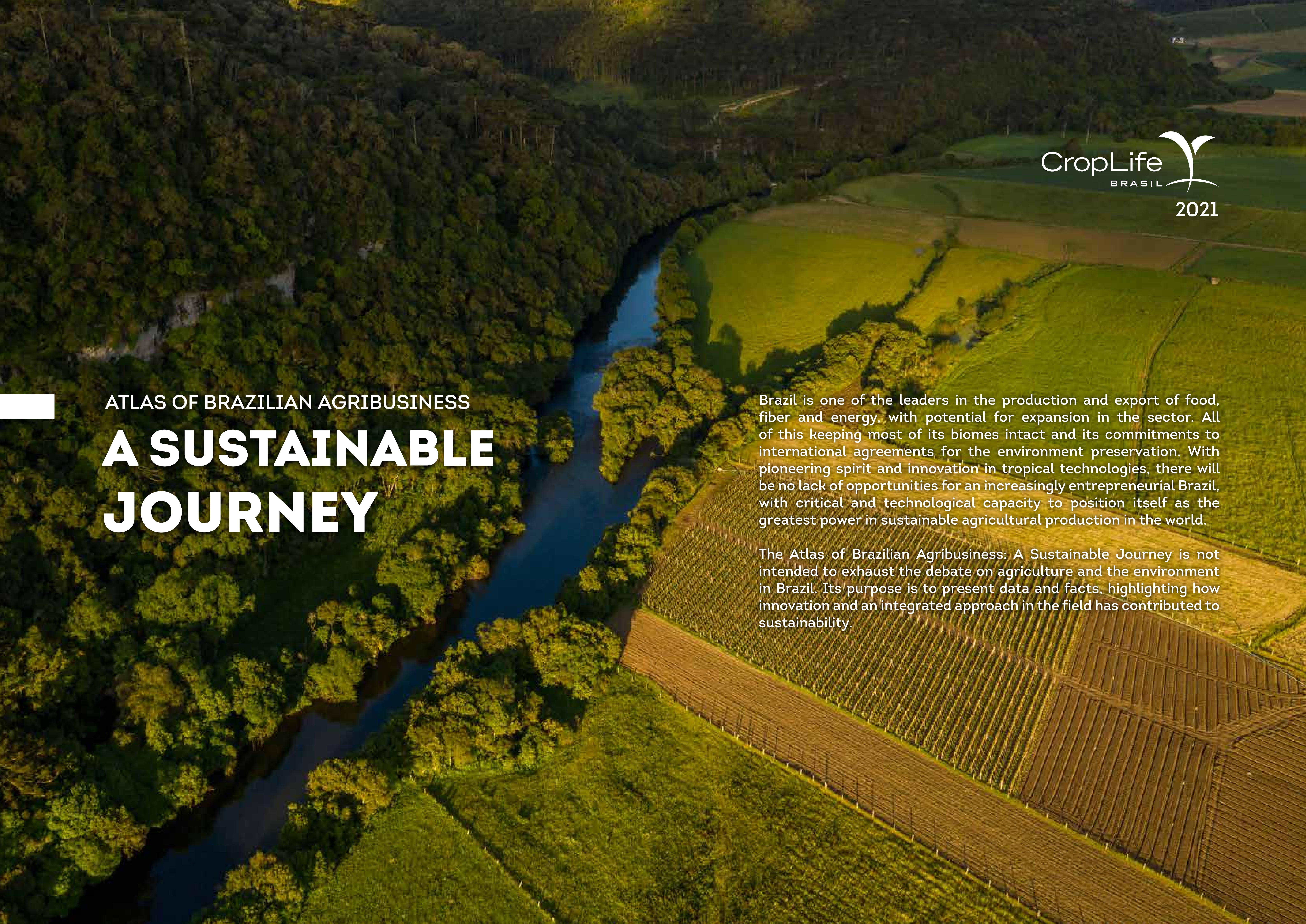


CropLife BRASIL

2021

ATLAS OF BRAZILIAN AGRIBUSINESS

A SUSTAINABLE JOURNEY

Brazil is one of the leaders in the production and export of food, fiber and energy, with potential for expansion in the sector. All of this keeping most of its biomes intact and its commitments to international agreements for the environment preservation. With pioneering spirit and innovation in tropical technologies, there will be no lack of opportunities for an increasingly entrepreneurial Brazil, with critical and technological capacity to position itself as the greatest power in sustainable agricultural production in the world.

The Atlas of Brazilian Agribusiness: A Sustainable Journey is not intended to exhaust the debate on agriculture and the environment in Brazil. Its purpose is to present data and facts, highlighting how innovation and an integrated approach in the field has contributed to sustainability.

INTRODUCTION

CHRISTIAN LOHBAUER
CEO

The world knows little about Brazil. When it comes to agribusiness sustainability, even less is known. It is necessary to clarify to both Brazilians and foreigners that the development of Brazilian agribusiness was not, is not now and will not be antagonistic to sustainability and environmental protection. In about 50 years of development, agribusiness has become the most vibrant economic activity in Brazil, producing cheaper, quality and safe food for more than 160 countries. All of this was done keeping 66% of Brazilian biomes intact, maintaining the commitment to international agreements to preserve the environment, reducing greenhouse gas emissions, protecting biodiversity and investing in innovation and increased productivity.

Croplife Brasil produced the Atlas of Brazilian Agribusiness: A Sustainable Journey with the purpose of bringing data and facts that prove the sustainable trajectory of agribusiness and its importance for the economic and social development of Brazil.

In addition, it presents information demonstrating the central role the country plays in sustainably by producing safe and cheap food for the world. Brazil is a democracy, has organized institutions and lives under the rule of law. It has a secular history of agricultural production and a society attentive to sustainable development issues.

The challenges are huge. The continental territory requires work and commitment from public and private authorities to enforce the Forest Code, one of the most complete environmental legislation on the planet.

The Atlas of Brazilian Agribusiness: A Sustainable Journey is not a document intended to exhaust the debate on agribusiness and the environment in Brazil. On the contrary, its purpose is to serve as the beginning of a process that incorporates increasingly detailed information on all aspects of sustainable development and food production in the country. Whenever possible, the data will be updated and expanded.

Producing safe food with sustainability is a Brazilian vocation.

CROPLIFE BRASIL

CropLife Brasil (CLB) is an association that brings together specialists, institutions and companies that work in the research and development of technologies in four essential areas for sustainable agricultural production: germplasm (seedlings and seeds), biotechnology, chemical pesticides and biological products. Based on scientific data and information, CLB works for the growth of Brazilian agribusiness, contributing to the increased supply of food, fiber and clean energy. By generating new and better technologies, our sector helps farmers to face the challenges of producing food, in quantity and with quality.

ATLAS OF BRAZILIAN AGRIBUSINES:

A SUSTAINABLE JOURNEY

chapter 1

BRAZIL: NUMBERS, HISTORY AND INSTITUTIONS

chapter 2

SUSTAINABLE AGRICULTURAL PRODUCTION

chapter 3

AGRICULTURE: SOCIAL AND ENVIRONMENTAL IMPACTS

chapter 4

GLOBAL FOOD SECURITY

REFERENCES

BRAZIL

NUMBERS, HISTORY AND INSTITUTIONS

BRAZIL IN THE WORLD

Brazil is a continental country. With 8.5 million square kilometers, it has the fifth largest territorial extension in the world. It is surpassed only by Russia, Canada, China and the United States.

Brazil occupies 47% of the territory of South America, where it is located.

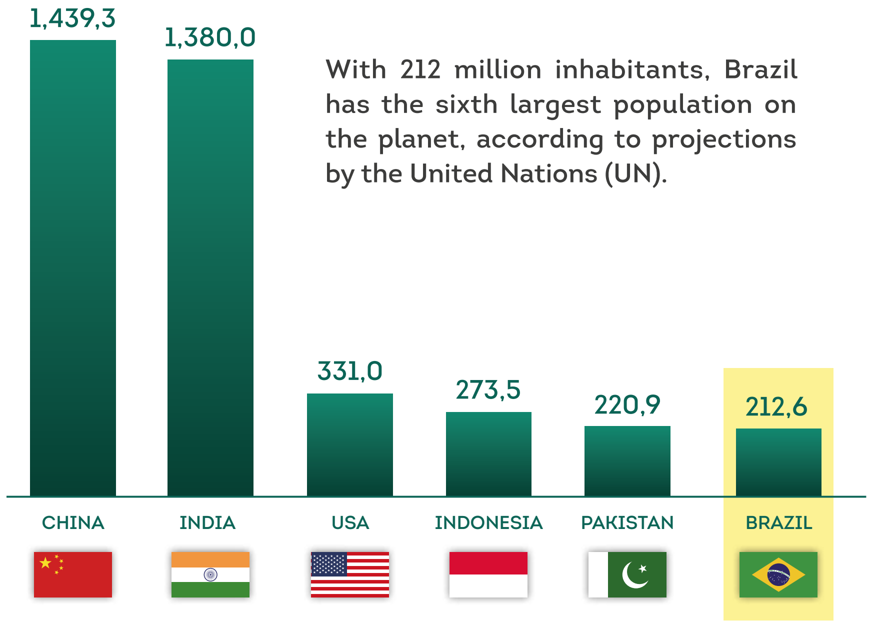
As for the other twelve countries on the sub-continent, Brazil does not have borders with just two: **Chile and Ecuador.**

BIGGEST COUNTRIES IN THE WORLD

source: IBGE (2018)

MOST POPULOUS COUNTRIES IN THE WORLD

(in millions of inhabitants)



With 212 million inhabitants, Brazil has the sixth largest population on the planet, according to projections by the United Nations (UN).

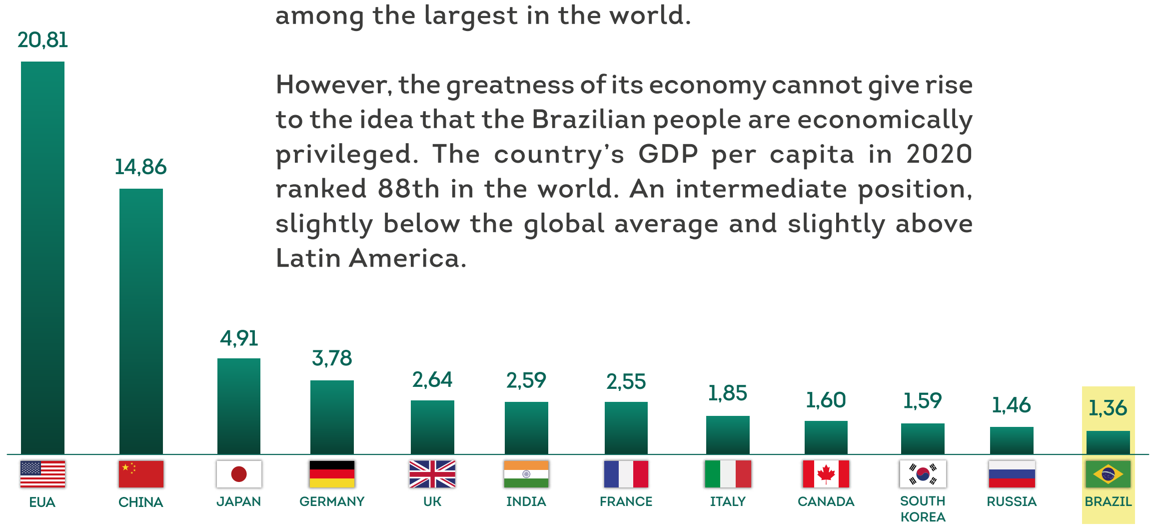
source: United Nations, World Population Prospects (2019)

GDP OF THE WORLD'S LARGEST ECONOMIES

(in trillions of dollars)

Brazil has a great economy. In 2020, its GDP (Gross Domestic Product) occupied the twelfth position among the largest in the world.

However, the greatness of its economy cannot give rise to the idea that the Brazilian people are economically privileged. The country's GDP per capita in 2020 ranked 88th in the world. An intermediate position, slightly below the global average and slightly above Latin America.



source: FMI (2020)

BIOME DIVERSITY

The Brazilian territory is occupied by six biomes, each with its typical climate, vegetation and fauna. They are: the Amazon, the Cerrado, the Atlantic Forest, the Caatinga, the Pampa and the Pantanal.

AMAZON

49,30%

The most extensive biome and also the most internationally known. With a hot and humid climate, it is considered the largest biological reserve in the world.

Area: 4,198,273 (km²)

CAATINGA

9,74%

Biome of the semiarid region of Brazil. Savannah-type vegetation with species that withstand long droughts.

Area: 829,436 (km²)

PANTANAL

2,10%

It is the largest floodplain on the planet. It houses representatives from almost all Brazilian fauna.

Area: 151,581 (km²)

PAMPA

1,78%

Located in the extreme south of Brazil, it has typical steppe vegetation with few forests. The climate is marked by the frequency of polar fronts and sub-zero temperatures in Winter.

Area: 178,831 (km²)

CERRADO

24,04%

Savannah-type vegetation with forests occurrence. It has been the main area of expansion of agricultural activity in Brazil in recent decades.

Area 2,047,190 (km²)

ATLANTIC FOREST

13,04%

It is located in the most densely populated region in Brazil. Exploited economically for five centuries, it has the most characterless nature.

Area: 1,110,456 (km²)

THE AMAZON

It is the most extensive biome and also the best known internationally. It is characterized by its hot and humid climate and its dense forest, the rainforest. Due to the variety of plant and animal species it houses, it is considered the largest biological reserve in the world.

THE CAATINGA

It is the biome of the semiarid region of Brazil. Its characteristic vegetation is a type of savannah with species capable of withstanding long droughts, interspersed with short and irregular rainy periods. The climate is hot and its forests are sparse.

THE CERRADO

It has a warm tropical climate with only two distinct seasons: the rainy one and the dry one. It is Savanna-type vegetation, with forests occurrence. The Cerrado has been the main area of expansion of agricultural activity in Brazil in recent decades.

THE PAMPA

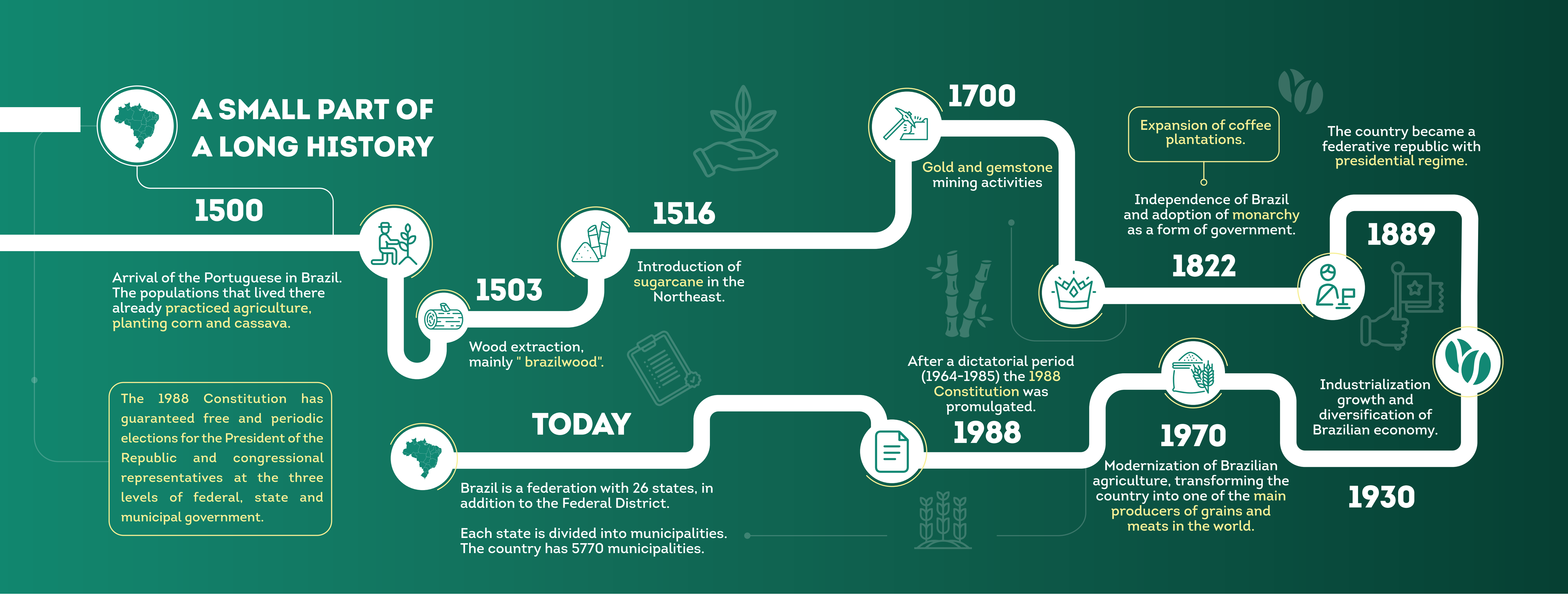
It is located in the extreme south of Brazil. It has typical steppe vegetation with few forests. Rains are regular and the climate is marked by the frequency of polar fronts and sub-zero temperatures in winter.

THE ATLANTIC FOREST

It is located in the most densely populated region in Brazil. Exploited economically for five centuries, it has the most characterless nature. Its typical vegetation is the rainforest, which can be dense or open and dependent on regular rainfall, without marked dry periods.

THE PANTANAL

It is the great floodplain of central-west Brazil. For several months a year, it is covered by the waters of the Paraguay River basin. Its typical vegetation is savannah with some forests occurrence. The Pantanal is also home to representatives of almost all Brazilian fauna.



The history of Brazil begins with the arrival of the Portuguese on its coast in 1500.

The populations that lived here already practiced agriculture, mainly with maize and cassava, products that are still important in Brazilian agricultural production. The concentration of trees in certain areas of native forests and the frequent plants occurrence outside their original ecosystems suggest that the former inhabitants of the Brazilian territory also practiced some type of forest management.

The intensive cultivation of the land began in 1516, with the introduction of sugarcane in the Northeast, which to date is one of the main products of Brazilian agriculture.

The first economic activity of the Portuguese in the new lands was extractivism. They explored the woods, mainly brazilwood, which provides a red dye. Brazilwood had such a prestige in the early days of the Colony that it ended up giving the territory its name.

The intensive cultivation of the land began in 1516 with the introduction of sugarcane in the Northeast, which to date is one of the main products of Brazilian agriculture. In the 18th century, agriculture gave way to gold and gemstones mining as Brazil's main economic activity. This period lasted only a century.

In 1822, Brazil became independent from Portugal. It became an Empire, adopting a form of government known as a constitutional monarchy.

By that time, coffee plantations were already expanding. Coffee was introduced in the country in the first half of the 18th century, and became the main engine of the Brazilian economy from 1830 to 1930.

Brazil abandoned the monarchic government system in 1889 and became a federative republic with a presidential regime.

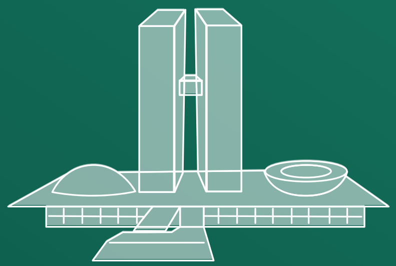
From the crisis of the 1930s and the Second World War, industrialization had a great impulse and the Brazilian economy was diversified.

From the crisis of the 1930s and the Second World War, industrialization had a great impulse and the Brazilian economy was diversified. Coffee continued to be the main agricultural product, but its importance for the economy as a whole was reduced.

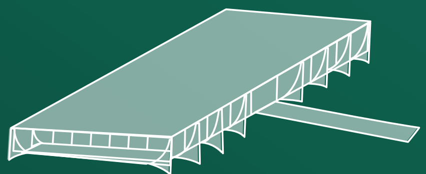
Brazilian agriculture entered a strong cycle of modernization in the 1970s. The process, which is still alive, made Brazil become an industry powerhouse, one of the world's leading grain and meat producers, within a period of less than 50 years, without abandoning advances in traditional crops, such as sugarcane and coffee.

After the authoritarian regime, which lasted from 1964 to 1985, the 1988 Constitution was promulgated.

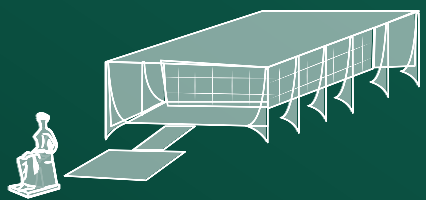
Brazil is a federation with 26 states, in addition to the Federal District, the federated unit where the capital, Brasília, is located. Each state is divided into municipalities with very different populations and sizes. Altogether, Brazil has 5770 municipalities. At the federal level, Brazil is constituted by three powers, namely:



Legislative,
exercised by the National Congress, constituted by the Chamber of Deputies and the Senate;



Executive,
exercised by the President of the Republic assisted by his Ministers;



Judiciary,
a complex system of courts, headed by the Supreme Court.

1990 - 1992

FERNANDO COLLOR DE MELLO

1992 - 1994

ITAMAR FRANCO

1995 - 2002

FERNANDO HENRIQUE CARDOSO

2003 - 2010

LUIZ INÁCIO LULA DA SILVA

2011 - 2016

DILMA ROUSSEFF

2016 - 2018

MICHEL TEMER

2019 - 2022

JAIR BOLSONARO

AGRICULTURAL RESEARCH: WHERE IT ALL BEGAN

It was during the Empire that the first institutions dedicated to higher education and research in the agrarian sciences were created in Brazil. The first agronomy school started its activities in 1877 in São Bento das Lajes, Bahia. This institution is currently part of the Universidade Federal da Bahia, Cruz das Almas campus.

A few years later, in 1883, the second agricultural college in the country was founded, in Pelotas, Rio Grande do Sul, which is now part of the Universidade Federal de Pelotas.

In 1887, *Instituto Agronômico de Campinas*, an institution dedicated to research, was created in São Paulo.

During the 20th century, other agrarian sciences schools and research institutions emerged in various parts of Brazil. It is worth mentioning the foundation of the Brazilian Agricultural Research Corporation (Embrapa), in 1973.

Embrapa is a public company with over two thousand researchers, distributed in 43 research units throughout Brazil and dedicated to practically all areas of Brazilian agriculture.

Agricultural research led Brazil to develop its own technology, adapted to the tropics, where most of its territory is located. Without this, the country would still be dependent on technologies developed to meet the needs of temperate climates.

Agricultural research led Brazil to develop its own technology, adapted to the tropics, where most of its territory is located.

Brazilian tropical agricultural technology is original, pioneering and innovative.

It is an invaluable contribution to the development and production of food in all countries located between the tropics, on the various continents. For Brazil, it was decisive in the great impulse of agricultural production has had in the last 50 years.

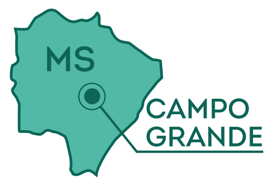
FIRST EMBRAPA HEADQUARTERS:

In 1974, the first products national centers were created.

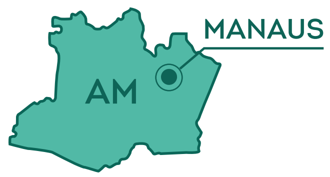
WHEAT

RICE AND BEANS

BEEF CATTLE

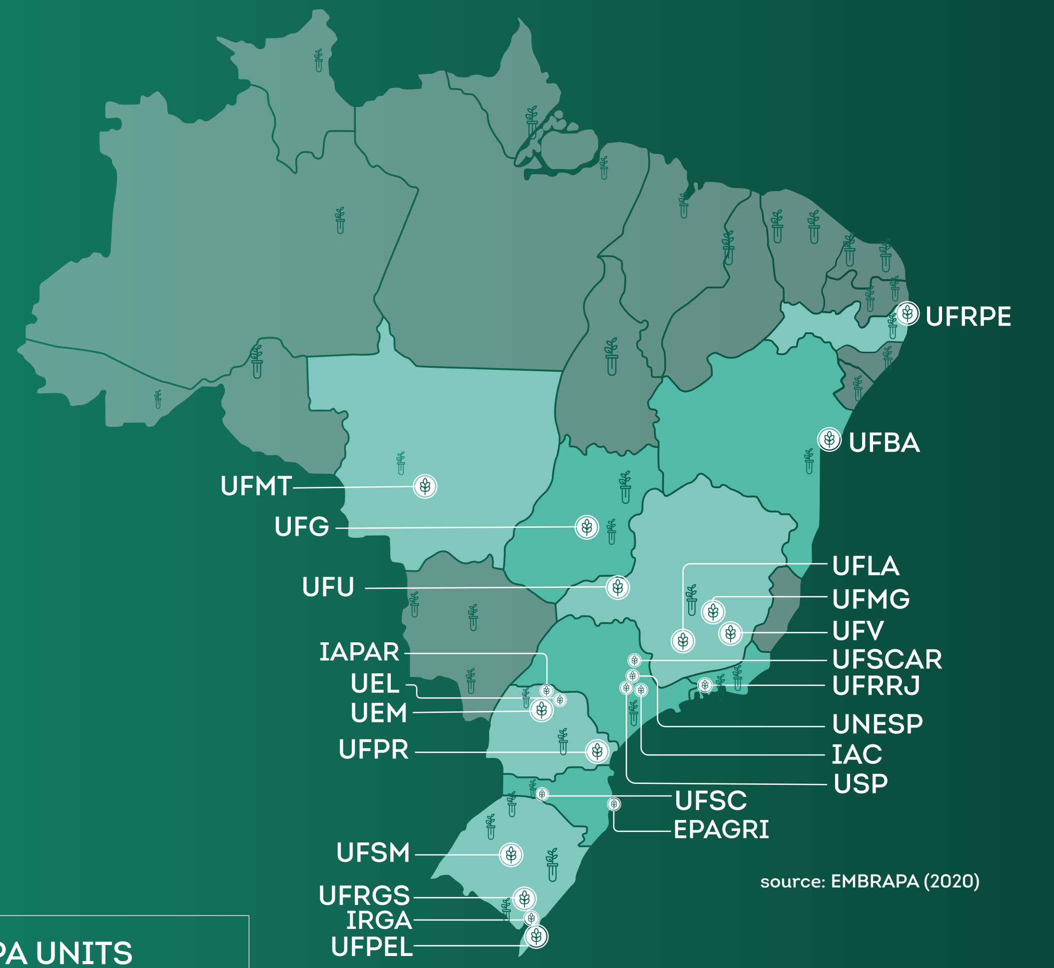


RUBBER TREE



source: EMBRAPA (2020)

MAIN PUBLIC INSTITUTIONS FOR AGRICULTURAL RESEARCH



source: EMBRAPA (2020)

EMBRAPA UNITS

RESEARCH INSTITUTES AND UNIVERSITIES

UFBA	Universidade Federal da Bahia	UFPR	Universidade Federal do Paraná
UFV	Universidade Federal de Viçosa	UFRPE	Universidade Federal Rural de Pernambuco
USP	Universidade de São Paulo	IAC	Instituto Agronômico de Campinas
UFLA	Universidade Federal de Lavras	UFMG	Universidade Federal de Minas Gerais
UNESP	Universidade Estadual Paulista Júlio de Mesquita Filho	UFRRJ	Universidade Federal do Rio de Janeiro
UFPEL	Universidade Federal de Pelotas	UFSC	Universidade Federal de Santa Catarina
UFRGS	Universidade Federal do Rio Grande do Sul	EPAGRI	Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina
IRGA	Instituto Rio Grandense do Arroz		
UFSM	Universidade Federal de Santa Maria	UEL	Universidade Estadual de Londrina
UEM	Universidade Estadual de Maringá	IAPAR	Instituto de Desenvolvimento Rural do Paraná
UFSCAR	Universidade Federal de São Carlos	UFU	Universidade Federal de Uberlândia
UFMT	Universidade Federal de Mato Grosso	UFG	Universidade Federal de Goiás

ENVIRONMENTAL LEGISLATION

Since the beginning, after the arrival of the Portuguese, Brazil has had laws aimed at protecting nature. Still in the 16th century, the Colonia zoned forests, establishing protected areas in them. Although the motivation was only the control of forest species of economic value, such as brazilwood, there was a limiting effect on the extraction of some forests.

The expression "hardwood", or *"Madeira de Lei"*, in Portuguese, used in Brazil to refer to good quality wood, has its origins in a legal provision dated 1827, which gave judges the power to establish protection rules for forest species of economic value.

Since the end of the 18th century, private and public initiatives have emerged to recover forests in devastated areas.

Since the end of the 18th century, private and public initiatives have emerged to recover forests in devastated areas. The most emblematic case is the one of Floresta da Tijuca, in Rio de Janeiro.

The initiative came from Emperor Pedro II. In 1862, he determined that native species of the Atlantic Forest should be planted in the place, which was previously occupied by coffee plantations. It was only in the 20th century, however, that the first steps were taken towards the elaboration of the environmental laws in force in Brazil.

1503

First laws designed to protect nature, aiming to limit the extraction of brazilwood.

1827

Origin of the expression "hardwood" (*Madeira de Lei*, in Portuguese), used in Brazil to refer to good quality wood, with economic value.

1862

Planting of native species from the Atlantic Forest in the Tijuca Forest, in Rio de Janeiro, as an initiative of Emperor D. Pedro II, to recover forests in devastated areas.

1930

First steps towards drafting the environmental laws currently in force in Brazil.

The year 1934 was marked by the institution of the Hunting and Fishing Code, which brought the first measures to protect wild fauna; the Forest Code, which classified forests into four types, establishing those that should be fully protected and those that could be exploited, and the Water Code, which determined the rules for their common use, particular use and for energy production.

The first environmental protection area in the country, Parque Nacional do Itatiaia, was created in 1937. The area is located in Serra da Mantiqueira and covers regions in the states of Rio de Janeiro and Minas Gerais.

1934

Institution of the Forest Code, establishing the forests that should be fully protected and those that could be exploited.

1937

Creation of the first environmental protection area in the country, the Parque Nacional do Itatiaia, in Serra da Mantiqueira, which covers areas in the states of Rio de Janeiro and Minas Gerais.

1965

Updating of the 1934 code, establishing that rural properties should have permanent preservation areas, in addition to legal reserves.

1973

Creation of the Special Environment Secretariat, the first federal body dedicated to acting exclusively in the preservation of nature.

1988

The 1988 Constitution dedicated a chapter to the environment: "Everyone has the right to an ecologically balanced environment, a common good for the people and essential to a healthy quality of life..." (art. 225).

1998

The Environmental Crimes Law was approved in 1998, providing punishment for acts and activities that harm the environment.

The New Forest Code dated 1965, updated the regulation from 1934 and established that rural properties should have permanent preservation areas – to protect springs, waterways, hilltops, and slopes, for example – in addition to legal reserves, a portion of each land where native vegetation would be preserved.

In 1973, the Special Environment Secretariat was created, the first federal body dedicated to acting exclusively in the preservation of nature.

The 1988 Constitution dedicated a chapter to the environment and defined: "Everyone has the right to an ecologically balanced environment, a common good for the people and essential to a healthy quality of life, and it is the duty of the Public Power and the community to defend it and preserve it for present and future generations" (art. 225).

The Environmental Crimes Law was approved in 1998, providing punishment for acts and activities that harm the environment.

1999

Creation of the National Environmental Education Policy, introducing environmental education at all levels of education in Brazil.

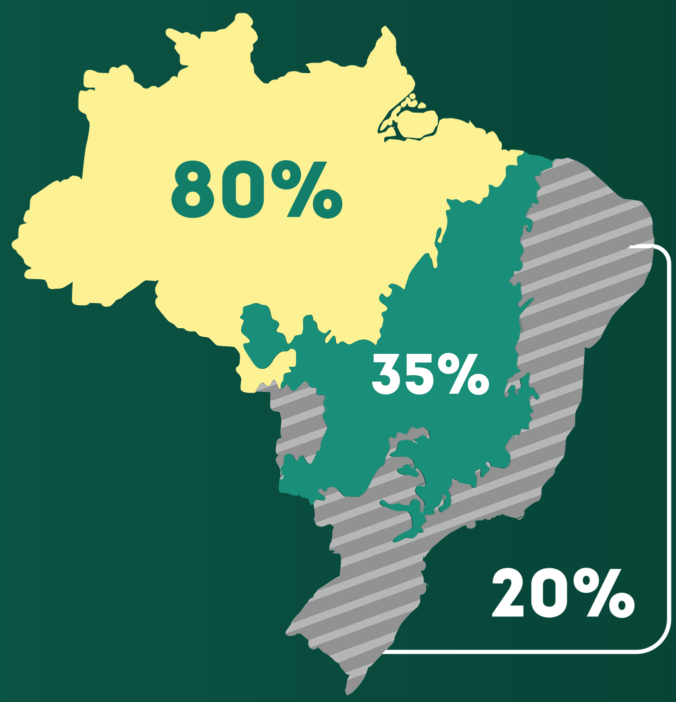
2012

The current Forest Code was approved in 2012 and replaces the 1965 Code, establishing general rules for the protection of vegetation, permanent preservation areas and Legal Reserves.

Brazilian Forest Code (2012)

Area preservation on rural properties depending on the biome location:

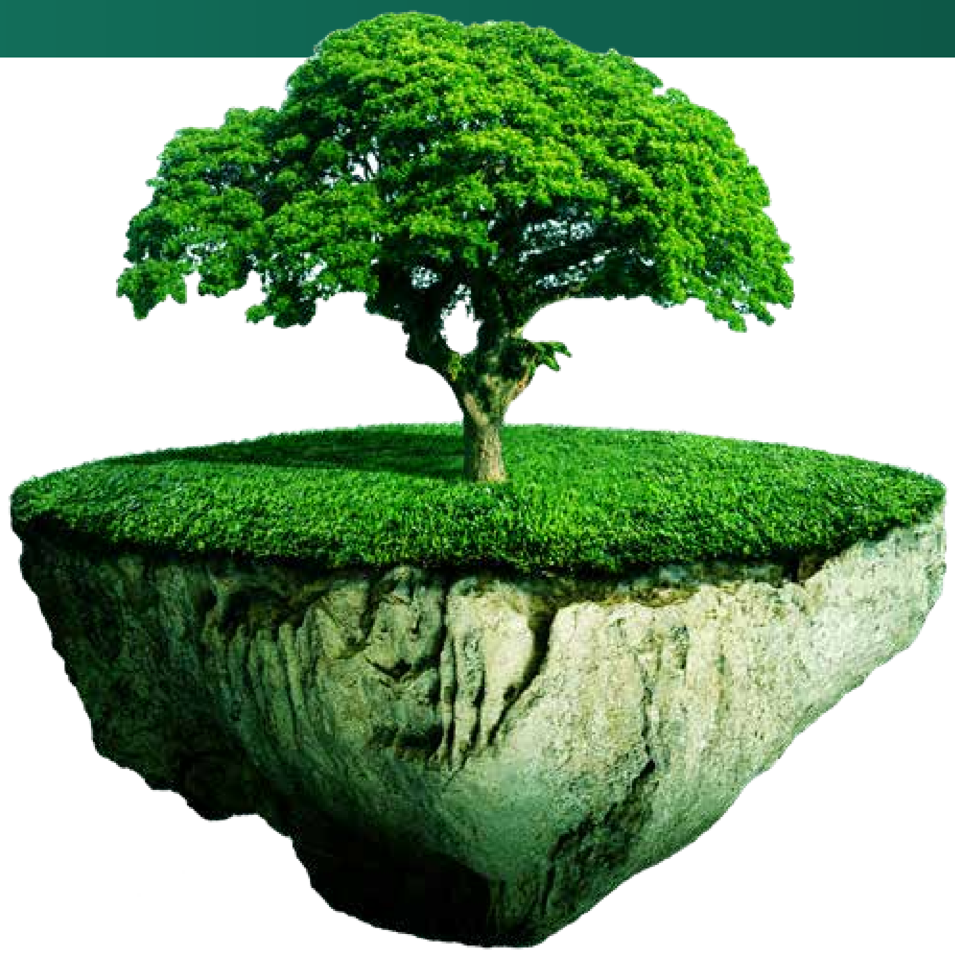
- 80% in the Amazon
- 35% in the Cerrado
- 20% in the other biomes



In 1999, the National Environmental Education Policy was created. It introduced environmental education at all levels of education in Brazil, aiming to sensitize the population to environmental protection issues.

The current Brazilian Forest Code or Environmental Code was enacted in 2012 (Law 2651/2012), after 13 years of debates in the National Congress. It replaces the 1965 Code and establishes general rules for the protection of vegetation, permanent preservation areas, and Legal Reserves. It also determines the rules for forests exploitation, controlling, and prevention of forest fires.

The 2012 Forest Code establishes that all properties have a minimum reserve area for native vegetation.



Its article 2 offers an overview of what nature represents to Brazilian society today: "The forests existing in the national territory and other forms of native vegetation, recognized as useful for the lands they cover, are goods of common interest to all inhabitants of the Country..."

The 2012 Forest Code establishes that all properties have a minimum reserve area for native vegetation. It is called the Legal Reserve (RL), which, depending on the type of vegetation and biome, should occupy 20% to 80% of the property's area. In the Amazon biome, the area destined for the Legal Reserve must be 80% of the total, in the Cerrado it is 35% and in the other biomes it is 20% of the total area.

At the federal level, the Ministry of Agriculture, Livestock and Supply (MAPA) and the Ministry of Environment (MMA) are primarily responsible for government actions in both areas.

All states and most municipalities also have specific bodies to act in agricultural production and the environment.

SUSTAINABLE

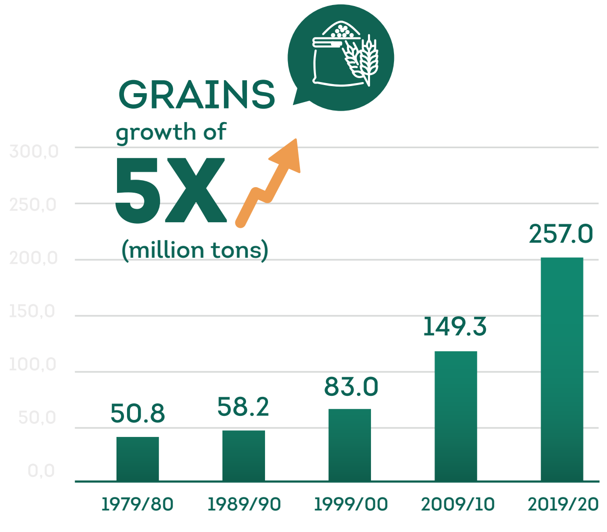
AGRICULTURAL PRODUCTION

AGRICULTURAL PRODUCTION HAS GROWN UP TO 5 TIMES IN THE LAST 40 YEARS

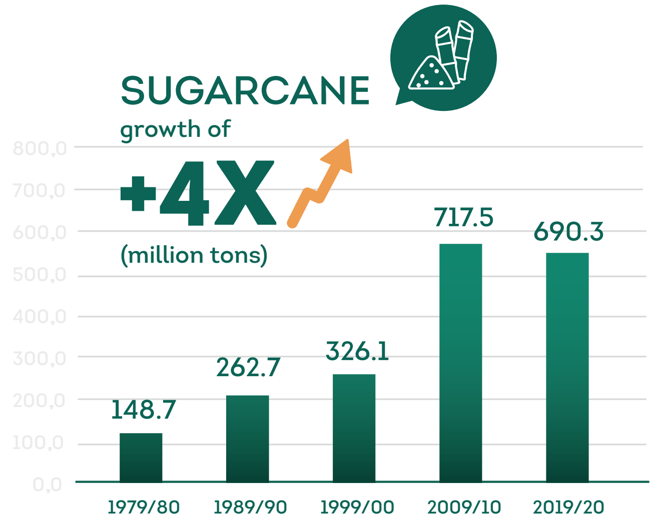
Brazil is one of the greatest agricultural powers on the planet. This fact was unimaginable just four decades ago. The expansion was mainly driven by grain production. In 1980 the country produced 50.8 million tons of grain; in 2020, almost 257 million. This represents an almost 5-fold growth in production.

The expansion was mainly driven by grain production. In 1980 the country produced 50.8 million tons of grain; in 2020, almost 257 million. This represents an almost 5-fold growth in production.

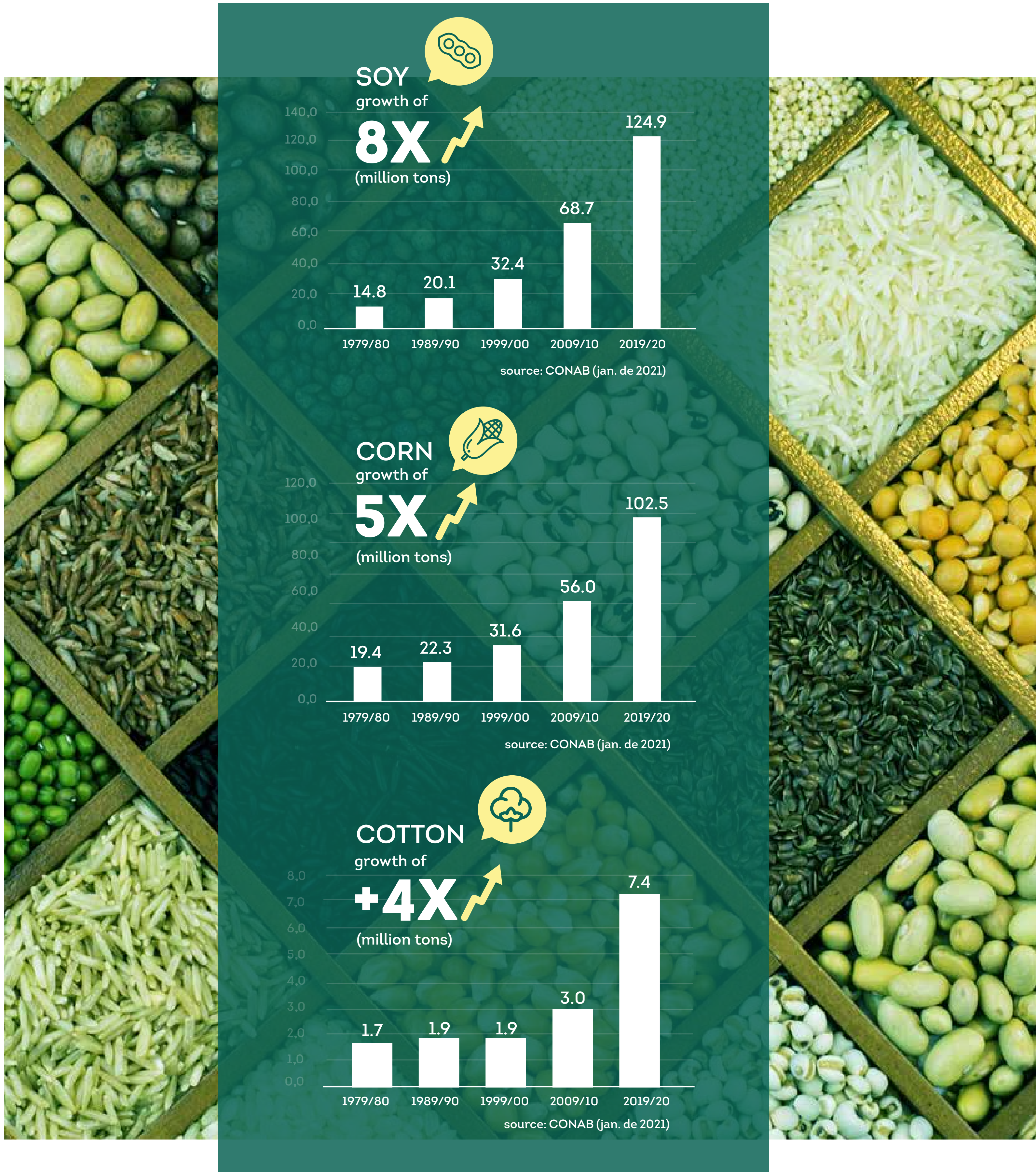
Even traditional crops in Brazil, which did not have such a regular growth, have changed their production level during this period. This is the case of sugarcane, which showed a four-time growth from 1980 to 2020.



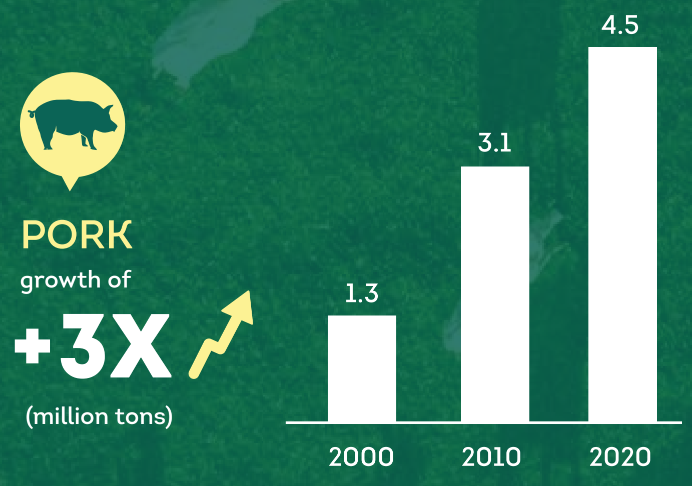
source: CONAB (jan. de 2021)

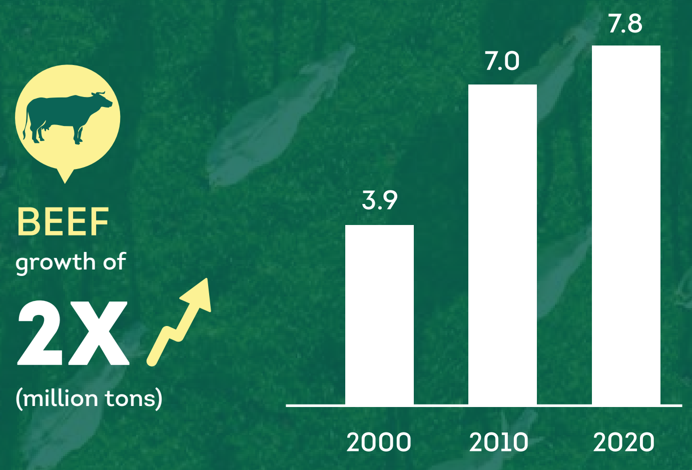


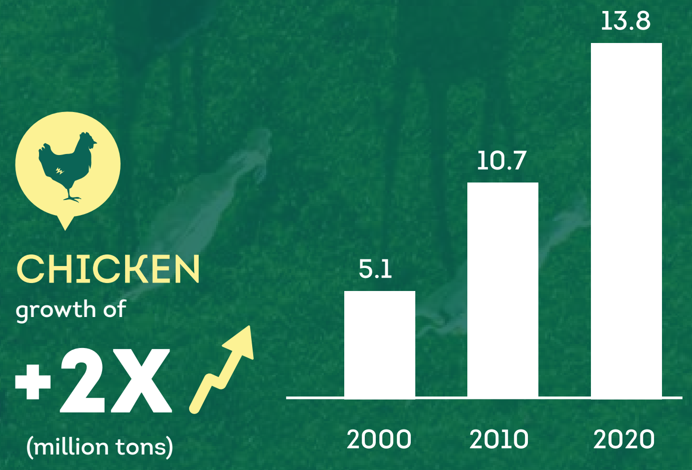
source: IBGE e LSPA (set. de 2020)



In addition to the expressive growth in the volume of grains, the production of animal protein has also shown an extraordinary increase in the last twenty years. More than three times for pork, two times for beef, and almost three times for chicken.







source: IBGE - Pesquisa Trimestral do Abate dos Animais (2020)

A COUNTRY OF DIVERSIFIED PRODUCTION

Despite having its flagships, Brazilian agriculture is very diversified. This is quite evident when a brief analysis is made considering only Brazilian agricultural products with production greater than one million tons per year and how they are distributed in the producing regions.

PRODUCTION GREATER THAN
ONE MILLION TON PER YEAR

NORTH
Açaí
Pineapple
Palm oil
Cassava

NORTH EAST
Pineapple
Banana
Coconut
Bean
Mango
Papaya
Watermelon

MIDWEST
Cotton
Beef
Bean
Corn
Soy
Sorghum

SOUTH EAST
Banana
Potatoes
Coffee
Sugarcane
Bean
Milk
Orange
Lemon
Chicken
Eggs
Tomato

SOUTH
Rice
Chicken
Onion
Pork
Bean
Milk
Apple
Wheat
Grape

source: IBGE: LSPA (setembro de 2020) / PAM (2019) / Pesquisa Trimestral do Abate dos Animais (2º Trimestre de 2020) / PPM (2019)

BRAZIL IS A GLOBAL LEADER IN THE USE OF RENEWABLE ENERGY

In addition to producing food, Brazilian agriculture also includes the production of sources for energy generation. Diversification is one of the central pillars of the Brazilian energy policy. The country also made international commitments for expanding the use of sustainable energy sources.

Renewable sources – including water, wind, sun and bioenergy – account for 46.2% of the energy consumed in Brazil

Renewable sources – including water, wind, sun and bioenergy – account for 46.2% of the energy consumed in Brazil. Most of these sources rely on agriculture, which makes the Brazilian energy matrix quite different from other countries.

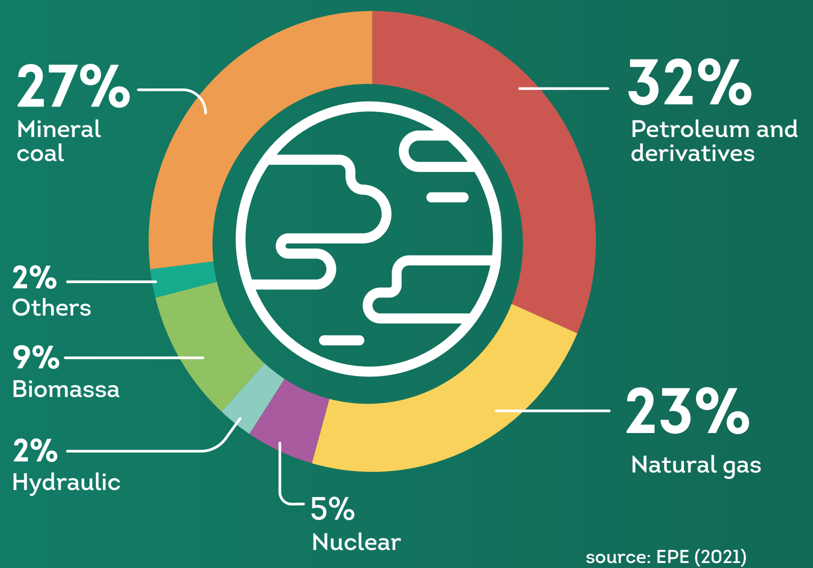
Worldwide, renewable energy sources account for only 13% of the energy matrix.

Worldwide, renewable energy sources account for only 13% of the energy matrix. Since the 1970s, Brazil has developed one of the most successful bioenergy programs in the world. In the beginning, it was based on ethanol extracted from sugarcane. Currently, the gasoline used in the country is mandatorily mixed with 27% ethanol and diesel with 10% biodiesel.

Currently, the gasoline used in the country is mandatorily mixed with 27% ethanol and diesel with 10% biodiesel.

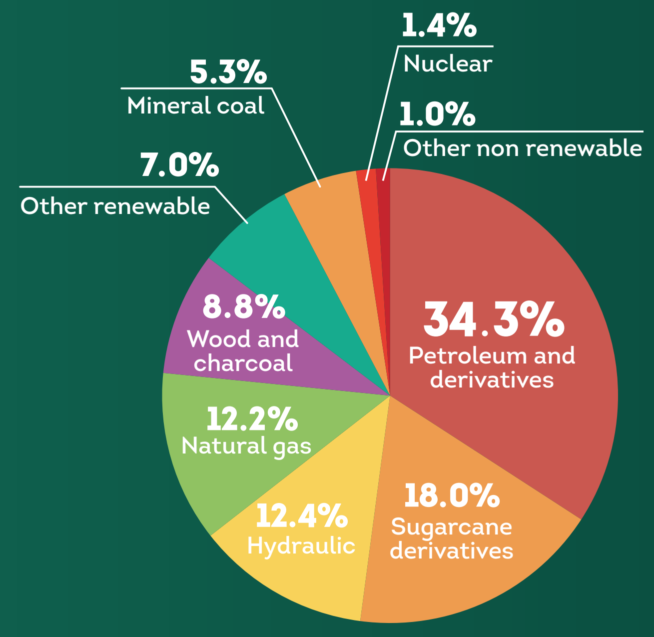
By far, the main raw material for ethanol is still sugarcane, but corn and other products such as oats, barley, wheat and sorghum have also started to be used. For biodiesel, the diversity of raw materials is greater, but soy stands out.

WORLDWIDE ENERGY MATRIX



source: EPE (2021)

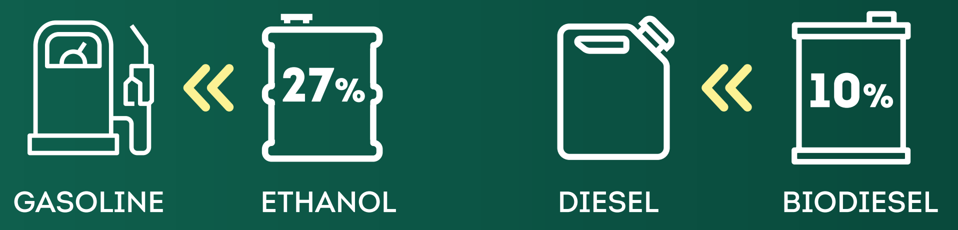
BRAZILIAN ENERGY MATRIX



source: EPE/BEN (2019/2020) E ANP (2021)

Since the 1970s, Brazil has developed one of the greatest bioenergy programs in the world, promoting the production and adoption of ethanol.

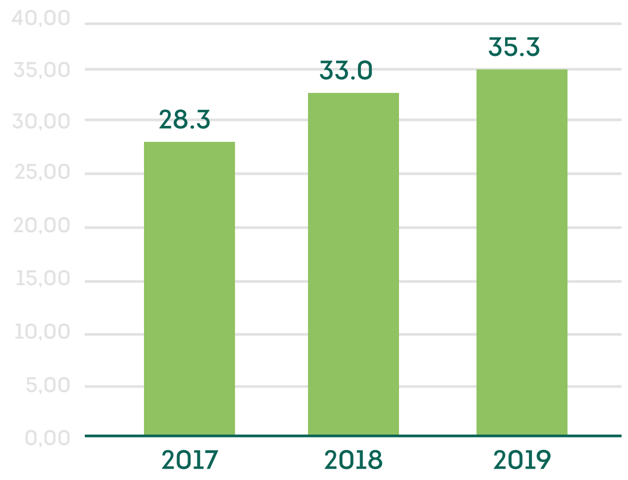
Currently, the gasoline used in the country is mandatorily mixed with 27% ethanol and diesel with 10% biodiesel.



USE OF ETHANOL IN BRAZIL REDUCES CO_2 EMISSIONS

ETHANOL PRODUCTION

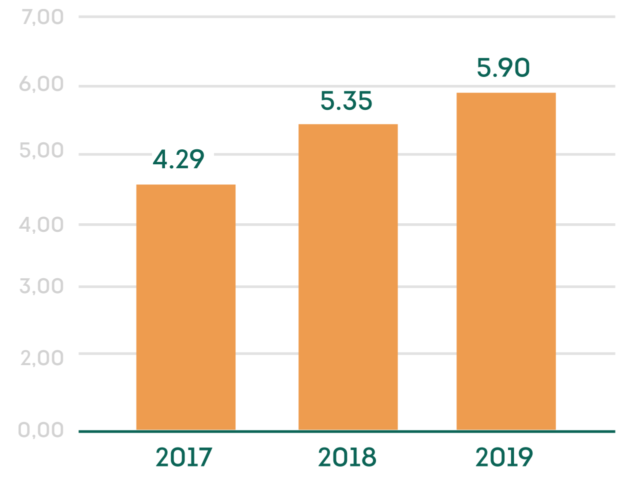
(million m³)



source: ANP (2020)

BIODIESEL PRODUCTION

(million m³)



souce: ANP (2020)

Last year, the Sugarcane Industry Association (UNICA) announced that between March 2003 (the birth date of flex technology in Brazilian automotive vehicles) and April 2021, the consumption of ethanol (both anhydrous and hydrated) avoided the emission of more than 556 million tons of CO_2 in the country.

The consumption of ethanol (both anhydrous and hydrated) avoided the emission of more than 556 million tons of CO_2 in the country.

According to the organization, the study was based on data from the National Petroleum, Natural Gas and Biofuels Agency (ANP). This volume is equivalent to the sum of the annual emissions of Argentina, Venezuela, Chile, Colombia, Uruguay and Paraguay.

When evaluating the emissions of greenhouse gases (GHG) in the life cycle of fuels, ethanol provides an up to 90% reduction in the emission of GHG compared to gasoline.

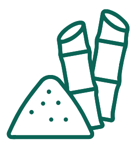
In addition, sugarcane biofuel practically eliminates the dispersion of particles that are harmful to health, which manages to penetrate into the deepest parts of the lung (-98% compared to gasoline and diesel), as well as toxic hydrocarbons (-99% in the emission of benzene, present in gasoline, and in the emission of polyaromatic hydrocarbons, generated in diesel-burning).

Although most of the renewable energy sources in Brazil come from sugarcane, the participation of firewood and charcoal from planted forests cannot be disregarded. These raw materials correspond to a percentage of 8.8% of the country's energy sources.

Expectations in relation to forest plantations for purposes of producing energy and using wood in new businesses (biorefineries for biomass) are quite high.

RAW MATERIALS USED IN ETHANOL PRODUCTION

SUGARCANE
99.65%



CORN
0.12%

OTHERS
0.23%

source: ANP (2020)

RAW MATERIALS USED IN BIODIESEL PRODUCTION

SOY OIL	68%	FRYING OIL	1.57%
BOVINE FAT	11.46%	COTTON OIL	1.03%
PALM FAT	2.02%	CHICKEN FAT	0.56%
PORK FAT	1.95%	CANOLA RAPESEED OIL	0.04%
CORN OIL	1.94%	OTHER MATERIALS (castor, babassu, sunflower, peanut, jatropha)	11.43%

source: ANP (2020)

PLANTED FORESTS ARE THE MAIN SOURCE FOR VARIOUS PRODUCTS IN BRAZIL

Although planted forests provide a significant part of the raw materials for bioenergy in Brazil, such as charcoal and firewood, they also produce wood for cellulose and other purposes.

The first commercial forests were planted in the beginning of the 20th century, when there was a shortage of native wood for the railways in the state of São Paulo. A great growth occurred from the 1960s. Since 2000, the value of forestry production exceeded the one of plant extraction.

> **The first commercial forests were planted in the beginning of the20th century, when there was a shortage of native wood for the railways in the state of São Paulo.**

The results of the Vegetal Extraction and Forestry Production (PEVS) research showed an increase of 1.2% in the total area of planted forests in the country in 2019, which represents an increase of 118.1 thousand hectares. About 79.4 thousand hectares of this total correspond to areas of eucalyptus, the predominant species in Brazilian territory.

> **In recent decades, as the cultivation of planted forests expanded, the production of products derived from Brazilian native forests fell markedly.**

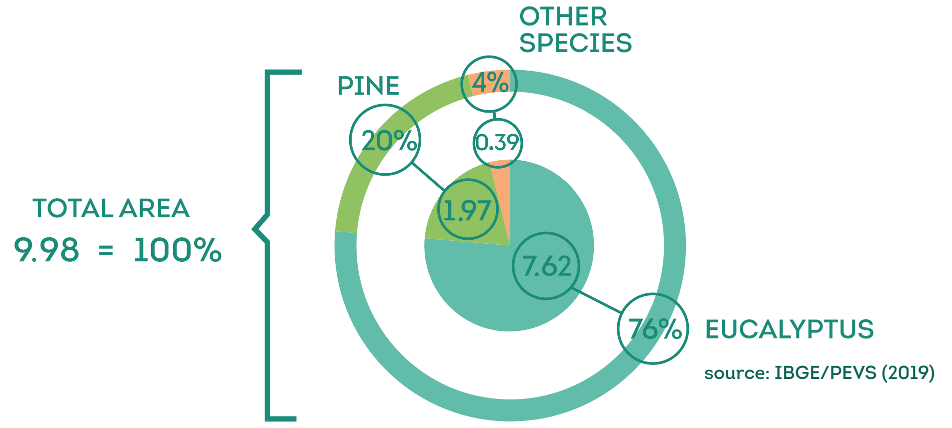
Taken together, eucalyptus and pine, account for the coverage of 96.1% of the cultivated areas with planted forests for commercial purposes.

According to the National Plan for the Development of Planted Forests, Brazil has a goal of adding another 2 million hectares to the 9.98 million hectares of planted forests by 2030.

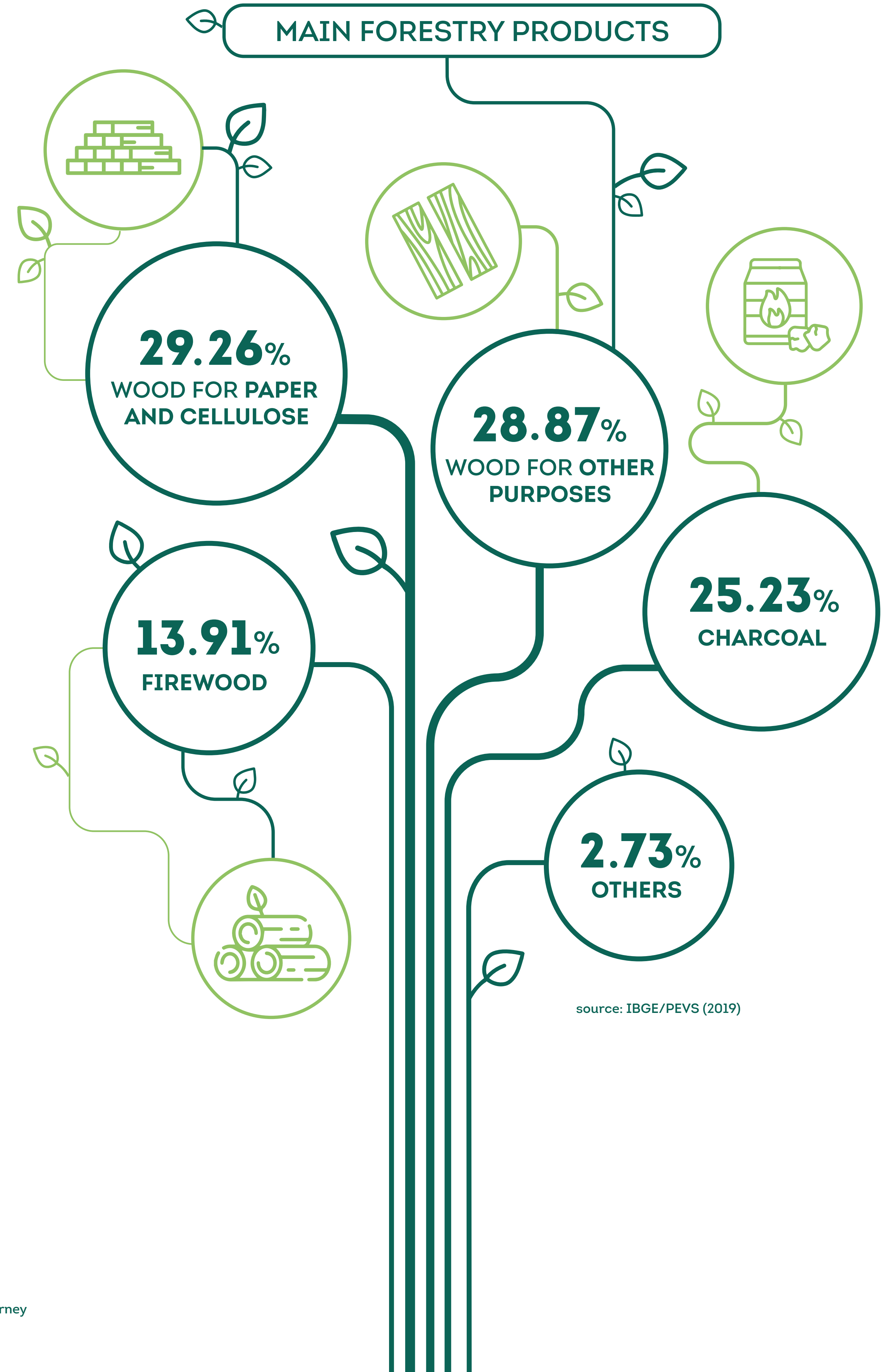
In other words, it intends to grow 20% of the current area. One of the consequences of planting forests is a decrease of human pressure on the native vegetation. This behavior is already observed in recent decades, as the cultivation of planted forests expanded, the production of products derived from Brazilian native forests fell markedly.

PLANTED AREA OF FOREST SPECIES

(million hectares)



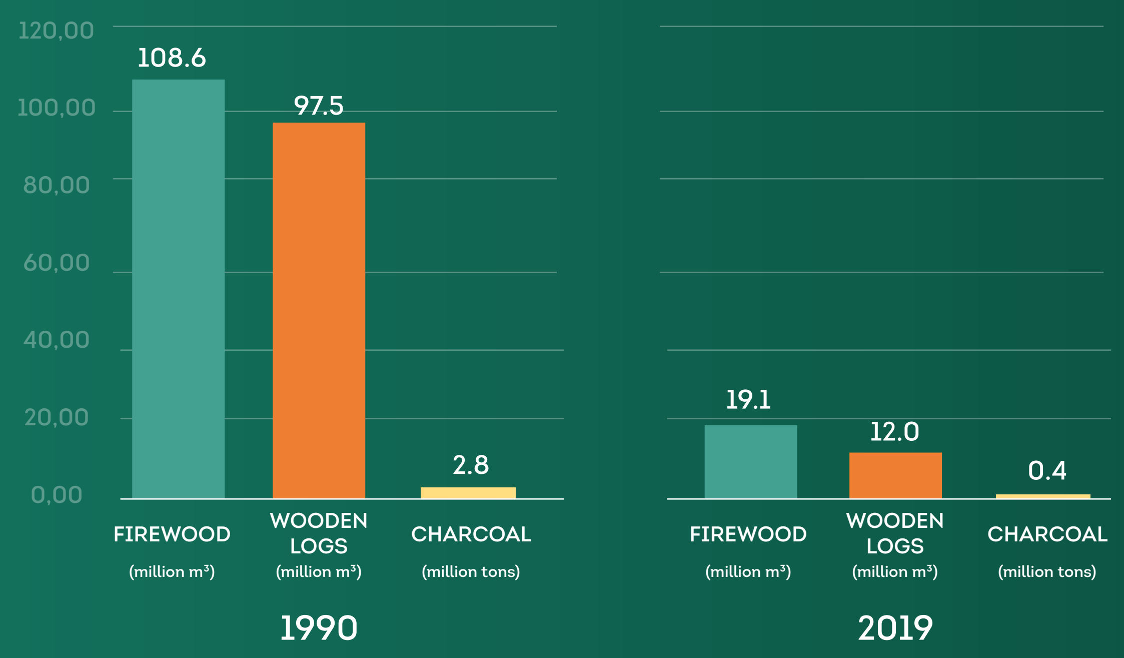
source: IBGE/PEVS (2019)



source: IBGE/PEVS (2019)

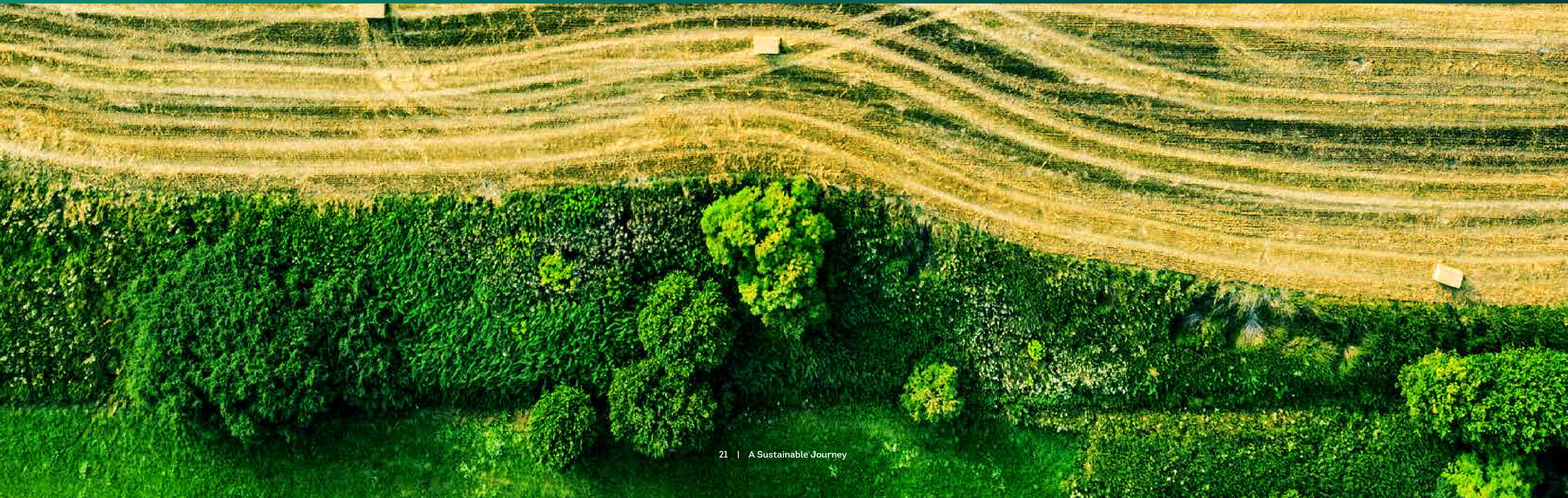
The fact that the production of these items has decreased in recent decades does not mean that native forests will one day cease to produce completely. As in many parts of the world, the sustainable exploitation of the native forest – without devastation – is allowed in Brazil under specific rules.

PRODUCTS FROM NATIVE FORESTS



source: IBGE/PEVS (2019)

In order to ensure that the forest product is originated from sustainable management, there are several certification systems in the country. The two most important are Cerflor (Brazilian Forest Certification Program), which is part of an international system – the PEFC (Endorsement of Forest Certification Scheme Program) -, and the FSC (Forest Stewardship Council), an international organization.



TECHNOLOGY HAS INCREASED AGRICULTURAL PRODUCTION AND SAVED AREA

The performance of Brazilian agriculture is generally associated with factors such as availability of natural resources, encouragement to the adoption of technologies adapted to tropical conditions, public policies, the entrepreneurial capacity of producers and organization of value chains that, together, explain the remarkable growth observed in the last few decades.

The main element that contributed to the expressive gains in productivity, and the consequent saving of natural resources was the use of technologies adapted to tropical conditions and the Brazilian reality.

The main element that contributed to the expressive gains in productivity, and the consequent saving of natural resources was the use of technologies adapted to tropical conditions and the Brazilian reality.

The development of earlier and more adapted varieties, resulting from genetic improvement, in addition to allowing the reduction of risks made the second crop viable in many regions of Brazil.

The development of earlier and more adapted varieties, resulting from genetic improvement, in addition to allowing the reduction of risks made the second crop viable in many regions of Brazil. Finally, the adoption of fertilizers, the access to machinery and equipment with advanced technology embedded in agriculture, such as GPS and sensors, has allowed a more rational use of inputs, thus reducing production costs and favoring the environment.

In addition, the adoption of conservation practices such as no-tillage, crop rotation, production systems integrating agriculture, livestock and forest, and more sustainable crop protection techniques, such as integrated pest management, more efficient use of pesticides and genetically improved plants resistant to diseases and pests are also noteworthy.

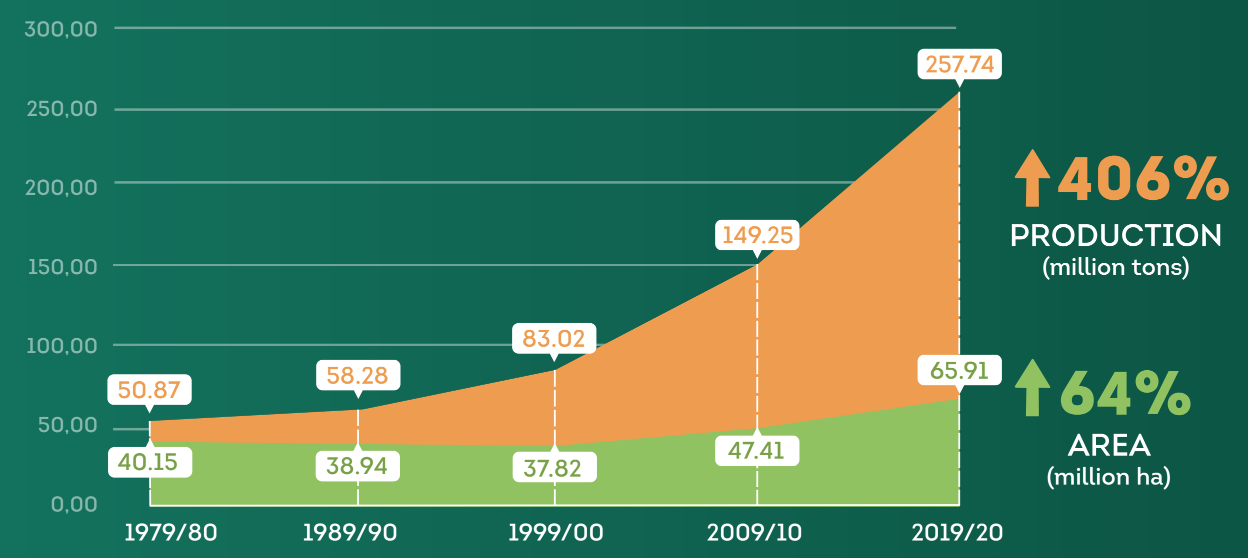
MULTIPLE CROPPING IN THE SAME PIECE OF LAND

The intensification of good agricultural practices contributed so that the growth of Brazilian agricultural production did not result in an equivalent decrease in native vegetation. A standard approach in Brazil consists of using the same area to plant two temporary crops in the same year. So, when we say that, in the same annual cycle, soy has occupied an area x and

A standard approach in Brazil consists of using the same area to plant two temporary crops in the same year.

corn an area y, it does not mean that the planted area of the two crops was equal to x + y. Indeed, much of the area of both crops is physically the same. One is planted in the first period of the agricultural year, i.e. spring-summer, and the other one in the second period, i.e. autumn-winter, exactly in the same area.

EVOLUTION OF GRAIN PRODUCTION AND PLANTING AREA



source: CONAB (outubro de 2020)

This type of rotation, which used to be restricted to some areas of Brazil before the boost, due to policies to encourage agriculture and the adoption of field technology is now widely adopted. While the multi-crop model is used in almost all grain-producing regions of Brazil, it is impractical in places with very severe winters.

The most common rotation is between soy and corn. However, depending on the region, several

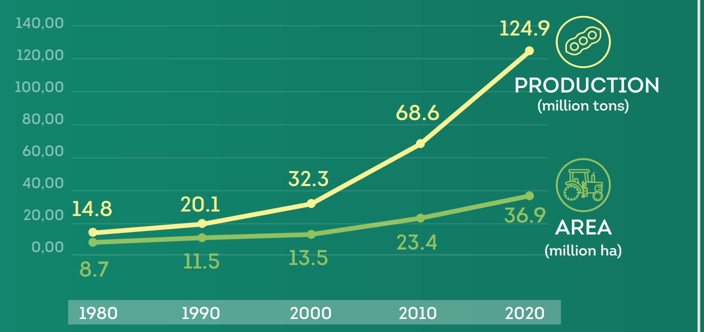
While the multi-crop model is used in almost all grain-producing regions of Brazil, it is impractical in places with very severe winters.

other crops are used, such as wheat, cotton and sorghum. In addition to soy, corn can also be rotated with other crops, including pastures for temporary use.

In addition to the better use of the area, with two crops in the same year, crops also became more productive.

As a result, between 1980 and 2020, while grain production grew 406%, the planted area did not increase by over 64%.

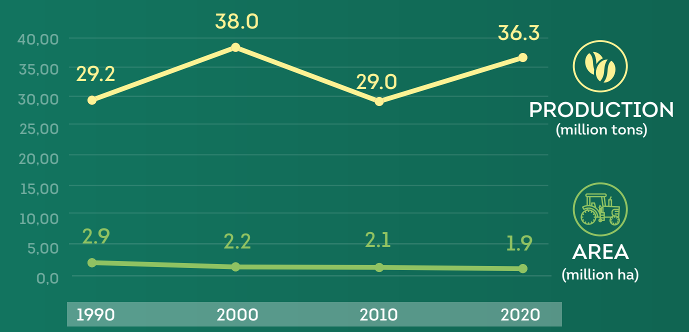
SOY - PRODUCTION X AREA



source: CONAB (2021)

Individually, the main products of Brazilian agriculture, have increased in productivity in recent decades. This fact is explained by the increased production without an equivalent increase in the area.

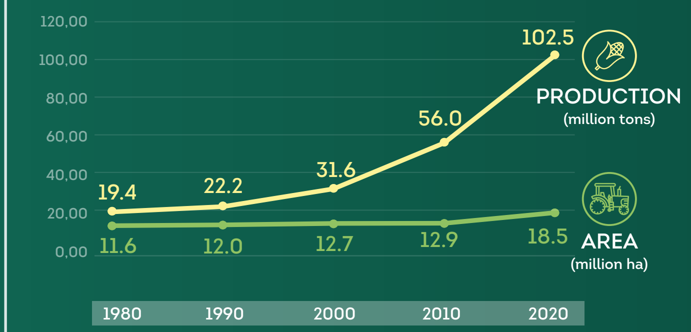
COFFEE - PRODUCTION X AREA



fonte: IBGE, PAM e LSPA (setembro de 2020)

Also, regarding productivity gain, it is worth noting that some crops have shown an increased production accompanied by a reduction in the planted area in recent decades. This was the case of coffee, which, in 2020, had a 24% increase in production compared to 1990, in a 34% smaller area.

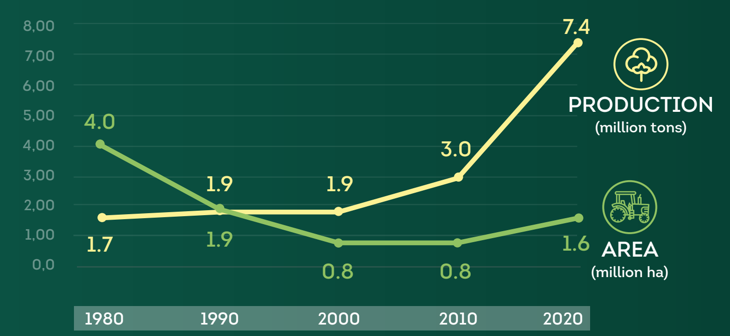
CORN - PRODUCTION X AREA



fonte: CONAB (2021)

Between 1980 and 2020, the increase in soybean area was 324%, while production grew 743%. In the case of corn, the difference is proportionally greater: production grew 428% and the area grew 59%.

COTTON - PRODUCTION X AREA

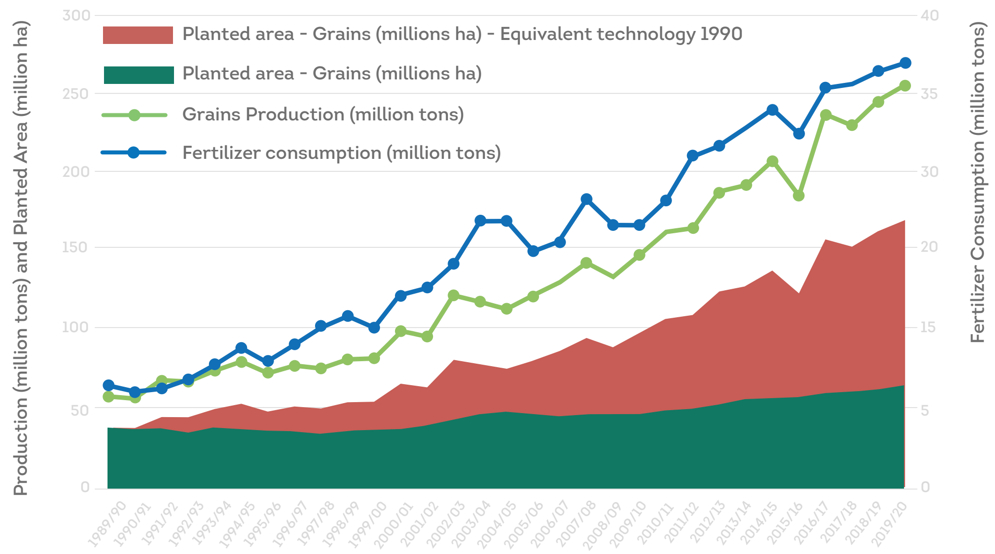


fonte: CONAB (setembro de 2021)

This effect is even more pronounced in cotton, which, between 1980 and 2020, had a 330% increase in production and a 60% reduction in the area.

FERTILIZERS INCREASE THE YIELD OF PLANTS IN THE FIELD AND SAVE AREA

EVOLUTION OF GRAIN PRODUCTION AND FERTILIZER CONSUMPTION



source: ANDA, CONAB (2021)

In order to guarantee agricultural production, nutrients must be made available in adequate amounts to the plants. Since at each cycle crops extract nutrients from the soil, a natural decrease in nutrient stocks is expected. Thus, it is necessary to add fertilizers, in order to replace losses and balance unfavorable soil compositions. In the absence of these adjustments, the depletion of soil reserves would make plant development unfeasible.

Since at each cycle crops extract nutrients from the soil, a natural decrease in nutrient stocks is expected.

After all, without nutrients, the plant does not grow normally and does not complete its life cycle; that is, it does not develop and does not reproduce.

Products aimed at plant nutrition, such as fertilizers and correctives, contribute decisively to a higher level of agricultural productivity, preventing new areas from being deforested to be incorporated into agricultural activities.

Products aimed at plant nutrition, such as fertilizers and correctives, contribute decisively to a higher level of agricultural productivity, preventing new areas from being deforested to be incorporated into agricultural activities.

The nature of soils in Brazil is markedly acidic, making it difficult for plants to absorb nutrients. In practice, before applying fertilizers, it is necessary to neutralize the soil, which can be made by adding correctives, such limestone.

The use of fertilizers and correctives is one of the main contributors to the increase in agricultural productivity worldwide. They account for about 40 to 50% of the world's agricultural production. In Brazil, this value is not different. In the 1989/90 harvest, the country produced 58.28 million tons of grain in an area of 38.94 million hectares.

The use of fertilizers and correctives is one of the main contributors to the increase in agricultural productivity worldwide.

By the 2020 harvest, 257.02 million tons of grain had been produced in 65.92 million hectares. In this context, in 1989, 1.50 tons were harvested per hectare, and in 2020 this value increased to 3.90 tons per hectare.

These numbers reveal how much Brazilian agriculture has become more efficient after 30 years of production. If Brazil were currently producing at the same level of productivity as in 1990, there would be a need to expand or deforest an area of approximately 105 million hectares. Thus, fertilizers represent a crucial technological tool for increasing crop productivity, since its adoption has closely followed the growth of agricultural production.

GENETIC IMPROVEMENT WAS ESSENTIAL TO ADAPT CROPS TO THE TROPICAL CLIMATE

Some of the most cultivated plants in Brazil were introduced soon after its discovery, such as wheat and sugarcane. The process of growing and adapting these plants to a new environment was part of genetic improvement in plants. The selection of those that best adapted and produced the most represents the beginning of a strategy that would be developed and established in the country centuries later.

The first research into plant breeding in Brazil took place at the Instituto Agronômico de Campinas (IAC), and at the Escola Superior de Agricultura Luiz de Queiroz – ESALQ/USP, in the early 1920s. At the IAC, research began with cotton. At ESALQ, with cassava, rice, and corn.

After that, other crops were studied, such as eucalyptus, vegetables, and soybeans.

The creation of universities and plant improvement companies developed and expanded crop studies. In the 1970s, Embrapa also supported and accelerated this development.

Currently, public and private institutions offer different cultivars for the main crops in Brazil. Always taking into account the new challenges that arise to be overcome by research.

Plant breeding techniques are extremely successful and have been widely used in Brazilian agriculture to increase the yield of various agricultural plants in the last five decades. Furthermore, under the diverse conditions and tropical climate, genetic improvement is even more desirable.

Plant breeding techniques are extemely successful and have been widely used in Brazilian agriculture to increase the yield of various plants in the last five decades.

Among the characteristics for adapting to these conditions are resistance to diseases and insects, tolerance to heat, soil salinity or frost, appropriate size, shape, and maturation time. In addition to the characteristics that contribute to a better adaptation to the environment, the following are also considered: ease of cultivation and handling, higher yields and better quality.

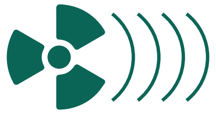
GENETIC IMPROVEMENT IS BEING CARRIED OUT FROM THE ANCESTRAL FARMERS

10,000 a.c
Start of agriculture

1866
Mendel Laws
(genetic inheritance)

1900
Conventional
genetic improvement

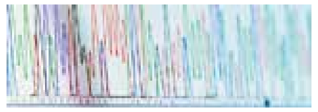
Dec. de 1930
Improvement
by mutation

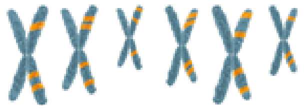


1953
Discovery of the
DNA structure

1972
Recombinant
DNA technology

1975
DNA sequencing
technique





Dec. de 1980
Improvement by
molecular markers

Dec. de 1990
Improvement by
genetic edition

2013

First in vitro vegetables using the CRISPR/Cas9 technique

Approximately 12,000 years ago, the soils were transformed by the progressive appearance of savannas rich in cereals (barley, corn and wheat), which, at that time, were quite heterogeneous.

As prehistoric man began to harvest and sow grains, always at the same time in the calendar, they started to eliminate some characteristics of these plants, such as dormancy, slow development, small seeds and fragile stems.

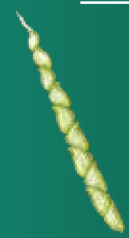
As the prehistoric man began to harvest and sow grains, always at the same time in the calendar, they started to eliminate some characteristics of these plants, such as dormancy, slow development, small seeds, and fragile stems. Seeds that carried these characteristics did not have enough time to develop or were lost.

Thus, plant breeding began in a completely empirical and random way.

It is not new to say that corn, as we know it, is very different from that of 12,000 years ago. The differences observed are due to the choices made by ancestral farmers, who over thousands of years have developed their skills for cultivation.

However, the ancestral peoples did not know that by cultivating these cereals for their food, they were already modifying the environment around them, and consequently selecting genes and changing the genome of these plants.

Also in prehistory, man became aware that by crossing only teosinte (corn ancestor) individuals with a greater amount of grains per cob, it would result in the production of teosinte "children" with an even greater number of grains. However, the ancestral peoples did not know that by cultivating these cereals for their food, they were already modifying the environment around them, and consequently selecting genes and changing the genome of these plants. Nowadays, genetic improvement incorporates various knowledge from the biological sciences and is widely used in plants and farm animals.



Teosinte

The ancestor of corn was very similar to grass. It had very few grains grouped in stalks that did not exceed 5 cm.

Modern Corn

Thousands of years of selection resulted in the corn as we know it today, with larger grains and in greater quantities.

BIOTECHNOLOGY HAS REVOLUTIONIZED AGRICULTURE

Over time, science has incorporated new tools for genetic improvement. Advances in knowledge about genetics, microbiology, chemistry, physiology, molecular biology, among others, were decisive for us to develop modern biotechnology as we know it.

In the botanic field, the first transgenic plants were adopted in the field in 1995 in the United States. In Brazil, the first seeds started to be cultivated in 1998.

Molecular discoveries resulted in a biotechnological revolution. Using recombinant DNA technology, it was possible to manipulate DNA for the first time. With this technique, the isolation and manipulation of genes became a reality in the health area with the production of human insulin in 1982.

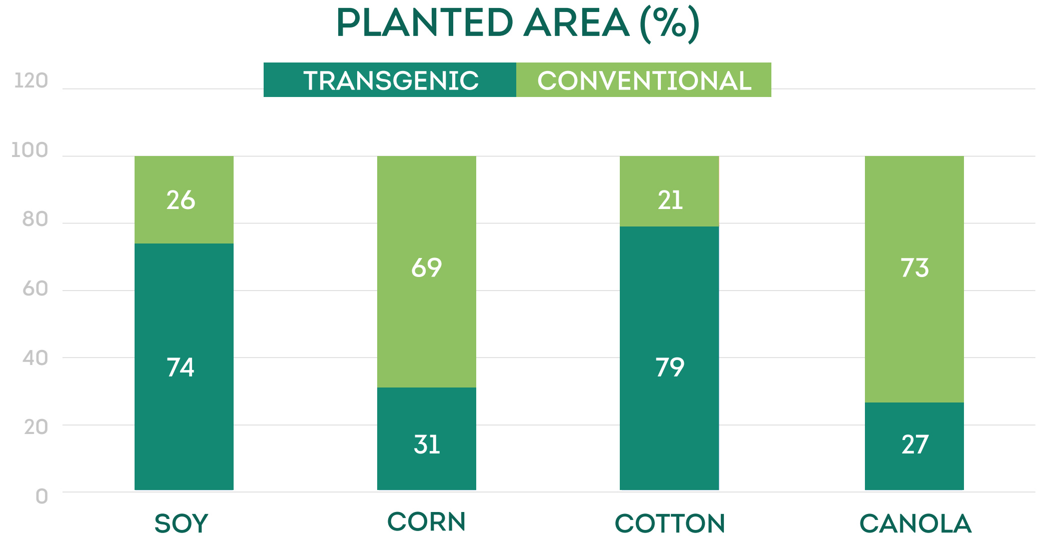
In the botanic field, the first transgenic plants were adopted in the field in 1995 in the United States. In Brazil, the first seeds started to be cultivated in 1998.

Present in crops worldwide for over 25 years, genetically modified plants have increased production, facilitated management, promoted economic and environmental benefits, optimized the use of crop protection products and allowed the development of disruptive technologies for the sector.

Present in crops worldwide for over 25 years, genetically modified plants have increased production, facilitated management, promoted economic and environmental benefits, optimized the use of crop protection products and allowed the development of disruptive technologies for the sector

BRAZIL IS THE SECOND LARGEST GMO PRODUCER IN THE WORLD

MOST ADOPTED TRANSGENIC CROPS WORLDWIDE



source: PG Economics, UK (junho 2020)

Since 1998, Brazil has adopted genetically modified organisms () in agriculture. Soybeans, corn, cotton, and sugarcane are the transgenic crops planted in the country.

The development of biotechnology in agriculture stands out as an important factor associated with the efficiency gain of Brazilian agricultural production in the last two decades.

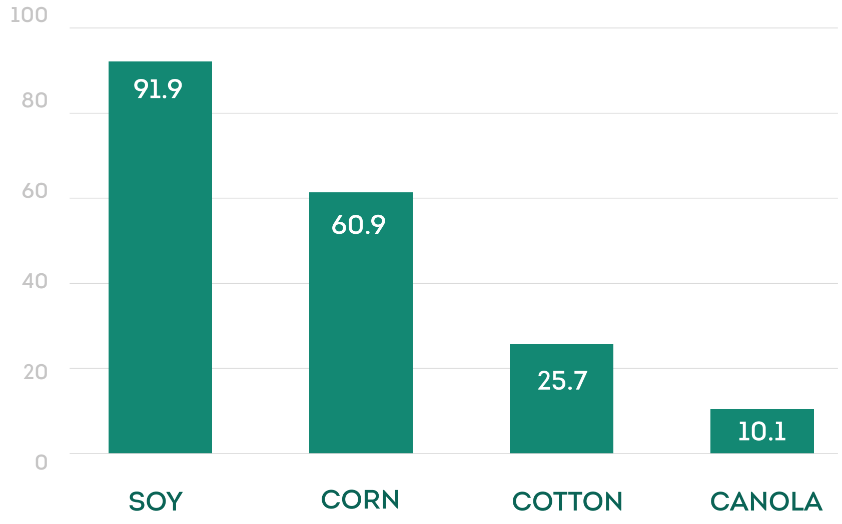
The development of biotechnology in agriculture stands out as an important factor associated with the efficiency gain of Brazilian agricultural production in the last two decades.

With 52.8 million hectares in 2019, Brazil has the second largest area of cultivation in the world. It accounts for 30.6% of the total area cultivated with in the world. It is only behind the United States, and is followed by Argentina, Canada, India, and China.

In 2019, 74% of soy crops in the world were transgenic, as well as 79% of cotton crops, 31% of corn crops and 27% of canola crops.

GMO CROPS PLANTED AREA

(million hectares)

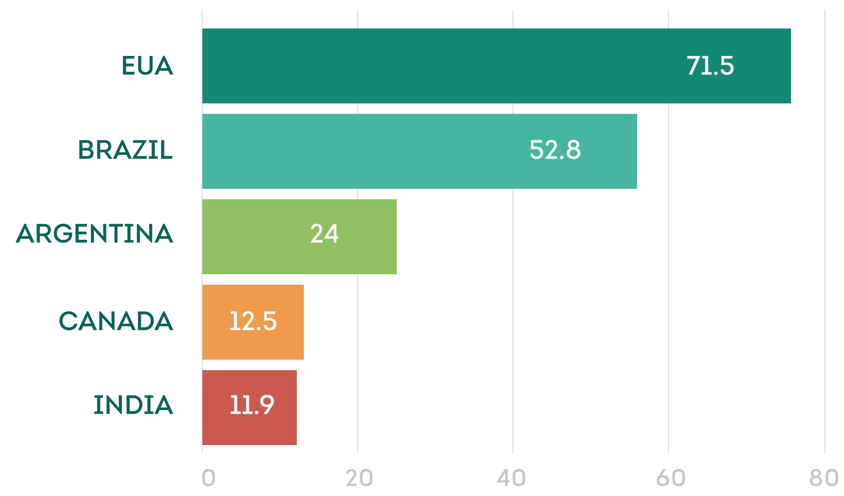


source: ISAAA (2019)

The use of higher-quality seeds and the development of biotechnology in agriculture stands out among the main factors that explain the efficiency gain of Brazilian agricultural production in the last two decades.

COUNTRIES WITH THE LARGEST AREAS OF GMO CULTIVATION IN THE WORLD

(million hectares)



source: ISAAA (2019)

OVER 20 YEARS OF GMO IN THE FIELD CONFIRM THE EXPECTED BENEFITS FOR BRAZIL

TOTAL GMO CULTIVATION AREA IN BRAZIL

58.2 million hectares

- SOY **35.1** million hectares
- CORN **16.3** million hectares
- COTTON **1.4** million hectares
- SUGARCANE **18** thousand hectares

source: ISAAA (2019)

Soy, with 35.1 million hectares, was the transgenic crop with the largest planted area in Brazil in 2019, followed by corn, with 16.3 million hectares; cotton, with 1.4 million hectares; and sugarcane, which started in 2018 with 400 hectares, had an area of 18 thousand hectares in 2019.

Considering only the characteristics of tolerance to herbicides and resistance to insects, GMO developed with the primary purpose of facilitating the management of crops and reducing costs, have already shown to be more productive and environment friendly, according to analyzes carried out by the English consultancy PG Economics.

Later, new characteristics were introduced by molecular biology techniques, resulting in drought-tolerant crops, with nutritional benefits and disease resistance.

ACCUMULATED IMPACTS OF GMO ADOPTION IN BRAZIL OVER 20 YEARS

ENVIRONMENTAL

Reduced use of crop protection products (thousand tons)	-839
Fuel economy (million liters)	-377
Planted area savings (million hectares)	-9.9
Reduced use of crop protection products (thousand tons of active ingredient)	-362.7
Reduction of total emissions (million tons of CO_2)	-26.5

source: 20 anos de Transgênicos no Brasil, Agroconsult (2018)

ECONOMIC

Increased grain production (million tons)	55.4
Increase in total revenue (billions of reais)	25.1
Increase in total profit (billions of reais)	35.8
Wealth generation (billions of reais)	45.3
Incremental contribution to GDP (billions of reais)	2.8

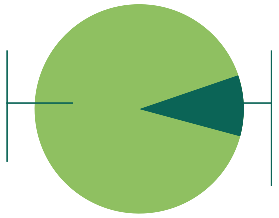
source: 20 anos de Transgênicos no Brasil, Agroconsult (2018)

AN ADOPTION OF BIOTECHNOLOGY IN THE WORLD GATHERS SOCIAL, ENVIRONMENTAL AND ECONOMIC BENEFITS

SOCIOECONOMIC BENEFITS OF TRANSGENIC CROPS

Benefits obtained from the global production between 1996 and 2018:

US$ **225** billions



US$ **18.95** billions only in 2018

Agricultural biotechnology allows the use of sustainable techniques that, in 2018, resulted in a reduction of carbon dioxide emissions into the atmosphere by:

which is equivalent to removing **15.5 million** cars in one year.

The factors that most clearly explain the success of biotechnology and its high rate of adoption worldwide and in Brazil are those observed directly on rural properties. Among them, the benefits arising from the efficiency of pest control in transgenic crops stand out.

BIOTECHNOLOGY HAS GENERATED AN INCREMENTAL PRODUCTION OF:

278 million tons of **SOY**

498 million tons of **CORN**

32.6 million tons of **COTTON**

Added to these factors are the simplification and greater the flexibility of crop management, reduced productive risk - here understood as greater security for the farmer throughout the crop cycle in relation to economic damage caused by pests – and reduced use of crop protection products. The combination of these elements can also provide advantages in terms of productivity and margin for the producer, with a potential positive impact on other sectors of the economy.

The impact analysis of the adoption of transgenics in crops around the world in the period from 1996 to 2018 revealed significant socio-environmental and economic benefits that justify their widespread adoption.

Twenty-tree million tons of carbon dioxide – CO_2 – stopped being issued only in 2018, equivalent to the volume produced by 15.5 million cars. 776 thousand tons of chemical crop protection products active ingredients were not used in the field, including insecticides and herbicides – an overall reduction of 8.6% for the period between 1996 and 2018. This corresponds to more than 1.6 times the total Chinese use of agricultural crop protection products per year.

Transgenics had an incremental production of 278 million tons of soy, 498 million tons of corn, 32.6 million tons of cotton, and 14 million tons of canola. The net income benefit for the world's agriculture, accumulated in the period from 1996 to 2018, was 225 billion dollars, an average increase of 96.7 dollars per cultivated hectare. In 2018 alone, this value was 18.95 billion dollars, which is equivalent to an average increase in income of 103 dollars per hectare.

Also in 2018, farmers had a greater financial return for every extra dollar invested in transgenic seeds, compared to conventional crops. In developing countries, this return averaged US$4.41 and, in developed countries, US$3.24.

The study by PG Economics concludes that, without GMO, it would be necessary to plant an additional 23.5 million hectares of soy, corn, and cotton, in order to maintain the production levels of these crops in 2018. Most of this area – 12.3 million hectares – would be used for soybeans.

For every **US$1** invested in agricultural biotechnology, producers receive:

US$ 4.41 in developing countries

US$ 3.24 in developed countries

776 thousand tons

chemical crop protection products active ingredients have NOT been used in the field, including insecticides and herbicides. An overall reduction of 8.6% between 1996 and 2018.

GMO FOODS ARE AMONG THE MOST ANALYZED AND SAFEST PRODUCTS

All GMO products must be analyzed for biosafety before being approved for use. In Brazil, the National Technical Biosafety Commission (CTNBio) is the body responsible for carrying out the analyses, in a case by case basis, of GMO, following the procedures established by the Biosafety Law (Law 11.105/05).

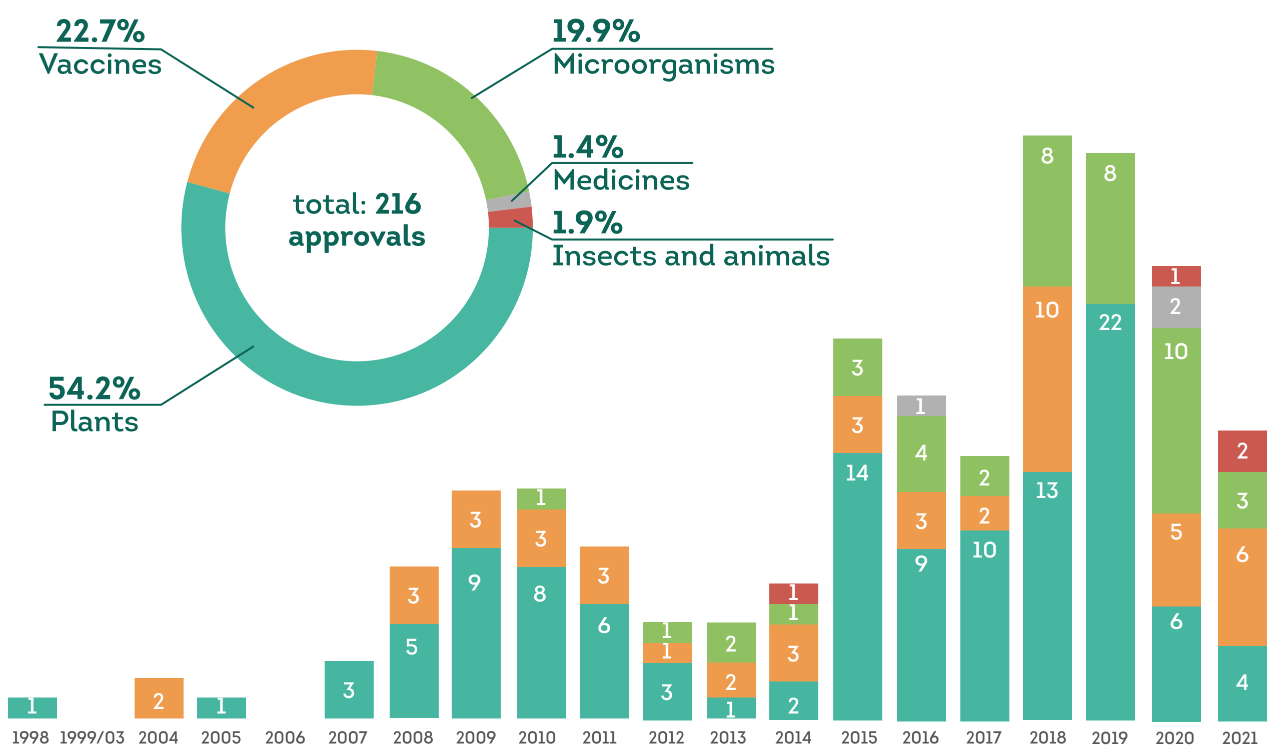
The Commission brings together 54 scientists, PhDs in various areas of knowledge, with the objective of providing technical advisory support to the federal government on issues related to GMO and derivatives.

The legislation also provides for the need for prior authorization, facilities registration and qualified professionals for research activities.

No institution can work with biotechnology in Brazil without the Certificate of Quality in Biosafety (CQB), which is also issued by CTNBio.

According to the regulations, each GMO must undergo a risk assessment before being marketed, which consists of studying the impact of genetic alteration on the plant, the environment and human and animal health. These assessments are submitted to CTNBio, which carries out the technical analysis of each product under development.

GMO APPROVED BY CTNBIO



source: CTNBio (2021)

The first authorization for the cultivation of GMO in Brazil was granted for glyphosate-tolerant GM soy, in October 1998. Since then, hundreds of genetically modified plants have been approved and released for planting on a commercial scale. Among the approved products, there are events (the genotype that has genes modified by molecular biology techniques) of soybeans, corn, cotton, beans, eucalyptus and sugarcane, with characteristics such as:

- **VIRUS RESISTANCE;**
- **TOLERANCE OR RESISTANCE TO DIFFERENT INSECTS;**
- **TOLERANCE OR RESISTANCE TO DIFFERENT HERBICIDES;**
- **DROUGHT TOLERANCE;**
- **INCREASED CELLULOSE PRODUCTION;**
- **IMPROVED OIL QUALITY.**

Although plants are the main biotechnology products submitted to CTNBio's assessment, several others have been analyzed and approved by it. Vaccines for animal and human use, cancer drugs, mosquitoes to control dengue and several microorganisms with application in industry, are just a few examples that illustrate the diversity of biosafety analyses conducted in Brazil.

Foods from GM crops that are currently on the market are as safe for human health as their counterparts from conventional crops.

THE HISTORY OF PLANT PROTECTION

OVER 4,000 YEARS AGO

Sumerian people added sulfur to their crops to eliminate pests.

MIDDLE AGES

Products such as arsenic, lead and mercury were used to control pests.

XVII CENTURY

Tobacco was used to combat pests and, to date, an infusion of rope tobacco is used to combat plant diseases.

1865

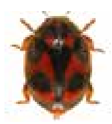
Paris Green, a mixture of arsenic and copper was discovered in Colorado (USA) for use in the control of the potato beetle.

1882

Discovery of the first fungicide known as Calda Bordalesa, a mixture of copper sulfate and lime, to control a disease called downy mildew in France.

1888

Beginning of biological control with the use of the insect *Rodolia cardinalis* in the USA.



1890

Powdered chemical product began to be used for seed treatment.

1938

First pesticides formulated using *Bacillus thurigiensis* (Bt) microorganism as an active ingredient in France.

1940

First synthetic pesticides used on a large scale in crops.

1945

DDT is made available to farmers, a compound developed in 1874 and widely used in World War II to kill malaria-carrying mosquitoes.

1950

50 new products (herbicides, insecticides and fungicides) available to rural products.

1960

50 new products (herbicides, insecticides and fungicides) available to rural products.

1961

The microorganism *Bacillus thurigiensis* (Bt) is registered as an insecticide in the US.

1970

Introduction to the Integrated Pest Management (IPM) principles, with greater attention to infestation monitoring and timing for the application of crop protection products.

1980

Start of research with GM plants.

1996

First Bt (insect resistant) corn is marketed in the USA.

2005

The first Bt plant (insect resistant) approved in Brazil is the cotton.

2006

Creation of the IAC Program for the Quality of Personal Protective Equipment in Agriculture.

2010

Increased investment and evaluations associated to the development and approvals of chemical crop protection products.

2014

Intensification in the use of Bt- and viruses-based biological products, such as *Nucleopolyhedrouirus* (HearNPV), to control the caterpillar *Helicouerpa armigera*, which arrived in Brazil in 2013.

LACK OF PROTECTION AGAINST PESTS AND DISEASES REDUCES FOOD PRODUCTION BY 20 TO 40%

Plant protection, using technologies that include crop protection products (chemical and biological), genetic improvement and biotechnology, play a crucial role in the success of Brazilian agricultural activity.

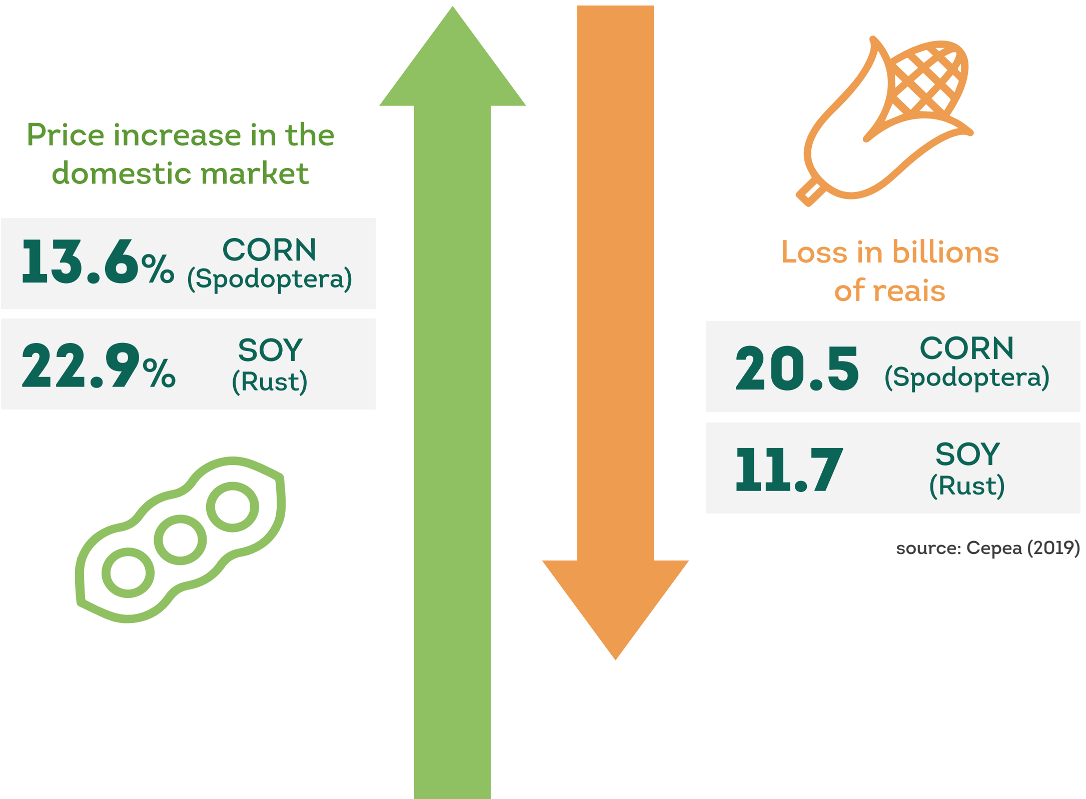
Plant protection acts by contributing so that the desirable characteristics present in the plant genetics and enhanced by other inputs are translated into production in the expected quantity and quality at the end of the plant's cycle.

Plant protection, using technologies that include crop protection products (chemical and biological), genetic improvement and biotechnology, play a crucial role in the success of Brazilian agricultural activity.

Data from the United Nations Food and Agriculture Organization (FAO) underscore this statement by revealing that the world loses 20 to 40% of all the food produced due to the attack of pests and diseases.

The Center for Advanced Studies in Applied Economics at the University of São Paulo (CEPEA/Esalq/USP) evaluated the impact of controlling pests and diseases in soy and corn on consumer prices. The lack of control can generate productivity losses of 6.6% to 40% in both crops, thus affecting the prices of the entire chain to the final product, which reaches the consumer's table.

EFFECTS OF THE LACK OF TREATMENT TO CONTROL PEST AND DISEASES IN SOYBEAN AND CORN



Regarding soybean rust, specifically, in order to assess the economic benefit of controlling the disease, CEPEA researchers simulated a condition in which producers would not use fungicides. Without the control of this disease, the compensation of the drop in productivity by the increase in the cultivated area would imply a 22.9% increase in the cost of soy in the domestic market.

Crop protection products go a long way before reaching the crops.

Thus, the economic result with soybeans planting would go from a profit of R$ 8.32 billion to a loss of R$ 3.37 billion for the national productive segment. Therefore, producers would incur a loss of R$ 11.7 billion.

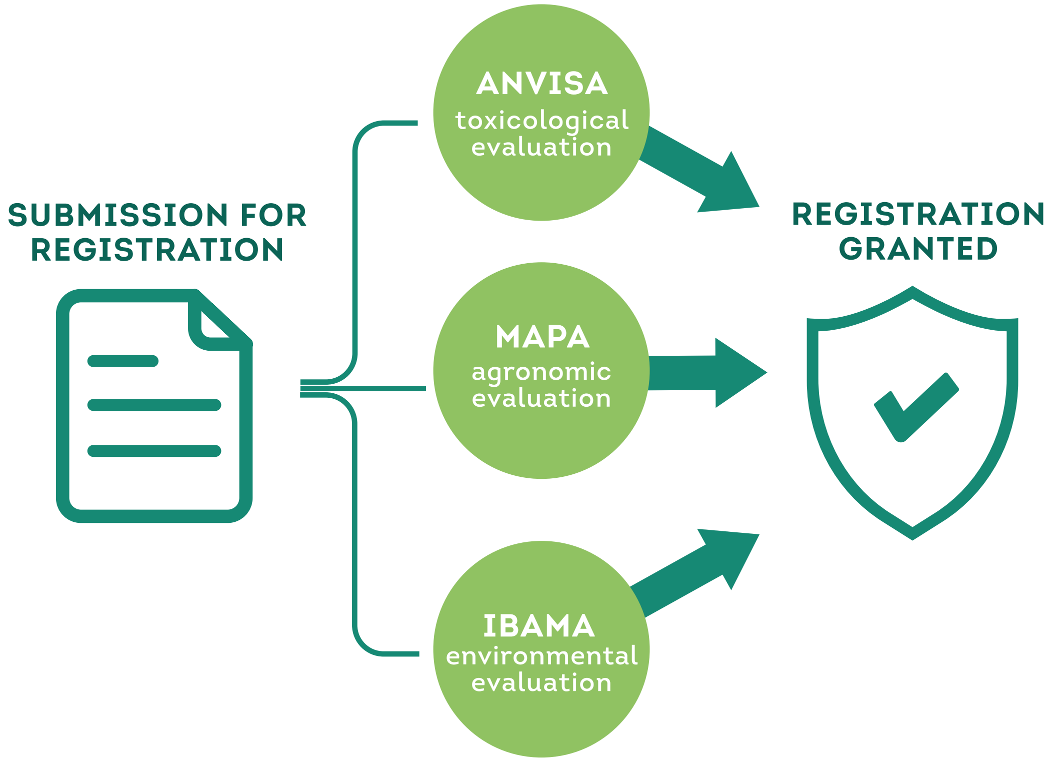
In the case of corn, not controlling the Spodoptera caterpillar would reduce national production by 40% in the first year of infestation with the pest and, the lower offer would consequently increase the prices by 13.6% on the national average. For the producer, the economic result with the planting of the crop would lead to a loss of R$ 20.5 billion.

BRAZILIAN REGULATORY SYSTEM GUARANTEES FOOD THAT IS SAFE TO HEALTH AND THE ENVIRONMENT

Crop protection products go a long way before reaching crops. Brazilian legislation is one of the most demanding in the world, with the need for approval in three different instances for pesticides to be granted registration: ANVISA, IBAMA and MAPA.

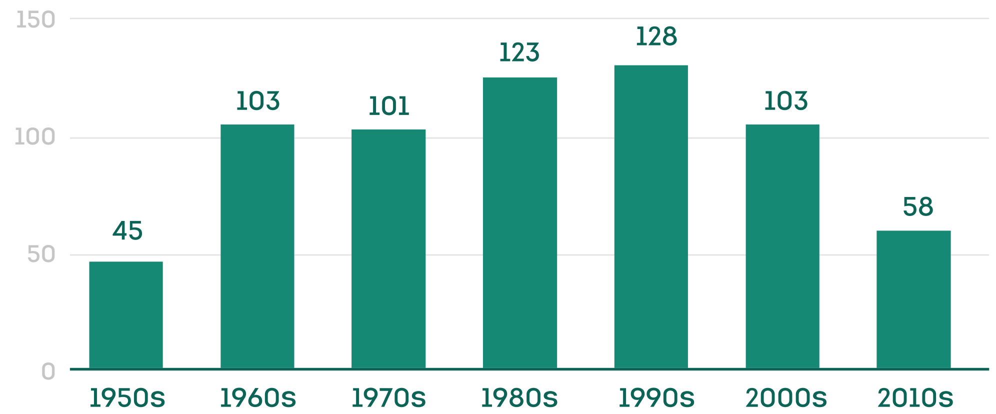
Each of these bodies analyzes a specific aspect of the products: ANVISA assesses issues associated with human health; IBAMA the aspects related to the environment; and the MAPA analyzes agronomic effectiveness and recommendations for use in the field. Only after these analyses, which follow international methodologies, the registration is granted for a product to be used in Brazil.

After this release, the products still undergo an analysis by each state so that they can finally be used by Brazilian farmers.



Worldwide, in the 1950s, 45 new active ingredients were made available for use in agriculture, such as herbicides, insecticides, and fungicides. In the 2010s, there was already an accumulated total of more than 600, the result of advances in science and investments in research and development.

NUMBER OF NEW ACTIVE INGREDIENTS INTRODUCED BY DECADE IN THE WORLD



source: Phillips MacDougall (2018)

In the 1960s, the focus of chemical products development was maximizing crops yield, by achieving the best control of weeds, pests and diseases possible. Since then, legal requirements to register crop protection products have been developed so that agronomic effectiveness is only one of many factors considered. Much greater attention has been paid to managing the risks to human health and the environmental impacts of these products.

In recent years, the regulation of these products has been intensified and has gained greater complexity, starting to require a large numbers of studies to demonstrate the hazard profile and risk assessment of active ingredients and formulated products. Typically, more than 150 studies are performed to register a new active ingredient, and the databases of most older active substances have been substantially updated with new studies, particularly to meet the requirements of the European Union, USA, and other members of the Organization for Economic Cooperation and Development (OECD).

In the plant protection area, there is a continuous search for products that are less and less toxic – both to humans and to the environment. Researchers work both for adapting existing products and developing new molecules, and products that are increasingly specific for certain pests and to serve a greater diversity of crops.

In the plant protection area, there is a continuous search for products that are less and less toxic – both to humans and to the environment.

For a new molecule with all the necessary qualities to be reached, around 160,000 substances are investigated.

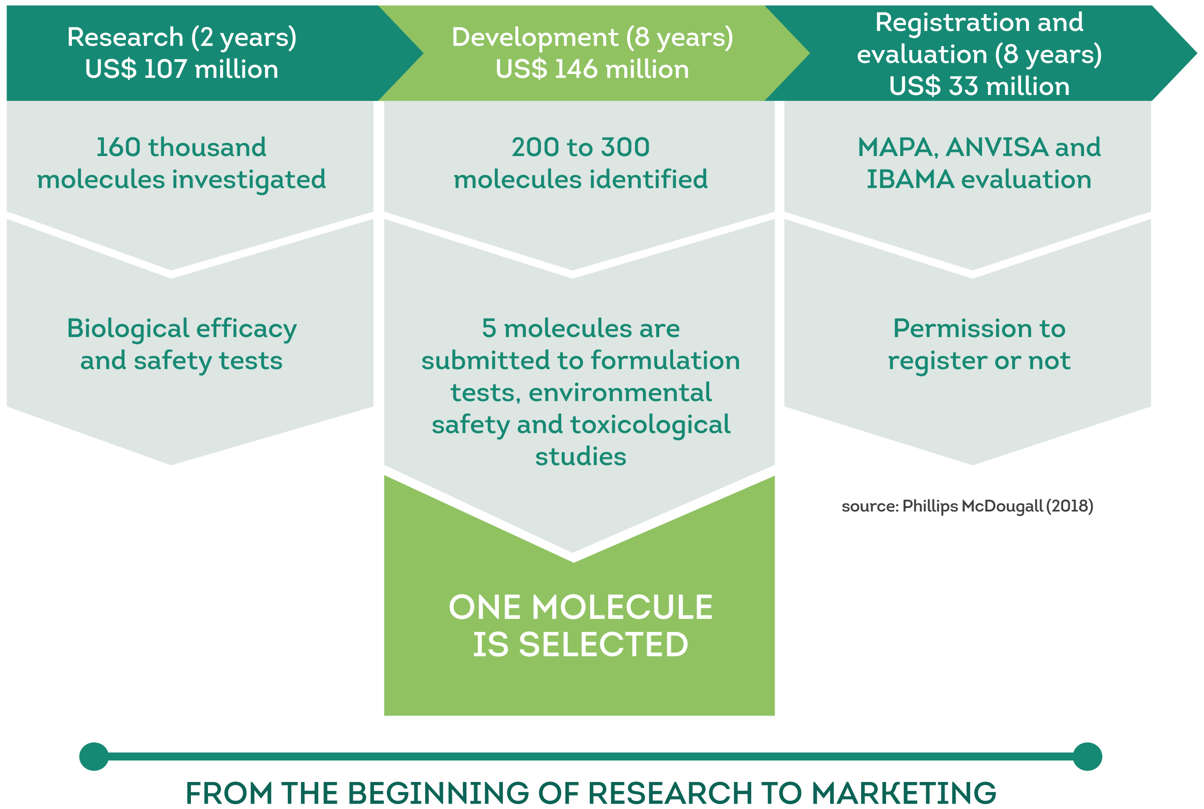
The development until approval of a new product or molecule can take up to 18 years in Brazil and requires an investment of approximately 286 million dollars.

In the 1950s, the average rate of fungicides, insecticides and herbicides application worldwide was 1,200, 1,700 and 2,300 grams of active ingredient per hectare, respectively. By 2010, those numbers had dropped to 100, 40 and 75 grams.

The improvement in the quality of products used for plant protection has resulted in their use in proportionately smaller quantities.

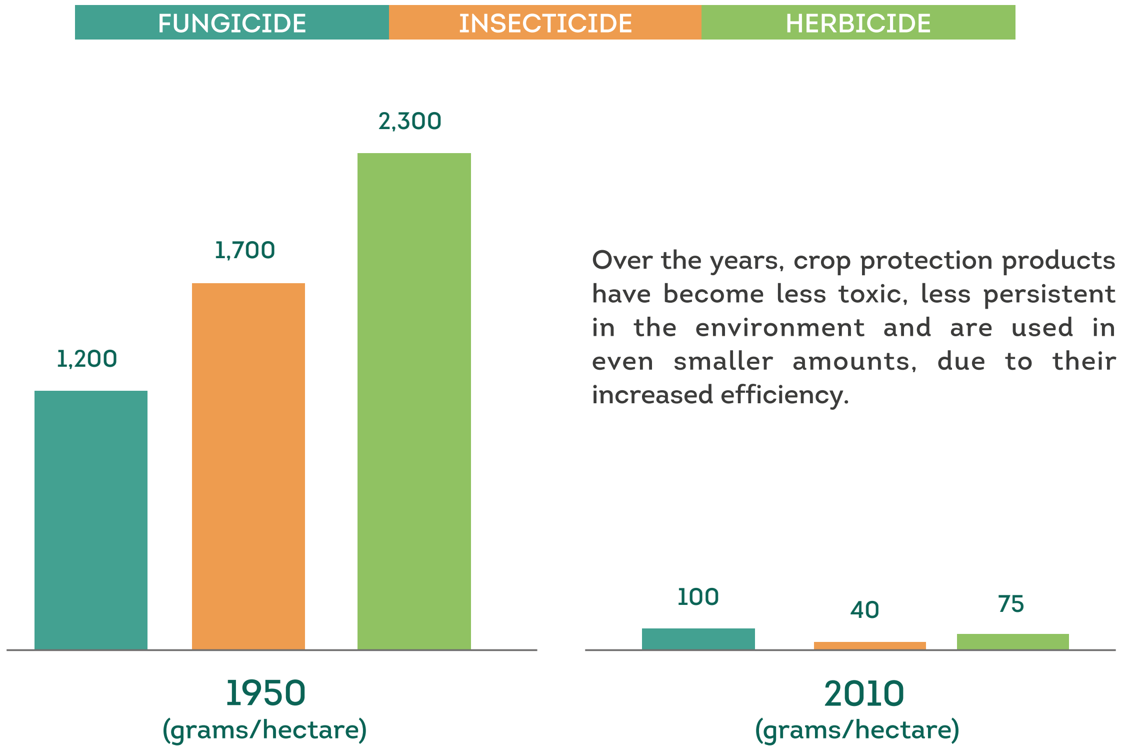
In the 1950s, the average rate of fungicides, insecticides and herbicides application worldwide was 1,200, 1,700 and 2,300 grams of active ingredient per hectare, respectively. By 2010, those numbers had dropped to 100, 40 and 75 grams.

RESEARCH AND DEVELOPMENT OF CHEMICAL CROP PROTECTION PRODUCTS



source: Phillips McDougall (2018)

CONSUMPTION OF CHEMICAL CROP PROTECTION PRODUCTS PER HECTARE



source: Phillips MacDougall (2018)

BRAZIL IS THE 25th CONSUMER OF CROP PROTECTION PODUCTS IN THE WORLD

The Brazilian consumption of crop protection products is directly associated with the agriculture dimensions and weather conditions.

Brazil is one of the largest agricultural producers in the world. In addition, it does not have a rigorous winter, which allows for more than one harvest in the same area, but prevents a break in the pest reproduction cycle due to cold.

Brazil is one of the largest agricultural producers in the world. In addition, it does not have a rigorous winter, which allows for more than one harvest in the same area, but prevents a break in the pest reproduction cycle due to cold.

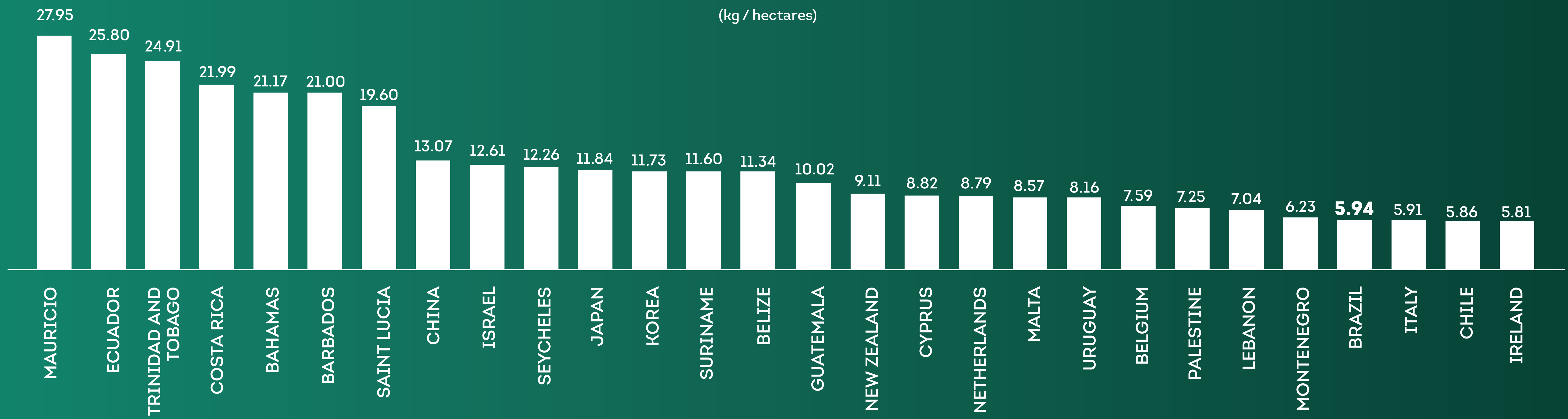
Considering the total volume of crop protection products, Brazil ranked third as a crop protection products consumer in 2018, behind China and The United States.

However, when examining the consumption of crop protection products per hectare, Brazil drops to 25th place.

Among the countries that consume more than or are at the same level of consumption as Brazil, six are in the European Union, a region known to be strict in the regulation of crop protection products: Cyprus, Netherlands, Malta, Belgium, Italy and Ireland.

CONSUMPTION OF CROP PROTECTION PRODUCTS PER HECTARE

(kg / hectares)



source: FAO (2018)

BRAZIL EXPORTS FOOD TO OVER 160 COUNTRIES WITH STRICT WASTE CONTROL

BRAZILIAN MONITORING OF PESTICIDE RESIDUES IN FOOD IS BROADER THAN IN EUROPE

	Brazil	UE countries**
Samples	4616	389
Food	14	10
Active ingredients	270	169
Non-compliance	41 Samples (0.89%)	4 Samples (0.90%)

*Program for Analysis of Pesticide Residues in Food - PARA (ANVISA) 2019 results (samples collected 2017/2018)
**European Control Program - 2019 (samples collected 2017/2018)

In order to ensure the free trade of food that is safe for both those who produce and those who consume it, countries need to adopt good agricultural practices.

Scientific knowledge in the control of diseases and pests in crops has advanced significantly in the last 20 years, which has driven the review of criteria and requirements within the scope of toxicological, environmental and agronomic efficacy assessment of crop protection products.

In Brazil, the responsibility for supervising the use of pesticides is shared between the Union and the States. MAPA has a program for the analysis of pesticides residues (National Plan for the Control of Residues and Contaminants in Products of Vegetal Origin - PNCRC) that collects food samples directly from rural properties.

The Program for Analysis of Pesticide Residues in Food - PARA - coordinated by ANVISA, analyzes fresh food samples collected at sale points.

These programs, together with those implemented by the states, are able to identify those who fail to follow the rules. The offending farmer can be identified, guided, and even punished.

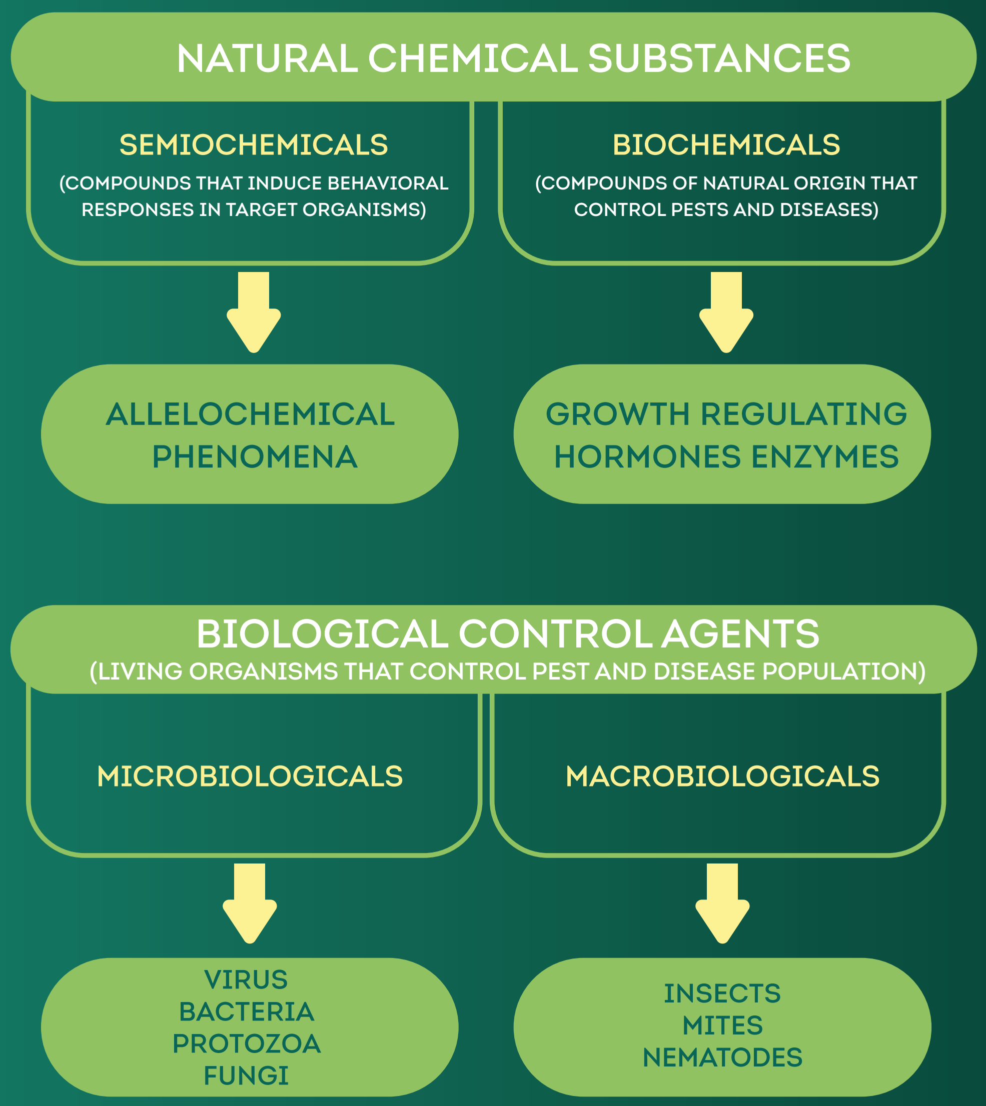
In the 2017-2018 biennium, PARA analyzed 4,616 samples and identified that 99% of the samples were compliant, i.e., they did not present pesticide residues levels that could pose a health risk.

Especially due to its leading role and competitive capacity as a food exporter to over 160 countries, Brazil has been seeking to keep up with scientific advances and the evolution of regulatory frameworks in countries that already have laws that are adequate to the needs of modern agriculture and the consumer's expectations. As is the case in the United States, Canada, Australia and the European Union.

THE NUMBER OF BIOLOGICAL CROP PROTECTION PRODUCTS REGISTERED IN THE LAST 20 YEARS IN BRAZIL IS GREATER THAN THE NUMBER OF CHEMICAL PRODUCTS

In recent times, there has been significant growth in the interest in the development of biological products for crop protection. The enthusiasm is not limited to big crop protection companies, but it is also observed among small companies and startups.

CLASSIFICATION OF BIOLOGICAL CONTROL PRODUCTS



source: MAPA e Croplife Brasil (2020)

In view of the integrated pest management (IPM), a greater diversity of pesticides for crop protection is essential. This fact significantly contributes to the intensification of the development of biological control products.

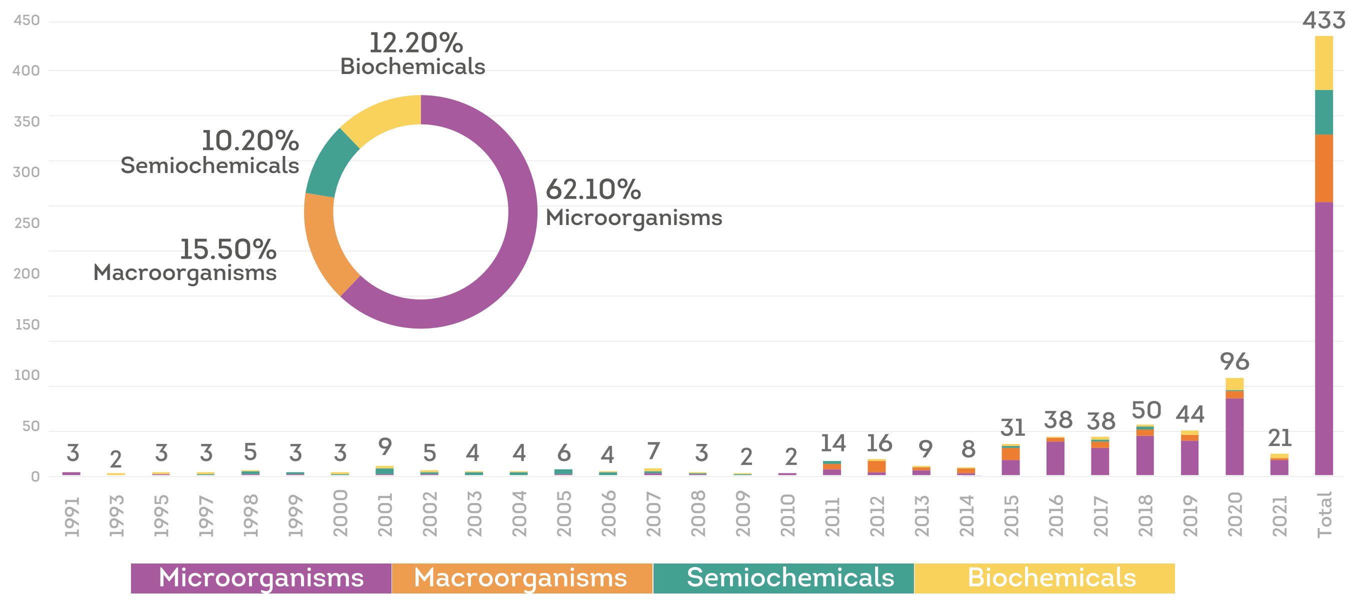
Between the 1960s and 1980s, there were very few launches of new biological crop protection products. The situation began to change in the 1990s. In the last 20 years, the number of new biological products registered has surpassed the number of chemical products registered in the period.

An additional stimulus to the adoption of biological products in the field came with the launch of the National Bioinputs Program, in 2020. The Program aims to encourage research, production and adoption of biological products, such as fertilizers and pesticides. The program is not aimed at organic agriculture, but at all farmers in the country in the most diverse production models.

For a biological product to be registered in Brazil, it has to follow the same path as chemical products: the assessment is carried out by three independent bodies – ANVISA, for health risks; IBAMA, for environmental risks; and MAPA, for agronomic efficiency. The product is only registered if it is approved by the three bodies.

In 2020, 96 new biological products were registered in Brazil, an annual record. A consolidated table from May 2021 showed a total of 433 registration granted since 1991.

BIOLOGICAL PRODUCTS APPROVED IN BRAZIL SINCE 1991



source: MAPA (2021)

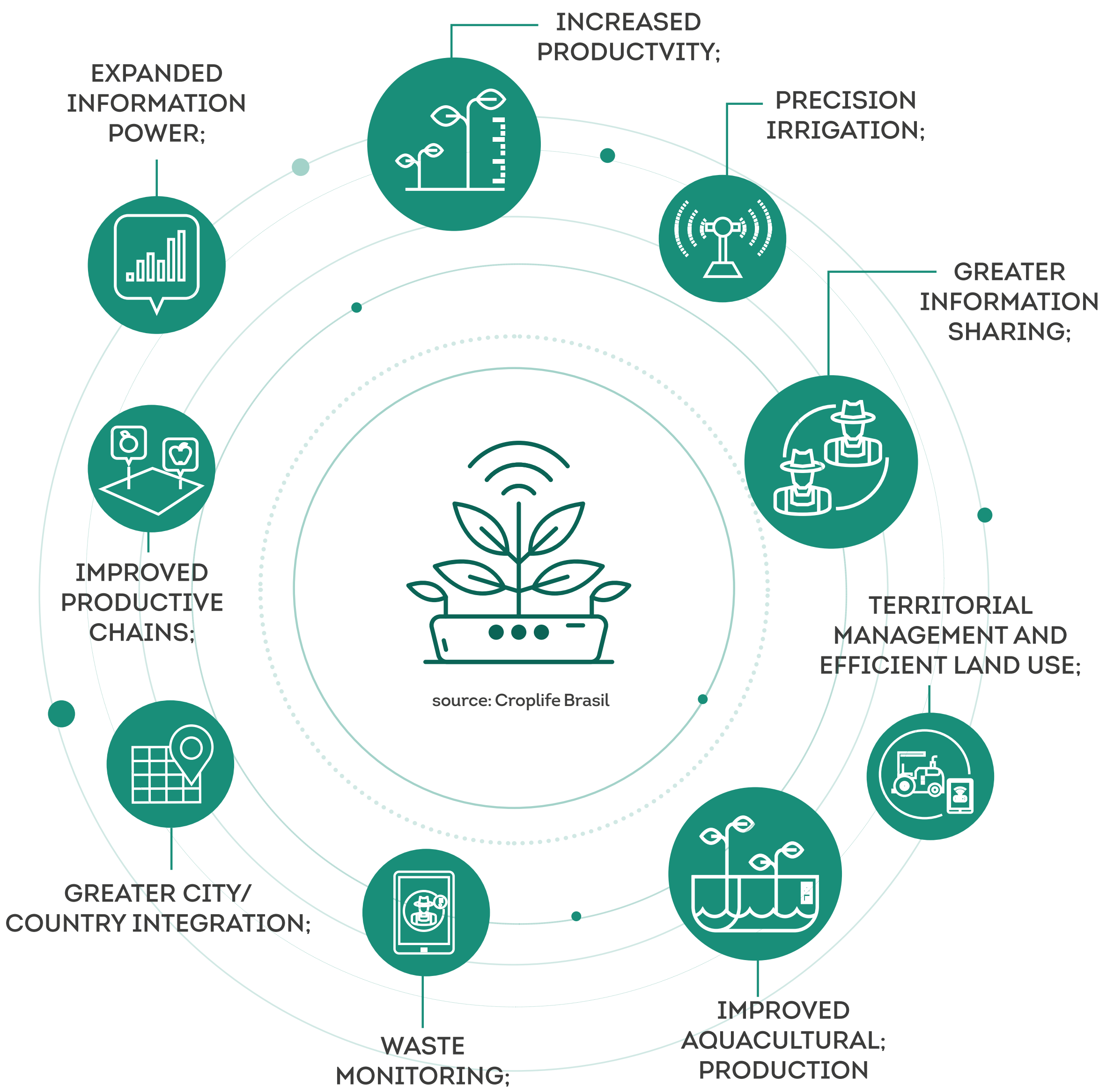
DIGITAL AGRICULTURE SAVES INPUTS AND NATURAL RESOURCES

In recent decades, information technology has opened up a great field of innovation for many activities, and agriculture has not been left out of this evolution.

With detailed and real-time data on the soil, seeds, crops and crop development, today's farmer has the opportunity to monitor his activity with an accuracy that would have been unthinkable in previous generations.

This makes it possible to rationalize the use of inputs, which brings two very important advantages: the reduction in farming costs and environment conservation. Brazilian agriculture has already entered the digital age.

The possibilities created in the digital age are huge and are constantly growing. Among others, it is possible to highlight the main technologies in use in Brazil:



INTERNET OF THINGS (IoT):
The internet is increasingly about things, not just people.
Machines, animals, plants and vehicles are connected to it so that they can be activated through remote commands based on the information received;

MONITORING SENSORS:
(plugged into machines, equipment and ground);

ARTIFICIAL INTELLIGENCE:
machines are capable of learning and making decisions;

SELF-DRIVING VEHICLES:
tractors, robots and drones that do not require human driving;

BIG DATA BY INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT):
data storage in large quantities;

CLOUD COMPUTING AND BLOCKCHAIN DATA PROTECTION:
Connectivity between mobile devices;

INTELLIGENT IRRIGATION SYSTEM: the water is applied into the soil according to the plant's water requirement. Applications and software determine the amount of water to be applied through data collected by sensors;

EMBEDDED SYSTEMS FOR TRACTORS, HARVESTERS AND SPRAYERS:
technologies embedded in agricultural machines, such as GPS and spraying controllers, which facilitate and optimize the rural producer's work. With embedded technology, the rural producer can make electronic control from planting to harvesting.

SINCE 2017, THE USE OF DRONES IN BRAZIL HAS BEEN REGULATED BY THREE GOVERNMENT BODIES:

The National Telecommunications Agency (Agência Nacional de Telecomunicações - Anatel) is responsible for recording the radio frequencies used by the drone and its remote controls. The goal is to avoid conflicts between frequencies.

The National Civil Aviation Agency (Agência Nacional de Aviação Civil - ANAC) regulates the devices. Those weighing up to 250 grams, generally used for recreation, do not need to be registered, but are subject to rules that limit their use. From there, drones fall into 3 categories: up to 25 kg, up to 150 kg and more than 150 kg. Each category has specific permissions and requirements.

The Department of Airspace Control (Departamento de Controle do Espaço Aéreo - Decea) is responsible for the traffic of all vehicles in Brazilian airspace, including unmanned vehicles, in the case of drones. It monitors compliance with the rules they must obey, according to their category, and imposes fines in case of non-compliance.

AGRICULTURE

SOCIAL AND ENVIRONMENTAL IMPACTS

66% OF BRAZILIAN TERRITORY IS OCCUPIED BY NATIVE VEGETATION

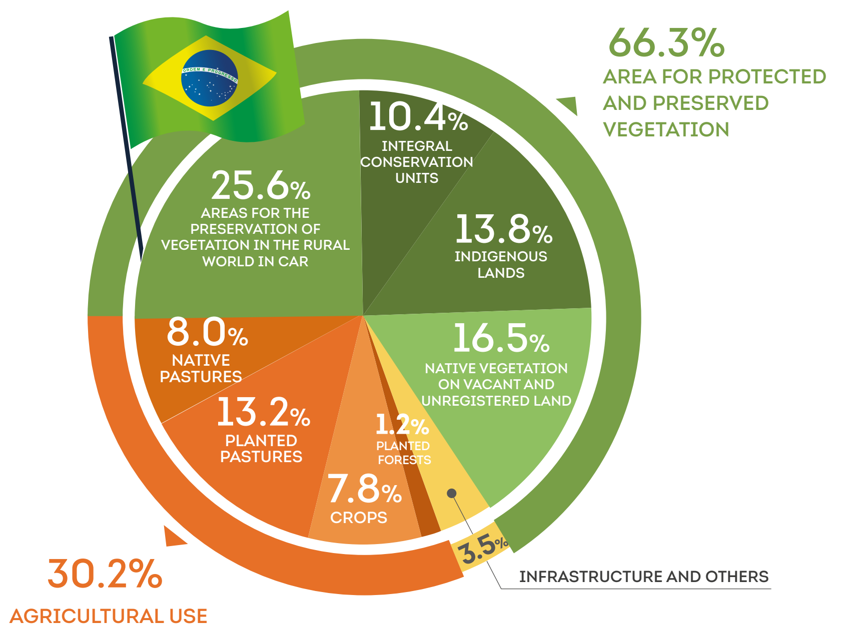
Brazil has used the most modern technologies together with conservation practices and diversification techniques, such as integration systems that involve farming, livestock, and forestry, thus resulting in a high capacity to increase production without opening new areas of native vegetation.

According to Embrapa, 66.3% of the country's total area remains native. Despite all the expansion of the last 50 years, agriculture does not exceed 7.8% of the Brazilian territory. Pastures account for 21.2% and planted forests occupy 1.2%.

Despite all the expansion of the last 50 years, agriculture does not exceed 7.8% of the Brazilian territory. Pastures account for 21.2% and planted forests occupy 1.2%.

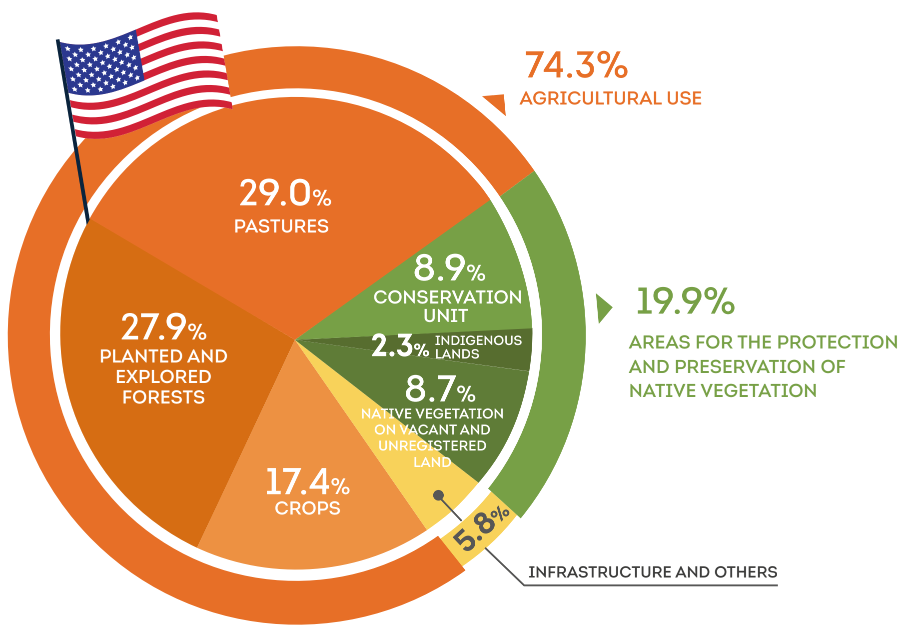
The total area dedicated to all agricultural activities represents 30.2% of the Brazilian territory and the native vegetation preservation area occupies 66.3%. Given this distribution and the observations on the existence of large extensions of degraded pastures, specialists claim that the incorporation of new areas for grain production in the coming years may occur on degraded areas, with the use of technologies and conservation practices, avoiding the incorporation of native areas.

LAND USE IN BRAZIL



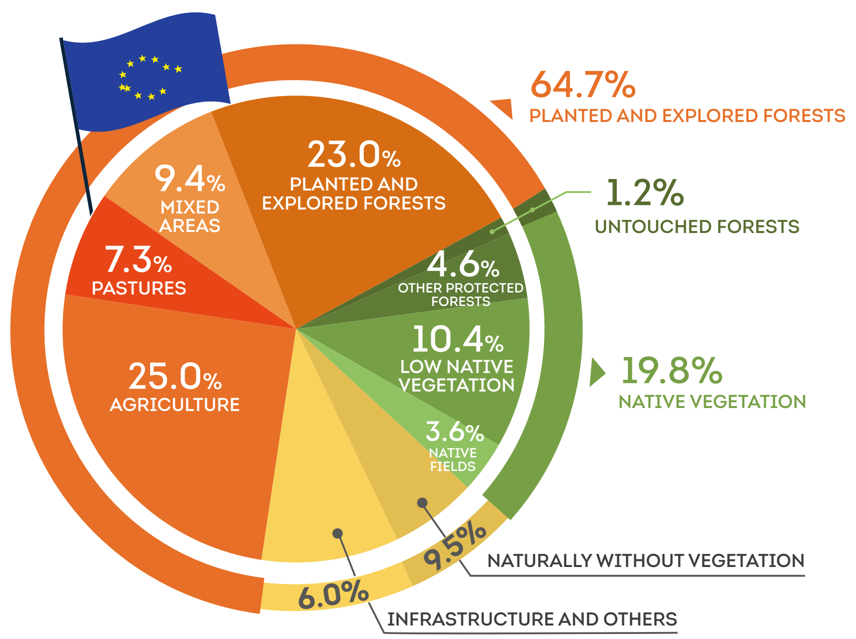
source: EMBRAPA (2018)

LAND USE IN THE USA



source: EMBRAPA (2018)

LAND USE IN EUROPE



source: EMBRAPA (2018)

The extension of the preserved native vegetation area in Brazil corresponds to that of 43 countries and 5 territories in Europe. The area of native vegetation protected by farmers on their properties is also expressive. Its extension corresponds to the area of 10 countries in Europe.

While Brazil dedicates 30.2% of its area to agriculture and forestry exploitation, the United States uses 74.3% and the European Union 64.7%.

While Brazil dedicates 30.2% of its area to agriculture and forestry exploitation, the United States uses 74.3% and the European Union 64.7%.

In both cases, the percentages are more than twice the Brazilian percentage. On the other hand, while Brazil dedicates 66.3% of its territory to the nature protection, this index falls to 19.9% in the United States and 17.9% in the European Union.

Land use in Brazil	Area (millions of ha)	% of Area
Native vegetation on private properties	218.25	25.6
Native vegetation on vacant properties	139.72	16.5
Indigenous land	117.34	13.8
Planted plasture	112.24	13.2
Integral conservation unit	88.43	10.4
Native pastures	68.02	8.0
Agriculture	66.32	7.8
Infrastructure and others	29.76	3.5
Planted forests	10.20	1.2

source: Embrapa Territorial (2018)

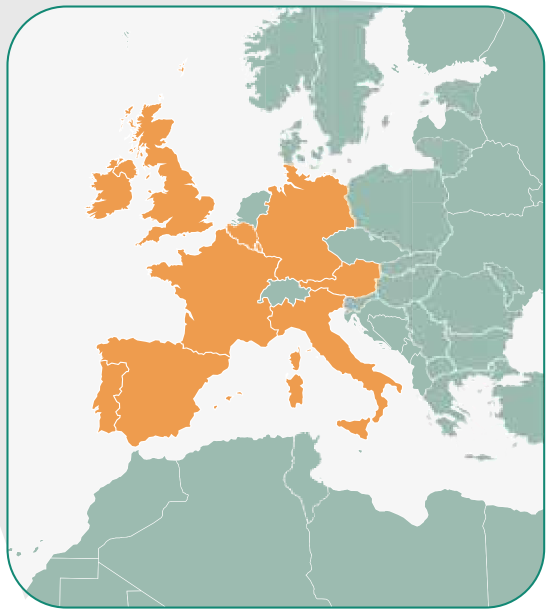
The extension of the preserved native vegetation area in Brazil corresponds to

43 COUNTRIES

AND 5 TERRITORIES OF EUROPE

The area of native vegetation protected by farmers on their properties corresponds to

10 EUROPEAN COUNTRIES



THE EUROPEAN LAND USE IS VERY DISTINCT FROM THE BRAZILIAN ONE

Since the European Union is located in a territory that has been intensively explored for longer than the Americas, and due to its greater demographic density, it has land use characteristics that distinguish it from Brazil and the United States. The level of human interference is such that the Region's environmental agency, when presenting data from its Monitoring Service - Cornelius -, does not disclose accurate numbers on native vegetation preservation. Whenever referring to forests, native fields and areas covered by shrubs, it is observed that the vegetation there can be of natural or planted origin. Regarding forest area, planted forests are not distinguished from native forests either. Two estimates used by the European Parliament in public policy debates, shed a little more light on the situation of native vegetation in the Region. One is that only 4% of forests remain untouched. The other estimate is that 80% of the forests in the European Union are commercially exploited.

Two estimates used by the European Parliament in public policy debates, shed a little more light on the situation of native vegetation in the Region. One is that only 4% of forests remain untouched. The other estimate is that 80% of the forests in the European Union are commercially exploited.

However, the data do not indicate that native vegetation is being cleared. On the contrary, forests are currently expanding in the European Union and the use of sustainable management techniques in their exploration has ensured their survival.

The fact that there is little untouched native vegetation does not diminish Europeans' efforts to protect as much of what they have left as possible. According to the latest report from Natura 2000, the European Union's flora and fauna preservation network, the Region has 27,852 terrestrial and marine protected areas. Of quite different sizes, the smallest land area is just 100 m^2 and is located in Germany; and the largest one is in Sweden, with 5,547 km^2.

Natura 2000 protects 20% of the European Union's forest area, five times more than the area covered by untouched forests.

Most of the area protected by the network – 60% – is composed, in addition to forests, by native grasslands and transition areas which, despite human intervention, still have a good part of their original coverage. Another important point is that there are protected areas, in small native fragments, even in regions that are intended for agricultural exploitation.

ILLEGAL DEFORESTATION IS NOT A RULE IN BRAZIL

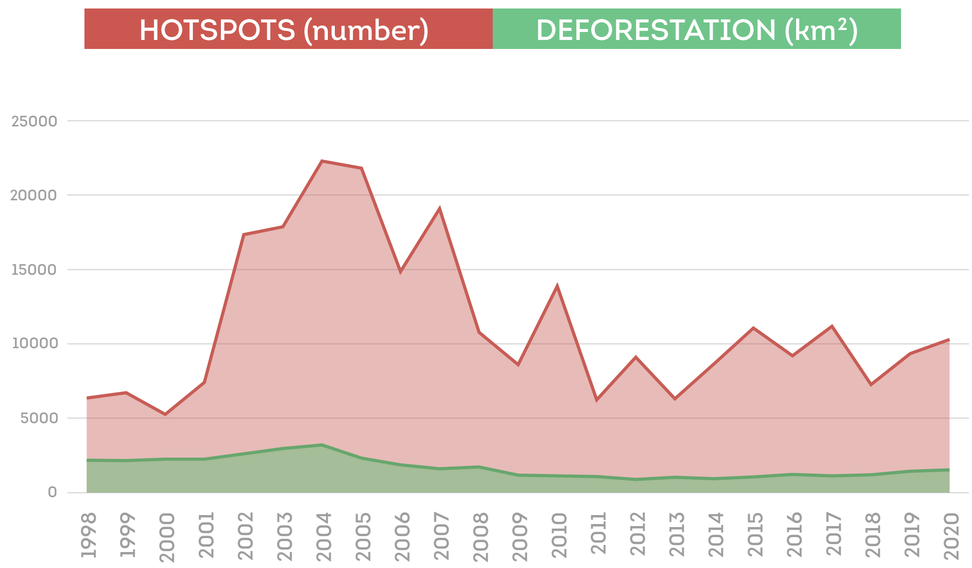
Deforestation is considered illegal when it occurs in areas that do not have authorization from the environmental agency to suppress native vegetation.

When deforestation is authorized by the environmental agency, based on studies that prove its compliance with forest legislation, it is not considered illegal. In addition, several important criteria for transparency in the processes of native vegetation suppression are observed, such as: identification of applicants, format, date of issue, validity and area.

Commonly, the terms deforestation and fires in the field are erroneously associated. Although fires and deforestation are closely related phenomena, they cannot be confused.
Each one has its own dynamics. When taking into account that many hotspots come from traditional fires, carried out in cultivated areas or pastures, it is clear that they are not related to deforestation. They occur in regions that have already been deforested, possibly centuries ago. On the other hand, the unsustainable and criminal exploitation of wood from native species, which is a serious problem in the Amazon, devastates the forest without using fire, at least initially. When the fire comes, if any, the area is already deforested.

Data from the National Institute for Space Research (INPE) show how the evolution of fires was different from deforestation in the Amazon between 1998 and 2018. The fire line is visibly more unstable than the deforestation line.

AMAZON FIRE X DEFORESTATION

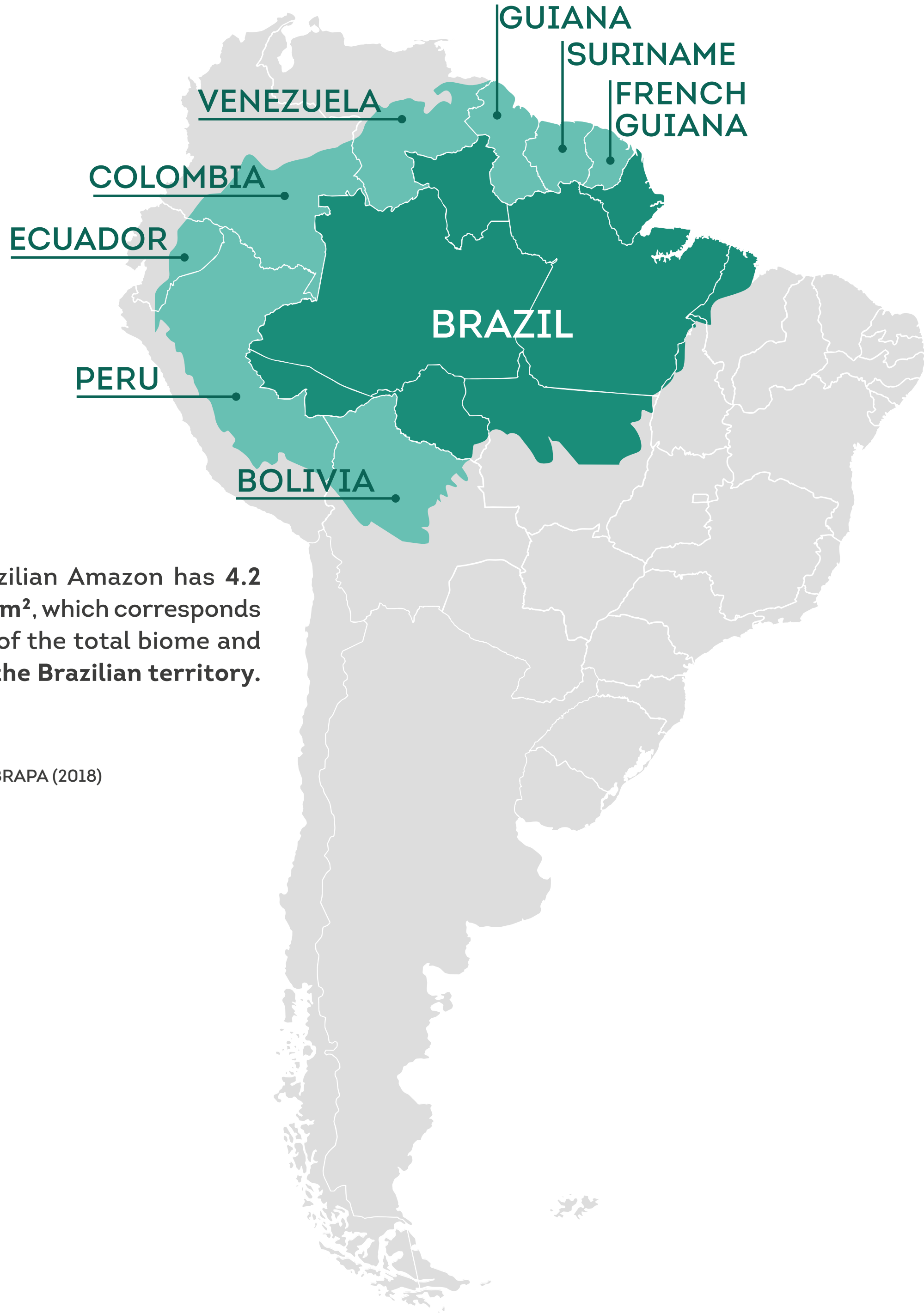


source: INPE (2020)

When it comes to deforestation, two biomes require special attention in Brazil: the Cerrado, where most of the agricultural growth in recent decades has taken place; and the Amazon, given the importance of its forest for the balance of the global environment.

49% OF THE BRAZILIAN AMAZON IS PRESERVED BY LAW

Before approaching deforestation in the Amazon, it should be noted that the Amazon is part of a biome that is not exclusively Brazilian. The biome is shared by nine countries, one of which is a European country, France, of which French Guiana is a part.

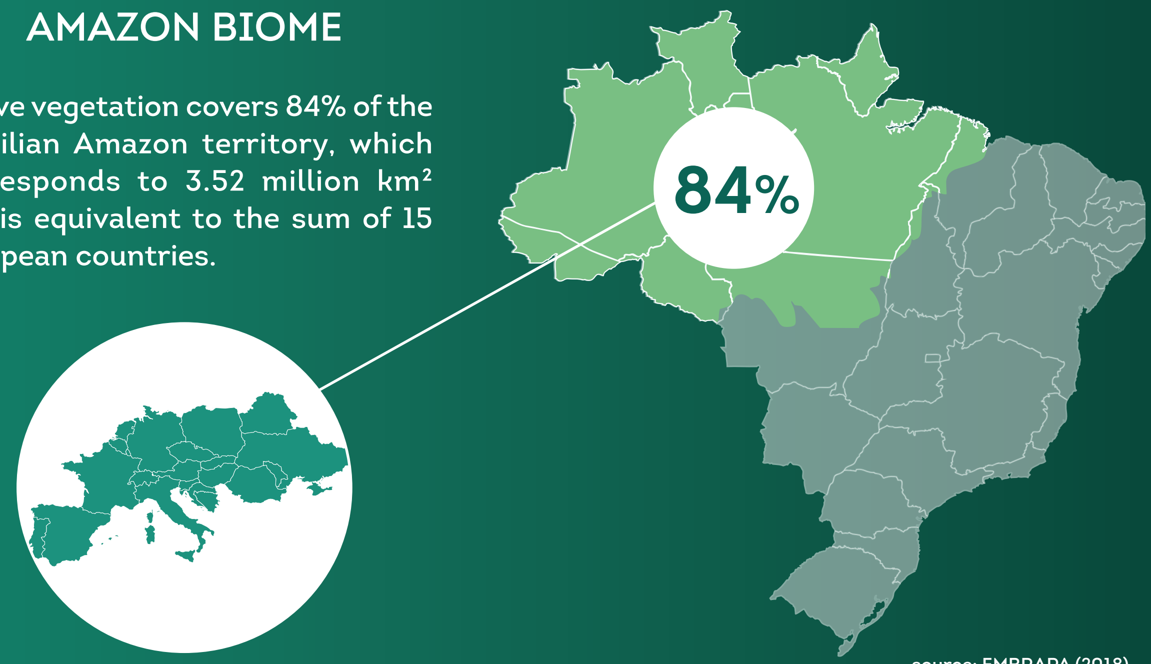


The Brazilian Amazon has **4.2 million km²**, which corresponds to **60%** of the total biome and **49% of the Brazilian territory.**

source: EMBRAPA (2018)

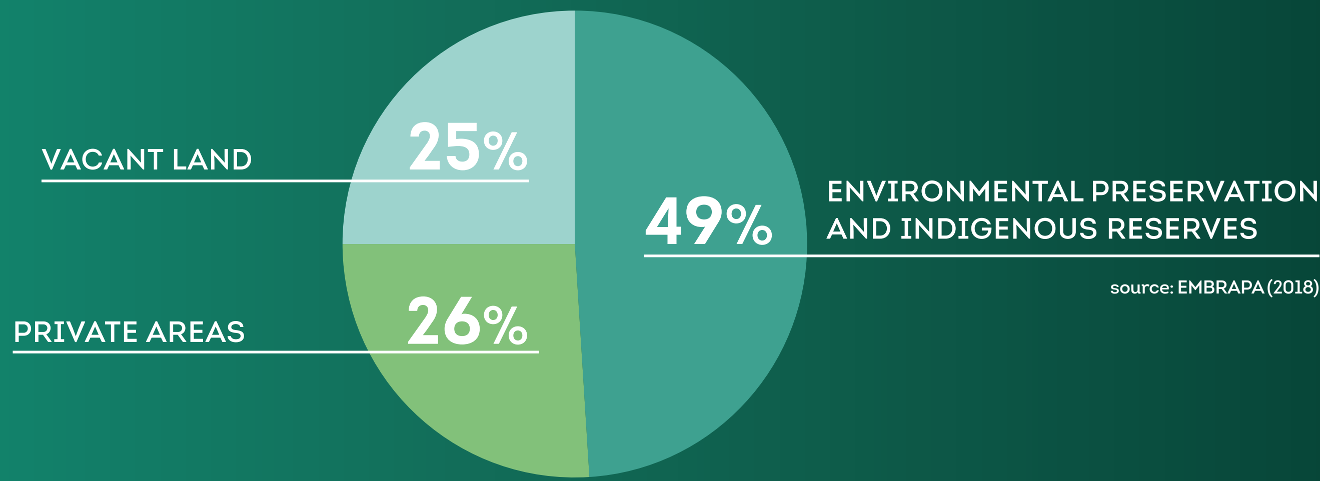
AMAZON BIOME

Native vegetation covers 84% of the Brazilian Amazon territory, which corresponds to 3.52 million km² and is equivalent to the sum of 15 European countries.



source: EMBRAPA (2018)

Almost half (49%) of the Brazilian Amazon area covered by native vegetation corresponds to environmental preservation units and indigenous reserves. It is a law-protected territory. Private owners own 26% of the area and the other 25% are vacant land.



source: EMBRAPA (2018)

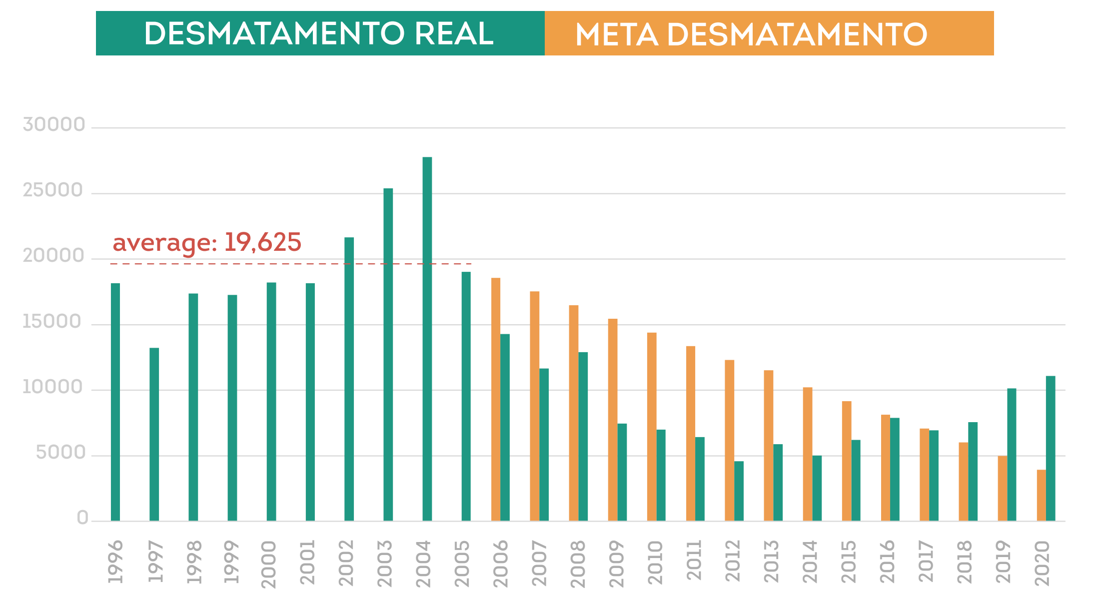
Since 2005, Brazil has established goals for the progressive reduction of deforestation in the Amazon and Cerrado. The Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm), which was launched in 2004 and elaborated within the scope of the Permanent Interministerial Working Group (GPTI), and is currently in its fourth phase, set a target for 2020 that the deforestation area was no greater than 20% of the average for the period 1996 to 2005. As it was 19,625 km² per year, the target Amazon deforestation in 2020 would correspond to a maximum of 3,925 km².

The plan cannot be considered fully successful, since there are signs that deforestation numbers in the Amazon in 2020 have been greater than expected. However, by 2017, the pattern of behavior was more favorable, when the target annual deforestation was 7,073 km², higher than the actual deforestation rate, which was 6,947 km². The problem started in 2018, when the target deforestation was 6,027 km² and the actual deforestation was 7,563 km². And the situation worsened in 2019, when the target of 4,981 km² was not even half of what was actually seen: effective deforestation of 10,129 km².

Even though the goal has not been reached since 2018, it is necessary to recognize the positive effect of the PPCDAm. Just compare the average annual deforestation rate in the Amazon over the last 20 years, which was 12,208 km², with that of the last 10 years: which is 6,763 km².

Even though the goal has not been reached since 2018, it is necessary to recognize the positive effect of the PPCDAm. Just compare the average annual deforestation rate in the Amazon over the last 20 years, which was 12,208 km², with that of the last 10 years: which is 6,763 km².

AMAZON DEFORESTATION (km²)



fonte: MMA com dados do sistema PRODES; INPE (2020)

The reduction in Amazon deforestation has received an invaluable contribution from two Brazilian agribusiness organizations: the Brazilian Association of Vegetable Oil Industries (Associação Brasileira das Indústrias de Óleos Vegetais - Abiove) and National Association of Grain Exporters (Associação Nacional dos Exportadores de Cereais - Anec).

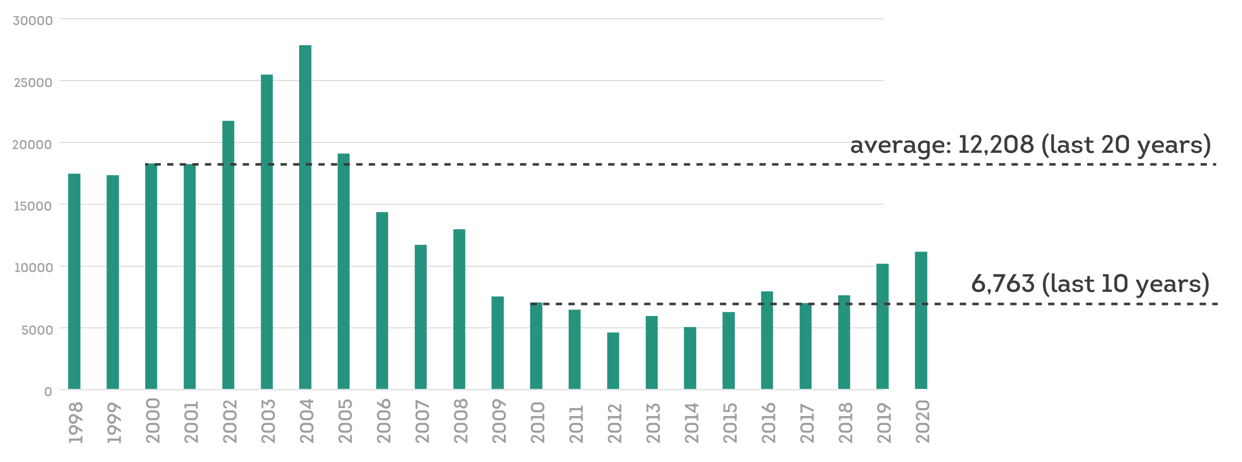
In 2006, the two entities declared a Soy Moratorium in the Amazon biome. This is a commitment of the companies associated with them not to purchase soy from new areas of deforestation in the biome.

The balance of the 2018/2019 harvest showed that only 1.8% of the soy planted in the Amazon was found in areas deforested after the declaration of the moratorium.

The monitoring of compliance with the moratorium is carried out systematically, via satellite, in the group of Amazonian municipalities that concentrate the largest production area. The list is updated on an ongoing basis. In the 2018/2019 harvest, the monitored municipalities accounted for 98% of the soy cultivation area in the biome. The 2% of unmonitored areas were spread over 77 municipalities.

The initiative's good results are evident. The balance of the 2018/2019 harvest showed that only 1.8% of the soy planted in the Amazon was found in areas deforested after the declaration of the moratorium. There are 88,234 hectares. The other 98.2% were cultivated in areas that had been previously deforested, mainly for the opening of pastures.

AMAZON DEFORESTATION (km²)



source: MMA com dados do sistema PRODES (2020)

52.5% OF THE CERRADO BIOME IS COVERED BY NATIVE VEGETATION

The goal established by the Action Plan for the Prevention and Control of Deforestation in the Cerrado (PPCerrado) adopted as a starting point the estimate that the average deforestation in the biome between 1999 and 2008 was 15,700 km². In fact, it was higher, according to INPE data.

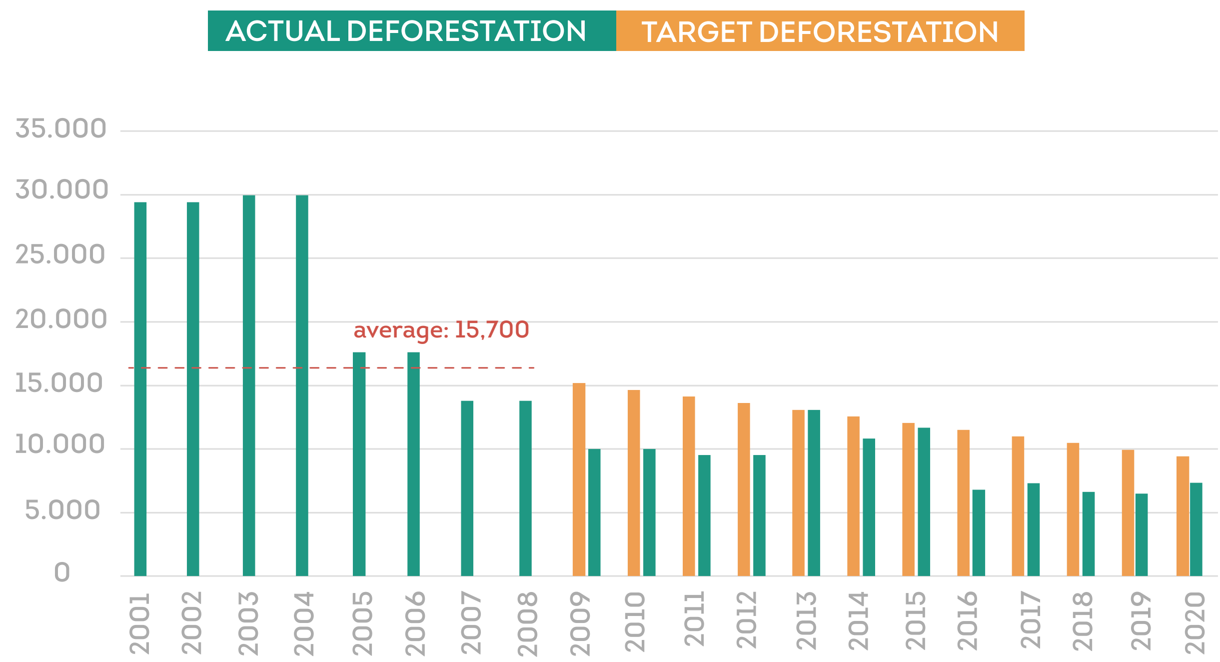
Anyway, this estimated average of 15,700 km² was the basis for the Plan to establish, in 2009, that in 2020 deforestation should not exceed 9,421 km², that is, it should drop 40%.

The plan reached 2019 with deforestation of 6,484 km², a rate 31% below the target for the year.

As in the Amazon, the vegetable oil industry has also been working to preserve Cerrado's environment. A study by Abiove and Agrosatélite showed that native vegetation covers 52.5% of the biome, despite the expansion of Brazilian agriculture in the region in recent decades.
In addition, the study points out ways for the soy crop to expand without causing deforestation. Currently, soy occupies only 8.9% of the Cerrado and could technically exploit another 21.9% in already deforested areas, corresponding to 43.9 million hectares.

There are also 25.39 million hectares covered with native vegetation, which are suitable for soybeans cultivation and can be deforested without violating Brazilian environmental legislation. This area corresponds to 12.4% of the Cerrado.

CERRADO DEFORESTATION REDUCTION PLAN (km²)



source: MMA com dados do sistema PRODES; INPE (2020)

In order to encourage the preservation of native vegetation in this agronomically and legally suitable area to be explored for the cultivation of soybeans, Abiove, in partnership with Agrossatélite, has created a mechanism to make it easier for the producer to enter the environmental services market.

The payment for environmental services, which began to be adopted in the world in the 1990s, gained a greater incentive in 2008, when the FAO (Food and Agriculture Organization of the United Nations) declared that this was the most effective method to guarantee the preservation of native vegetation.

BRAZILIAN AGRICULTURAL PRODUCERS FOLLOW STRICT ENVIRONMENTAL REQUIREMENTS

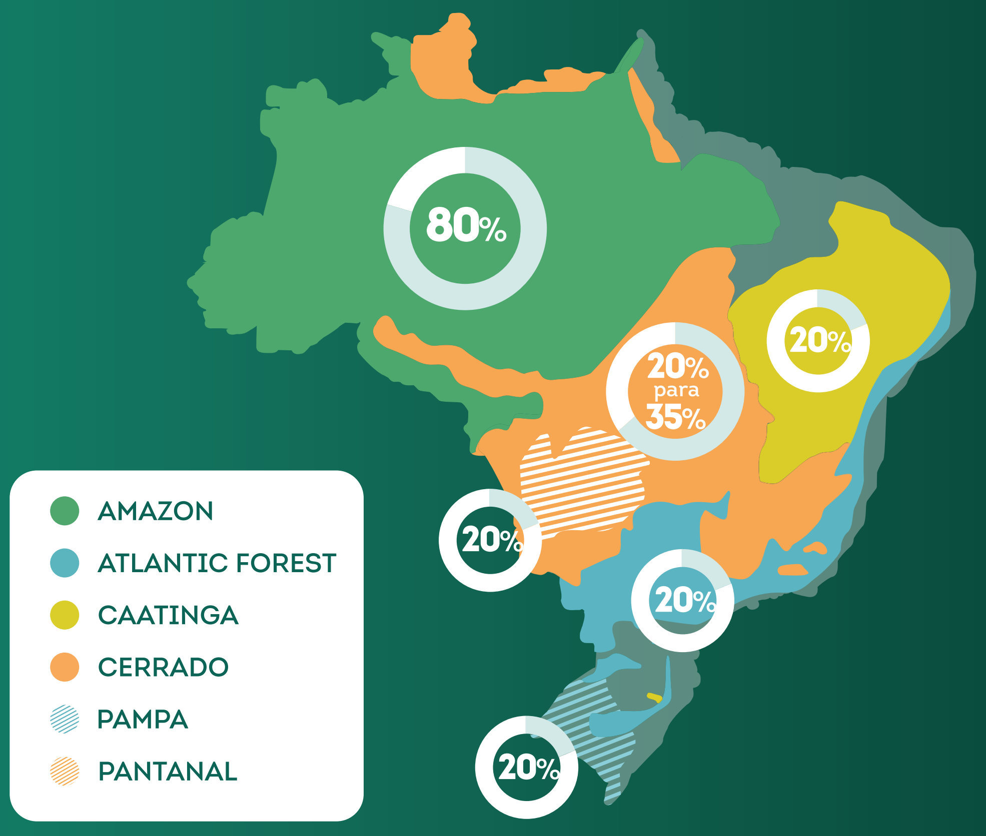
In addition to the positive environmental effects resulting from the incorporation of various technologies associated with production, such as rational use of inputs, water-saving, crop protection products and lower emissions due to the adoption of biotechnology, the compliance of producers with the Forest Code is essential when it comes to sustainability.

The 2012 Forest Code establishes that all properties have a minimum native vegetation reserve area. It is called the Legal Reserve (RL), which depending on the type of vegetation and biome, should occupy 20% to 80% of the property's area.

The 2012 Forest Code establishes that all properties have a minimum native vegetation reserve area. It is called the Legal Reserve (RL), which depending on the type of vegetation and biome, should occupy 20% to 80% of the property's area.

In the Amazon biome, the area intended for the Legal Reserve must be 80% of the total area, 35% in the Cerrado and 20% in then other biomes. In addition to the Legal Reserve, producers must protect the areas on the banks of large and small watercourses, ponds and lakes. Additionally, they must preserve other areas such as those surrounding the springs, steep slopes and hilltops. These are called Permanent Protection Areas (APP) In order to make compliance possible, the Forest Code established two instruments. The first is the Rural Environmental Registry (CAR), in which the producer registers his/ her property with the Ministry of Agriculture.

If the property fails to comply with environmental legislation, the producer must use the second instrument created by the Forest Code, which is the Environmental Regularization Program (PRA). In addition to the federal government's PRA, there are equivalent programs in 18 states. By adhering to one of them, the producer must recover his/ her property so as to bring it in accordance with environmental legislation.



Forest Code

Legal Reserve (RL): reserve area for native vegetation, which depending on the type of vegetation and biome, should occupy 20% to 80% of the property's area.

Permanent Protection Areas (APP): protection of the banks of watercourses, in addition to areas surrounding springs, steep slopes and hilltops.

Rural Environmental Registry (CAR): property registration with the Ministry of Agriculture, describing its current reality in terms of economic exploitation and environmental preservation.

Environmental Regularization Program (PRA): recovery of the property to bring it in accordance with environmental legislation. Non-compliant properties must adhere to the program in order to avoid possible punishment.

RECOGNITION FOR THOSE WHO PRESERVE NATURE IS ALREADY A REALITY IN BRAZIL

The intense use of natural resources generates externalities with potential impacts on society and future generations. The basic premise for the payment for environmental services is to compensate those who manage the environment in such a way that benefits society as a whole.

However, even before the definition of the legal framework, several initiatives were being developed for the implementation of PSA in Brazil.

PAYMENT FOR ENVIRONMENTAL SERVICES (PSA) PROGRAMS

AMAZON FUND

It was instituted by Decree No. 6,527 of August 1st, 2009, which provides for financing actions that contribute to the prevention, monitoring and fight against forest deforestation, in addition to promoting the conservation and sustainable use of forests in the Amazon biome.

The initiative's objective is to reduce greenhouse gas emissions into the atmosphere, resulting from deforested and burned areas in the Brazilian Amazon.

FOREST PROGRAM +

It was launched in July 2020 by the Ministry of the Environment with the objective of paying for environmental services, for various activities aimed at native vegetation protection. They include monitoring, surveillance and firefighting, planting trees, environmental inventory, installing agroforestry systems and research.

The Program is aimed at all rural producers and landowners from all biomes. In the initial phase, a pilot project will be tested in the Amazon, with a budget of 500 million reais (about 90 million dollars).

PSA INITIATIVES LINKED TO BRAZILIAN MUNICIPALITIES

INITIATIVE	PLACE
Projeto Conservador das Águas	Extrema - MG
Projeto Produtores de Água e Floresta	Rio Claro - RJ
Projeto Produtor de Água no Pipiripau	Brasília - DF
Produtor de Água no Descoberto	Brasília - DF
Projeto Produtor de Água João Leite	Goiânia - GO
Produtores de Água	Rio Verde - GO
Projeto Recuperação do Rio Capivari	Bom Despacho - MG
Projeto Ambrósio	Captólio - MG
Projeto de Conservação de Água e Solo	Carmo do Cajuru - MG
Projeto Perobas	Doresópolis - MG
Projeto Santuário das Águas	Formiga - MG
Projeto Guardião dos Igarapés	Igarapé - MG
Projeto Conservador das Águas	Nova Serrana - MG
Projeto Bocaina - Produtor de Água	Passos - MG
Projeto Oásis - Nascentes de Pimenta	Pimenta - MG
Projeto Araras	Piumhi - MG
Produtor de Água na bacia do Rio Mutum	Uberaba - MG
Manancial Vivo	Campo Grande - MS
Projeto Conservador das Águas	Brasil Novo - PA
Projeto Rio Sesmaria	Resende - RJ
Projeto Protetor das Águas	Vera Cruz - RS
Projeto Produtor de Água no Rio Camboriú	Balneário Camboriú - SC
Projeto Produtor de Água	Canindé do São Francisco - SE
Conservador das Águas na Bacia do Rio Batalha	Bauru - SP
Bacias Jaguariúna	Jaguariúna - SP
Projeto Produtor de Água no PCJ	Joanópolis e Nazaré Paulista - SP
Projeto Produtor de Água Ribeirão Lajeado	Penápolis - SP
Produtor de Água Salesópolis	Salesópolis - SP
Mais Água	São José dos Campos - SP

LOW CARBON AGRICULTURE IS AN OFFICIAL PROGRAM

Good agricultural practices were included as part of Brazil's efforts towards voluntary commitment to reduce greenhouse gas emissions, assumed at the 15th Conference of the Parties (COP15), held in 2009 in Copenhagen. In 2011, the Brazilian government launched the National Plan for Low Carbon Emission in Agriculture (ABC Plan), with the objective of encouraging the adoption of more resilient techniques, with greater productive gains and low carbon emission by rural producers.

The goals established by the ABC Plan were set for the year 2020, and by 2018 several goals had already been surpassed. A total of six technologies are encouraged by the ABC Plan:

1. RECOVERY OF DEGRADED PASTURE (RDP):

Degraded pastures are the result of insufficient investments and inadequate management. It is estimated that the country has around 168 million hectares of pastures and that 26.7% of this area is in a state of severe degradation, 38.7% is moderately degraded and 41.1% is in good condition.

The recovery of degraded areas has the potential to increase productivity, through the greater stocking of animals, improved forage, and mitigation of carbon emissions in the activity. The target established in the ABC Plan was the recovery of 15 million hectares of pastures by 2020. It is estimated that by 2018, 70% of the total would have been achieved, but these estimates vary depending on the methodology adopted.

2. INTEGRATED CROP-LIVESTOCK-FORESTRY SYSTEMS (ICLFS)

It is a sustainable production strategy that integrates agriculture, livestock and planted forests in combinations that can vary greatly. Research conducted in various regions of Brazil indicates that integration systems contribute to the preservation of soil quality, water conservation, better animal performance by increasing thermal comfort, mitigation of the effects of greenhouse gases and enhanced synergy between the plant species and animal husbandry.

Despite the potential benefits, the area occupied by ILPF systems in Brazil is still small: 11.5 million hectares, or 5% of the area occupied by agriculture and livestock.

Among the factors that explain this low adoption of ILPF systems, cultural aspects, the need for the initial investment, shortage of qualified labor, lack of information and technical assistance stand out.

However, the objective of the ABC Plan was to adopt Crop-Livestock-Forest Integration techniques in 4 million hectares by 2020, and by 2018 the target had already reached 146% of this amount.

3. NO-TILL FARMING:

This practice consists in reducing soil mobilization at the time of planting, by limiting it to the sowing line or pit. Thus, the ground cover is maintained and the interval between the harvest and the new planting is reduced or even suppressed. The system contributes to soil conservation and, by preventing erosion, it also favors water preservation.

The system improves fertilizing efficiency, soil organic matter content, and reduces fossil energy consumption by reducing the number of machine operations, thus mitigating the emission of greenhouse gases.

This practice has been increasingly adopted in Brazil and was one of the main factors responsible for the growth of Brazilian agriculture in recent decades. The plan was drawn up until 2020 aimed at incorporating 8 million hectares to this practice, but by 2018 the area had already reached 159% of the initial objective.

4. BIOLOGICAL NITROGEN FIXATION (BNF):

One of the limitations of tropical and subtropical soils for agricultural production is due to their lack of nitrogen, an essential element for plant nutrition. Biological nitrogen fixation technology uses microorganisms capable of converting nitrogen from the atmosphere to make it assimilable by plants.

In addition to lowering farming costs, it protects the environment, by increasing the organic matter in the soil and reducing the emission of greenhouse gases. In Brazil, the most significant contribution of FBN was observed in the soybean crop, where the use of inoculants, from the 1960s, has guaranteed the country's competitiveness when compared to other producing countries, with a direct impact on the trade balance.

In Brazil, the other crops that can benefit from FBN are sugarcane, corn, common beans, cowpea, rice and wheat. Also concerning environmental benefits, FBN is a technology that can be used in efforts to recover degraded areas, especially where the unsustainable use of the soil has resulted in the loss of soil organic matter and loss of productivity.

ABC Plan's goal was to take the Biological Nitrogen Fixation to over 5.5 million hectares, and an estimated 193% of this goal had already been achieved that by 2018.

5. PLANTED FORESTS:

Planted forests, in addition to reducing the pressure on native forests, capture CO2 from the atmosphere, helping to reduce the effects of global warming.

The Plan's objective was to plant 3 million hectares of forests and, in this case, only 21% of the goal had been reached by 2018.

6. ANIMAL MANURE MANAGEMENT:

Animal waste emits methane gas, one of the main causes of the greenhouse effect. Disposing them correctly represents a direct contribution to the efforts to contain global warming.

To this end, the ABC Plan encourages the adoption, by creators, of composting and biodigestion technologies in the production of fertilizer and biogas. The plan intended to stimulate the treatment of 4.4 million cubic meters of animal waste, and an estimated 39% of the target have been achieved by 2018.

TECHNOLOGIES ENCOURAGED BY THE ABC PLAN

RECOVERY OF DEGRADED PASTURE (RDP)

COMMITMENT (by 2020):

To encourage the recovery of 15.0 million ha of degraded pastures, in order to mitigate 83 to 104 million Mg CO_2eq.

ACHIEVED (from 2010 to 2018):

A total of 10.45 million ha of degraded pastures were recovered, corresponding to 70% of the target, contributing with an aumont between 39.57 and 57.52 million MgCO_2eq and between 42 e 62% of the established target.

NO-TILL FARMING

COMMITMENT (by 2020):

To encourage the adoption of 8.0 million ha of SPD in order to mitigate 16 to 20 million Mg CO_2eq.

ACHIEVED (FROM 2010 TO 2016):

A total of 12.72 million ha were planted using SPD, corresponding to 159% of the target, contributing to the mitigation of 23.28 million Mg CO_2eq and 129% of the established target.

INTEGRATED CROP-LIVESTOCK-FORESTRY SYSTEMS (ICLFS)

COMMITMENT (by 2020):

To encourage the adoption of 4.0 million ha of ILPF in order to mitigate 18 to 22 million Mg CO_2eq.

ACHIEVED (from 2010 to 2016):

A total of 5.83 million ha were converted into ILPF area, corresponding to 146% of the target, contributing to the mitigation of 22.11 million Mg CO_2eq and 111% of the established target.

BIOLOGICAL NITROGEN FIXATION (BNF)

COMMITMENT (by 2020):

To encourage the adoption of 5.5 million ha of FBN in order to mitigate 10 million Mg CO_2eq.

ACHIEVED (from 2010 to 2016):

A total of 10.64 million ha were planted using FBN, corresponding to 193% of the target, contributing to the mitigation from 18.03 to 19.74 million Mg CO_2eq and between 180 e 197% established target.

PLANTED FORESTS

COMMITMENT (by 2020):

To encourage the planting of 3.0 million ha of FP in order to mitigate 8 to 10 million Mg CO_2eq.

ACHIEVED (from 2010 to 2016):

A total of 0.63 million ha of forests were planted for commercial purposes, corresponding to 21% of the target, contributing to the mitigation of 25.37 million Mg CO_2eq, considering the carbon sequestration in biomass.

ANIMAL MANURE MANAGEMENT

COMMITMENT (by 2020):

To encourage the treatment of 4.40 million m^3 of animal waste in order to mitigate 6.9 million Mg CO_2eq.

ACHIEVED (from 2010 to 2016):

Between 1.71 and 4.51 million m^3 of swine manure were treated, corresponding to a reach of 39 to 103% of the target treatment volume, contributing to the mitigation of 2.67 to 7.04 million Mg CO_2eq. and a reach of 39 to 103% of the target established for TDA.

BRAZILIAN AGRIBUSINESS HAS BEEN CONTRIBUTING TO MITIGATE CLIMATE CHANGE

In December 2020, Brazil shared with the UN (United Nations Framework Convention on Climate Change – UNFCCC) the update of its goals to reduce the emission of greenhouse gases, in line with the Paris Agreement.

Authorization for countries to continue to account for emission reductions occurring outside their territory encourages the carbon credit market. In this market, those who manage to reduce emissions obtain credits that can be traded with those who cannot.

Signed in 2015, the central point of the Agreement was to establish as a goal that the global average temperature would not reach 2°C above pre-industrial levels. For this purpose, each country must make its contribution, by adopting policies that lead to the reduction of greenhouse gas emissions.

Another important point was the decision to create financial flows in order to promote the efforts necessary for the Agreement's goal to be reached. Authorization for countries to continue to account for emission reductions occurring outside their territory encourages the carbon credit market.

When Brazil ratified the Agreement, on September 20th, 2016, the country's first Intended Nationally Determined Contributions (INDC) were considered to achieve the global goal of reducing greenhouse gas emissions.

The Brazilian targets also include the industrial and transport sectors. The 2015 Brazilian contribution established, for 2025, the goal of reducing greenhouse gas emissions to 37% below the levels of 2005. In addition, it presented as an indicative target, for 2030, a reduction to 43% below the levels of 2005.

The new contribution, from 2020, reaffirms the 2025 target and makes the 2030 target, which was only indicative, official. A new indicative target, now for 2060, is to achieve climate neutrality, that is, to sequester as much carbon from the atmosphere as it may emit.

By updating its international commitments to protect the environment, Brazil has shown consistency with a strong tradition. Since the world became aware that natural resources are finite, Brazil has been present at all major international meetings to debate and seek solutions to the problem. It participated in the 1st United Nations Conference on the Human Environment, the Stockholm Conference, in 1972. It hosted the United Nations Conference on the Environment and Sustainable Development, Eco-92, in Rio de Janeiro, which approved the Biodiversity Convention. It adhered to all major multilateral environmental treaties, approved laws and developed public policies to promote sustainable development.

INDC - INTENDED NATIONALLY DETERMINED CONTRIBUTIONS

SECTOR	INDC PROPOSALS
FOREST	• Strengthen compliance with the Forest Code at the federal, state and municipal levels; • Strengthen policies and measures with a view to achieving zero illegal deforestation in the Brazilian Amazon by 2030 and offsetting greenhouse gas emissions from legal vegetation clearing by 2030; • Restore and reforest 12 million hectares of forests by 2030, for multiple uses; • Expand the scale of sustainable management systems for native forests, through georeferencing and traceability systems applicable to the management of native forests, with a view to discouraging illegal and unsustainable practices.

SECTOR	INDC PROPOSALS
TRANSPORT	• Promote efficiency measures, improvements in transport infrastructure and public transport in urban areas.

SECTOR	INDC PROPOSALS
INDUSTRY	• Promote new standards of clean technologies and expand energy efficiency measures and low-carbon emission infrastructure.

SECTOR	INDC PROPOSALS
ENERGY	• Increase the share of sustainable bioenergy in the Brazilian energy matrix to approximately 18% by 2030, expanding the consumption of advanced (second generation) biofuels, and increasing the share of biodiesel in the diesel mixture; • Achieve an estimated 45% share of renewable energy in the composition of the energy matrix in 2030, including: • Expand the use of renewable sources, in addition to hydropower, in the total energy matrix to a share of 28% to 33% by 2030; • Expand the domestic use of non-fossil energy sources, increasing the share of renewable energy (in addition to hydropower) in the supply of electricity to at least 23% by 2030, including by increasing the share of wind, biomass and solar energy; • Achieve 20% efficiency gains in the electricity sector by 2030.

SECTOR	INDC PROPOSALS
AGRICULTURE	• Strengthen the National Plan for Low Carbon Emission in Agriculture (ABC Plan) as the main strategy for sustainable development in agriculture, including through the additional restoration of 15 million hectares of degraded pastures by 2030 and the increase of 5 million hectares of crop-livestock-forest integration (iLPF) systems by 2030.

source: MMA (2015)

BRAZIL HAS THE LARGEST SAFE DISPOSAL PROGRAM FOR CROP PROTECTION PRODUCTS PACKAGING IN THE WORLD

Also concerning sustainability in the agricultural sector, it is worth noting that Brazil has one of the most important programs for the disposal of solid residues of crop protection products in the world.

The *Campo Limpo System* is an initiative developed by the crop protection products industry to ensure the correct disposal of empty packaging. The Campo Limpo System is managed by the National Institute for Processing Empty Packaging (inpEV), which has a partnership with around 100 companies and organizations linked to the crop protection industry.

The System is based on the principle, already defined by law in Brazil, that the crop protection companies, distribution channels, farmers, and the government are jointly responsible for preventing them from contaminating the environment.

Since 2002, the Campo Limpo System has collected 550,000 tons of used crop protection products packaging. In 2019, there were 45,563 tons. It is estimated that this accounts for about 94% of the packages sold in the year.

Therefore, each sector has its role in the effort to prevent packaging from becoming a threat to nature.

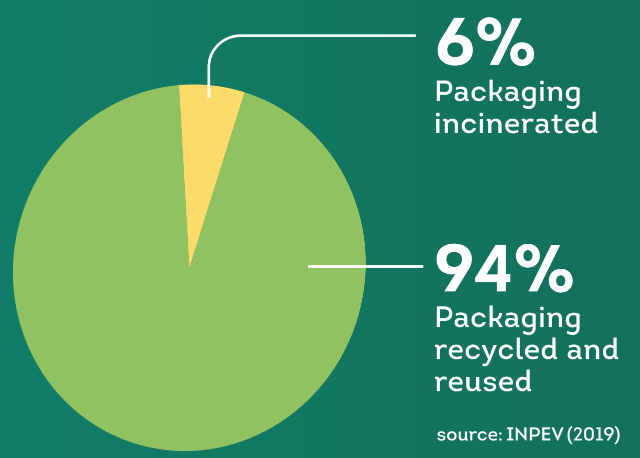
Organized in all regions of the country, the Campo Limpo system brings together 112 companies, more than 4,500 crop protection products points of sale and 1.8 million agricultural properties.

Once used, the package is taken by the farmer to collection stations or centers, or is collected by traveling collection stations. Then, they are taken to 10 recyclers or incinerators. Of the packages collected, 94% are recycled and reused, and 6% are incinerated.

Since 2002, the Campo Limpo System has collected 550,000 tons of used crop protection products packaging. In 2019, there were 45,563 tons. It is estimated that this accounts for about 94% of the packages sold in the year.

CAMPO LIMPO SYSTEM RESULTS

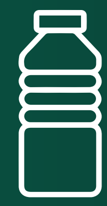
material disposal (%)



source: INPEV (2019)

Of the packages collected, 94% are recycled and reused, and 6% are incinerated.

550,000 (tons) since 2002



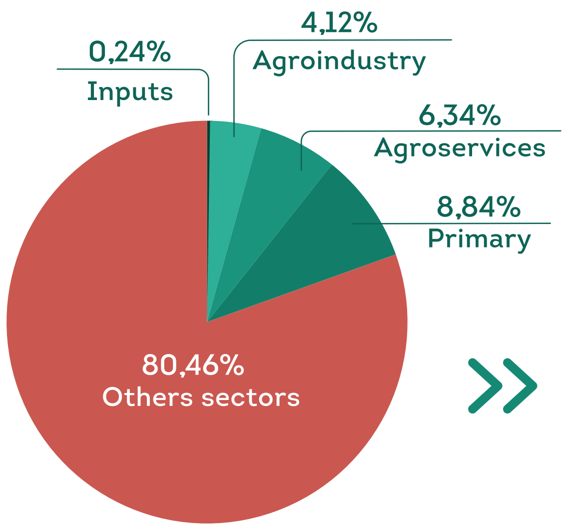
45,563 (tons) in 2019

94% packaging sold in the year

BRAZILIAN AGRIBUSINESS ENGAGES MANY PEOPLE

In 2019, the Brazilian agribusiness GDP accounted for 21.4% of the country's total GDP. The sector was responsible for more than 18 million jobs, and agribusiness and services employed 3.8 million and 5.9 million people, respectively, while 226.8 thousand people were employed in the input segment. In the countryside, 8.2 million people were employed.

EMPLOYMENT IN BRAZILIAN AGRIBUSINESS



agribusiness accounts for 19.54% of jobs in Brazil.

Sector	Employment (million)	%
Inputs	0.23	0.24
Agroindustry	3.84	4.12
Agroservices	5.92	6.34
Primary	8.26	8.84
Agribusiness/total	18.25	19.54
Brazil/other sectors	75.14	80.46
Brazil/total	93.39	100

source: Cepea, a partir de informações dos microdados da PNAD-Contínua e dados da RAIS (2019)

An important piece of data to assess the effect of agricultural advances in Brazil on people's lives is the evolution of the human development index (HDI) in agricultural areas. The HDI is a development assessment measure that takes into account three basic dimensions: per capita income, health and education. The closer this number is to 1, the greater the human development in the region.

Between 1991 and 2010, the index calculated at the municipal level, totaled for Brazil, went from 0.493 to 0.727, a 47%-increase.

Kleffmann consultancy analyzed the HDI in soy, corn, cotton and sugarcane producing municipalities in the Brazilian Cerrado, the main area of agricultural expansion in recent decades, and concluded that the index grew in a more markedly manner in these municipalities than in non-agricultural ones. The HDI grew 64% in municipalities that concentrate soy production, 65% in sugarcane producing municipalities, 73% in corn producing municipalities, and 131% in municipalities that concentrate cotton production.

Among the greatest advances presented in the human development index in the period, soy-producing municipalities in Tocantins, Maranhão, Piauí and Bahia stood out, as well as Mato Grosso, which more than doubled the HDI values in the early 1990s.

Producing Municipalities HDI	1991	2010	percentage growth
NON-AGRICULTURAL	0,4576	0,7166	57%
SOY	0,4457	0,7292	64%
SUGARCANE	0,4426	0,729	65%
COTTON	0,306	0,7071	131%
CORN	0,4102	0,7099	73%

source: Kleffmann (2014)

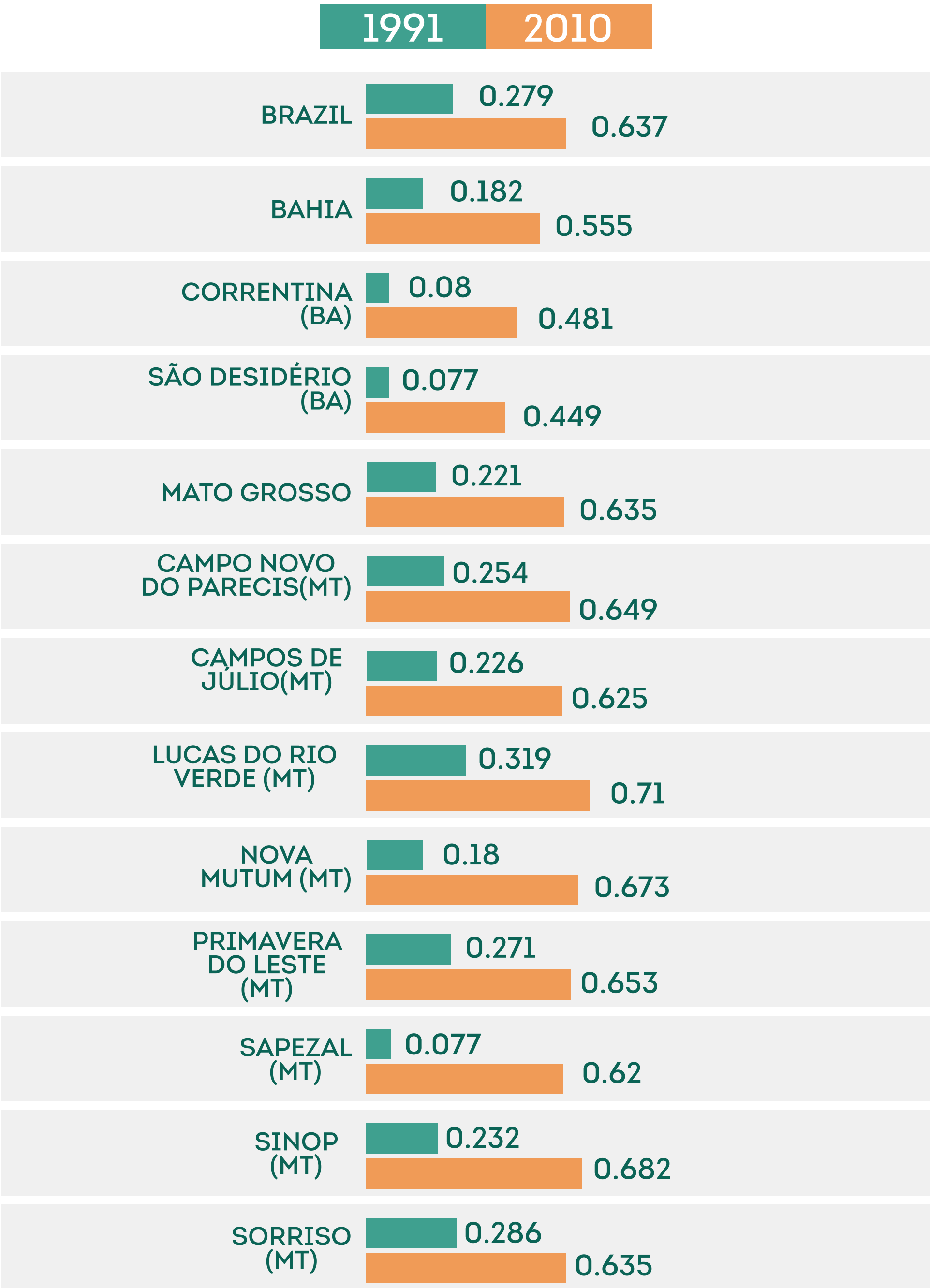
Rank	Municipality	Mesoregion	State	Planted area 2010 (ha)	MHDI 1991	MHDI 2000	MHDI 2010	HDI evolution (1991-2010)
1st	Campos Lindos	Eastern Tocantins	TO	48,000	0.14	0.34	0.54	294%
2nd	Gaúcha do Norte	Northern Mato Grosso	MT	72,000	0.18	0.51	0.62	236%
3rd	Baixa Grande do Ribeiro	Southwest Piauí	PI	73,761	0.20	0.35	0.56	179%
4th	Jaborandi	Extreme Western Bahia	BA	50,000	0.24	0.37	0.61	161%
5th	Ipiranga do Norte	Northern Mato Grosso	MT	171,850	0.28	0.60	0.73	160%
6th	Santa Rita do Trivelato	Northern Mato Grosso	MT	135,000	0.32	0.60	0.74	133%
7th	Tasso Fragoso	Southern Maranhão	MA	104,759	0.26	0.45	0.60	130%
8th	Riachão das Neves	Extreme Western Bahia	BA	64,194	0.27	0.39	0.58	116%
9th	Correntina	Extreme Western Bahia	BA	101,000	0.28	0.44	0.60	116%
10th	Sapezal	Northern Mato Grosso	MT	378,167	0.34	0.60	0.73	115%

source: Kleffmann (2014)

Another interesting aspect related to the HDI concerns education. In the period from 1991 to 2010, the education-related index component showed a more accentuated evolution than the others, despite the very low level of the Brazilian general educational indicators. In the municipalities of Bahia dedicated to cotton, for example, the education-associated HDIs were at levels below 0.08 in 1991, as observed in Correntina and São Desidério, while Bahia had overall values around 0.182 and Brazil 0.279. In 2010, the same municipalities showed values above 0.449. While in 1991 the HDI values in the education dimension were between 0.07 and 0.309 in important producing municipalities in Mato Grosso, such regions started to present values above 0.62 in 2010.

Compared to the other components of the HDI, in the State of Bahia, while the longevity and income dimensions grew 35% and 22%, respectively, between 1991 and 2010, the increase related to education was 205%. In Mato Grosso, longevity and income increased by 26% and 17%, against 187% of the education component in the period. Finally, for comparison purposes, in São Paulo, longevity and income evolved 16% and 8%, while the education dimension increased 98% between 1991 and 2010. The evolution of the education-related index at a higher pace than the others, due to its importance for the reduction of extreme poverty, has the potential to reduce the deep inter-regional inequalities that characterize the social indicators in Brazil.

EDUCATION HDI IN 1991 AND 2010 IN THE MAIN MUNICIPALITIES OF PRODUCING REGIONS



source: Atlas do Desenvolvimento Humano no Brasil. Pnud Brasil, Ipea e FJP (2020)

DIMENSION OF BRAZILIAN HDI INDICES AND INDICATORS FROM 1991 TO 2010

		1991	2000	2010	VAR 2010/1991
BAHIA	IDH	0.386	0.512	0.660	71%
	Longevity	0.582	0.680	0.783	35%
	Education	0.182	0.332	0.555	205%
	Income	0.543	0.594	0.663	22%
MATO GROSSO	IDH	0.449	0.601	0.725	61%
	Longevity	0.654	0.740	0.821	26%
	Education	0.221	0.426	0.635	187%
	Income	0.627	0.689	0.732	17%
SÃO PAULO	IDH	0.578	0.702	0.783	35%
	Longevity	0.730	0.786	0.845	16%
	Education	0.363	0.581	0.719	98%
	Income	0.729	0.756	0.789	8%

source: Atlas do Desenvolvimento Humano no Brasil. Pnud Brasil, Ipea e FJP (2020)

In summary, the success of agriculture, initially directly measured by the generation of local income, represents a real possibility of expanding its effects to improve social indicators, thus contributing to reduce the huge inequality among Brazilians in the various regions of Brazil, in terms of living conditions and opportunities.

ESG IN BRAZILIAN AGRIBUSINESS

The growing visibility of actions that take into account the environment, social aspects and governance, represented by the acronym ESG (Environmental, Social and Governance), and its growing valuation will translate into the growing importance of these aspects in the financing criteria, boosting initiatives that prioritize the rational use of natural resources and practices that mitigate the impacts of production.

It is evident that Brazil has undertaken a set of efforts both in legislation and in business activities in order to value initiatives that mitigate human action on the environment, especially in agricultural activities.

GLOBAL
FOOD SECURITY

HUNGER IS A CHALLENGE TO BE OVERCOME WORLDWIDE

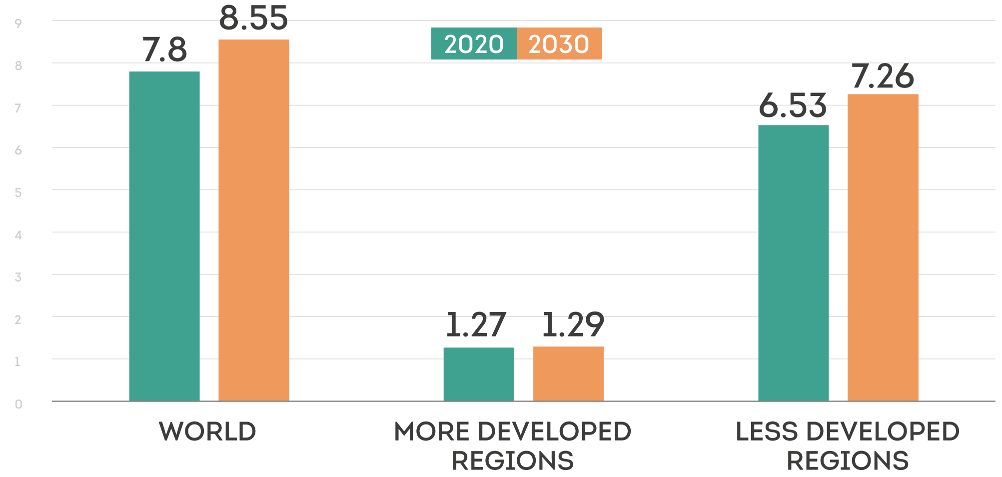
The current world population is 7.8 billion inhabitants. The vast majority live in the least developed regions of the planet: 6.3 billion people. The outlook for the next 10 years is that the world's population will grow 9.6% and reach 8.6 billion inhabitants. But, while growth in more developed regions will be 1.5%, in less developed regions it will be 11.2%, reaching a total of 7.26 billion people.

But, while growth in more developed regions will be 1.5%, in less developed regions it will be 11.2%, reaching a total of 7.26 billion people

According to the United Nations (UN), the population of Africa will show the greatest growth until 2030. The expected increase is 25.9%, followed by the Oceania, with a rate just below half of the African growth. Then the Americas and Asia will grow by similar proportions.

Finally, in Europe, the population will decline over the next 10 years.

WORLD POPULATION



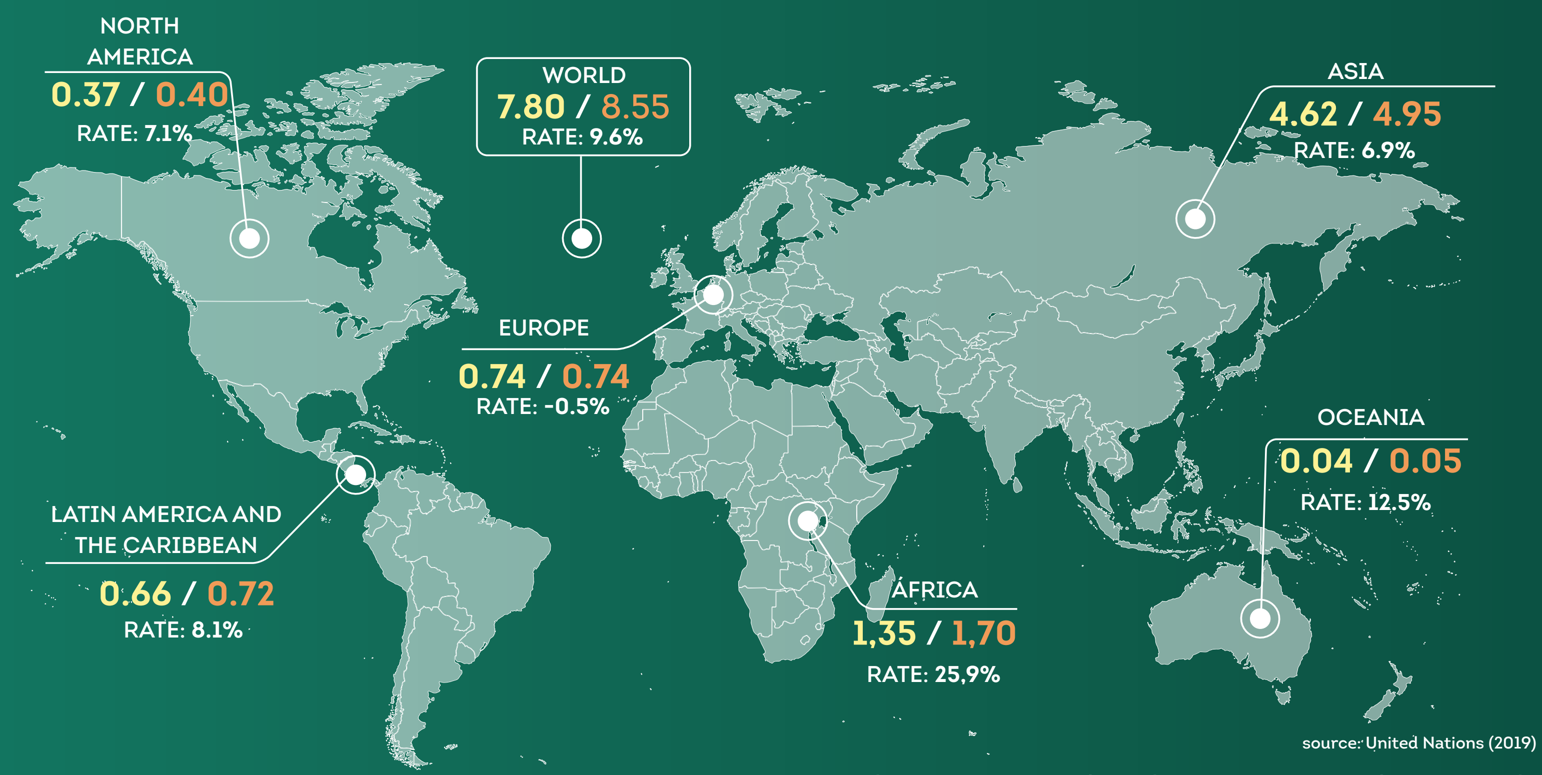
source: United Nations (2019)

WORLD POPULATION BY CONTINENT

(in billions of inhabitants)

With this, the expected growth of the world population will be more accentuated in regions with a more challenging scenario related to hunger or undernourishment.

Since hunger and undernourishment represent the greatest challenges facing humanity, the topic has been discussed in the most diverse forums around the world. In 2015, the UN General Assembly approved an Agenda for Sustainable Development, with 17 goals to be achieved by 2030. Among them, the goal of "ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture" gained significant repercussions.



source: United Nations (2019)

Note: The rate corresponds to the percentage population growth.

Among them, the goal of "ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture" gained significant repercussions.

Undernourishment, which had been declining since the beginning of the century, reached its lowest value in 2014, with 628.9 million people, or 8.6% of the world's population. In 2019, after five years of growth, the problem affected 687.8 million people or 8.9% of humanity.

Prospects are not optimistic. According to FAO's latest report on the state of food security and nutrition in the world, from 2020, hunger is expected to affect 841.4 million people in 2030, or 9.8% of the world's population.

Many factors are associated with the problem. Overall, events of war and natural disasters promote specific situations of discontinued or insufficient access to food. However, the most common case refers to insufficient income to purchase food, which leads to a chronic problem that is not geographically limited. This fact is aggravated in the world by the COVID-19 pandemic.

In addition to access to insufficient quantities, there are also situations in which the varieties of food available result in an inadequate combination of nutrients, leading to undernourishment due to unbalanced diets. It can even trigger another public health problem, i.e. obesity.

The lack of access to food in adequate quantity and quality is accentuated by inequality. According to current data, North America and Europe, which have a undernourishment rate below 2.5% of the population, will not change their level, while in Africa, Latin America, and Oceania, the scenario is expected to worsen until 2030.

GLOBAL UNDERNOURISHMENT

UNDERNOURISHMENT

reached its lowest point in 2014, with 628.9 million people, or 8.6% of the world's population;

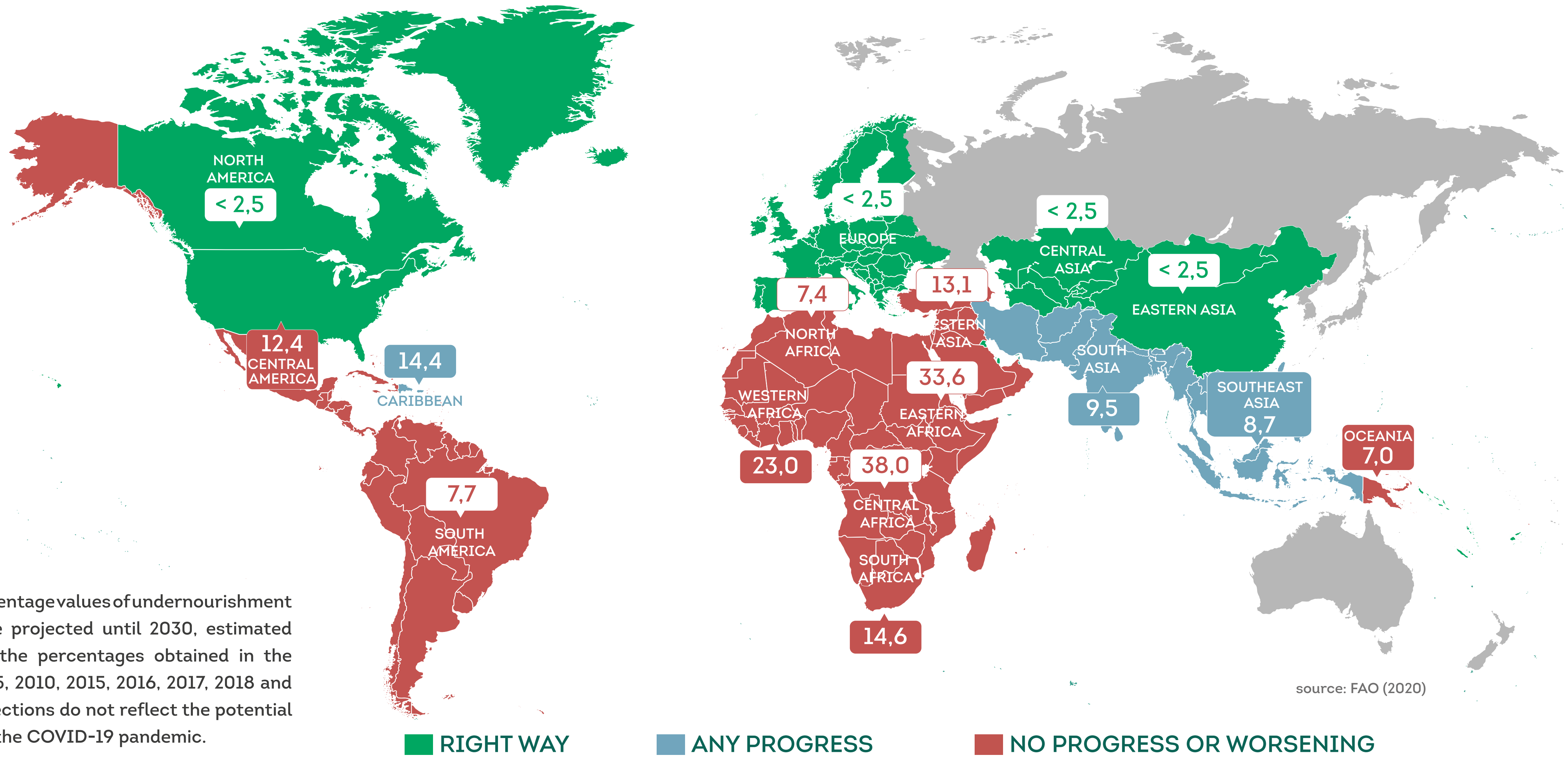
IN 2019,
after five years of growth, the problem affected 687.8 million people or 8.9% of humanity

OUTLOOK 2030,
hunger will affect 841.4 million people, or 9.8% of the world's population.

source: FAO (2020)

SUSTAINABLE DEVELOPMENT GOALS (SDGs)

WORLDWIDE UNDERNOURISHMENT PREVALENCE - PROJECTIONS 2030 (%)



Note: Percentage values of undernourishment prevalence projected until 2030, estimated based on the percentages obtained in the years 2005, 2010, 2015, 2016, 2017, 2018 and 2019. Projections do not reflect the potential impact of the COVID-19 pandemic.

The "State of Food Security and Nutrition in the World" report, produced jointly by the UN Food and Agriculture Organization (FAO), the International Fund for Agricultural Development (IFAD), the United Nations Children's Fund (UNICEF), the UN World Food Program (WFP) and the World Health Organization (WHO), present evidence that a healthy diet costs much more than US$1.90 a day, the international poverty line.

Products like nutrient-rich dairy, fruits, vegetables, and protein-rich foods (both of plant and animal origin) are the most expensive food groups.

Products like nutrient-rich dairy, fruits, vegetables, and protein-rich foods (both of plant and animal origin) are the most expensive food groups.

The latest estimates are that three billion people or more cannot afford a healthy diet. In sub-Saharan Africa and South Asia, 57% of the population are in these conditions, although no region, including North America and Europe, is completely free of this situation.

According to the report, in 2019, between a quarter and a third of children under the age of five, around 191 million individuals, suffered from wasting (progressive atrophy of organs) or growth retardation. Another 38 million children under the age of 5 were overweight. Among adults, obesity has become highly widespread.

The cost of food, according to the FAO report, is an important factor to contain hunger rates in the world and the deterioration in food quality. FAO's report presents the result of a survey conducted with data from 2017, which analyzes three different types of diet:

1. **Energy-sufficient diet:** it provides the numbers of calories needed for daily work. It contains starchy foods only, which can be corn, wheat or rice, depending on the country.

2. **Nutrients-adequate diet:** in addition to the calories mentioned above, it includes carbohydrates, proteins, fats, vitamins, and minerals.

3. **Healthy diet:** it differs from the adequate diet by the greater variety of foods that make it up, in addition to a more rigorous balance. Although it varies according to age and individual needs, a healthy diet should have less than 30% of energy from fat, preferably unsaturated fats over saturated ones, and should not contain trans fats. It should also have little sugar intake, at least 400 grams of fruits and vegetables a day, and a maximum of 5 grams of salt.

source: FAO (2020)

It should be noted that making available a greater variety of high-protein products, which increases the possibilities of composing more adequate diets, also constitutes an important contribution to reducing food insecurity.

It should be noted that making available a greater variety of high-protein products, which increases the possibilities of composing more adequate diets, also constitutes an important contribution to reducing food insecurity.

When relating food prices with the populations' income, it is observed that more than 3 billion people in the world are economically unable to have a healthy diet. This corresponds to 38.3% of the world population. A nutrient-adequate diet is out of reach for 1.5 billion people; and even the energy-sufficient diet is unattainable for 185 million people.

Trade-restrictive policies tend to raise the cost of food, which can be particularly harmful for countries that are net food importers.

A series of policies have been recommended to mitigate the problem, such as investments and social programs to improve the conditions of undernourished or malnourished populations.

There is also a warning about trade barriers: Governments must carefully assess the impacts of the growing number of barriers to international trade on the purchasing power of nutritious food (including reduced non-tariff measures to ensure food security). Trade-restrictive policies tend to raise the cost of food, which can be particularly harmful for countries that are net food importers.

The challenges related to hunger or inadequate nutrition in the world give a special role to countries that produce food surpluses, such as Brazil. An increased supply of agricultural products, though does not guarantee the access of the entire population to the necessary quantities and qualities, can contribute to reduced food costs and facilitated acquisition of these goods by the most vulnerable populations.

In addition to quantity, the availability of food options that allow for a richer diet is very important. Brazilian contributions in both aspects are positive. Brazilian production is varied and generates exportable surpluses.

In addition to quantity, the availability of food options that allow for a richer diet is very important. Brazilian contributions in both aspects are positive. Brazilian production is varied and generates exportable surpluses.

GREATER FOOD PRODUCTION IN BRAZIL LOWERED THE RELATIVE COST OF THE BASIC FOOD BASKET

The contribution of the agricultural sector to Brazilian society can be illustrated by analyzing the evolution of the real price of the food basket composed of the most consumed food products in the country. The reference food basket in Brazil has shown a reduction in the real value for several decades and represented, in 2006, 43% of the value observed in December 1974. With the recovery of food prices in the following years and in view of the Covid-19 pandemic, the real value of the food basket, in 2020, returned to a level close to 55% of the values from 1974.

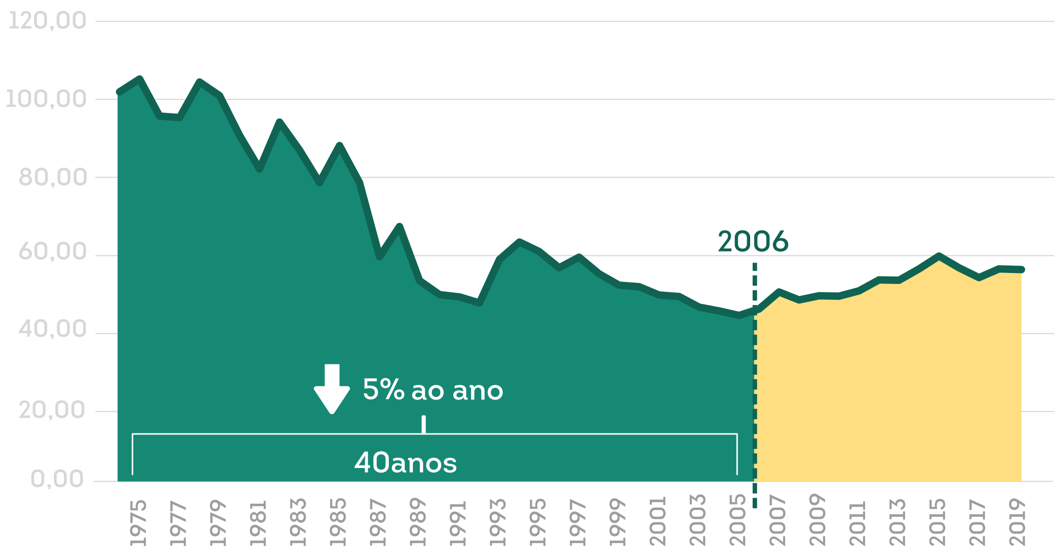
Worldwide, the real food price index, according to the FAO (United Nations Food and Agriculture Organization), showed the minimum value in 1987, reaching 48% of the 1974 value. At the highest point after the 2006 shock, reached in 2011, food was already equivalent to 86% of the values observed in 1974. Therefore, it is noted that the greater agricultural offer in Brazil contained the increase in food prices more effectively than what happened in the rest of the world.

The latest scenario reveals that the world faces a new period of high food prices, with low global stocks. This should make Brazil's growing surplus supply remain valuable to the world for a long time to come.

The latest scenario reveals that the world faces a new period of high food prices, with low global stocks. This should make Brazil's growing surplus supply remain valuable to the world for a long time to come.

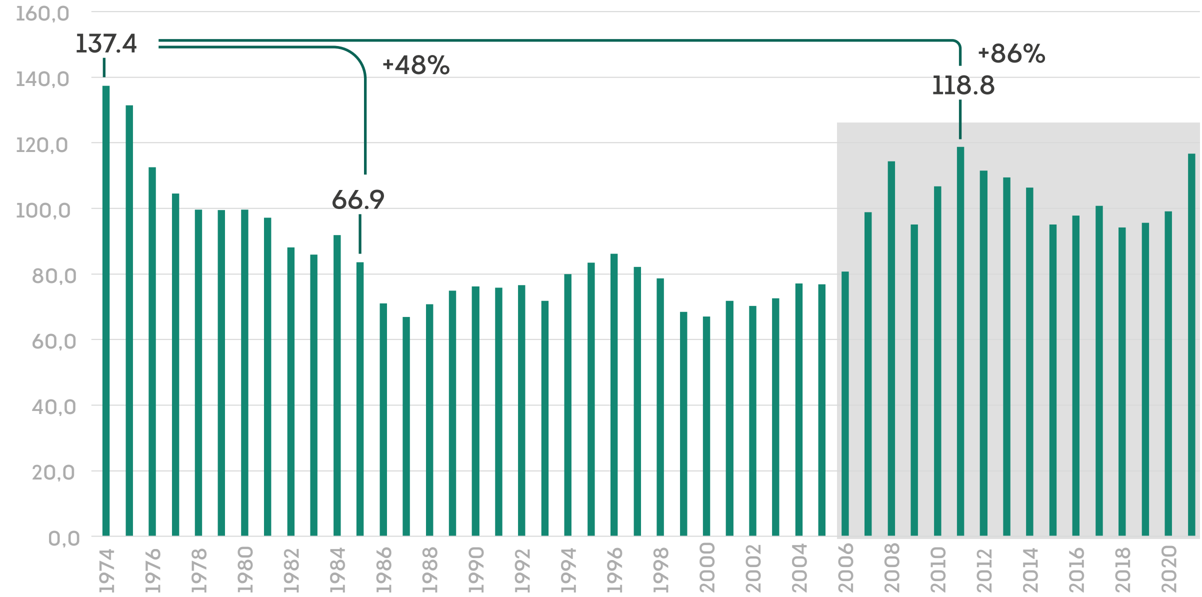
RELATIVE COST OF THE BASIC FOOD BASKET

(Index* Dec/75=100)



Source: Calculations performed with data on the basic food basket relative cost from the DIEESE (Departamento Intersindical de Estatística e Estudos Socioeconômicos) (2020)

REAL FOOD PRICE



source: FAO (2021)

BRAZIL, A LEADING COUNTRY IN THE FIGHT AGAINST HUNGER IN THE WORLD

Brazil is able to remain a relevant producer in the next decade.

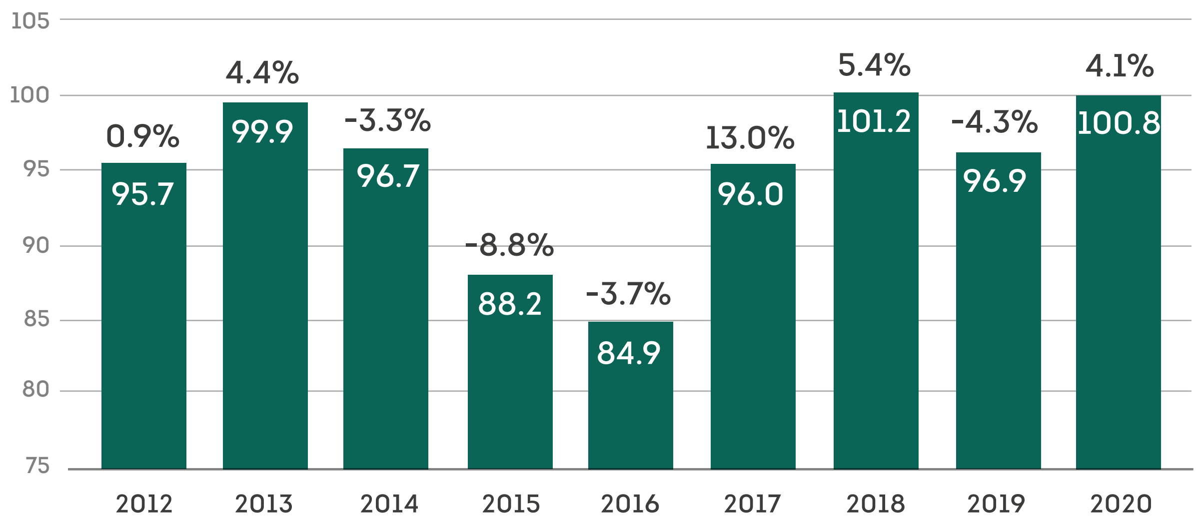
Brazil exports around 40 agricultural products.

The country is currently ranked as the world's largest exporter of beef, chicken, soy, coffee, orange juice and sugar, and the second largest exporter of corn.

Brazil exports around 40 agricultural products. According to data from the WTO (World Trade Organization), in 2018 the country had a 5.2% share in world agricultural exports, only behind the European Union and the United States. Almost every country in the world is Brazil's customer. Sales of agricultural products from Brazil to the world grew by 4.1% in value and 9.4% in quantity in 2020, compared to the previous year.

EVOLUTION OF AGRIBUSINESS EXPORTS

Exports (US$ billion) — Growth compared to the previous year (%)



source: MDIC/ COMEX STAT (2021)

BRAZILIAN EXPORT MAIN AGRIBUSINESS PRODUCTS

Product	Exports (US$ billions)		Variation (2019 - 2020)	Exports (billion tons)		Variation (2019 - 2020)
	2019	2020	Value	2019	2020	Weight
Soy beans	26.1	28.6	9.6%	74.0	83.0	12.0%
Fresh beef	6.6	7.5	13.8	1.6	1.7	9.9%
Raw cane sugar	4.5	7.4	65.2%	16.0	26.8	67.9%
Cellulose	7.5	6.0	-19.9%	15.3	16.2	6.0%
Soybeann meal	5,9	5,9	1,0%	16,7	17,0	1,6%
Corn	7.2	5.9	-18.9%	42.7	34.6	- 18.9%
Fresh chicken	6.7	5.7	-14.3%	4.1	4.0	-1.1%
Green coffee	4.6	5.0	8.7%	2.2	2.4	6.4%
Cotton (not carded or combed)	2.6	3.2	22.2%	1.6	2.1	31.7%
Fresh Pork	1.5	2.1	42.5%	0.7	0.9	37.2%
Paper	2.0	1.8	-12.9%	2.2	2.1	-3.6%
Unmanufactured smoke	2.0	1.5	-26.2%	0.4	0.4	-6.9%
Orange juice	1.9	1.4	-25.4%	2.3	2.0	-9.2%
Refined sugar	0.7	1.4	95.9%	1.9	4.0	107.5%
Ethyl alcohol	1.0	1.2	20.3%	1.5	2.2	40.2%
Others	16.2	16.4	1.0%	16.5	19.0	14.9%
Total Agribusiness	**96.9**	**100,8**	**4,1%**	**199,7**	**218,4**	**9.4%**

source: MDIC/ COMEX STAT (2021)

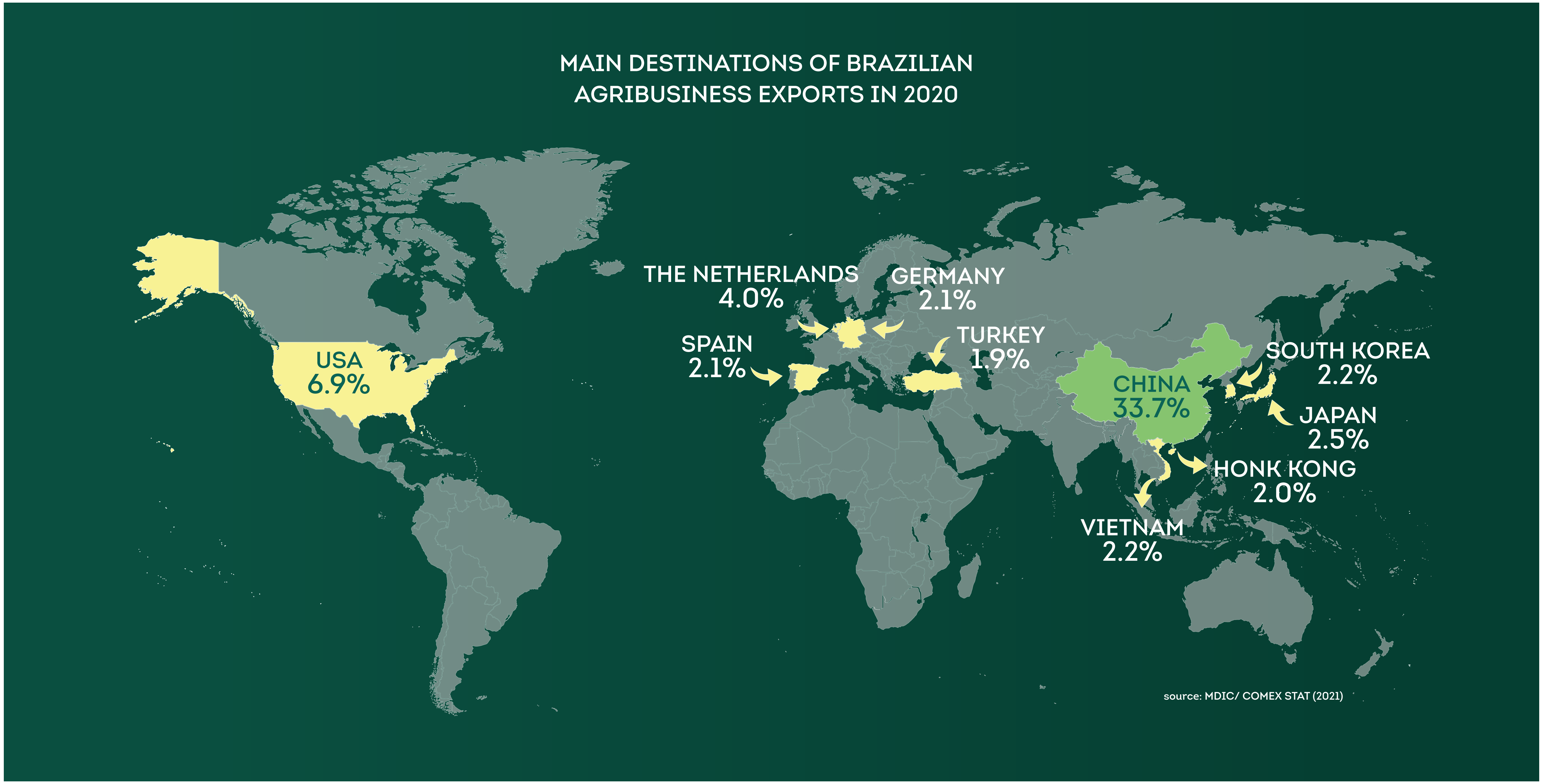
In terms of the geographic distribution of Brazilian agribusiness exports, in 2020, more than half, i.e. 52.6%, were destined for countries in the Asia and Oceania region, and China was the main destination, with a 33.7% share. The European Union was the second-largest region, with 16.2%, and North.

agribusiness exports, in 2020, more than half, i.e. 52.6%, were destined for countries in the Asia and Oceania region, and China was the main destination, with a 33.7% share.

America ranked as the third destination for agribusiness exports, with an 8.6% share, and the main market was the United States, with 6.9%. Approximately 6% of the total exported by Brazilian agribusiness were destined to Africa.

In 2020, around 82% of total exports to China were concentrated in three products: soybeans (61.5%), fresh beef (11.9%) and cellulose (8.4%).

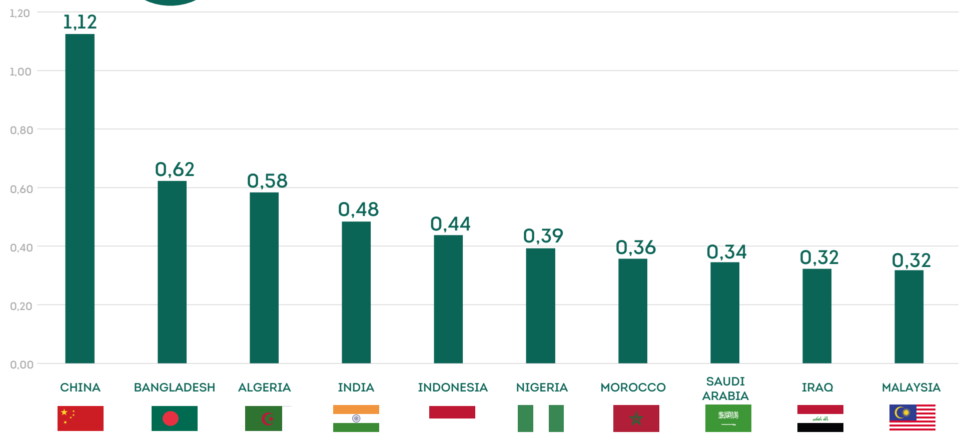
China is the main buyer of five agricultural products that are among the top 10 in Brazilian exports. In 2020, around 82% of total exports to China were concentrated in three products: soybeans (61.5%), fresh beef (11.9%) and cellulose (8.4%). We highlight the growth of raw cane sugar, which grew 222.3% compared to 2019. In addition, the export of fresh pork practically doubled in the last year. Finally, fresh beef sales to China grew 50.3% in the period.



BRAZILIAN EXPORT MAIN DESTINATIONS 2020

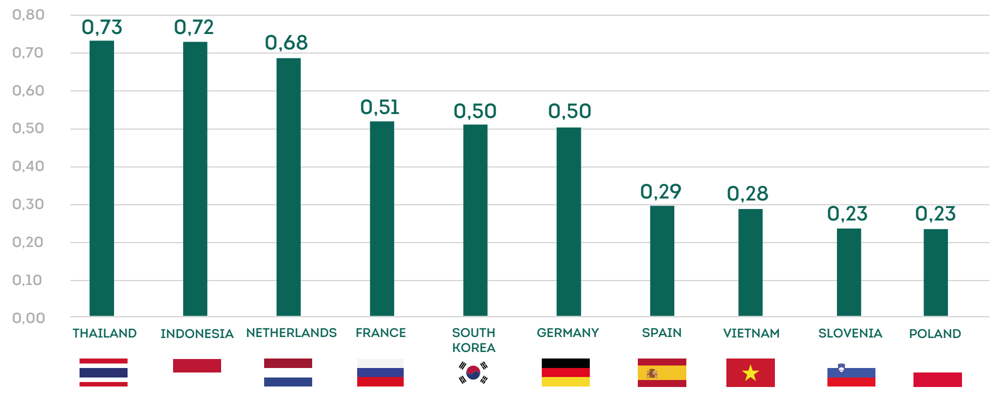
Other agricultural products, among the top 10 Brazilian exports, had Thailand, Japan and Germany as the main buyers.

SUGARS AND MOLASSES:
JAN - NOV 2020 (US$ billion)



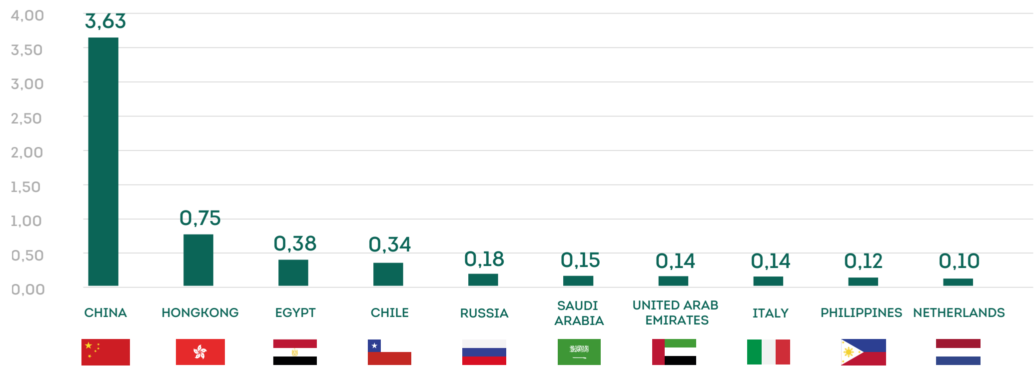
source: SECEX (2020)

SOYBEAN MEAL:
JAN - NOV 2020 (US$ billion)



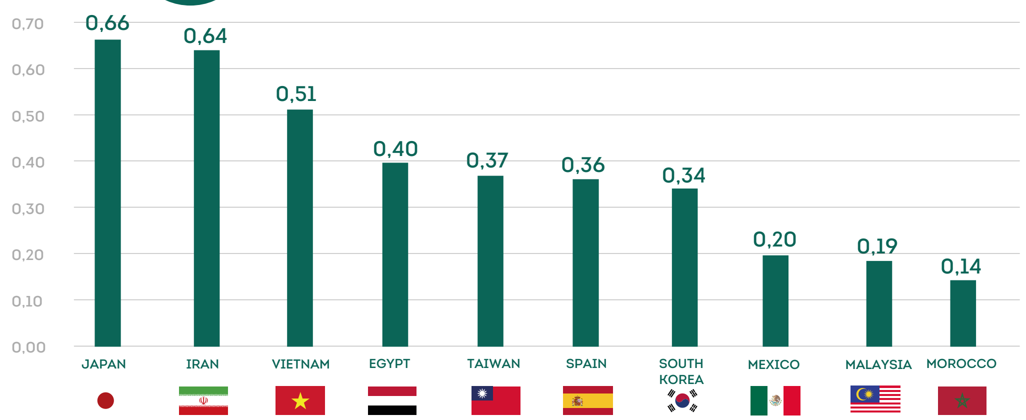
source: SECEX (2020)

BEEF:
JAN - NOV 2020 (US$ billion)



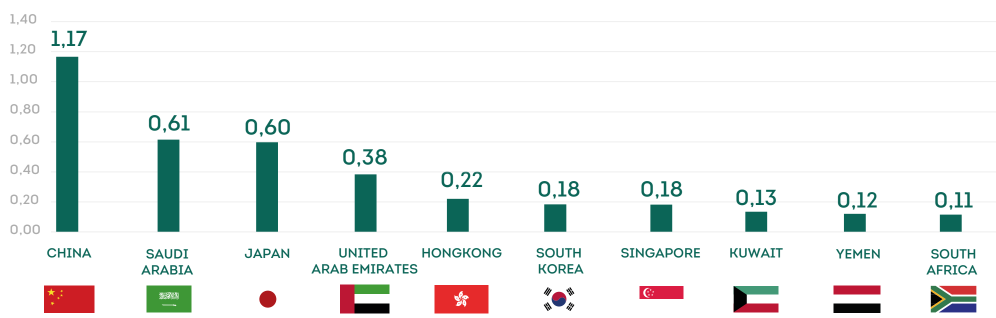
source: SECEX (2020)

UNGROUND CORN:
JAN - NOV 2020 (US$ billion)



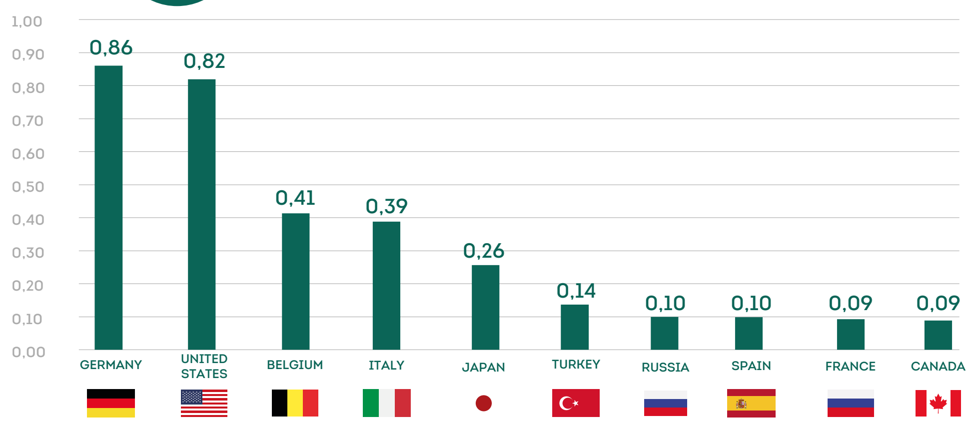
source: SECEX (2020)

POULTRY:
JAN - NOV 2020 (US$ billion)



source: SECEX (2020)

UNROASTED COFFEE
JAN - NOV 2020 (US$ billion)



source: SECEX (2020)

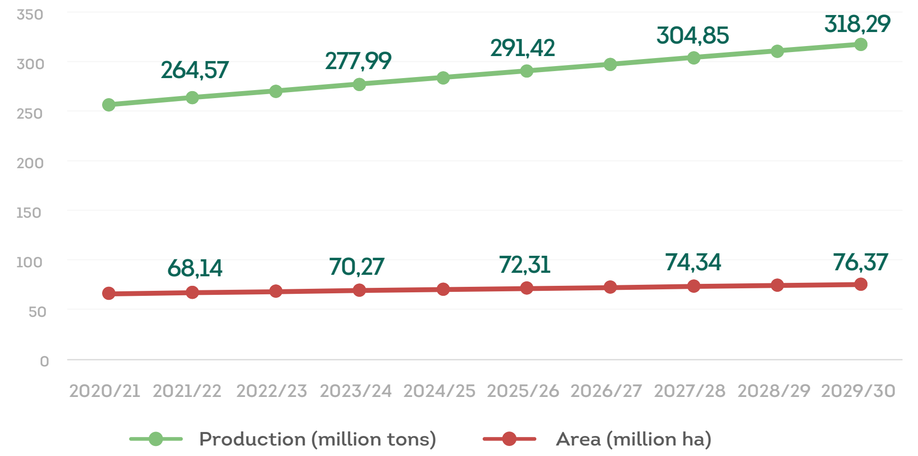
THE OUTLOOK FOR AGRICULTURAL PRODUCTION IN BRAZIL IS QUITE OPTIMISTIC

The projected growth for agriculture over the next 10 years makes Brazil continue to play this leading role in the food supply. This projection was disclosed in the study by the Ministry of Agriculture, Livestock and Supply (MAPA) in 2020. According to the analysis, the growth of technology adoption and productivity growth are expected to continue.

In the case of grains, the area is expected to grow 16.7% compared to the 2019/2020 harvest, while the production is expected to grow 26.9%.

In the case of grains, the area is expected to grow 16.7% compared to the 2019/2020 harvest, while the production is expected to grow 26.9%.

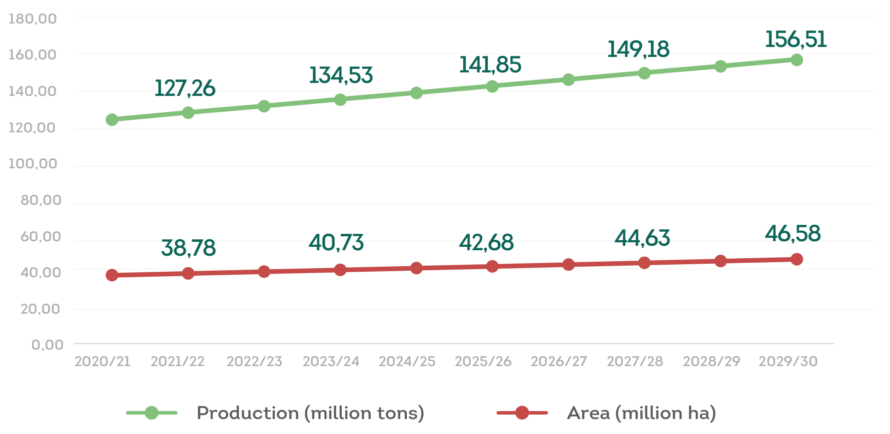
CHALLENGES FOR 2030 AND THE ROLE OF BRAZIL GRAINS (PROJECTIONS FOR 2030)



source: MAPA (2020)

SOY (PROJECTIONS FOR 2030)

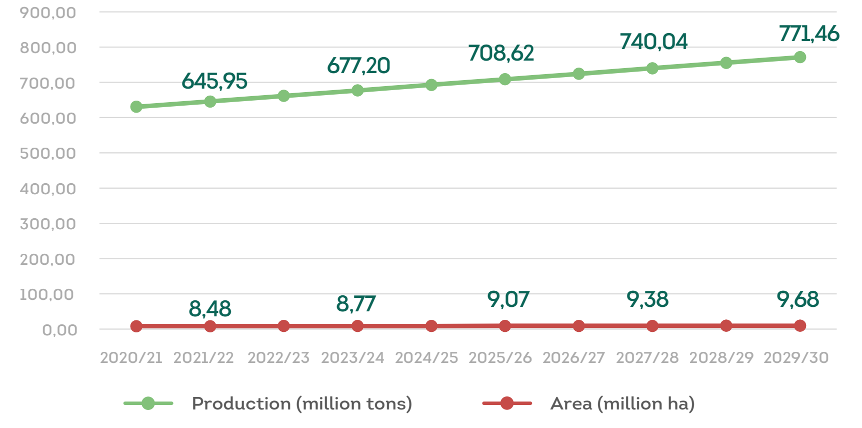
Soy production is expected to grow by 30.1% in the period, with an increase of 26.4% in planted area.



source: MAPA (2020)

SUGARCANE (PROJECTIONS FOR 2030)

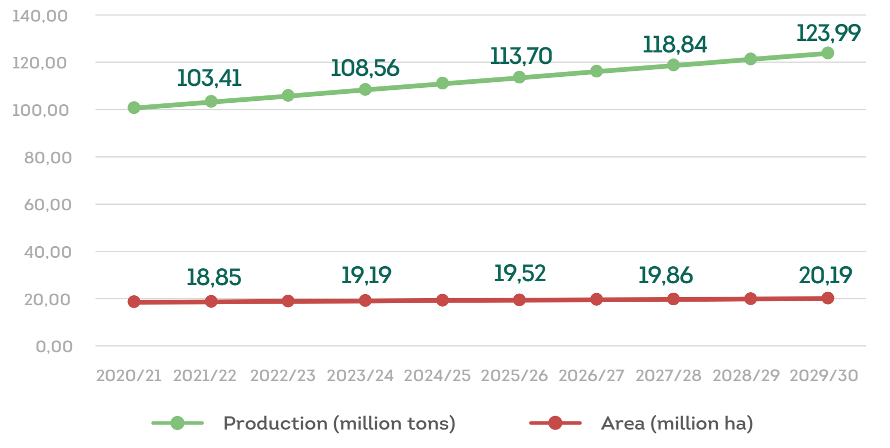
The increase in productivity will not be restricted to grains. Sugarcane, the crop that has launched commercial agriculture in Brazil 500 years ago, continues to improve productivity. By 2030, its production is expected to grow 20.0%, with an increase of 14.6% in planted area.



source: MAPA (2020)

CORN (PROJECTIONS FOR 2030)

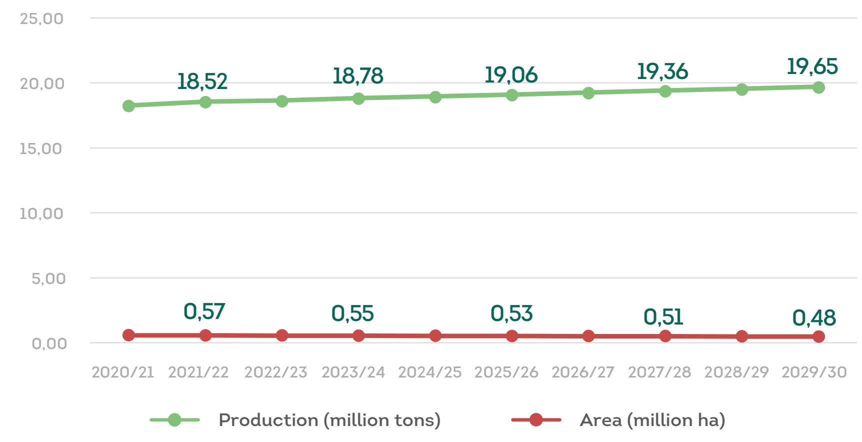
Similar to soy, corn production is expected to grow 21.2% until 2030, with an increase of 9.1% in area.



source: MAPA (2020)

ORANGE (PROJECTIONS FOR 2030)

There are also products expected to show a reduction in the planted area and still increased production. This is the case of orange, which is expected to grow by 6.9% in production, with a drop of 14.4% in the planted area.

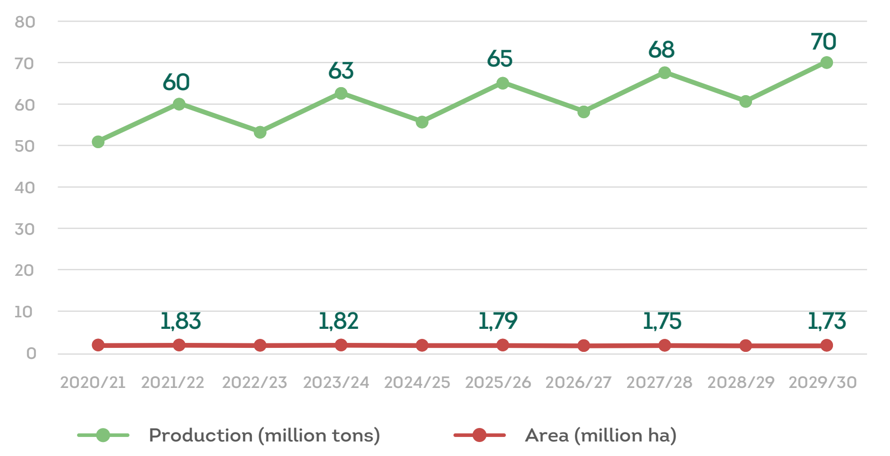


source: MAPA (2020)

The most expressive case of increased productivity shall be the potato.

A decrease in planted area of 21.7% with a production growth of 14.5% is expected for it.

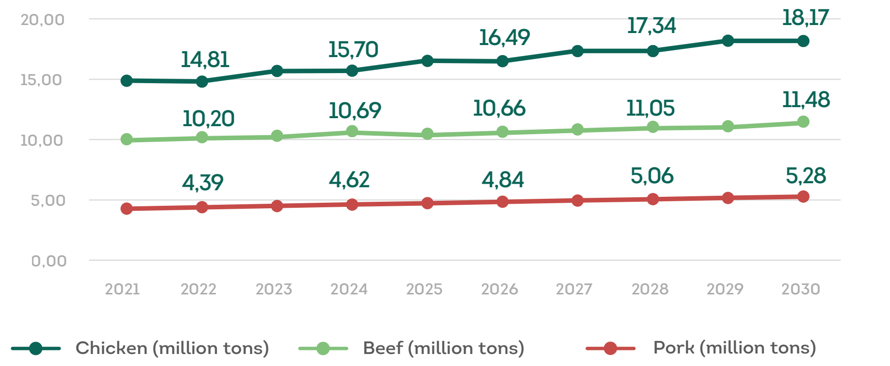
COFFEE (PROJECTIONS FOR 2030)



source: MAPA (2020)

Coffee is expected to maintain the trend observed in recent decades, decreasing the planted area while increasing production. This crop has a peculiarity: its cycle is biannual. A larger harvest, the so-called full harvest, is always followed by a smaller harvest, and vice versa. An area reduction of 8.0% with an increase of 22.6% in production is expected by 2030, which will also be a full-harvest year.

MEATS (PROJECTIONS FOR 2030)



source: MAPA (2020)

In the case of meat, the perspective is also for growth until 2030. The study projects a growth of 28.1% for chicken. Pork is expected to be slightly behind, with an increase of 26.8%. The growth of beef production is not expected to be so great, 16.2%.

Even though it is not enough to solve the problem of undernourishment, an increased food supply is a crucial way to overcome the difficulty of populations around the world in accessing an adequate diet. Therefore, there is a growing expectation that the world's food supply capacity will be guaranteed, as well as the generation of exportable surpluses, thus enabling access to food, namely oilseeds, carbohydrates and animal proteins, to an increasing number of people. Brazil is one of the few countries that can meet this demand. And official projections reveal that the country is ready for the challenge.

REFERENCES

Adalbert B., et al. (2017) Differences in the progress of the biopesticide revolution between the EU and other major crop-growing regions. Pest Management Science.

Agência Nacional do Petróleo, Gás Natural e Biocombustíveis [ANP] Anuário Estatístico 2020. Available at < https://www.gov.br/anp/pt-br/centrais-de-conteudo/publicacoes/anuario-estatistico/anuario-estatistico-2020#Se%C3%A7%C3%A3o%204 > Access in: March 29th, 2021

Agência Nacional de Vigilância Sanitária [ANVIISA] – Programa de Análise de Resíduos de Agrotóxicos em Alimentos [PARA] Available at < https://www.gov.br/anvisa/pt-br/assuntos/agrotoxicos/programa-de-analise-de-residuos-em-alimentos/arquivos/3770json-file-1 > Access in: : 25th May. 2021

Agência Nacional de Vigilância Sanitária [ANVISA]. Gerência de Processos Regulatórios – GPROR. Biblioteca de Agrotóxicos. Brasília: M, 8 p. 2019. Available at < http://portal.anvisa.gov.br/documents/33880/4967127/Biblioteca+de+Agrot%C3%B3xicos_Portal.pdf.> Access in: : 21st January 2021.

Agroconsult. 20 anos de transgênicos: benefícios ambientais, econômicos e sociais no Brasil. Available at < https://croplifebrasil.org/publicacoes/20-anos-de-transgenicos-beneficios-ambientais-economicos-e-sociais-no-brasil/ > Access in: : 30th December. 2020.

AGROSTAT - Estatísticas de Comércio Exterior do Agronegócio Brasileiro (2020). Available at < http://indicadores.agricultura.gov.br/agrostat/index.htm> Access in: : 13th May. 2021.

Amorim, L.; Rezende, J.A.M. & Bergamin Filho, A. eds. Manual de Fitopatologia. Volume 1 – Princípios e Conceitos. 4ª Edição. Editora Agronômica Ceres Ltda. 2011. 704p.
Andorf, C. et al. (2019) Technological advances in Mayze breeding: past, present and future. Theoretical and Applied Genetics.

Associação Brasileira do Agronegócio da Região de Ribeirão Preto [ABAGRP]. Uso das Terras. Available at < https://www.abagrp.org.br/uso-das-terras > Access in: : 13th January 2021.

Atlas do Desenvolvimento Humano no Brasil. Pnud Brasil, Ipea e FJP, 2020. Available at <http://atlasbrasil.org.br/acervo/biblioteca> Access in: : 15th December. 2020.

BRASIL. LEI Nº 12.651, DE 25 DE MayO DE 2012. Dispõe sobre a proteção da vegetação nativa, Brasília, DF. Available at <http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/ l12651.htm >. Access in: : 02nd February. 2021.

BRASIL. CONSTITUIÇÃO DA REPÚBLICA FEDERATIVA DO BRASIL DE 1988. Available at < http://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm > Access in: : 02nd February. 2021.

BRASIL. LEI Nº 9.605, DE 12 DE FebruaryEREIRO DE 1998. Dispõe sobre as sanções penais e administrativas derivadas de condutas e atividades lesivas ao meio ambiente, Brasília, DF. Available at < http://www.planalto.gov.br/ccivil_03/leis/l9605.htm#:~:text=LEI%20N%C2%BA%209.605%2C%20DE%2012%20DE%20FebruaryEREIRO%20DE%201998.&text=Disp%C3%B5e%20sobre%20as%20san%C3%A7%C3%B5es%20penais,ambiente%2C%20e%20d%C3%A1%20outras%20provid%C3%AAncias >. Access in: : 04th February. 2021.

BRASIL. LEI No 9.795, DE 27 DE AprilIL DE 1999. Dispõe sobre a educação ambiental, institui a Política Nacional de Educação Ambiental, Brasília, DF. Available at: < http://www.planalto.gov.br/ccivil_03/leis/l9795.htm >. Access in: : 04th February. 2021.

Bruetschy, C. (2019) The EU regulatory framework on genetically modified organisms (GMOs). Transgenic Research.
Casarin, V.; Casarin, N.B. Fertilizantes: Contribuindo para o futuro da humanidade. Nutrientes para a Vida. Available at: <https://www.nutrientesparaavida.org.br/wp-content/uploads/2020/03/Fertilizante-contribuindo-para-o-futuro-da-humanidade.pdf> Access in: : 26th May. 2021.

Castro, C.N. (2016) Pesquisa Agropecuária Pública Brasileira: Histórico e Perspectivas. Boletim Regional, Urbano e Ambiental, IPEA. Available at: < http://repositorio.ipea.gov.br/bitstream/11058/7104/1/BRU_n15_Pesquisa.pdf> Access in: : 25th January 2021.

Centro de Estudos Avançados em Economia Aplicada [CEPEA]. Mensuração econômica da incidência de pragas e doenças no Brasil: uma aplicação para as culturas de soja, milho e algodão. Parte 1| Mayo de 2019. Available at: < https://www.cepea.esalq.usp.br/upload/kceditor/files/Cepea_EstudoPragaseDoencas_Parte%201.pdf > Access in: : 12th January 2021.

Centro de Estudos Avançados em Economia Aplicada [CEPEA]. Boletim Cepea do Mercado de Trabalho (2019). Available at: < https://www.cepea.esalq.usp.br/upload/kceditor/ files/2019_1%20TRI%20Relatorio%20MERCADODETRABALHO_CEPEA.pdf > Access in: : 23rd February. 2021.

Chaim, A. HISTÓRIA DA PULVERIZAÇÃO. Pesquisa agropecuária brasileira. 1999. Available at <https://www.agencia.cnptia.embrapa.br/recursos/Chaim_historiaID-Dcdtr0CVWl.pdf> Access in: : 07 June. 2021.

Comissão Técnica Nacional de Biossegurança (CTNBio). Available at: < http://ctnbio.mctic.gov.br/inicio > Access in: : 08th January 2021.

Companhia Nacional de Abastecimento [CONAB] (2021). Safras. Available at: < https://www.conab.gov.br/info-agro/safras/serie-historica-das-safras >. Access in: : 20th January 2021.

Contini, E. et al. (2020) Agro brasileiro em evolução: complexidade e especialização. Revista de política agrícola.

CropLife Brasil. Histórico e inovação do melhoramento genético – Ferramentas moleculares que prometem acelerar prática milenar (2019). Available at: <https://croplifebrasil.org/publicacoes/historico-e-inovacao-do-melhoramento-genetico-plantas/ > Access in: : 06th June. 2021.

CropLife Brasil. Publicações. Available at: < https://croplifebrasil.org/publicacoes/ > Access 02nd June. 2021

Dinâmica das pastagens Brasileiras: Ocupação de áreas e indícios de degradação - 2010 a 2018 Coordenador Dr. Laerte Guimarães Ferreira Júnior Equipe M.Sc. Claudinei Oliveira-Santos M.Sc. Vinícius Vieira Mesquita Dr. Leandro Leal Parente, Universidade Federal de Viçosa

Empresa Brasileira de Pesquisa Agropecuária [EMBRAPA]. Embrapa no Brasil. Available at: < https://www.embrapa.br/embrapa-no-brasil> Access in: : 23th de January de 2021.

Empresa Brasileira de Pesquisa Agropecuária [EMBRAPA]. Embrapa Territorial. Available at: < https://www.embrapa.br/territorial/publicacoes > Access in: : 15th February. 2021.

Empresa Brasileira de Pesquisa Agropecuária [EMBRAPA]. Mitigação das emissões de gases de efeitos estufa pela adoção das tecnologias do Plano ABC: estimativas parciais Available at: < https://www.gov.br/agricultura/pt-br/assuntos/sustentabilidade/plano-abc/arquivo-publicacoes-plano-abc/mitigacao-das-emissoes-de-gases-de-efeitos-estufa-pela-adocao-das-tecnologias-do-plano-abc-estimativas-parciais.pdf > Access in: : 15th May. 2021.

Empresa Brasileira de Pesquisa Agropecuária [EMBRAPA]. 2018. Síntese Ocupação e Uso das Terras no Brasil. Available at: < https://www.embrapa.br/car/sintese > Access in: 23 February. 2021. Empresa Brasileira de Pesquisa Agropecuária [EMBRAPA]. 2018. Visão 2030: o futuro da agricultura brasileira. Available at: < https://www.embrapa.br/visao/trajetoria-da-agricultura-brasileira
> Access in: : 23th February. 2021.

Empresa de Pesquisa Energética [EPE] Matriz Energética e Elétrica 2020. Available at: <https://www.epe.gov.br/pt/abcdenergia/matriz-energetica-e-eletrica > Access in: : 20 December. 2020. Empresa de Pesquisa Energética [EPE] Balanço Energético Nacional [BEM]. Available at: <https://www.epe.gov.br/pt/abcdenergia/matriz-energetica-e-eletrica > Access in: : 20th December. 2020.

Endorsement of Forest Certification Scheme Programme [PEFC]. Available at: <https://www.pefc.org/ > Access in: : 18th February. 2021.

European Environment Agency [EEA] Copernicus Land Monitoring Service – Corine Land Cover. Available at: < https://www.eea.europa.eu/data-and-maps/data/copernicus-land-monitoring-service-corine > Access in: : 19th December. 2020.

European Parliament [EP]. Available at: < https://europa.eu/european-union/about-eu/institutions-bodies/european-parliament_en > Access in: : 19th December. 2020.

Federação da Agricultura e Pecuária do Estado de Mato Grosso [FAMATO]. Ocupação e Uso das Terras no Brasil (2017). Available at: <https://sistemafamato.org.br/portal/famato/arquivos/publicacoes/2_Evaristo_de_Miranda.pdf > Access in: : 17th February. 2021.

Filho, I. A. P., e Borghi, E. (2020) Sementes de milho: nova safra, novas cultivares e continua a dominância dos transgênicos. 1. ed. Embrapa Milho e Sorgo
Fontes, E. M. G. e Valadares-Inglis, M. C. Controle biológico de pragas da agricultura. 1. ed. Brasília: Embrapa, 2020.

Food and Agriculture Organization of the United Nations [FAO] Preço real dos alimentos – índice FAO - FAO Food Price Index. Available at: < http://www.fao.org/worldfoodsituation/foodpricesindex/en/ > Access in: : 19th May. 2021.

Food and Agriculture Organization of the United Nations [FAO] Revisão das normas fitossanitárias para o comércio de plantas e produtos vegetais. Available at: < http://www.fao.org/brasil/noticias/detail-events/pt/c/293049/ > Access in: : 19th May. 2021.

Food and Agriculture Organization of the United Nations [FAO]. FAOSTAT - Pesticides Use. Available at: < http://www.fao.org/faostat/en/#data/RP > Access in: : 15th February. 2021.

Food and Agriculture Organization of the United Nations [FAO] The State of Food Security and Nutrition in the World 2020. Available at: < http://www.fao.org/3/ca9692en/ca9692en.pdf > Access in: : 05th March 2021.

Forest Stewardship Council (FSC). Available at: < https://fsc.org/en > Access in: : 18th February. 2021. Gedil, M., e Andorf, C. et al. Technological advances in Mayze breeding: past, present and future. Theoretical and Applied Genetics, 2019.

Goyal, R.K.; Schmidt, M.A.; Hynes, M.F. (2021) Molecular Biology in the Improvement of Biological Nitrogen Fixation by Rhizobia and Extending the Scope to Cereals. Microorganisms 2021, 9, 125. https://doi.org/ 10.3390/microorganisms9010125

Instituto Brasileiro de Geografia e Estatística [IBGE]. O Brasil no Mundo. Available at: <https://cnae.ibge.gov.br/en/component/content/article/94-7a12/7a12-vamos-conhecer-o-brasil/nosso-territorio/1461-o-brasil-no-mundo.html> Access in: : 10th January de 2021.

Instituto Brasileiro de Geografia e Estatística [IBGE] Biomas Brasileiros. Available at: < https://educa.ibge.gov.br/jovens/conheca-o-brasil/territorio/18307-biomas-brasileiros.html> Access in: : 25th January 2021.

Instituto Brasileiro de Geografia e Estatística [IBGE] Pesquisa Trimestral do Abate de AniMays. Available at: < https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9203-pesquisas-trimestrais-do-abate-de-aniMays.html?=&t=series-historicas > Access in: : 20th May. 2021.

Instituto Brasileiro de Geografia e Estatística [IBGE] Levantamento Sistemático da Produção Agrícola – LSPA. Available at: < https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9201-levantamento-sistematico-da-?=&t=o-que-e > Access in: : 20th January 2021.

Instituto Brasileiro de Geografia e Estatística [IBGE] Produção Agrícola Municipal - PAM. Available at: < https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9117-producao-agricola-municipal-culturas-temporarias-e-permanentes.html?=&t=o-que-e > Access in: : 20th January 2021.

Instituto Brasileiro de Geografia e Estatística [IBGE] Pesquisa da Pecuária Municipal - PPM. 2019. Available at: < https://sidra.ibge.gov.br/pesquisa/ppm/quadros/brasil/2019 > Access in: : 20th January 2021.

Instituto Brasileiro de Geografia e Estatística [IBGE] Produção da Extração Vegetal e da Silvicultura – PEVS (2019). Available at: < https://metadados.ibge.gov.br/consulta/estatisticos/operacoes-estatisticas/VS > Access in: : 29th March 2021.

Instituto Nacional de Processamento de Embalagens Vazias [INPEV] (2019). Sistema Campo Limpo. Available at: < https://www.inpev.org.br/sistema-campo-limpo/> Access in: : 09th March 2021.

Instituto Nacional de Pesquisas Espaciais [INPE] TerrAprilasilis, Sistema PRODES (2021) Available at: <http://terrAprilasilis.dpi.inpe.br/app/dashboard/deforestation/biomes/cerrado/increments> Access in: 20th May. 2021.

Instituto de Pesquisa Econômica Aplicada [IPEA] (2020). Atlas do Desenvolvimento Humano no Brasil (2020). Available at: < https://atlasbrasil.org.br/ > Access in: 14th March 2021.

International Energy Agency [IEA]. Data and statistics (2020). Available at: < https://www.iea.org/data-and-statistics > Access in: 29th January 2021.

International Monetary Fund [IMF], World Economic Outlook Database, October 2020. Available at < https://www.imf.org/en/Publications/WEO/weo-database/2020/October> Access in: 21st January 2021.

International Service for the Acquisition of Agri-biotech Applications [ISAAA] 2019. Global Status of Commercialized Biotech/GM Crops in 2019: Biotech Crops Drive SocioEconomic Development and Sustainable Environment in the New Frontier. ISAAA Brief No. 55. ISAAA: Ithaca, NY. Available at: < https://www.isaaa.org/purchasepublications/itemdescription.asp?ItemType=ECOPY&Control=IB055-2019-ECOPY> Access in: 20th January 2021.

Fontes E. M. G. e Valadares-Inglis M. C., Controle biológico de pragas da agricultura. Embrapa, 2020

Jacob, R. (2017) The Role of Soil Microorganisms in Plant Mineral Nutrition—Current Knowledge and Future Directions. Frontiers in Plant Science.

Katarzyna C., et al. (2015). Biopesticides – towards increased consumer safety in the EU. Pest Management Science.

Jia, F., et al. (2020) Soybean supply chain management and sustainability: A systematic literature review. Journal of Cleaner Production.

Lauret R. et al., Sustainable Development in Agriculture and its Antecedents, Barriers and Consequences – An Exploratory Study. Sustainable Production and Consumption, 2021.

MANZATTO, C. V. (et. al). Mitigação das emissões de Gases de Efeitos Estufa pela adoção das tecnologias do Plano ABC: estimativas parciais. Embrapa Meio Ambiente. Jaguariúna, SP. 2020.

Medina Pastor, P.; Triacchini, G. The 2018 European Union report on pesticide residues in food. 2020. Disponivel em < https://efsa.onlinelibrary.wiley.com/doi/10.2903/j.efsa.2020.6057 > Access in: 30th January 2021.

Menkil, A. An Integrated molecular and conventional breeding scheme for enhancing genetic gain in Mayze in Africa. Frontiers in Plant Science, 2019.

Ministério da Agricultura, Pecuária e Abastecimento [MAPA] Plano Nacional de Desenvolvimento de Florestas Plantadas (2018). Available at: < https://www.gov.br/agricultura/pt-br/assuntos/politica-agricola/outras-publicacoes/plano-nacional-de-desenvolvimento-de-florestas-plantadas.pdf > Access in: 29th March 2021.

Ministério da Agricultura, Pecuária e Abastecimento [MAPA]. Plano ABC. Available at: < https://www.gov.br/agricultura/pt-br/assuntos/sustentabilidade/plano-abc > Access in: 30th April 2021.

Ministério da Agricultura Pecuária e Abastecimento [MAPA]. Coordenação Geral de Agrotóxico e Afins. Manual de procedimentos para o registro de agrotóxicos. Brasília. 2012.

Ministério da Agricultura, Pecuária e Abastecimento [MAPA] O Plano Setorial de Mitigação e de Adaptação às Mudanças Climáticas para a Consolidação de uma Economia de Baixa Emissão de Carbono na Agricultura - Plano ABC. Available at: < https://www.gov.br/agricultura/pt-br/assuntos/sustentabilidade/plano-abc/plano-abc-agricultura-de-baixa-emissao-de-carbono > Access in: 15th January 2021.

Ministério da Agricultura, Pecuária e Abastecimento [MAPA]. Projeções do Agronegócio. Brasil 2019/2020 a 2029/2030 Projeções de Longo Prazo. Available at: < file:///C:/Users/Cliente/Downloads/PROJE%C3%87%C3%93ES%20DO%20AGRONEG%C3%93CIO_2019-20%20a%202029-30.pdf > Access in: 15th December. 2020.

Ministério da Indústria, Comércio Exterior e Serviços [MDIC] Comex Stat (2021). Available at: < http://comexstat.mdic.gov.br/pt/home > Access in: 30th April 2021.

Ministério do Meio Ambiente [MMA]. Monitoramento do Desmatamento da Floresta Amazônica Brasileira por Satélite (2020). Available at: < http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes > Access in: 19th January 2021.

Ministério do Meio Ambiente [MMA]. Fundo Amazônia. Available at: < http://www.fundoamazonia.gov.br/pt/home/ > Access in: 15th March 2021.

Ministério do Meio Ambiente [MMA]. Programa Floresta +. Available at: < https://www.gov.br/mma/pt-br/noticias/mma-institui-programa-floresta-para-remunerar-quem-protege-a-mata-nativa > Access in: 18th December .2020.

Ministério do Meio Ambiente [MMA]. REDD+Brasil. Available at: < http://redd.mma.gov.br/pt/noticias-principais/414-entenda-melhor-a-indc-do-brasil > Access in: 20 January 2021.

Miranda, R.A. Breve História da Agropecuária Brasileira (2020). Available at: < https://www.embrapa.br/busca-de-publicacoes/-/publicacao/1122598/breve-historia-da-agropecuaria-brasileira> Access in: 30th March 2021.

Neves, M.F. e Castro, L.T. Marketing e estratégia em agronegócios e alimentos (2003). Editora Atlas. 366 p.

Nishimoto, R. (2019) Global trends in the crop protection industry. Journal of Pesticide Science. 44(3), 141–147. DOI: 10.1584/jpestics.D19-101.

Objetivos de Desenvolvimento Sustentável [ODS] Indicadores Brasileiros para os Objetivos de Desenvolvimento Sustentável. Available at: < https://odsbrasil.gov.br/ > Access in: 20th April 2021.

Pawlak K. e Kołodziejczak M. (2020) The Role of Agriculture in Ensuring Food Security in Developing Countries: Considerations in the Context of the Problem of Sustainable Food Production.

Phillips McDougall (2018); Evolution of the Crop Protection Industry since 1960. PG Economics (UK). Crop biotechnology continues to provide higher farmer income and significant environmental benefits (2020). Available at: < https://pgeconomics.co.uk/press+releases/25/nology+continues+to+provide+higher+farmer+income+and+significant+environmental+benefits> Access in: 26th May. 2021.

Programa Brasileiro de Certificação Florestal (CERFLOR). Available at: < https://pgeconomics.co.uk/press+releases/25/ology+continues+to+provide+higher+farmer+income+and+significant+environmental+benefits> Access in: 26th May. 2021.

Programa Brasileiro de Certificação Florestal (CERFLOR). Available at: < https://snif.florestal.gov.br/pt-br/certificacao-florestal/322-certificacao-cerflor > Access in: 20th February. 2021.
Qaim M. (2020) Role of New Plant Breeding Technologies for Food Security and Sustainable Agricultural Development. Applied Economic Perspectives and Policy.

Sandeep Kumar et al. (eds.) (2019) Transgenic Plants: Methods and Protocols, Methods in Molecular Biology. Springer Nature.

Secretaria de Comércio Exterior [SECEX]. (2020). Available at: < http://www.investexportbrasil.gov.br/secex > Access in: 20th December. 2020.

Singh A, et al. (2019) Advances in controlled release pesticide formulations: prospects to safer integrated pest management and sustainable agriculture. Journal of Hazardous Materials,
Soman R. e Balachandran S., Trends and technologies behind controlled-release fertilizers. Controlled Release Fertilizers for Sustainable Agriculture, 2021.

Swale, D.R. (2019) Perspectives on new strategies for the identification and development of insecticide targets, Pesticide Biochemistry and Physiology. vol. 161, p. 23-32.
Tauger, M. B., Agriculture in World History. Routledge, 2 ed., 2020.

Tesfahun W., Climate change mitigation and adaptation through biotechnology approaches: A review. Cogent Food and Agriculture, 2018.

Thygesen, P. (2019) Clarifying the regulation of genome editing in Australia: situation for genetically modified organisms. Transgenic Research.

United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019: Highlights (ST/ESA/SER.A/423). Available at: < https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf> Access in: 15th January 2021.

United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revison. Available at: < https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf > Access in: 10th January 2021.

Van Eenennaam, A. L. (2014) Prevalence and impacts of genetically engineered feedstuffs on livestock populations. Journal of Animal Science, 92. Available at: https://asas.org/docs/default-source/jas-files/jas8124_final.pdf?sfvrsn

ATLAS OF BRAZILIAN AGRIBUSINESS
A SUSTAINABLE JOURNEY

This material was prepared with the aim of presenting data and facts that reveal the trajectory of Brazilian agribusiness, contextualizing how innovation and an integrated approach have contributed to sustainable agricultural production.

Idealization & organization:
Christian Lohbauer
Ary Albuquerque

Technical review:
Adriana Brondani
Leila Campos Vieira
Juliana Ramiro

Writing:
Gabriel Romeiro

Graphic design and layout:
Jéssica Lima