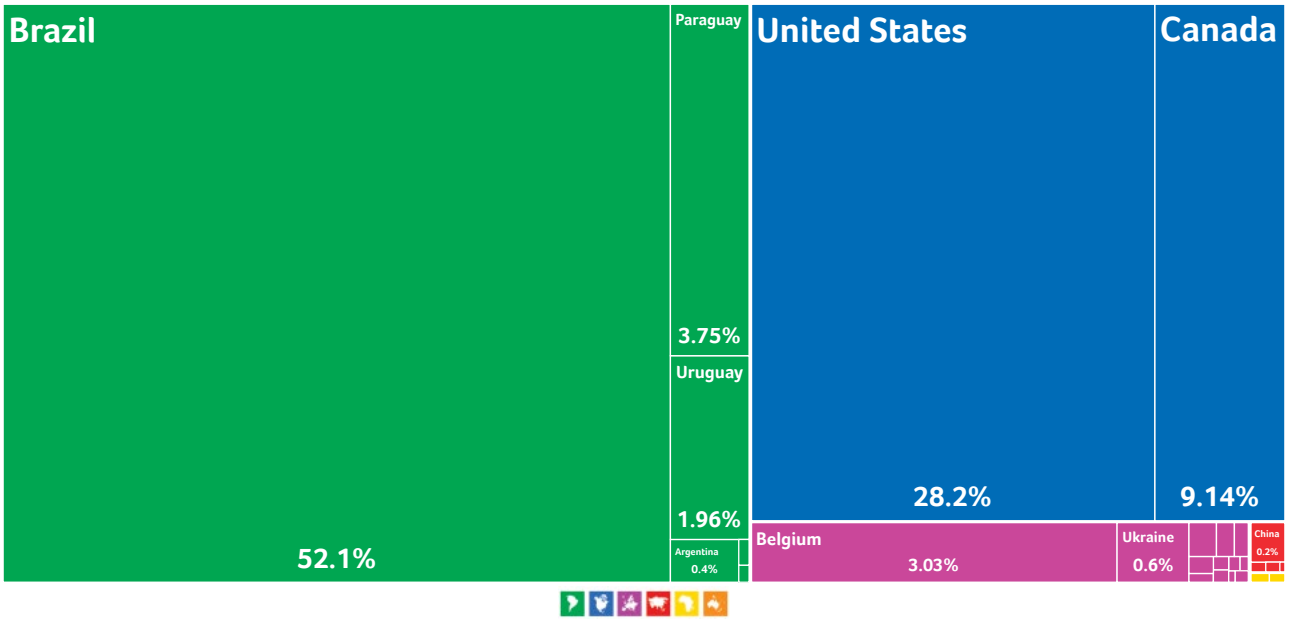
Figure A3 – Brazil's soybeans export market shares (2004-2019)



Source: OEC (2021).

Note: The total trade value for the period was US$ 262B.

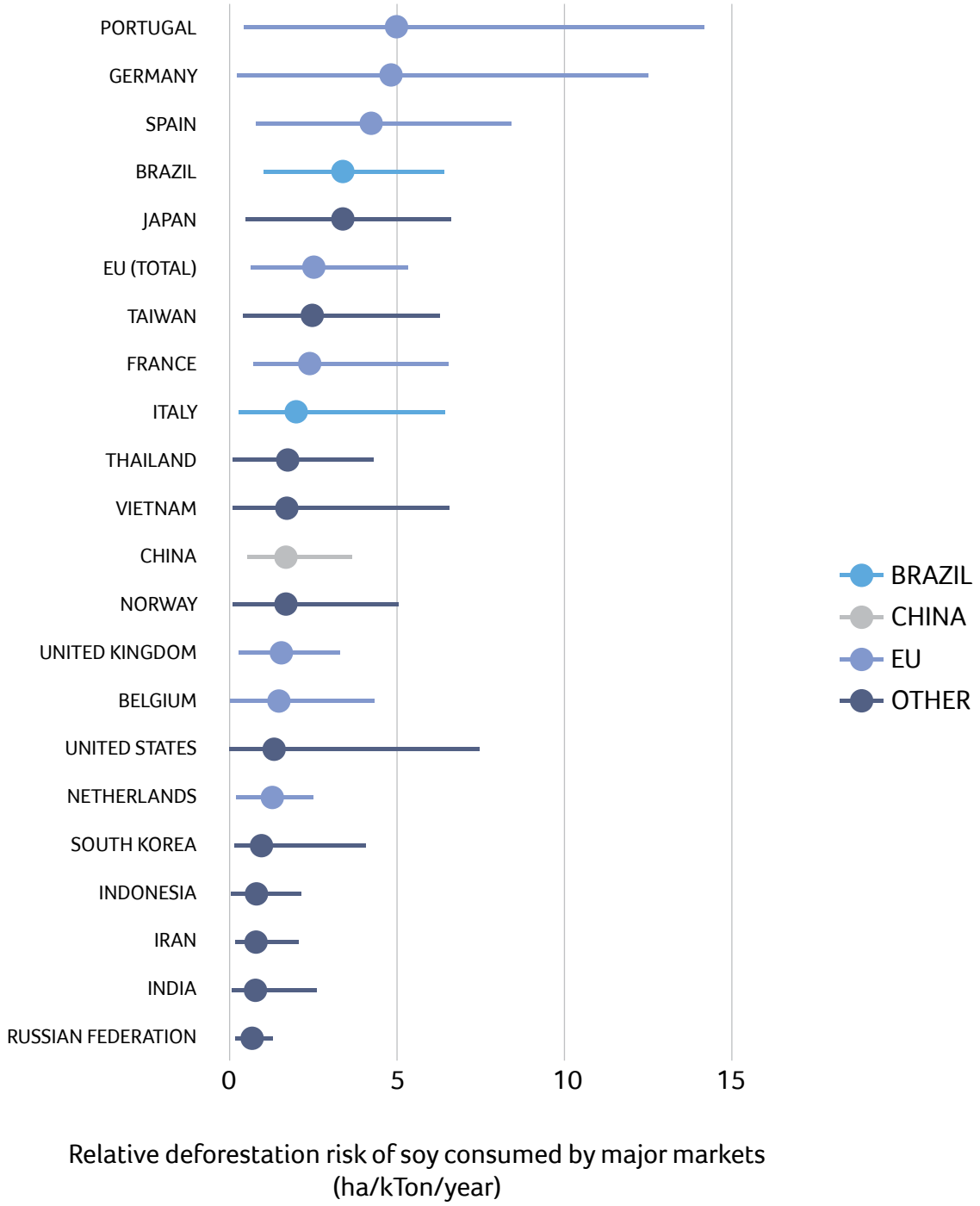
Figure A4 – Netherlands' soybeans import market shares (2004-2019)



Source: OEC (2021).

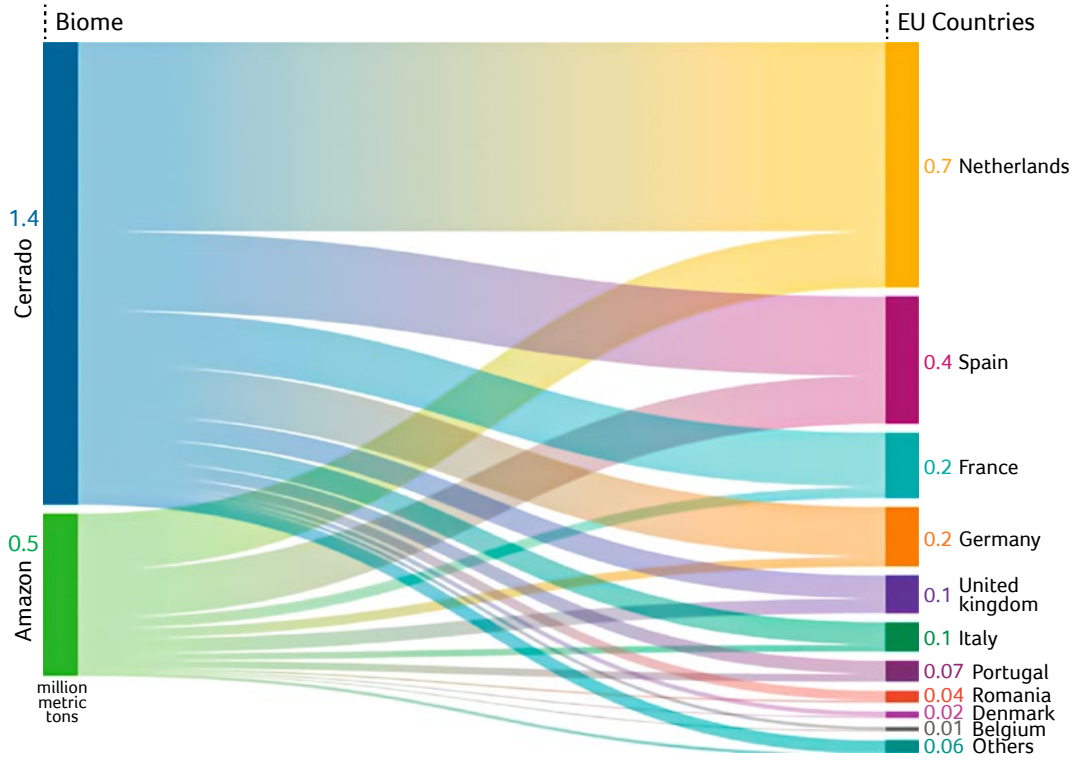
Note: The total trade value for the period was US$ 23.9B.

Figure A5 – Relative deforestation risk of soy consumed by major markets for the period 2006-2016 (ha/kTon/year)



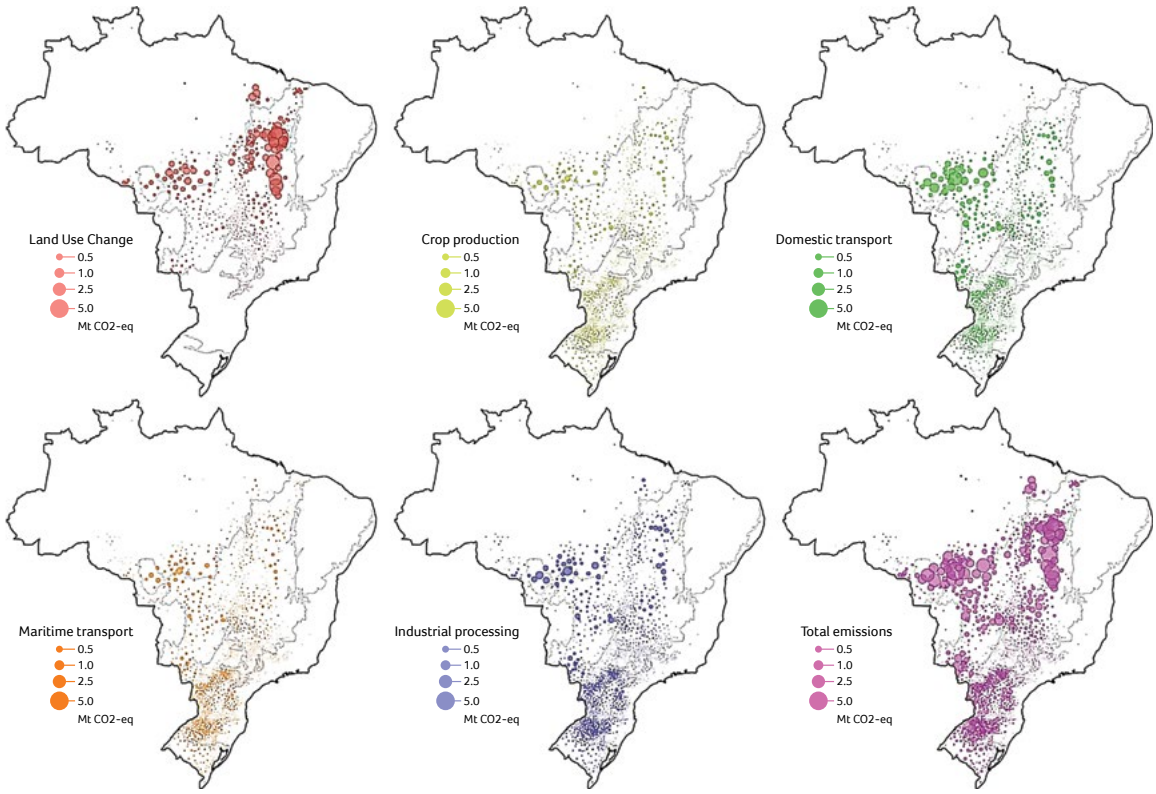
Source: Trase (2018).

Figure A6 – Source and country destinations of soy potentially contaminated with potentially illegal deforestation. Estimated annual average between 2009 and 2017 from TRASE



Source: Rajão et al. (2020).

Figure A7 – Total CO2-eq. embodied in soy exports in the period 2010-2015 at the municipal level (Mt)



Source: Escobar et al. (2020).

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