TRADE, DEVELOPMENT & THE ENVIRONMENT HUB

Global Soybean Trade

The Geopolitics of a Bean

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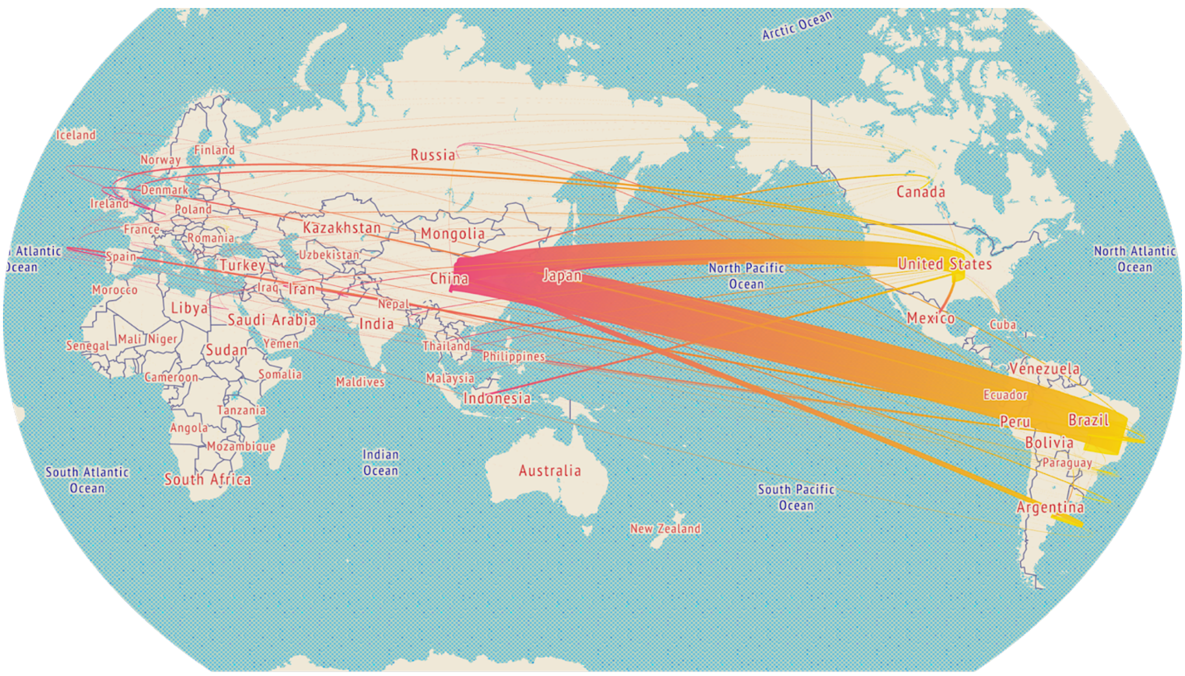

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1. Introduction

With a diameter of only 5 to 11 millimetres on average, it is fascinating to think how soybean is currently affecting – and affected by – changes in economy, environment and society, both at the global and at the local level. Bearing in mind the main objective of the *Trade Hub* project and the specific contribution of *Work Package 4*, the present Scoping Study analyses the evolution of the '*geopolitics*' of international trade flows, dissecting social, institutional, economic and environmental outcomes along the value chain of this commodity.

Originally cultivated in China more than 3000 years ago (Hymowitz, 1970), soybean today is a global commodity, with 170 countries directly taking part – either as importers, exporters or both – to international trade flows in 2017 (*Figure 11*). The industrial and the agrarian revolution not only contributed to reshaping the traditional geography of soybean diffusion, production and consumption all over the world, but also ignited another fundamental shift for this crop: from a food staple traditionally grown and consumed in China and Eastern Asia for thousands of years, by the 20th Century soybean had turned into a versatile and globally demanded cash crop, with a new production centre based in the USA (Prodöhl, 2019).

Production rates increased constantly over time, often faster than the world population growth rate, with a further acceleration in soybean production volumes from the beginning of the new millennium. Driven by the Chinese economic boom and by their renewed appetite for soybean, and sustained by the rapid expansion of the production in countries such as Argentina and Brazil, the world's production doubled since the early 2000's, with about 350 million tons harvested over almost 125 million hectares in 2018 (*Figure 2* and *Figure 3*).

The extraordinary expansion of soybean production, harvested area and trade volumes in the last two decades undoubtedly created economic benefits, but it also raised awareness over the negative impacts of this sector on environment and society (Fearnside, 2001; Brown, 2012a; Garrett, Rueda and Lambin, 2013; Fehlenberg *et al.*, 2017; Sun *et al.*, 2018; He *et al.*, 2019), leading to a global call for a sustainable shift in the soybean industry (KPMG International Cooperative, 2013; Boerema *et al.*, 2016; Kastens *et al.*, 2017; RTRS, 2017; Wu *et al.*, 2020).

This report takes stock of the existing literature and data, analysing the evolution of global soybean trade flows and the related implications for society and environment. Following the approach proposed by De Maria (2019) and adapting it to the specific focus of this scoping study, we organised this study around a number of distinct but intertwined thematic areas: *History, Economics, Environment, People* and *Institutions*. In order to take into account not only the global dynamics, but also the peculiarity of the local contexts, we present short country-specific sections for Tanzania, China and Brazil. We then lay out a set of open questions, as well as our strategy to address them in the future, before offering some concluding remarks.

2. A Brief History of Soybean

Soybean is a legume that was originally domesticated more than three thousands year ago in the North-Eastern part of China (Hymowitz, 1970). The production, processing and consumption of this crop remained centred in China and Eastern Asia for centuries, but today soybean is a global commodity – with 170 countries trading this crop internationally for an estimated total value of 58 billion US$ in 2017[1].

Figure 1 summarises the key moments that contributed to the diffusion of this crop all over the world. Soybean was cultivated in Europe for the first time in 1737 (Shurtleff and Aoyagi, 2014) and it was later introduced in North America, in 1765 (Hymowitz and Harlan, 1983). During the agrarian and the industrial revolution, the demand of European nations for soybeans grew in parallel with their appetite for fats and oils. The introduction of margarine as a cheap substitute for butter and the continuous multiplication of potential uses, supported the growth of soybean demand and production in the coming centuries, ultimately reshaping the whole sector. By the mid 20th Century, the conversion of soybean from a food crop into a cash crop – now mainly grown on the other side of the Pacific Ocean – was complete (Prodöhl, 2019, p. 461):

> *"[...] the versatility of soy – and soy oil in particular – offered a highly successful response to the agricultural and industrial challenges that the United States faced during the Great Depression and the Second World War. By the end of the war, American farmers in the Midwest cultivated more soybeans than their Chinese counterparts."*

As a consequence of the changing market dynamics, the USA became the leading country in soybean production – representing almost 75% of the world's market in 1965 (Brown, 2012b), with yields almost double compared to China, Argentina and Brazil (*Figure 4*).

According to Prodöhl (*Ibid.)*, in the early 1920's most of the demand for soybean was still driven by the need of soybean oil, whilst the soybean cake and meal[2] were only considered production residues. Today, the situation is reversed and more than 80% of soybean (*Figure 8*) is processed into the highly demanded soybean meal – which is arguably the most common animal feed in the world due to the combination of high protein content and relatively low prices (Witte, 1995; Dei, 2011). The remaining production – just below 20% – goes into soybean oil, which can be used for the production of both edible (e.g. soy sauce, tofu) and non-edible products (cosmetics, soaps and detergents), as well as a base for diesel fuels (Asbridge, 1995).

Starting from the early 2000s – in the span of less than two decades – the economic geography of the soybean industry rapidly evolved into the new current structure. In 2001, on December the 11th, China joined the WTO. This symbolic date not only marks a milestone for the trade liberalisation process of the country, but it also represents a crucial moment in its history, characterised by a period of rapid and protracted economic growth. Today, with an import worth 36.6 billion dollar in 2017 alone[3], China is – and by far – the greatest importer and consumer country, and almost two thirds of all soybean traded in the world goes to the People's Republic. The modern US production and export primacy – which lasted for about a century – is now contented by Brazil.

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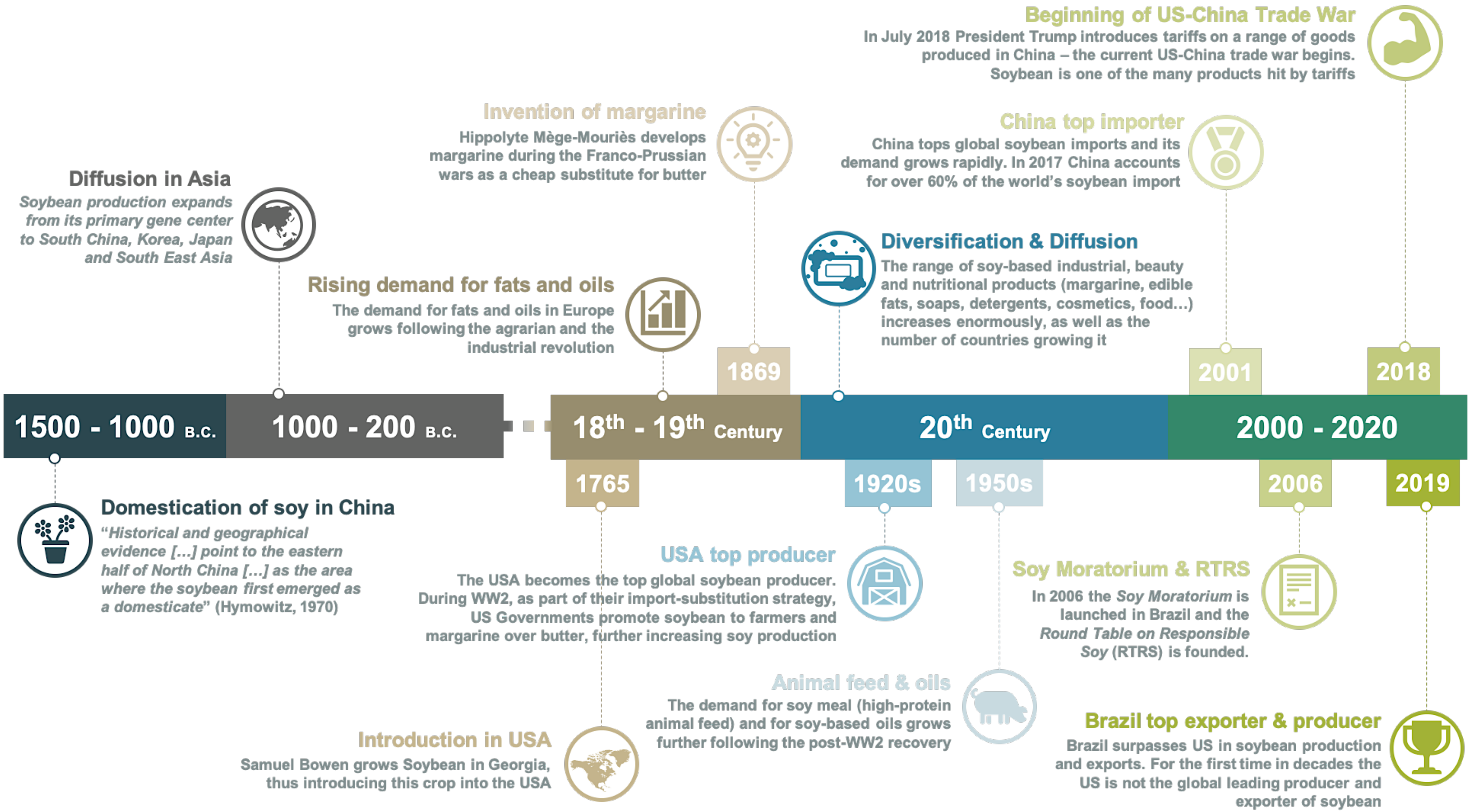
[1] Source: OEC, 2020 – Total value of soybean (HS92: 1201) trade in 2017. Available on-line: https://oec.world/en/profile/hs92/1201/ (Last accessed on 10/03/2020).

[2] Soybean cake and soybean meal are both by-products of the soybean oil extraction, widely used as animal feed. While the meal is the result of mechanical pressing, the cake is extracted with solvents.

[3] See *note 1*.

Figure 1 – History of soybean: production, consumption and trade



Source: De Maria, M. (2020) for Trade Hub. *License*: CC-BY 4.0.

On the one hand, the rapid expansion of soybean area in Brazil – which can be seen also as the result of a process of technological and genetic improvement, gradually perfecting the adaptation of a temperate crop to tropical climate – has been linked with deforestation, loss of biodiversity and reduction of other natural ecosystems (Fearnside, 2001; Barona *et al.*, 2010; Fehlenberg *et al.*, 2017), thus leading to increasing efforts in producing and sourcing this crop more sustainably. These efforts – which will be discussed more in detail in other sections of this report – include a series of voluntary standards and multi-stakeholder initiatives, such as the *Round Table on Responsible Soy*, the *Soy Moratorium* in Brazil, the *Soy Sourcing Guidelines* developed by the European Feed Manufacturers' Federation, as well as a series of internal corporate standards (KPMG International Cooperative, 2013; FEFAC and ITC, 2015; Inakake de Souza *et al.*, 2016; RTRS, 2017). On the other hand, the recent US-China trade war is putting at risk the efforts made in the past to ensure a more sustainable soybean value chain, both globally and locally. Indeed, according to Fuchs (Fuchs *et al.*, 2019, p. 451):

> *"Last year, the United States introduced tariffs of up to 25% on Chinese imported goods worth US$250 billion. In retaliation, the Chinese government imposed tariffs of 25% on $110-billion worth of US goods — including soya beans, a crop mainly used for animal feed. As a result, exports of US soya beans to China dropped by 50% in 2018, even though the trade war began only midway through the year. We forecast that a surge of tropical deforestation could occur as a result of the fresh demand being placed on China's other major suppliers to provide up to 37.6 million tonnes of the crop"*

Today, the main soybean trade routes converge over the Pacific Ocean (*Figure 11*), shaping a triangle between China, Brazil and the United States of America (Gale, Valdes and Ash, 2019). The historical production centre for this crop – China – is now the main consumer and its growing demand for soybean is mainly fed by the Americas – with Brazil and the USA producing together close to 80% of the world's soybean (*Figure 5*) and accounting for a similar joint share of the global export (*Figure 12*). If much of the soybean industry and related commercial flows converge around these three major players, it is also true that more than 170 countries took part to the international trade of this crop in 2017. This picture reveals the existence of a complex '*geopolitics*' of soybean trade flows, where a myriad of small actors – a number of countries each with their own interest – coexist in the international arena alongside the major players, which are embodied by the USA-China-Brazil triarchy.

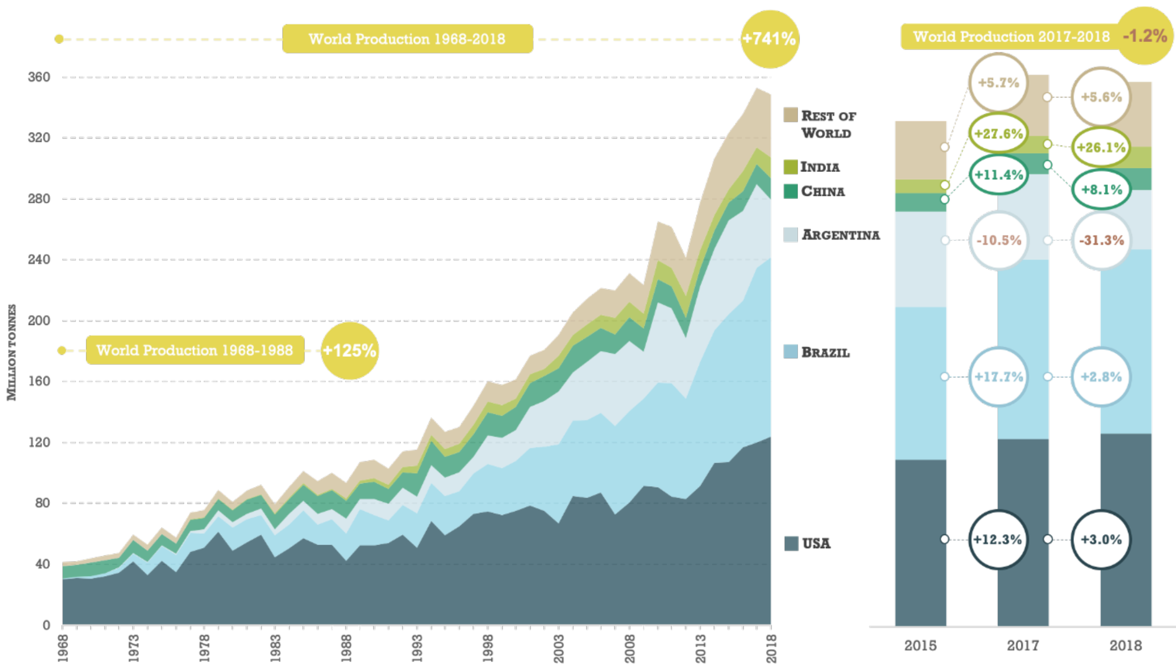
3. Economics

The previous section of this study described the historical evolution of the soybean industry, highlighting the key drivers and the main structural changes over time – from the initial domestication of this plant over three thousand years ago, up until the present day. This section focuses on the economics of soybean production, consumption and trade in the last half a century. If we want to summarise this long and complex story in one sentence, then the current structure of the global soybean industry can be seen as the response and adaptation to one main challenge – that is, meeting the constantly increasing demand for this crop that arises from its versatility.

3.1. Production

Data for the 1968-2018 period, reveals a relentless growth in the total soybean production levels (*Figure* 2), in the area harvested (*Figure* 3) and in the average yield for this crop (*Figure 4*). In 50 years, the world's soybean production increased by 8.4 times, the average yield almost doubled, and the global surface devoted to this crop grew by 4.3 times – from 28.8 million hectares (ha) in 1968, to almost 125 million ha in 2018, which corresponds to an aggregated area larger than the whole South Africa. Such an extraordinary growth in global production levels appears to be the combination of two main forces: extensification – that is, the expansion of the soybean area – and intensification – which can be seen as the increase in average yields due to genetic improvements and better production techniques.

Figure 2 – Evolution and composition of global soybean production (1968-2018)

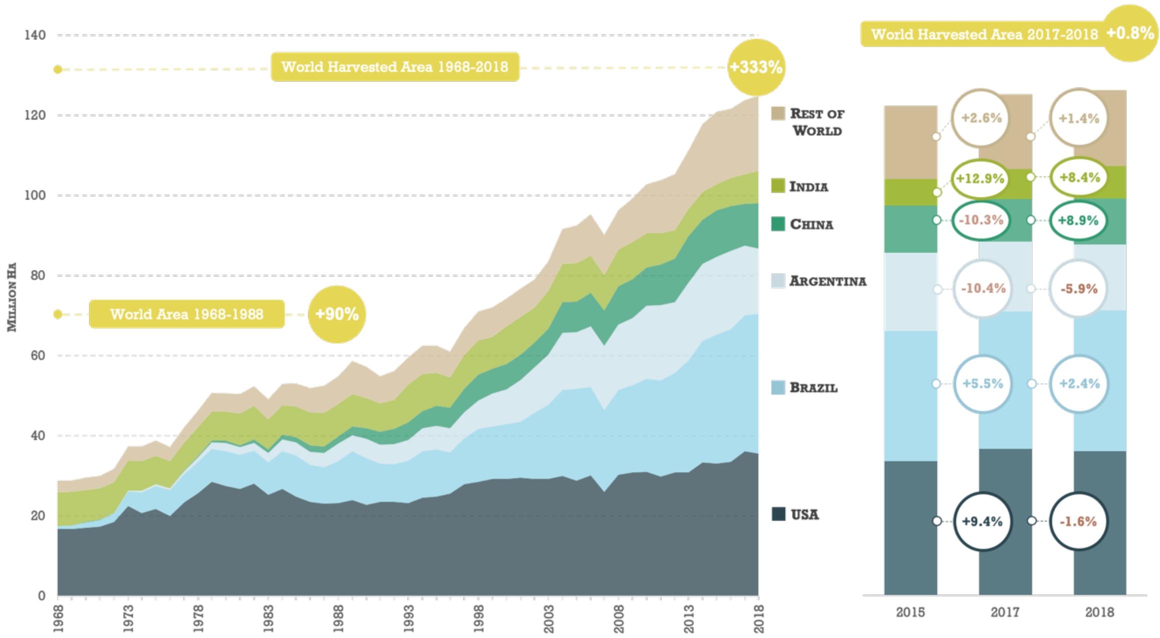


Source: De Maria, M. (2020) for [Trade Hub](). Based on [FAOSTAT]() data. *License*: [CC-BY 4.0]().

Commercial and industrial soybean production started to expand in the USA during the 1920s, but it grew so rapidly that in the 1960s the United States already played the lion's share in both soybean production and trade (Merry Baker, 2004). In 1968, the USA produced over 30 million tonnes of soybean, corresponding to 72.7% of the global production. Gradually, new countries – mainly in South America – started to expand their soybean production, supplementing the bourgeoning demand for this crop. By 1999, the USA had increased their domestic production by almost 2.5 times compared to the 1968 levels, but they only accounted for about 46% of the global production by that time.

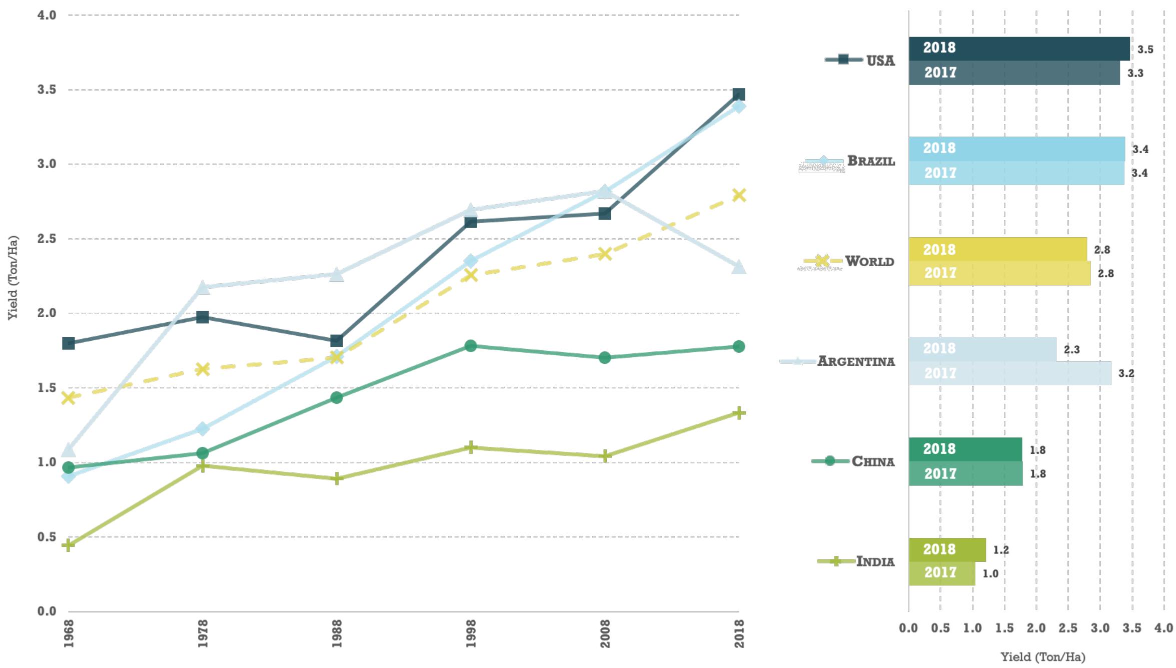
Despite the relative decline in the US share, the production of soybean is still very concentrated at present. In 2018, five countries alone – namely, Brazil, USA, Argentina, India and China – produced almost 90% of the soybean in the world (*Figure* 5). All other countries that cultivated soybean in the same year – 91 countries excluding the top five – cumulatively produced 41.4 million tonnes, corresponding to about 12% of the world market today and to less than the soybean harvested in the USA alone in 1973.

Figure 3 – Evolution and composition of soybean harvested area (1968-2018)



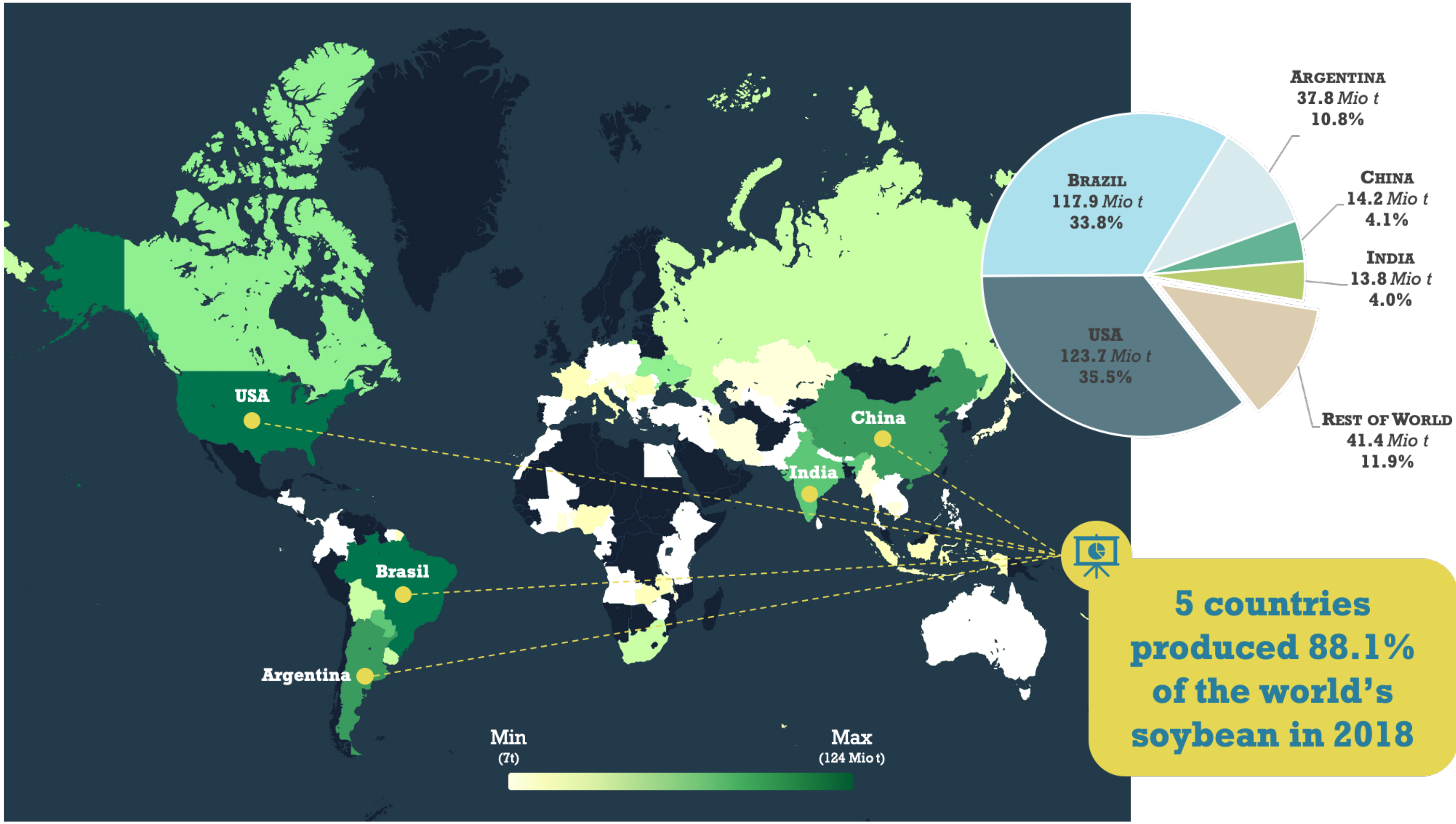
Source: De Maria, M. (2020) for Trade Hub. Based on FAOSTAT data. *License*: CC-BY 4.0.

Figure 4 – Evolution of average soybean yields (1968-2018)



Source: De Maria, M. (2020) for Trade Hub. Based on FAOSTAT data. *License*: CC-BY 4.0.

Figure 5 – Soybean production in 2018



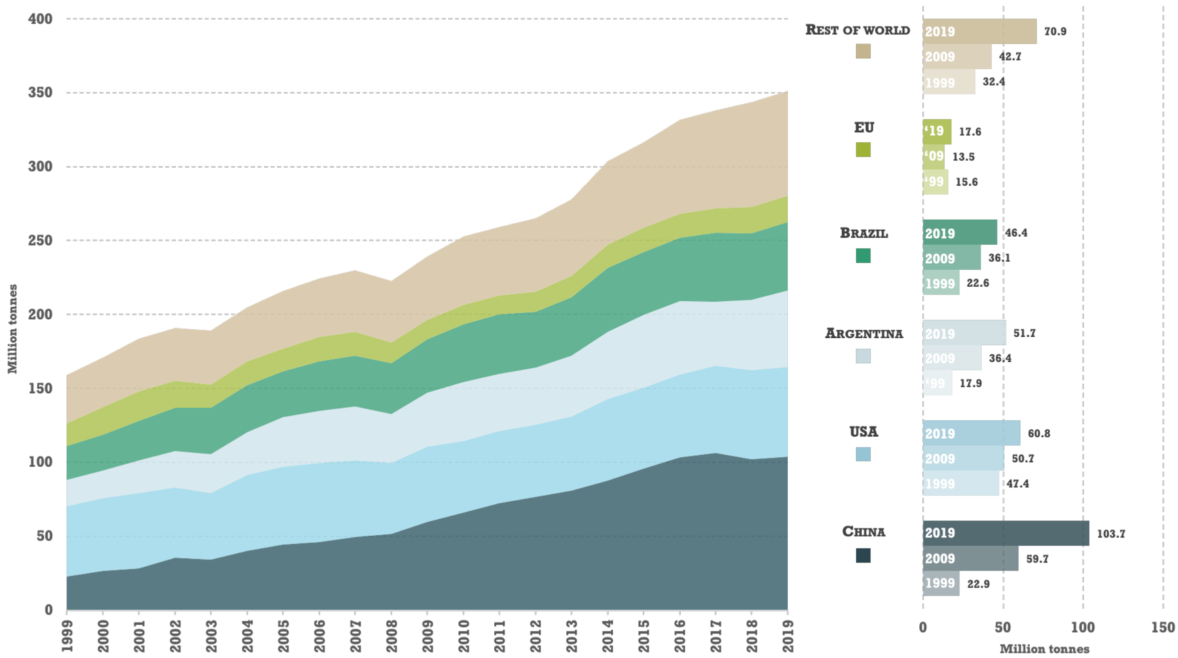
Source: De Maria, M. (2020) for Trade Hub. Based on FAOSTAT data. *License*: CC-BY 4.0.

In 2018, Reuters reported that Brazil was set to become the top Soybean producer[4], surpassing the USA for the first time in history. Official FAOSTAT data for 2018 – the latest available record as we write this study – still saw the USA as the world's leading soybean producer, but estimates for the 2019 season5 suggest that this might actually be the year when Brazil will overtake the USA as the world's largest soybean producer.

3.2. Consumption

The exceptional growth in the global soybean production levels mirrors, of course, the consumption patterns for this crop. Domestic soybean consumption data from the Foreign Agriculture Service of the USDA shows that the 5 largest consumers – namely China, USA, Argentina, Brazil and the EU – consumed about 80% of the soybean globally produced in 2019 (*Figure 6*). In 1999, China used domestically less than half of the soybean consumed in the USA, despite having 4.5 times the population recorded in the United States at that time. In 2009 China's soybean consumption had already surpassed the USA, making China the largest soybean consumer country in the world. Ten years later, in 2019, China consumes about 30% of the world's soybean. If China today uses about 5 times more soybean than in 1999, it domestically produces almost as much – and possibly a little less – soybean as in 1999, with an internal production that meets just about 14% of the country's consumption.

Figure 6 – Evolution and decomposition of soybean consumption by country



Source: De Maria, M. (2020) for Trade Hub. Based on USDA – FAS data. *License*: CC-BY 4.0.

[4] See for instance Reuters: https://www.reuters.com/article/us-brazil-soy-usa/brazil-to-pass-u-s-as-worlds-largest-soy-producer-in-2018-idUSKBN1IC2IW.

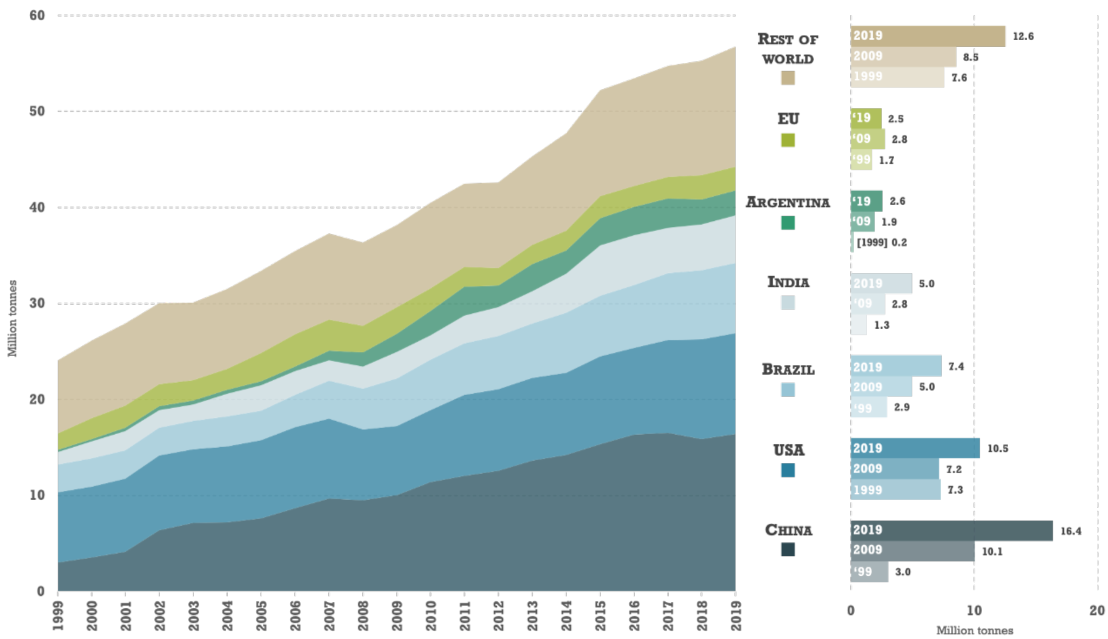
[5] See for instance the Financial Times: https://www.ft.com/content/8b2bb828-1ad0-11ea-97df-cc63de1d73f4.

Soybean in China has multiple uses: is used in the production of soybean oil (Sturgeon and Gereffi, 2013), traditional fermented soybean products, soy sauce and – mainly – soybean meal for livestock feed (Guo *et al.*, 2018). According to Brown (2012, p.95):

> *"As China's appetite for meat, milk, and eggs has soared, so too has its use of soybean meal. And since nearly half the world's pigs are in China, the lion's share of soy use is in pig feed. Its fast-growing poultry industry is also dependent on soybean meal. In addition, China now uses large quantities of soy in feed for farmed fish."*

Interestingly, while China is the largest seafood exporter[6] in the world, it is a net importer for pig meat[7] and poultry[8], which – coupled with data on domestic consumption of soybean (*Figure 6*) and soy oil (*Figure 7*) – suggests that most of the soybean in China is used to meet domestic consumption needs along the value chain. The *'rest of world'* category in *Figure 6* indicates that a number of – mainly developing – economies are following a similar path, increasing their domestic levels of soybean consumption. This is a consequence of the growing appetite for livestock products in a number of developing countries, led by the emerging middle class that can increasingly afford these commodities (Lee *et al.*, 2016; Westcott and Hansen, 2016). Soybean oil consumption is also expanding rapidly, with China and India respectively first and fourth in the world's consumption ranking in 2019 (*Figure 7*) and jointly importing almost a third of the soybean oil globally traded[9].

Figure 7 – Evolution of soybean oil domestic consumption



Source: De Maria, M. (2020) for [Trade Hub](). Based on [USDA – FAS]() data. *License*: [CC-BY 4.0]().

[6] See, for instance, OEC data for fillet fish trade (https://oec.world/en/profile/hs92/0304/) and the 2019 World Seafood Map by Rabobank (https://research.rabobank.com/far/en/sectors/animal-protein/world-seafood-trade-map.html).

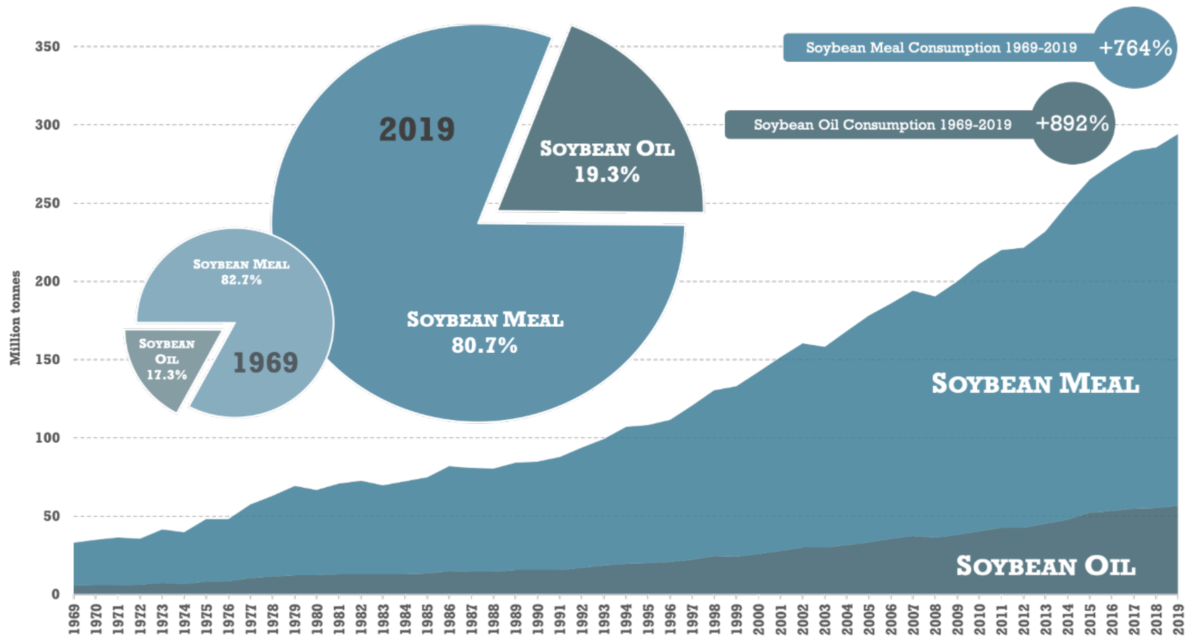
[7] See: https://oec.world/en/profile/hs92/0203/.

[8] See: https://oec.world/en/profile/hs92/0207/.

[9] See: https://oec.world/en/profile/hs92/1507/.

Each bushel of soybean weighs about 27.22 kg and produces about 5 kg of oil and 21.9 kg of protein-rich meal, with the rest being waste (Dei, 2011; American Soybean Association, 2018). For this reason, the proportion between the total soybean oil and meal globally consumed remained fairly constant during the last 50 year. However, in absolute terms, the total consumption of both soybean meal and oil grew steadily over time (*Figure 8*), mirroring soybean consumption and production trends.

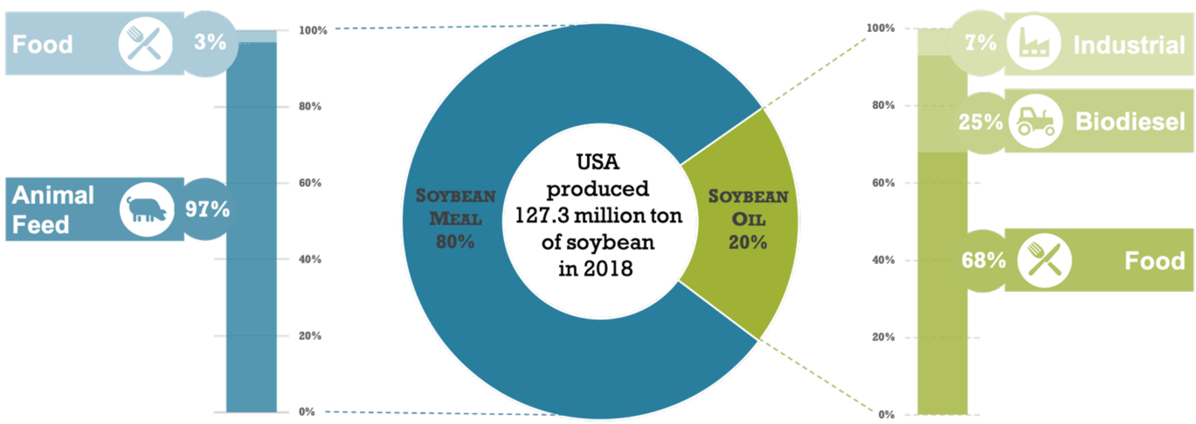
Figure 8 – Global soybean meal and soybean oil consumption



Source: De Maria, M. (2020) for Trade Hub. Based on USDA – FAS data. *License*: CC-BY 4.0.

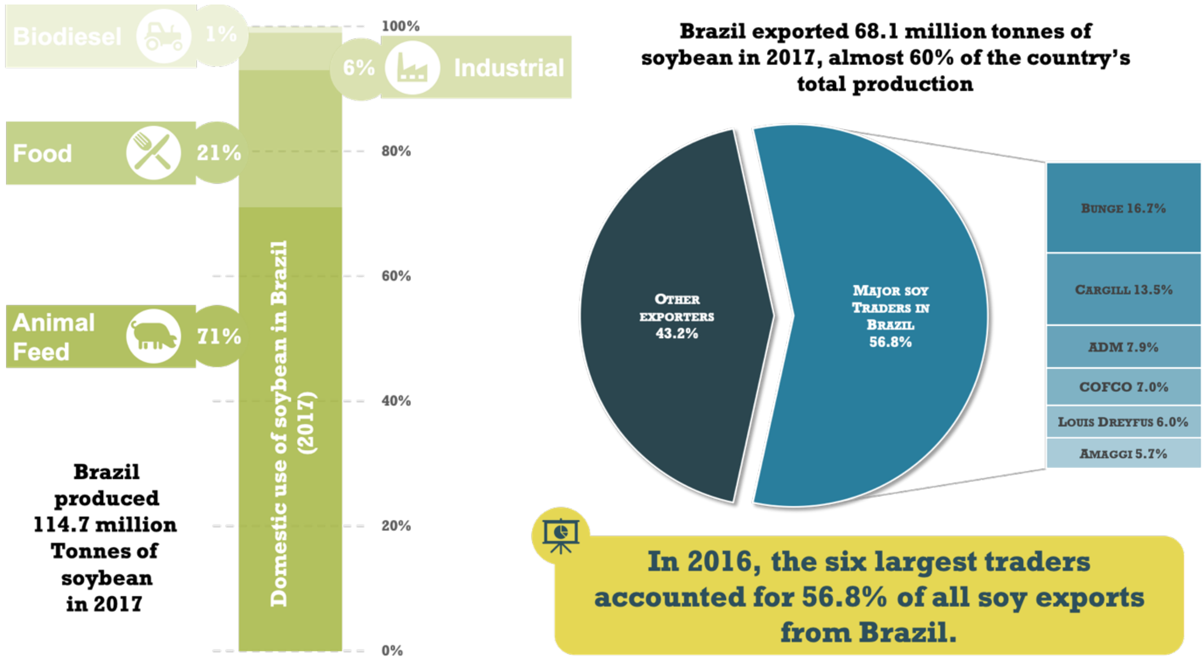
Final uses for soybean in USA and Brazil – the two largest producer countries by far – are reported, respectively, in *Figure 9* and *Figure 10*. In the USA, soybean meal is almost completely used in the animal feed industry, with only a residual share (3%) directly processed by the food industry. Conversely, soybean oil is mainly used for direct food production (68%), while other major uses comprise biodiesel production (25%) and industrial processing (7%) for products ranging from cosmetics to detergents.

Figure 9 – Domestic use of soybean in the USA



Source: De Maria, M. (2020), based on Soybean Producers Association. *License*: CC-BY 4.0.

Figure 10 – Domestic use of soybean and export market in Brazil



Source: De Maria, M. (2020) for Trade Hub. Domestic uses are based on (Fuchs *et al.*, 2019). Export and production figures are Based on FAOSTAT data. Market shares for major Brazilian exporters were retrieved from Trase's 2018 yearbook (Trase, 2018). *License*: CC-BY 4.0.

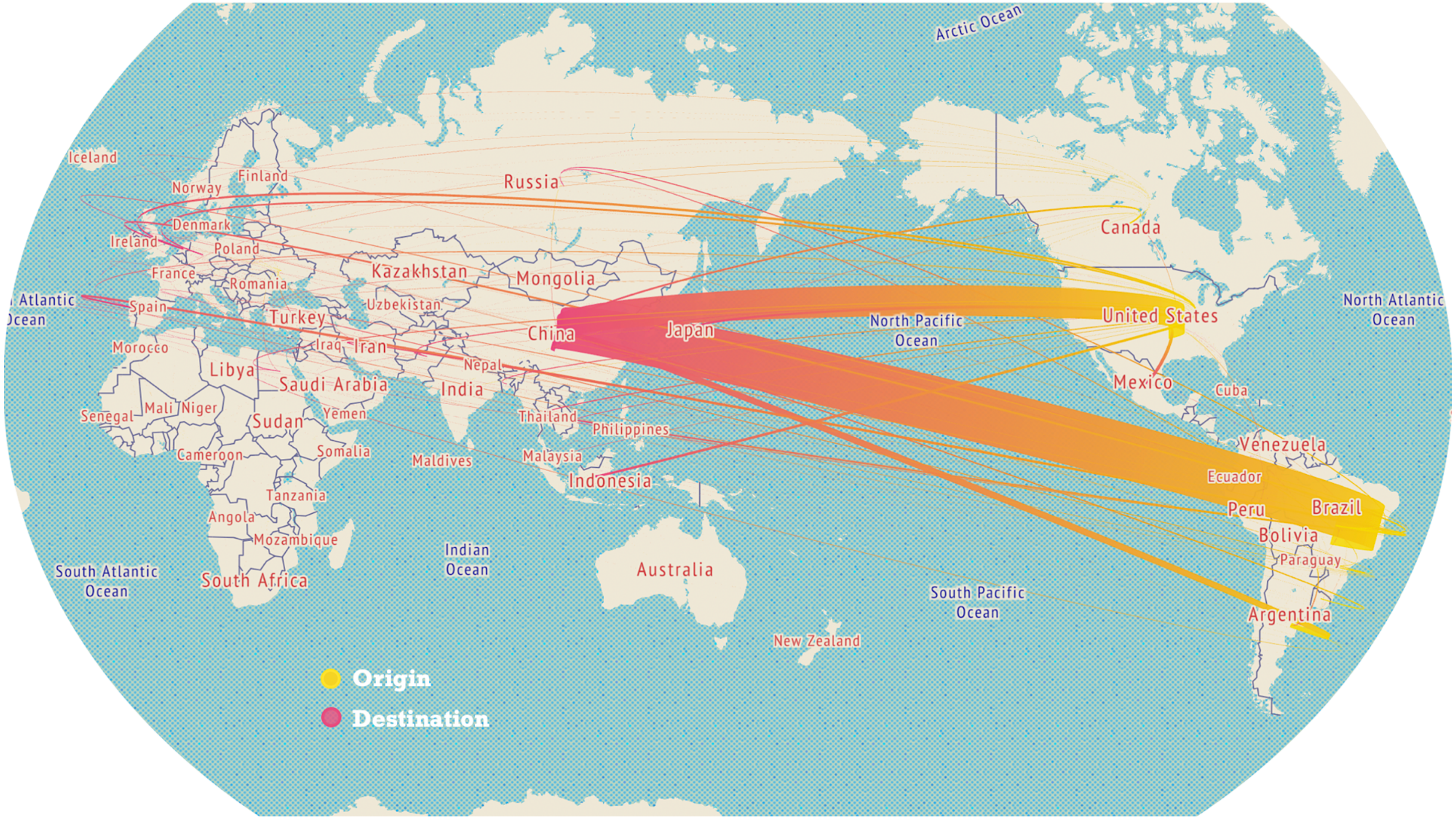
Given the current composition of the value chain, soybean cannot be considered a *food crop* – not directly at least – and should be regarded as something more than a simple *cash crop*. Indeed, thanks to its versatility and to the increasing number of uses, soybean has been labelled as a *flexible crop*. In this sense, Oliveira and Schneider – who also captured the fact the key stakeholders in the soy industry anticipate further proliferation of soy's uses in the near future – suggested that (2016, p. 168):

> *"As a crop defined largely by the value and usefulness of its co-products – namely, soybean meal and soybean oil – soy might be regarded as a fundamentally flexible crop"*

The soy complex, just like other grain industries, is typically hourglass-shaped, with a large number of producers and consumers at both ends of the value chain, and a small number of processors and traders in the middle, who uses strategically their position to leverage market power upstream and downstream (Murphy and Burch, 2012). For instance, with hundreds of thousands of farms cultivating soybean in Brazil according to the latest Agricultural Census data[10], and arguably billions of final consumers for soy-based products all over the world, six traders alone – namely Bunge, Cargill, ADM, COFCO, Luis Dreyfus and AMAGGI – control more than a half of the Brazilian export market (Trase, 2018). The market power and the concentration of the actors sitting in the middle of the soy value chain often extends over national borders, with an estimated 60% to 70% of the Chinese crushing and oil extracting facilities controlled by foreign groups (Schneider, 2014).

[10] See: https://www.ibge.gov.br/en/statistics/economic/agriculture-forestry-and-fishing/17234-census-of-agriculture.html.

Figure 11 – Global soybean trade flows in 2017



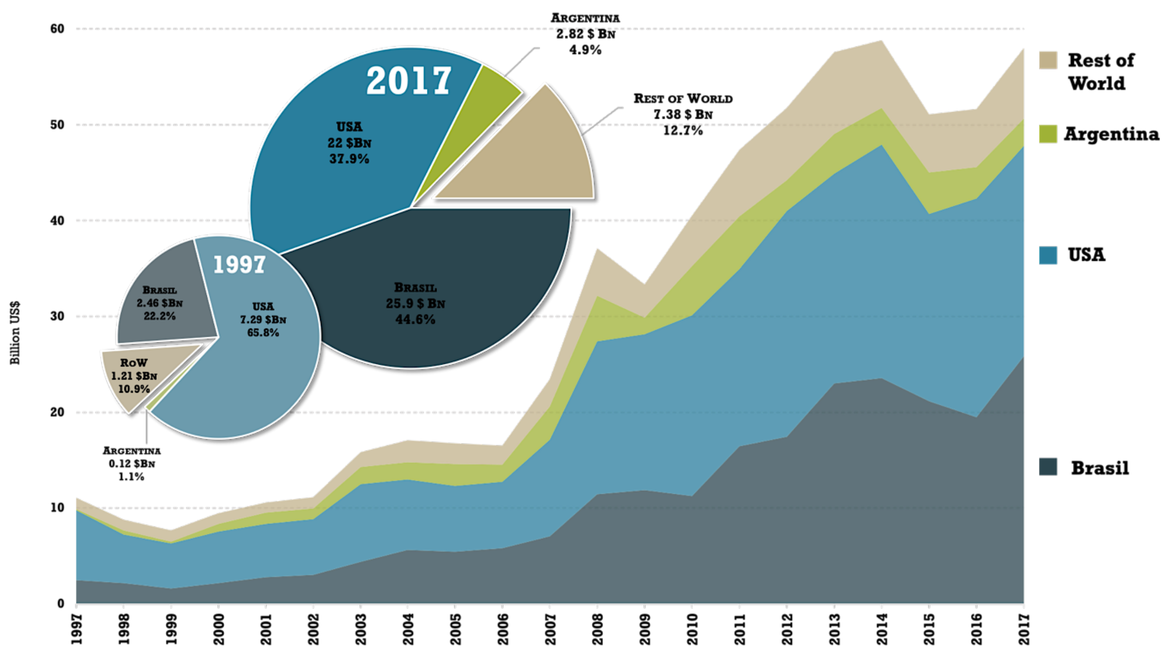
Source: De Maria, M. (2020) for Trade Hub. Based on OEC 3.0 data, using open source on-line geospatial tool Kepler. *License*: CC-BY 4.0.

3.3. Trade

Global soybean trade flows are a gargantuan business worth over 58 billion US$ (current) in 2017, with an additional 23 billion for soybean meal trade and 9 billion for soybean oil. As a comparison, the rice trade in the same year totalled 20.2 billion US$ in value. The wheat trade, with an estimated value of 42.6 billion US$, was worth about twice as much the rice one, but it was still about 16-billion-short compared to international soybean flows[11].

The current geography of soybean international trade flows is massively concentrated around two '*magnetic*' poles. On the one hand, the Americas represent the export (and production) pole, with most of the soybean traded internationally originating from the US, Brazil and Argentina. On the other hand, the import (and consumption) pole is situated in Asia – which attracted as a continent about 80% of global import flows in 2017, with China playing the lion's share (*Figure 13*). China's soybean production remained fairly constant in the last two decades, while its consumption levels increased constantly in the same period, giving the opportunity to foreign exporter countries to close this gap (Brown, 2012a; Guo *et al.*, 2018).

Figure 12 – Global soybean export flows



Source: De Maria, M. (2020) for Trade Hub. Based on OEC data. *License*: CC-BY 4.0.

In 1997, about two every three beans of soy in the international market came from the USA (*Figure 12*). Two decades later, Brazil is the main exporter of soybean in the world and – due to a combination of bad weather and international trade frictions between China and USA[12] –

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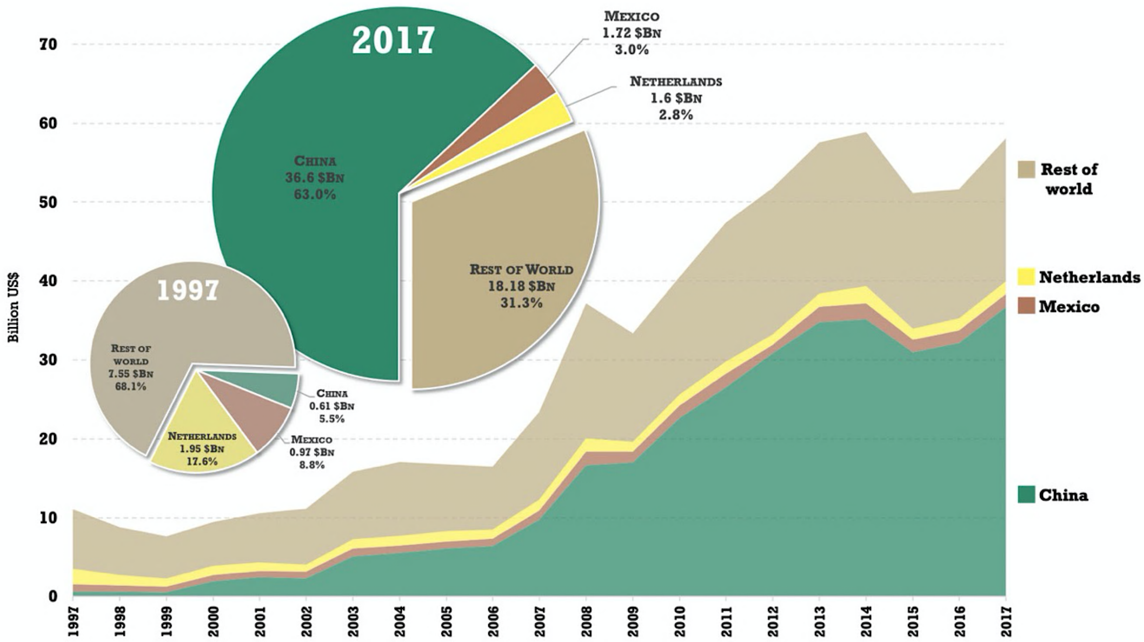
[11] All aggregated figures for international trade reported in this paragraph are taken from OEC and are available on-line: https://oec.world/en/.

[12] See the USDA report on oilseed published in December 2019. The report is available on-line: https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Oilseeds%20and%20Products%20Update_Brasilia_Brazil_12-28-2019.

is set to become the largest producer for this commodity in the 2019 harvesting season. Still in 1997, China accounted for just 5.5% of global soybean imports. Twenty years later, China – which joined the WTO in 2001 – represents alone 63% of the world's soybean import market, with the second and the third largest importer countries – Mexico and the Netherlands – jointly accounting for only 6% of the total imports.

Figure 13 – Global soybean import flows



Source: De Maria, M. (2020) for Trade Hub. Based on OEC data. *License*: CC-BY 4.0.

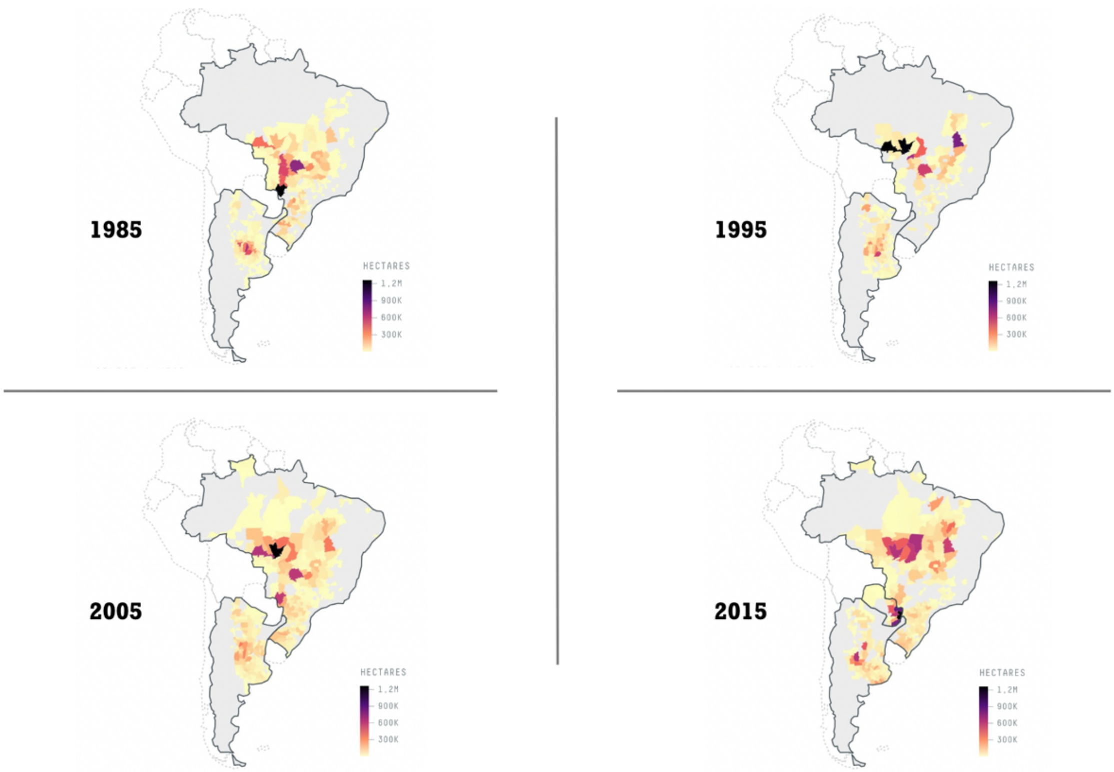
4. Environment

The soybean miracle – that is, the constant increase in production, consumption and trade for this crop – created tangible economic benefits, both for the production (e.g. income and profit generation, job creation, etc.) and the consumption side (e.g. increased diversity and availability of soy-based products at more affordable prices). However, these economic benefits were distributed very differently among different regions and stakeholders (Weinhold, Killick and Reis, 2013; Choi and Kim, 2016; Martinelli *et al.*, 2017) and should be balanced considering the possible negative impacts on the environment and people. This section discusses the main environmental issues related to soybean production and trade, while the following one focuses on the implications on people, societies and livelihoods.

Before expanding on other relevant aspects, the soybean sector is also related to the wider discussion exploring the nexus between human diets, food consumption, agricultural production systems and environmental impacts. Plant-based food is increasingly found to be more efficient – both from a nutritional and an environmental perspective – than animal based food (Carlsson-Kanyama and González, 2009; Clark and Tilman, 2017), and similar findings applies to the soybean sector in Brazil, especially when examined in comparison with livestock activities (Sparovek *et al.*, 2018).

Land use change directly driven by soybean expansion is one of major environmental concerns, as it can lead to the reduction of natural habitats, such as rainforest and savannah, and biodiversity loss. The loss of natural ecosystems due to expansion of cultivated areas, together with the intensification of agricultural practices, also reduce the ability of the ecosystem to supply goods and services that support human population and contribute to its well-being, i.e. ecosystem services (MEA, 2005; Schleicher *et al.*, 2018). According to FAOSTAT data, in the period 2000-2018 the area devoted to soybean increased by over 50 million hectares globally, with a 21-million-hectares expansion in Brazil alone (*Figure 15*).

Figure 14 – Soybean expansion in Brazil, Argentina and Paraguay



Source: Trase 2018 Yearbook, Chapter III (Trase, 2018).

In 2006, the Greenpeace report “*Eating up the Amazon*” exposed soybean cultivation as one of the major drivers for deforestation in the Amazon, with an estimated 1.2 million hectares of soybean planted within the Amazon rainforest in 2004-2005 alone (Greenpeace, 2006; Leblois, Damette and Wolfersberger, 2017). The increasing awareness of the soy-driven deforestation led in 2006 to the establishment of the *Soy Moratorium* – a voluntary agreement that prevents soybean traders from buying this crop from deforested areas in the Amazon. The *Moratorium*, which is now in place indefinitely, was successful in reducing the rate of soy-led deforestation in the Amazon rainforest (Inakake de Souza *et al.*, 2016). However, it also contributed to shifting the expansion of soy frontier further South, endangering native species, vegetation and watersheds in the Cerrado – one of the most important biodiversity hotspots in the world – and leading to a call for the *Soy Moratorium* to cover this biogeographical region too (Inakake de Souza *et al.*, 2016; Spring, 2018; Nepstad *et al.*, 2019; Rausch *et al.*, 2019).

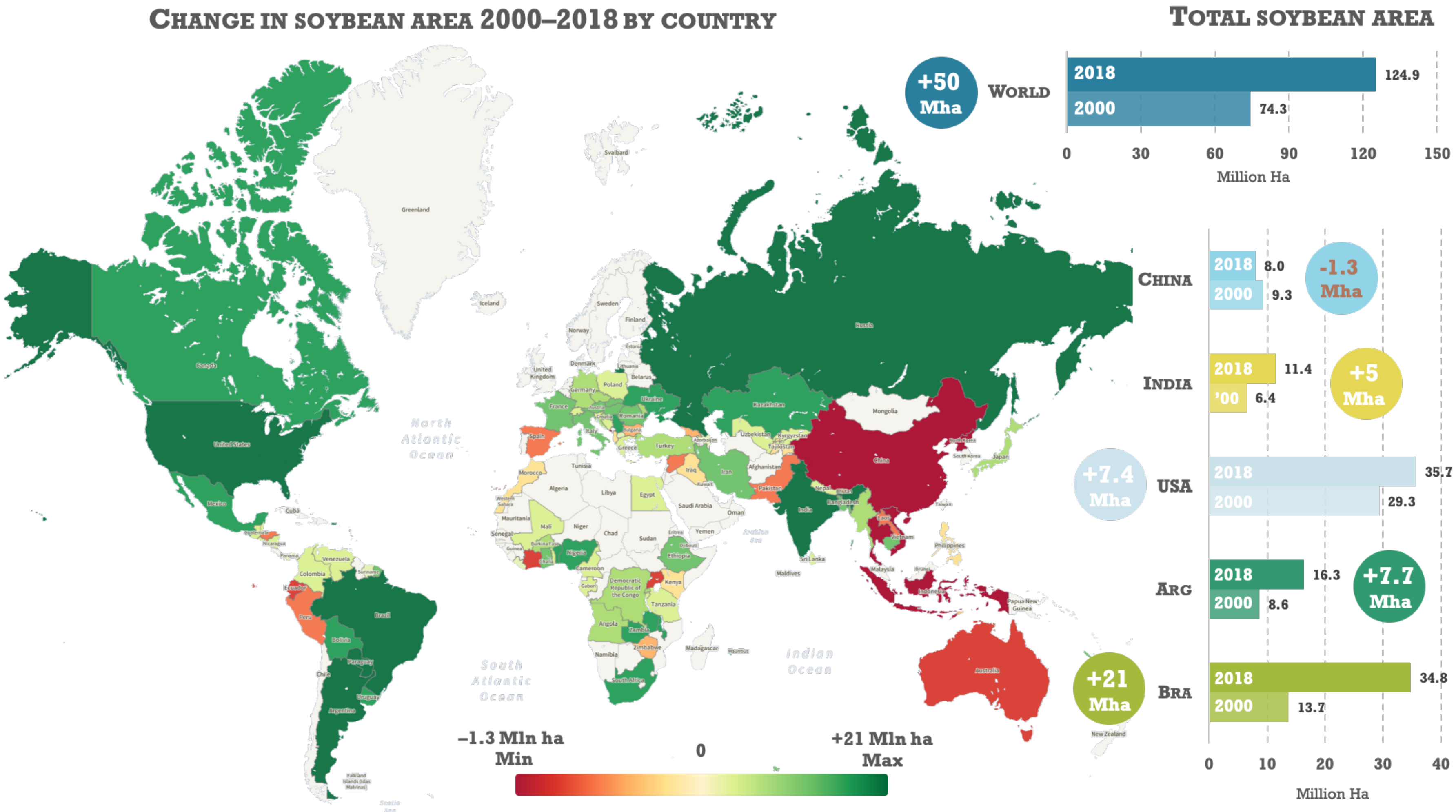
As highlighted in recent studies focusing on biodiversity threats generated by the expansion of the soy industry in the Cerrado area (Green *et al.*, 2019; Durán *et al.*, 2020), the overall impact on ecosystems can be diversified both in terms of the sources – that is, which countries, actors and sectors are mainly responsible for negative impacts on biodiversity – and of the species affected – as in the very same habitat, some species might be more endangered than others. In this sense, Green *et al.* (2019, p. 23202) not only provide compelling examples and methods for linking different sources of harm with the different species that are affected, but also emphasise the importance of doing so in order to improve the sustainability of supply chains and trade flows:

> *"Distinct sourcing patterns of consumer countries and trading companies result in substantially different impacts on endemic species. Connections between individual buyers and specific hot spots explain the disproportionate impacts of some actors on endemic species and individual threatened species, such as the particular impact of European Union consumers on the recent habitat losses for the iconic giant anteater (Myrmecophaga tridactyla). In making these linkages explicit, our approach enables commodity buyers and investors to target their efforts much more closely to improve the sustainability of their supply chains in their sourcing regions while also transforming our ability to monitor the impact of such commitments over time"*

Brazil is not the only country where the growth of soybean-related activities is threatening natural resources. Other producer countries are experiencing negative environmental impacts too. For instance, in Argentina – where the soybean cultivated area increased by 7.7 million hectares in the period 2000-2018 (*Figure 15)* – the soybean production has been directly identified as one of the drivers for deforestation and loss of grasslands and rangelands in the Gran Chaco, with additional negative effects for neighbouring countries Bolivia and Paraguay (Fehlenberg *et al.*, 2017). The global – and globalised – nature of soybean production, consumption and trade operations suggest that, whilst the diverse environmental impacts of the soybean industry are intertwined, they are also differentiated in magnitude, nature and space, based on the specific roles played by each region and actor within the international value chain for this crop. Vause (forthcoming), used the concept of '*impact inequality*' to suggest that while production and consumption activities for international commodity trade are localised, their impact on the biosphere – which depends also on the stock of biosphere and on its regenerative rate, and not only on population size and specific technologies used for production, transport and consumption – are to be identified at the global level.

In general, the scientific literature – and in some cases with a specific focus on soybean – has been increasingly emphasising the need for telecoupling land use changes and other environmental impacts among countries that might be distant in space, but closely tied with respect to their commercial relationships (Reenberg and Fenger, 2011; Macdonald *et al.*, 2015; Gasparri *et al.*, 2016; Silva *et al.*, 2017; Sun, Tong and Liu, 2017; Torres, Moran and Silva, 2017; Yao, Hertel and Taheripour, 2018). For instance, Sun *et al.* (2018), telecoupling global soybean trade and production dynamics, recently challenged the idea that international trade simply shifts negative environmental impacts from importing countries to exporting – and producing – countries, so that net importers actually benefit from the trade-induced environmental displacement. In particular, their results suggest that the substitution of soybean – a nitrogen-fixing crop – with other crops in importing countries such as China, ultimately increased the level of nitrogen pollution, therefore damaging the domestic environment in China, as well as in other soybean net-importer countries.

Figure 15 – Global soybean area change in the period 2000-2018



Source: De Maria, M. (2020) for Trade Hub. Based on FAOSTAT data, using open source geospatial tool Kepler for the map. *License*: CC-BY 4.0.

Torres, Moran and Silva (2017) analysed the role of property rights and land use policies in the telecoupled Sino-Brazilian soybean trade system, highlighting the implication of different tenure systems in the two countries with respect to conservation goals. China – the receiving country – has partially reduced its soybean surface by favouring foreign imports and by giving farmers incentives to substitute soybean with other crops. In doing so, the country regenerated forest areas, responded to soil erosion and reduced the flooding risk. Brazil – the sending country – has managed to profit from the increasing demand for soybean coming from China expanding its soybean area into natural landscapes, with a tenure regime that facilitated the expansion of soybean estates and, at the same time, the concentration of land ownership.

Boerema *et al.* (2016), focusing their attention on the implications of soybean expansion and trade for Brazil, Argentina and EU in the period 1961-2008, highlighted how the loss of natural ecosystems is not only limited to deforestation and reduction of permanent grasslands in exporter countries. Indeed, as a result of the increased availability of cheap animal feed in the form of soybean meal and cake, permanent pastures and grasslands tend to be converted to other uses also in importer countries. In general, their paper suggests that the economic gains from the soybean international trade should be balanced against the related environmental costs, estimating that (*Ibid.*, p. 6):

> *"The environmental and socio-economic impact of land use changes since 1961 in EU, Brazil and Argentina due to the soybean trade, has reached an average net loss of 120 billion $/y in 2008. This is mainly the consequence of losses in ecosystem services from deforestation and converted tropical grassland and savannahs in Brazil and Argentina, and to a small extent also the converted grasslands in Europe. The conservative estimate of the total cumulated loss of natural capital by EU-soybean trade between 1961 and 2008 amounts to 1.7 trillion dollars."*

While the relative weight of domestic and international factors remains uncertain, and despite the inherent limitations and uncertainties associated with different valuation methods, it is clear that environmental costs of the soybean trade – which, among other things, include the loss of biodiversity and natural ecosystems, as well as the increasing pressure on natural resources such as land and water – can be sizeable. For this reason, the call for a more sustainable soybean sector gained momentum in recent years, with a number of multilateral stakeholder coalitions advocating for better regulations, improved standards and reliable certifications (KPMG International Cooperative, 2013; FEFAC and ITC, 2015; Inakake de Souza *et al.*, 2016; RTRS, 2017).

Despite these efforts, most of the available schemes remain incomplete, voluntary and – in some cases – competing, thus limiting the uptake by different stakeholders involved at different level of soybean value chain and reducing their overall mitigation potential. For instance, we have previously highlighted how the success of the Soy Moratorium in reducing deforestation in the Brazilian Amazon forest has been partially offset by the diversion of the soybean expansion frontier towards the Cerrado (Inakake de Souza *et al.*, 2016; Kastens *et al.*, 2017). Another compelling example of the limited effect of sustainability schemes in the soybean industry comes from the figures reported by the European Soy Monitor (IDH and IUCN NL, 2019), which estimated that in 2017 only 22% of the soybean used in European Union was responsibly sourced and just 13% was deforestation-free. With Asian countries absorbing about 80% of global soybean export, it is also reasonable to ask whether the EU market is big enough to drive a sustainable transition of the soybean industry.

The specific structure of this report distinguishes between the economic, environmental, social and institutional aspects associated with the soybean complex, taking into account as much as possible both the global and at the local perspective. If this approach possibly provides a greater clarity and facilitates the readers' understating, it might sometimes fail to highlight the transmission mechanisms that link together the different spheres affected by soybean trade, production and consumption activities. Therefore, it is important to highlight that the soy-induced loss of natural habitats – which we have extensively discussed in this section devoted to the environment – has also direct and indirect consequences for people and communities – which will be the focus of the next section. For instance, in Uruguay, the loss of grasslands, which provided high yields for honey, has negatively affected beekeepers (Malkamäki, Toppinen and Kanninen, 2016), whilst in Argentina the loss of forest has decreased the supply of firewood used to satisfy local energy demand (Krapovickas, Sacchi and Hafner, 2016). Moreover, the intensification of agricultural practices and of agrochemical use put pressure on water basins, reducing the availability and the quality of this important resource for other human activities (Moreira *et al.*, 2012; Greenpeace, 2018). Finally, the clearance of forest, grasslands and savannahs reduces the amount of carbon that can be sequestered, and therefore the potential for mitigating climate change, with a range of negative impacts for human populations both at the global and at the local level (Bonini *et al.*, 2018).

5. People

At the early stage of the evolution towards the current triadic structure of the international soybean market, Fearnside (2001, p. 23) raised both social and environmental concerns regarding Brazilian soybean '*miracle*':

> *"Soybeans are much more damaging than other crops because they justify massive transportation infrastructure projects that unleash a chain of events leading to destruction of natural habitats over wide areas in addition to what is directly cultivated for soybeans. […] Brazil may someday come to see the need for discouraging rather than subsidizing this crop because many of its effects are unfavourable to national interests, including severe concentration of land tenure and income, expulsion of population to Amazonian frontier […] and the opportunity cost of substantial drains on government resources."*

The implications of the current phase of the '*soybean boom*' are not limited to the environmental sphere, as they extend to people too. In his seminal contribution, Fearnside (2001) anticipated some of the social impacts potentially connected with the soybean expansion in Brazil, including the implications of building mega-infrastructures needed for the transportation of the raw material from the production sites to international shipping facilities; the increasing concentration of land tenure and soy-related income in the hands of a small number of estate owners; and the risk of evictions, dispossession and uncontrolled urbanisation for local populations and Indigenous People pushed away by the expansion of soybean cultivated areas.

In their review of the *Soy Moratorium*, Inakake de Souza *et al.* (2016, p. 8) indicated that some of Fearnside's concerns – 15 years after their original formulation – actually materialised:

“Nearing completion, the BR-163 highway – or the ‘soya highway’ – is a highway connecting consolidated crop areas in central Brazil to the Santarém port in the northern Amazon region. The construction of the highway opened the doors of the region to a ‘development’ process bedevilled by corruption, land grabbing and the establishment of large farms”

The impact of soybean expansion on people and communities is complex and multidimensional and it ranges from contributing to economic well-being through economic growth and development (Lima, Skutsch and de Medeiros Costa, 2011; Weinhold, Killick and Reis, 2013; Choi and Kim, 2016; Krapovickas, Sacchi and Hafner, 2016) to increased health risks due to higher pollution of natural resource (Ruder et al., 2009; Cardozo et al., 2016; Bernieri et al., 2019) and intangible impacts such as the loss of cultural identity due to changes in landscape (Auer, Maceira and Nahuelhual, 2017).

Interestingly, a recent study exploring the impact of soybean expansion in Brazilian municipalities on socio-economic and human development, found evidence of both negative and positive effects on populations affected by the expansion of the soybean frontier (Martinelli *et al.*, 2017). On the one hand, the increased income generated by the soybean sector, together with the improved transport and infrastructure network, is associated with improved health and education performances – as measured by the Human Development Index (HDI) – in the municipalities with a high incidence of soy plantations. On the other hand, it seems that, in the very same municipalities, the level of inequality – as measured by the GINI index – has grown faster compared to non-soy areas. In other words, if the ‘*soybean miracle*’ has the potential to contribute the human development of affected communities, it can also exacerbate social and economic disparities. Choi and Kim (2016) found that in Brazil the increase in soy acreage between 1976 and 2013 did not have an impact on economic growth, whilst it was associated with increased inequality – as measured by the GINI index – and with a larger number of people under the poverty line. However, a geographically disaggregated analysis shows that the effect differs between northern and southern regions. In the northern regions. where large-scale acquisitions of land are more common, an increase in soy acreage significantly increases the number of people below the poverty line, while in the southern regions, where small-scale farmers are prevalent, the effect is the opposite and a higher soybean acreage has a positive effect on poverty. This indicates that the potential of the soybean expansion to contribute to improving the economic conditions of the rural population without increasing inequalities may also depend on how the development process is realised and whether small-scale farmers are actively included in the soybean production.

The economic benefits that may arise from soybean trade are also highlighted as a positive contribution to well-being by the farmers and local residents involved in the agricultural development process in South American countries (Steward, 2007; Lima, Skutsch and de Medeiros Costa, 2011; Cardozo *et al.*, 2016; Auer, Maceira and Nahuelhual, 2017). However, the same stakeholders also pointed out how economic development might come at the expense of intangible benefits, such as the cultural identity associated with traditional agricultural practices and landscape management (Krapovickas, Sacchi and Hafner, 2016; Auer, Maceira and Nahuelhual, 2017), and highlighted the lack of attention of local rural development policies toward specific community needs for their own development (Steward, 2007). Interviews with different actors involved in the soy value chain in Brazil (Santarém area) showed that different actors value benefits and costs of soybean expansion differently (*Ibid.*). Local government officials and agrobusiness actors strongly valued the potential economic benefits related to soybean trading, whilst NGOs members emphasised the possible negative environmental effects, including soy-led related deforestation. Finally, the rural residents and smallholder farmers focused mainly on the negative effects related to the increasing pressure to sell their lands and the lack of alternative development opportunities. On the contrary, Lima, Skutsch and de Medeiros Costa (2011) found that in Brazil farmers and labourers involved in the soy sector strongly valued the effect on income and improved housing and infrastructure brought by agricultural development and intensification. At the same time, some participants were also concerned about the negative impacts on water quality and the health risks associated with increasing use of agrochemicals.

The *soybean miracle* in South American countries such as Brazil, Argentina, Bolivia and Paraguay, has also been linked to the surge in large-scale land acquisitions – a phenomenon that in its most hideous connotation is also known as '*land grabbing*'. According to a recent report published by Greenpeace (2019), the expansion of agrobusiness corporations in the soybean frontier has led to evictions, dispossession and land conflicts with indigenous people and local communities. These land grabbing processes strongly affect the well-being of local communities and smallholder farmers and have an impact on both material assets – through increased land concentration and polarisation of the distribution of economic benefits across the population (Lima, Skutsch and de Medeiros Costa, 2011; Choi and Kim, 2016) – and intangible dimensions – by reducing the small-scale farmers sense of security and their capability to be free to make life choices (Cardozo *et al.*, 2016; Busscher, Parra and Vanclay, 2020). Busscher, Parra and Vanclay (2020) examined the land grabbing process in a rural region of Argentina where the demand for land for soy production has been increasing since the 90s. They found that the recent agricultural development has been characterised by illegal and coerced land acquisitions, facilitated by informal land tenure rights, with an observed increase of conflicts between new landowners and informal land occupiers.

The many faces of *land grabbing* have been documented in the literature (De Maria, 2019), but the so-called '*meat grab'* – as described by Schneider (2014) – is particularly relevant in the soybean case. The '*meat grab*' not only relates to large-scale land deals motivated by the direct (animal housing and stocking) and indirect (monocropping for animal feed) industrial production of meat, but also suggests that the notion of food security might be more complex and nuanced than what it was usually understood. Indeed, when national food security goals are pursued through meat grabs, then the "*we will feed our Nation*" political slogan should be balanced with the pressure that the industrial meat production system generates on the environment, as well as with the social injustice that is often embedded in the land grabbing phenomenon – even when environmental and social impacts are displaced to distant places, well outside the national borders.

The large-scale land acquisitions phenomenon also highlights another issue that is relevant for the global soybean industry – that is, the acceptance of foreign investments in destination countries. For instance Oliveira (2018) discussed the general perception associated with Chinese investments in Brazil. The strong ties characterizing the Sino-Brazilian commercial partnership, with the soybean sector being one of the best examples of the interdependence between these two countries, are clear. However, it is also true that Chinese agri-food and land investments in Brazil have been singled out by the media and often described with a narrative imbued with Sinophobia, while this was not the case for other foreign investments coming from the EU, USA, Argentina and Japan, which are often grater in volume – and similar in their nature and implications – compared to the Chinese ones. In this sense, Oliveira concludes by arguing that (*Ibid.*, p. 114):

> *"challenges to national and food sovereignty arise, ultimately, from the transnational soybean production system regardless of the national character of any particular companies or their cross-border relations"*

It must be noted that Brazil, is not just giving away land to foreign investors, but it is also at the same time actively buying land for his agrobusiness abroad, being one of the main foreign investor in other Latin American countries of the so called '*Soybean Republic'* constituted by Argentina, Bolivia, Brazil, Paraguay and Uruguay (Damonte, 2014).

Soybean international trade has many different types of impact on the well-being of the people living in the soybean producing countries. Such impacts influence different well-being dimensions, both tangible and intangible, and typically vary across the value chain and among different stakeholders (Dreoni, Shaafsma and Matthews, forthcoming). These impact on people might have received somehow less attention compared to the environmental consequences of this industry, but they are still very relevant for improving the sustainability of the soybean value chain. For instance, out of five criteria that have been identified for certifying responsible soy by RTRS – the Round Table on Responsible Soy – at least two are markedly social in nature, as they relates to responsible labour conditions and responsible community relations (RTRS, 2017).

6. Institutions

According to the famous definition proposed by North (1991):

> *"Institutions are the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights). Throughout history, institutions have been devised by human beings to create order and reduce uncertainty in exchange."*

In this sense, a number of institutions *de jure* and *de facto* affect soybean production, consumption and trade decisions at different levels – including international forums and institutions, multilateral and bilateral trade agreements, national-level policies and, transversally, public and private stakeholders.

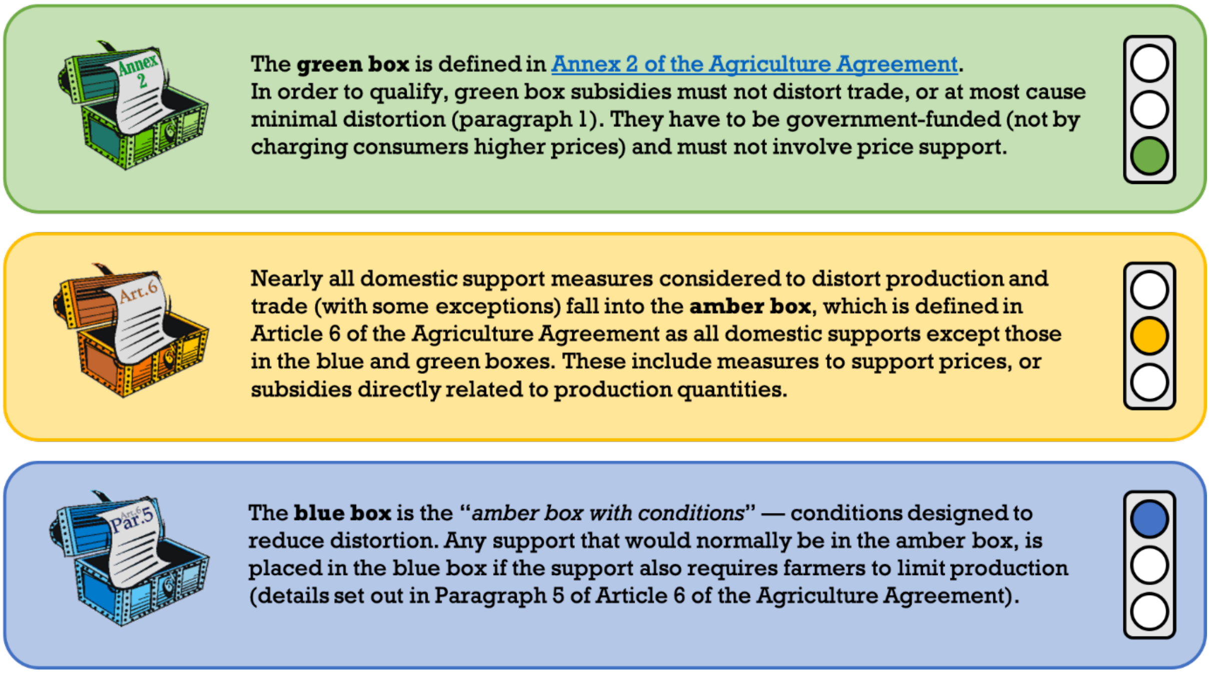
6.1. Agriculture and the WTO

The WTO Agreement on Agriculture (hereinafter simply the Agreement or AA) constitutes the main legal text on the international trade of agricultural commodities (WTO, 2015). The Agreement – which covers raw agricultural commodities (including soybean), as well as tobacco, processed food, alcoholic and non-alcoholic drinks, but excludes products from forestry and fishing activities – entered in force in 1995, with the explicit aim of reforming agricultural trade by reducing the distortions limiting free trade in the agri-food sector. The AA contains rules and commitments that apply to three main areas of agricultural trade, namely *market access*, *domestic support* and *export subsidies*. The Agreement also includes provisions aimed at protecting net-food importer countries, as well as developing and least developed countries.

Regarding *market access*, the main rationale of the Agreement was to reduce the average tariff on agricultural commodities – with an average 36% cut over 6 years on all agricultural products for developed countries and 24% over 10 years for developing countries – and to convert other non-tariff measures – such as quotas – into equivalent or lower tariffs. In general, the AA pushed towards the '*tariffication*' of the agricultural trade, but it also introduced a '*tariff-quota*' system, such that the quantity of given products that were imported in the base period 1986-1991 before the AA came into force were generally charged lower tariffs, while the new quantities exceeding the base period import quota were subject to higher – and sometimes very high – tariff rates.

On the issue of *domestic support*, the Agreement classified a wide range of existing measures supporting domestic agriculture based on their likely distortion potential on production and trade. In particular, the AA reduced the space for measures directly affecting agricultural production – the so-called '*Amber Box*' – with developed countries agreeing to reduce the aggregate value of this type of measures by 20% over 6 years and developing economies committing for a 13% cut over a decade. Other domestic support measures did not receive any limitation and were included in the '*Green Box*'. For instance, direct payments to farmers '*decupled*' – that is not directly linked to – production levels, were incorporated in this box, as they were seen as not having or having only a very limited distortive impact on production and trade. Finally, the '*Blue Box'* was defined for direct payments that are not restricted, as they were based on fixed areas, yields or livestock heads, but calculated on historical figures and therefore not related to current production levels.

Figure 16 – Green, amber and blue boxes in the WTO



Source: Authors' elaboration based on WTO (2020).

The last pillar of the Agreement covered *export subsidies*. The developed country block agreed to reduce by 36% the overall value of these subsidies and by 21% subsidised quantities over 6 years. In parallel, developing countries committed to diminish the total value of agricultural export subsidies by 24% and the subsidised quantities by 14% over a longer 10-year period.

The AA signed at the end of the Uruguay Round of WTO negotiations represented a milestone in many ways. By introducing a separate and specific WTO Agreement for Agriculture, the AA itself somehow formalised the notion of '*agriculture exceptionalism*' (Daugbjerg and Swinbank, 2012; Kim and Lee, 2017) – that is, the idea that the agri-food sector, given its strategical role in feeding nations and the political sensitiveness of the related issues, requires peculiar policies and regulations compared to other sectors of the economy. However, in recognising the peculiar nature of agriculture and the need for a tailor-made liberalisation agreement, the Uruguay Round also showed that an Agriculture Agreement was possible, therefore reinforcing the hopes for further liberalisation over the international trade of agricultural commodities in view of the upcoming Doha Round of WTO negotiations.

If the AA was a negotiation success, its impact on the actual reduction of the level of protection and support on agricultural trade was more nuanced. On the one hand, the Agreement laid the basis for the reduction of export subsidies experienced over the last two decades (*Figure 17*); it improved market access favouring tariff-related mechanisms over non-tariff measures through the '*tariffication*' approach; it clearly separated through the *Green*, *Blue* and *Amber Boxes* different forms of domestic support for agricultural activities based on their potential to distort free-market trade; and – last but not least – it pushed WTO members to commit on measurable targets in terms of tariff and support reduction in agriculture. On the other hand, Swinnen, Olper and Vandemoortele (2012, p. 1100), in assessing the impact of the Uruguay Round Agreement on Agriculture, concluded that:

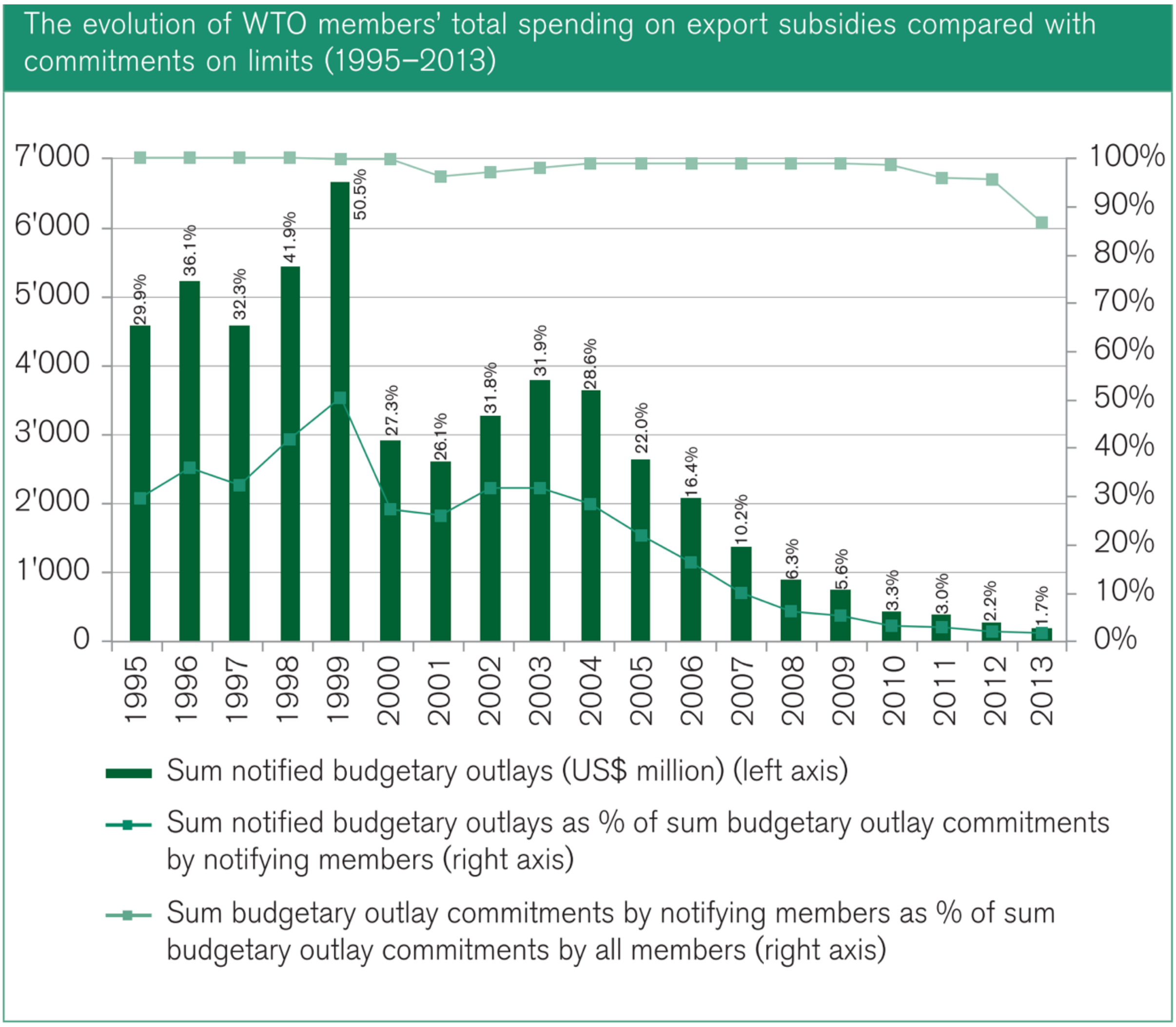
> *"[…] this WTO agreement (or joining the WTO) did not cause a significant reduction in the total amount of support to agriculture but […] it caused a significant shift from distortionary to less distortionary instruments."*

Despite a promising start, agricultural negotiations remained in a deadlock for most of the Doha Round. In 2011, in a bid to resolve the long lasting *impasse*, the WTO members agreed on a paradigm shift for the ongoing negotiations. They put the idea of striking a new comprehensive agreement – the so called single undertaking approach – on agricultural trade on hold, and decided to concentrate instead only on those particular areas of the AA where it was most likely to make progress in negotiations (Scott, 2017; Herwig and Pang, 2019).

At the 9th WTO Ministerial Conference held in Bali in 2013, the main agricultural packages tabled for discussion were related to the removal of export subsidies; to persistently underfilled *tariff-quotas*; to the issue of public stockholding for food security reasons in developing countries; and to the potential addition to the *Green Box* of a series of measures of particular interest for developing countries. Two years later, at the 10th WTO Ministerial Conference held in Nairobi, developed countries committed to immediately eliminating the remaining export subsidies, while developing countries were granted three more years – up to the end of 2018 – to do the same. The discussions over the issue of public stockholding for food security purposes – which demonstrates the deep ramifications and interconnections between agricultural trade and food security – became increasingly important and were tabled for fast-tracked and dedicated sessions.

Despite these efforts, the last WTO Ministerial Conference held in Buenos Aires in 2017[13], did not reached an agreement on a permanent solution to the issue of public stockholding for food security purposes. In practice this led to extending the validity of the so called '*Peace Clause*' introduced in Bali, which allowed developing countries to provide subsidies under public stockholding programmes without the risk of being legally challenged within the WTO's dispute settlement system[14].

Figure 17 – Reduction of WTO members export subsidies



Source: WTO (2015, p. 29).

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[13] The 11th WTO Ministerial Conference held in 2017 in Buenos Aires is the latest so far, as the 12th WTO Ministerial conference originally scheduled to take place in summer 2020 in Kazakhstan has been put on hold due to the current Covid-19 emergency.

[14] See: https://www.wto.org/english/thewto_e/minist_e/mc11_e/briefing_notes_e/bfagric_e.htm.

6.2. Agriculture and international, multilateral and bilateral relations

In recent years, the different agricultural packages tabled for the Doha Round did not make further significant progress, but WTO members expressed an interest in discussing further issues related to the fishery sector and in aligning the ongoing negotiations with the Sustainable Development Goals (SDGs). In this sense, a recent WTO publication (WTO, 2018) recognises the central role that international trade – and therefore the WTO – can play in achieving sustainable development and identifies 9 SDGs specifically on which trade can make a difference (*Figure 18*). Interestingly, if in principle the publication acknowledges the linkages between international trade and the environment, the emphasis was mainly on SDGs focusing on socio-economic aspects (*No Poverty*, *Zero Hunger*, *Good Health*, *Gender Equality*, *Decent Work and Economic Growth*, …). Only *SDG14 – Life Below Water* is explicitly mentioned in the publication among the SDGs directly focusing on environmental issues. Other SDGs such as *SDG12 – Responsible Consumption and Production*, *SDG13 – Climate Action* and *SDG15 – Life of Land* are not discussed directly, implicitly suggesting that the WTO does not necessarily see the space for a direct engagement over these goals. However, the evidence presented so far suggests that issues related to responsible consumption and production, deforestation and biodiversity and ecosystem loss, are particularly important when looking at international trade flows for soybean.

Together with WTO agreements, a number of bilateral and multilateral trade agreements that potentially affect the soy industry exist. For instance, the *EU-Mercosur Trade Agreement* – which has not been ratified yet, but has reached a preliminary agreement in 2019, after about 20 years of negotiations – put the promotion of sustainable development at the core of the negotiations, with an explicit emphasis on environmental protection, climate action and responsible supply chains[15]. It is hard to quantify the total value of this Trade Agreement once ratified, but it is worth mentioning that the MERCOSUR region – which in this particular case include Argentina, Brazil, Paraguay and Uruguay – was a destination for EU goods worth €45 billion in 2018 and an additional €23 billion worth of EU services in 2017[16]. The link with soybean has been directly discussed when, in October 2019, a question about the issue of GM soy imports from Mercosur countries and the potential impact on deforestation in the context of the *EU-Mercosur Trade Agreement* was addressed to the European Commission[17]. The question received an official answer emphasising the importance of the Trade and Sustainable Development Chapter of the preliminary version of the *EU-Mercosur Trade agreement*[18].

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15 See: https://trade.ec.europa.eu/doclib/docs/2019/june/tradoc_157957.pdf.

16 See: https://trade.ec.europa.eu/doclib/docs/2019/june/tradoc_157954.pdf.

17 See: https://www.europarl.europa.eu/doceo/document/P-9-2019-003089_EN.html.

18 See: https://www.europarl.europa.eu/doceo/document/P-9-2019-003089-ASW_EN.html.

Figure 18 – Trade, WTO and the SDGs

How trade contributes to delivering key Sustainable Development Goals

SDG 1: No Poverty
There is increasing evidence that well planned and strategically executed trade policy initiatives can impact positively on sustainable poverty reduction. Trade opening has also generated higher living standards through greater productivity, increased competition and more choice for consumers and better prices in the marketplace.

SDG 2: Zero Hunger
Eliminating subsidies that cause distortions in agriculture markets will lead to fairer more competitive markets helping both farmers and consumers while contributing to food security. The WTO's 2015 decision on export competition eliminated export subsidies in agriculture, thereby delivering on Target 2.B of this goal.

SDG 3: Good Health and Well-being
One of the main objectives under SDG 3 is to ensure access to affordable medicines for all. An important amendment to the WTO's TRIPS Agreement recently entered into force. This measure will make it easier for developing countries to have a secure legal pathway to access affordable medicines in line with Target 3.B of this goal.

SDG 5: Gender Equality
Trade can create opportunities for women's employment and economic development. Through trade, job opportunities for women have increased significantly. Jobs in export sectors also tend to have better pay and conditions. Export sectors are an important job provider for women in developing countries.

SDG 8: Decent Work and Economic Growth
Trade-led inclusive economic growth enhances a country's income-generating capacity, which is one of the essential prerequisites for achieving sustainable development. The WTO's Aid for Trade initiative can make a big difference in supplementing domestic efforts in building trade capacity, and SDG 8 contains a specific target for countries to increase support under this initiative.

SDG 9: Industry, Innovation and Infrastructure
Trade produces dynamic gains in the economy by increasing competition and the transfer of technology, knowledge and innovation. Open markets have been identified as a key determinant of trade and investment between developing and developed countries allowing for the transfer of technologies which result in industrialization and development, helping to achieve SDG 9.

SDG 10: Reduced Inequalities
At the global level, changes in development patterns have been transforming prospects of the world's poorest people, decreasing inequality between countries. WTO rules try to reduce the impact of existing inequalities through the principle of Special and Differential Treatment for Developing Countries. This allows the use of flexibilities by developing and least-developed countries to take into account their capacity constraints.

SDG 14: Life Below Water
The WTO plays an important role in supporting global, regional and local efforts to tackle environmental degradation of our oceans under SDG 14. The Decision on Fisheries Subsidies taken by WTO members in December 2017 is a step forward in multilateral efforts to comply with SDG Target 14.6, committing members to prohibit subsidies that contribute to overcapacity and overfishing, and eliminate subsidies that contribute to illegal, unreported and unregulated fishing, with special and differential treatment for developing and least-developed countries. Members committed to fulfilling this commitment by the 12th Ministerial Conference.

SDG 17: Partnerships for the Goals
SDG 17 recognizes trade as a means of implementation for the 2030 Agenda. The targets under this goal call for: countries to promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system; the increase of developing countries' exports and doubling the share of exports of least-developed countries (LDCs); and the implementation of duty-free and quota-free market access for LDCs with transparent and simple rules of origin for exported goods. The WTO is the key channel for delivering these goals.

Source: WTO (2018, p. 4).

Despite the – fragile, according to some commentaries[19] – truce sanctioned by the signature of the *Phase One Trade Deal* in January 2020, the recent trade war between US and China constitutes an important example of how bilateral institutional and political relations between countries can affect global soybean trade flows. During his presidential campaign and later during his presidency, as part of his '*America first*' policy package, Donald Trump made clear his intent to promote a paradigm shift in US trade policy in an effort to reduce the American

[19] See, among others, the Financial Times (https://www.ft.com/content/65557ec4-3851-11ea-a6d3-9a26f8c3cba4), Foreign Affairs (https://www.foreignaffairs.com/articles/united-states/2020-01-13/delicate-truce-us-chinese-trade-war) and the Economist (https://www.economist.com/finance-and-economics/2019/12/18/the-ceasefire-in-the-trade-war-between-america-and-china-is-fragile).

deficit in the trade balance and to shield American firms and workers from the increasing international competition (Noland, 2018). Starting from January 2018, the Trump administration moved from words to deeds under Section 301 of 1974 US Trade Act, initially imposing tariffs on global imports for products such as solar panels, aluminium and steel, and then targeting directly China's export to the US, with an escalation of measures that started on June 2018, with a 25% tariff on about $50 billions of Chinese products[20]. As a part of what will become a series of regular retaliation measures in response to US tariffs, China shortly after announced 25% tariffs on a number of US goods, including soybean.

A recent UNCTAD report exploring trade tensions as one of the key trends in trade policy in 2018, used the soybean example to analyse the potential range of complex – and sometimes conflicting – implications of the US-China trade war on third-party countries (UNCTAD, 2019, p. 4):

> *"Still, while United States and Chinese tariffs can be beneficial to some foreign competitors, the overall effects would be more uncertain depending on each country's economic structure as well as the extent to which tariffs will affect prices. A clarifying example of these dynamics is provided by Chinese tariffs imposed on United States soybeans. Because of the importance of these two markets (China accounts for more than half of global imports of soybeans and United States is the world largest soybeans producer), the tariffs on soybeans have substantially disrupted world trade of this commodity. As discussed above, one consequence of such tariffs has been a diversion of trade to favour several exporting countries, in particular Brazil which suddenly become the main supplier of soybeans to China. However, while higher price premiums have been welcomed by Brazilian producers, not everyone has been happy. One concern of Brazilian soybean producers is that higher prices brought about by the Chinese tariffs may hamper Brazilian procurers' long-term competitiveness. In a situation where the magnitude and duration of tariffs is unclear, Brazilian producers are reluctant to make investment decisions that may turn unprofitable if tariffs are revoked. Moreover, Brazilian firms operating in sectors using soybeans as inputs (e.g. feed for livestock) are bound to lose competitiveness because of higher prices due to the increase in demand for Brazilian soybeans from Chinese buyers."*

Despite the focus on the three *soybean giants* represented by China, USA and Brazil, the report acknowledged that the implications of the US-China trade war disrupted the global soybean trade, therefore affecting in different ways also hundreds of other trading countries that regularly participate to the international trade for this commodity.

Some authors noted that the trade friction between China and USA not only disrupted international trade, but also challenged international trade institutions and their jurisprudence. In particular, while the US-China trade dispute was ongoing, the Trump administration blocked the election of the remaining members of the WTO Appellate Body, thus stalling the functioning of the highest level of the WTO dispute settlement mechanism in the moment when it was needed the most[21]. Similarly, the trade armistice that China and US signed recently

[20] For a detailed timeline of the US-China trade war, see: https://www.reuters.com/article/us-usa-trade-china-timeline/timeline-key-dates-in-the-u-s-china-trade-war-idUSKBN1ZE1AA.

[21] See, for instance, Foreign Politics (https://foreignpolicy.com/2020/01/09/trumps-real-trade-war-is-being-waged-on-the-wto/), Asia Times (https://asiatimes.com/2019/12/wto-caught-in-crossfire-of-us-

came along the lines of a self-managed and self-negotiated bilateral trade agreement, and not by the means of international trade institutions and dispute resolution mechanisms. With the recent COVID-19 emergency creating additional tensions between USA and China, the WTO has *de facto* been reduced to the role of spectator, while two world superpowers continue to wage a tariff-based war. This situation led some experts to call for a deeper reform of the most important trade institution on the planet (Ciuriak, 2019; Petersmann, 2019; Hoekman, 2020).

While the Doha Round continues, the WTO Agricultural Agreement and the Agreement on the Application of Sanitary and Phytosanitary Measures (WTO, 2010) represent the main international framework regulating the international trade of agricultural commodities – including soybeans. Another important factor of friction for free trade addressed by the WTO is represented by the so-called Non-Tariff Measures (NTM), which are intrinsically elusive and harder to assess compared to tariff and quotas – (WTO, 2012). These measures include, among others, import licensing, rules of origin, custom inspection and valuation rules, technical barriers to trade, sanitary and phytosanitary standards, as well as a wide range of investment measures that can potentially distort international trade. A recent study by Peci and Sanjuán (2020) highlighted how not all NTM are the same, with some of these measures having a restricting effect on trade, and others – on the contrary – facilitating its expansion. However, in their case study on Chinese pork imports (*Ibid.*), the authors found that the strongest NTM tend to be higher than the average import tariff applied by China on these products (14%), with *ad valorem* equivalents for stricter NTM ranging from 15 to 33%.

As if economic and institutional ramifications were not complex enough, a bulk of research focused on the environmental implications of the Sino-American trade war. Indeed, if many agree that the main economic effect of the trade war for the soybean sector – at least in the short term – was the diversion of trade flows for this commodity, then it is important to note that this led to profound changes into global and local land use dynamics. For instance, Fuchs *et al.* (2019) suggested that substituting the American production hit by the Chinese tariffs with the Brazilian soybean would lead to further expansion of soybean frontier in Brazil, therefore putting at risk the achievements of the *Soy Moratorium* and potentially leading to increased deforestation in the Amazon. Another study using the soybean case in the context of the US-China trade war (He *et al.*, 2019) produced evidence for the fact that the new tariffs waged by the USA and China increased global environmental costs, potentially reducing the overall level of sustainability of the global agri-food chain.

6.3. Public and private actors

The distinction between international, multilateral and bilateral institutions is not the only one that matters for soybean trade. Another important distinction that helps understanding the impact of institutions on the soybean industry is represented by the public-private dichotomy. In principle, this characterisation also extends to financial institutions, which – in many ways – play an important role in the international trade for agricultural commodities. However, the variety and the complexity of the different financial tools that are available in this space are such that the distinction between public and private financial instruments sometimes becomes nuanced and difficult to make. For instance, financial tools for controlling price volatility in the

china-trade-war/), and The New York Times (https://www.nytimes.com/2019/12/08/business/trump-trade-war-wto.html).

commodity market, are often a mix of private tools – such as future markets and forward contracting – and public or mixed (with both public and private components) insurance schemes. At the international level, other relevant financial measures are targeted to *Net Food-Importing Developing Countries* (NFIDCs) concerned with food security goals or hit by temporary shocks – such as the *Rapid Credit Facility* and the *Standby Credit Facility* provided by the IMF – or are generally related to financial and technical assistance for developing countries in the context of cooperation programmes and international agreements – such as the WTO-led Aid for Trade initiative (FAO, 2018).

At the national and subnational level, central governments and local authorities shape economic, agricultural and environmental policies, influencing decisions all along the value chain – from the beginning of the production process, up until the final consumption. For instance, a FAO-commissioned report analysed the role of public policies in the extraordinary transformation that saw Brazil transitioning from a position of agricultural net importer in the 1960's, to the current status of one of the world's leading agribusiness players (Santana and Nascimento, 2012). The shift from an import-substitution approach with massive state intervention in the agricultural sector between 1965 and 1985, to a free-market liberalization strategy in the following years, and later on – since the 2000s – on incentives for private-sector-led investments and on the rural credit scheme, contributed to improving food security in Brazil and to make it the largest exporter of agricultural commodities such as coffee, sugar and soybean. But this remarkable growth came at a cost, as the constant production increase and the related expansion of the area devoted to the cultivation of agricultural commodities imposed a range of environmental and social costs – some of which, with a particular focus on the soybean sector, have been previously reviewed in this study.

If it is true that the public sector can influence social and environmental outcomes too, and not just the economic performance of agricultural activities, private – and often voluntary – schemes for sustainable and responsible food chains are becoming increasingly important in the context of the global agri-food system (Raynolds, Murray and Heller, 2007; FAO, 2017). Voluntary standards and certifications are typically promoted by a variety of players, including private sector actors, consumer organizations, civil society groups, public-private partnerships and multi-stakeholder initiatives. Furthermore, these initiatives range from company-specific schemes to national and international standards. Firm-level standards that are relevant for the soybean sector includes the *Cargill Triple-S*[22], the *AMAGGI Responsible Standard*[23] and the *ADM Responsible soybean standard*[24]. National level voluntary schemes comprise, among others, the already mentioned *Soy Moratorium* in Brazil and the *US Soy Sustainability Assurance Protocol* (USSEC, 2018). Examples of international schemes – which are sometimes harmonized and adapted over country-specific regulations – include the certification issued by the *Roundtable for Responsible Soy* (RTRS) based on the homonym standards (RTRS, 2017) and the *Soy Sourcing Guidelines* developed by the European Feed Manufacturers' Federation (FEFAC and ITC, 2015).

On the one hand, the multiplication of such voluntary schemes reflects how sustainability issues are increasingly important for the soybean sector. On the other hand, the proliferation

[22] See: https://www.soja3s.com/en/.

[23] See: https://www.amaggi.com.br/en/sustainability/amaggi-responsible-standard/.

[24] See: https://assets.adm.com/Sustainability/ADM-Sustainable-Soy-Standard_180911_120112.pdf.

of voluntary certification systems adds an extra layer of complexity, with too many – and sometimes competing – standards, which are often individually tailored around the needs of the certified entities, rather than on the social and environmental issues that they deem to tackle. For instance, a report commissioned by FEFAC assessing the suitability of different voluntary standards for sourcing deforestation-free soy, identified 17 different voluntary certification schemes in the soy industry alone (Kusumaningtyas and Van Gelder, 2019). In addition, Schouten, Leroy and Glasbergen (2012), in analysing the governance structure of private multi-stakeholder institutions with a particular focus on the RTRS and on the Roundtable on Sustainable Palm Oil (RTSPO), highlighted the risk for these arrangements to fall short in some aspects related to the democracy of their deliberative mechanisms. In doing so, they also revitalized the existing concern that private-led self-mandated multi-stakeholder platforms might not necessarily be a perfect – or a better – substitute for public institutions (Lövbrand and Khan, 2010).

Despite the efforts in harmonizing the different existing voluntary schemes and the growing pressure towards the adoption of sustainable and responsible standards for sourcing and producing agricultural commodities, the voluntary nature of these schemes might intrinsically reduce the scope for their application. For instance, RTRS – which arguably proposed the biggest international certification scheme for responsible soybean sourcing and production – certified about 4.5 million tons of soybean over 1.2 million hectares in 2018[25], corresponding to just 1.2% of the quantity harvested and to 0.9% of the area devoted to soybean globally in the same year.

7. Country Focuses

This section of the study focuses on country-specific aspects of soybean production, consumption and trade. We describe the main characteristics of the soybean sector in Tanzania, a relatively small player in international flows for this commodity, alongside with country-specific sections focusing on big actors of the soybean complex – namely, China, the biggest importer, and Brazil, the largest exporter.

7.1. Soybean in Tanzania

Tanzania is a net importer of soybeans (*Glycine max* (*L.*)), importing an average of 8,643Mt per year. However, available data do suggest that the country at times not only exports soybean, but it also has the potential to be a net-exporter (*Figure 19*). Imports are mainly driven by high demand in the domestic market. The demand for soybean in Tanzania comes from increasing livestock production, and local fortification of human foods (Wilson, 2015). Available data indicate that more than 60% of soybean in Tanzania is processed into feed for chicken, fish, pigs and other animals as a substitute for dried small fish. The rest is for human consumption in various forms – mainly soy drink, soy oil, and soy flour. There is limited use of the commodity as raw material in other industries (Khojely *et al.*, 2018).

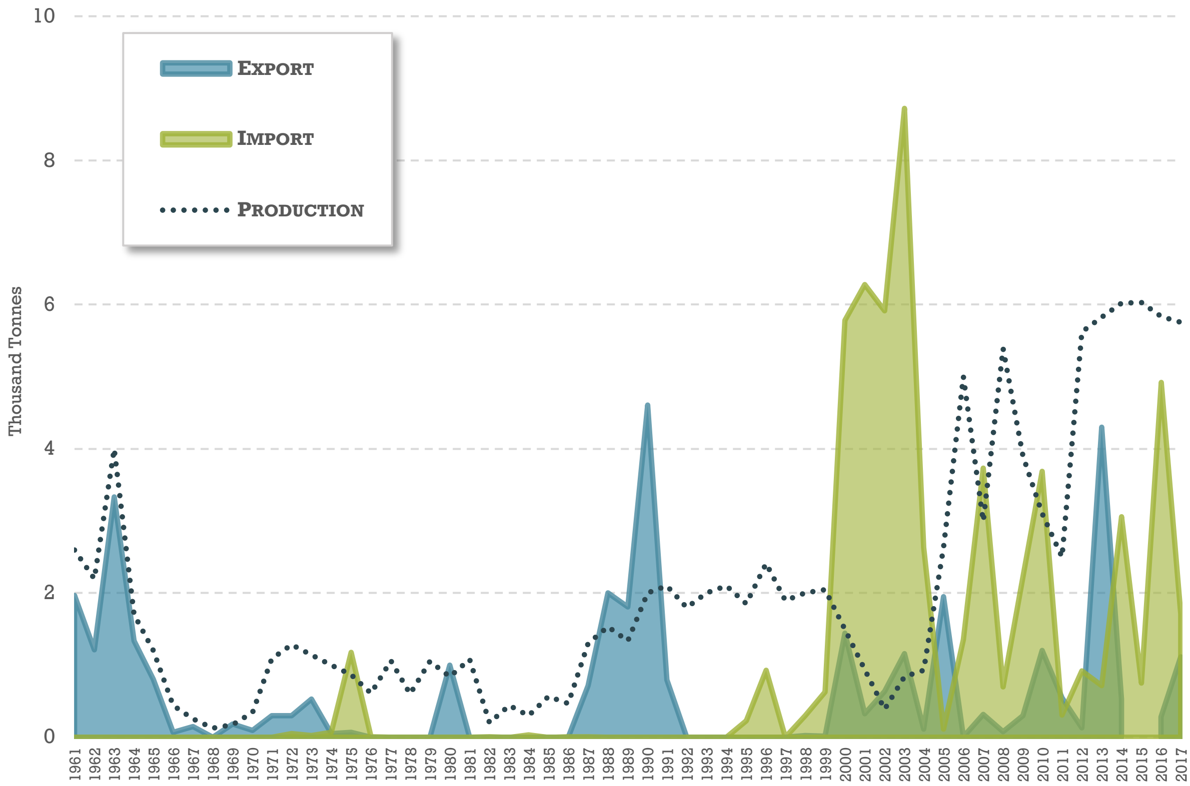
Tanzania produces an average of 5,843 metric tons (t) of soybeans annually. Yield is generally around 1 t/ha, which is lower than the world average. According to Khojely *et al.*(*Ibid.*), the main reasons for the low yield are the use of low yielding varieties, presence of acidic soils,

[25] See: http://www.responsiblesoy.org/mercado/volumenes-y-productores-certificados/?lang=en.

limited application of fertilizer and poor crop management. Production of soybeans is concentrated in Southern Highlands of Tanzania, but the crop is grown in 11 regions of Tanzania with the Ruvuma region making more than 85% of the total national production.

Tanzania is experiencing positive growth in soybean production. The country experienced a drastic change in growth in 2018 of more than 50% due to increased demand in the feed industry (NBS, 2018). The production is highly influenced by market signals and tends to experience fluctuations. The crop is mainly grown by smallholder farmers (>95%) and planted as monocrop through contract farming (>80%) arrangements where traders or processors provide seeds to farmers and farmers produce for them. Therefore, the production volumes greatly depend on the responses from these buyers.

Figure 19 – Soybean production, import and export quantities in Tanzania



Source: Kangile, J. R. (2020), based on FAOSTAT data. *License*: CC-BY 4.0.

Many countries in Africa, including Tanzania, anticipate increased soybean production. This is due to the growing demand from the feed industry and to the ongoing exploration around the use of soybean in the bio-energy sector (Boerema *et al.*, 2016; Foyer *et al.*, 2019). The country, through the *Tanzania Soybean Development Strategy* (TSDS) predicted that soybean production in Tanzania would experience an exponential increase, from 6,000 tonnes in 2014 to 2 million tonnes in 2020. However, the data suggest that this has not occurred. The available data indicate the maximum annual growth that the soybean sector achieved in Tanzania is around 50%, and even assuming that this value would remain constant in the coming years, it would take over 15 years to reach the target stated in the TSDS. Additionally, the forecasted soybean demand for feed in Tanzania is 150,000 t/year (NBS, 2018). This huge demand is anticipated as a combination of to the scarcity of fish products and the upward trend in chicken consumption.

These growth ambitions need to be aligned with strategic efforts of devising ways of contending the anticipated negative environmental and socio-economic effects. The anticipated increase in production will increase the pressure on the country's land reserves, exacerbating the competition between competing land uses (and users), with potential repercussions in terms of land conflicts, deforestation and biodiversity loss. Other potential negative environmental impacts include increased greenhouse gas emissions; reduction of quality and availability of water resources and; higher incidence of fire risk and burning associated with land clearing and expansion; and soil erosion and degradation (Schmitz *et al.*, 2012; Peeters, 2014; Lufuke, 2017).

7.2. Soybean in Brazil

The soybean supply chain is extremely important for the Brazilian economy. Agricultural products are the top exported commodity group and soybean is the highest exported commodity in this group. In 2018, Brazilian soybean exports accounted for 42.7 billion dollars[26], but the economic contributions of soybean for the Brazilian economy is wider, as it includes also the industries producing input and machinery, the logistic and the transport sector, and more. These industries are well established in the country and provide a relevant source of employment.

Soybean was first planted in Brazil in 1882 in the tropical region of Bahia, but successful plantations only started 60 years later, when the crop was introduced to the subtropical region in the southern states (CESB, 2018). The climatic similarity to other producing regions in the Northern hemisphere allowed Brazilian farmers in the subtropical regions to adopt technologies and production techniques used in the US.

The Brazilian participation in the international soybean market gained significance during the 1970s when the global demand for soy exceeded supply. The price of the commodity increased dramatically, and subsequently this appreciation stimulated research and technology development for the production of this crop in Brazil (Sampaio, Sampaio and Bertrand, 2012). The Federal Government also played a significant role in the promotion of soybean through public investment into agricultural research and development, especially with the creation of the *Brazilian Corporation for Agricultural and Livestock Research* (EMBRAPA) in 1973, which – with a division specialised on soybean, the *EMBRAPA Soja* – developed new varieties suitable for the tropical climate that characterises most of the country (Filomeno, 2013).

The southern states concentrated most of the soybean production until 1990. Later on, further investments in plant genetics and soil fertilization allowed the expansion of soybean in central Brazil, and particularly in the Cerrado ecosystem. Without the technological improvements, the cultivation in the central Brazil soils would not have been possible. Between 1980 and 1990, the production in the Cerrado increased more than 7 times, and today more than 60% of the Brazilian soybean is sourced from this region. The availability of land for expansion and

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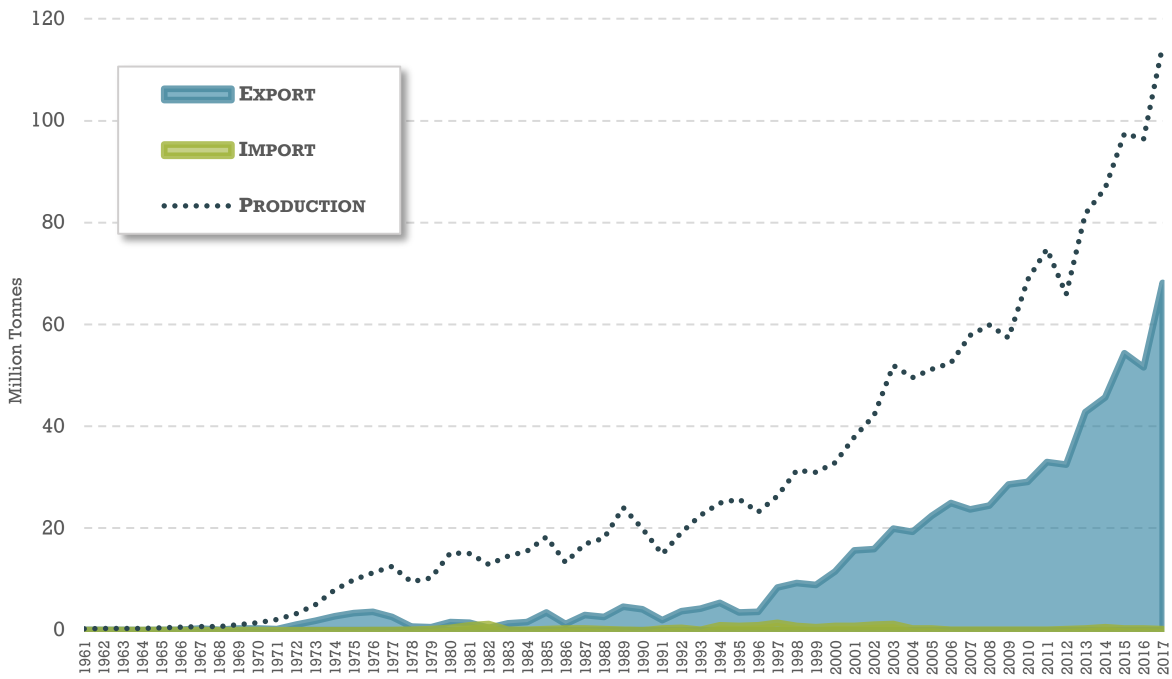
[26] See: https://resourcetrade.earth/.

investments in production technology were fundamental for Brazil to increase grain and meat production. Brazil soybean production 76-folded between 1970 and 2017, from 1.5 million tonnes to 114 million tonnes in 2017. Brazil, which is already one of the largest producers worldwide, has also one the greatest potential to increase production further, given the existing infrastructure, the endowment of water resources, and the flat land still available for mechanized expansion (CESB, 2018).

The projections indicate that agriculture will further expand in the central region of the country, with the most threatened region being the north-eastern Cerrado, in the MATOPIBA area (acronym representing the four States of Maranhão, Tocantins, Piaui, and Bahia). This 73-million-hectare (Mha) region includes 337 municipalities and concentrates the largest remnants of the Cerrado´s native vegetation, many species of which are not protected yet.

There are many social impacts caused from rapid land-use transitions and agricultural expansion, including internal migration processes, especially on land with high suitability for soybean. The land acquisition process, initially led by family enterprises, is accelerated by the presence of land companies and foreign investments. Despite increased commodity production, the socioeconomic impacts have not been perceived equally in different areas of the MATOPIBA territory (Favareto *et al.*, 2019).

Figure 20 – Soybean production, import and export quantities in Brazil



Source: De Maria, M. (2020), based on FAOSTAT data*. License*: CC-BY 4.0.

The Cerrado is a global biodiversity hotspot, the most diverse tropical savanna ecosystem, habitat for more than 4800 plant and vertebrate species with high levels of endemism. This savanna provides important ecosystem services, as it encompasses the headwaters of the three largest water basins in South America. From the original 200 Mha cover, approximately 19.8% remains intact (Strassburg *et al.*, 2017). The Cerrado´s native vegetation plays a significant role in global and local climate. The greenhouse gas emissions due to ecosystem loss accounted for 17% of the Brazilian budget in 2017 and there is growing number of scientific publications suggesting that deforestation increases local temperature, thus affecting agricultural productivity (Cohn *et al.*, 2019). In addition, if above-ground reserves of carbon are typically small in the Brazilian savanna, especially when compared with the Amazon forest, it is also true that the Cerrado retains an important carbon stock below the ground (Batlle-Bayer, Batjes and Bindraban, 2010).

Agricultural expansion and infrastructure development are major drivers of land-use change in the Cerrado. Between 2003 and 2014, approximately 22% of soybean expansion occurred over native vegetation, with a loss of 1.3 Mha native vegetation. The *Native Vegetation Protection Law* (LPVN) – also known as the new *Forest Code* – regulates the amount of land that farmers should designate for conservation and agriculture production. In the Cerrado biogeographical region, it requires farmers to set-aside from 20% to 35% of the farm areas – through legal reserves and permanent protected areas along water bodies and slopes – to conserve native vegetation. Although millions of hectares can be legally cleared, Rausch *et al.* (2019) estimated that 51% of soybean farms have cleared beyond the requirements included in the *Forest Code*.

Illegal deforestation is another major area of environmental concern in Brazil. For instance, a recent study jointly produced by Trase, ICV and Imaflora, draws a direct connection between illegal deforestation in the Mato Grosso and soybean export, estimating that, between 2012 and 2017, over a quarter of the total deforestation in the region – mostly illegal under the Brazilian law given the lack of licenses – took place on soybean farms (Vasconcelos *et al.*, 2020). In addition, the authors estimated that (*Ibid.*, p. 10):

> *"81% of the soy grown on farms where illegal deforestation took place in Mato Grosso was exported in 2018, with 46% of this shipped to China – Brazil's biggest export market. The European Union (EU) is the second most exposed export market for soy from farms with illegal deforestation. It is estimated that around 14% of that soy was shipped to the EU. Around 19% of the soy produced on farms where illegal deforestation occurred remained in the domestic market."*

By 2050, it is expected that Brazil will expand the soybean production area by 12.4 Mha, and approximately 10.8 Mha of this expansion will occur in the Cerrado biome (Soterroni *et al.*, 2018). Under a business as usual scenario – not accounting full compliance with the *Forest Code* – soybean would expand for 3.6 Mha over native vegetation (*Ibid.*). However, there is an estimated 22.9 Mha of cleared land highly suitable for soybean in the region, which would allow for potentially meeting the future soybean demand without native vegetation loss (Greenpeace, 2018; Green *et al.*, 2019; Rausch *et al.*, 2019).

The main challenge for the environmental sustainability of soybean – and agriculture in general – is how to increase production without causing further ecosystem loss. The key strategies to increase sustainable production while meeting global demand involves promoting crop expansion over degraded pasture, associated with increased productivity on livestock systems and financial incentives for ecosystem protection (Sparovek *et al.*, 2018). In parallel, soybean expansion also raises important socio-economic issues in Brazil, with a business (and development) model that produces high profits and benefits, but mainly for a few, exacerbating inequalities and favouring land grabbing, concentration of tenure and land disputes (Martinelli *et al.*, 2017; Greenpeace, 2018; Favareto *et al.*, 2019).

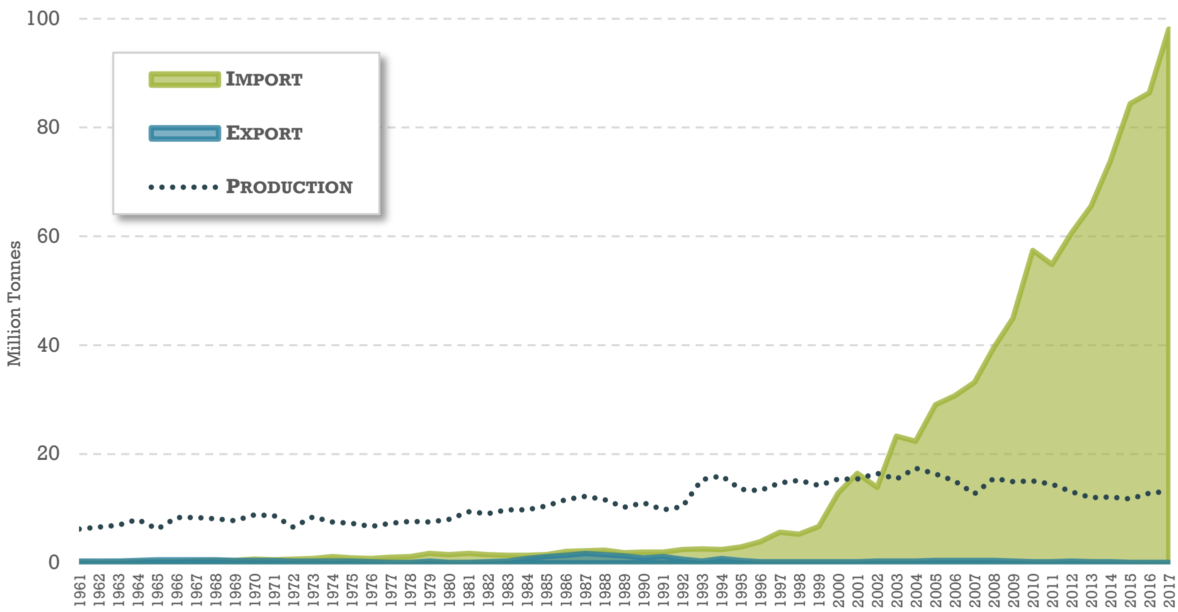
7.3. Soybean in China

The relationship between China and soybean dates back to more than three thousand years ago. In his seminal contribution, Hymowitz (1970, p. 417) retraced the early stage of the domestication and diffusion of soy, making clear how China played a crucial role:

> *"Historical and geographical evidence […] point to the eastern half of North China what is essentially todays winter wheat-kaoliang region as the area where the soybean first emerged as a domesticate around the 11th century B.C. During the Chou Dynasty, the winter wheat-kaoliang region was probably the gene center. Later Manchuria became the gene center for soybeans. […] The emergence of a domesticate carries with it the connotation of a trial and error process. This process for soybeans took place during the Shang Dynasty or earlier. The migration of the soybean from the primary gene center to South China, Korea, Japan and South East Asia probably took place during the expansion of the Chou Dynasty"*

Despite being among the top five soybean producers in the World, China is no longer the largest production centre, with the USA and Brazil currently contending to each other the production primacy for this crop. Among the top five global soybean producers, China is the only country that saw a reduction of the total area devoted to this crop in the 2000-2018 period, with 1.3 million hectares converted to a different use (*Figure 15*). After reaching a production peak of 17.4 million tonnes in 2004, China's domestic soybean production recorded 13.1 million tonnes in 2017 (*Figure 21*) and 14.1 million tonnes in 2018 (*Figure 5*).

Figure 21 – Soybean production, import and export quantities in China



Source: De Maria, M. (2020), based on FAOSTAT data. *License*: CC-BY 4.0.

If export and production levels remained relatively low and fairly stable in China over the last 25 years or so, soybean imports – and, in parallel, domestic consumption levels – started an unprecedented growth from the early 90's (*Figure 21*). Today China is the world's leading consumer of soybean, with over 100 million tonnes consumed with its national borders in 2019 alone (*Figure 7*) – that is, about 30 percent of the global annual production of soybean. With a stagnant – and sometimes decreasing – domestic production, China had to increase soybean imports in order to meet the ever-growing internal demand. In the span of just two decades, the Chinese share of global soybean import flows grew from 5.5% in 1997 to 63% in 2017 (*Figure 13*). In 2017, soybean – with an estimated value of 36.6 billion dollars – was the largest agricultural import and the sixth largest product imported in China overall[27].

The fast-growing demand for soybean originating from China is the result of complex set of socio-economic, institutional and environmental factors. We previously discussed how soybean is a *flex* crop, which can be used to produce a variety of products (Oliveira and Schneider, 2016). Over the last few decades, the flexibility of soybean translated into a consumption shift in China, where the use of soy as feed for fish and livestock rapidly surpassed direct human consumption of traditional soy-based food products. Indeed, the existing demand for traditional products such as fermented soybean products and soy sauce, has been reinforced by the growing appetite for fish – with a strong export-oriented component – and livestock products such as poultry and pig meat – mainly consumed domestically (Brown, 2012a; Guo *et al.*, 2018). Interestingly, while China is the largest seafood exporter[28] in the world, it is a net importer for pig meat[29] and poultry[30], which – coupled with data on domestic consumption of soybean (*Figure 6*) and soy oil (*Figure 7*) – suggests that most of the soybean in China is used to meet the demand that originates within its national borders.

Starting from the 1970s, China implemented a series of reforms that resulted in a profound structural change of the country's economy, which deeply reshaped also the agricultural sector (Huang and Rozelle, 2018). In that period, the Chinese central government designated the feed sector as a priority industry, aiming at increasing the national capacity of producing animal-based products. Over the 1990s, China became the largest consumer and producer of feed ingredients and livestock products, which led the government to reduce the rate of grain self-sufficiency, making soybean the single most liberalised crop in the country (Solidaridad Network and SSTP, 2017). As a consequence, Soybean imports from China skyrocketed from 2.9 million tonnes in 1995 to over 98 million tonnes in 2017 (*Figure 21*).

Environmental and pedoclimatic conditions are such that soybean yields in USA and Brazil, currently the largest soybean producing countries, are on average almost double than in China (*Figure 4*), where local producers face problems such as water scarcity and land degradation (Jia *et al.*, 2020; Wu *et al.*, 2020). The competitive advantage in soybean production made USA and Brazil a perfect source for the ever-growing demand coming from China, mutually reinforcing the interconnection and the leading role of these three countries in the global geopolitics of soybean production, consumption and trade flows (Gale, Valdes and Ash, 2019). The trade war between US and China not only highlighted the strategic importance of the global soybean industry, but also the interdependence of the Sino-Brazilian-American

[27] See: https://oec.world/en/visualize/tree_map/hs92/import/chn/all/show/2017/.

[28] See, for instance, OEC data for fillet fish trade (https://oec.world/en/profile/hs92/0304/) and the 2019 World Seafood Map by Rabobank (https://research.rabobank.com/far/en/sectors/animal-protein/world-seafood-trade-map.html).

[29] See: https://oec.world/en/profile/hs92/0203/.

[30] See: https://oec.world/en/profile/hs92/0207/.

soybean complex (Adjemian, Smith and He, 2019) and the telecoupled nature of its environmental and socio-economic implications (Silva *et al.*, 2017; Torres, Moran and Silva, 2017; Yao, Hertel and Taheripour, 2018; Taherzadeh and Caro, 2019).

As the diplomatic relationship between China and the USA – after the fragile commercial truce reached in January 2020 – seems to have worsened over the COVID-19 emergency, the Chinese soybean sector continues to rely on foreign and multinational traders such as ADM, Bunge, Cargill and Dreyfus, mainly sourcing the product from North and South America (Murphy and Burch, 2012; Oliveira and Schneider, 2016; Solidaridad Network and SSTP, 2017). In parallel, Chinese farmers increasingly convert cropland originally devoted to soybean production to different uses, with China facing – as the largest soybean importer – a series of new socio-economic (Solidaridad Network and SSTP, 2017; Torres, Moran and Silva, 2017; Adjemian, Smith and He, 2019; Jia *et al.*, 2020) and environmental challenges (Sun *et al.*, 2018; Sun, Qi and Reed, 2018) – including how to ensure deforestation-free soybean sourcing in a highly price-sensitive industry with tight profit margins, especially for Chinese crushers, or how to ensure alternative sources of revenues and smooth transitions to other crops for soybean farmers in China who are unable to compete with foreign producers – to increase the sustainability of the soybean sector (Taherzadeh and Caro, 2019).

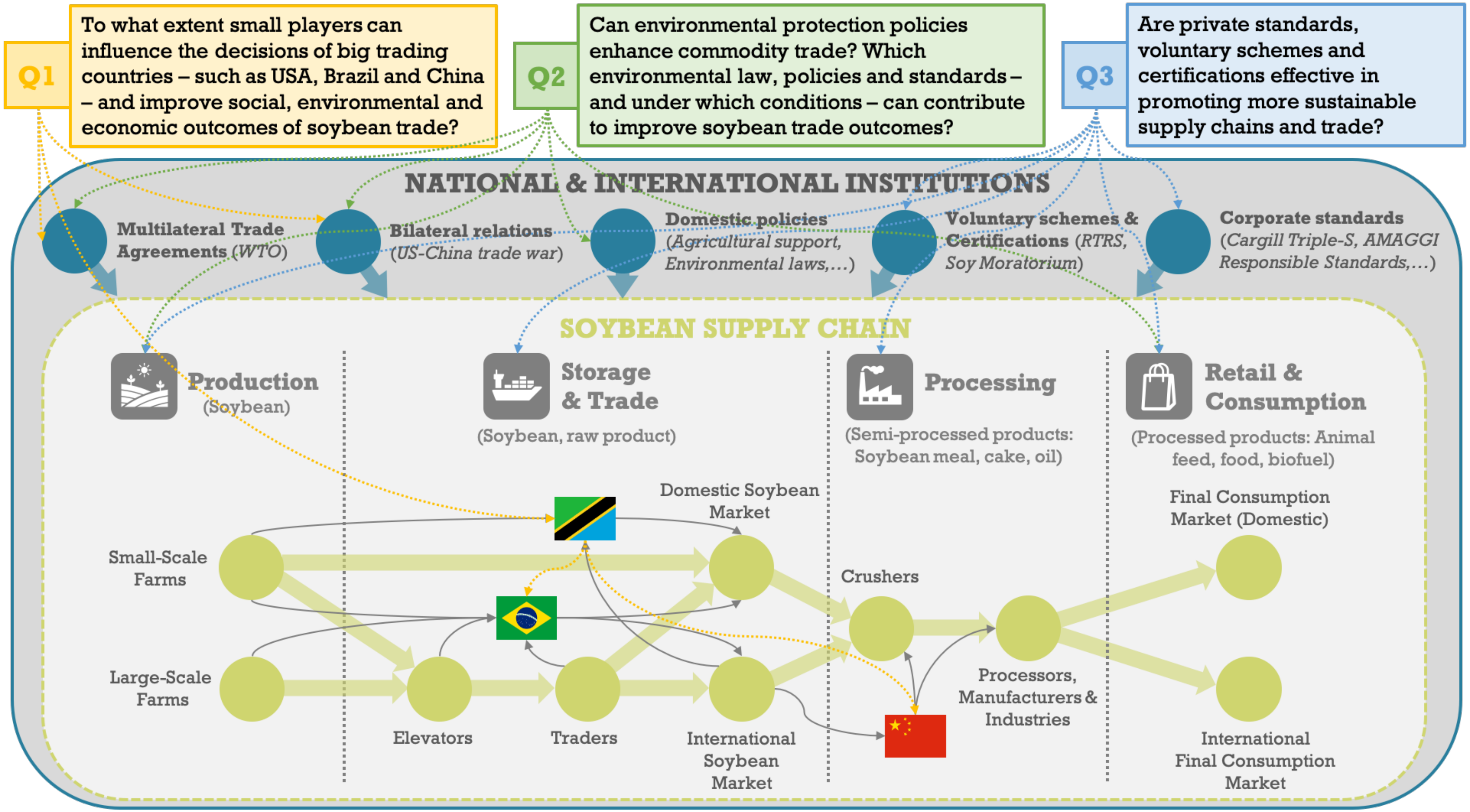
8. Our Contribution: Open Questions and Potential Answers

With this scoping study we have so far reviewed the existing literature and the evolution of data on soybean trade, disentangling the different dimensions and interconnections that characterise national and international commercial flows for this commodity. If our review tackle*s* the complexity of issues related to soybean trade, it also contributes to raise some open questions that our WP, in collaboration with other Trade Hub partners, will explore in the future. In particular, we identified three issues on which we will focus our attention and we situated them within the soybean impact pathway and supply chain diagram that was developed in the context of the Trade Hub Project (*Figure 22*).

The first issue relates to the global geopolitics of soybean trade. We have shown how the current soybean industry is polarised around three big players – namely China, Brazil and USA – which are responsible for most of the soybean production, consumption and trade patterns. At the same time, soybean is today a global commodity, with some 170 countries participating to its international trade. The US-China trade war revealed how trade frictions between two major players disrupted the international soybean market, favouring the historical overtaking of the Brazilian soybean sector over the USA as the largest producer in the world, and therefore generating cost and opportunities for other trading countries. With the WTO dispute settlement body hung and with the *impasse* that characterised trade negotiations over the Doha Round in the background, a question arises:

> *Are small soybean trading countries fated to be simple spectators – and price-takers – for the decision made by USA, Brazil and China in the international soybean market?*

Figure 22 – Locating our research questions within the soybean supply chain



Source: Fiennes, S. and De Maria, M. (2020) for Trade Hub. *License*: CC-BY 4.0.

Also:

To what extent small players can influence the actions and the policies of larger trading partners? Can small trading countries contribute to the achievement of better economic, social and environmental outcomes from the international trade of soybean?

Using a game theory approach, we will investigate the strategy space for different countries – smaller and larger trading partners – under different policy scenarios, ultimately aiming at improving social, economic and environmental outcomes from the international trade of soybean.

The second question that the current study leaves unanswered has to deal with the mutual influence of environmental protection policies and trade volumes. We reviewed a bulk of literature taking into account the environmental impact of the soybean '*boom*', revealing how the incredible expansion of soybean cultivated areas in the last two decades had a detrimental impact on natural ecosystems and biodiversity in exporter and producer countries (Fearnside, 2001; Barona *et al.*, 2010; Boerema *et al.*, 2016; Inakake de Souza *et al.*, 2016; Trase, 2018; Fuchs *et al.*, 2019; He *et al.*, 2019), as well as on net importers (Sun *et al.*, 2018). If our study reveals the existence of a consensus over the negative environmental impact induced by the recent expansion of soybean traded quantities, a crucial question – which introduces a new perspective by turning the traditional link between trade and environment upside down – remains unexplored:

Can environmental protection policies and regulations enhance – both in terms of quality and quantity – international trade for agricultural commodities?

And if this is the case:

Which environmental interventions, policies and standards – and under which conditions – can contribute to improving the socio-economic outcomes of international trade?

For instance, we have previously discussed the Soy Moratorium in Brazil (Inakake de Souza et al., 2016; Kastens et al., 2017; Nepstad et al., 2019), describing how this innovative and voluntary tool might have contributed to reducing soy-led habitat and biodiversity loss since its establishment in 2006. While the *Soy Moratorium* was in place, the Brazilian soybean '*miracle*' continued, making this country the larger soybean producer and exporter in the world. Given this, it became reasonable to ask whether this scheme slowed down the Brazilian expansion, or if – on the contrary – it contributed to improving the country's performance in the international soybean market. If damaging the domestic natural environment seems to have a detrimental effect on trade and FDI (Kahouli and Omri, 2017), can protecting ecosystems and biodiversity enhance international trade, both for exporter and importer countries? Can, for instance, adopting sustainable techniques give a competitive advantage to early adopters?

Using a gravity model – augmented with variables that capture the quality of environmental regulations put in place at the national and international level – we will explore whether stricter environmental regulations can have a positive impact – for who and under which circumstances – on traded volumes for global agricultural commodities such as soybeans.

Stemming from the same question, we will also explore with a combination of qualitative and quantitative methods the existing debate over the effect of joining the WTO for different countries, with a particular focus on the impact over the quality of national-level environmental regulations. Are the arguments proposed by Neumayer (2004) and Conca (2011) – who suggested, in different ways, that joining the WTO might contribute to damage the environment of member states – still valid for a country like Tanzania?

The third open question that we are going to explore further respond to the need of increasing the sustainability levels of the global supply chain for soybean. Given the proliferation of voluntary schemes for sustainable, deforestation-free and responsible soy sourcing, but their relative low weight with respect to global production and trade volumes (IDH and IUCN NL, 2019), we asked ourselves the following question:

> *Are private led multi-stakeholder schemes and standards an effective tool in promoting more sustainable supply chains for agricultural commodities?*

And also:

> *Can these schemes be mainstreamed and harmonised? What incentives are need for different stakeholders sitting at different points of the value chain to expand the adoption of and the participation in voluntary schemes for responsible, deforestation-free and sustainable soy markets?*

By building a simplified but realistic model of the hourglass-shaped global soybean market which considers producers, traders and final consumers, we aim at identifying the key factors promoting or discouraging the adoption of voluntary schemes and standards, their potential for growth, and the incentives that can contribute to their success.

Finally, while these open questions originated from the analysis of soybean trade, production and consumption flows, it is reasonable to ask ourselves whether the same questions – and the potential lessons to be learned – can apply to other agricultural commodities.

9. Conclusions

Throughout this study we revealed the multiplicity of issues associated with the soybean boom. We retraced the historical moments that contributed to make soybean a *global flex crop*, increasingly appreciated and demanded for its versatility in a variety of markets all over the world. Alongside the evolution of soybean sector, we depicted the current structure of this industry by disentangling the complex set of – diverse but interrelated – economic, social, institutional and environmental issues that characterise at present international trade flows for this commodity.

Building on a comprehensive review of the existing literature and the main sources of data in the field, our research identified potential costs and benefits associated with the international market for soybean, the key stakeholders and the main policies, standards and regulations that affect the sustainability of the soybean value chain. In doing so, we balanced national level perspectives for a variety of countries with the global – international – scenario.

While clarifying and organising the existing evidence, we also reported on existing controversies and identified a set of open issues that still needs to be addressed in order to promote further sustainable and responsible trade for soybean. Finally, we focused on a set of open questions on which we will concentrate our effort in the future, not only providing justifications for their relevance, but also indicating how we intend to address these problems as a work package and in close collaboration with a wide coalition of partners of the Trade Hub project.

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