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SUSTAINABLE ECONOMIES

Trase Yearbook 2018

Sustainability in forest-risk supply chains: Spotlight on Brazilian soy



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Feedback:

This is the first Trase Yearbook. We welcome your feedback, comments and suggestions to help maximise the value that can be gained from Trase data and make future Trase Yearbooks more useful. Please write to us at info@trase.earth.

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The Trase Yearbook presents the latest insights on the sustainability of global agricultural commodity supply chains associated with tropical deforestation.

Based on Trase's unique transparency data, and with a spotlight on soy in 2018, it provides a first systematic assessment of the sourcing patterns of major buying companies and countries, the deforestation risk associated with the major companies and import markets that dominate Brazil's soy exports, and the links between deforestation commitments and changes on the ground.

The Trase Yearbook is also published online at yearbook2018.trase.earth, including interactive visualizations allowing the reader to explore the patterns of global trade in forest-risk crops, soy expansion in South America, and the dynamics of Brazilian soy supply chains and associated deforestation risk across time and between companies and importing countries.

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Foreword

Frances Seymour

The first Trase Yearbook arrives not a moment too soon. 2018 is a pivotal year for the nexus of deforestation, commodity supply chain commitments, and action at the level of sub-national jurisdictions:

- ✔ Global Forest Watch reports that 2017 was the second-worst year on record for global tree cover loss, down only slightly from 2016.
- ✔ Companies that have committed to get deforestation out of their supply chains are waking up to the fact their 2020 target date is just around the corner, and are scrambling to accelerate progress.
- ✔ An increasing number of leaders of sub-national jurisdictions have committed to low-carbon development paths, and are beginning to grapple with the challenges of implementation.

The Trase Yearbook enables enhanced action and new partnerships at the intersection of these interlocking crises/opportunities. The Yearbook goes beyond the unique data available on Trase.earth to provide analysis of the patterns revealed by the data, which link the loss of forests and other native ecosystems to the companies and consumer markets associated with that loss. “Deforestation risk” – expressed in a share of hectares of forest cleared in a producer jurisdiction – is assigned to buyer companies and consumer markets proportional to the volume of exports that they source from that region.

The Trase Yearbook 2018 shines a spotlight on soy exports from Brazil, where recent upticks in deforestation in both the Amazon and the Cerrado have raised alarm and generated new commitments from companies such as Bunge and Louis Dreyfus. Future Trase Yearbooks will provide annual updates on progress toward sustainability, and expand to cover additional commodities and geographies, with an ambition of covering 70% of all globally traded forest-risk commodities by 2020.

The analysis contained in this Yearbook will immediately empower progressive companies with the information they need to address the areas of greatest deforestation risk in their soy supply chains. At the same time, it empowers activists with the information they need to prioritize advocacy efforts aimed at buyer companies and consumer

markets that are not fulfilling their commitments to zero-deforestation soy, or have not yet made such commitments at all.

Over time, the information contained in Trase Yearbooks will enable leaders in producer jurisdictions to partner with progressive companies to demonstrate progress in overcoming commodity-driven deforestation, and justify reward for such progress in the form of preferential sourcing and investment. And for analysts, Trase Yearbooks will illuminate the still-opaque linkages between commitments to zero deforestation and changes on the ground over time.

Already, the 2018 Yearbook contains some eyebrow-raising findings related to the concentration of deforestation risk across particular soy producing areas, traders, and markets. And while 40% of soy exported from Brazil is covered by some sort of zero-deforestation commitment, companies with and without commitments are associated with similar levels of risk.

The transparency enabled by trase.earth data and the analysis in the 2018 Trase Yearbook are potent weapons in the fight against deforestation. Companies, consumers, activists, and leaders of progressive jurisdictions should use them to full effect.

July 2018

Frances Seymour is a Distinguished Senior Fellow at the World Resources Institute and Senior Adviser to the David and Lucile Packard Foundation.

Executive Summary

The Trase Yearbook presents the latest insights on the sustainability of global agricultural commodity supply chains associated with tropical deforestation, based on Trase's unique transparency data. These data link commodity production and associated impacts, including deforestation, to specific trading companies and consumer markets.

The Trase Yearbook is intended to help companies and governments manage risks and target investments in sustainable production, whilst also supporting the wider sustainability community in assessing progress towards commitments and goals.

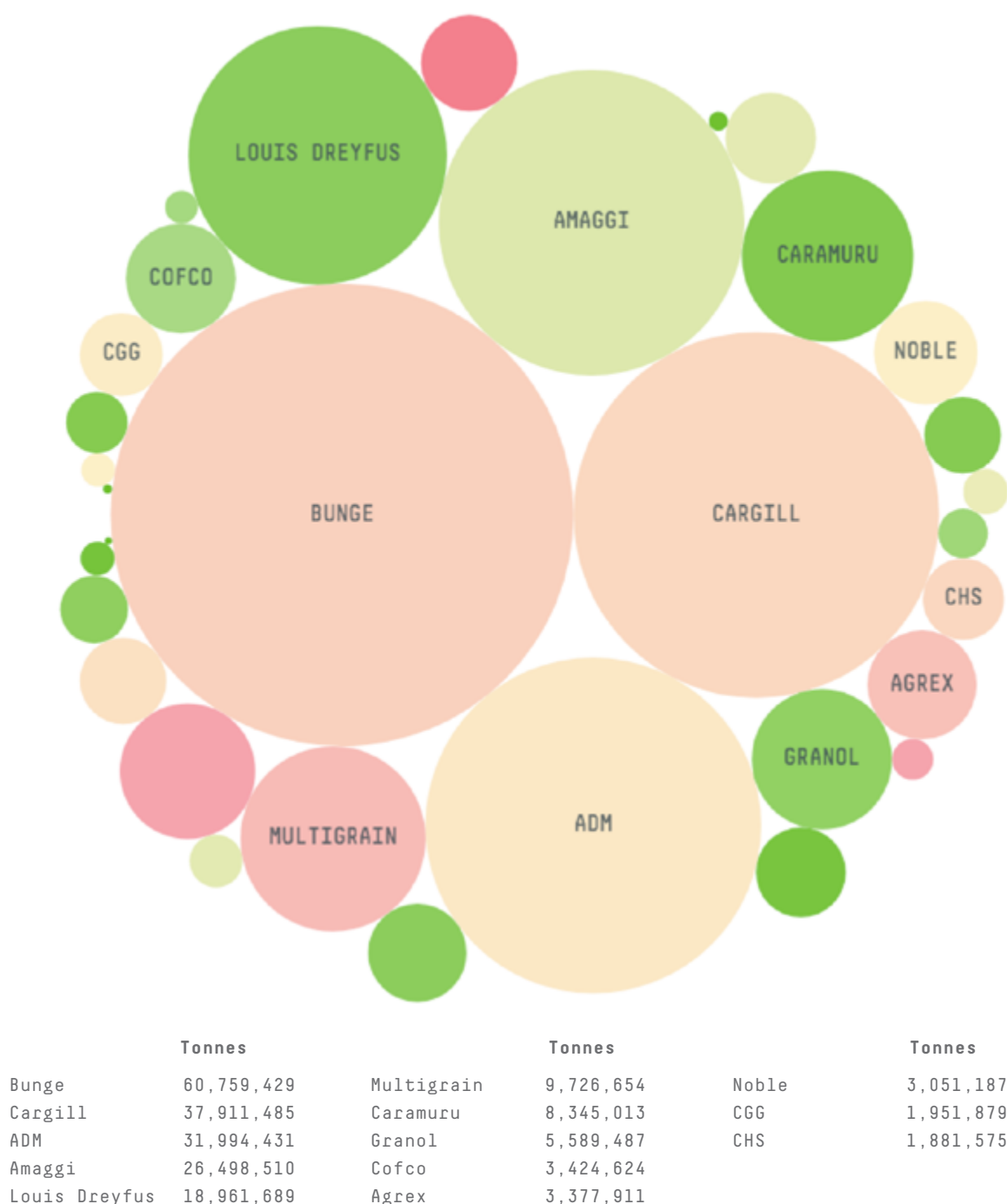
This first Trase Yearbook zooms in on soy production in South America, and particularly the emerging world leader in soy exports, Brazil.

It provides a first systematic assessment of:

- ✔️ sourcing patterns of major buying companies and countries;
- ✔️ the 'deforestation risk' associated with the major companies that dominate Brazil's soy exports;
- ✔️ the 'deforestation risk' associated with major consumer markets, including the EU and China;
- ✔️ the links between deforestation commitments and changes on the ground.

Spotlights on South America, and Brazilian soy

South America has become a world leader in the production and export of some of the most important forest-risk commodities. In 2017, more than 450 million tonnes of soy, palm oil, sugar cane products, maize, cocoa and coffee were exported by the region's largest producer countries of forest-risk commodities: Argentina, Bolivia, Brazil, Colombia, Ecuador, Paraguay, Peru, and Uruguay. Trase data show that more than half of this export volume was handled by just 36 "mega-traders" – out of more than 2500 companies exporting from the region.



Volumes of soy exported from Brazil in 2006-2016 per trader

Of all the forest-risk commodities, the most traded in international markets is soy – including soybeans, oil and cake. In 2016, three South American countries – Brazil, Argentina and Paraguay – together produced almost 50% of the world’s soy covering 56 million hectares of land, an area the size of France and a forty-fold increase since 1970. In 2018, Brazil is expected to overtake the United States to become the largest producer of soy in the world.

However, soy production is also linked to substantial direct and indirect deforestation and conversion of other forms of native vegetation in some of South America’s most iconic biomes: particularly the Brazilian Cerrado and the Gran Chaco in Argentina, Paraguay and Bolivia. Today, soy expansion in the Cerrado is expanding faster than anywhere else in the world – often into areas of species-rich native vegetation and biodiversity. In the Cerrado’s newest soy frontier region, known as Matopiba, 37% of the expansion of soy cropland in the last decade was through the direct conversion of native vegetation.

Given its global importance as a forest-risk commodity, Brazilian soy was the first commodity covered by Trase’s supply chain transparency mapping. Future Yearbook assessments will expand to cover other commodities and countries mapped on trase.earth. By 2020, Trase aims to cover 70% of all globally traded forest-risk commodities.

How does Trase assess deforestation risk in commodity supply chains?

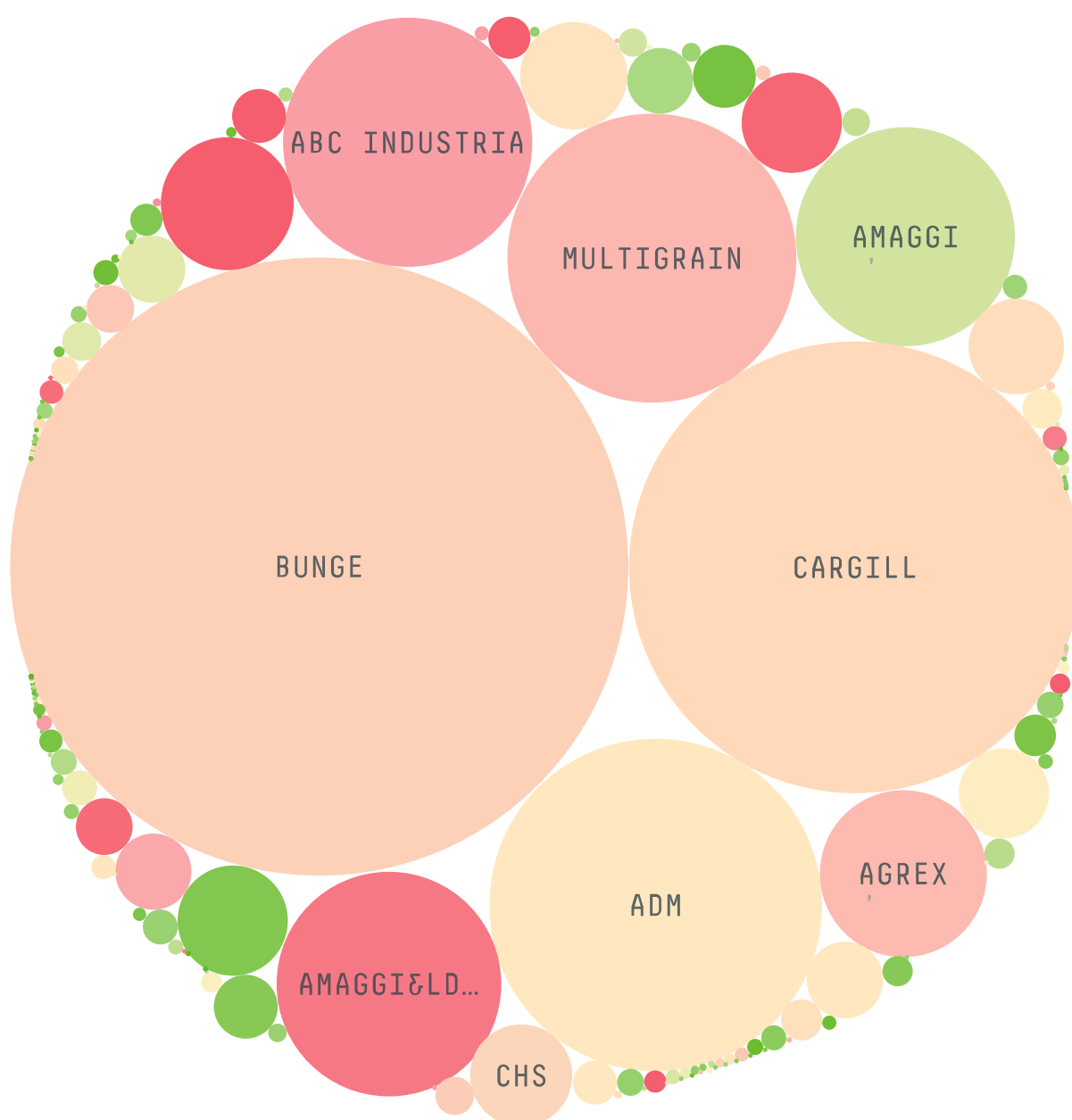
Trase generates indicators of ‘deforestation risk’ using localised data on commodity production, sourcing patterns and deforestation. This indicator, measured in terms of hectares, assesses a company’s – or import country’s – exposure to the risk that the commodity it is sourcing is associated with deforestation in the region where it was produced. 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. Therefore, if a company is sourcing 500 tonnes of soy from a Brazilian municipality that produces 1000 tonnes, and where 800 hectares of deforestation can be directly linked to soy production, the soy deforestation risk for that company in that municipality is 400 ha (50% of the total). To allow comparisons between actors that source very different volumes of soy a relative measure of deforestation risk is hectares per tonne of exports.

Trase Yearbook 2018 only uses deforestation risk directly associated with soy expansion and includes the clearance of native vegetation in both the Amazon and the Cerrado biomes.

Headline findings

- ✓ **The six largest soy traders accounted for 57% of soy exports from Brazil in 2016 and two-thirds of the total deforestation risk associated with soy expansion in the preceding decade.**

The six largest traders exporting soy from Brazil in 2016 were Bunge, Cargill, ADM, Louis Dreyfus, COFCO and Amaggi. Taken together, the supply chains of these six traders are associated with two-thirds of the total deforestation risk directly linked to soy expansion, the majority of it in the Cerrado.



Total deforestation risk of major soy traders 2006-2016

✓ **Half of the total deforestation risk associated with exports of Brazilian soy in 2016 was linked to Chinese imports; however, other consumer markets, including in the EU, were also exposed to a high relative deforestation risk per tonne of soy imports.**

Around 60% of Brazilian soy exports in 2016 went to China. These were associated with 50% (~10,000 ha) of the total deforestation risk directly linked to Brazilian soy exports in 2016. While many European countries imported much smaller amounts of soy than China, Trase's high-resolution supply chain maps show that these imports were often associated with a higher deforestation risk per tonne.

✓ **In the last decade the Brazilian Cerrado, and in particular the Matopiba region in the north of the biome, became the world's major hotspot for soy-associated deforestation and habitat loss.**

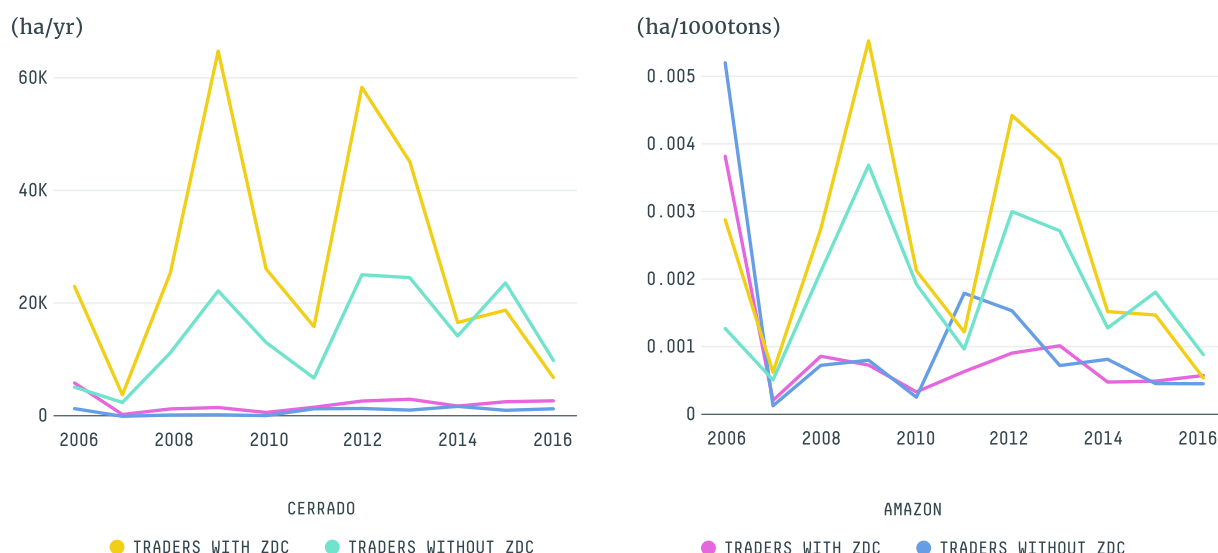
Between 2000 and 2016, 14% of all soy expansion in Brazil took place in the Matopiba region alone; and in the last decade, 37% was on native vegetation cleared directly for soy. Sixteen of the 20 companies with the highest relative deforestation risk (per tonne) across Brazil source significant volumes of soy (>10,000 tonnes per year) from Matopiba. While the major soy traders all have a strong presence in Matopiba, many relative newcomers and smaller companies are also operating in this emerging soy frontier. These newer companies include new joint-ventures and foreign companies, including from Asia, and other companies that have only recently moved into the soy sector.

✓ **Major investments in their own soy infrastructure underpin the strong connections of many traders – and those who buy from them – to specific regions of production, including deforestation hotspots.**

The latest Trase data estimate that for some two-thirds of Brazil's soy-exporting municipalities – distributed across the entire country – more than half of exports were handled by a single trader, while in approximately one-fifth of municipalities a single trader handled all of the exports. These strong connections underscore the key role these companies play in shaping the development trajectories of these regions and the future sustainability of soy.

✓ **Over 40% of all soy exports from Brazil are now covered by some form of zero-deforestation commitment (ZDC) – but coverage remains very uneven between regions.**

In recent years a growing number of companies in Brazilian soy supply chains have been making ZDCs. In 2016, 42% of all soy exports from Brazil were covered by some form of ZDC. While almost all the soy exported from the Amazon is covered by the Soy Moratorium – with some traders not yet signatories – less than half of soy exported from the Cerrado biome was covered by a ZDC.



Deforestation risk of traders
with and without zero deforestation commitments

✔ **Trase data show that during the last decade soy traders in the Brazilian market with zero-deforestation commitments have been associated with similar levels of deforestation risk as companies that have not made such commitments.**

For the period 2006–2016, the four traders that have made commitments (ADM, Bunge, Cargill, and Amaggi) have been exposed to a total direct deforestation risk of 326,000 hectares of deforestation and native vegetation clearance linked to soy expansion. This follows a year-on-year trend in risk exposure that is similar to other companies, with overall soy-associated deforestation across Brazil falling sharply in recent years. Whilst zero-deforestation commitments are a positive step forwards, it is too early to assess whether they are effective in reducing deforestation. These findings underscore both the scale of the challenge and the enormous potential benefits to be gained from implementing such commitments.

✔ **Trase data show that the seven European countries that have made ZDCs through the Amsterdam Declaration remain exposed to high levels of deforestation risk.**

Over the last decade, signatories of the Amsterdam Declaration were exposed to similar or higher levels of relative deforestation risk - hectares of deforestation per tonne of exports - than major consumer markets such as China, with no discernible decline in deforestation risk since the declaration came into force in 2015.

An opportunity for change

Government projections of soy production in Brazil indicate that around 10 million more hectares of land may be converted to soy production within the next decade. Much of this will likely be concentrated in the already vulnerable Cerrado. Ensuring that this projected expansion does not drive more deforestation is an immense challenge. Yet further loss is not inevitable, when, in the Cerrado alone, nearly 20 million hectares of already cleared land, much of which is degraded, low productivity pasture, is classified as suitable for soy.

By linking soy traders and buyers to the places where soy is grown, Trase data can help to identify and manage risks, highlight opportunities for new partnerships and investment to improve sustainability, and monitor progress over time. This provides a critical missing part of the puzzle of shifting soy to a more sustainable footing.



What is different about the Trase approach to supply chain mapping?

Trase uses a powerful new approach to supply chain mapping and visualisation that brings a new level of understanding to complex global supply chains of commodities such as soy, beef and palm oil that drive the majority of tropical deforestation today. Trase provides unique sub-national maps of the supply chains connecting individual regions and jurisdictions of production to specific trading companies and consumer markets for all exports of a given commodity. The jurisdictional focus of Trase makes it possible to discriminate differences in agricultural conditions and sustainability between different sourcing regions whilst also providing complete coverage of the exports from a given country.

Trase uses only publicly accessible data, such as customs records and shipping manifests, tax registration data, and subnational production data.

Chapter 1

Agricultural commodities and tropical deforestation

HIGHLIGHTS

- ✔ Production and trade of agricultural commodities has exploded in recent decades and exports from tropical regions continue to grow rapidly. Much of this activity is directly or indirectly driving deforestation and conversion of vulnerable habitats.
- ✔ South America is a powerhouse of agricultural production, and is increasingly linked to emerging economies such as China which are rapidly increasing their dependence on the region. 80% of global soy production comes from just three countries, two of which are Brazil and Argentina, and China is the world's largest consumer of soy with over half of its imports coming from Brazil.
- ✔ The high-resolution supply chain data and analyses provided by Trase helps go beyond national-scale analyses of the sustainability of global commodity trade to provide actionable information for tackling environmental and social risks in supply chains.

In recent decades, the map of global trade in agricultural commodities has been dramatically redrawn.

Today, almost every country relies on commodity imports from distant corners of the planet. In particular, so-called flex crops such as soy, oil palm oil, maize and sugarcane are growing ever more important in a globalised economy that prizes their versatility: for food, for feed, for biofuels and for an increasing number of other commercial applications.

Demand for these commodities has been met by a remarkable increase in agricultural output. Crop production has risen from around 2.5 trillion tonnes in the early 1960s, to over 9 trillion tonnes today¹. This has been achieved by a combination of intensifying production on existing farmland and the conversion of large tracts of the world's remaining wilderness areas to agriculture.

While cutting food waste and improving access to agricultural produce will help, the reality is that intensification and expansion of farming will probably continue in the face of a growing and increasingly affluent global population.

1.1 The environmental impacts of agricultural expansion

Global increases in agricultural production have often been achieved in ways that are anything but sustainable. Health and environmental risks linked to agro-chemicals, veterinary antibiotics, fertiliser run-off, and soil degradation and more have become major concerns, and agricultural expansion remains the greatest threat to biodiversity worldwide.

Nowhere is this more true than in tropical countries. The tropics include many important habitats that provide vital environmental services at local and global scales, and are among the most biodiverse in the world. However, many large tropical countries are emerging as powerhouses of global commodity production, vital to the global economy.

Tropical deforestation brings the challenge into sharp focus. Two-thirds of tropical deforestation in recent years has been driven by expansion for a handful of agricultural commodities, such as soy, beef, palm oil and timber that are consumed worldwide in countless forms. As well as the local damage to forests and other natural habitats, this is also affecting the rights and livelihoods of local communities, and accelerating climate change.

Concern about these impacts is increasingly affecting companies, investors and governments. Faced with increasing risks to their reputations and operations, they have made ambitious commitments to 'deforestation-free' activities and supply chains.

¹ www.fao.org/faostat/en/



Agriculture has expanded rapidly across the tropics in recent decades.
Photo credit:istock.com/phototreat

But is real progress towards these commitments being made? Who are the key players that must act and how are they connected to landscapes on the ground? And where and how can they achieve the greatest impact?

These are the questions this Trase Yearbook 2018 sets out to answer, drawing on the unique data and insights provided by the Trase initiative. This chapter offers a bird's eye view of the global trade in agricultural commodities – limited here to croplands – before zooming in to South American soy (see Chapter 3), and a more detailed assessment of how Trase data can help in bringing about change.

Tropical regions are critical to the production and export of many commercially important agricultural commodities

Forest-risk commodities are traded and consumed the world over. But the bulk come from just a handful of producer countries. For example, according to FAO data², in 2016:

- ✓ More than 80% of palm oil was produced in just two countries: Indonesia (53%) and Malaysia (29%).
- ✓ More than 80% of soybean was produced in three countries: the United States (35%), Brazil (29%) and Argentina (18%). Although, in 2018, Brazil is expected to overtake the US³ in soy production.
- ✓ Almost 40% of the world's sugarcane was produced by Brazil alone.

² www.fao.org/faostat/en/

³ news.agropages.com/News/NewsDetail---23235.htm

Looking at trade linkages between producing and consuming countries, it becomes clear that there are some critical inter-dependencies.

China, in particular, stands out⁴. It consumes around 60% of global soybean exports, with more than half of this coming from Brazil in 2017. More recent data suggest that China's dominance in global markets has further increased⁵. Meanwhile, the harvested area under soy production in China decreased by around 30% between 2000 and 2016⁶. In essence, China is outsourcing its soybean production. And new trade tariffs on US soy mean that China's dependence on Brazilian imports could increase dramatically⁷.

The global map of production and trade of several of the world's most important global commodities reveals interdependencies between sources of supply and demand and the important role of tropical regions in providing these materials.

1.2 Global dependence on tropical producers is both beneficial and problematic

The production of major agricultural commodities is critically important to the economies of tropical countries. From a purely economic perspective, production for export is an attractive option. In Malaysia, for example, the gross production value of palm oil in 2016 was around USD 12.5 billion⁸, contributing around 4.2% to GDP. In Brazil, sugarcane, soy and maize – the three largest crop commodities by production volume – had a gross production value of USD 60.6 billion, contributing 3.4% of GDP, and soybeans are Brazil's most valuable export commodity, worth over USD 20 billion⁹.

However, the fact that the demands of growing consumption are being met by a relatively small number of tropical regions has consequences. It is putting intense pressure on many biodiversity-rich and sensitive landscapes. Converting natural ecosystems to farmland may bring economic growth in the short term, but could fundamentally impact long-term human prosperity and well-being.

From the point of view of international food and resource security, dependence on a small number of producing countries is also a big concern. For example, as well as having a devastating effects on local economies and the livelihoods they support, climate change-related crop losses in key consumer countries would also indirectly impact¹⁰ global importers and consumers.

⁴ <https://www.reuters.com/article/us-china-economy-trade-soybeans/soy-source-brazils-share-of-soybean-exports-to-china-hits-record-idUSKBN1FE111>

⁵ <https://www.reuters.com/article/us-china-economy-trade-soybeans/soy-source-brazils-share-of-soybean-exports-to-china-hits-record-idUSKBN1FE111>

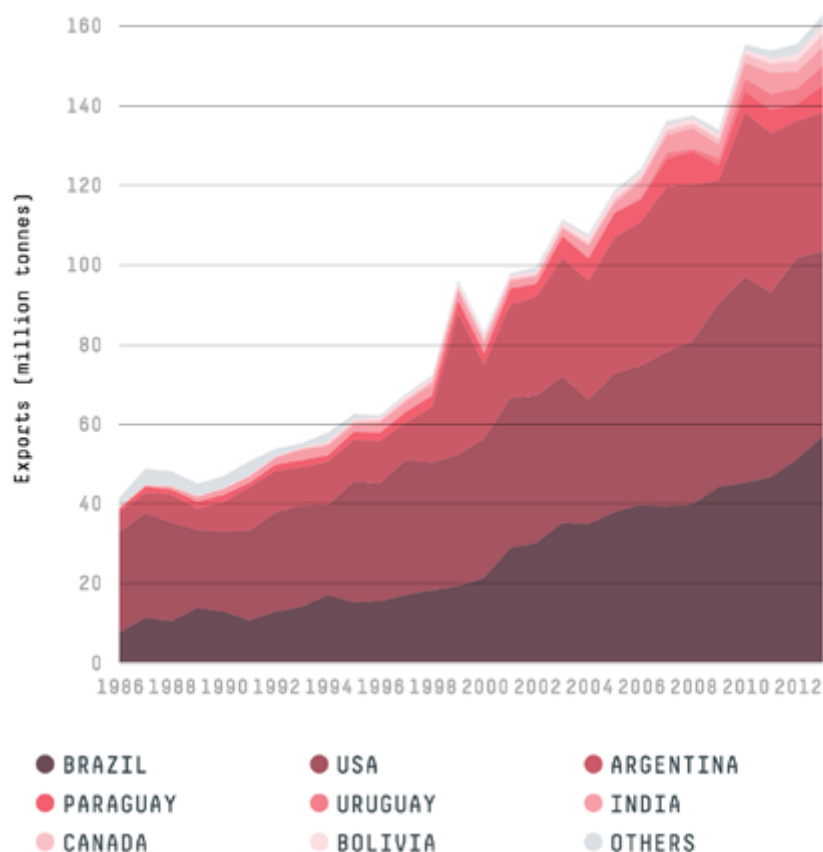
⁶ www.fao.org/faostat/en/#home

⁷ <https://www.reuters.com/article/us-usa-soybeans-china/u-s-soybeans-plunge-on-renewed-fears-of-trade-war-with-china-idUSKBN1J92LN>

⁸ www.fao.org/faostat/en/#home

⁹ <https://wits.worldbank.org/CountrySnapshot/en/BRA/textview>

¹⁰ <https://www.weadapt.org/sites/weadapt.org/files/meetingtheglobalchallengeofadaptation.pdf>



Trends in soy exports 1986-2012

1.3 South America: an emerging powerhouse of commodity crop production and export

Brazil, Argentina and Paraguay, among other South American countries, have rapidly developed into important centres of production and trade in agricultural commodities. Together, they account for around 50% of global soy production (up from around 1% in 1961) and in 2017 exported almost 150 million tonnes globally.

The area of harvested cropland and pasture in these countries has grown from 299 million hectares in 1961 (29% of total land area) to 453 million hectares¹¹ in 2015 (39% of total land area). And, in contrast to many other areas of the world, there is significant potential for further expansion.

While yields per hectare have increased, largely as a result of intensified production, expansion remains an important concern. For example, while soy productivity in Brazil almost tripled between 1961 and 2016, this coincided with a 25-fold increase in soy cropland, with particularly rapid growth since 1990 (see Chapter 3).

Expansion of this type is playing a decisive role in deforestation and loss of sensitive habitats in critical areas including the Amazon and Cerrado landscapes of Brazil, and the Gran Chaco of Argentina and Paraguay.

¹¹ www.fao.org/faostat/en/#home

1.4 Supply chain transparency can help increase the sustainability of tropical export crop production

For agricultural trade to become more sustainable, fast and effective action is required on a large scale. Supply chain transparency is a prerequisite for reliable analysis and intervention planning.

National-level production and trade data have enabled analyses like those presented in this chapter, painting in broad strokes the links between commodity production and deforestation. But these are of little practical use to most decision-makers – whether representing government or corporate interests, whether at home or abroad – who are concerned with tackling specific impacts in specific places.

Later chapters in this Trase Yearbook 2018 showcase the kinds of deep insights made available by Trase’s unique supply chain transparency data and tools.

Chapter 2

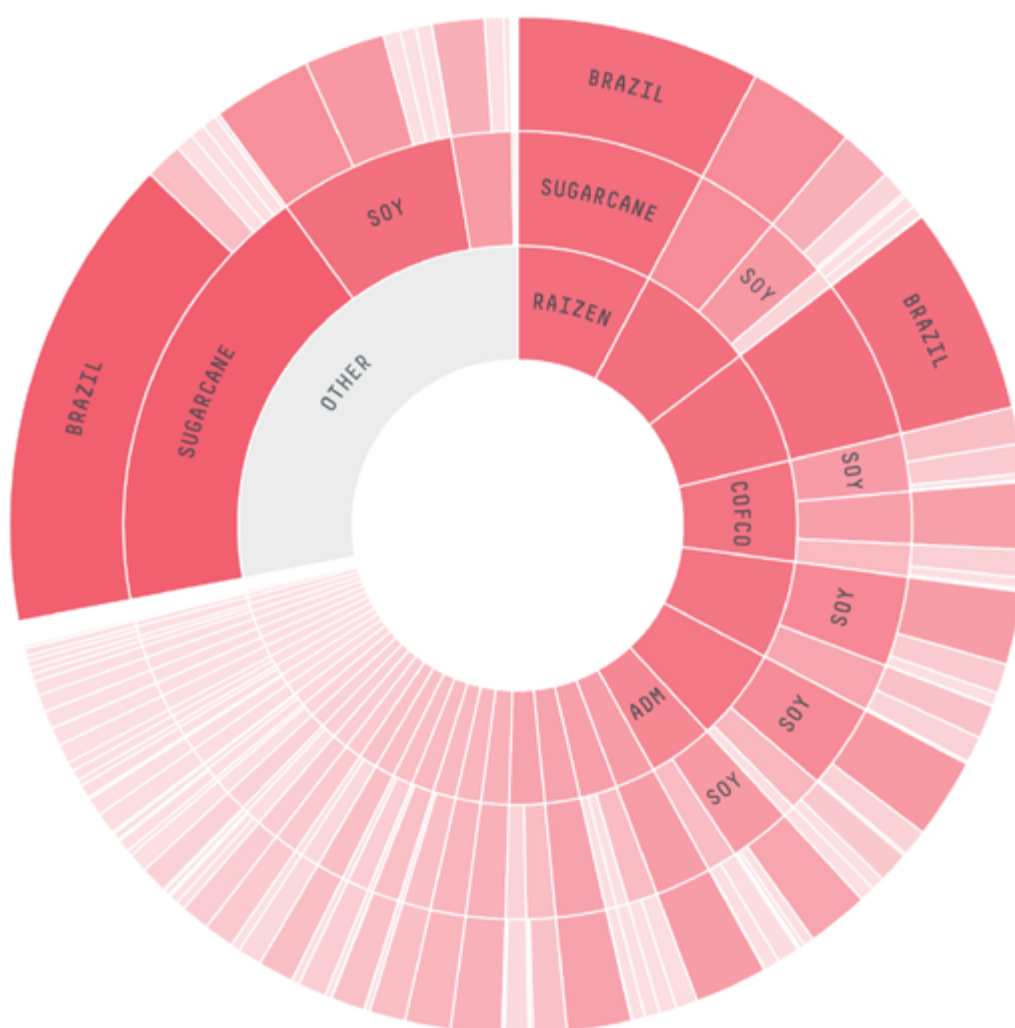
Exports of forest-risk commodities from South America

HIGHLIGHTS

- ✔ Of the 2,500 traders exporting 450 million tonnes of forest-risk commodities from South America, just 36 account for over half of exports.
- ✔ Trase data detail the activities of traders in forest risk commodity supply chains, revealing that many of the largest companies have operations that extend over multiple commodities and multiple producer countries.

Using Trase data, it is possible to analyse in detail the activities of these traders across entire markets, and assess their current and potential role in moving towards more sustainable supply chains.

The eight countries exported a total of more than 450 million tonnes of soy, palm oil, palm kernel oil, cane sugar, maize, cocoa and coffee in 2017. These exports were handled by well over 2,500 traders; but just 36 traders accounted for half of all exports.



CHAPTER 2

2.1 Linking traders to commodities

Companies trading sugar, and sugar-based products like ethanol, represent a significant proportion of exports of these seven commodities. Four of the top ten traders exclusively export sugar products.

The remaining top traders export multiple commodities. And much of the traded volume is made up of maize, soy and cane sugar, coming particularly from two global powerhouses of agricultural production, Brazil and Argentina.



Four of the top ten traders exclusively export sugar products.

Exports of sugarcane products are also notable for the fact that Brazilian production dominates. The top 20 sugar traders in South America exclusively source from Brazil.

Soy and maize exporters, on the other hand, show more diversity. Several of the same traders are dominant in both commodities, notably Archer Daniels Midland (ADM), Bunge, Cargill and COFCO. All of these companies are well established in multiple producer countries, particularly Argentina, Brazil and Paraguay. Chapter 4 gives more information on the sourcing patterns of these companies, while chapters 5 and 6 explore the exposure of these companies to deforestation risk, and linkages between voluntary zero-deforestation commitments and changes on the ground.

Slightly further down the list of major soy traders, we find companies that have a vital role to play in particular producer countries. For example, Amaggi (Brazil), Vicentin (Argentina) and Aceitera General Deheza (Argentina) export the vast majority of their soy from a single country.

Soy, corn and sugarcane products make up the majority of exports by weight. However, it is helpful to look at other forest-risk commodities to get a clearer picture of these supply chains.

South American cocoa exports are dominated by Ecuador, while Brazil and Colombia dominate coffee exports. Olam stands out as a major trader in both cocoa and coffee exports. It sits alongside other familiar names, including major traders of other agricultural commodities, such as Louis Dreyfus and Cargill, and major manufacturers like Nestlé.

2.2 Significant challenges abound. But so too do big opportunities for positive change

The highly consolidated trade in forest-risk commodities illustrated by these data creates both important opportunities and significant challenges for moving towards more sustainable supply chains.

On the one hand, the key players can exert tremendous leverage to promote superior standards among thousands of producers, in terms of avoiding deforestation, agricultural practices, labour conditions and many other aspects of sustainability.

On the other hand, their dominance gives them considerable power to suppress farm-gate prices, exert political influence, and justify their practices in the name of food security, often at the expense of social or environmental concerns¹².

Later chapters in the Trase Yearbook 2018 assess in more detail how a handful of major traders are involved in the supply chains of Brazilian soy, their potential exposure to deforestation risk, as well as the impact of their commitments to combating tropical deforestation.

¹² <https://onlinelibrary.wiley.com/doi/abs/10.1002/agr.20271>

Chapter 3

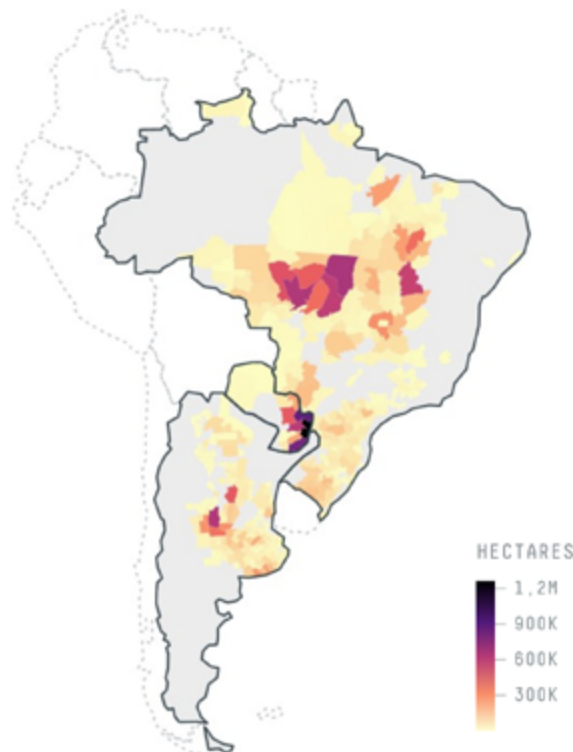
Soy expansion in South America

HIGHLIGHTS

- ✔ Argentina, Brazil and Paraguay now produce almost 50% of the world's soy, up from just 3% fifty years ago.
- ✔ Much of this growth comes from a forty-fold increase in land farmed for soy, from 1.4m ha in 1970, to 56m ha today.
- ✔ Expansion into native vegetation threatens key habitats in these countries.

The story of soy in South America is one of astounding growth.

Fifty years ago, Brazil, Argentina and Paraguay together accounted for just 3% of the world's soy production. By 2016 that number had risen to almost 50%. Soy is now South America's most traded agricultural commodity. This is in response to growing global demand, particularly for soy as an animal feed as the consumption of meat, eggs and dairy has soared. Today, these three countries account for more than 95% of the continent's harvested area for soy.



Soy expansion in Brazil, Argentina and Paraguay in 2015

3.1 A brief history of an agricultural miracle

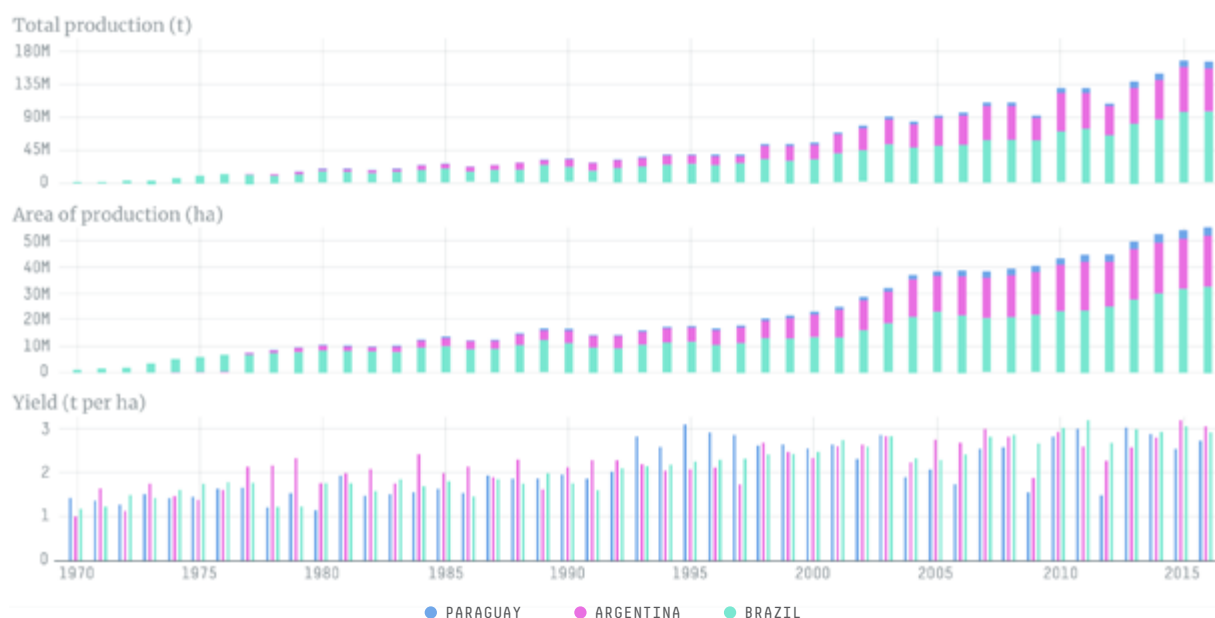
The 1970s saw the first big increases in soy production in South America. Global demand for soy was fuelled by the collapse of Peruvian anchovy fisheries, a major global source of protein for animal feed. In 1973, then by far the world's biggest exporter of soy, the US imposed an embargo on soy exports, fearing that heightened overseas demand would disrupt its domestic feed supply chain. Soy prices in the world market tripled. Japan, then a major importer of US soy, was hit particularly hard and started to seek new suppliers. In 1980, the US would again embargo soy exports, this time to the Soviet Union on account of its invasion of Afghanistan.

These events sent a powerful signal to South American governments to ramp up soy production. They responded by promoting colonization and expansion of agricultural frontiers through subsidised credit, price support and technical assistance to producers, and increased investment in agricultural research and rural infrastructure.



Soy expansion into native vegetation threatens key habitats across South America. Photo credit: Toby Gardner

Between 1970 and 1980, soy production in Brazil, Argentina and Paraguay increased twelvefold. At the same time, its cultivated area increased eightfold¹³, from 1.4 million hectares (Mha) to 11.3 Mha, alongside a significant increase in yields.



Trends in soy production in Argentina, Brazil and Paraguay

¹³ www.fao.org/faostat

In the next decades, continued growth was sustained by increasing global demand for animal feeds. In the 1990s and 2000s, global concern about “mad cow” disease (bovine spongiform encephalopathy, or BSE) led to stricter legislation on the use of animal products in livestock feed across Europe, creating extra demand for soy as a safer alternative protein source.

3.2 In just a few decades, a number of important ecosystems have come under threat from soy’s rapid expansion in South America

Soy expansion in South America was initially concentrated in the subtropical regions of northeastern Argentina, southern Brazil, and eastern Paraguay where conditions were most suited to existing soy varieties introduced from the US.

But from the mid-1970s, agronomic improvements, and government investment, quickly pushed agricultural expansion into tropical regions. Over the following decade, this opened up the centre of Brazil to the development of industrial-scale production of soy, rice, cotton, maize and sugarcane.

Soy expanded rapidly northwards into the Cerrado, with production by the mid-1990s across the states of Mato Grosso do Sul, Mato Grosso, Bahia and Goiás. Since then, public and private sector investment have continued to increase, and international companies have played an ever-more important role. The agribusiness sector has boomed, and soy has become the country’s most valuable export commodity¹⁴ – overtaking even oil and mineral exports.



The Cerrado, arguably the most species-rich savannah biome in the world.
Photo credit: istock.com/thirata

¹⁴ <https://wits.worldbank.org/CountrySnapshot/en/BRA/textview>

Since the 1970s, the Cerrado has lost nearly half of its natural vegetation, originally covering some 200 Mha, to extensive cattle grazing and agricultural expansion. As one of the most profitable land uses, soy has been a major driver of speculative land clearance. Using the Brazilian government deforestation monitoring data from PRODES¹⁵ an estimated 1.8 million ha of soy in the Amazon in 2016 and 3.5 million ha of soy in the Cerrado in 2015 were under native vegetation in the year 2000 – amounting to roughly 40 and 20% of the total area of soy in each biome respectively today. While it cannot be claimed that soy expansion was a factor in all this land conversion, it undoubtedly played a major role.

This has had severe impacts on biodiversity and environmental services¹⁶, including climate control, hydrological cycling and pollination. And, hand in hand with economic growth, it has caused social displacement¹⁷ and an increase in social inequality.

3.3 A handful of dominant soy traders emerge

It was during this period of soy expansion, in the 1990s and early 2000s, that some of the best-known and biggest players in soy established their dominance, coming to invest in Brazilian soy for the first time in history.

Archer Daniels Midland (ADM), Bunge, Cargill and Louis Dreyfus all made large investments and grew rapidly in Brazil through a series of mergers and acquisitions, before continuing to expand significantly through to the early 2000s. After this period of massive expansion, the dominance of these four companies would become established for the next two decades.

Importantly, the investments they made in the late 1990s and 2000s established firm links between each of the companies and different geographic centres of soy production that continue to this day (see Chapter 4).

Investment in the soy industry at that time – including the building of production, storage and processing units in Brazil and other South American countries – was encouraged by rapidly rising demand for soy and the vast areas of land available for production. The Brazilian Government put in place favourable tax laws for the export of primary products, including soy. The most famous of these was the 1996 Kandir law that eliminated state taxes to stimulate export-oriented productive sectors and improve Brazil's trade balance. These measures spurred Brazilian soy exports, alongside increased demand from China and the EU, particularly after Europe's ban on the use of animal protein for feedstock in 2001.

Brazilian farmers, of all types of crop, could not have flourished as they did without access to cheap rural credit, price guarantees and insurances. During the 2015 crop year, for example, the Brazilian Government offered BRL 187.7 billion (USD 62.4

¹⁵ www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes

¹⁶ <https://www.nature.com/articles/s41559-017-0099>

¹⁷ <https://www.tandfonline.com/doi/abs/10.1080/03066150.2015.1010077>



Argentina, Brazil and Paraguay now produce almost 50% of the world's soy, up from just 3% fifty years ago. Photo credit: [istock.com/josemoraes](https://www.istock.com/photo/1050000000/josemoraes)

billion) in rural public credit to banks, cooperatives and Brazilian farmers – up from around BRL 50 billion (USD 17.3 billion) in 2003. In the Cerrado states, producers received around 70% of total public rural credits distributed in Brazil.

The introduction of genetically-modified (GM) crop technology in the 1990s in Argentina, and during the early 2000s in Brazil and Paraguay, further stimulated development of the soy sector. New seed varieties helped producers increase their yield and expand into areas that were not agriculturally viable before. Today, more than 90% of the soy production in the region is GM.

Brazil is the region's – and, since 2018, the world's – largest producer of soy, with average productivity rates having tripled since 1970, from 1.1 tonnes per hectare (t/ha) to 2.9 t/ha in 2016. During the same period, the area of the country cultivated for soy grew 25 times, from 1.3 Mha in 1970 to more than 33 Mha in 2016¹⁸.

This upward trajectory looks set to continue with a more positive outlook for Brazilian soy than ever. In April 2018, Brazil's vegetable oil association, ABIOVE, said it expects the nation's 2018 soybean crop to reach a record 117.4m tonnes¹⁹ – up 2.3% on its previous estimate.

The price of Brazilian soy has also seen a marked rise²⁰ in recent months due to severe droughts in Argentina and the first exchanges in a possible trade war between China and the US. The United States Department of Agriculture (USDA) now forecasts²¹ a 2% increase in the soy harvest area in Brazil this year to 35.8 Mha due to predicted higher prices and the growth in both Chinese demand and domestic consumption.

¹⁸ www.fao.org/faostat/en/#home

¹⁹ <https://www.agricensus.com/Article/Abiove-revises-upwards-Brazil-soybean-crop-projection-1373.html>

²⁰ <https://www.dtnpf.com/agriculture/web/ag/perspectives/blogs/south-america-calling/blog-post/2018/05/11/brazilian-farmers-take-advantage>

²¹ <https://www.feednavigator.com/Article/2018/04/27/USDA-Brazil-looks-to-expand-soybean-planted-acres-shrink-ending-stocks>

3.4 Soy expansion has helped create new agricultural frontiers within threatened ecosystems

In the last ten years, the Brazilian Cerrado, Argentine Gran Chaco and Paraguayan Atlantic Forest have been the major expansion zones of soy in South America. In Brazil, much of the soy expansion is now happening in the agricultural frontier area of Matopiba (see also Chapter 5).

Using the Trase data it is possible to assess, with a new level of precision, the role played by different companies in driving this rapid increase in the prominence of soy, including the markets that they serve, and the areas from which they source. Making these connections can transform our understanding as to the role different buying companies and countries play in shaping local development trajectories, and the future sustainability of soy.

Chapter 4

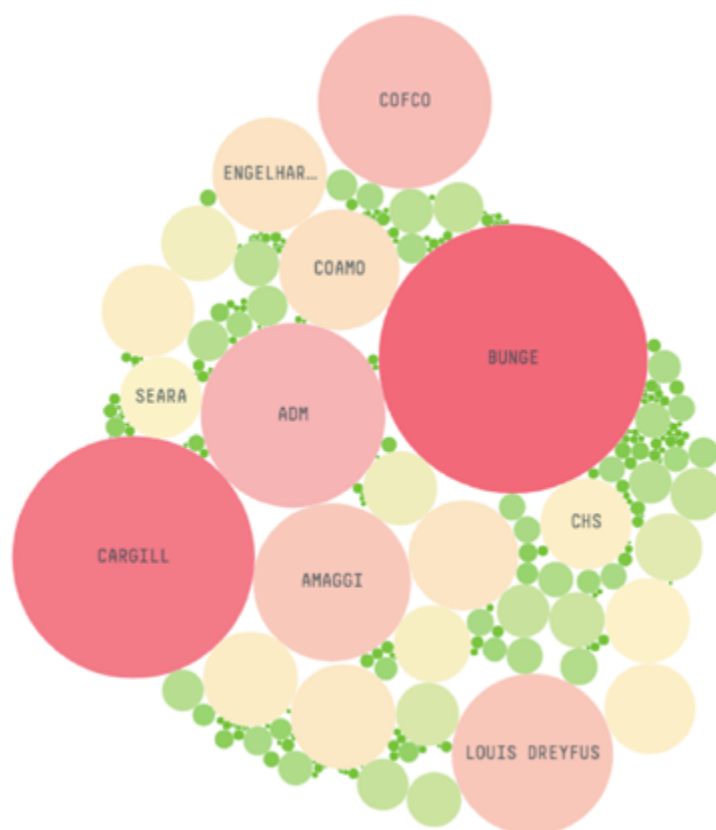
Brazilian soy supply chains: linking buyers to landscapes

HIGHLIGHTS

- ✔ The soy trade in Brazil has long been dominated by just a handful of major traders. In 2016 the largest six exporters traded almost 60% of soy.
- ✔ Changing market dynamics and strong growth in global demand for soy – particularly from China – have brought a number of fast-growing new entrants to the market, many of which are operating at the new soy frontier in Matopiba.
- ✔ Major private infrastructure investments underpin the strong connections of many traders to distinct regions of production. This underscores the key role these companies can play in shaping the development trajectories of these regions and the future sustainability of soy.

More than 1,000 companies exported soy from Brazil between 2005 and 2016, but no more than 40 have held a significant share of the market – over 1% of total trade – in any given year. Amongst these, the global commodity traders Archer Daniels Midland (ADM), Bunge, Cargill and Louis Dreyfus have long predominated, with Brazilian firms Amaggi, COAMO and Bianchini also accounting for a sizeable part of the trade. In recent years, the Chinese food giant COFCO has grown rapidly to come alongside these major traders in terms of scale and influence.

In 2016, the six largest traders – Bunge, Cargill, ADM, COFCO, Louis Dreyfus and Amaggi – accounted for 57% of all soy exports from Brazil.



The number and dominance of soy traders in Brazil in 2016

These large firms are asset rich. With different levels of vertical integration, they each operate a network of soy related facilities that help mark out their different sourcing regions across Brazil. These include not only silos and warehouses that enable traders to respond rapidly to demand signals, but also large crushing facilities, railroads and port terminals.

These investments in infrastructure – taken together with their trading relationships and the commercial strategies they pursue – help explain the sourcing patterns of major soy traders, and underpin strong, often long-standing connections with specific regions of production. The latest Trase data estimate that for some two-thirds of Brazil's soy-exporting municipalities – distributed across the entire country – more than half of exports were handled by a single trader, while in approximately one-fifth of municipalities a single trader handled all of the exports. These connections highlight the key role these companies can play in shaping local development trajectories, and the future sustainability of soy.

Bunge – 11,005,247 tonnes exported in 2016 (16.7%)

Headquartered in New York, Bunge has long been the largest soy trader in Brazil. Despite having now been present in the country for over a century, it was not until 1997 that Bunge secured its preeminent position. By acquiring Ceval²², the largest soy processor at the time, Bunge secured a series of strategic assets in central Mato Grosso and western Bahia, where it continues to source a large proportion of its soy. According to self-disclosures and official records, its assets include 8 crushing facilities (approx 27,000 tn / day), 140 silos and 6 port terminals.

Cargill – 8,910,912 tonnes exported in 2016 (13.5%)

Cargill is the largest privately-owned company in the US and has been operating in Brazil since 1965. With operations spanning the majority of Brazil's soy producing states, Cargill has particularly close connections to north and north-west regions of the Amazon in which it operates two port terminals, one in Santarém and the other in Porto Velho. According to self disclosures and official records, its assets include 6 crushing facilities (approx. 14,000 tn/day), 140 silos and 5 port terminals.

ADM – 5,176,241 tonnes exported in 2016 (7.86%)

Archer Daniels Midland (ADM) is headquartered in Illinois, US and has been operating in Brazil since 1997. This multinational commodity trader sources most of its soy from Mato Grosso state, where it operates Brazil's single largest soy crushing facility, in Rondonópolis, with a capacity of 7,000 tons per day. According to self disclosures and official records, its assets include 5 crushing facilities (approx. 13,600 tn/day), 60 silos and 6 port operations.

COFCO – 4,582,884 tonnes exported in 2016 (6.96%)

COFCO is the most prominent of the new entrants into the Brazilian market. As China's largest food and agriculture company, it only entered the Brazilian soy export market in 2014 having acquired two fast-growing exporters, the Singaporean-listed Noble and Dutch based Nidera. According to self disclosures and official records, its assets include 2 crushing facilities (approx. 5,200 tn/day), 25 silos and 2 port terminals.

Louis Dreyfus – 3,939,337 tonnes exported in 2016 (5.99%)

Louis Dreyfus Company is a Dutch multinational which has operated in Brazil since 1942. Its operations are concentrated in Brazil's South and Center-West, with the majority of its exports leaving via the ports of Santos and Paranaguá. Since 2009 it has been part of a joint venture with Amaggi in the frontier region of Matopiba, which now also includes the Japanese cooperative Zen-Noh. According to self disclosures and official records, its assets include 3 crushing facilities (approx. 8,000 tn/day), 40 silos and 1 port terminal.

Amaggi – 3,782,863 tonnes exported in 2016 (5.75%)

Amaggi is the largest of the Brazilian soy traders. It was established in 1977 by the Maggi family and is headquartered in the largest soy producing state of Mato Grosso. Unlike the other major traders, Amaggi produces much of its own soy. In addition to its trading infrastructure, it operates ten farms with a collective area of more than 200,000 hectares²³. Since 2009 it has been part of a joint venture with Louis Dreyfus in the frontier region of Matopiba, which now also includes the Japanese cooperative Zen-Noh. According to self disclosures and official records, its assets include 2 crushing facilities (approx. 5,000 tn/day), 30 silos and 2 port terminals.

²² www.fundacaobunge.org.br/acervocmb/assets/historicos/historico-ceval.pdf

²³ amaggi.com.br/wp-content/uploads/2014/08/Relatorio-de-sustentabilidade-2013-Versão_Completa_Inglês.pdf

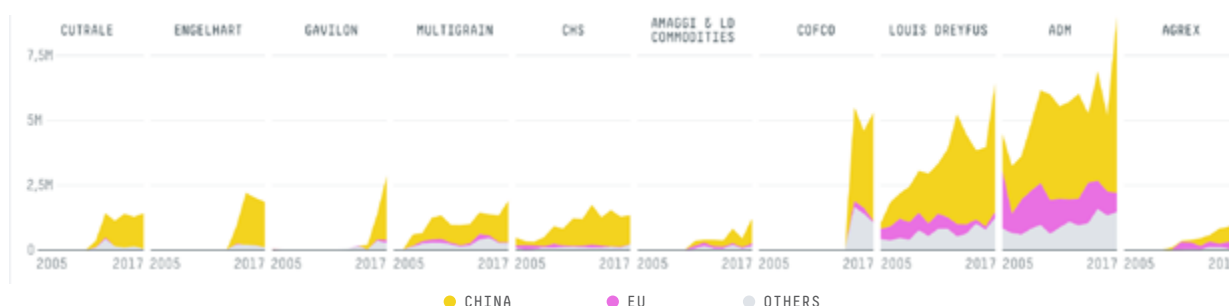
4.1 A fast-growing market and new entrants on the rise

In recent years, shifting market dynamics and the strong growth in global and domestic demand for soy have created new opportunities for trading companies, and increased pressure for further expansion into agricultural frontier regions. As two of the world's largest producers of poultry and pork – and therefore consumers of animal feed – the Brazilian and Chinese markets have been at the forefront of this growth.

With around a third of feed for poultry and pork typically being comprised of soy cake, large meat producers have developed industrial grain processing operations to rival some of the largest soy traders. In Brazil, for example, the major poultry producer BRF operates multiple crushing facilities with the capacity to process around 3,000 tons of soy per day. Brazil is the world's largest exporter of chickens and also has a growing domestic market.

Meanwhile, as the country which produced almost half of the world's pork²⁴ in 2017, China has fast emerged as the biggest global importer of soy. Exports of soy from Brazil to China have risen by 300% over the last decade, with much of the trade being in raw beans that are processed into feed on arrival.

As shipments to China have grown to comprise two-third of Brazil's soy exports (and nearly 80% of its raw beans exports), major traders have shifted their patterns of operation and investment accordingly. It has also spurred the entry of new companies into the market.



The response of different traders to China's emergence as the world's biggest soy importer

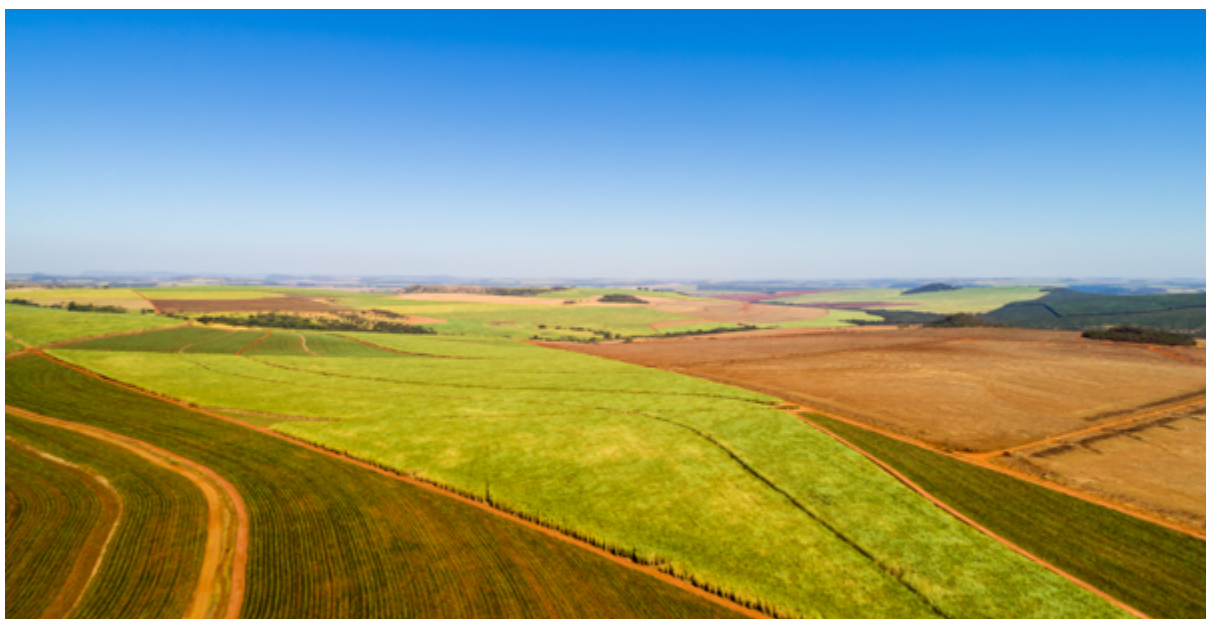
The new entrants are diverse, and include joint-ventures by long standing players, large companies from Asia, and established Brazilian companies from other sectors.

Cutrale and Engelhart, for instance, are Brazilian companies that have transitioned to trading soy from different sectors. Once focused solely on the citrus fruit business, Cutrale has repurposed assets in the south of Brazil to establish itself as a significant trader of soy since 2012. Meanwhile Engelhart, which was spun off from the investment bank BTG Pactual, runs an 'asset-light' operation comprised primarily of wholesale facilities in Mato Grosso, Goiás and Rio Grande do Sul.

²⁴ https://apps.fas.usda.gov/psdonline/circulars/livestock_poultry.pdf

Amongst major Asian traders, there has been a move to acquire upstream assets in order to secure supply and grow. COFCO acquired two of the fastest growing traders, Noble and Nidera in 2014, establishing it as the fourth largest trader in Brazil by the following year. From Japan, several sogo sosha – general trading companies – have also made a strong entry into the Brazilian soy industry in recent years. This includes Marubeni, Mitsui and Mitsubishi which own Gaviolon, Multigrain and Agrex respectively.

4.2 New entrants attracted to Matopiba



Matopiba is the most active agricultural frontier in Brazil, with soybeans being the most important crop. Photo credit:istock.ψom/gustavofrazao

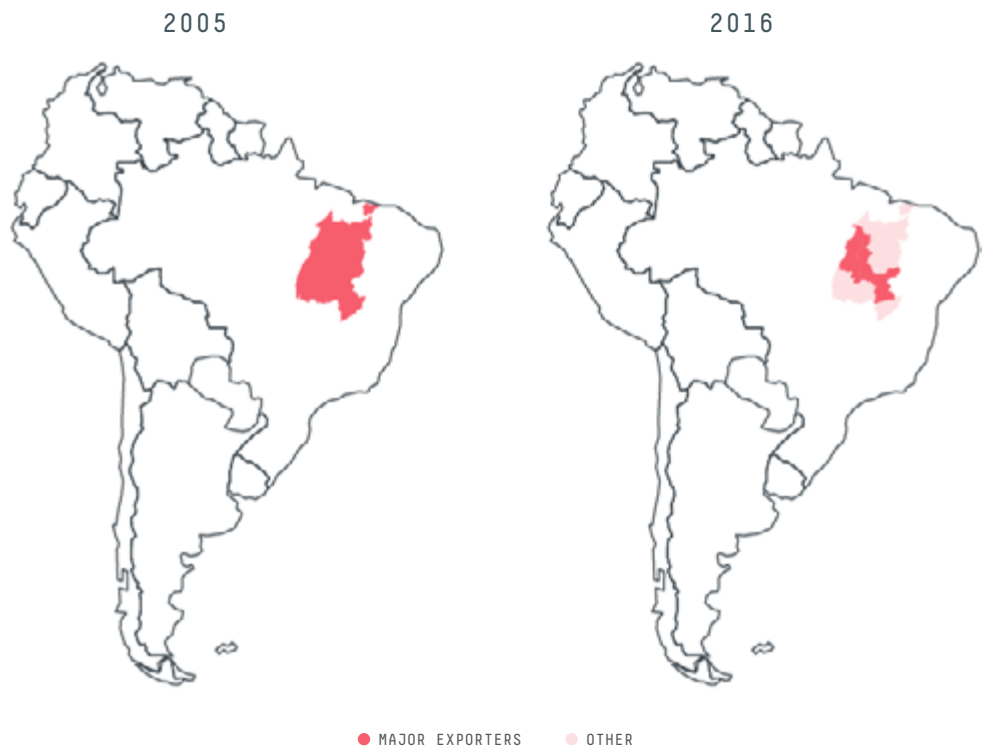
Many of these new and emerging traders have clear links to the Cerrado and, more specifically, to the frontier region of Matopiba. Several factors have made this region attractive to new entrants, including public sector support, new export routes, and lower levels of environmental regulation.

Through major capital investment, a number of companies have rapidly emerged as key players in the soy trade here in recent years. For instance, the newly-developed Tegram grains terminal in Itaqui port, Maranhão is jointly owned²⁵ by several traders – Amaggi & LD commodities (now Amaggi LD Zen-Noh), Glencore, CGG Trading and Toyota Tsusho's NovaAgri.

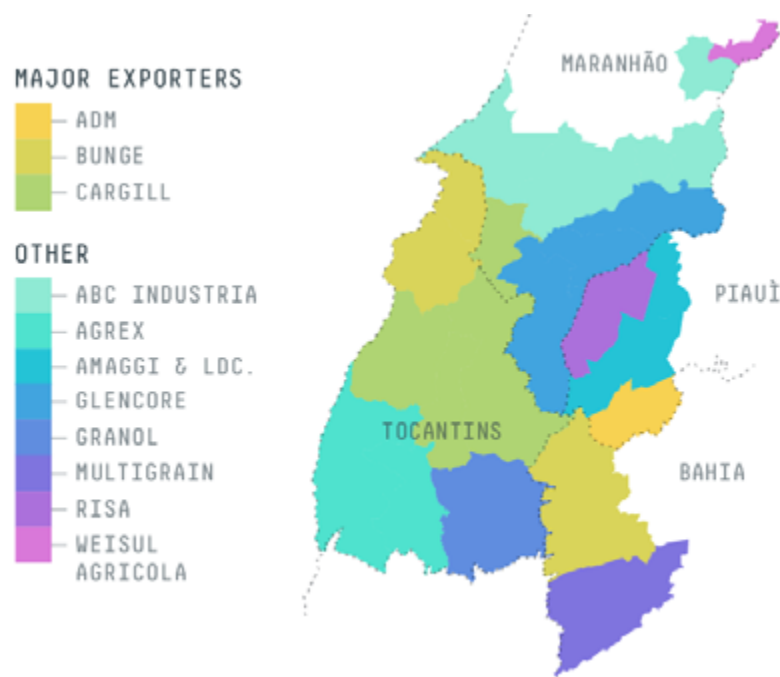
With an advantageous position from which to export to Asia – the port is 4,000 km closer to the Panama Canal than Brazil's main soy exporting port of Santos – many of

²⁵ <https://uk.reuters.com/article/uk-louis-dryfs-com-m-a-zennoh/dreyfus-amaggi-sell-stake-in-brazil-jv-to-japans-zen-noh-idUKKBN15029X>

the traders most closely associated with the Chinese market are also operating here. The map below shows how new entrants have come to dominate in parts of Matopiba between 2005 and 2016, whilst certain areas remain primarily in the hands of the established major traders.



Dominance of major traders in Matopiba, 2005 and 2016



Most dominant trader per microregion in Matopiba, 2016

But links to Matopiba also mean increased deforestation risk. During the last decade more than 37% of soy expansion in the Matopiba region was due to direct conversion of Cerrado vegetation. Accordingly, companies with a strong presence in Matopiba have some of the highest relative deforestation rates – in terms of hectare of land cleared of native vegetation per tonne of exports – in the country.



The Brazilian Cerrado. Credit: Alexander Lees

4.3 Opportunities to transition to more sustainable supply chains

Given these dynamics, different companies and consumer markets will have significantly different roles to play in efforts to strengthen the sustainability of soy supply chains.

Companies that have a physical presence in a landscape – such as processing and storage facilities – have a key role to play in ensuring a supply of more sustainable soy by working directly with farmers. They can do this, for example, through closer enforcement of legal compliance and standards, and by working directly with producers to lower the costs and increase the incentives for producing more sustainable, deforestation-free soy. This underscores the vital role of the biggest traders that own the vast majority of processing and storage facilities – and increasingly those newcomers that are investing heavily in the new soy frontiers. At the same time it is vital to foster new sustainability initiatives and partnerships in emerging markets, particularly China.

By linking soy traders and buyers to the places where soy is grown, Trase data can help to identify and manage risks, highlight opportunities for new partnerships and investment to improve sustainability, and monitor progress over time. This provides a critical missing part of the puzzle of shifting soy to a more sustainable footing.

Chapter 5

Assessing deforestation risk in Brazilian soy exports

HIGHLIGHTS

- ✔ The six largest soy traders accounted for over half of soy exports from Brazil in 2016 and two-thirds of the total deforestation risk associated with soy expansion in the preceding decade.
- ✔ Sourcing patterns of trading companies determine exposure to deforestation risk.
- ✔ Companies sourcing soy from Matopiba are exposed to the highest deforestation risk.
- ✔ Half of the total deforestation risk associated with exports of Brazilian soy in 2016 was linked to Chinese imports.
- ✔ Despite importing lower volumes EU countries are exposed to a higher relative deforestation risk- ha per tonne - than China.

Today, soy fields cover more than 33 million hectares (Mha) in Brazil – an area the size of Malaysia – up from 13 million ha in 2000. The expansion of soy (see Chapter 3) has transformed the countryside in much of South America, delivering both economic gains – soybeans made up 10% of total exports (US\$ 20 billion in Brazil in 2016²⁶) – and environmental and social impacts.

Soy expansion is both a direct and indirect cause of the large-scale conversion of biodiverse forests and savannahs in Brazil, and disentangling the links between soy expansion and the loss of forests and other native vegetation is complicated.

Direct deforestation occurs when native vegetation is cleared and planted with soy within a short period of time. Between 2005 and 2016, at least 1.1Mha (an area larger than seven times the size of London) of native vegetation in the Amazon and Cerrado biomes were directly cleared for soy. This is 3% of the total area that soy now covers across Brazil, and 1% and 7% of the total area of soy in the Amazon and Cerrado biomes, respectively.

Indirect conversion occurs on an even larger scale. The arrival of high-value cash crops like soy can drive land speculation, pushing up the price of surrounding land and incentivising further clearance. Newly cleared land is often first used as cattle pasture before eventually being sold or rented out for soy production. This expansion of soy onto pasture can lead, in turn, to further deforestation as cattle ranching moves into frontier regions where deforestation continues. Identifying the precise role that soy played in driving deforestation in years before soy was planted is complex.



Today, soy fields cover more than 33 mha in Brazil – up from 13 mha in 2000. Photo credit:Toby Gardner

²⁶ <https://atlas.media.mit.edu/en/profile/country/bra/>

What is possible to measure is the area of land currently planted with soy that was under native vegetation in the recent past. In the Amazon, 0.94 million ha of soy cropland in 2016 was under native forest in 2003, and similarly, 1.2 million ha of soy cropland in the Cerrado was under native vegetation in 2003. These numbers are even larger if the time-series is extended back to 2000 and government PRODES data is used to estimate deforestation in the Cerrado rather than the more conservative estimates from the LAPIG sensor. In this case approximately 1.8 million ha of soy in the Amazon in 2016 and 3.5 million a of soy in the Cerrado in 2015 were under native vegetation in the year 2000 – amounting to roughly 40 and 20% of the total area of soy in each biome respectively today. While it cannot be claimed that soy expansion was a factor in all this land conversion, it undoubtedly played a major role.

This first Trase Yearbook focuses, however, on deforestation risk associated with direct conversion for soy in each year. Future analyses of Trase data will include assessments of conversion in preceding years, including the impacts of indirect conversion.

It is important to note that this measure of direct conversion is conservative. Preparation of land for planting can occur over multiple years. Also, we use annual deforestation alert data from the LAPIG alert system²⁷, which often underestimates clearance in the Cerrado biome.

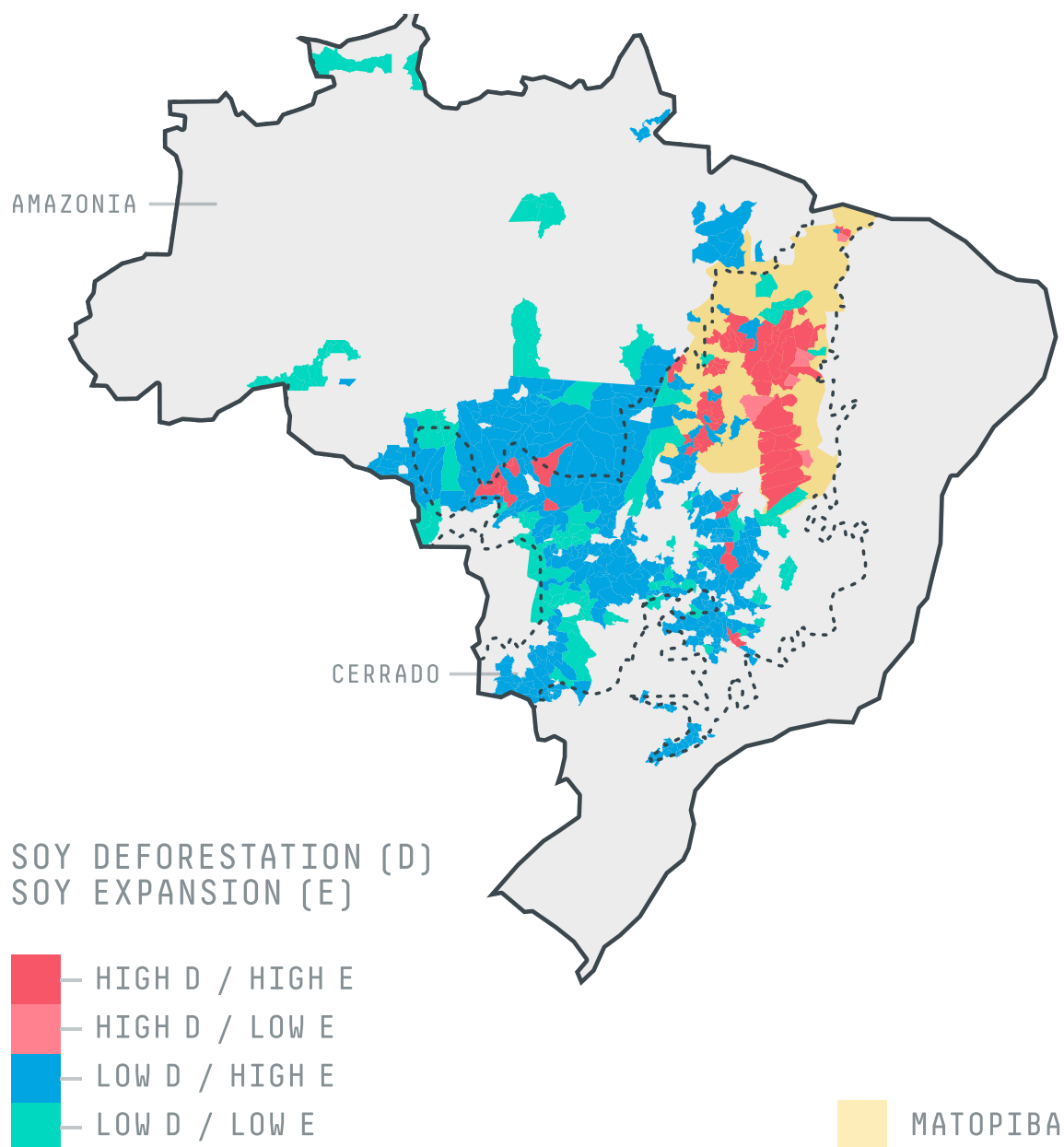
5.1 Shifting patterns of soy expansion and deforestation across Brazil

Today, direct deforestation for soy is particularly low in the Amazon, having fallen from 30% to less than 1%²⁸ between 2006 and 2014. This is partly due to the impact of the Soy Moratorium which, together with a combination of other governance measures focused on curbing deforestation in the biome, has helped reduce the proportion of soy expansion directly associated with deforestation.

In the last decade, most soy deforestation in Brazil has instead occurred in the transition area between the Amazon and the Cerrado in Mato Grosso state, and in the Matopiba region of the Cerrado – arguably the world’s fastest growing soy frontier. Beyond Brazil, deforestation for soy in South America is most notable in the dry subtropical forests of the Gran Chaco of Argentina, Paraguay and Bolivia – another of the world’s ‘forgotten biomes’ that is home to a unique biodiversity, as well as a large number of indigenous groups. Future editions of the Trase Yearbook also plan to assess the sustainability of soy supply chains originating in the Chaco, in addition to the Brazilian Amazon and Cerrado.

²⁷ <https://www.lapig.iesa.ufg.br/lapig/index.php/component/jdownloads/download/4-periodicos/322-an-operational-deforestation-mapping-system-using-modis-data-and-spatial-context-analysis>

²⁸ science.sciencemag.org/content/347/6220/377?sid=44327b90-2737-4de1-bb36-2ada6c435626



Frontiers of soy expansion in Brazil, 2010-2016

Municipalities are divided into four categories: high soy expansion with high direct soy deforestation; high soy expansion with low direct soy deforestation; low soy expansion with high direct soy deforestation; and low soy expansion with low direct soy deforestation. High soy expansion is defined as >1% growth in the proportion of the municipality that is planted with soy each year. High direct soy deforestation is defined as >200 ha direct soy deforestation per 1,000 ha soy cropland (20%). In regions of high expansion and low deforestation, soy expansion tends to occur into cattle pasture or other crops, where its environmental impacts are lower, though it may still cause indirect deforestation. The main regions of high expansion and high deforestation are shown in red (concentrated in the cerrado and particularly matopiba). The older deforestation frontiers of the cerrado, where soy is predominantly expanding into previously cleared areas, are shaded in blue.

5.2 Matopiba: one of the worlds most active frontiers of soy expansion

In the last decade, the Matopiba region in the northeast of the Cerrado, which covers around a third of the biome, has become one of the world's major hotspots for soy-associated deforestation and habitat loss.

Matopiba owes its very identity to its emergence over the last decade as a new agricultural frontier – its name is made up of the initials of the four Brazilian states of Maranhão, Tocantins, Piauí and Bahia, which share borders in Matopiba. Between 2001 and 2017, soy expanded by 310% in Matopiba alone, and accounted for 14% – approximately 4 million ha – of all soy expansion in Brazil, although the relative rate of expansion has slowed in the last decade, with an increase of 135% between 2007 and 2017 from 1.7 to 4 million ha.



Companies sourcing soy from Matopiba are exposed to the highest deforestation risk of all companies exporting soy from Brazil.
Photo credit: [istock.com/marabelo](https://www.istock.com/marabelo)

This expansion has been a major driver of economic growth in the region²⁹. In 2015 soy represented 17% of the GDP of soy producing municipalities as a whole, whilst amongst the top producers the contribution of soy to municipal GDP was more than half, and reaching more than two-thirds in epicentres of soy production like Formosa do Rio Preto in the state of Bahia and Baixa Grande de Ribeiro in Piauí. For municipalities with a large soy production (>100 million BRL) the contribution of soy to municipal GDP is approximately twice that in Matopiba as it is for municipalities in the rest of the Cerrado biome.

The environmental cost of the rapid expansion of soy in Matopiba is most visible in the clearance of native Cerrado vegetation. Using a conservative estimate of deforestation from the LAPIG alert system, 850,000 ha of Cerrado vegetation in Matopiba were cleared directly for soy between 2005 and 2016. This area is equivalent to 20% of the total area of soy planted in 2016 and 37% of the total area of soy expansion during that period, with the remainder expanding onto land that was initially cleared for some other land-use than soy. Most strikingly 76% of the total area of Cerrado vegetation that was directly cleared for soy between 2005 and 2016 was within the Matopiba region.

Looking ahead Matopiba is at particular risk of further soy-associated deforestation for a number of reasons.

Firstly, there is a large amount of ongoing investment in soy infrastructure in Matopiba, with over 100 new soy storage and wholesale facilities being opened between 2005 and 2015. While most of the total soy-crushing capacity (turning soybeans into soy oil and soy cake) is in Brazil is in the south of the country, Matopiba has seen a 75% increase in crushing capacity over the same period.

Secondly, Matopiba still has high levels of native vegetation cover, and some of the largest expanses of undisturbed savannah in the Cerrado.

Thirdly, compared to the Amazon, the Cerrado has relatively low levels of legal protection. Just 20–35% of the native vegetation in each individual private property in the Cerrado is protected from clearance by Brazil's new Forest Code³⁰, compared to 80% in the Amazon. And only 7.7% of the Cerrado is in any kind of public protected reserve compared to almost 50% in the Amazon.

Finally, the Matopiba region includes some of the poorest areas of Brazil, with low levels of institutional and technical capacity in local government agencies, including in environmental enforcement.

These factors suggest that the already considerable momentum behind soy expansion in Matopiba will continue to grow. Reconciling the demand for this expansion with the importance of conserving remaining areas of Cerrado vegetation represents an immense challenge. Yet further loss is not inevitable given the existence of nearly 20 million hectares of already cleared land, much of which is degraded, low productivity pasture, that is classified as suitable for soy – and with appropriate territorial planning presents a strategic opportunity³¹ for both agricultural development and conservation.

²⁹ <https://www.ibge.gov.br/estatisticas-novoportal/economicas/contas-nacionais/9088-produto-interno-bruto-dos-municipios.html?=&t=o-que-e>

³⁰ assets.wwf.org.uk/downloads/wwf_brazils_new_forest_code_guide_1.pdf

³¹ www.inputbrasil.org/wp-content/uploads/2016/11/The-expansion-of-soybean-production-in-the-Cerrado_Agroicone_INPUT.pdf

5.3 Major companies and brands are increasingly exposed to legal and reputational risks associated with unsustainable soy expansion

Recent events have underscored the reputational, legal and even operational risks for soy traders and other downstream buyers that are linked to regions where soy is causing deforestation and land conversion. High-profile campaigns³² have targeted global brands that source soy from high-risk areas, including the Cerrado in Brazil, and the Argentinian and Paraguayan Chaco.

In May 2018, some of Brazil's biggest soy traders, including Cargill and Bunge, alongside other transnational commodity companies ABC Indústria e Comércio, JJ Samar Agronegócios Eireli, and Uniggel Proteção de Plantas, were fined as part of the Brazilian Environment Agency's Operation Soy Sauce³³. These companies were found to be sourcing soy from areas under embargo due to illegal deforestation, attracting fines of BRL 24.6 million (USD 6.7 million).

Such risks do not only apply to soy traders and consumer goods brands. In 2016 the Brazilian government fined the bank Santander BRL 50 million (USD 16 million) for financing the planting of soy and other grains in embargoed areas³⁴.



Agriculture at the forest frontier" Credit: Alexander Lees

³² www.mightyearth.org/germanys-mystery-meat-despite-grown-in-germany-marketing-investigation-shows-large-companies-selling-meat-connected-to-the-destruction-of-amazon-rainforest-2/

³³ <https://news.mongabay.com/2018/06/29-million-deforestation-fines-game-changer-for-brazilian-soy-trade/>

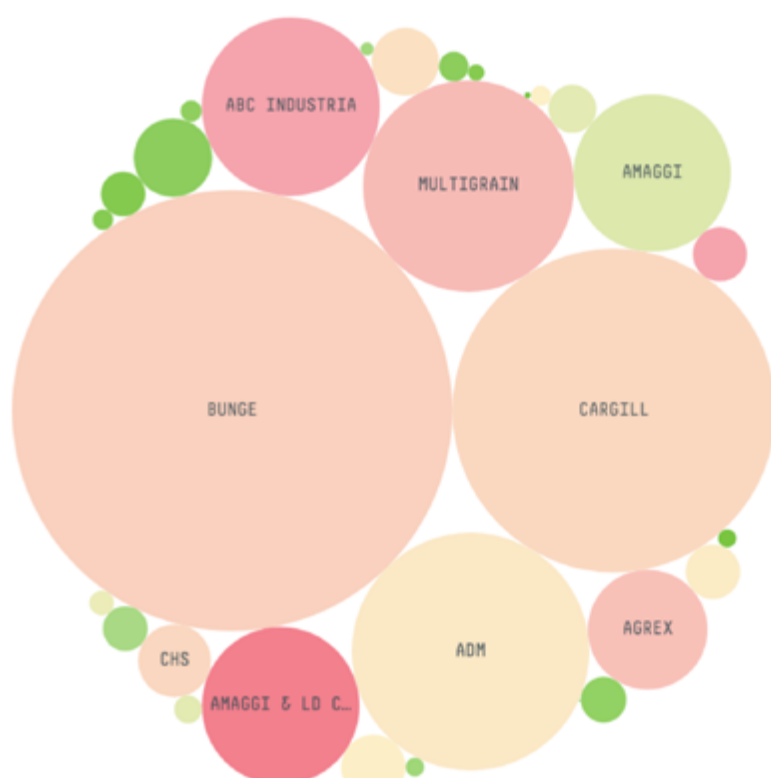
³⁴ <https://news.mongabay.com/2017/04/brazils-deforestation-sheriff-has-been-fired/>

Of course some deforestation in Brazil is legal, with farm owners entitled to clear between 20% and 80% of their land depending on the biome in which their property is located. But land clearance without the necessary permits and/or in excess of what is permitted is commonplace. In 2016 more than 80% of deforestation in the Amazon and one-third of native vegetation clearance in the Cerrado occurred in properties that had already cleared the maximum legally permissible area and is likely to be illegal. Moreover, in the Cerrado biome alone an estimated 60% of soy was planted on properties that had exceeded the legal limits for land conversion.

5.4 Assessing deforestation risks in supply chains of Brazilian soy

The risk that companies and consumer markets are exposed to deforestation in their supply chain is not uniform; it depends on where they source from and how their sourcing strategies change over time.

Identifying the connections between buyers and deforestation hotspots like Matopiba is the first step in identifying priorities for action. The complexity of soy supply chains has meant that it was not previously possible to reliably connect downstream actors to individual regions. However, Trase data systematically links all of Brazil's soy-exporting municipalities to the companies and countries that trade with them, making it possible to assess exposure to the risk that the commodity being sourced is associated with deforestation in the regions where it was produced – providing the indicator of supply chain 'deforestation risk' that is used by Trase. Because the assessment of risk given by Trase covers the entirety of exports of a given commodity it provides a unique and comprehensive risk profile that can help prioritise further analysis and action, and increase accountability for all.



Total deforestation risk is measured in hectares and estimates a companies' exposure to the risk that the soy it is trading is associated with deforestation in its sourcing regions, with amounts of deforestation risk being allocated to different traders in proportion to volumes sourced from each location.

Total deforestation risk of the major traders exporting soy from Brazil between 2006-2016

The top six soy traders – Bunge, Cargill, ADM, Louis Dreyfus, Amaggi and COFCO – make up 58% of total Brazilian soy exports, and were exposed to 68% of deforestation risk due to soy between 2006 and 2016.

However, companies handling comparatively small volumes of soy may be exposed to much greater levels of relative deforestation risk (hectares of risk per tonne of soy exported) than some of the bigger players, if they are sourcing from particularly high-risk areas.

This is important because many of these smaller and ‘riskier’ traders also play an active role in driving the expansion of the soy frontier – and could therefore be critical in shifting the production of soy in frontier regions onto a more sustainable footing.

5.5 Deforestation risk varies depending on sourcing patterns

A good illustration of how an actor’s sourcing strategies affect their exposure to deforestation risk is the case of Amaggi & LD Commodities, a joint venture between major soy traders Amaggi and Louis Dreyfus.



Sourcing from the Cerrado increases the deforestation risk for companies
Credit: Alexander Lees

Louis Dreyfus exported 6.5% of Brazilian soy in 2006–2016. In this period it mostly sourced from the south of Brazil, where there has been little recent deforestation for soy. The company’s total deforestation risk in the period was 5,300 ha (equivalent to only 1% of the total deforestation associated with soy exports in that period). And because of its high volumes and its sourcing from areas with little soy deforestation

risk, the company's relative deforestation risk in the period was just 0.3 ha/1000 t.

The operations of Amaggi – the fifth-largest soy exporter in Brazil, with 6% of exports – are centred in Mato Grosso. There, direct soy deforestation is much greater than in southern Brazil (even though much of the land that is now planted with soy in Mato Grosso was cleared in the 1990s and 2000s).

Amaggi was therefore exposed to a higher relative deforestation risk than Louis Dreyfus, although still comparatively low – 0.8 ha/1000 t – and a total deforestation four times greater than that of Louis Dreyfus at 21,200 ha in the same period. This was still far less than the 256,000 ha of total combined deforestation risk exposure of the two largest soy traders, Bunge and Cargill.

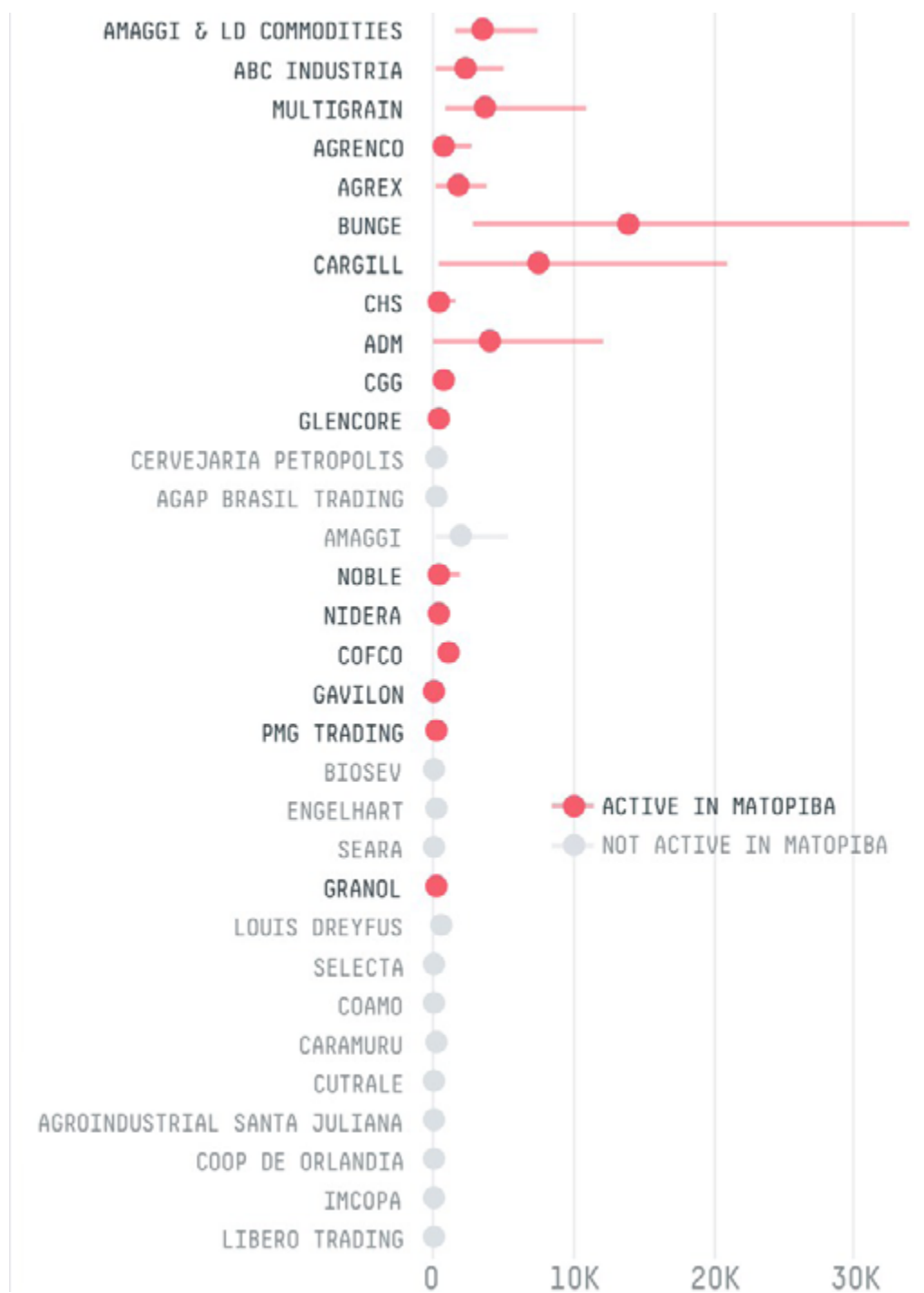
However, the relative deforestation risk of the joint venture Amaggi & LD Commodities – which, since 2017, is one-third owned by Japanese cooperative Zen-Noh – dwarfs that of both its parent companies. Amaggi & LD Commodities was created with the purpose of gaining a foothold in Matopiba. In the words of Amaggi Chairman Pedro Jacyr Bongioiolo: 'Since the region of Bahia, Maranhão, Piauí and Tocantins is the new agricultural frontier of the country, we believe there is a great possibility of expansion of our business in these states'.

Between 2009 and 2016, the joint-venture exported 2.6 million tonnes of soy from Matopiba (9% of all soy exported from the region), and was exposed to much higher relative deforestation risk than the parent companies: 8 ha per 1,000 tonnes. It is important to note that in absolute terms, the total deforestation risk associated with Amaggi & LD Commodities between 2011-2016 stands out less, at 21,165 ha – still within the top ten, but an order of magnitude less than that of the largest companies.

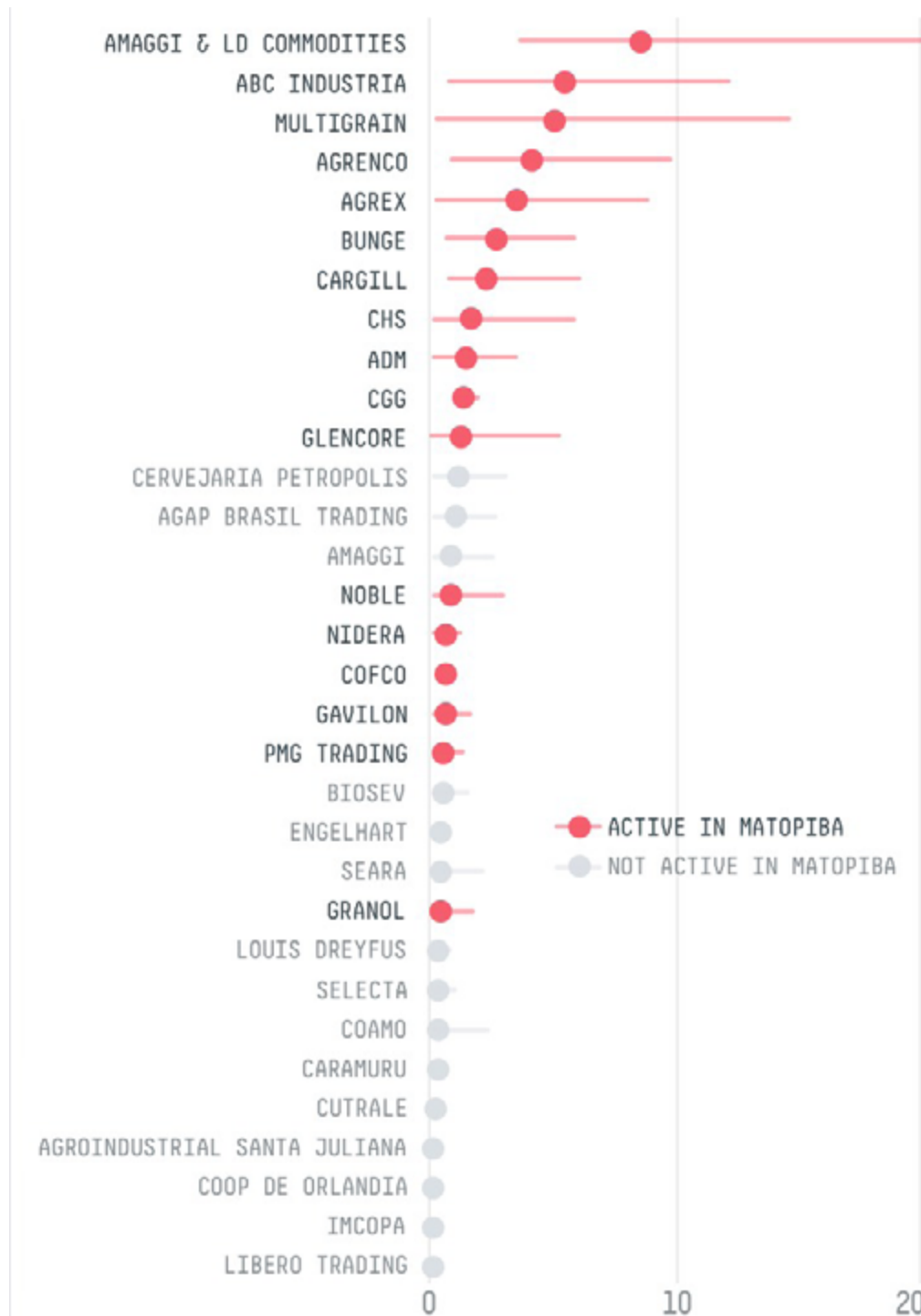
Amaggi & LD Commodities are of course not alone in sourcing from Matopiba. Indeed, 16 of the 20 companies with the highest relative deforestation risk exposure were actively sourcing soy – more than 10,000 tonnes per year – from Matopiba, and many of these same companies also had comparably high total levels of deforestation risk exposure.



Soy is the most valuable internationally traded forest-risk commodity.
Photo credit: Toby Gardner



Deforestation risk of top exporters (ha/yr)



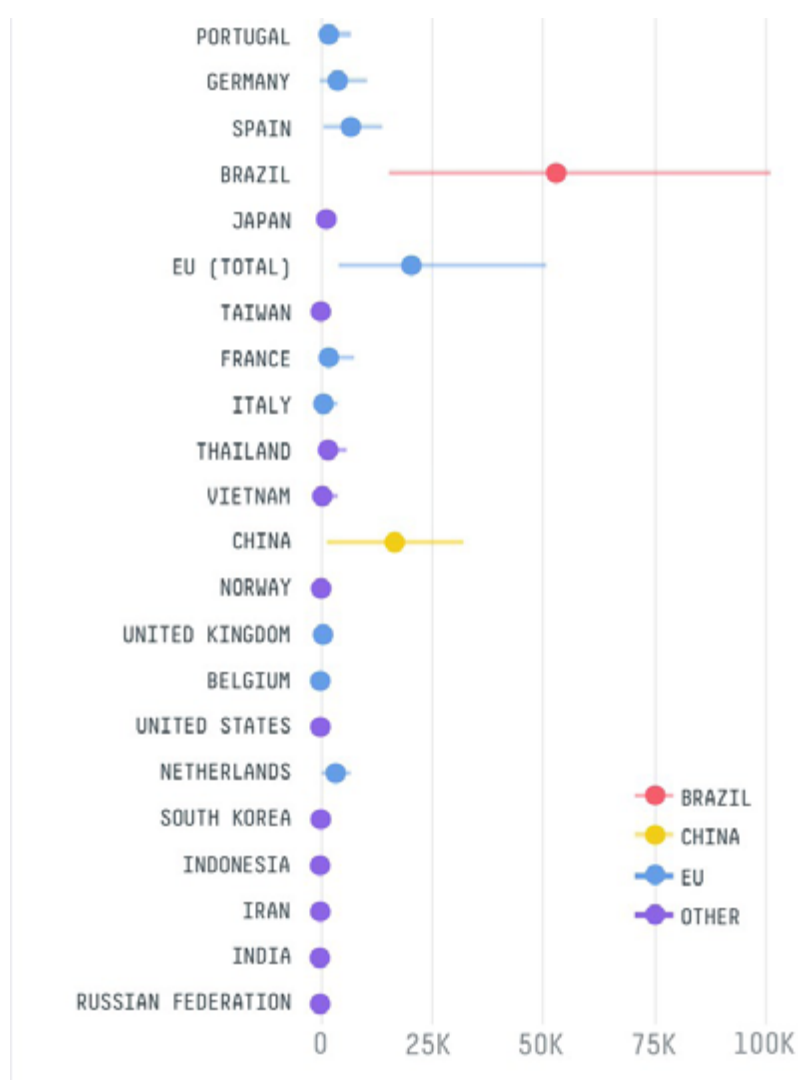
Relative deforestation risk of top exporters (ha/1000 ton/yr)

The point shows the mean deforestation risk per trader per year, identifying companies that are active (> 10,000 tonnes) in MatoPIBA. The error bars show the minimum and maximum between 2006–2016. Major traders are defined as those that export more than 1% of total soy exports in at least one year. Of the 36 companies that satisfy this criterion 32 are shown in the figure, with the remaining four either sourcing exclusively from outside the amazon and cerrado or source from regions that have not been detected by trase.

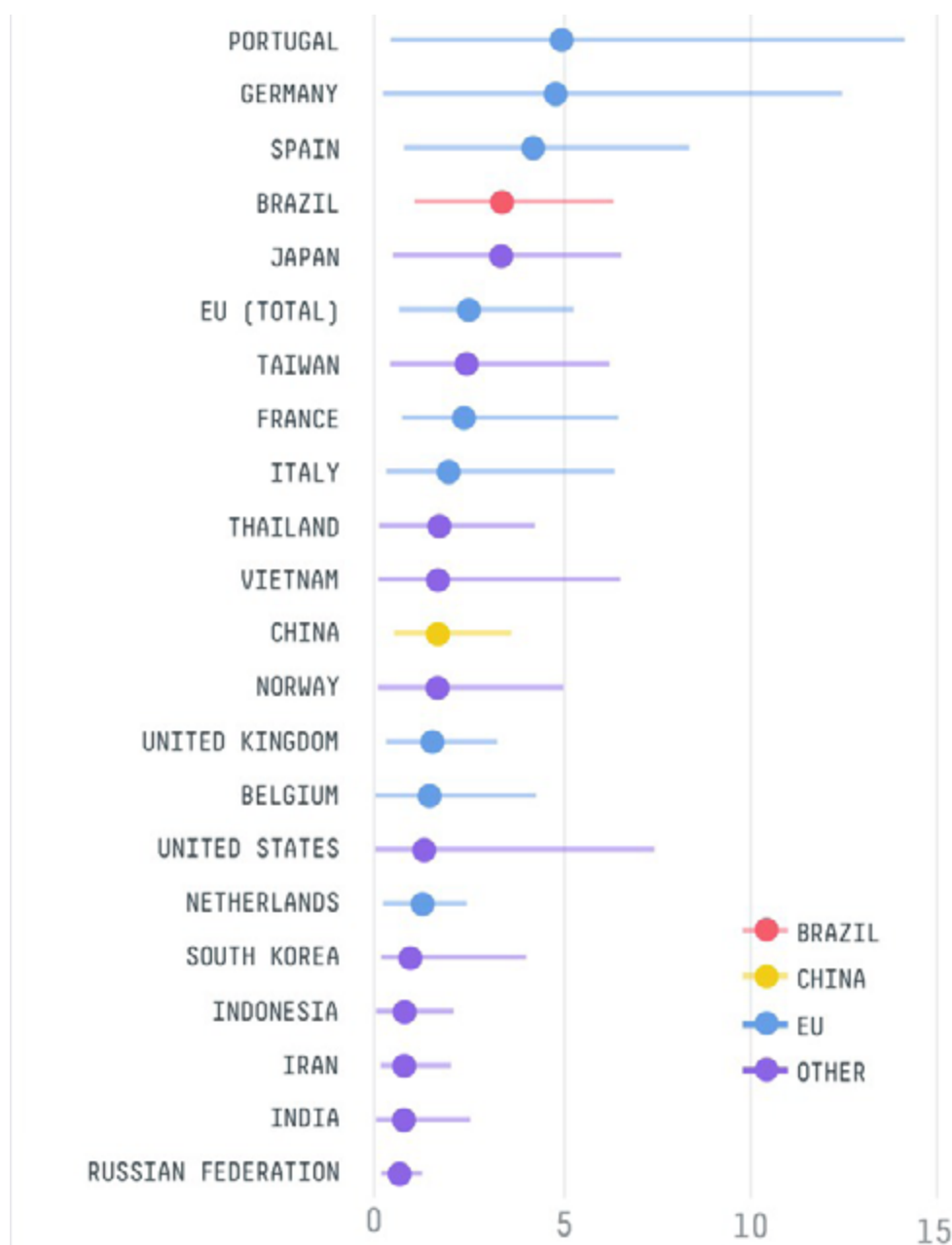
5.6 Risk exposure is transmitted along supply chains to consumer markets

Deforestation risk exposure associated with soy exports does not end with the traders operating in Brazil. Buyers like consumer goods companies and big retailers that sell thousands of products that contain soy are also exposed to deforestation risk through their supply chains. These companies, as well as many national governments in consumer markets, are showing increasing concern for the deforestation ‘embedded’ in their imports.

Given their large market share, China and Brazil are exposed to the most soy-associated deforestation risk. In total, Chinese soy imports, which made up 60% of Brazilian exports in 2016, were potentially associated with 50% (around 10,000 ha) of the deforestation associated with exported soy in that year, mainly in the Cerrado. However, other countries are also importing soy with a high risk of associated soy deforestation, and have some of the highest levels of relative deforestation risk exposure. This includes many EU members and Japan, due to their supply chains being linked to particularly active areas of soy expansion.



Deforestation risk of soy consumed by major markets (ha/year)



Relative deforestation risk of soy consumed by major markets
[ha/kTon/year]

Points show the mean deforestation risk (total or relative) linked directly to soy expansion per country for the period 2006–2016. The error bars show the minimum and maximum between 2006–2016. Total deforestation risk is measured in hectares and estimates a countries' exposure to the risk that the soy it is importing is associated with deforestation in its sourcing regions, with amounts of deforestation risk being allocated to different countries in proportion to volumes sourced from each location. Relative deforestation risk is hectares of direct soy deforestation risk per tonne of exports, allowing comparison of relative impacts of countries that trade very different volumes of soy. Deforestation risk is shown only for the amazon and cerrado biomes, where most soy-associated deforestation is occurring.

5.7 Expansion without deforestation – an opportunity for more sustainable soy production in Brazil?

Government projections³⁵ of soy production in Brazil indicate that around 10 Mha of land may be converted to soy within the next decade. Much of this will be concentrated in the already vulnerable Cerrado biome. Ensuring that this projected expansion does not drive more deforestation is an immense challenge. Yet further loss is not inevitable, when, in the Cerrado alone, nearly 20 million hectares of already cleared land, much of which is degraded, low productivity pasture, is classified as suitable for soy³⁶ – of which some 2 million hectares are in Matopiba.

By linking soy traders and buyers to the places where soy is grown, Trase data can help to identify and manage risks, highlight opportunities for new partnerships and investment to improve sustainability – including, and most importantly in high risk regions, and monitor progress over time. This provides a critical missing part of the puzzle of shifting soy to a more sustainable footing, and can help harness rising levels of concern in the private sector for strengthening the conservation of the Cerrado³⁷ more broadly.



Native Cerrado vegetation in Brazil. Credit: Alexander Lees

³⁵ www.agricultura.gov.br/assuntos/politica-agricola/todas-publicacoes-de-politica-agricola/projecoes-do-agronegocio/projecoes-do-agronegocio-2017-a-2027-versao-preliminar-25-07-17.pdf/view

³⁶ www.inputbrasil.org/wp-content/uploads/2016/11/The-expansion-of-soybean-production-in-the-Cerrado_Agroicone_INPUT.pdf

³⁷ wwf.panda.org/wwf_news/press_releases/?310899/Environmentalists-ask-markets-to-help-stop-the-destruction-of-the-Cerrado

Chapter 6

Zero-deforestation commitments and Brazilian soy

HIGHLIGHTS

- ✔ Coverage of soy traded under a zero-deforestation commitment is very uneven between regions in Brazil.
- ✔ Less than half of soy exported from the Cerrado biome in 2016 was covered by any zero-deforestation commitment.
- ✔ Between 2006-2016 soy traders with zero-deforestation commitments have been associated with similar levels of deforestation risk as non-committed companies.
- ✔ Over the last decade, signatories of the Amsterdam Declaration were exposed to similar or higher levels of relative deforestation risk – than major consumer markets such as China, with no discernible decline in deforestation risk since the declaration came into force in 2015.

Companies and countries sourcing forest-risk commodities have come under increasing scrutiny and public pressure to eliminate deforestation in their supply chains. As a result, a growing number – more than 100 to date – have made public commitments to do so.

These commitments are often referred to as zero-deforestation commitments (ZDCs). Making ZDCs is ambitious and commendable. However, most ZDCs contain little information about how they will be implemented on the ground, or how progress will be measured.

Given the complexity and opacity of the supply chains involved, the impact of individual ZDCs remains difficult to track: it remains unclear whether they are leading to real reductions in deforestation.

Trase data offer a new opportunity to track the success of ZDCs, creating the measures of environmental performance by linking actors to places, and combining supply chain data with local indicators. This chapter provides the first systematic insights into the impact of ZDCs in relation to Brazilian soy.



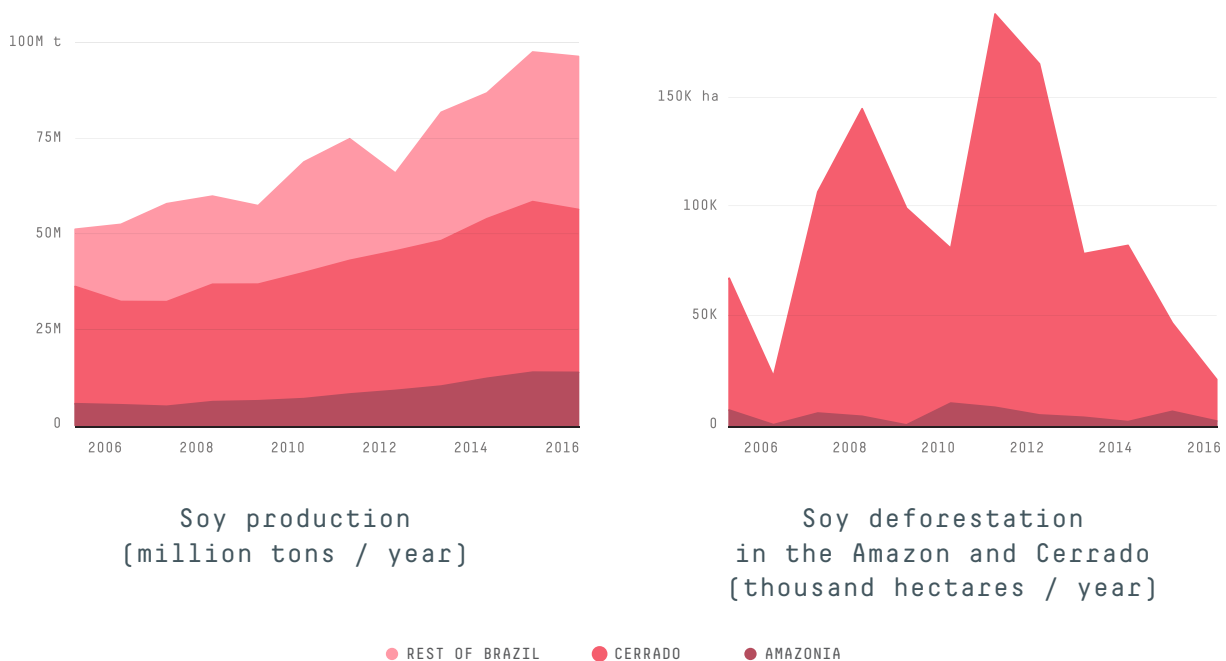
Protecting forests and natural vegetation preserves habitat that is vital for wildlife, including endangered species, photo: Alexander Lees

6.1 Zero-deforestation commitments in the Brazilian soy sector

One of the first ZDCs was made in 2006, when major soy traders responsible for around 90% of all the soy sourced from the Brazilian Amazon signed up to the Soy Moratorium – a commitment not to purchase soy planted on land in the Amazon deforested after 2008.

The Soy Moratorium was a landmark, multi-stakeholder initiative which brought together companies, environmental NGOs and the Brazilian government. It combined an independent, robust monitoring system and powerful enforcement mechanism – through market exclusion of non-compliant soy. Together with strong-handed efforts by the the Brazilian government to reduce Amazonian deforestation, the Moratorium helped to reduce the proportion of soy planted on recently deforested land in that biome from 30% in 2006 to around 1% by 2014.

However, despite its success in helping to reduce the direct conversion of Amazon rainforest to soy plantations, the Soy Moratorium has several limitations. The most obvious is that most soy cultivation in Brazil takes place not in the Amazon, but in the neighbouring Cerrado, a highly biodiverse savannah ecosystem that is outside of the scope of the Moratorium.



Soy production
(million tons / year)

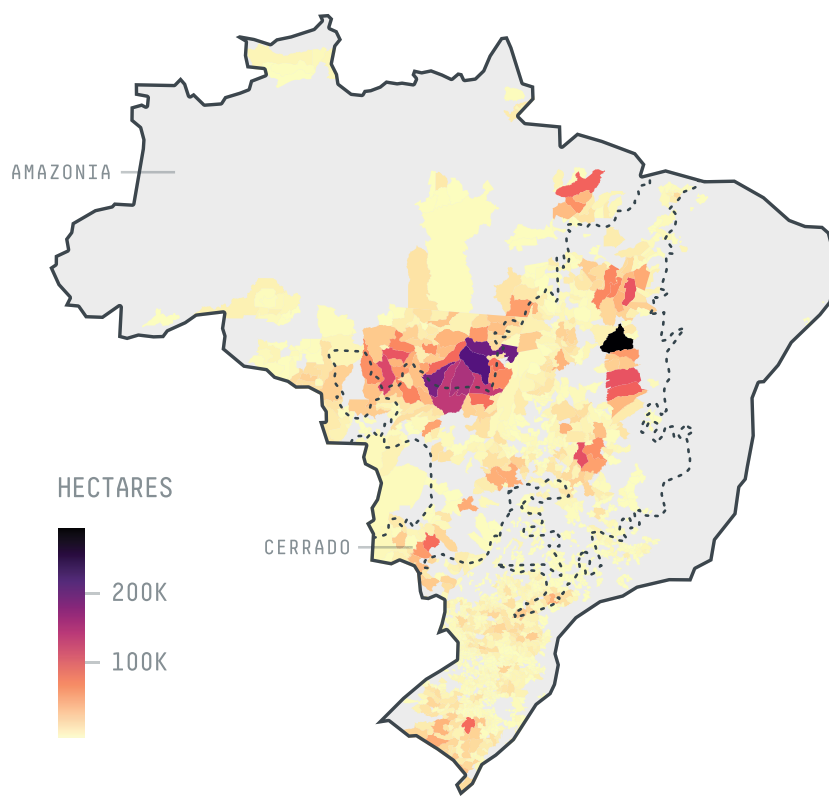
Soy deforestation
in the Amazon and Cerrado
(thousand hectares / year)

The limited reach of the Soy Moratorium

Most soy production and soy-associated deforestation occurs outside the Amazon

By not covering the Cerrado, the Moratorium therefore does not address most soy-associated deforestation and habitat conversion (including the clearance of large areas of savannah and shrubland).

The Soy Moratorium may even exacerbate soy-associated land conversion in the Cerrado, by displacing soy expansion away from the Amazon.



Soy expansion, 2005-2016
Most recent soy expansion has been in the Cerrado

6.2 Zero-deforestation commitments are increasing in coverage, but not evenly

Given the limitations of biome-specific ZDCs like the Soy Moratorium, it is encouraging that an increasing number of companies and countries are making commitments to eliminate deforestation across their entire supply chains, and beyond the Amazon. In the soy sector, four major traders – Cargill, Bunge, Archer Daniels Midland (ADM) and Amaggi, together responsible for almost half of Brazilian soy exports between 2006 and 2016 – have each recently made ZDCs that encompass their entire supply chain, though there remains a lack of clarity regarding their scope.

These commitments, together with the Soy Moratorium in the Amazon mean that a growing proportion of soy is now traded under some form of ZDC. In 2016, 28 million tonnes – 42.2% of all soy exports from Brazil – were covered by ZDCs made by soy traders.

Many more consumer-facing companies have also signed up to zero deforestation agreements such as the 2014 New York Declaration on Forests, including Walmart,

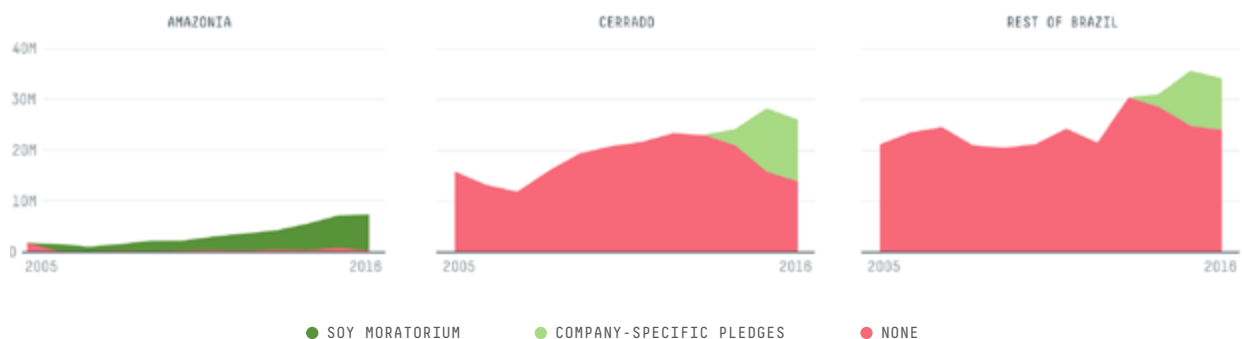


The New York Declaration on forests was signed in 2014 by governments, companies and civil society. Its main goal is to halve the rate of deforestation by 2020.
Photo credit:istock.com/franckreporter

McDonalds, and L’Oreal, who all manufacture and sell products which contain soy, or soy-fed meat.

When it comes to countries, seven European countries (Denmark, France, Germany, the Netherlands, Norway, the UK and Italy) – which together were the destination for 22% of soy exports from Brazil in the last decade – signed the Amsterdam Declarations in 2015 to promote the elimination of deforestation from agricultural commodity supply chains.

Even with the rise in global ZDCs, the geographic coverage of ZDCs remains highly uneven. While almost all the soy exported from the Amazon is covered by the Soy Moratorium, less than half of soy exported from the Cerrado biome in 2016 was covered by any ZDC.



Volumes of Brazilian soy exported under Zero Deforestation Commitments (tons)

These volumes reflect the soy exported by companies who are signatories of the soy moratorium, plus the four major traders who have publically available, written commitments: Cargill, Bunge, ADM and Amaggi.

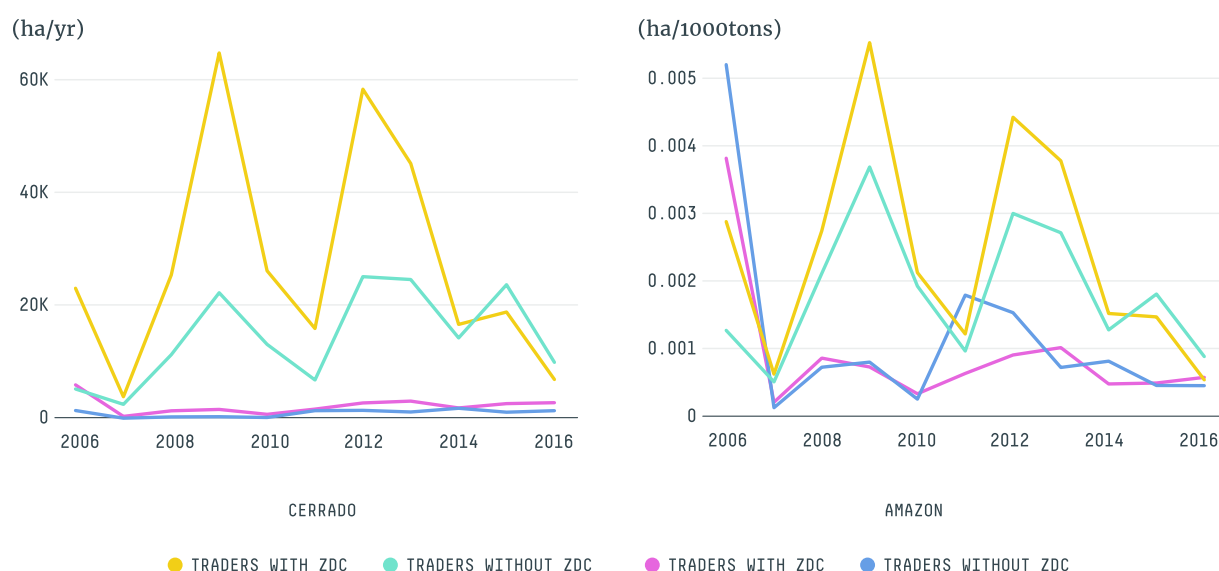
This is particularly problematic because without strong action, there is a very real risk that the Cerrado will suffer further widespread deforestation. While only a small fraction of total deforestation in the Cerrado can be directly attributed to soy, this proportion is much higher in some areas. In the frontier region of Matopiba, at least 37% of soy expansion between 2005 and 2016 was through direct conversion, and 20% of the total area cleared since 2000 is now under soy (see also Chapter 5).

Further, the coverage of ZDCs in the Cerrado may well be even lower than we estimate. It is often not clear whether zero-deforestation commitments are intended to include biomes such as the Cerrado and Gran Chaco that are densely forested in some places but also include more open savannah-tree formations in others. If these commitments exclude these important biomes, their ability to foster a sustainable soy sector would be significantly weakened.

6.3 Are zero-deforestation commitments already having an impact?

If ZDCs are working, then we would expect that the rate of soy-associated deforestation would be low, or at least going down, in areas where the actors that have made commitments are sourcing large volumes of soy.

Trase allows, for the first time, the monitoring of deforestation risks in the areas where different companies are active. By linking all of Brazil's soy exporting municipalities to the companies and countries that trade with them, it is possible to estimate the risk that they are exposed to deforestation in their sourcing regions – their overall 'deforestation risk'.



Deforestation risk of traders with and without zero deforestation commitments (ZDC)

For the period 2006-2016 soy traders in the Brazilian market with zero-deforestation commitments have been associated with similar levels of deforestation risk as companies that have not made such commitments. During this period the four traders that have made commitments (ADM, Bunge, Cargill, and Amaggi) were exposed to a deforestation risk of 326,000 hectares of direct soy-associated deforestation and land conversion. That means their exports of soy were potentially associated with deforestation of an area more than twice the size of London across the Amazon and Cerrado in Brazil. This is two-thirds of the deforestation risk across all traders.

These companies are also exposed to some of the highest relative deforestation risk per tonne of exported soy in both biomes. In fact, until 2015, these companies were exposed to higher deforestation risk in Brazil than all non-committed companies put together (see also Chapter 5).

While it is too early to draw firm conclusions about the impact of the ZDCs these companies have made – Cargill in 2014, ADM and Bunge in 2015, and Amaggi in 2017 – it is encouraging to see that collectively their level of exposure to deforestation risk has been falling since 2012. Whilst no conclusions can be drawn from a simple visual inspection of the trends it is perhaps promising to see that their exposure to relative deforestation risk fell below that of non-committed companies – and therefore the rest of the market – for the first time in 2015.

Of course, this change in pattern may well also reflect an increase in deforestation risk exposure among non-committed companies – which highlights the need to encourage all companies, big and small, new and old, to make commitments and monitor their supply chains.

In either case, the combined direct soy-deforestation risk exposure of these committed companies still exceeded 9,000 ha in 2016 (45% of the total), suggesting that companies with ZDCs have a long way to go to reassure their downstream customers that their soy is truly deforestation-free.

Similarly, the Amsterdam Declaration was signed only at the end of 2015, making it too soon to confidently assess what impact it may be having. But Trase data can be used to monitor trends and assess its future performance. Over the last decade, signatories



Deforestation risk of Amsterdam Declaration signatories and other import markets

were exposed to similar or higher levels of deforestation risk as other EU countries and major markets like China, with no dramatic decline in deforestation risk among signatories since the declaration was signed.

Despite the stark challenges that ZDCs face – the New York Declaration on Forests and Amsterdam Declarations, for example, target an end to commodity-associated deforestation by 2020, which is now just around the corner – it should not be forgotten that these commitments are new and ambitious. They can be a powerful tool for achieving sustainable commodity production.

But to do so they must be strengthened and enforced. Systemic weaknesses that need to be addressed in current commitments include: the need to move from zero-net deforestation targets, which allow reforestation to compensate for forest loss, to zero-absolute deforestation; ambiguity regarding the types of habitat encompassed by commitments, and the importance of explicitly including wooded savannahs and other natural habitats that fall under commonly agreed definitions of forests (e.g. by the FAO); the need for annual targets to ensure year-on-year improvements; a need to encompass the entire supply chain, not just direct suppliers; and a need to broaden implementation strategies beyond a strong reliance on certification programs which place an undue burden on producers. A broader challenge influencing the effectiveness of commitments is the need for transparency in how deforestation risks linked to supply chains change over time.

Whatever their scope, as these ZDCs evolve, transparency initiatives like Trase will be critically important for assessing progress, identifying priorities for greater investment, and strengthening accountability for both companies and governments.

In this Yearbook, we have focused on soy in South America – for the most part, in Brazil. In future, Trase will expand cover to other commodities and geographies in more detail, where it can similarly be used to monitor the risks of actors, performance of sustainability commitments, and ultimately support the transition to the sustainable, deforestation-free production of all major tropical commodities.



Brazilian Cerrado remains one of the most threatened tropical ecosystems in South America, Credit: Alexander Lees

Glossary

Amazon

The forest of the Amazon basin of South America covering 5.5 million square kilometres. It represents over half of the planet's remaining rainforest and comprises the largest and most biodiverse tract of tropical rainforest in the world. The majority (60%) of the forest is contained within Brazil, but it also spans parts of Peru, Colombia, Venezuela, Ecuador, Bolivia, Guyana, Suriname and French Guiana.

Amsterdam Declarations

Non-legally binding political commitments to help stimulate and support private sector action to meet zero-deforestation goals. The aim is to achieve more sustainable and deforestation-free agricultural commodity supply chains in Europe by 2020. So far, Denmark, France, Germany, Italy, the Netherlands, Norway, and the UK are signatories.

Atlantic Forest

A forest biome originally covering 1.3 million square kilometres, extending along the Atlantic coast of Brazil from Rio Grande do Norte state in the northeast to Rio Grande do Sul state in the south, and inland as far as Paraguay and the Misiones Province of Argentina. It has one of the highest proportions of endemic species of any biome in the world, with many species under threat of extinction following the clearance of more than 85% of its original extent.

Cerrado

A tropical mesic savannah in Brazil, formerly covering 2 million km² and large areas of the states of Goiás, Mato Grosso do Sul, Mato Grosso, Tocantins and Minas Gerais. Approximately 20% remains relatively intact. It is arguably the most species-rich savannah biome in the world and is formed of a complex mosaic of forests, woodlands and open savannah formations and is the second largest of Brazil's biomes after the Amazon rainforest, extending marginally into Paraguay and Bolivia.

Deforestation

Deforestation is the conversion of forests and other native vegetation into other land uses (e.g. agriculture, urban areas). When reporting statistics for deforestation we use LAPIG data for the Cerrado and Prodes in the Amazon. Deforestation is particularly difficult to define in the Cerrado, which is a woody savannah biome, that includes

complex mosaics of forest and savannah. Whilst the LAPIG deforestation alerts include the clearance of areas that are not densely forested, they are a conservative measure of habitat loss in the Cerrado. In future years Trase will provide updated measures of deforestation in the Cerrado using the new Prodes Cerrado product from the Brazilian government and maps being developed by the Mapbiomas project. When reporting soy-associated deforestation, we only consider the area of forest or savannah that is cleared each year.

Deforestation risk

Trase generates indicators of 'deforestation risk' using localised data on commodity production, sourcing patterns and deforestation. This indicator, measured in terms of hectares, assesses a company's – or import country's – exposure to the risk that the commodity it is sourcing is associated with deforestation in the region where it was produced. 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. Therefore, in the case of soy, if a company is sourcing 500 tonnes of soy from a Brazilian municipality that produces 1000 tonnes, and where 800 hectares of deforestation can be directly linked to soy production, the soy deforestation risk for that company in that municipality is 400 ha (50% of the total). Trase Yearbook 2018 only uses deforestation risk directly associated with soy expansion and includes the clearance of native vegetation in both the Amazon and the Cerrado biomes.

Direct conversion

The area of land that is directly converted to soy each year. This is a conservative estimate as land can be cleared for soy a number of years prior to planting. Figures for direct conversion are calculated based on the overlay of annual maps of deforestation and habitat loss with maps of areas planted with soy. Annual deforestation data used are LAPIG in the Cerrado and Prodes in the Amazon. Soy maps are from Agrosatelite, for crop years 2000/01, 2006/07, 2013/14, and 2016/17.

Gran Chaco

A sparsely populated, semi-arid lowland divided among eastern Bolivia, western Paraguay, northern Argentina and a portion of the Brazilian states of Mato Grosso and Mato Grosso do Sul, where it is connected with the Pantanal biome. At least one quarter of forests in the Chaco have

been cleared for croplands and grazing lands in the last 30 years. It has a diverse and unique flora and fauna and has some of the highest temperatures in South America.

Habitat clearance

The conversion of forests, savannah, and other areas of wilderness into agriculture or other human land use (e.g. urban areas). Habitat clearance for agriculture is one of the leading causes of biodiversity loss and carbon emissions worldwide.

Illegal deforestation

In the Brazilian Amazon, as per the New Forest Code of 2012, property owners must maintain 80% of their land under forest, known as a Legal Reserve. In the rest of Brazil, the Legal Reserve accounts for 20-35% of the area of each property, depending on the biome. Deforestation can be illegal in three ways: farmers (i) do not have the rights to the land; (ii) clear more than the legally authorizable amount; (iii) have the rights on the land and are within the legal limits, but do not have the official authorization. Our estimate of the extent of illegal deforestation considers only (ii) and are therefore conservative. Our estimate of the proportion of soy planted on non-compliant properties is based on the same underestimate, though it also does not take into account where a property owner owns multiple properties and may compensate for deforestation in one area by having more in another. Data from The Geography of the Brazilian Agriculture, 2018. Available at: www.imaflora.org/atlasagropecuario.

Indirect conversion

Even where soy does not immediately expand into forest or savannahs, it can be a driver of indirect conversion of these habitats. The expansion of soy can drive deforestation by increasing land prices, leading to speculative clearing, and by displacing other land-uses (typically cattle ranching) further into the forest.

Matopiba

Matopiba is an abbreviation for the Brazilian states of Maranhão, Tocantins, Piauí and Bahia. This region encompasses 337 municipalities and a total area of 73 million ha. Over 90% of Matopiba is in the Cerrado biome with the region making up some 37% of the total extent of the biome. It is the most active agricultural frontier in Brazil with soybeans being the most important crop. Soybeans expanded by about 300% since 2001 and currently cover an area of more than 4 million ha. The rapid expansion of soy and other crops has driven widespread deforestation and loss of native habitat, with

at least 37% of soy expansion in the last decade replacing native vegetation with a year of clearance.

New York Declaration on Forests

A voluntary and non-legally binding political declaration between governments, companies and civil society. Signed in 2014, its main goal is to halve the rate of deforestation by 2020, to end it by 2030, and to restore hundreds of millions of acres of degraded land. More specifically, it aims to end all agriculturally-related deforestation already by 2020.

Raw equivalents

Many agricultural commodities undergo some level of processing before they are traded and sold. For example, soy is commonly processed into oil and soy meal. Sugarcane is processed to make sugar. In analyses of trade data in Trase we convert traded volumes back to the primary commodity equivalents (e.g. soybean, sugarcane) to account for the quantity of raw produce needed for the commodity exported.

Relative deforestation risk

To allow comparisons between buyers that source very different volumes of soy a relative measure of deforestation risk is calculated as the total deforestation risk, in hectares, divided by the number of tonnes exported by that buyer - ha/tonne.

Soy Moratorium

A commitment made in 2006 by companies that make up more than 90% of Brazil's soy trade not to purchase soy planted on recently deforested land in the Amazon.

Zero-deforestation commitment (ZDC)

Commitments made by companies and countries that their supply chains will not include commodities associated with deforestation (i.e. planted on recently deforested land). Multi-stakeholder examples include the 2014 New York Declaration on Forests (NYDF) and 2015 Amsterdam declarations. In the 2018 Trase Yearbook we focus on four commitments made by major soy traders - Cargill (who signed the NYDF in 2014), Bunge and Archer Daniels Midland (who made company-specific commitments in 2015), and Amaggi (who made a commitment in 2017). We only focus on commitments where they are made in writing and are publicly available.

Annex 1

Data and methods used in Trase Yearbook 2018

Calculating soy-associated deforestation

Expansion of soy is based on periodic land cover classifications from Agrosatelite, based on a combination of analysis and visual interpretation of both Landsat and Modis imagery (http://biomas.agrosatelite.com.br/img/Analise_geoespacial_da_dinamica_das_culturas_anuais_no_bioma_Cerrado_2000a2014.pdf). Soy crop maps are available for harvest years 2000/01, 2006/07, 2006/07, 2013/14 and 2016/17.

Soy-associated deforestation is calculated by identifying areas where forest or savannah is cleared in the years immediately preceding when the soy was planted. This is calculated by combining annual maps of native vegetation clearance with the next available soy map. So, soy-associated deforestation for a given area in 2012 is calculated by aggregating the areas of conversion in 2012 that were mapped as soy in 2014. Because of the nature of the available data, the period between conversion attributable to soy and the planting of soy varies between years.

To estimate deforestation we use Prodes data for the Amazon and LAPIG data for the Cerrado. This is a conservative measure of soy-associated deforestation. The LAPIG estimate, based on MODIS imagery (and validated using Landsat), is known to underestimate deforestation compared to higher-resolution methods. But land is also often cleared for soy a number of years before planting, including due to indirect effects from increases in the price of land and speculation linked to the expansion of soy.

Deforestation is particularly difficult to define in the Cerrado, which is a woody savannah biome, including complex mosaics of forest and savannah. Whilst the LAPIG deforestation alerts include the clearance of areas that are not densely forested, they are a conservative measure of habitat loss in the Cerrado. Brazilian government data on deforestation in the Cerrado biome (Prodes Cerrado) was published after research for the Yearbook was finished. In future years Trase will provide updated measures of deforestation in the Cerrado using the new Prodes Cerrado product from the Brazilian government and maps being developed by the Mapbiomas project.

Deforestation risk

Trase generates indicators of 'deforestation risk' using localised data on commodity production, sourcing patterns and deforestation. This indicator, measured in terms of hectares, assesses a company's – or import country's – exposure to the risk that the commodity it is sourcing is associated with deforestation in the region where it was produced.

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 [Equation 1].

$$[Deforestation\ risk]_{(c, yr)} = \sum_{(m, yr)} [soy\ deforestation]_{(m, yr)} * [proportion\ soy]_{(c, m, yr)}$$

Soy buyer: company or country, c
Municipality, m
Year, yr

For example, if a trader sources 500 tonnes from municipality A in a year where there were 1000 tonnes of soy produced, and 100 hectares of direct soy deforestation, and also sources 800 tons from municipality B, where there were 1000 tonnes of soy produced and 100 hectares of direct soy deforestation, their deforestation risk would be: 130 hectares (i.e. $100 \times 0.5 + 100 \times 0.8$). Trase Yearbook 2018 only uses deforestation risk directly associated with soy expansion and includes the clearance of native vegetation in both the Amazon and the Cerrado biomes.

DATA	DESCRIPTION	SOURCE
Supply chains	National exports. Trade data from port of loading to country of destination via exporting and importing companies. Available for soy, palm oil, palm kernel oil, cane sugar, maize, cocoa and coffee in Argentina, Brazil, Bolivia, Colombia, Costa Rica, Ecuador, Paraguay, Peru and Uruguay.	Trase (publication of national exports for additional countries forthcoming on trase.earth)
	Sub-national exports. SEI-PCS Brazil soy 2.2 (Yearbook edition). Trade from municipality of production to country of destination via exporting and importing companies.	Trase (publication of expanded time series forthcoming on trase.earth)
Global commodity trade data	<p>The UN Food and Agricultural Organisation (FAO) publishes annual statistics on production and trade of agricultural commodities, and their derivatives, based on a combination of submissions from national statistics agencies and imputed estimates. Bilateral trade tables detail the export (or import) of material from country A to country B.</p> <p>Raw data from FAO does not account for re-exports, where imported goods are exported in the same state. This means FAO trade data on its own may not be representative of the original source of the traded material. To control for this phenomenon, we apply matrix methods - using, as inputs, production statistics, bilateral trade data, and conversion factors to convert secondary products into primary equivalents - to redistribute exports taking place from countries which are not primary producers, back to sources of production.</p> <p>Data for selected commodities resulting from these methods was provided by Thomas Kastner (Senckenberg Biodiversity and Climate Research Centre) for the years 1986 to 2013.</p>	<p>FAO Production and Trade data: http://www.fao.org/faostat/en/</p> <p>Re-export methods: https://www.sciencedirect.com/science/article/pii/S092180091100019X</p>

Soy production	Argentina - Ministry of Agribusiness	http://ide.agroindustria.gob.ar/visor/
	Brazil - Brazilian Bureau of Statistics (IBGE)	https://www.ibge.gov.br/estatisticas-novoportal/economicas/agricultura-e-pecuaria/9117-producao-agricola-municipal-culturas-temporarias-e-permanentes.html?=&t=o-que-e
	Paraguay - Ministry of Agriculture and Livestock	http://www.mag.gov.py/index.php/institucion/dependencias/sintesis-estadistica
Deforestation	INPE-PRODES deforestation estimates in the Amazon Biome and municipalities on the border between the Amazon and Cerrado Biomes	http://www.dpi.inpe.br/prodes-digital/prodesmunicipal.php
	LAPIG deforestation alerts for the Cerrado Biome, including the Legal Amazon portion and municipalities bordering the Atlantic Forest	http://maps.lapig.iesa.ufg.br/

The future of the Trase Yearbook

The 2018 Trase Yearbook is a pilot report with a spotlight on Brazilian soy exports. Future Trase Yearbooks will present annual assessments and updates of the sustainability of different commodity supply chains based on Trase's unique data. The coverage of future editions will increase as the supply chain maps for new commodities and countries are published on the Trase online platform, trase.earth.

As well as providing a go-to synthesis of key indicators of supply chain sustainability, each Yearbook will report an update on key trends observed during the previous year, as well as more focused analyses on priority regions and commodities. A primary goal will remain the assessment of progress towards zero-deforestation commitments and other sustainability policies, providing an entry point for individual companies and governments to assess trends in risk and performance. To help identify new opportunities for positive change the Yearbook will build from this assessment to highlight both the limitations and successes of efforts by companies and governments to improve the sustainability of the production and trade in forest-risk commodities.

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