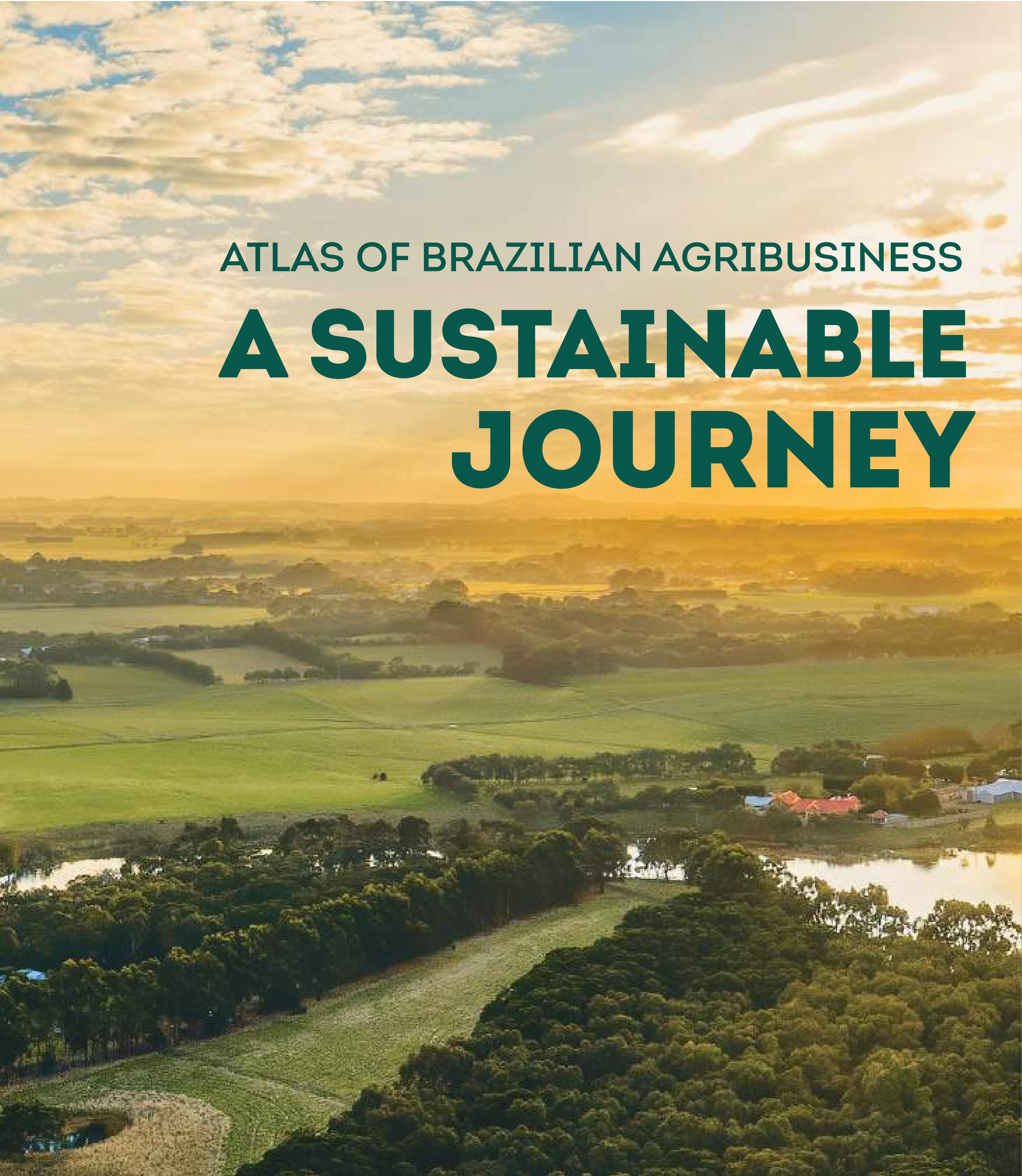

ATLAS OF BRAZILIAN AGRIBUSINESS

A SUSTAINABLE JOURNEY

2nd Edition - 2022

Brazil is one of the leaders in the production and export of food, fiber and energy, with potential for expansion in the sector. All this while keeping most of its biomes intact and its commitments to international agreements for the preservation of the environment. With a pioneering spirit and innovation in tropical technologies, opportunities will not be lacking for a country that is inwcreasingly entrepreneurial, with critical and technological capacity to position itself as the greatest power of 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 ambition is to present data and facts, highlighting how innovation and an integrated approach in the field have contributed to sustainability.

CropLife BRASIL

Connected by the farm.
Together for the future>

CHRISTIAN LOHBAUER
CEO OF CROPLIFE BRASIL

Introduction

In 2021, CropLife Brasil initiated a movement. Through the publication of the *Brazilian Agribusiness Atlas: A Sustainable Journey* we paved the way to show that present day Brazilian agribusiness is the result of a continuous improvement process that begun more than 50 years ago. Far from wanting to exhaust the discussion about the matter, the idea was to stimulate the dialogue and take it to a level beyond rhetorical fallacies and easy solutions, which are hardly ever efficient. CropLife believes that sustainability is a challenging goal, a sophisticated concept, and a transformation journey.

The revised and updated 2022 version of the Atlas intents to bring even more people to this conversation. This is because agribusiness, particularly the Brazilian, as one of the most important engines of society, does not have its limits where the fences of farms are. Once it produces feed and food, generates jobs and income, and protects the environment, it is an essential development driver and, as such, surpasses countryside boundaries. The sector is a fundamental piece of a global puzzle, since it nourishes, sustainably, as it is responsible and conscious of the future.

This new edition is an invitation to Brazilians and foreigners to discover the agribusiness because everyone is part of it. And also because it will be necessary a joint effort to help agriculture overcome unprecedented confluence of challenges by 2050. According to the Food and Agriculture Organization (FAO – UN) these threats are the 30 percent increment in the planet's population, the increased pressure of pests and diseases, the intensified competition for arable land, the scarcity of water and energy resources, and, finally, climate change.

Currently, Brazilian agribusiness harvests fruits of its dedication and sows future solutions. It is where constant evolution inspires revolutions. It is the place where innovation meets the will to continuously do more and better. That is why agribusiness is everywhere, touching everybody, at all times.

Connected by the farm,
Together for the <future>

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 increase in the supply of food, fiber and clean energy. By generating new and better technologies, our sector helps farmers face the challenges of producing food, in quantity and with quality.

2nd Edition

ATLAS OF BRAZILIAN AGRIBUSINESS:
A SUSTAINABLE JOURNEY

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BRAZIL

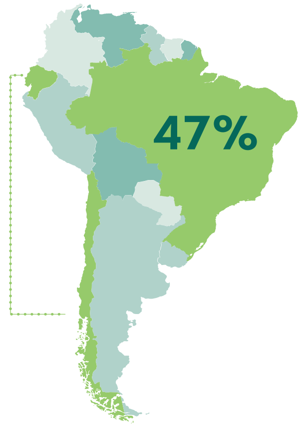
NUMBERS, HISTORY AND INSTITUTIONS

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 subcontinent, Brazil only does not share borders with two: **Chile and Ecuador.**

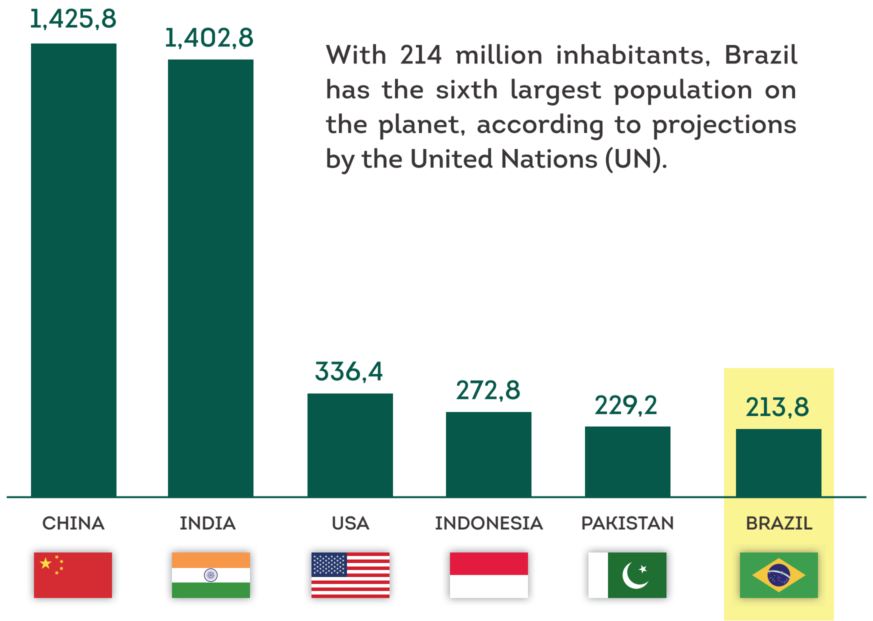


THE LARGEST COUNTRIES IN THE WORLD

source: IBGE (2018)

THE MOST POPULOUS COUNTRIES IN THE WORLD

(in millions of inhabitants)



With 214 million inhabitants, Brazil has the sixth largest population on the planet, according to projections by the United Nations (UN).

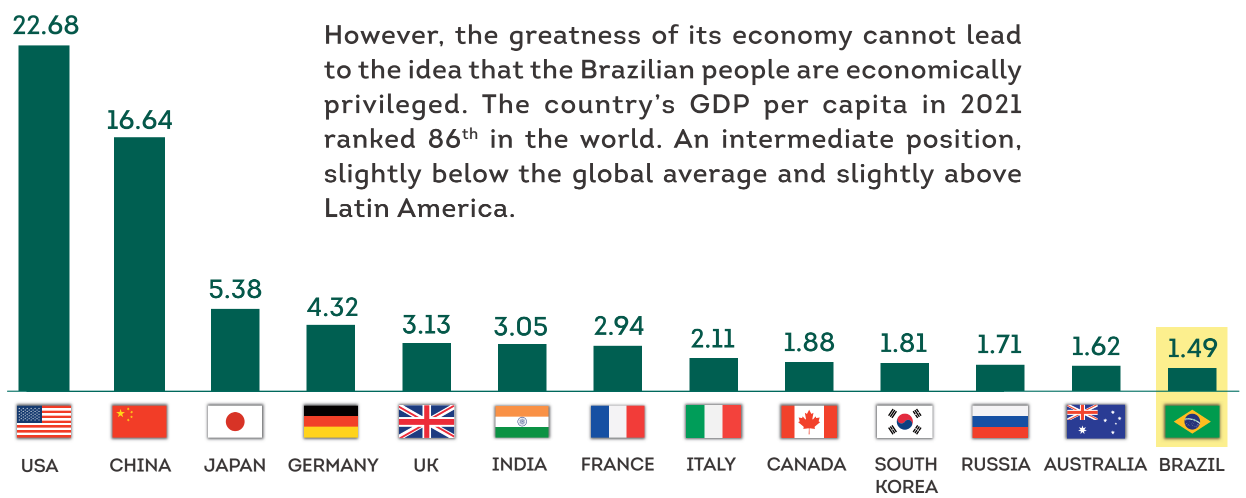
source: United Nations, World Population Prospects (2022)

GDP OF THE WORLD'S LARGEST ECONOMIES

(in trillions of dollars)

Brazil has a great economy. In 2021, its GDP (Gross Domestic Product) occupied the thirteenth position among the largest in the world.

However, the greatness of its economy cannot lead to the idea that the Brazilian people are economically privileged. The country's GDP per capita in 2021 ranked 86th in the world. An intermediate position, slightly below the global average and slightly above Latin America.



source: FMI (2021)

Biome diversity

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

49.30%

AMAZON

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)

2.10%

PANTANAL

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

Area: 151,581 (km²)

24.04%

CERRADO

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)

1.78%

PAMPA

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)

13.04%

ATLANTIC FOREST

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)

9.74%

CAATINGA

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

Area: 829,436 (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 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 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 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.

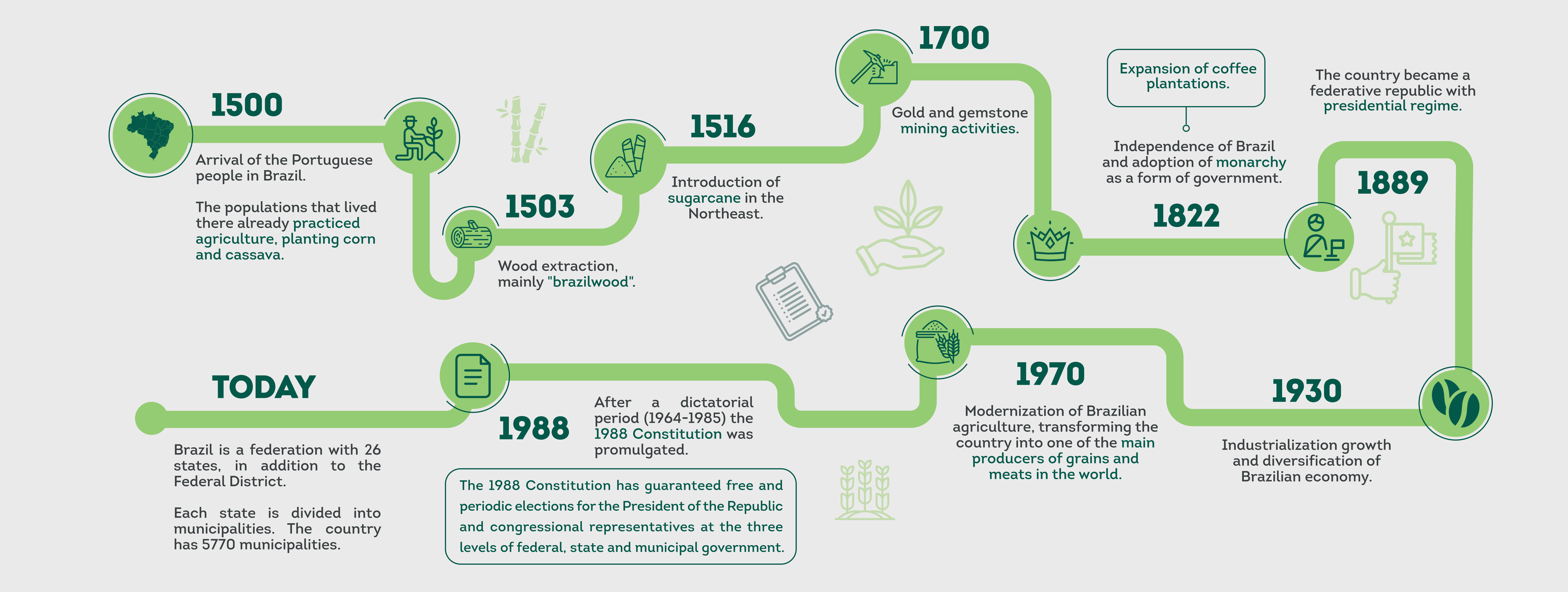
THE PAMPA

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 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.

A small part of a long history



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

The populations that lived here already practiced agriculture, mainly corn 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 is to date, one of the main products of Brazilian agriculture.

The first economic activity of the Portuguese people 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 is to date, one of the main products of Brazilian agriculture. In the 18th century, agriculture gave way to gold and gemstone 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.

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

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

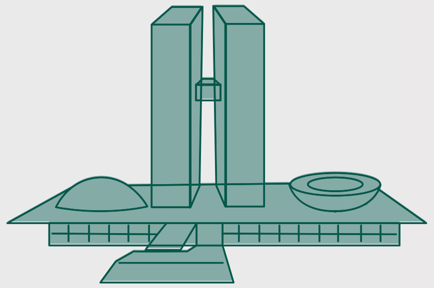
From the crisis of the 1930s and the Second World War, industrialization had a great impulse and the Brazilian economy was diversified.

Coffee continued to be the main agricultural product, but its importance for the economy as a whole was reduced.

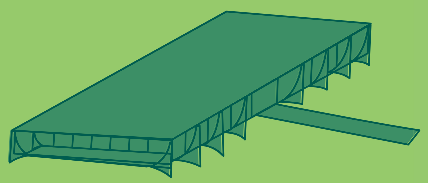
Brazilian agriculture entered a strong cycle of modernization in the 1970s. The process, which is still alive, made Brazil become an industry powerhouse, one of the world's leading grain and meat producers, within a period of less than 50 years, without abandoning advances in traditional crops, such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

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

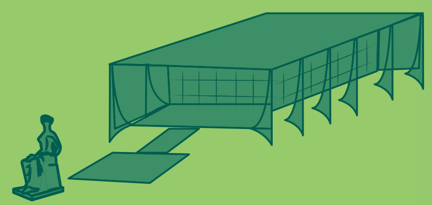
Brazil is a federation with 26 states, in addition to the Federal District, the federated unit where the capital, Brasilia, is located. Each state is divided into municipalities with very different populations and sizes. Altogether, Brazil has 5770 municipalities. At the federal level, Brazil is constituted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

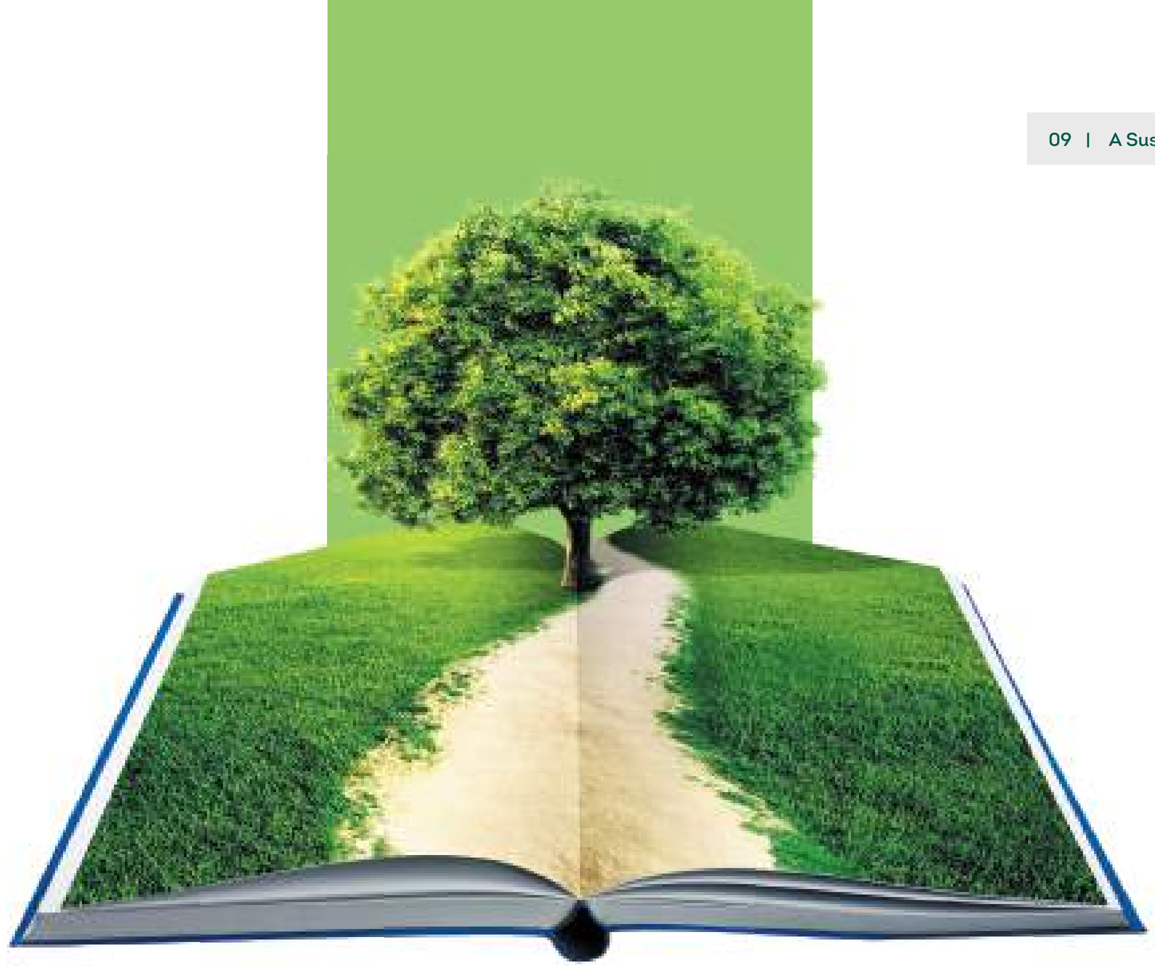
2003 - 2010
LUIZ INÁCIO LULA DA SILVA

2011 - 2016
DILMA ROUSSEFF

2016 - 2018
MICHEL TEMER

2019 - 2022
JAIR BOLSONARO

Environmental legislation



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

Since the beginning, after the arrival of the Portuguese people, Brazil has had laws aimed at protecting nature. Still in the 16th century, the colonial power 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 from 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. The most emblematic case is the one of Floresta da Tijuca, in Rio de Janeiro.

The initiative came from Emperor Dom 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 the elaboration of the environmental laws currently in force in Brazil.

1934

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

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

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.

The New Forest Code of 1965 updated the 1934 regulation and provided that rural properties had permanent preservation areas – to protect springs, water courses, 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 Secretariat for the Environment was created, the first federal agency dedicated to act 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.

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

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

1973

Creation of the Special Secretariat for the Environment, the first federal agency dedicated exclusively to 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.

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.

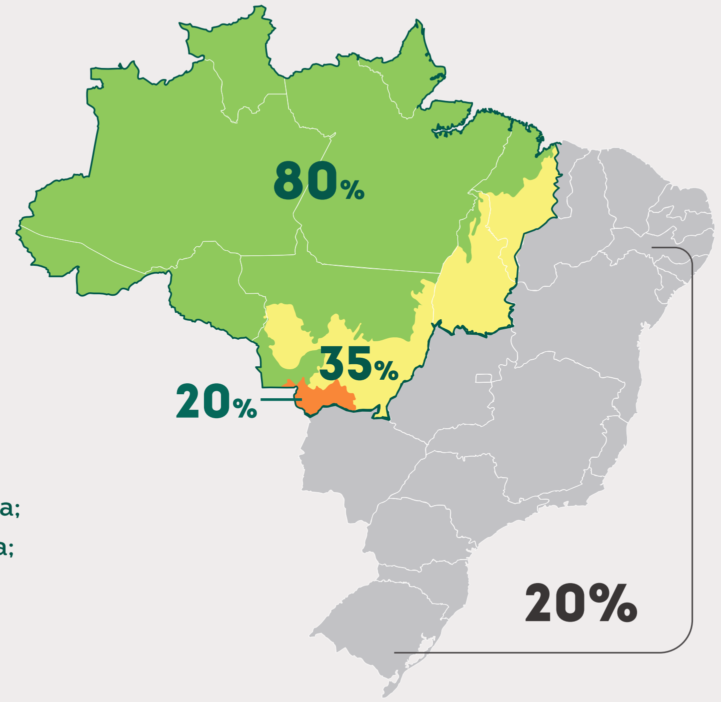
BRAZILIAN FOREST CODE (2012)

Area preservation on rural properties depending on the biome location:

Legal Amazon:

- 80% of the property located in a forested area;
- 35% of the property located in a Cerrado area;
- 20% of the property located in the area of general fields.

Other regions of the Country: 20%



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.

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

The current Brazilian Forest Code or Environmental Code was enacted in 2012 (Law 12651/2012), 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.

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, for example, the area destined for the Legal Reserve must be 80% of the property located in a forested area; 35% of the property located in a Cerrado area; 20% of the property located in the area of general fields.

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 agencies to act in agricultural production and the environment.

SUSTAINABLE

AGRICULTURAL PRODUCTION

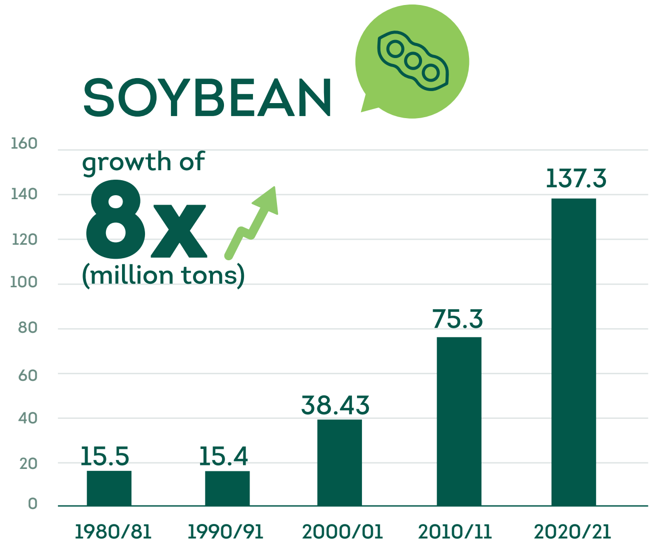
Agricultural production has expanded in the last 40 years

The expansion was mainly driven by grain production. In 1981 the country produced 52.2 million tons of grain; in 2021, almost 252.8 million. This represents an almost 5-fold growth in production.

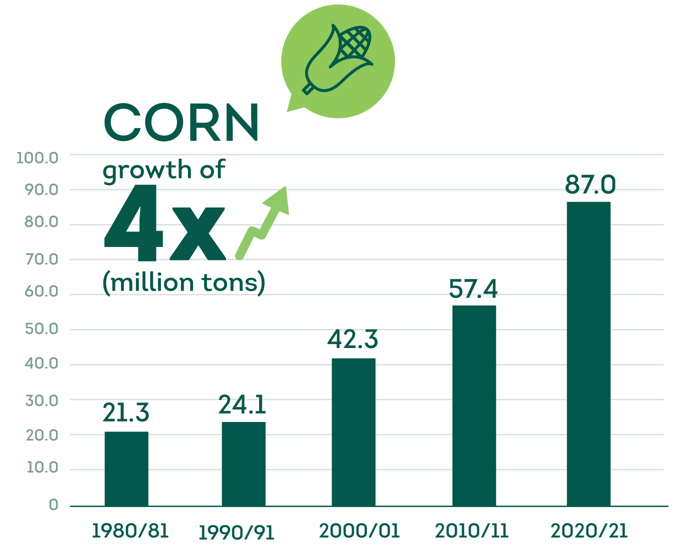
Brazil is one of the greatest agricultural powers on the planet. This fact was unimaginable just four decades ago. The expansion was mainly driven by grain production.

In 1981 the country produced 52.2 million tons of grain; in 2021, almost 252.8 million. This represents an almost 5-fold growth in production.

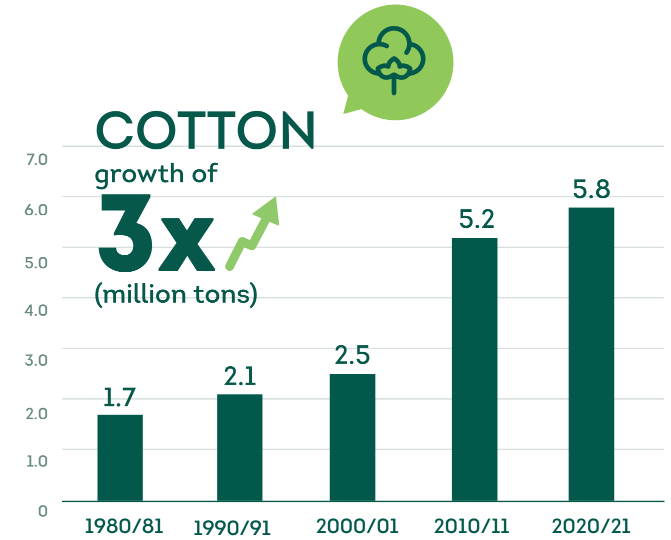
Even traditional crops in Brazil, which did not have such a regular growth, have changed their production level during this period. This is the case of sugarcane, which showed a 4-fold growth from 1981 to 2021.



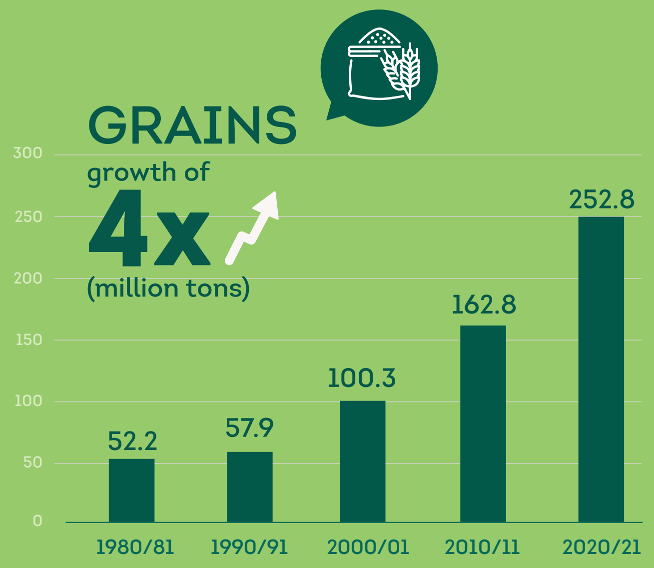
source: CONAB (december, 2021)



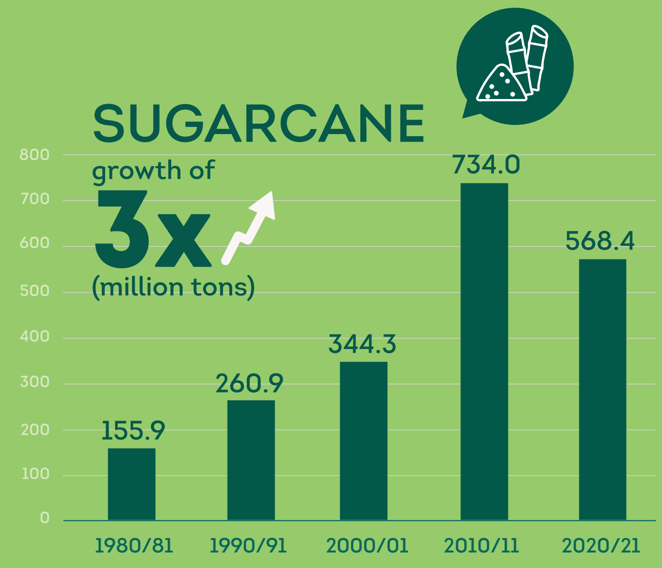
source: CONAB (january, 2021)



source: CONAB (december, 2021)

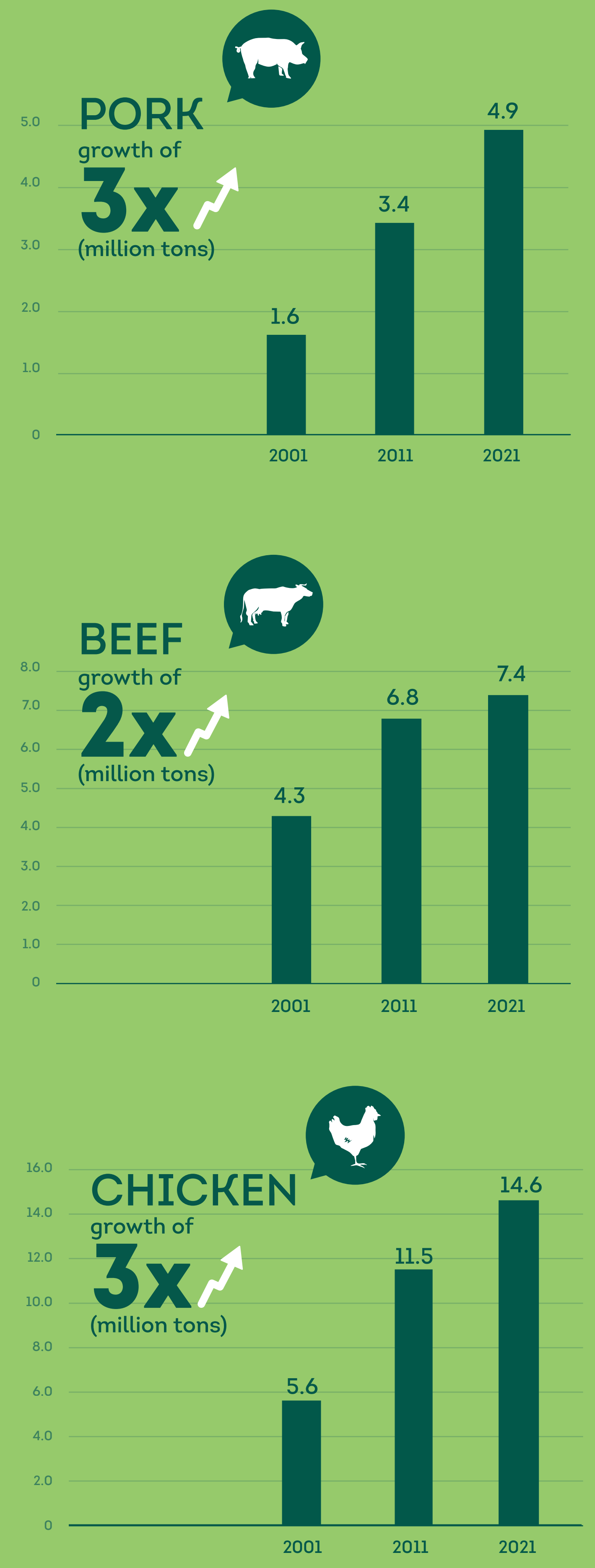


source: CONAB (december, 2021)



source: IBGE and CONAB (december, 2021)

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, almost twice for beef, and almost three times for chicken.



source: IBGE - Quarterly Survey of Animal Slaughter (2021)

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

CENTRAL-WEST
Cotton
Beef
Bean
Corn
Soybean
Sorghum

SOUTH
Rice
Chicken
Onion
Pork
Bean
Milk
Apple
Wheat
Grape

NORTHEAST
Pineapple
Banana
Coconut
Bean
Mango
Papaya
Watermelon

SOUTHEAST
Banana
Potatoes
Coffee
Sugarcane
Bean
Milk
Orange
Lemon
Chicken eggs
Tomato

source: IBGE: LSPA (september, 2020) / PAM (2019) / Quarterly Survey of Animal Slaughter (2nd quarter of 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.

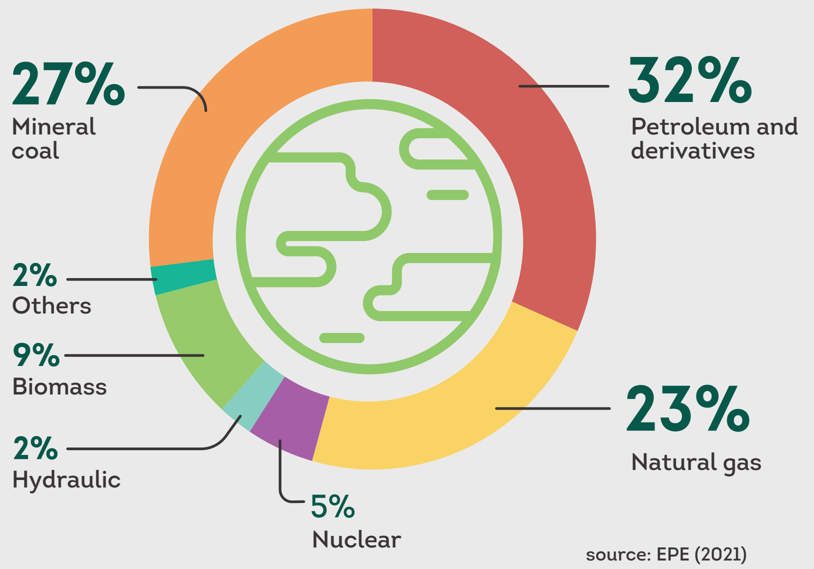
Worldwide, renewable energy sources account for only 13% of the energy matrix.

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

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.

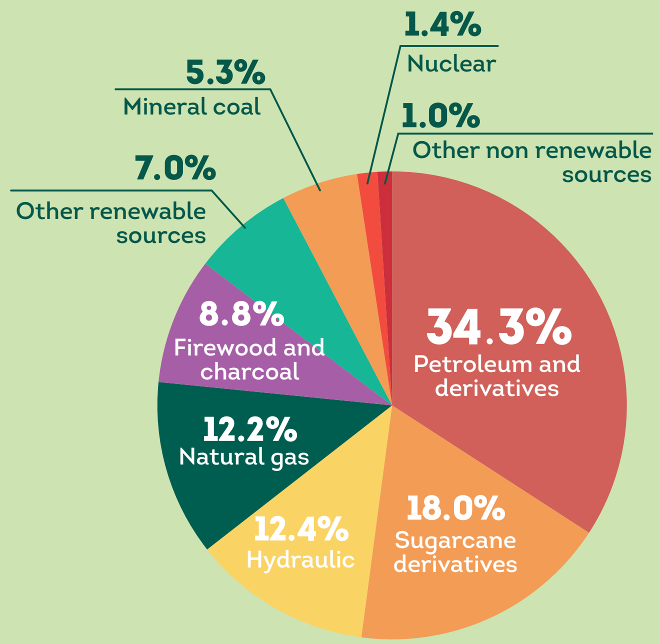
By far, the main raw material for ethanol is still sugarcane, but corn and other products such as oats, barley, wheat and sorghum have also started to be used. For biodiesel, the diversity of raw materials is greater, but soybean stands out.

WORLDWIDE ENERGY MATRIX

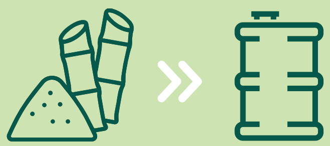


source: EPE (2021)

BRAZILIAN ENERGY MATRIX

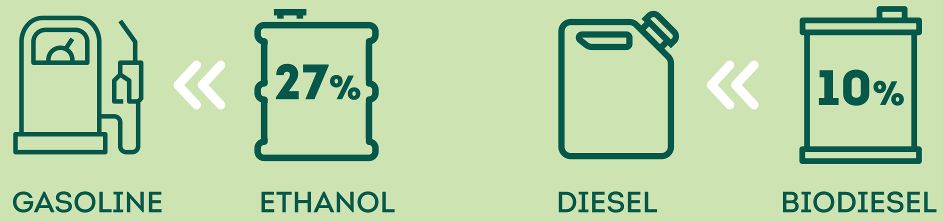


source: EPE/BEN (2019/2020) and ANP (2021)



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

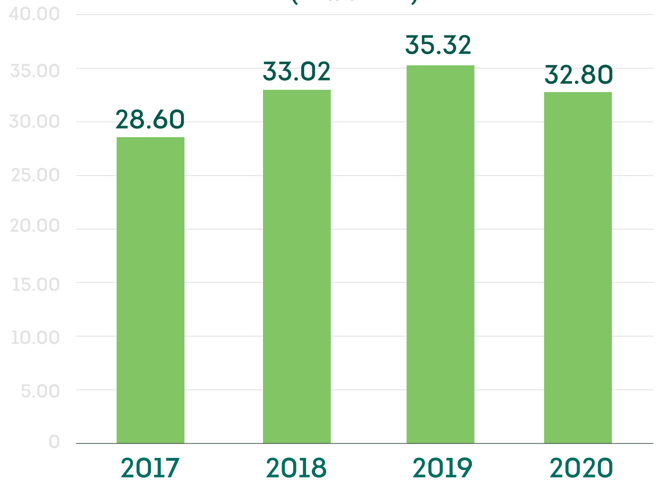
Currently, the gasoline used in the country is mandatorily mixed with 27% ethanol and diesel with 10% biodiesel.



Use of ethanol in Brazil reduces CO_2 emissions

ETHANOL PRODUCTION

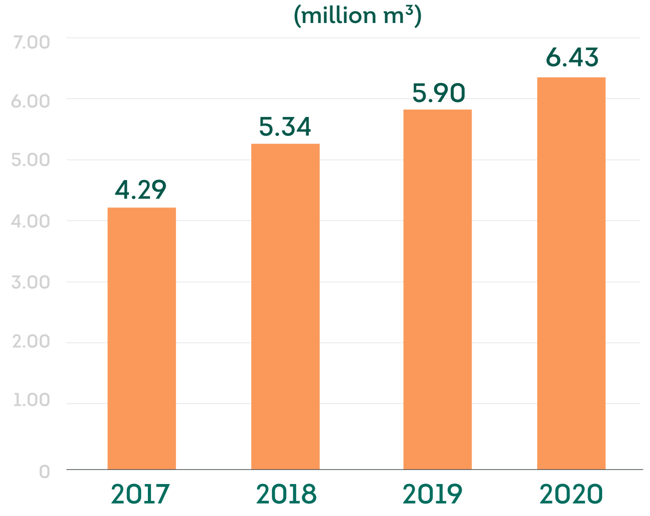
(million m³)



source: ANP (2021)

BIODIESEL PRODUCTION

(million m³)



source: ANP (2021)

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

Last year, the Brazilian Sugarcane Industry and Bioenergy 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.

According to the organization, the study was based on data from the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (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.

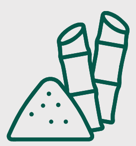
In addition, sugarcane biofuel practically eliminates the dispersion of particles that are harmful to health, which manages to penetrate into the deepest parts of the lung (-98% compared to gasoline and diesel), as well as toxic hydrocarbons (-99% in the emission of benzene, present in gasoline, and 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	CORN	OTHERS
99.65%	0.12%	0.23%



source: ANP (2020)

RAW MATERIALS USED IN BIODIESEL PRODUCTION

SOYBEAN 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 bean, babassu, sunflower, peanut, jatropha)	11.43%

source: ANP (2020)

Planted forests are the main source for various products in Brazil

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.

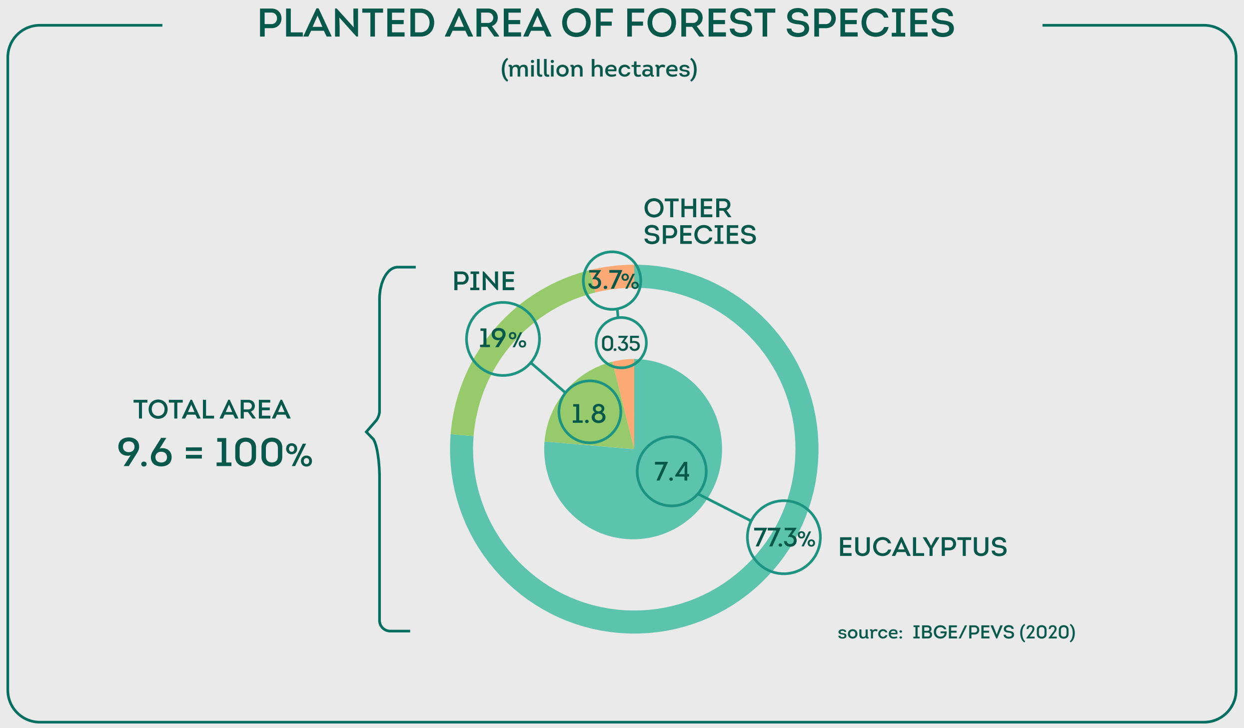
Although planted forests provide a significant part of the raw materials for bioenergy in Brazil, such as charcoal and firewood, they also produce wood for cellulose and other purposes.

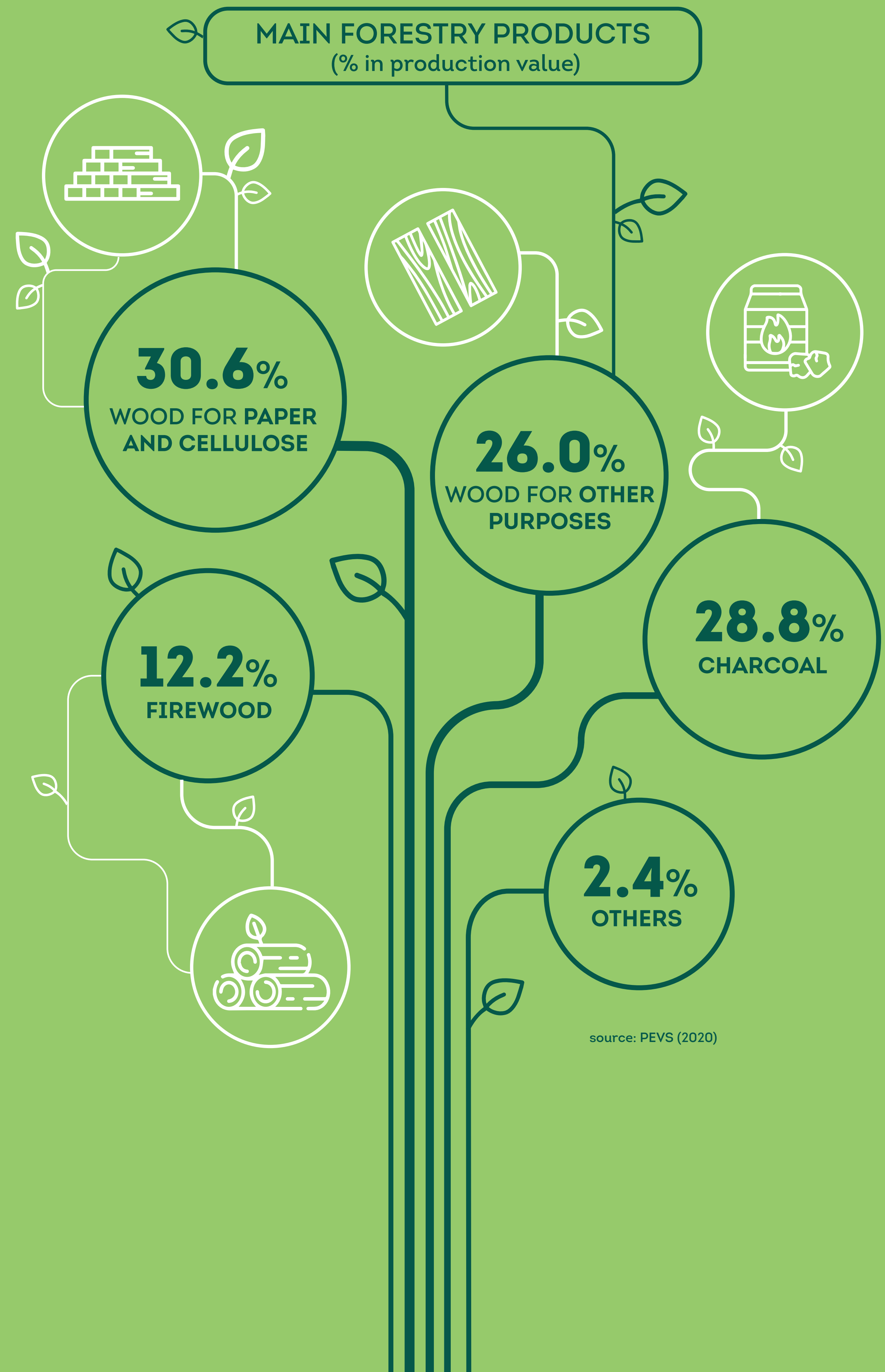
The first commercial forests were planted in the beginning of the 20th century, when there was a shortage of native wood for the railways in the state of São Paulo. A great growth occurred from the 1960s. Since 2000, the value of forestry production exceeded the one of plant extraction.

The results of the research on Production of Vegetal Extraction and Forestry (PEVS, in Portuguese) showed a reduction of 0.7% in the total area of planted forests in the country in 2020, which represents 70.9 thousand hectares of a total coverage of 9.6 million hectares. With the exception of the Southeast Region, which grew by 1.3%, the other regions reduced their planted areas.

The Southeast Region represents 37.2% of the planted forest areas in the country, especially eucalyptus, which predominates in 91% of the area.

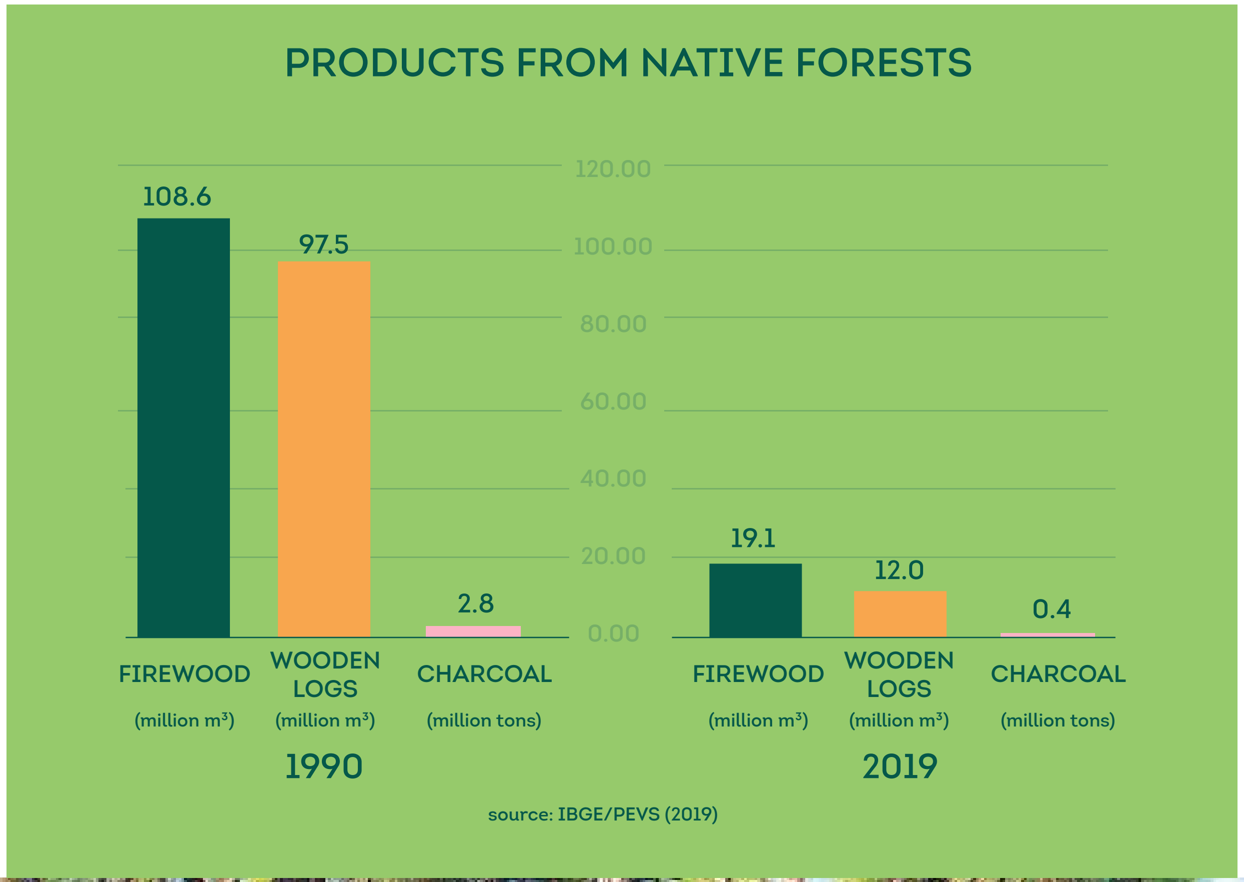
According to PEVS, in 2020, almost all groups of loggers surveyed indicated a predominance of eucalyptus wood-based production in the National Territory, with the exception of the use of pine logs for other purposes, which reached 50.1% of the total against 45.3% for eucalyptus.





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.

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 – PEFC (Programme for the Endorsement of Forest Certification), and the FSC (Forest Stewardship Council), an international organization.



Technology has increased agricultural production and saved area

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 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 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.

Brazil: multicropping's land

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

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, soybean has occupied an area x and 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.

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.

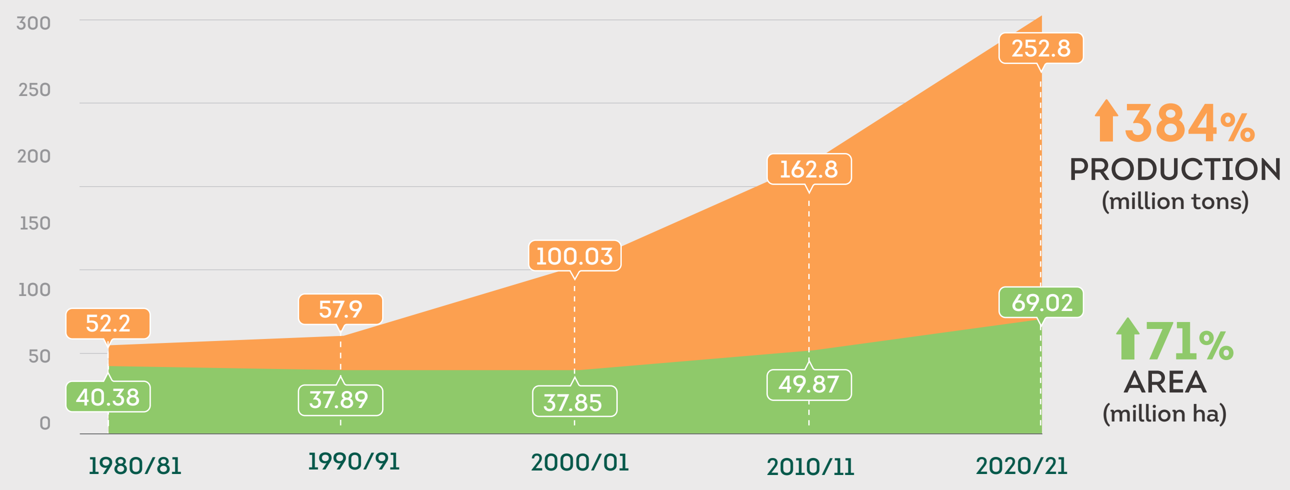
The most common rotation is between soybean and corn. However, depending on the region, several other crops are used, such as wheat, cotton and sorghum. In addition to soybean, corn can also be rotated with other crops, including pastures for temporary use.

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 1981 and 2021, while grain production grew 384%, the planted area did not increase by over 71%.

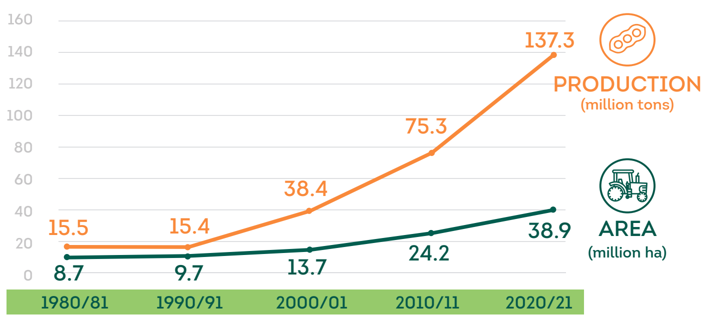
While the multi-crop model is used in almost all grain-producing regions of Brazil, it is impractical in places with very severe winters.

EVOLUTION OF GRAIN PRODUCTION AND PLANTING AREA



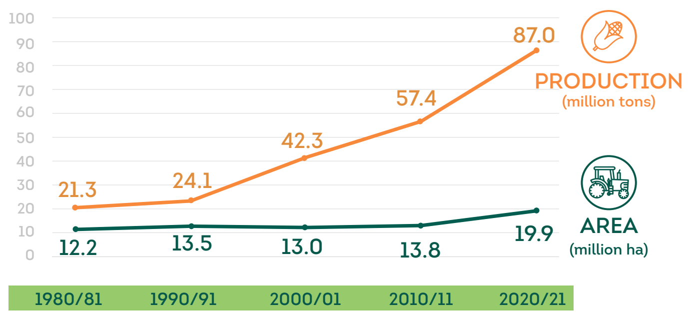
source: CONAB (december, 2021)

SOYBEAN - PRODUCTION X AREA



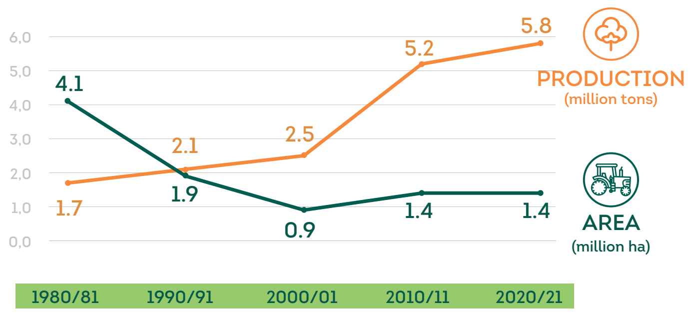
source: CONAB (december, 2021)

CORN - PRODUCTION X AREA



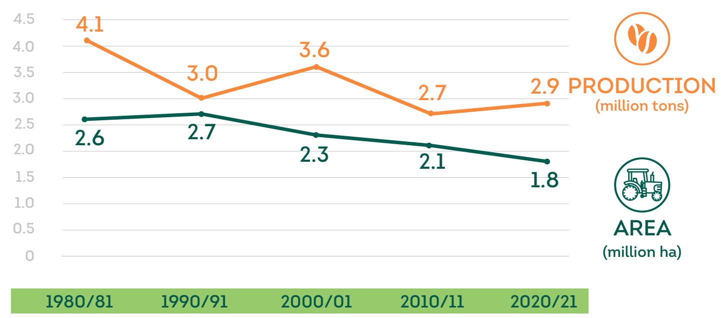
source: CONAB (december, 2021)

COTTON - PRODUCTION X AREA



source: CONAB (december, 2021)

COFFEE - PRODUCTION X AREA



source: IBGE, PAM, LSPA and 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.

Between 1981 and 2021, the increase in soybean area was 347%, while production grew 786%. In the case of corn, the difference is proportionally greater: production grew 308% and the area grew 63%.

This effect is even more pronounced in cotton, which, between 1981 and 2021, had a 241% increase in production and a 66% reduction in the area.

Also, regarding productivity gain, it's worth noting that, in the last decades, in some crops there was an increase in production accompanied by a reduction in the planted area. This was the coffee case, which in 2020 had 24% more production than in 1990, in an area 34% smaller.

In 2021, the area was 31% lower than in 1981, with a 29% reduction in production as well. This difference is characterized by the biennial condition of the crop, with production fluctuation in consecutive years. Due to the biennial nature, the coffee crop produces a high load in one year, and the next year the crop production is very low.

Fertilizers: increase in production yield and area savings

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

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.

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.

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.

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 as limestone.

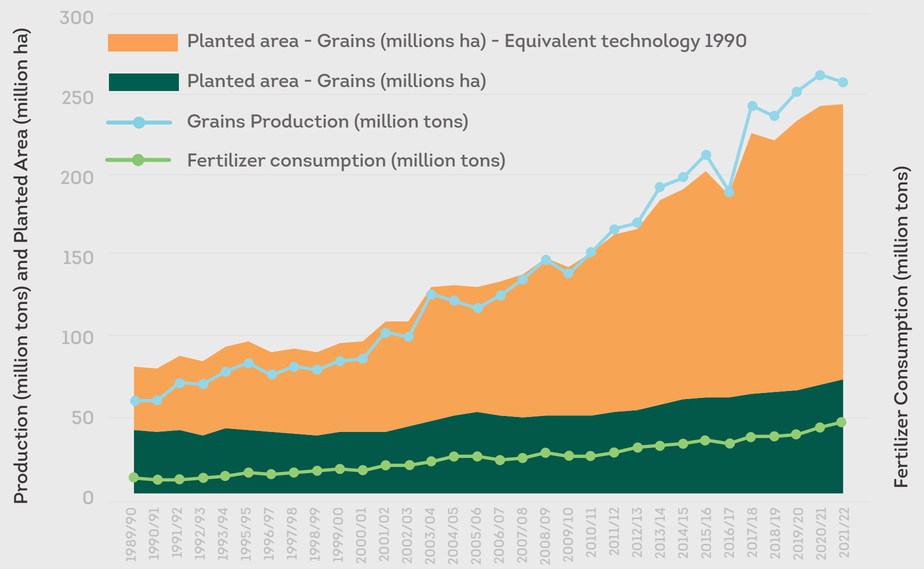
The use of fertilizers and correctives is one of the main contributors to the increase in agricultural productivity worldwide. They account for about 40 to 50% of the world's agricultural production. In Brazil, this value is not different. In the 1989/90 harvest, the country produced 58.28 million tons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

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.

By the 2021 harvest, 252.8 million tons of grain had been produced in 69.02 million hectares. In this context, in 1989, 1.50 tons were harvested per hectare, and in 2021 this value increased to 3.7 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.

EVOLUTION OF GRAIN PRODUCTION AND FERTILIZER CONSUMPTION



source: ANDA, CONAB (2021)

80% of the soybean area in Brazil uses microorganisms to fix nitrogen

The war in Ukraine made evident the strong dependence we have on the import of chemical fertilizers. In the case of nitrogen compounds, essential for plant growth, 77% come from abroad. The only crop that does not depend on this import is soy. And this is precisely due to the use of biological nitrogen-fixing microorganisms (N_2), which results in savings of approximately 10 billion dollars in nitrogen fertilizer, according to a study published in Frontiers in Microbiology.

In addition, the replacement of chemical fertilizers by N2-fixing microorganisms contributes substantially to the reduction of Greenhouse Gas (GHG) emissions.

Considering that each kilogram of nitrogen fertilizer corresponds to about 10 kg of CO_2eq emissions, one of the GHGs, approximately 430 million tons of CO_2eq would be released annually if no biological N_2 fixer were used in soybean plantations in Brazil.

Biological nitrogen fixation uses microorganisms, mainly bacteria, capable of capturing the nutrient from the air and making it viable for use by plants.

This ensures greater productivity in crops, in addition to economic and environmental gains.

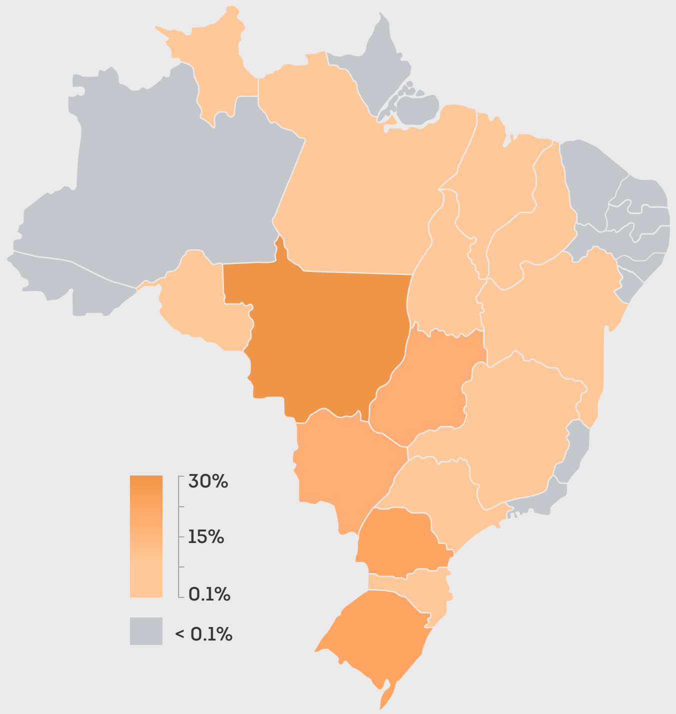
Brazilian soybeans have 80% of their planted area using *Bradyrhizobium*-based biofertilizers, nitrogen-fixing bacteria. This scenario shows the environmental and economic impact of replacing chemical fertilizers by these microorganisms.

Considering that Brazil is the largest producer and exporter of soy in the world, the impact of using this technology is particularly important. Plants mainly need three types of fertilizers to develop: nitrogen, phosphorus and potassium. In the case of soybeans, as nitrogen is supplied as a biofertilizer most of the time, only the other two nutrients are needed in the form of chemical fertilizer.

Brazil has been developing nitrogen biofertilizers since 1960, when soybean cultivation began to expand in the country. The idea was to develop and improve bacteria and microorganism-based products to replace chemical nitrogen. However, there has been a greater growth in the use of these products in the last ten years as genetic sequencing tools have become more accessible.

We can say that three major sectors acted strongly to allow the replacement of chemical nitrogen by microorganisms that fix this nutrient in soybean crops. First, research, through Embrapa and universities, which brought the technology needed for development; the legislature, which allowed the regulation of these products; and industry, responsible for adoption and commercialization.

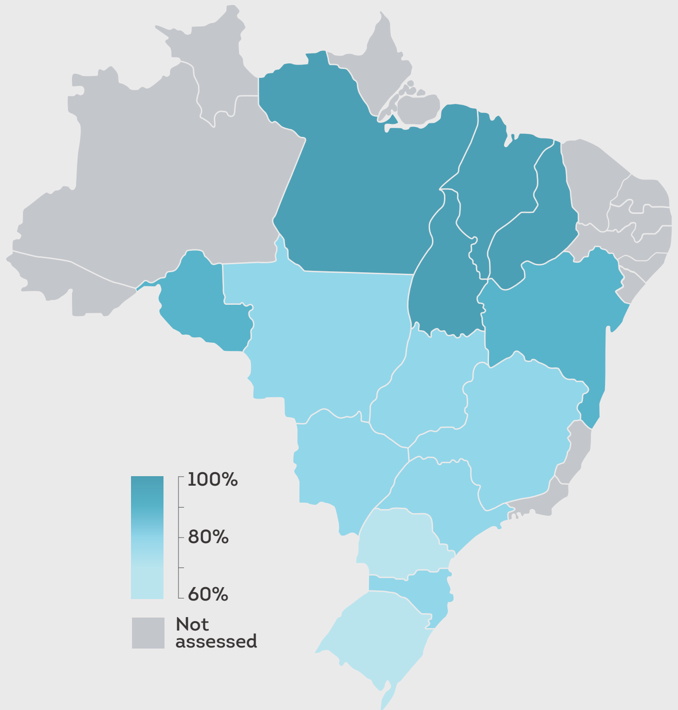
DISTRIBUTION OF AGTECHS BY REGION AND FEDERATIVE UNIT



source: Adapted from Olmo et al. (2022)

ADOPTION BY STATES OF *BRADYRHIZOBIUM* INOCULATION

Brazilian soybeans have 80% of their planted area using *Bradyrhizobium*-based biofertilizers, nitrogen-fixing bacteria. This scenario shows the environmental and economic impact of replacing chemical fertilizers by these microorganisms.



source: Adapted from Olmo et al. (2022)

Irrigation systems increase productivity and optimize water use

Many producers rely exclusively on rain to irrigate their crops. However, other farmers can count on wells and water courses close to the properties, obtaining this resource directly from aquifers and rivers, through irrigation.

The expansion of agriculture in Brazil was only possible thanks to the use of irrigation, especially in those regions affected by the continuous scarcity of water resources, such as in the Brazilian semiarid region, which requires the constant use of this practice. However, in regions affected by water shortages at specific times of the year, such as in the central region of the country, supplementary irrigation practices are required in the dry months.

According to data from the National Water and Sanitation Agency (ANA) and the Agricultural Census, Brazil has about 8.2 million irrigated hectares, but with potential for expansion in the coming years. Projections indicate the incorporation of 4.2 million irrigated hectares by 2040 – an average of around 200 thousand hectares per year – bringing the country closer to the total area of 12.4 million irrigated hectares.

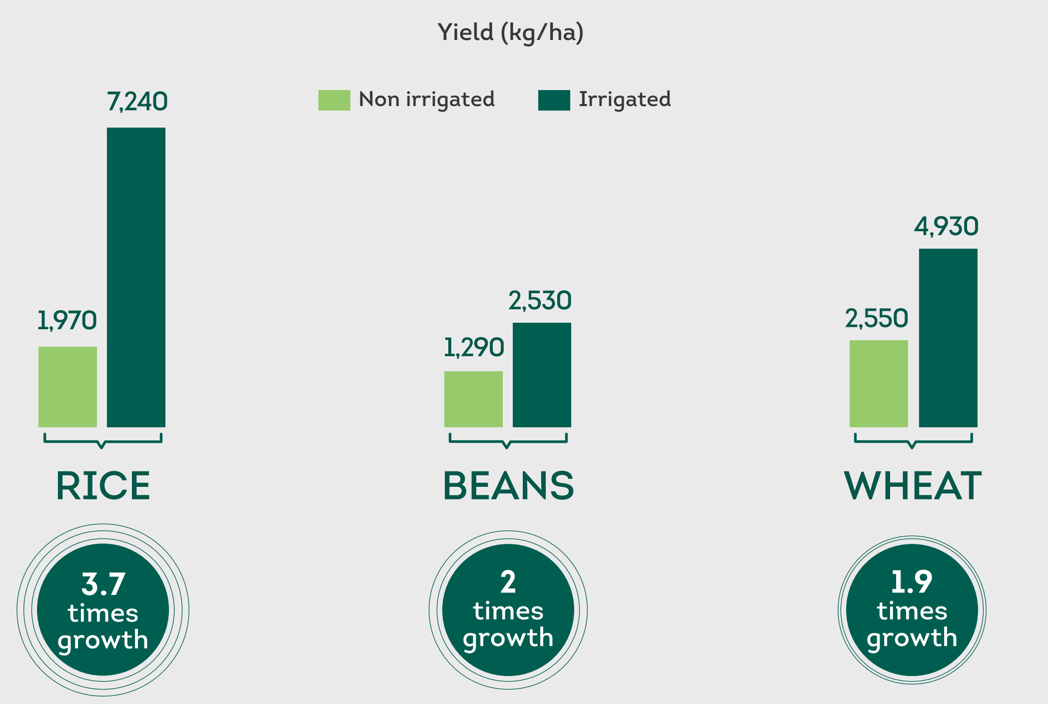
For many years, investments have been made in technologies and water infrastructures capable of meeting the demands of agricultural crops, without wasting this resource, which is highly susceptible to climatic variations.

All irrigation systems in Brazil must be authorized by the government and comply with the rational use of water, legal requirements and management instruments. They must also prioritize the sustainability of the activity, increasing efficiency and reducing waste.

The modernization of agriculture has made the capture and use of water resources key elements for the sustainable expansion of farming and increased productivity. In recent years it has been the central topic of discussions and partnerships between governments, universities and industries that have resulted in improvements in legislation and technologies for more efficient use of water.

Irrigated agriculture, in addition to providing stability in production, has the ability to increase it, as is the case with soybeans, whose productivity gain can reach 37% in irrigated crops. This difference in yield can also be observed in crops such as rice, beans and wheat, when compared to the same rainfed crops. Without the use of irrigation, a considerable increase in the planted area would be necessary to produce the same amount of food, evidencing the environmental importance of this resource in production systems.

YIELD IN PREDOMINANTLY IRRIGATED AND NON-IRRIGATED CONDITIONS – BRAZIL



source: from PAM information (IBGE, 2020) and Embrapa Rice and Beans (2020)

Genetic breeding 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.

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.

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.

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 breeding: a practice from ancestral farming

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.

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 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.

Also in prehistory, man became aware that by crossing only teosinte (corn's 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 people did not know that by cultivating these cereals for their food, they were already modifying the environment around them, and consequently, selecting genes and altering the genome of these plants.

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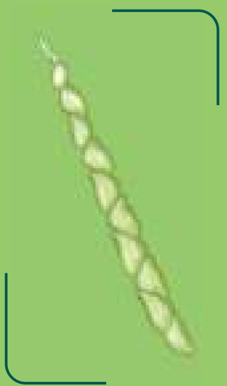
Nowadays, genetic improvement incorporates various knowledge from the biological sciences and is widely used in plants and farm animals.

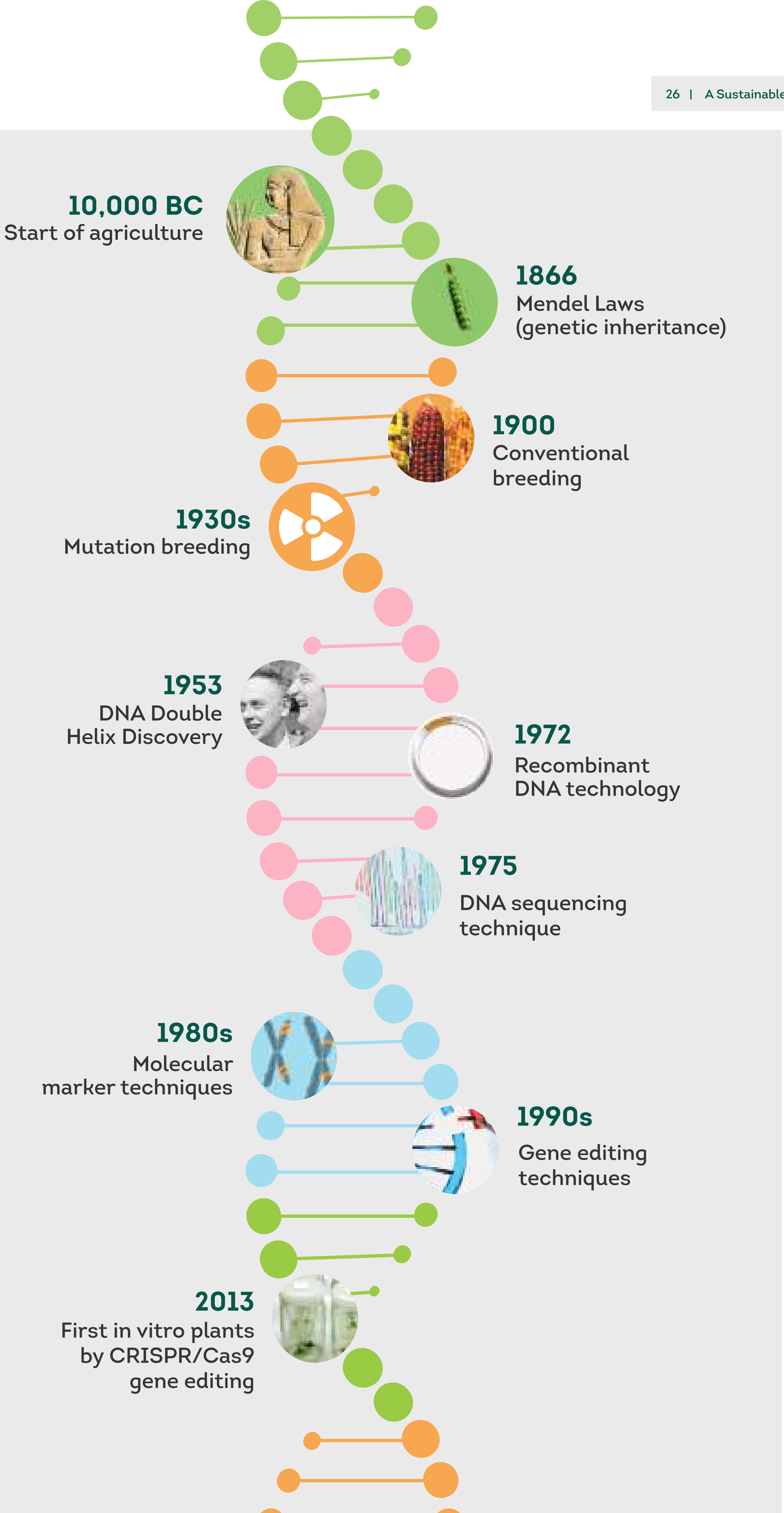


Teosinte

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.

The first GMO 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.

The first GMO 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.

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Brazil is the second largest GMO producer in the world

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.

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

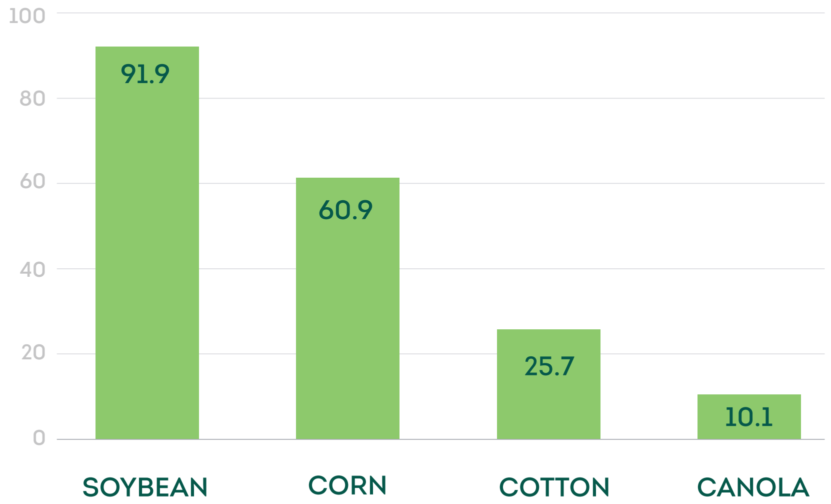
The development of biotechnology in agriculture stands out as an important factor associated with the efficiency gain of Brazilian agricultural production in the last two decades.

With 56 million hectares in 2021, Brazil has the second largest area of cultivation in the world. It accounts for 30.6% of the total cultivated area in the world. It is only behind the United States, and is followed by Argentina, Canada, India, and China.

In 2020, 74% of soybean in the world were genetic modified, as well as 79% of cotton, 31% of corn and 27% of canola crops.

GMO CROPS PLANTED AREA

(million hectares)

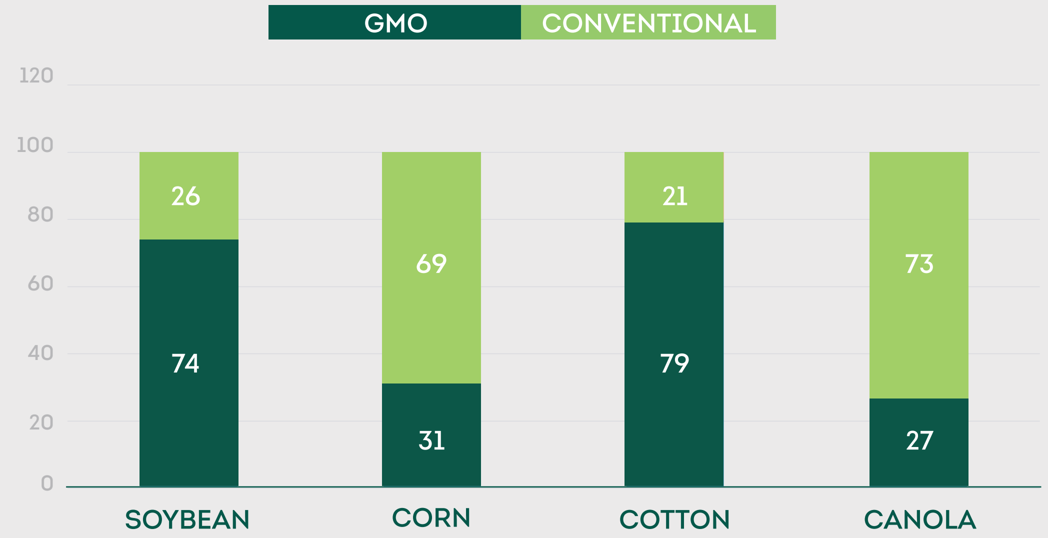


source: ISAAA (2019)

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.

THE MOST ADOPTED GMO CROPS WORLDWIDE

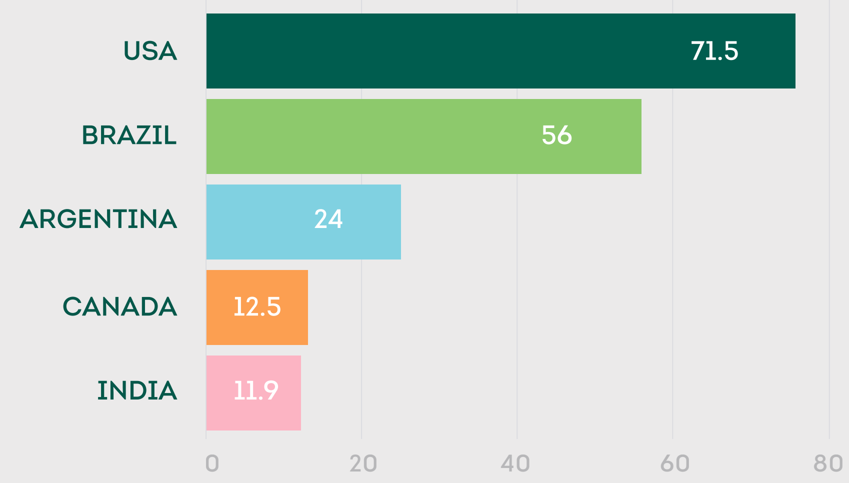
PLANTED AREA (%)



source: PG Economics, UK (june, 2020)

COUNTRIES WITH THE LARGEST ARES OF GMO ADOPTION IN THE WORLD

(million hectares)



source: ISAAA (2019), CLB (2022)

Over 20 years of GMO in the field confirm the expected benefits for Brazil

TOTAL AREA OF GMOS PLANTED IN BRAZIL

SOYBEAN* 37.4

CORN* 17.4

TOTAL* 56

SUGARCANE 37 thousand hectares

COTTON* 1.2

* in million hectares

source: ISAAA (2019), CLB (2022)

Soybean, with 37.4 million hectares, was the GMO crop with the largest planted area in Brazil in 2019, followed by corn, with 17.4 million hectares; cotton, with 1.2 million hectares; and sugarcane, which started in 2018 with 400 hectares, had an area of 37 thousand hectares in 2021.

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.

IMPACTS OF THE ADOPTION OF GMO 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 Years of GMOs in Brazil: Environmental, Economic and Social Impacts, 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 Years of GMOs in Brazil: Environmental, Economic and Social Impacts, Agroconsult (2018)

An adoption of biotechnology in the world gathers social, environmental and economic benefits

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 GMO crops stand out.

Added to these factors are the simplification and greater 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 GMO 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.

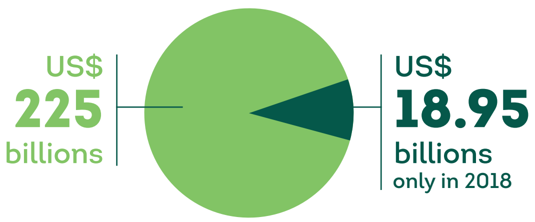
GMO had an incremental production of 278 million tons of soybean, 498 million tons of corn, 32.6 million tons of cotton, and 14 million tons of canola. The net income benefit for the world's agriculture, accumulated in the period from 1996 to 2018, was 225 billion dollars, an average increase of 96.7 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 GMO 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 soybean, 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.

GMO CROPS' SOCIOECONOMIC BENEFITS

Benefits obtained from the global production between 1996 and 2018:

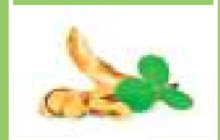


Agricultural biotechnology allows the use of sustainable techniques that, in 2018, resulted in a reduction of carbon dioxide emissions into the atmosphere by:

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

BIOTECHNOLOGY HAS PROVIDED AN ADDITIONAL PRODUCTION OF:

278 million tons of **SOYBEAN**



498 million tons of **CORN**

32.6 million tons of **COTTON**

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 Commission on Biosafety (CTNBio) is the committee 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).

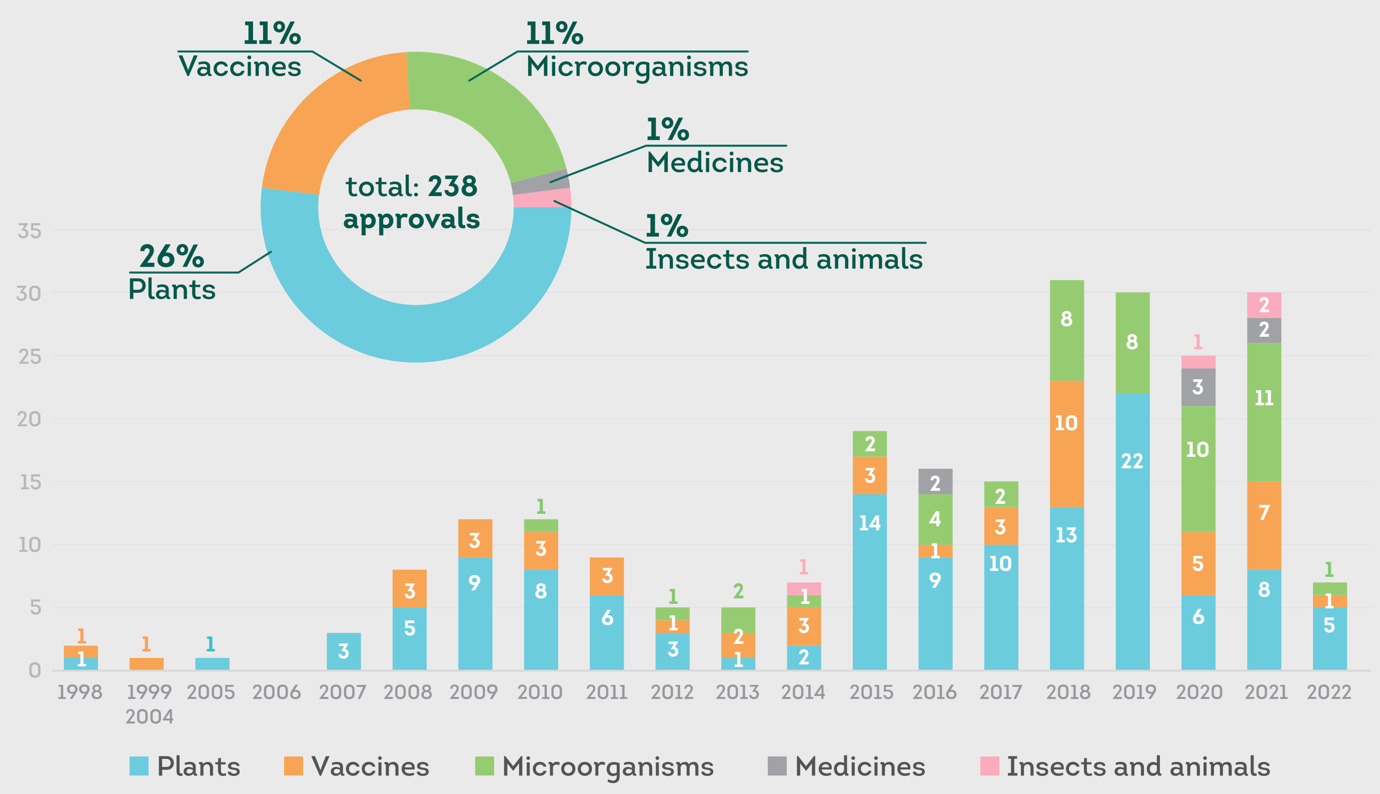
The Commission brings together 54 scientists, PhDs in various areas of knowledge, with the objective of providing technical advisory support to the federal government on issues related to GMO and derivatives.

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 Biosafety Quality Certificate (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.

The first authorization for the cultivation of GMO in Brazil was granted for glyphosate-tolerant GM soybean, 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:

GMO APPROVED BY CTNBio



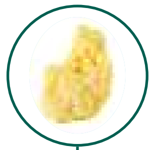
source: CTNBio (July, 2022)

- **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

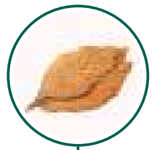


OVER 4,000 YEARS AGO

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

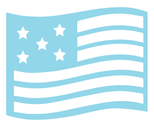
DDT is made available to farmers, a compound developed in 1874 and widely used in World War II to kill malaria-carrying mosquitoes.

1950

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

1960

Development of more efficient chemical products with less risk to human health and the environment.



1961

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

1970

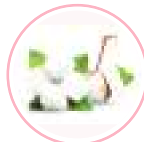
Introduction to the Integrated Pest Management (IPM) principles, with greater attention to infestation monitoring and timing for the application of crop protection products.

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 *Helicoverpa 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 breeding and biotechnology, play a crucial role in the success of Brazilian agricultural activity.

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.

Data from the Food and Agriculture Organization of the United Nations (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 on Applied Economics at the University of São Paulo (CEPEA/Esalq/USP) evaluated the impact of controlling pests and diseases in soybean 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.

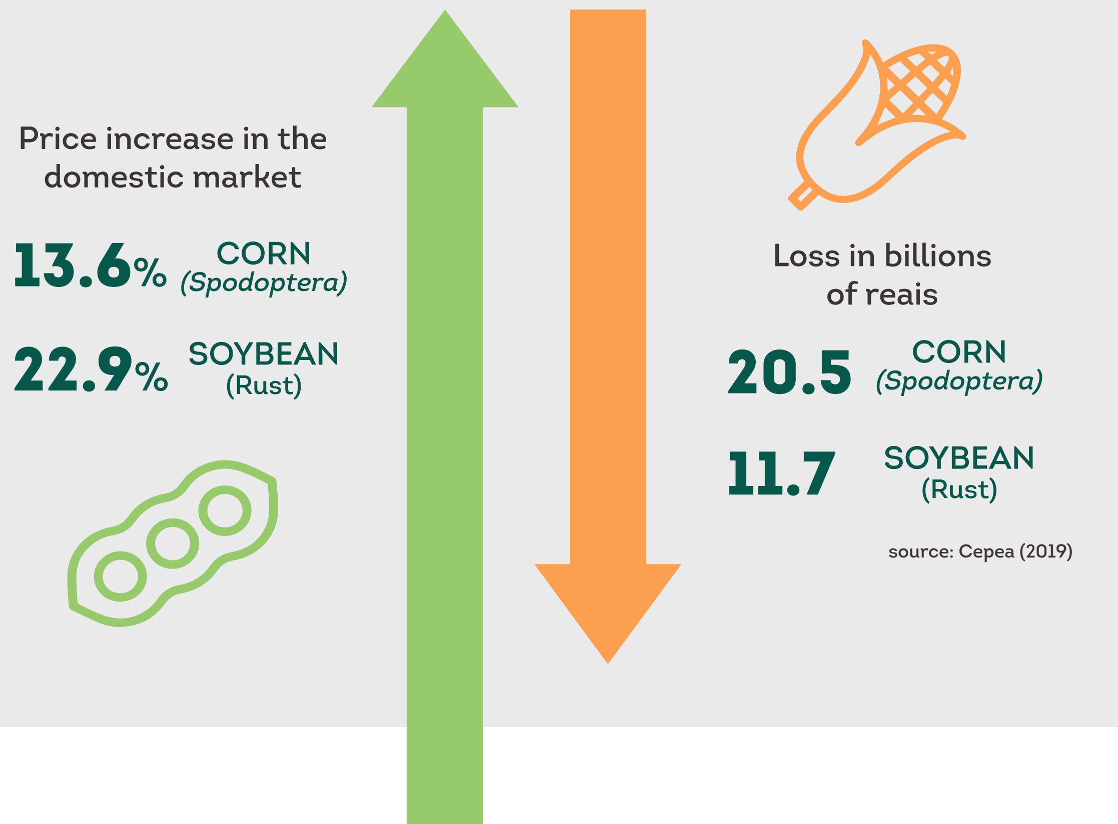
Regarding soybean rust, specifically, in order to assess the economic benefit of controlling the disease, CEPEA researchers simulated a condition in which producers would not use fungicides.

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 soybean in the domestic market.

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.

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



source: Cepea (2019)

Brazilian regulatory system guarantees safe foods for 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 to obtain registration: Anvisa (Brazilian Health Regulatory Agency), IBAMA (Brazilian Institute of Environment and Renewable Natural Resoures) and MAPA (Ministry of Agriculture, Livestock and Food Suply).

Each of these agencies 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.

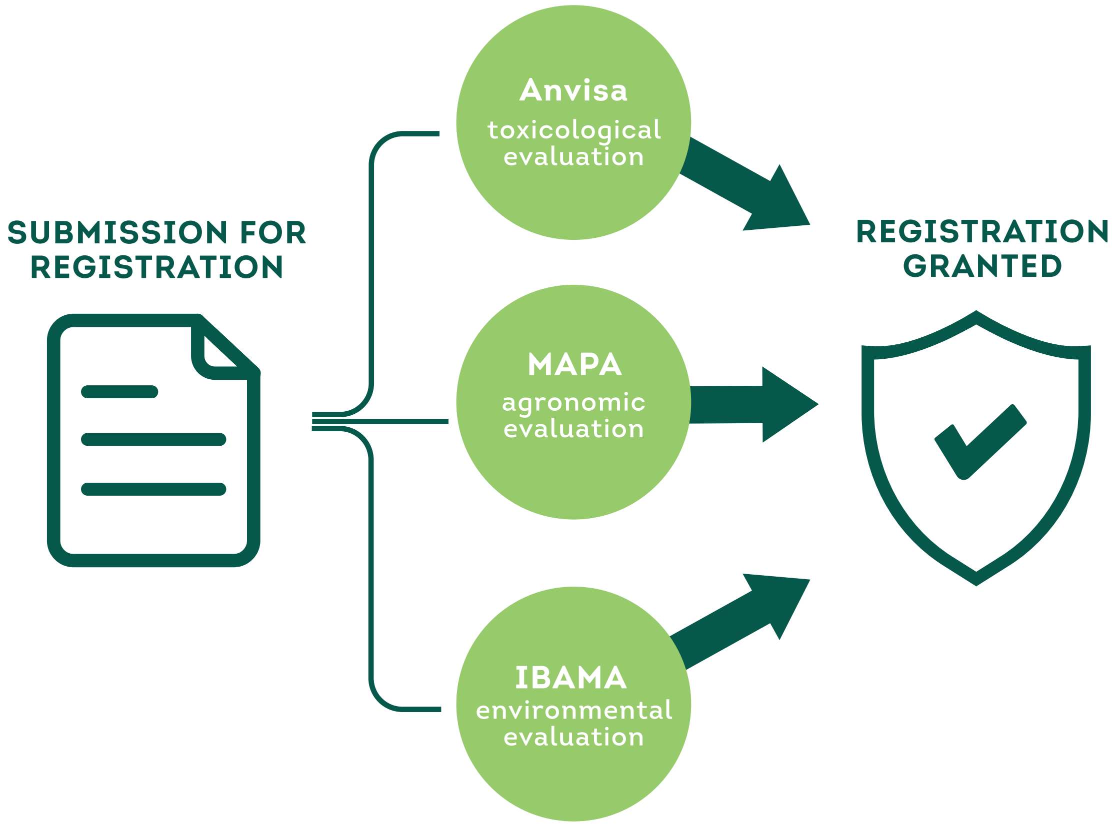
After this release, the products still undergo an analysis by each state so that they can finally be used by Brazilian farmers.

The substance that gives efficacy to the formulated final product is called the active ingredient.

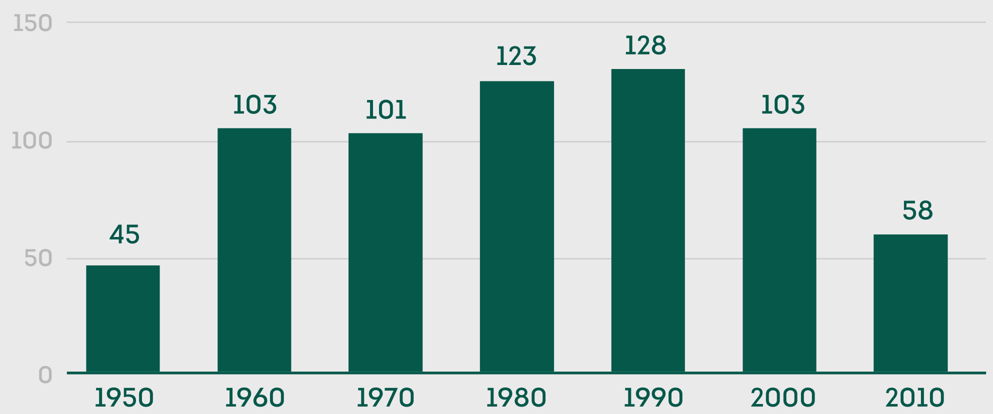
Worldwide, in the 1950s, 45 new active ingredients were made available for use in agriculture, such as herbicides, insecticides, and fungicides. In the 2010s, there was already an accumulated total of more than 600, the result of advances in science and investments in research and development.

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, the USA, and other members of the Organization for Economic Cooperation and Development (OECD).



NUMBER OF NEW ACTIVE INGREDIENTS INTRODUCED BY DECADE IN THE WORLD



source: Phillips MacDougall (2018)

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.

In the plant protection area, there is a continuous search for products that are 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.

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

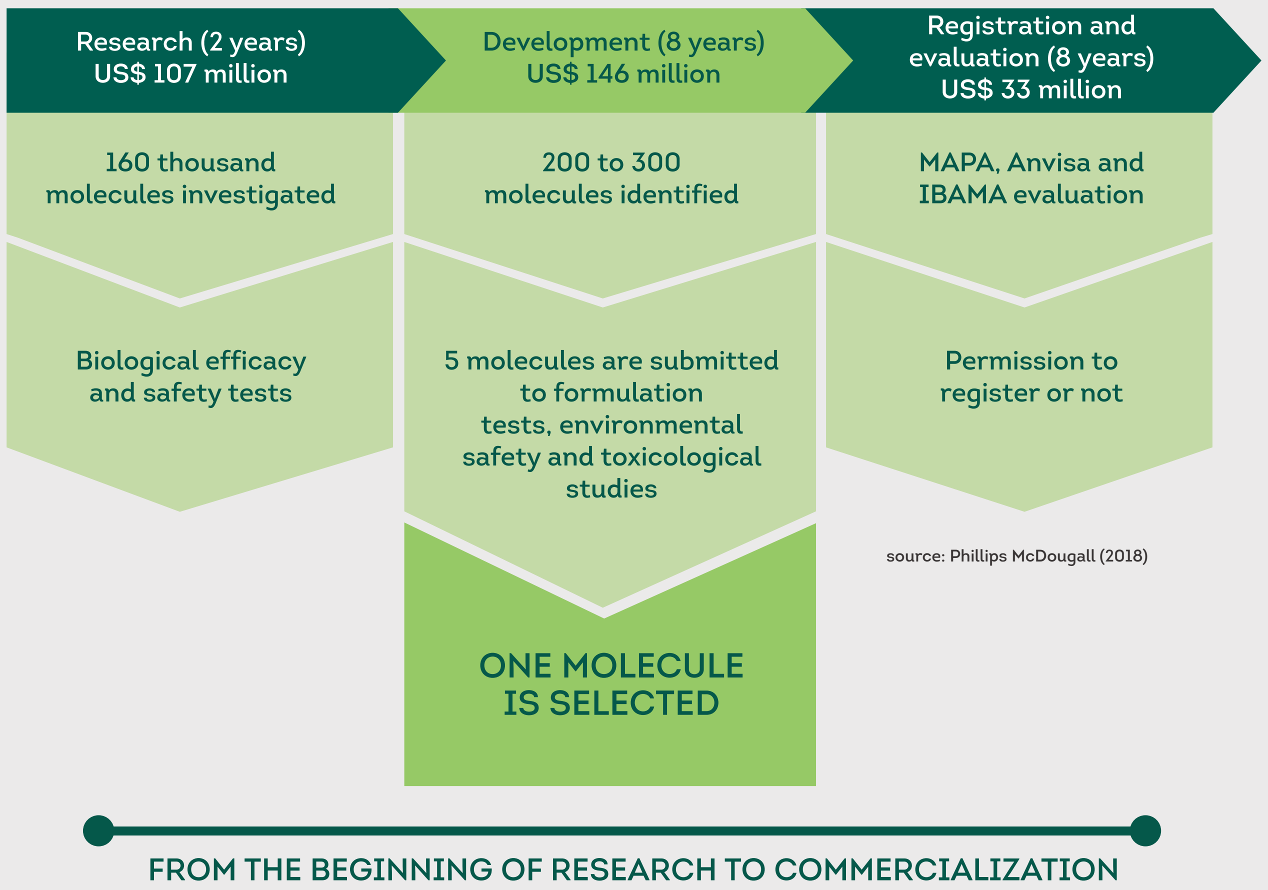
From the development into the approval of a new product or molecule can take up to 18 years in Brazil and requires an investment of approximately 286 million dollars.

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.

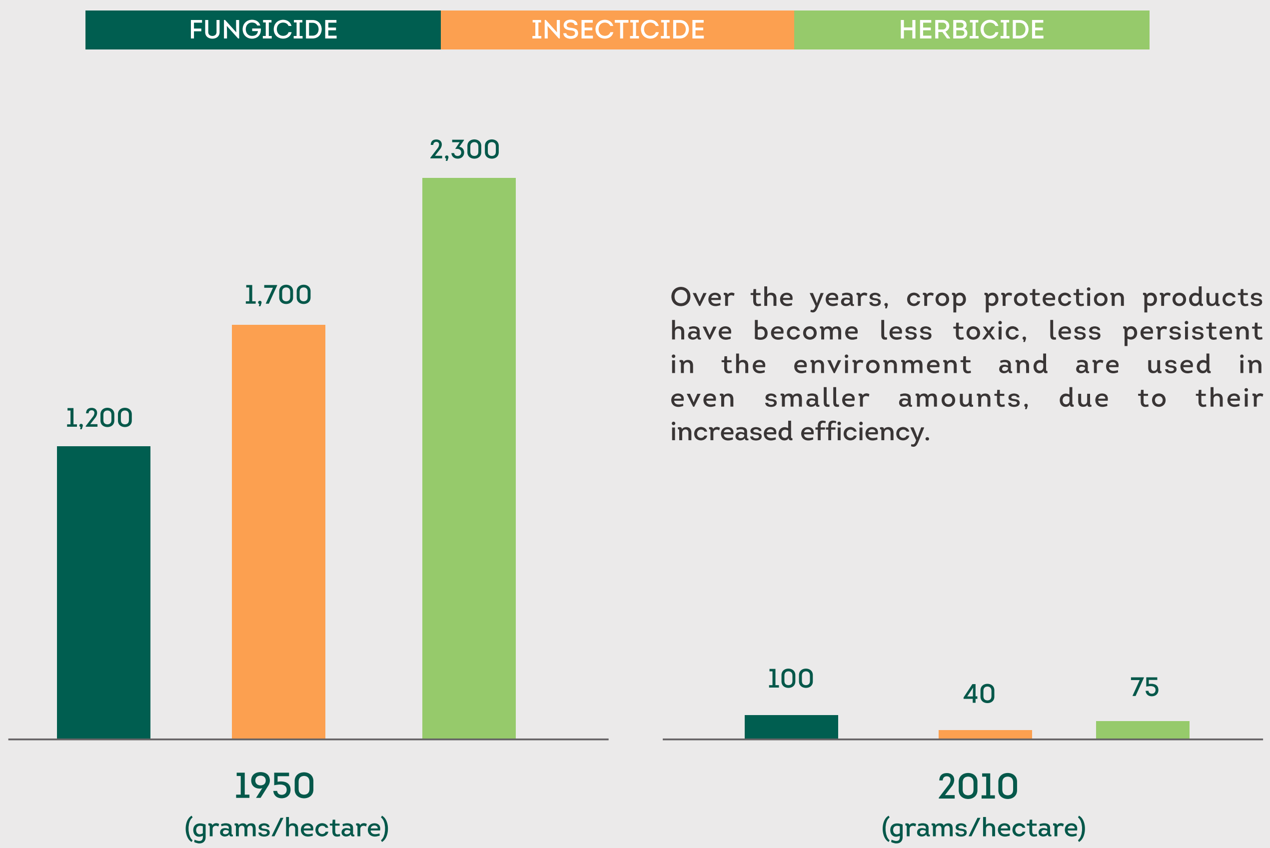
In the 1950s, the average rate of fungicides, insecticides and herbicides application worldwide was 1,200, 1,700 and 2,300 grams of active ingredient per hectare, respectively. By 2010, those numbers had dropped to 100, 40 and 75 grams.

RESEARCH AND DEVELOPMENT OF CHEMICAL PESTICIDES



source: Phillips McDougall (2018)

CONSUMPTION OF CHEMICAL PESTICIDES PER HECTARE



Over the years, crop protection products have become less toxic, less persistent in the environment and are used in even smaller amounts, due to their increased efficiency.

source: Phillips MacDougall (2018)

Brazil is the world's 25th pesticide consumer

The Brazilian consumption of pesticides 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.

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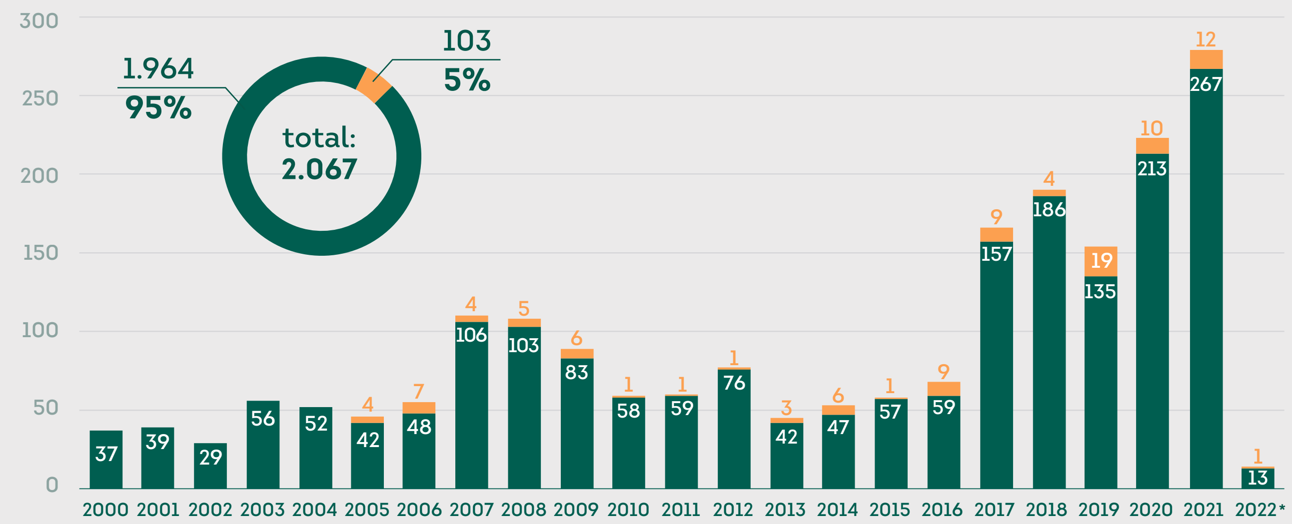
Considering the total volume of pesticides, Brazil ranked third as pesticide consumer in 2018, behind China and the United States.

However, when examining the consumption of chemical pesticides per hectare, Brazil drops to 25th place.

Among the countries that consume more than Brazil or are at the same level of consumption, there are six from the European Union, a region known to be strict in regulating the use of pesticides: Cyprus, the Netherlands, Malta, Belgium, Italy and Ireland.

CHEMICAL PESTICIDES REGISTERED IN BRAZIL



source: MAPA; Croplife (2022)

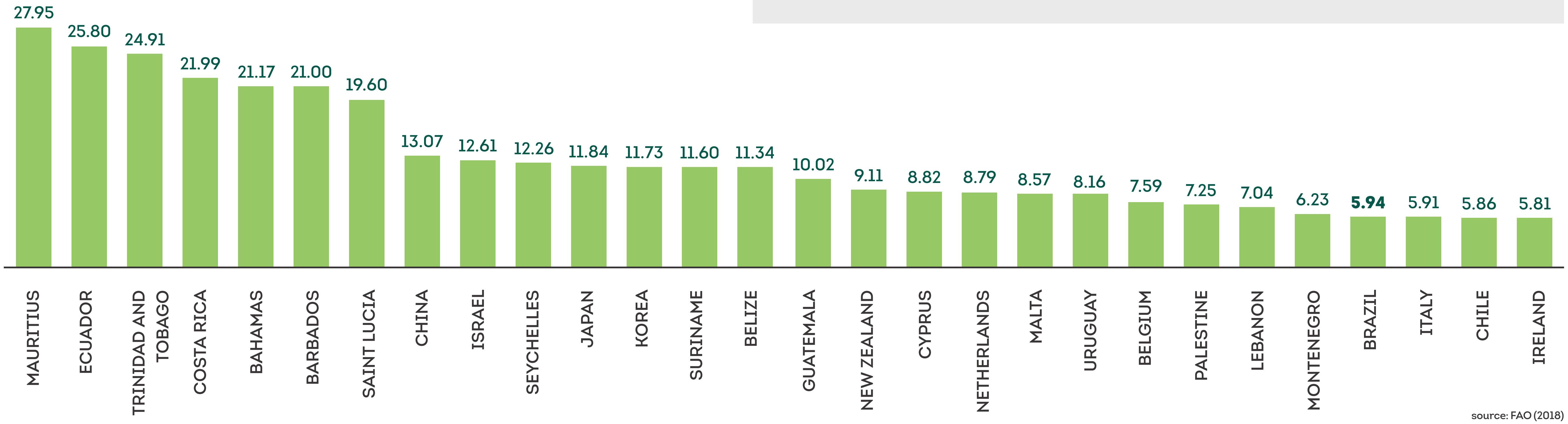
*april, 2022

Formulated Products (FP):
Developed from active ingredients and components that will constitute the formulation that had been previously registered in Brazil. Generic products (products developed from active ingredients that have lost their patent) are also included here.

New Formulated Product (NFP):
Developed from the new technical product whose formulation is unprecedented based on an innovative molecule.

CONSUMPTION OF CHEMICAL PESTICIDES PER HECTARE

(kg / hectare)



source: FAO (2018)

Brazil exports food to over 160 countries with strict waste control

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.

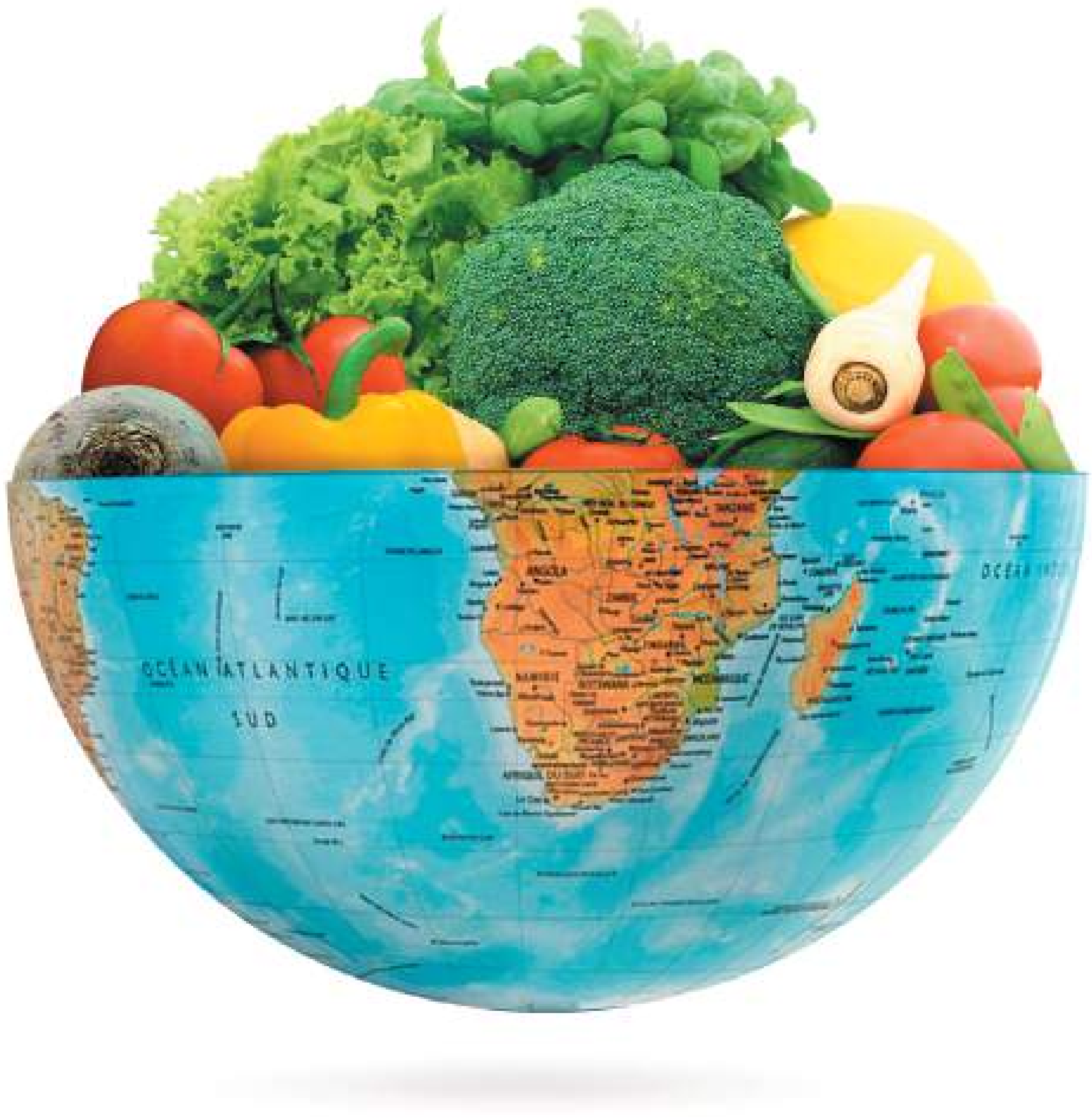
In Brazil, the responsibility for supervising the use of pesticides is shared between the Union and the States. MAPA has a program for the analysis of pesticides residues (National Plan for the Control of Residues and Contaminants in Products of Vegetal Origin – PNCRC) that collects food samples directly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



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

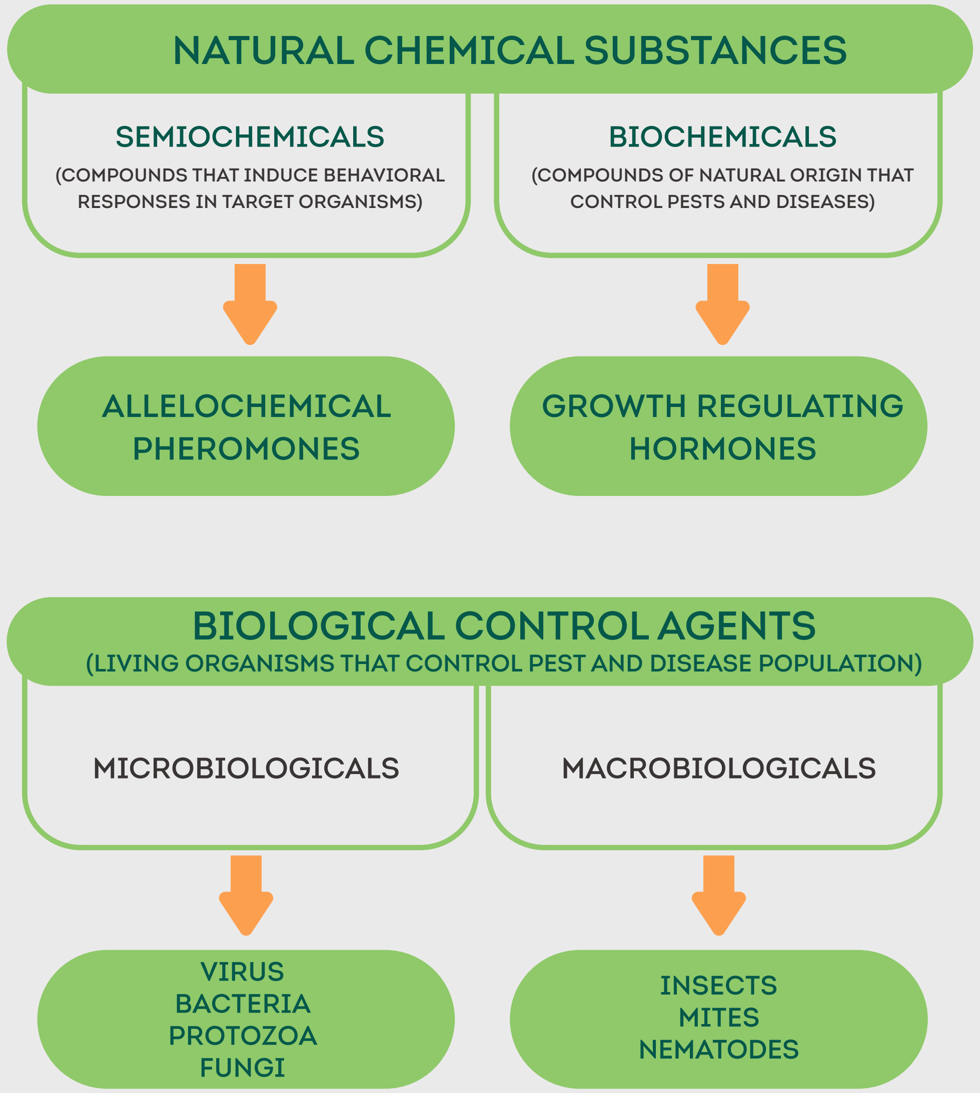
	Brazil	EU countries**
Samples	4616	389
Food	14	10
Active ingredients	270	169
Non-compliance	41	4
	Samples (0.89%)	Samples (0.90%)

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

The number of biological pesticides registered in the last 20 years in Brazil is greater than the number of chemical pesticides

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 and 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.

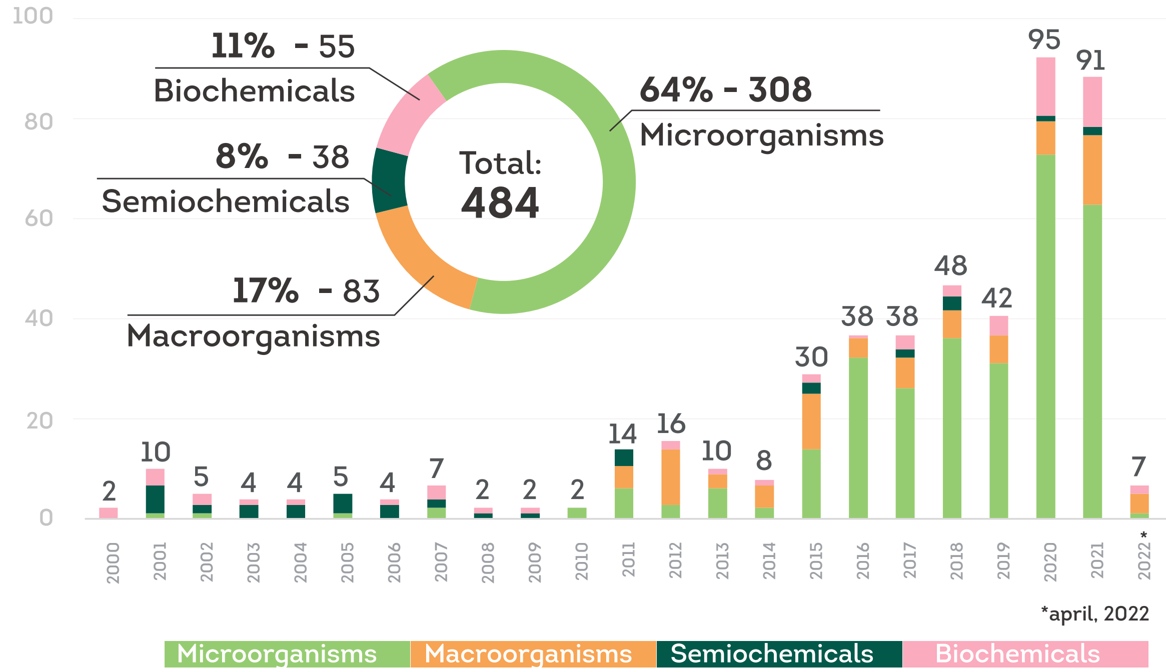
Between the 1960s and 1980s, there were very few launches of new biological crop protection products. The situation began to change in the 1990s. In the last 20 years, the number of new biological products registered has surpassed the number of chemical products registered in the period.

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 agencies – 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 agencies.

In 2020, 96 new biological products were registered in Brazil, an annual record. A consolidated table from March 2022 showed a total of 484 registration granted since 2000.

BIOLOGICAL PRODUCTS APPROVED IN BRAZIL SINCE 2000



source: MAPA (2022)

Information technology increases productivity and sustainability of Brazilian farms

Brazilian agribusiness has entered the digital universe once and for all. Agriculture 4.0, which gained momentum in 2010, opened a new frontier of possibilities to make farms and agro-industries even more productive, efficient and sustainable.

Techniques and tools such as drones, robots, sensors for collecting and transmitting data and software, among other innovations, allow monitoring climate and soil conditions, locating outbreaks of diseases or even the need for water and nutrients in crops. Always with extreme precision. And it still has autonomous machines, which do not require the presence of operators.

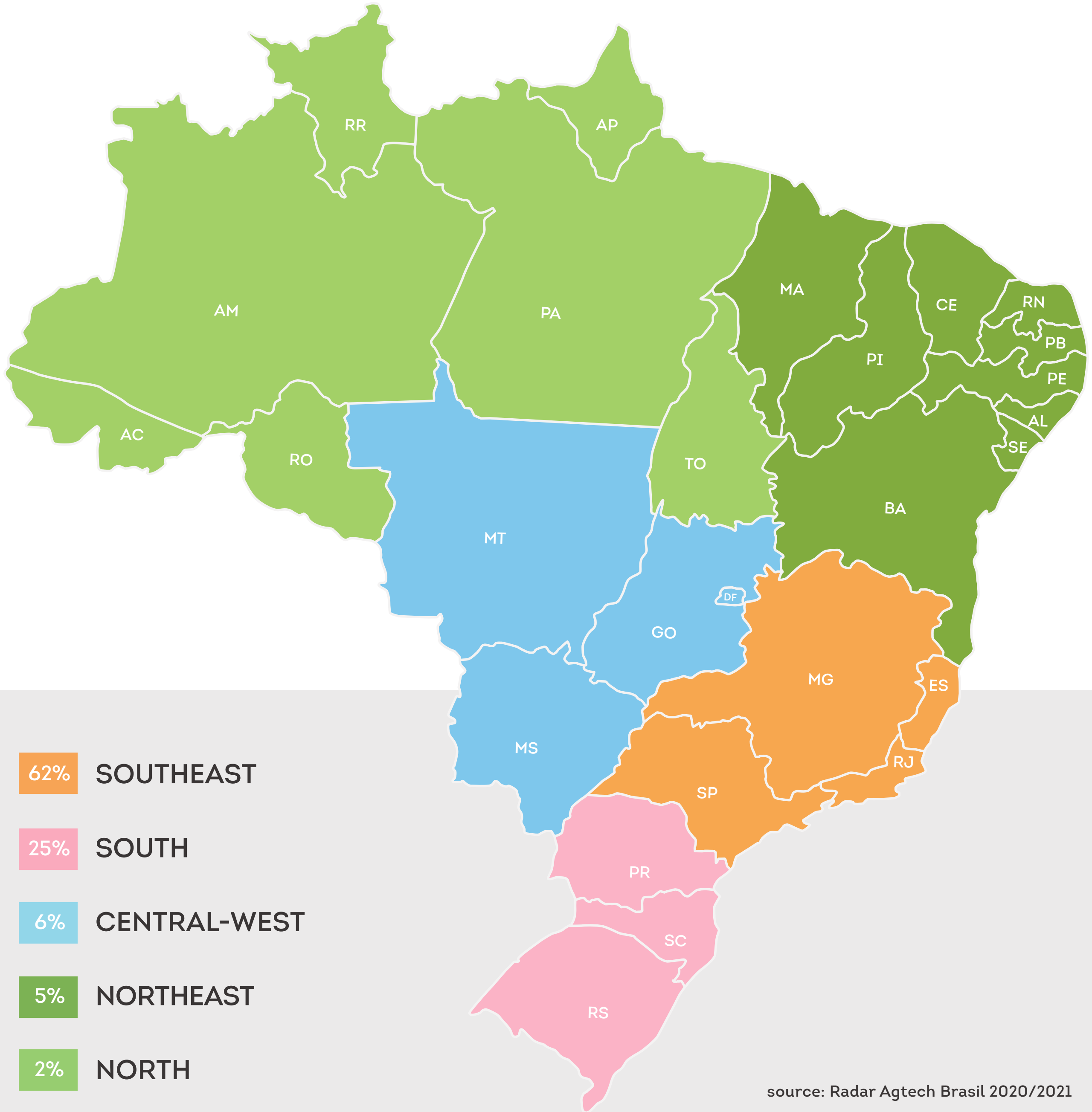
In livestock, new technologies make it possible to monitor the weight gain of animals, feed conversion and even detect the estrus in sows.

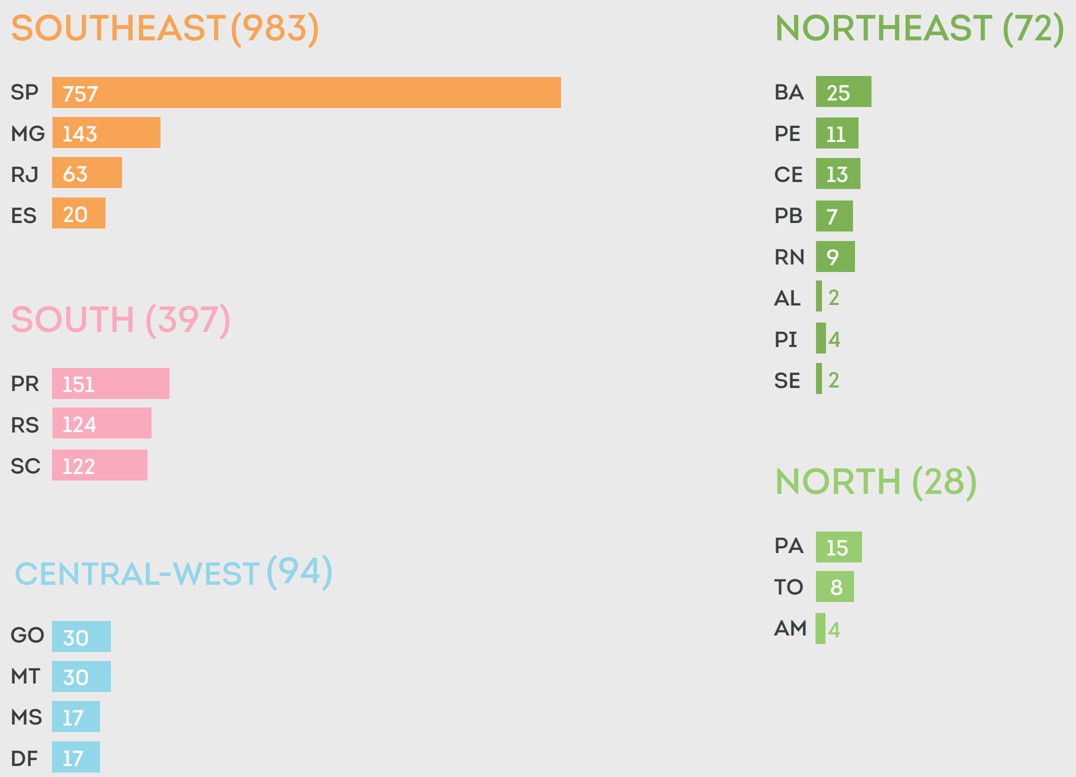
Almost everything can be done in real time and accompanied by applications installed on cell phones and computers.

The information generated by these new systems is essential for the farmer to make the best decisions at the right moment. With this, it can optimize the use of equipment, inputs, labor and natural resources. Which, of course, results in increased productivity and profitability.

The growth of Agriculture 4.0 in Brazil is evidenced by the exponential increase in the number of companies working in the development of digital technologies and solutions in the country. The Radar Agtech Brasil report, for the 2020/21 biennium, identified 1,574 startups (agtechs) focused on the national agri-food sector. Almost 90% focused on the Southeast (62.5%) and South (25.2%) regions of the country. The federative unit with the highest number of agtechs is São Paulo, with 48.1% of the country's total.

DISTRIBUTION OF AGTECHS BY REGION AND FEDERATIVE UNIT





62% SOUTHEAST
25% SOUTH
6% CENTRAL-WEST
5% NORTHEAST
2% NORTH

source: Radar Agtech Brasil 2020/2021

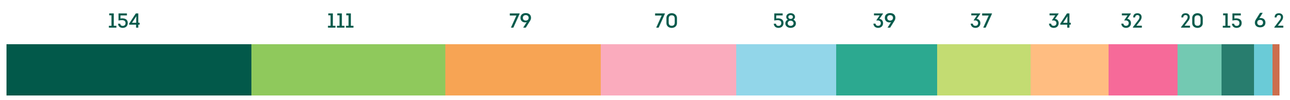
Brazilian startups deliver innovative solutions by segment

The farming production is commonly associated with the production inside the farm, but what comes before and after the farm is just as relevant for agriculture. The Radar Agtech 2020/2021 study identified 200 agtechs working before the farm, 657 inside the farm and 717 agtechs after the farm.

BEFORE THE FARM

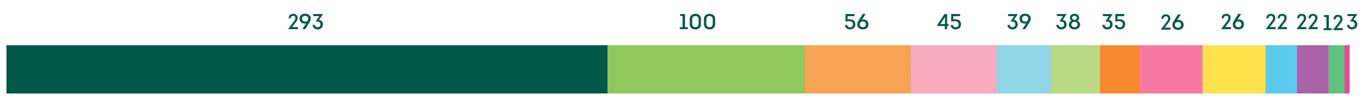
- Fertilizers, inoculants and nutrients
- Seeds, seedlings and plant genomics
- Animal genomics and breeding
- Credit, exchange, insurance, carbon credits and fiduciary
- Animal nutrition and health
- Analysis laboratory test
- Marketplace of raw materials for agribusiness

INSIDE THE FARM



- Rural property management system
- Integrating platform for systems, solutions and data
- Drones, machines and equipment
- Remote sensoring, diagnosis and image monitoring
- Content, education, social media
- Internet of things for agriculture: detection of plagues, soil, climate and irrigation
- Telemetry and automation
- Meteorology and irrigation and water management
- Biological control and integrated plague handling
- Agricultural waste management
- Shared economy
- Connectiveness and telecommunications
- Apiculture and pollination

AFTER THE FARM



- Innovative food and new food trends
- Marketplaces and trade and sales platforms for agriculture and livestock products
- Storage, infrastructure and logistics
- Online grocery
- Online restaurants and meal kits
- Food stores and services autonomous management system
- Biodiversity and sustainability
- Food industry and processing 4.0
- Packaging, environment and recycling systems
- Bioenergy and renewable energy
- Urban farming: plant factory and new ways of farming
- Food safety and traceability
- Cloud kitchen and ghost kitchen

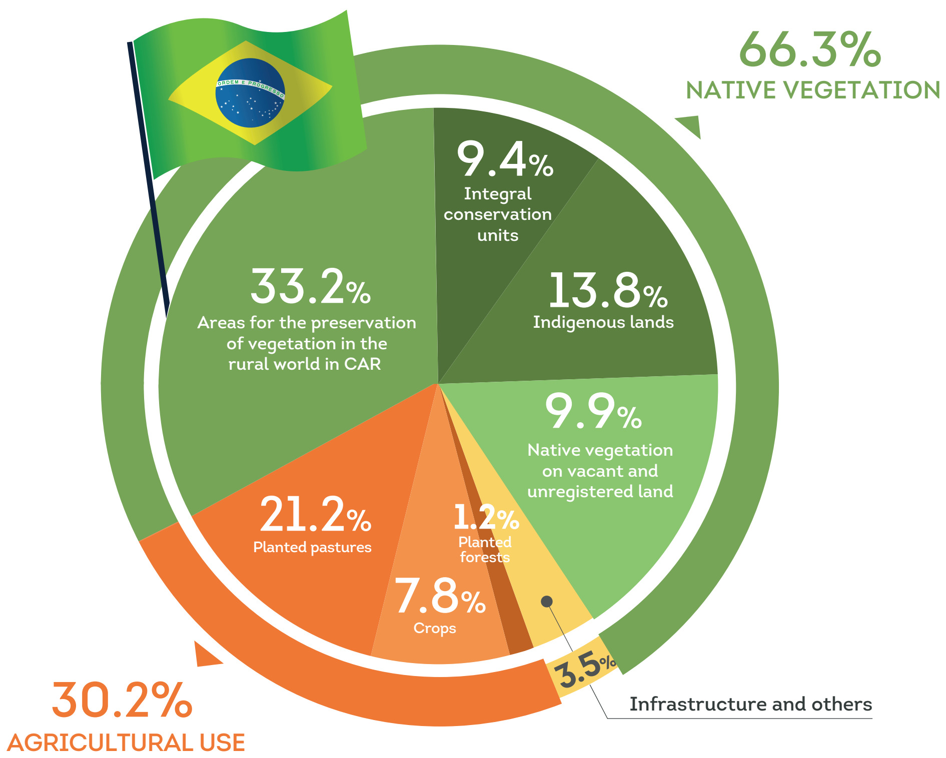
source: Radar Agtech Brasil 2020/2021

AGRICULTURE

SOCIAL AND ENVIRONMENTAL IMPACTS

66% of Brazilian territory is occupied by native vegetation

LAND USE IN BRAZIL



source: MMA, FUNAI, EMBRAPA (2018); IBGE (2019); SFB/SICAR (2021)

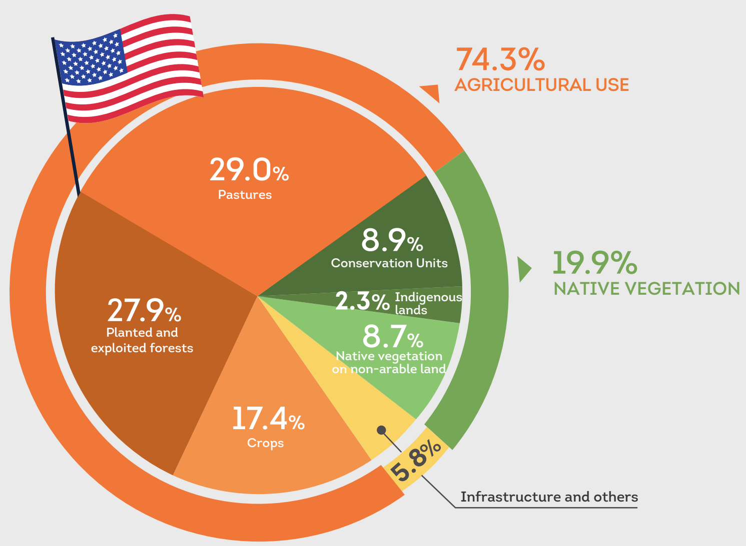
Despite all the expansion of the last 50 years, agriculture does not exceed 7.8% of the Brazilian territory. Pastures account for 21.2% and planted forests occupy 1.2%.

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%.

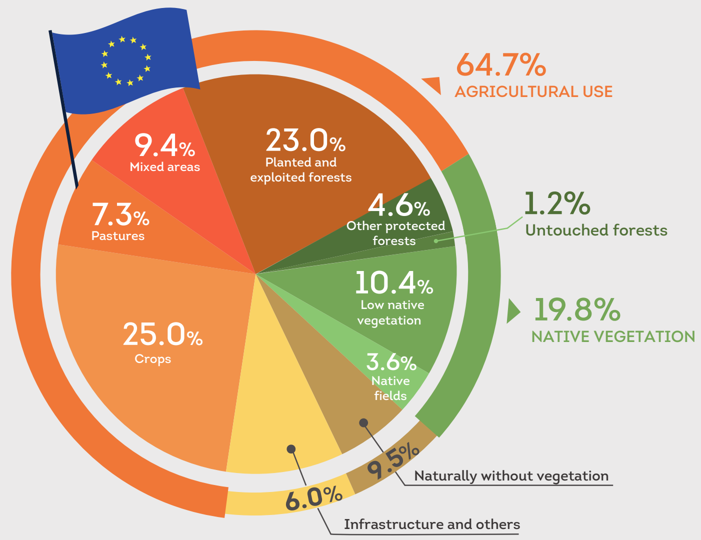
The total area dedicated to all agricultural activities represents 30.2% of the Brazilian territory and the native vegetation preservation area occupies 66.3%. Given this distribution and the observations on the existence of large extensions of degraded pastures, specialists claim that the incorporation 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 THE USA



source: USDA, Economic Research Service using data from the Major Land Use data; EMBRAPA (2018)

LAND USE IN THE EUROPEAN UNION



source: EEA - European Environmental Agency/Copernicus-Corine e EP - European Parliament (2018)

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%.

The extension of the preserved native vegetation area in Brazil corresponds to 48 countries and territories in Europe. The area of native vegetation protected by farmers on their properties is also expressive. Its extension corresponds to the area of 16 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%.

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.

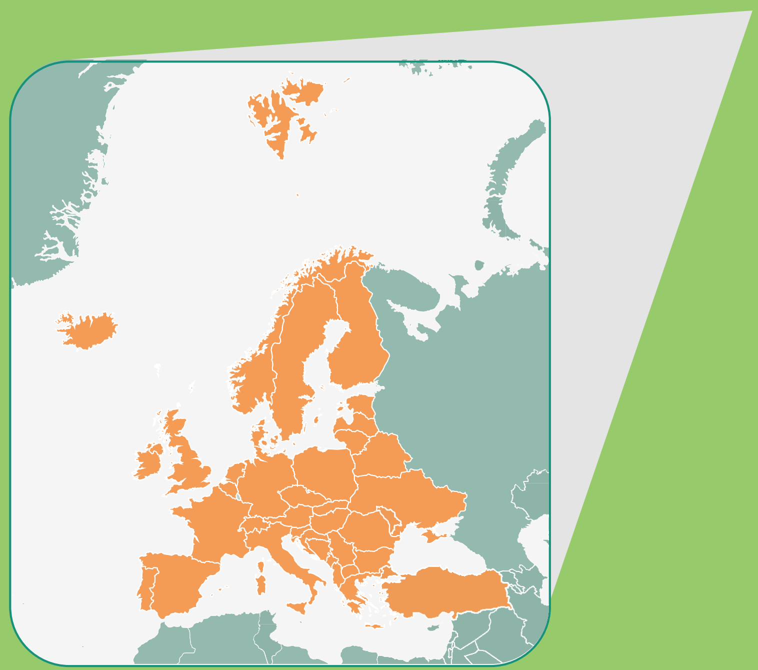
Land use in Brazil	Area (km^2)	% of Area
Preserved areas in the rural world	2,828,588	33.2
Integral conservation units	799,973,0	9.4
Indigenous land	1,174,428	13.8
Native vegetation in military areas and returned land	839,370,0	9.9
Planted forests	102,124,0	1.2
Agriculture	663,807,0	7.8
Pastures	1,804,193	21.2
Infraestructure and others	297,863,0	3.5
Total area of Brazil	8,510,346	100.0

source: Embrapa (2021)

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

48 COUNTRIES

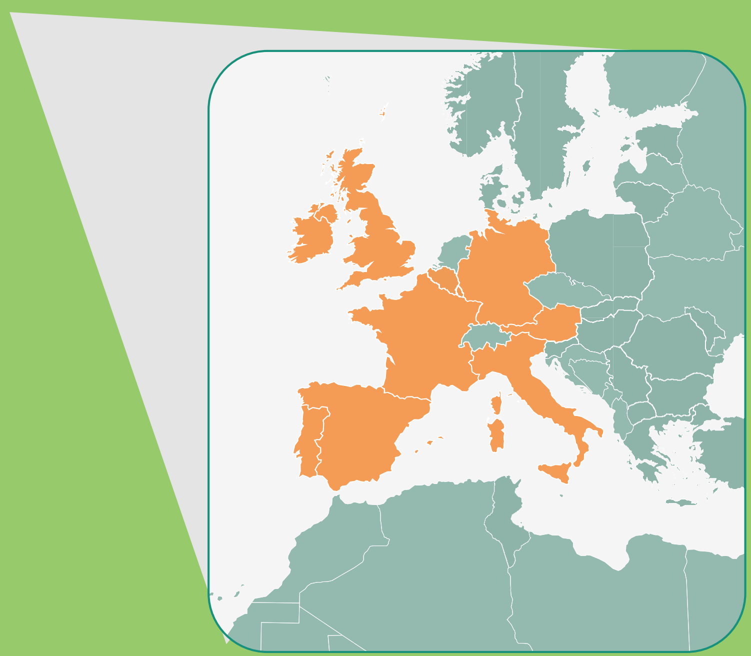
AND TERRITORIES OF EUROPE



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

16 EUROPEAN

COUNTRIES

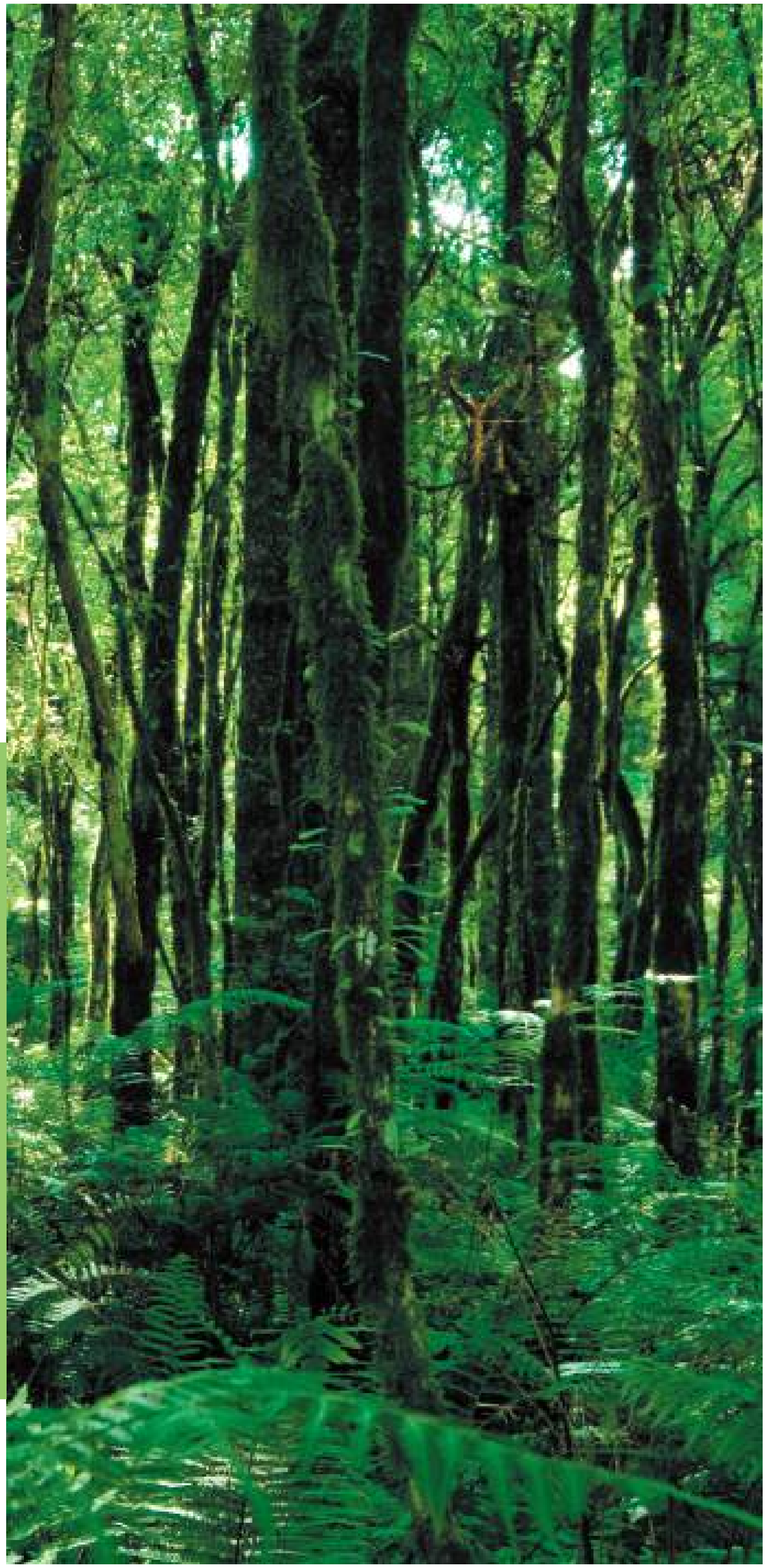


The European land use is very distinct from the Brazilian one

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.

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.



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 m² and is located in Germany; and the largest one is in Sweden, with 5,547 km².

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.

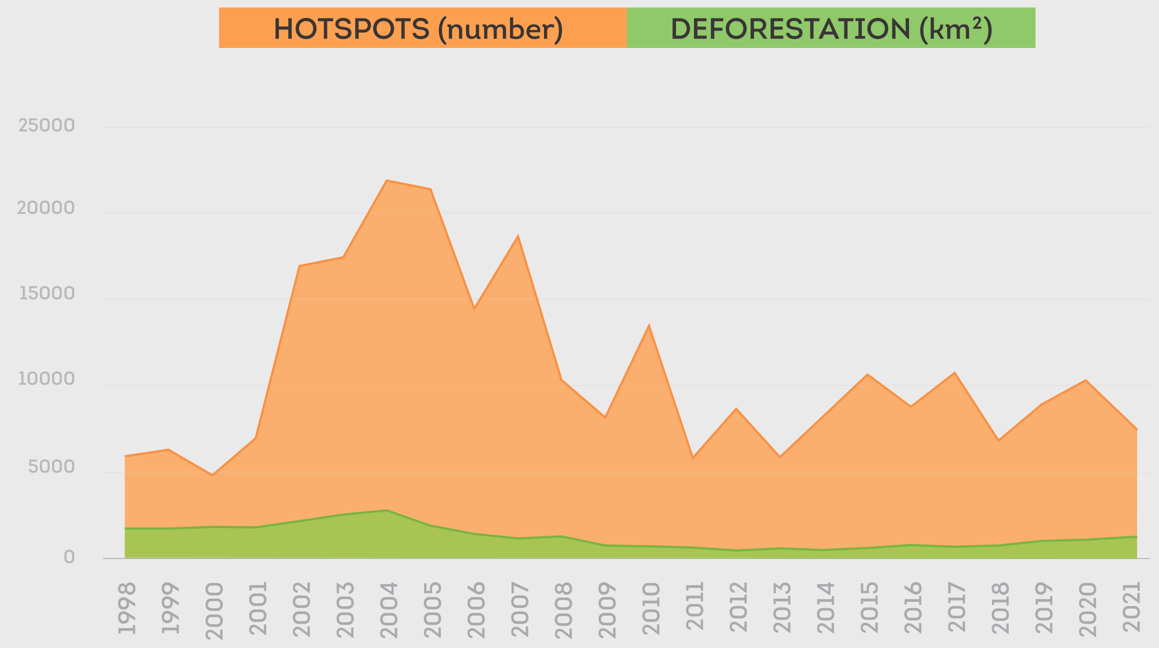
When deforestation is authorized by the environmental agency, based on studies that prove its compliance with forest legislation, it is not considered illegal. In addition, several important criteria for transparency in the processes of native vegetation suppression are observed, such as: identification 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 2021. The fire line is visibly more unstable than the deforestation line.

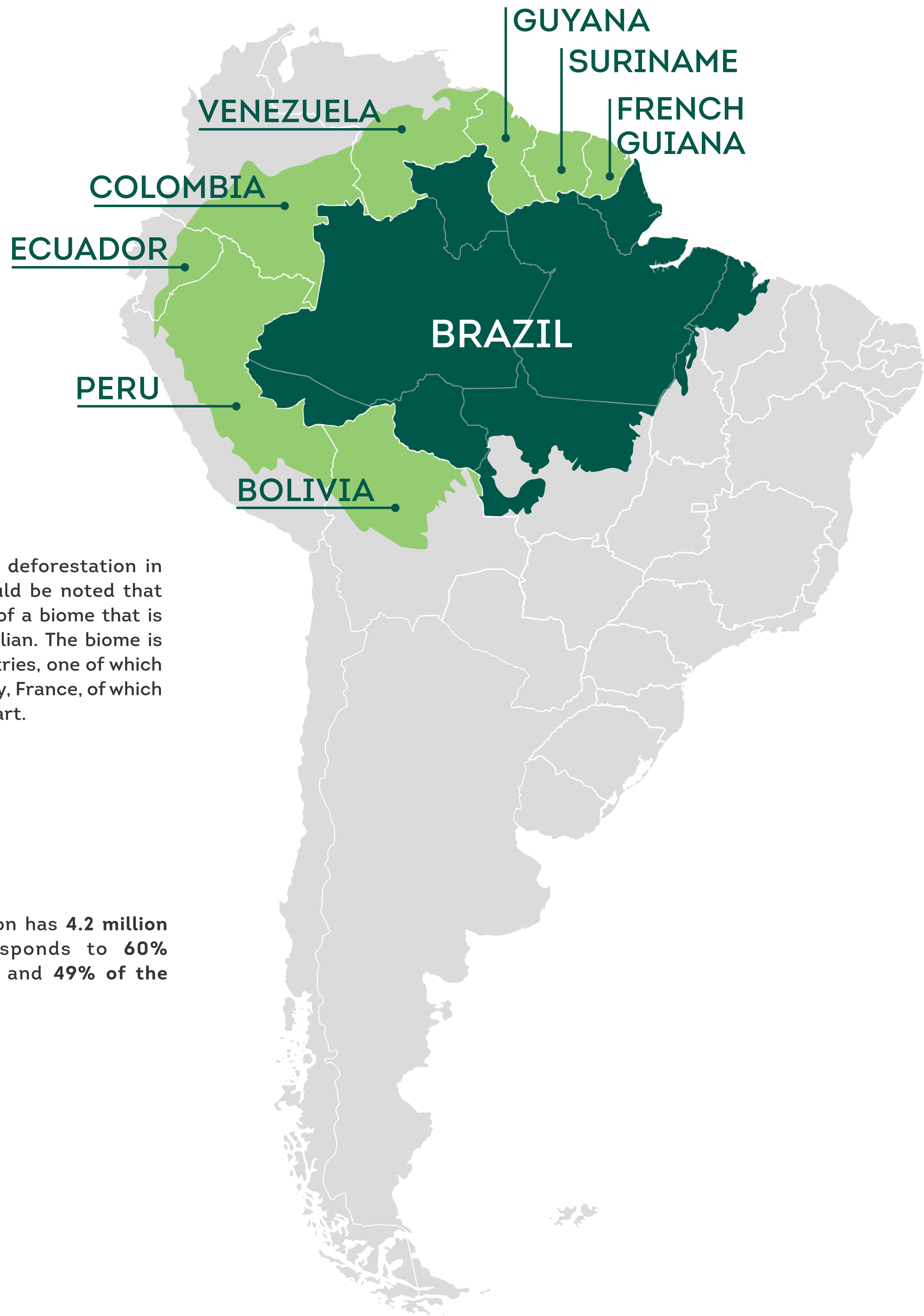
THE AMAZON BIOME



source: INPE (2022)

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



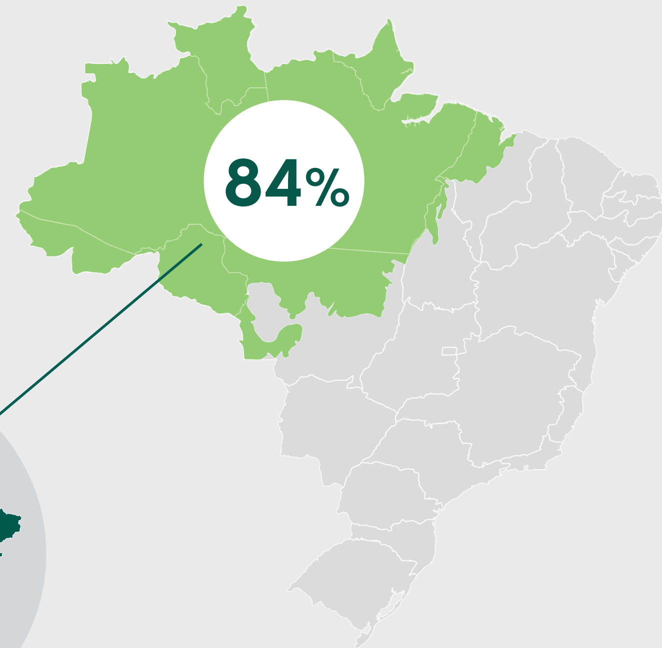
Before approaching deforestation in the Amazon, it should be noted that the Amazon is part of a biome that is not exclusively Brazilian. The biome is shared by nine countries, one of which is a European country, France, of which French Guiana is a part.

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)

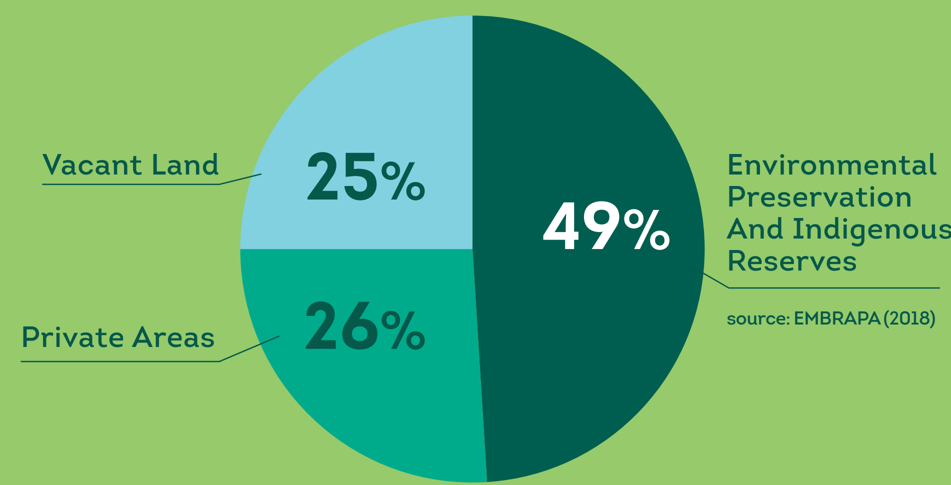
AMAZON BIOME

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)

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 10,129 km², with that of the last 10 years: which is 6,947 km².

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 10,129 km², with that of the last 10 years: which is 6,947 km².

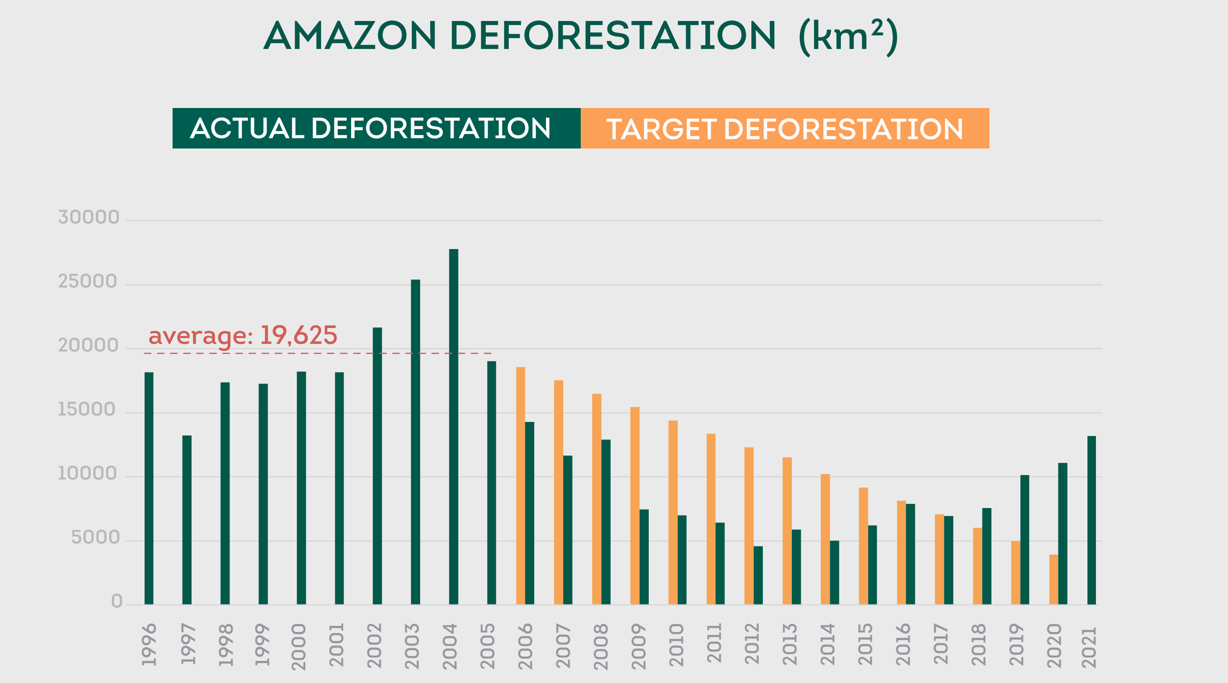
The reduction in Amazon deforestation has received an invaluable contribution from two Brazilian agribusiness organizations: the Brazilian National Association of Vegetable Oil Industries (Abiove) and National Association of Grain Exporters (ANEC).

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

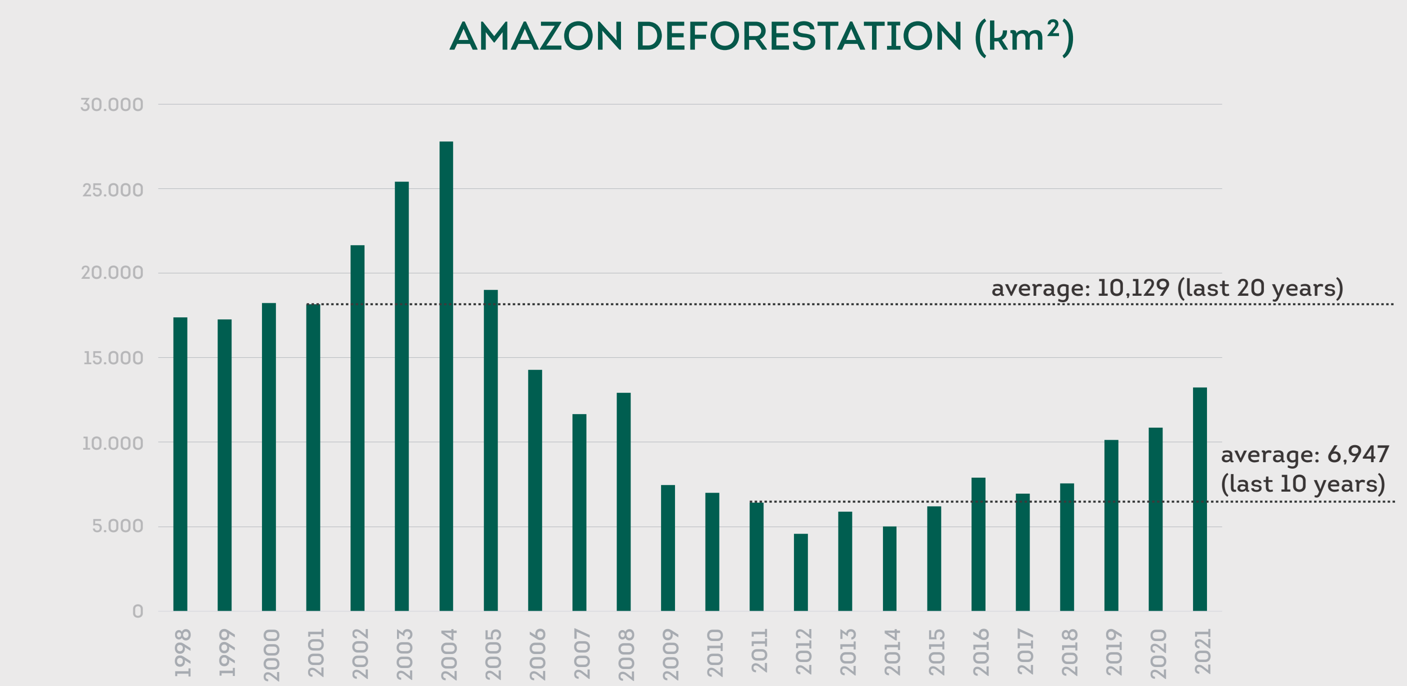
The balance of the 2018/2019 harvest showed that only 1.8% of the soybean planted in the Amazon was found in areas deforested after the declaration of the moratorium.

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 soybean 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 soybean 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.



source: MMA with PRODES data system; INPE (2022)



source: INPE (2022)

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 and Forest Fires 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%.

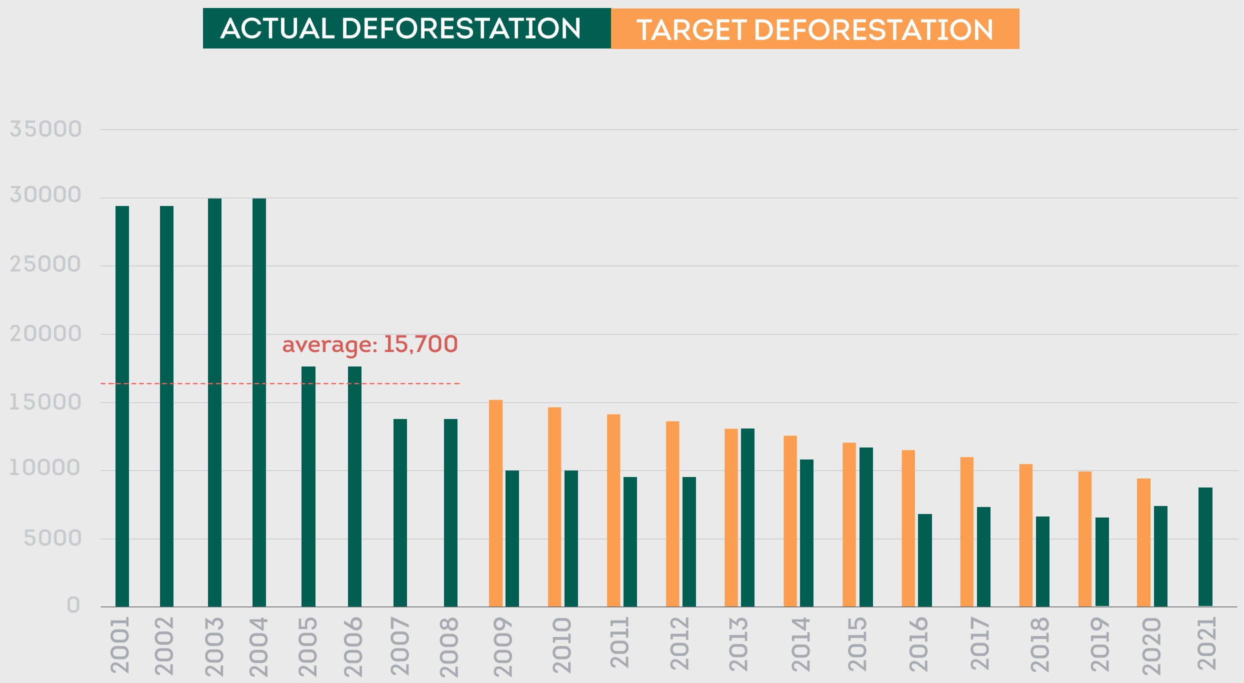
The plan reached 2019 with deforestation of 6,484 km², a rate 31% below the target for the year.

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.

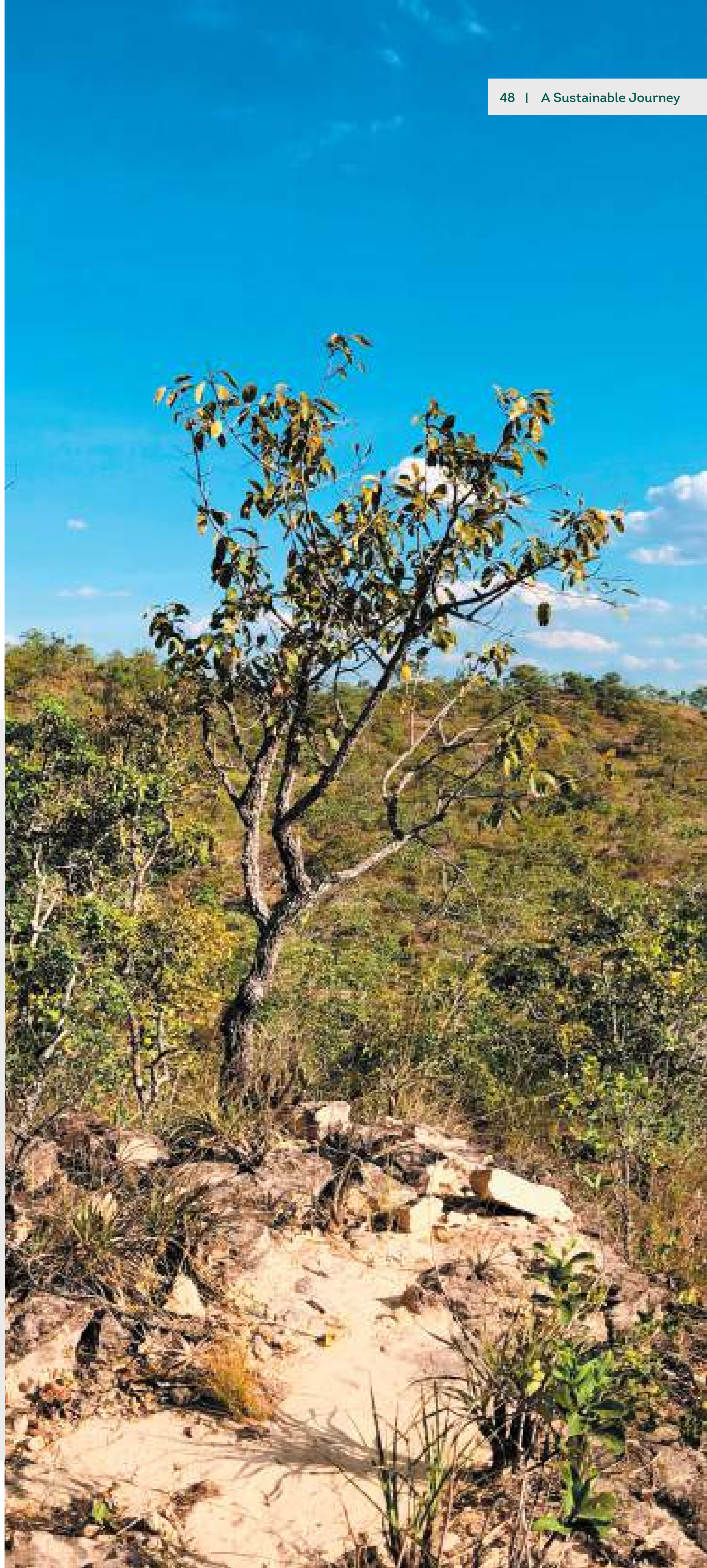
In addition, the study points out ways for the soybean crop to expand without causing deforestation. Currently, soybean occupies only 8.9% of the Cerrado and could technically exploit another 21.9% in already deforested areas, corresponding to 43.9 million hectares.

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 with PRODES data system; INPE (2022)



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 Agrosatélite, 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

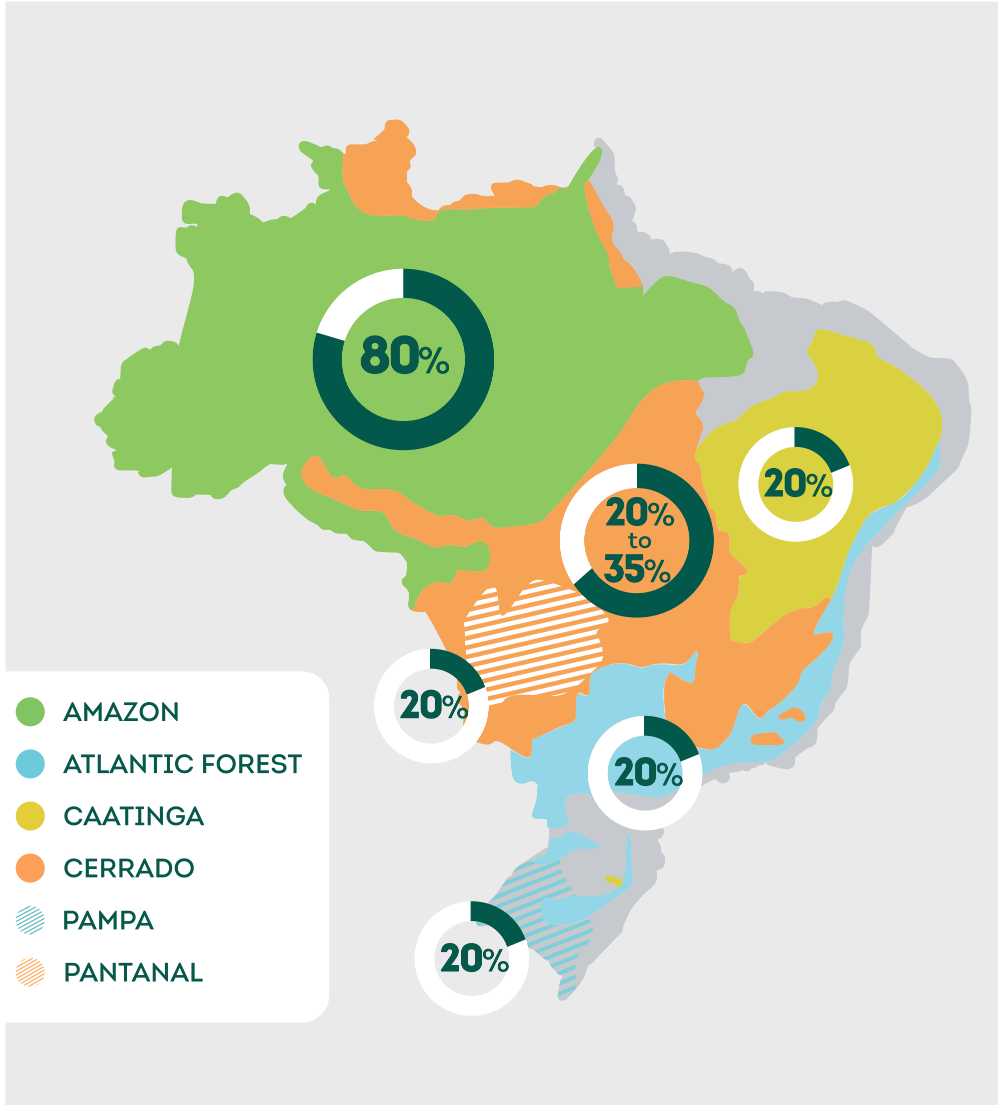
The 2012 Forest Code establishes that all properties have a minimum native vegetation reserve area. It is called the Legal Reserve (RL, in Portuguese), which depending on the type of vegetation and biome, should occupy 20% to 80% of the property's area.

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, in Portuguese), 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 property located in a forested 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 Preservation Areas (APP, in Portuguese). In order to make compliance possible, the Forest Code established two instruments. The first is the Rural Environmental Registry (CAR, in Portuguese), 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 Portuguese). 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 Preservation 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.

By April 2022, more than 6.5 million registrations had been made, representing a total area of 613 million hectares. The number of requests to join the PRA at that time was already approximately 3.4 million. Based on these data, one can see how much farmers are focused on preservation. The cost of adapting non-conforming areas and the impossibility of earning income in areas that need to constitute a Legal Reserve or APPs are major limitations for rural producers to comply with the requirements contained in the legislation.

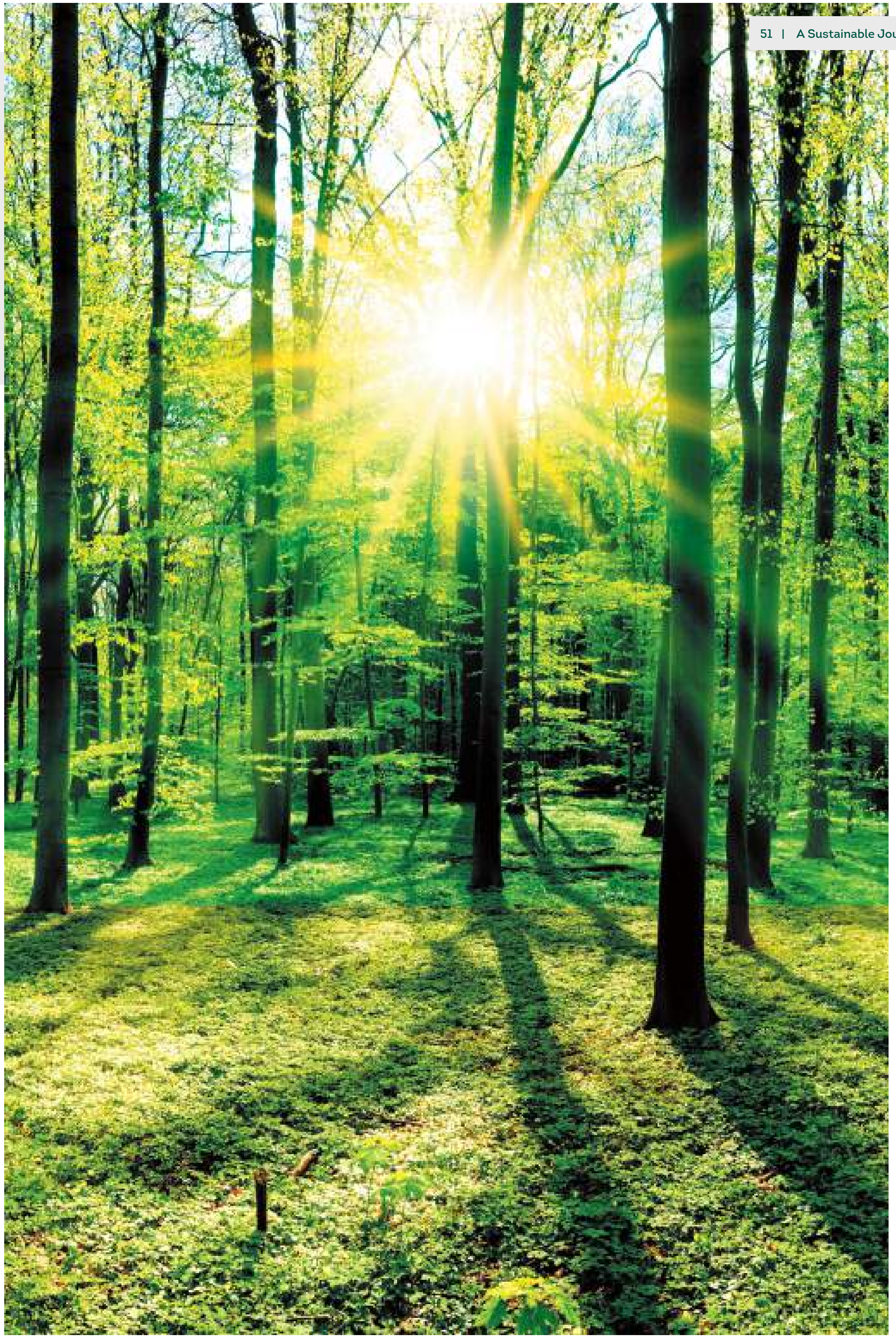
To circumvent this issue, the Forest Code provides a fundamental mechanism to ensure its compliance: the creation of economic incentives that reward those who conserve, through the Payment for Environmental Services (PSA, in Portuguese). This mechanism, relatively new as it came into force in 2021, involves a more effective alternative to environmental control policies, rewarding providers of environmental services.

RURAL ENVIRONMENTAL REGISTRY (CAR)
DATA DECLARED UNTIL APRIL 11, 2022

GENERAL DATA		
6,576,890 Registration (No.)	**612,567,861** Registered area (ha)	**52** Applications to join the PRA (%)
1,494,856 Registration that have undergone some type of analysis (No.)	**225,693,652** Area of records that underwent some type of analysis (ha)	
28,631 Registration with completed environmental regularity analysis (No.)	**12,237,917** Registration area with environmental regularity analysis completed (ha)	

DATA BY PROPERTY TYPE		
RURAL PROPERTIES		
6,557,255 Registration (No.)	**518,200,823** Registered area (ha)	**6,458,147** CPF/CNPJ (No.) Identification documents
TRADITIONAL TERRITORIES OF TRADITIONAL PEOPLES AND COMMUNITIES		
3,174 Registration (No.)	**39,409,543** Registered area (ha)	**215,433** CPF/CNPJ (No.) Identification documents
LAND REFORM SETTLEMENTS		
16,461 Registration (No.)	**54,960,495** Registered area (ha)	**735,859** CPF/CNPJ (No.) Identification documents

source: Brazilian Forest Service

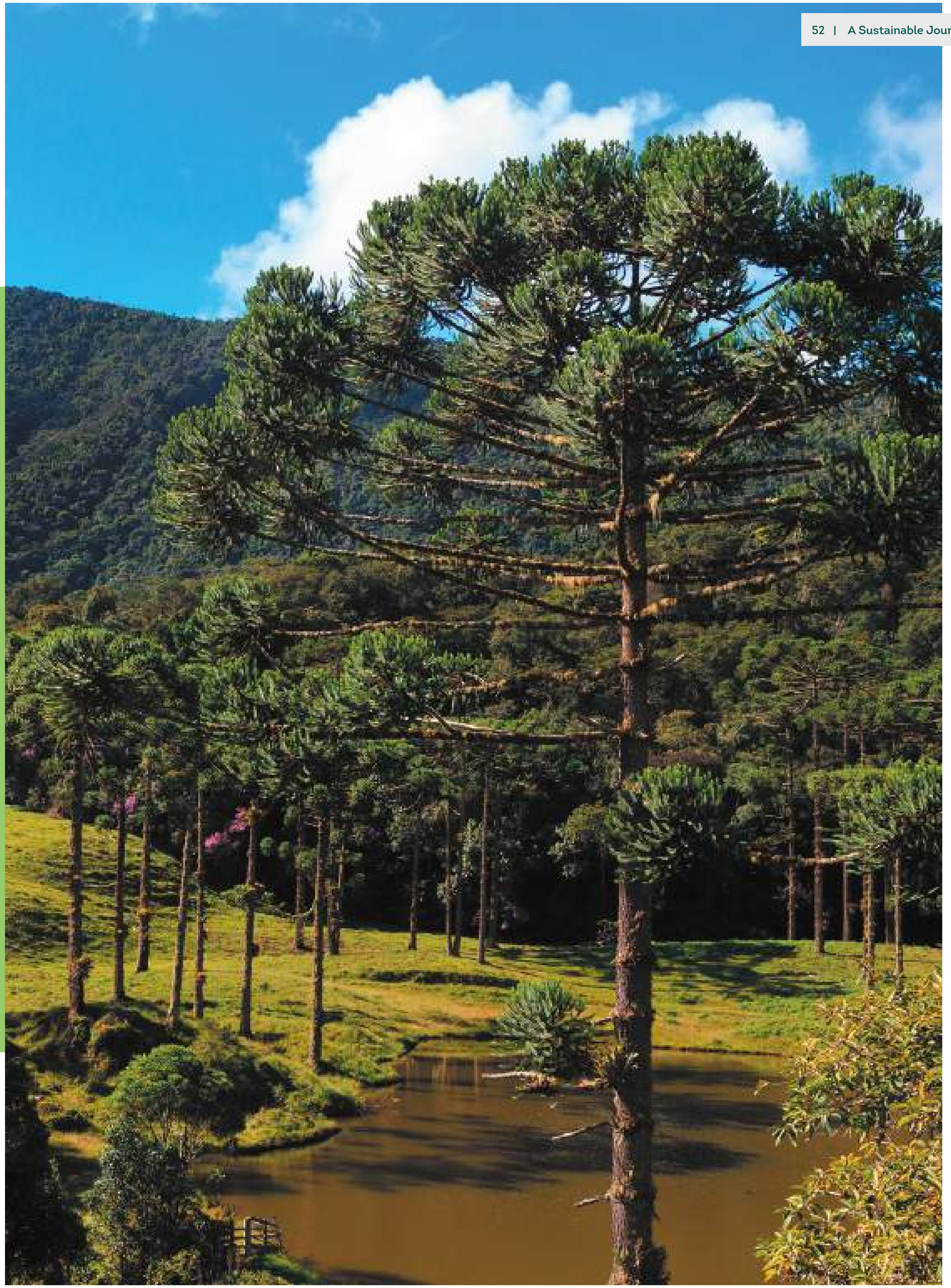


Approximately 98% of properties registered in the CAR have not presented deforestation in the past 3 years

In order to contribute to the understanding of the dynamics of land use in Brazil and other tropical countries, the Brazilian Annual Land Use and Land Cover Mapping Project (MapBiomas) was born in March 2015. The idea of the initiative was to develop and implement a fast, reliable and low-cost methodology to generate annual maps of land cover and use in Brazil from 1985 to the present day (and subsequent annual update).

On July 15, 2022, MapBiomas released its latest report, pointing to a 20% increase in deforestation in the country in the last year. Considering the period from 2019 to 2021, the number of properties with at least one deforestation event detected was 134,318, representing 2.1% of Brazilian rural properties.

In other words, no deforestation was detected in the last 3 years in almost 98% of rural properties. The project also identified the main drivers of deforestation pressure: agriculture, artisanal mining, mining, urban expansion and others, such as pressure to build wind and solar plants.



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 PROGRAMS (PSA)

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.

FLORESTA + 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).

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. RESTORATION OF DEGRADED PASTURES:

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 ICLF 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 ICLF 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-TILLAGE SYSTEMS:

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 BNF 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 BNF are sugarcane, corn, common beans, cowpea, rice and wheat. Also concerning environmental benefits, BNF 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 CO_2 from the atmosphere, helping to mitigate 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 WASTE 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

RESTORATION OF DEGRADED PASTURES

COMMITMENT (by 2020):

To encourage the recovery of 15.0 million hectares 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 hectares of degraded pastures were recovered, corresponding to 70% of the target, contributing with an amount between 39.57 and 57.52 million Mg CO_2eq and between 42 e 62% of the established target.

BIOLOGICAL NITROGEN FIXATION (BNF)

COMMITMENT (by 2020):

To encourage the adoption of 5.5 million hectares of BNF in order to mitigate 10 million Mg CO_2eq.

ACHIEVED (from 2010 to 2016):

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

INTEGRATED CROP-LIVESTOCK-FORESTRY SYSTEMS (ICLFS)

COMMITMENT (by 2020):

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

ACHIEVED (from 2010 to 2016):

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

PLANTED FORESTS (PF)

COMMITMENT (by 2020):

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

ACHIEVED (from 2010 to 2016):

A total of 0.63 million hectares 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.

NO-TILLAGE SYSTEMS

COMMITMENT (by 2020):

To encourage the adoption of 8.0 million hectares of no-tillage systems in order to mitigate 16 to 20 million Mg CO_2eq.

ACHIEVED (from 2010 to 2016):

A total of 12.72 million hectares were planted using no-tillage systems, corresponding to 159% of the target, contributing to the mitigation of 23.28 million Mg CO_2eq and 129% of the established target.

ANIMAL WASTE 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 animal waste management.

For the set of technologies provided for in the ABC Plan, in its first phase (2010 to 2020), adoption was found in 52 million hectares. This result made it possible to mitigate around 170 million tons of CO_2eq, which represented the achievement of 115% of the target established for the period.

The new phase of the Brazilian Plan for Adaptation and Low Carbon Emission in Agriculture, renamed ABC+ (Brazilian Agricultural Policy for Climate Adaptation and Low Carbon Emission), to be carried out from 2020 to 2030, had its bases laid in a document prepared by the Ministry of Agriculture in 2021.

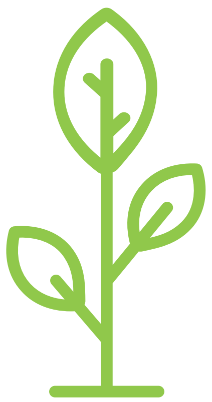
It is understood from this document, that the ABC+ will continue to be an instrument to promote sustainable agriculture, incorporating an integrated approach to the landscape and the mitigation of greenhouse gases. The strategies adopted and consolidated in the first cycle (2010-2020) were reinforced, focusing on encouraging the adoption of Sustainable Systems, Practices, Products and Production Processes (SPS_{ABC}), always based on technical-scientific bases.

In the new cycle (2020-2030), institutional governance and monitoring and evaluation systems for integrated data management should be strengthened. Economic incentives and market instruments capable of remunerating sustainable production systems will also be promoted, which increases the need to focus on developing Measurement, Reporting and Verification (MRV) mechanisms, in line with internationally accepted scientific criteria.

The changes meet the need to facilitate the appreciation and communication of the contributions of Brazilian agriculture to sustainability with the desirable improvement of the country's image at the national and international level.

ABC TECHNOLOGIES

Voluntary Goals (until 2020)	• Adoption of technologies in 35.5 million ha (~ Germany) • Mitigation of 133 to 163 million Mg CO_2eq



- Restoration of Degraded Pastures – **15 million ha**
- Integrated crop-livestock-forestry systems (ICLFS) – **4 million ha**
- No-tillage systems – **8 million ha**
- Planted forests – **3 million ha**
- Biological nitrogen fixation (BNF) – **5.5 million ha**
- Animal Waste Management – **4 million m³**

Results (from 2010 to 2020)	Adoption in 52 million ha (~ 1,5 Germany) Mitigation ≃ 170 million Mg CO_2eq. Reach ≃ 115% of the target

CONCEPTUAL FOUNDATIONS OF THE ABC+ PLAN

The ABC+ highlights as one of the conceptual basis the Integrated Landscape Approach (ILA), through which the management of the agricultural territory must take into account the different elements of the rural landscape, reflecting its diversified, systemic and dynamic aspect.

The incentive for the adoption and maintenance of Sustainable Systems, Practices, Products and Production Processes (SPS_{ABC}), occurs by emphasizing the efficient use of areas suitable for agricultural production, with a strong stimulus for environmental regularization, the valorization of the landscape, the recovery and conservation of the soil, water and biodiversity quality, and the enhancement of local specificities and regional cultures.

It is understood that this multifunctional approach enhances the effective conservation of natural resources, without harming the producer's productivity and income, in addition to promoting the economic valuation of ecosystem services generated during food production and equating conflicts in the rural environment, mostly linked to the Territorial Planning.

The goals set out in the ABC+ Plan involve the mitigation of just over 1 billion of CO_2eq by 2030, in addition to the incorporation of almost 73 million hectares, 208 million cubic meters of waste and 5 million animals to practices or systems of sustainable production.

SPS_{ABC} EXPANSION COMMITMENTS, UNTIL 2030, CONSIDERING 2020 AS THE BASE YEAR

Sustainable Systems, Practices, Products and Production Processes (SPS_{ABC})	Scaling up of adoption (millions of ha)	Potential for mitigating GHG emissions (millions of Mg CO_2eq)
Degraded Pasture Recovery Program	30	113.7
No-tillage Grain System	12.5	12.11
Vegetable No-Tillage System	0.08	0.88
Integrated Crop-Livestock-Forestry Systems	10	37.9
Agroforestry Systems	0.1	0.38
Planted Forests	4	510
Bioinputs	13	23.4
Irrigated Systems	3	50
Management of Animal Production Waste	208.4 million m³	277.80
Intensive Termination	5 million animals	16.24
TOTAL SPS_{ABC}	72,68 million ha 208,40 million m³ 5 million animals	1,042,41 million Mg CO_2eq

source: Mapa/DEPROS, 2021

In ABC+, mitigation and adaptation strategies are combined. The former, which limit current and future emissions and/or encourage sinks for GHGs, are known to be effective in mitigating the effects of climate change. However, with the increase in the frequency of extreme events in the country and the urgency to strengthen actions aimed at reducing the vulnerability of agricultural production systems and increasing the resilience of the national sector, adaptation actions grow in importance and deserve to be highlighted.

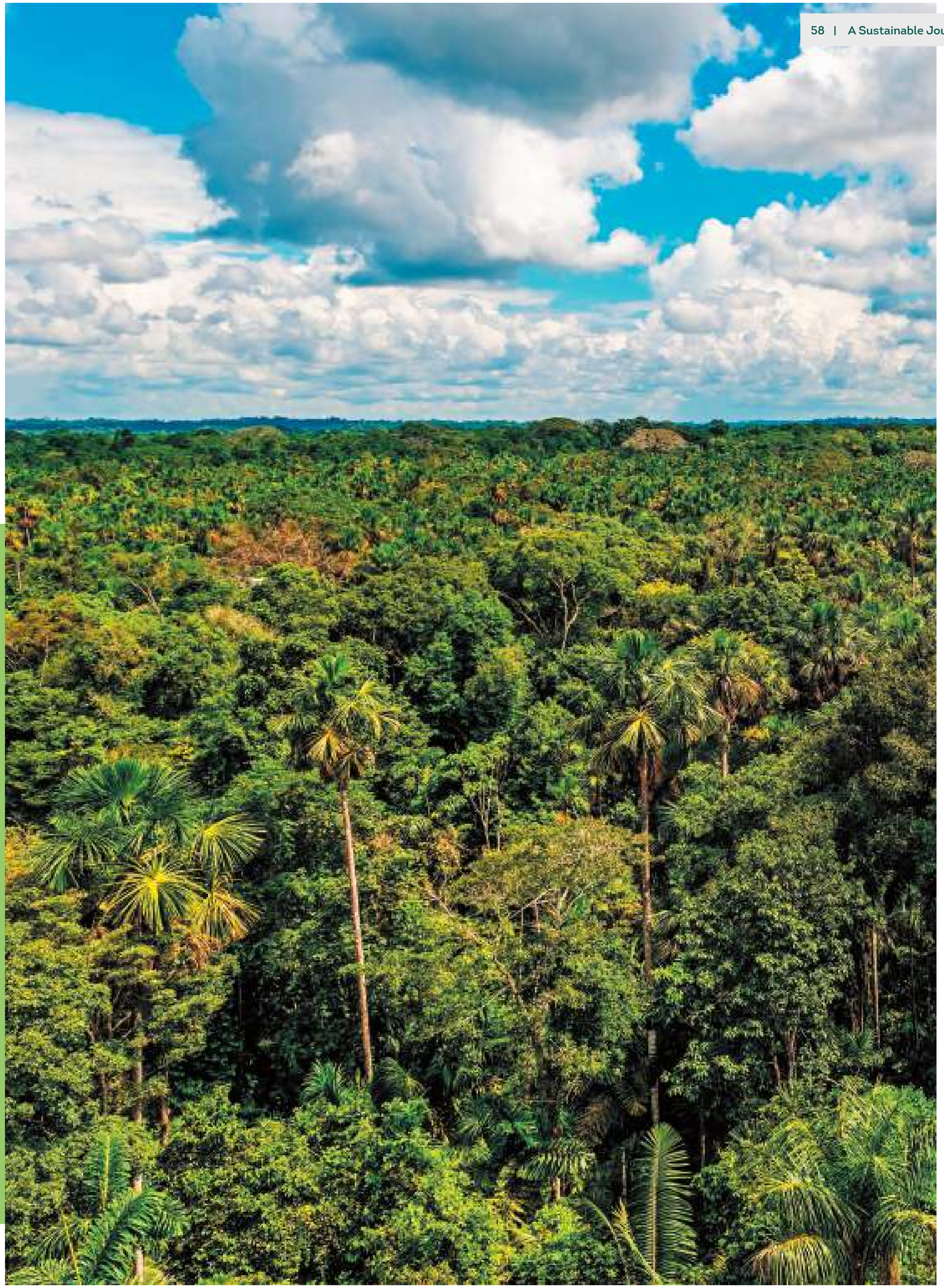
In general terms, adaptation strategies focus on: (I) adoption and maintenance of conservation practices; (II) adoption and maintenance of integrated systems; and (III) genetic improvement and increased biological diversity.

Strategies that strengthen the resilience of production systems and ensure productive efficiency and profitability in more challenging climate scenarios are also worth mentioning, such as (I) integrated risk management, climate forecasting and territorial zoning and early warning systems; (II) socioeconomic and environmental performance analysis systems; and (III) technical assistance.

Among the ABC+ strategies, the following stand out:

1. Maintaining motivation for adoption of conservationist and sustainable farming systems, fostering increased productivity and income, resilience and control of greenhouse gas emissions;
2. Strengthening initiatives for technology transfer and diffusion, training and technical assistance;
3. Encouraging and supporting applied research for development or improvement of Sustainable Systems, Practices, Products and Production Processes;
4. Expanding mechanisms that recognize and reward farmers for adopting Sustainable Systems, Practices, Products and Production Processes;
5. Fostering diversified financial and tax related instruments to support Sustainable Systems, Practices, Products and Production Processes;
6. Improving the ABC+ information management system for putting in place effective Measurement, Reporting and Verification (MRV) Mechanisms; and,
7. Promoting an Integrated Landscape Approach in order to encourage compliance with environmental rules and sustainable production.

Strategies 5 and 6 contain important initiatives to value emission reduction efforts, including carbon pricing through the establishment of a carbon market. A step taken in this direction was the publication of decree 11,075, in May, which we will discuss next.



Brazilian agribusiness has been contributing to mitigate climate change

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.

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.

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 official the 2030 target, which until then, was only an indicative. 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
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
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
AGRICULTURE	• Strengthen the National Plan for Adaptation and 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 Integrated Crop-Livestock-Forestry Systems (ICLFS) by 2030.

source: MMA (2015)

Carbon market

The sustainable trajectory of Brazilian agriculture results from various incentives related to the search for efficiency, availability of technologies, public policies and the performance of companies. Specifically in relation to practices that lead to the reduction of GHG emissions, incentives can also be related to carbon pricing initiatives. In other words, the recognition of practices that involve lower carbon emissions add value to products and create new market opportunities.

Simply put, the carbon market is a pricing instrument used to encourage the reduction of greenhouse gas emissions. Companies receive limits on the amount of carbon they can emit (quotas), either by government imposition or voluntary commitments made by sectors or companies, and to emit GHGs above the quota, it is necessary to buy licenses, which are sold by organizations that have managed to cut their emissions, therefore, generate carbon credits.

The negotiation between those who have credits and those who need to obtain permission (licenses) takes place in a market similar to a Stock Exchange and the value of the licenses can be defined by the regulatory agency or by the law of supply and demand. By limiting the volume of greenhouse gases and allowing companies to trade licenses among themselves, the government creates an incentive system for economic sectors to adopt cleaner technologies.

The Kyoto Protocol was an important step towards encouraging sustainable projects, by establishing GHG emission limits for developed countries and the possibility for developing countries to sell carbon credits to developed countries to meet emission reduction targets. Over time, in addition to projects conceived within the scope of the Kyoto Protocol, in the Clean Development Mechanism (CDM), initiatives were developed in the so-called voluntary market, outside the scope of the United Nations, due to the growth in the number of companies that seek to neutralize their emissions.

A Brazilian carbon market was being studied in Brazil, through the PMR Brazil Project, within the scope of the Partnership for Market Readiness (PMR), a World Bank program that provides support to prepare and implement climate change mitigation policies, including pricing instruments of carbon in order to increase the scale of GHG mitigation.

According to the Voluntary Carbon Market in Brazil report by Fundação Getúlio Vargas (FGV EESP), the volume of credits generated in the voluntary carbon market in projects developed in Brazil in 2021 showed a significant increase: 236% in relation to the volume generated in 2020 and 779% in relation to the volume generated in 2019.

Following the international market trend, the significant increase in the amount of credits generated was led by the energy production and conservation sectors and by projects involving Agriculture, Forests and Land Use - also known by the acronym AFOLU (Agriculture, Forestry and Other Land Use), in which the projects called REDD+ (Reducing Emissions from Deforestation and Forest Degradation) stand out.

The Agriculture, Forestry and Other Land Use (AFOLU) sector encompasses agricultural activities that emit GHGs (CH_4, N_2O and CO_2) and emissions and removals (CO_2) derived from land use change and /or management that alters the carbon stocks of biomass and soils.

There is, therefore, great potential for the generation of credits by agriculture and the forestry sector in Brazil, due to the extension of the existing areas in the country and the dissemination of several practices that can result in the mitigation or removal of GHGs from the atmosphere, as explored in the chapter which deals with the ABC Plan. The development of a carbon market in Brazil can help to accelerate the development of decarbonization projects in the country.

In this sense, in May 2022, DECREE No. 11,075 was signed, which establishes the procedures for the preparation of Sectorial Climate Change Mitigation Plans and institutes the National System for the Reduction of Greenhouse Gas Emissions - Sinare, which must work as a hub for recording emissions, reductions, offsets and credit transactions.

The text of the decree also deals with the governance of the systems –divided between the Ministry of Economy and the Ministry of the Environment– and presents the definition of assets such as carbon credits and methane credits. According to the text, the sectors will be able to present proposals for the emission reduction curves within a period of 180 days - extendable for another 180 days.

The decree is a normative act that still depends on several regulations. The text does not foresee, for example, the creation of a regulated carbon market, as it does not involve any obligation to reduce emissions. Despite the relative uncertainty regarding various definitions, the initiative to publish the decree can be seen as a way of placing the issue at the center of the national debate on decarbonization and an opportunity for Brazil to position itself as an agri-environmental power.

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 Packages (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.

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 411 fixed receiving units and 4,100 itinerant receipts, facilitating access for farmers located in areas further away from the fixed units. From there, they are taken to 9 recyclers and 4 incinerators. Of the collected packaging, 93% is recycled and reused, and 7% is incinerated.

Since 2002, the *Campo Limpo System* has collected 670 thousand tons of used crop protection products packaging. In 2021, there were 53.5 thousand tons. It is estimated that this accounts for about 94% of the packages sold in the year.

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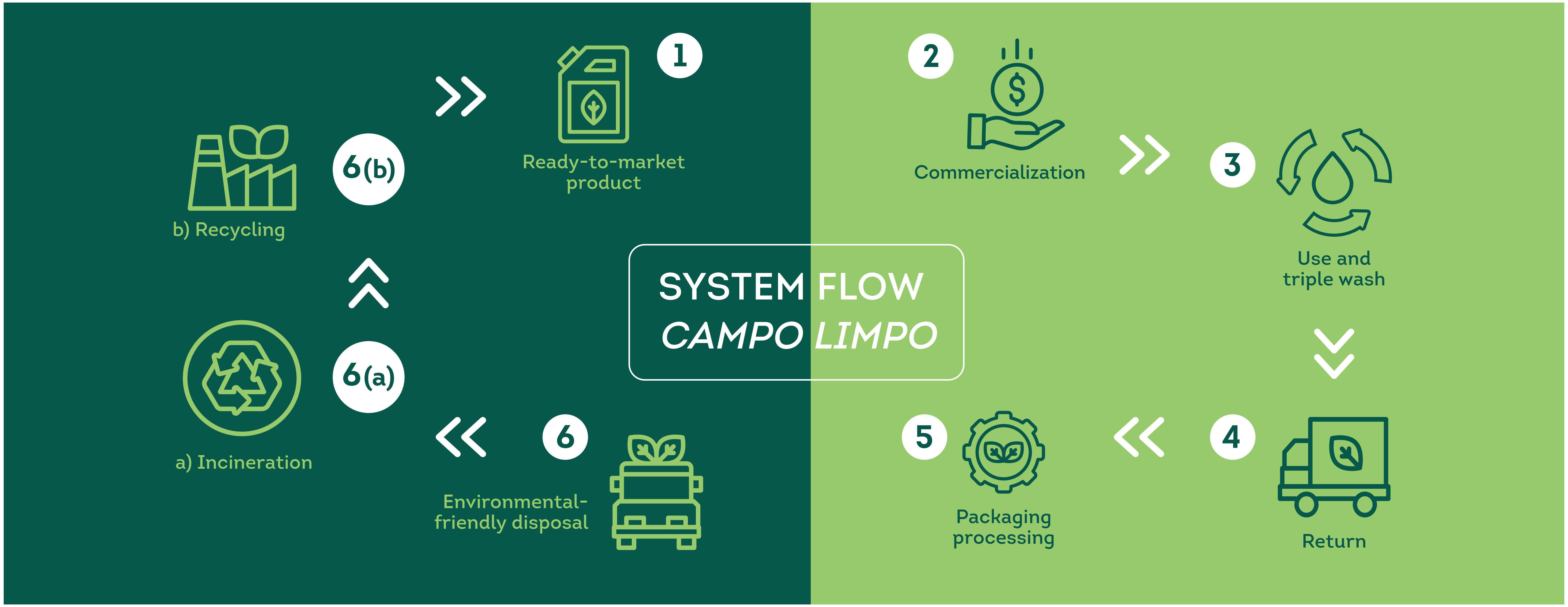
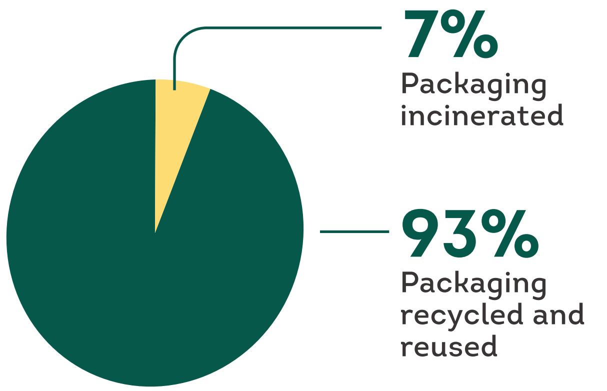


CAMPO LIMPO SYSTEM RESULTS

material disposal (%)



source: INPEV (2022)

Among the collected packaging, 93% are recycled and reused, and 7% are incinerated.

more than
670
thousand tons
since 2002

more than
53.5
thousand tons
in 2021

94%
packaging
sold in the year

The volume of packages received and sent by the *Campo Limpo System* grows year after year. In 2021, there were 53.5 tons, exceeding the target initially projected for the period (53 thousand tons). The result was 7% higher than that recorded in 2020.

Emissions

899 thousand tons of CO_2eq avoided (2002-2021), which is equivalent to 16 thousand truck trips around the Earth.

75,589 tons of carbon dioxide equivalent avoided in 2021 alone.

Energy

36 billion megajoules of energy were not consumed, enough to power 5.2 million homes for a year.

4 billion megajoules of energy saved in 2021 alone.

Water

225 million liters of water have not been consumed since 2019, which is equivalent to the daily consumption of 1.1 million people.

89.8 million liters of water saved in 2021 alone.

Destination of 650 thousand tons of empty packaging.

Weight equivalent to 570 statues of Christ the Redeemer (Rio de Janeiro - RJ)

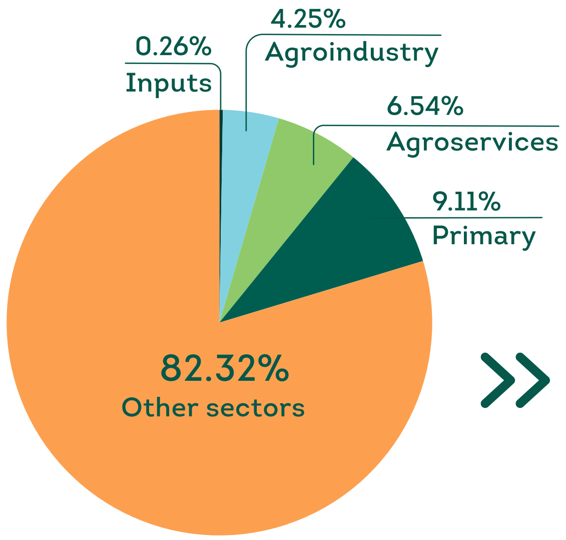
Emission avoids of 899 thousand tons of CO_2eq Carbon captured by 6.5 million trees.

Avoided consumption of 36 million gigajoules of energy, enough to supply 5.2 million homes for a year.

Brazilian agribusiness engages many people

In 2021, the Brazilian agribusiness GDP (Gross Domestic Product) accounted for 27.4% of the country's total GDP. In 2021, the sector was responsible for more than 19 million jobs, and agribusiness and services employed 4 million and 6 million people, respectively, while 234 thousand people were employed in the input segment. In the countryside, 8.6 million people were employed.

EMPLOYMENT IN BRAZILIAN AGRIBUSINESS



Agribusiness accounts for 20.15% of jobs in Brazil.

Sector	Employment (million)	%
Inputs	0.24	0.26
Agroindustry	3.95	4.25
Agroservices	6.08	6.54
Primary	8.47	9.11
Agribusiness/total	18.74	20.15
Brazil/other sectors	76.54	82.32
Brazil/total	95.28	100

source: Cepea (2021)

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 soybean, 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 soybean production, 65% in sugarcane producing municipalities, 73% in corn producing municipalities, and 131% in municipalities that concentrate cotton production.

Producing Municipalities HDI	1991	2010	percentage growth
NON-AGRICULTURAL	0.493	0.727	47%
SOYBEAN	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)

Among the greatest advances presented in the human development index in the period, soybean-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.

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%

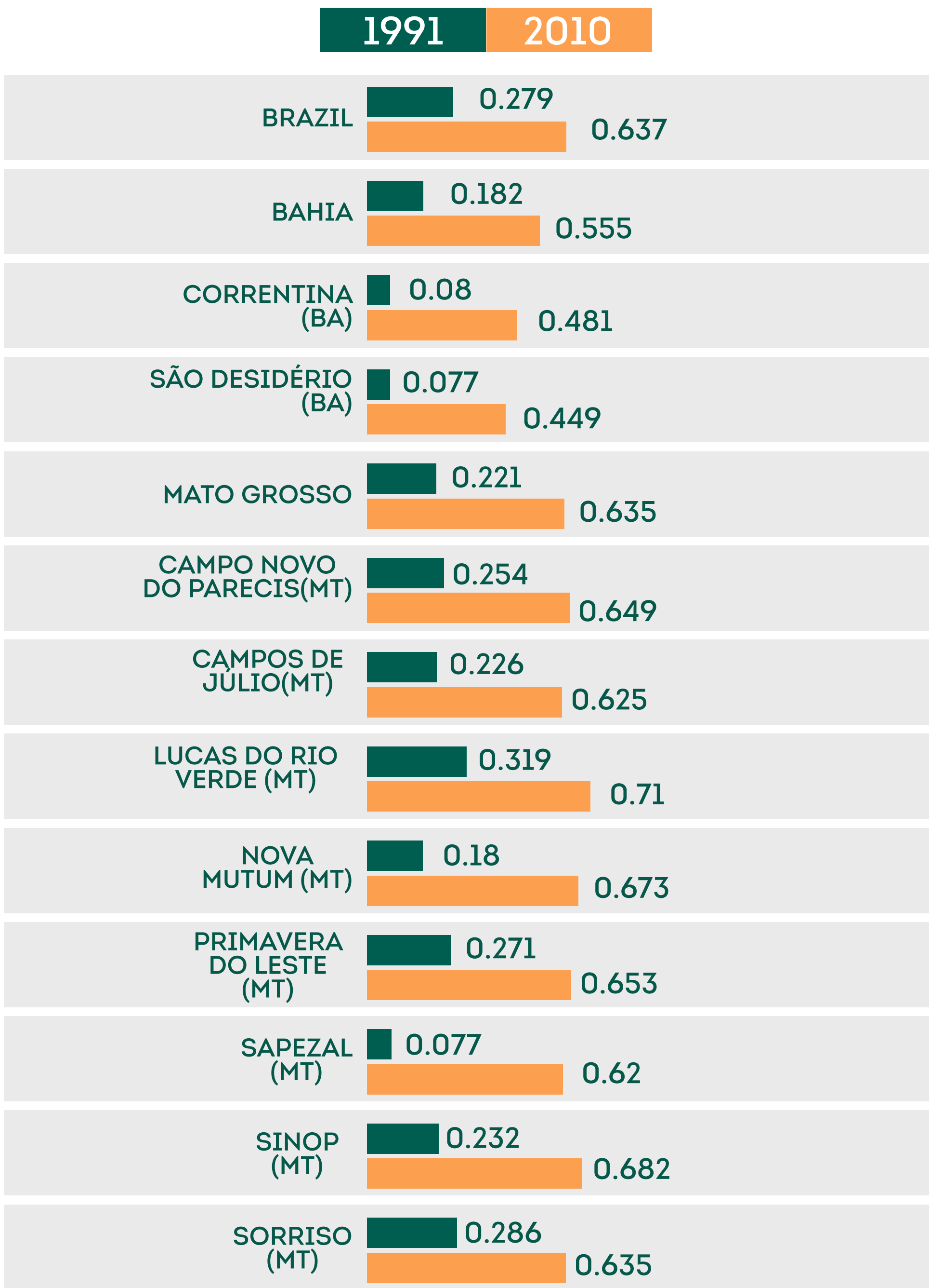
source: Kleffmann (2014)

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 of Human Development in Brazil, Pnud Brasil, Ipea and FJP (2020)

DIMENSION OF BRAZILIAN HDI INDICES AND INDICATORS FROM 1991 TO 2010

		1991	2000	2010	VAR 2010/1991
BAHIA	HDI	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	HDI	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	HDI	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%

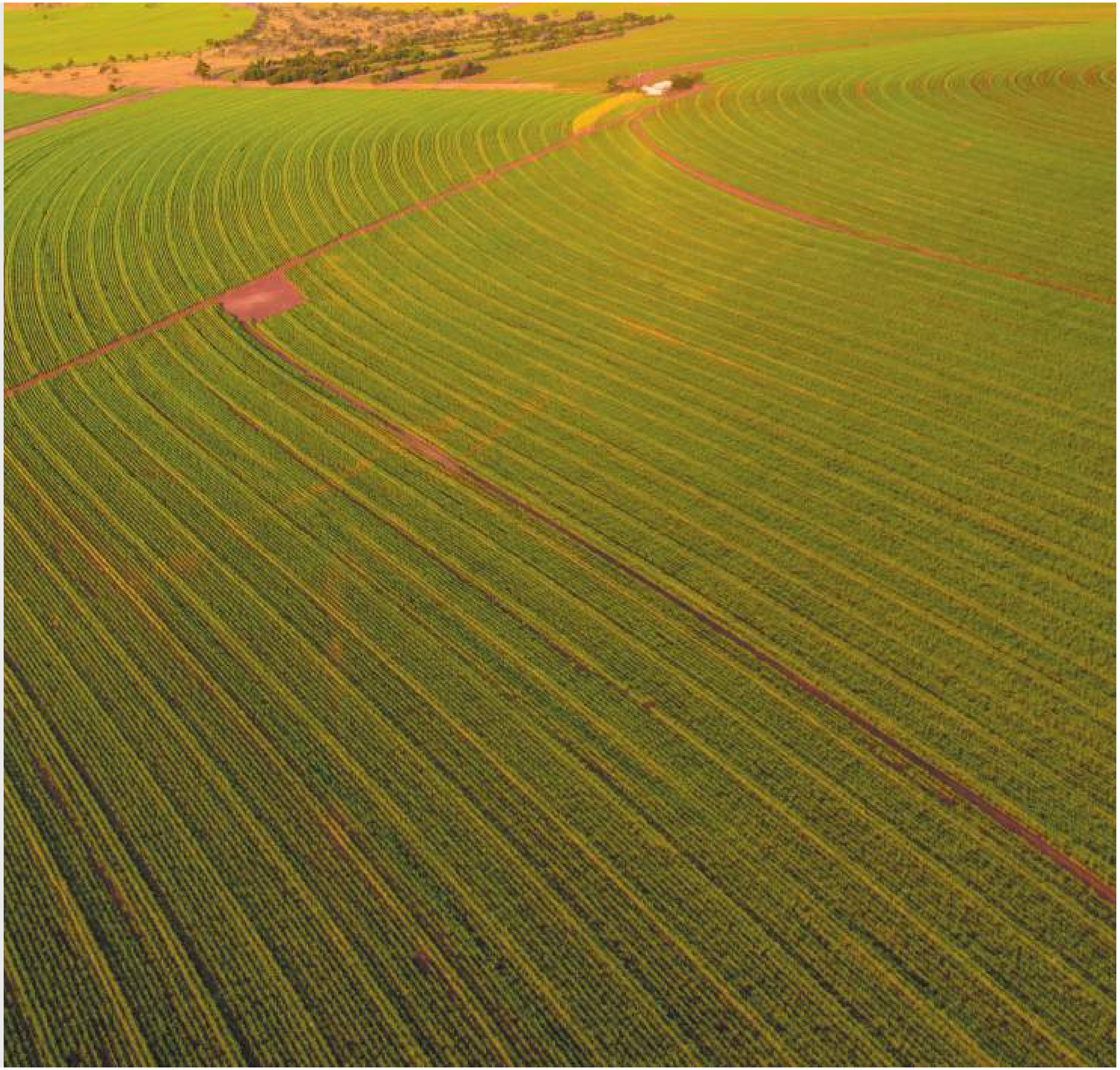
source: Atlas of Human Development in Brazil, Pnud Brasil, Ipea and FJP (2020)

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

> **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.**

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.

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.

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.

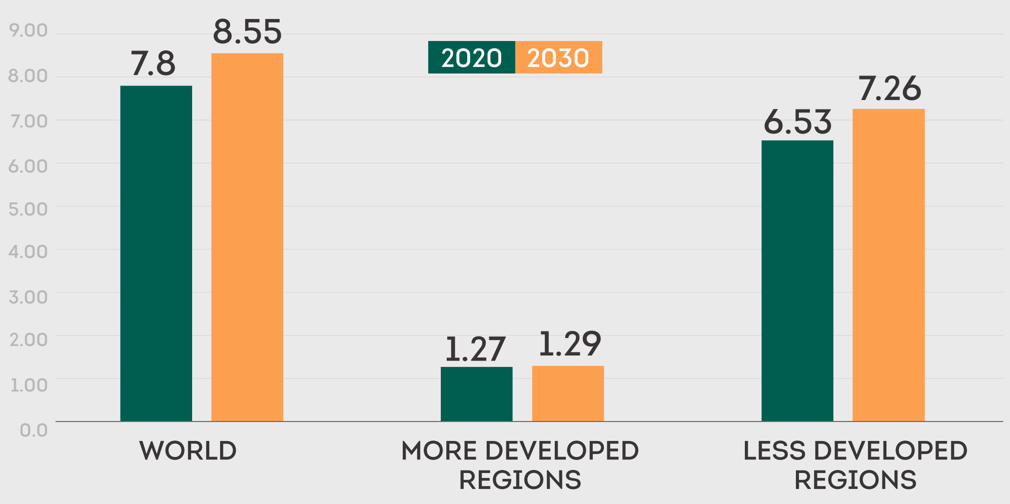
Since hunger and undernourishment represent the greatest challenges facing humanity, the topic has been discussed in the most diverse forums around the world.

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

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.

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.

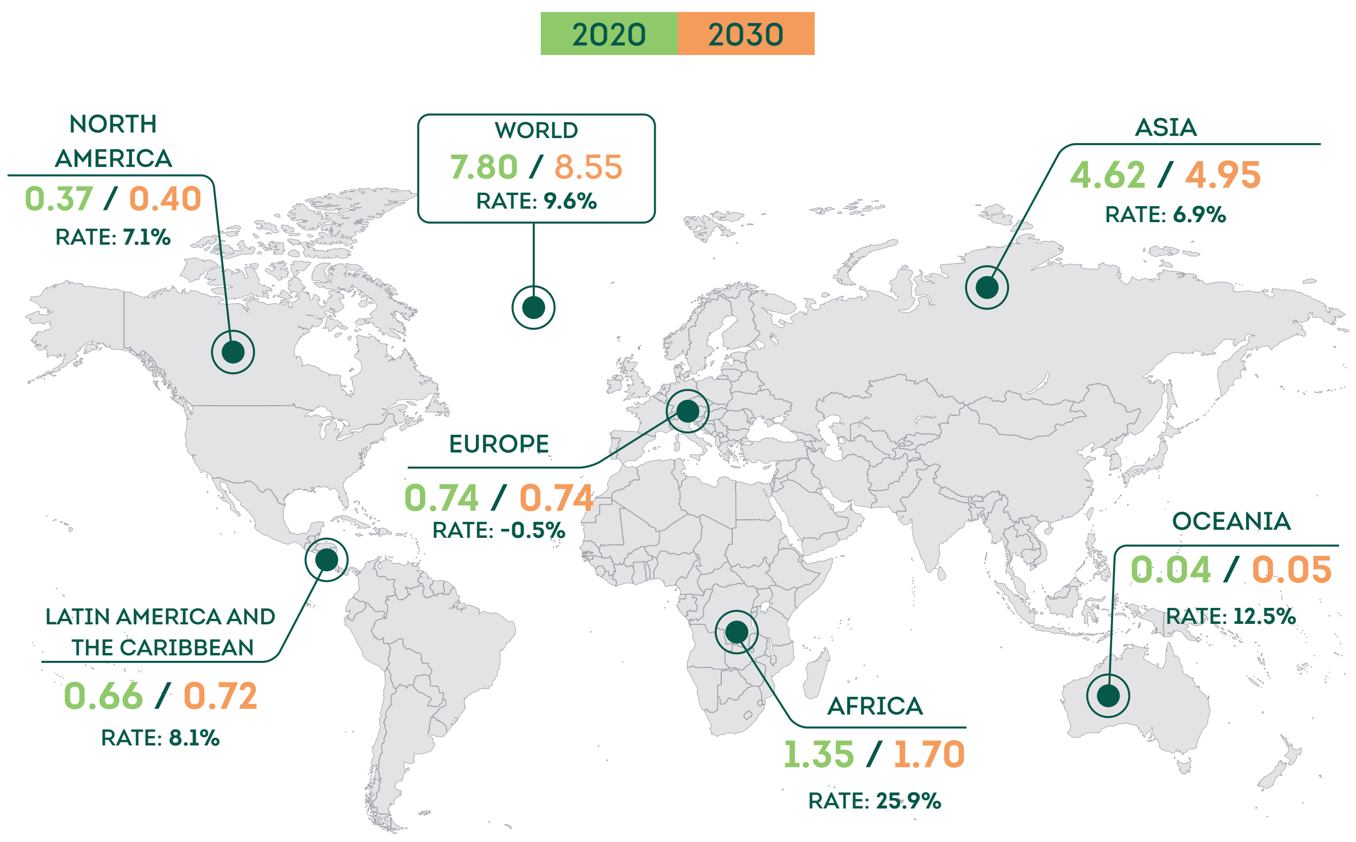
WORLD POPULATION



source: United Nations (2019)

WORLD POPULATION BY CONTINENT

(in billions of inhabitants)



Note: The rate corresponds to the percentage population growth.

source: United Nations (2019)

According to FAO's latest report on the state of food security and nutrition in the world, from 2022, projections are that nearly 670 million people will still be facing hunger in 2030 – 8 percent of the world population, which is the same as in 2015 when the 2030 Agenda was launched.

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;

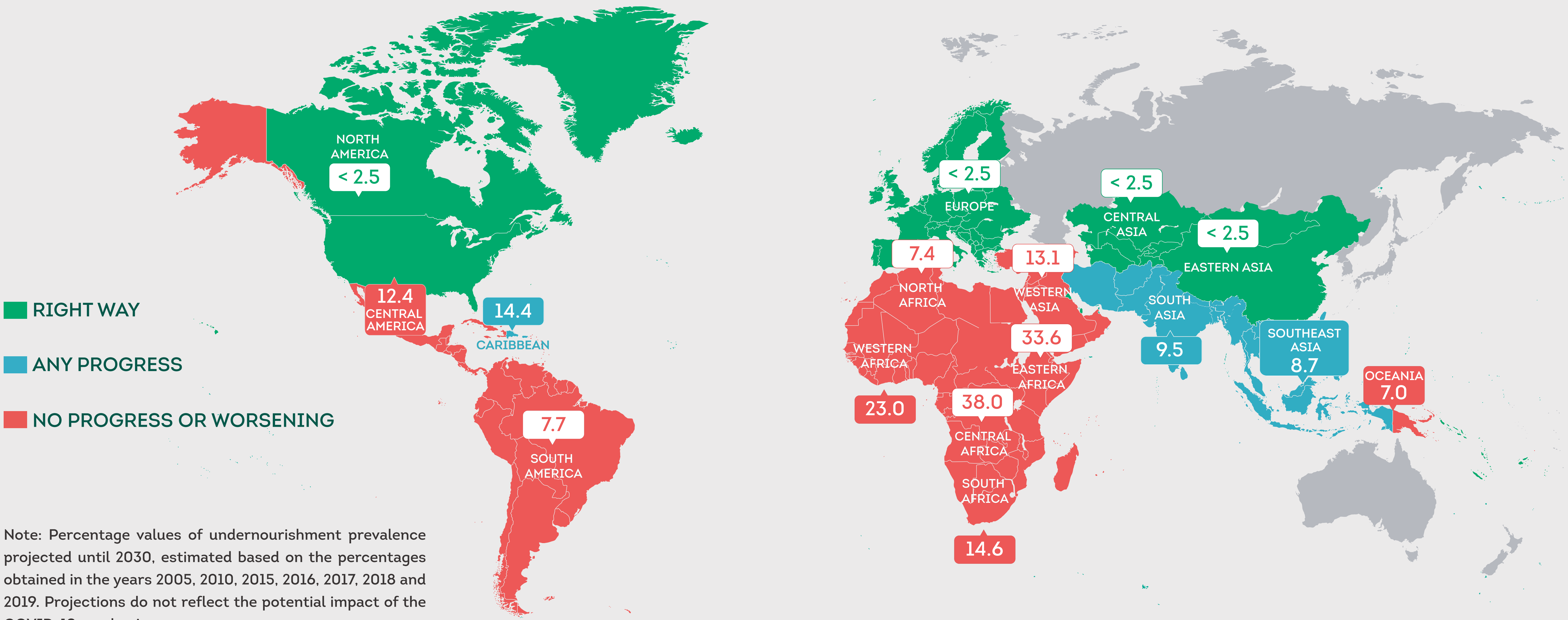
IN 2019,
after five years of growth, the problem affected 687.8 million people or 8.9% of humanity

OUTLOOK 2030,
hunger will affect nearly 670 million people, or 8% of the world population

source: FAO (2022)

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.

source: FAO (2020)

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.

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

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.

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.

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.

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.

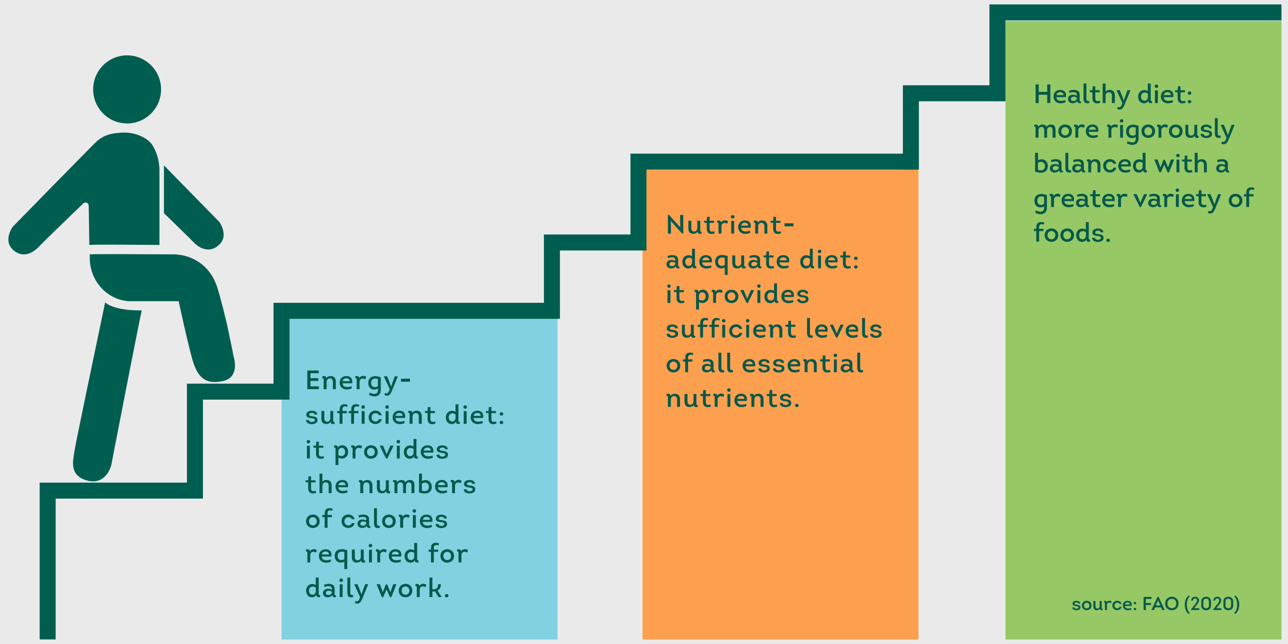
2

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.

DIET QUALITY LEVELS



Food Safety in Brazil

In Brazil, as in the rest of the world, we have seen a considerable deterioration in food security indicators in recent years. The latest survey by the Brazilian Research Network on Food Sovereignty and Security – PENSSAN, called the National Food Security Survey, carried out between the end of 2021 and the beginning of 2022, reveals that 28% of the surveyed households express concerns about the inability to purchase food, a situation defined as mild food insecurity (FI).

The survey evaluated situations of insecurity at mild, moderate and severe levels. The severe level reveals that the household experienced hunger in the last three months prior to the analysis. In ⅓ of the households (30.7%) there was already a report of insufficient food to meet the needs of their residents, that is, food insecurity (FI) was identified in the moderate or severe modalities. The most severe cases, identified as severe FI, were identified in 15.5% of households.

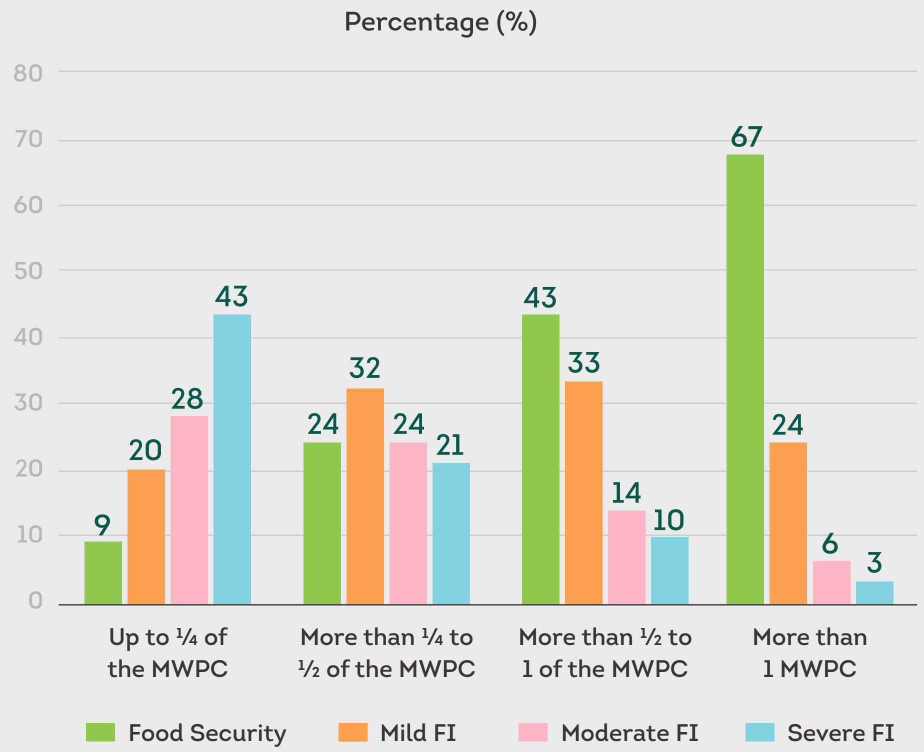
Evidently, family income directly influences the food security situation. In households where the average income per resident is below ¼ of the minimum wage (up to ¼ of the MWPC – Minimum Wage Per Capita), only 9% have adequate access to food and severe food insecurity reaches 43%. For incomes between ¼ and ½ MWPC, it is observed that 24% declared adequate access to food and the severe form of food insecurity drops to 21%. Above 1 MWPC, severe food insecurity drops to 3%.

The pandemic that devastated the world from the beginning of 2020 and which culminated in a major economic and social crisis exacerbated problems that had already been imposed on the country, such as the difficulty of recomposing income from work in formal or informal employment. Additionally, the situation was exacerbated by the conflict in Ukraine, which affected the supply of grains, agricultural inputs and fuel prices, contributing to the rise in food prices. As a consequence, the historic inequality in Brazil has become even more accentuated.

Family farmers/rural producers, not integrated into organized production chains or linked to exports, who were able to partially mitigate losses due to the increase in product prices and the dollar in Brazil, have greater difficulties in recovering income to pre-pandemic levels. These producers suffered from increases in input costs and difficulties in the flow of production, which contributed to food insecurity results even more negative than those observed in urban areas. Areas of family farming that had long been excluded from commercial agriculture saw the historical difficulties of access to markets deepen and also faced a reduction in resources destined for government purchases.

Despite the emergency measures taken with the pandemic, the aggravation requires even broader and bolder measures to face the problem.

FOOD SECURITY IN BRAZIL ACCORDING TO PER CAPITA FAMILY INCOME



source: PENSSAN, 2022

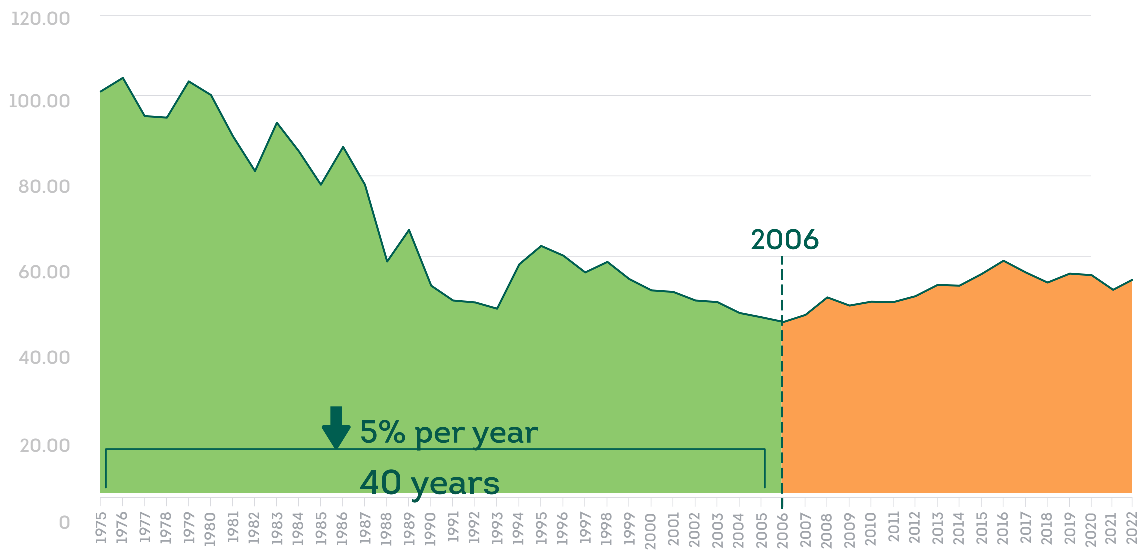
The contribution of agricultural production to fighting hunger

Hunger is basically a problem of access to food. This depends on the existence of products, that is, on the adequate supply of food and on the conditions for acquiring these goods, that is, on the availability of income by families. In the absence of sufficient income for the purchase of food by the families, the implementation of public policies remains.

In terms of supply, the contribution of the Brazilian agricultural sector to the domestic market has been highly effective in recent decades by allowing the country to move from a net importer to a net exporter of various products. This performance contributed to the fact that, for forty years, from 1975 to 2005, the real cost of the basic food basket was reduced by an average of 5% per year. For various reasons, despite the domestic supply of agricultural products showing an upward trend for most products, the real cost of the basket started to recover.

RELATIVE COST OF THE BASIC FOOD BASKET

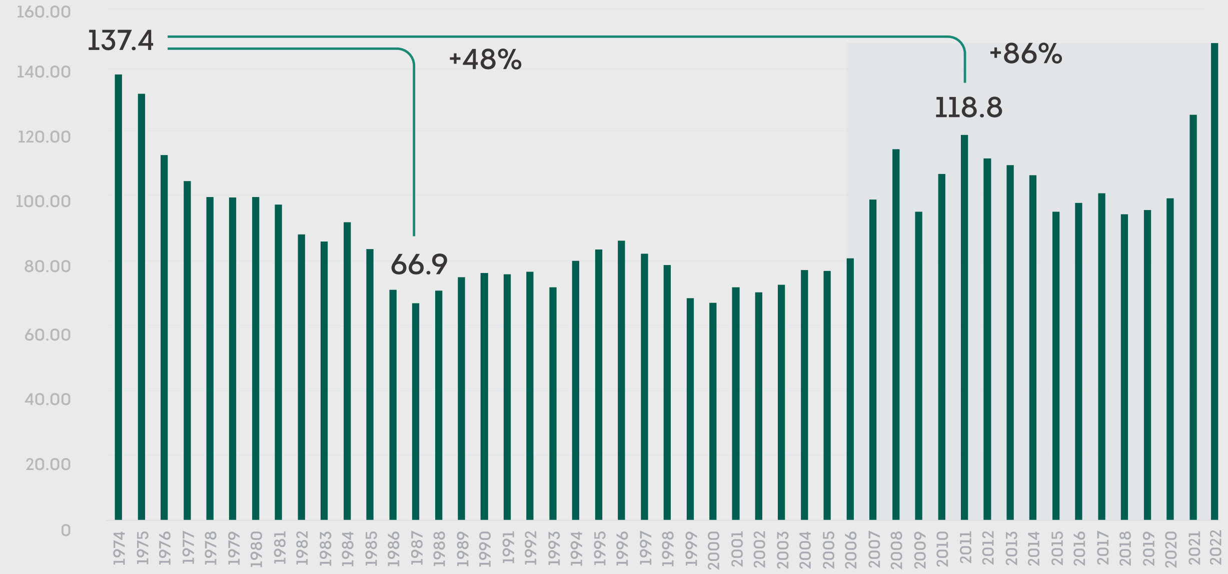
(Index*Dec/75=100)



source: Calculations performed with data on the relative cost of the DIEESE basic food basket (DIEESE)2022

Unfortunately, the increase in supply has not been enough to make possible further real declines in consumer prices, but it has certainly contributed to containing price increases that would make access to these goods even more difficult. Macroeconomic issues, international supply and demand, crises, climate issues and more recently, the supply disorder caused by the pandemic and war explain fluctuations in supply and demand that have raised agricultural prices. In global terms, food prices also show an upward trend, as shown by FAO data.

REAL FOOD PRICE



source: FAO (2022)

Insufficient income has affected the conditions of access to food in large populations around the world. In Brazil, the precariousness of employment, greater informality and the loss of effectiveness of some social policies contribute to the situation of food insecurity. Undoubtedly, we are facing a great challenge: we will need to rebuild the purchasing power of the Brazilian population and calibrate public policies to combat the food insecurity that has returned to grow in the country.

From any angle, efforts to increase agricultural production, with less environmental impact, will continue to represent agriculture's major contribution to facing the enormous global challenge of hunger.

Brazil, a leading country in the fight against hunger in the world

Brazil exports around 40 agricultural products.

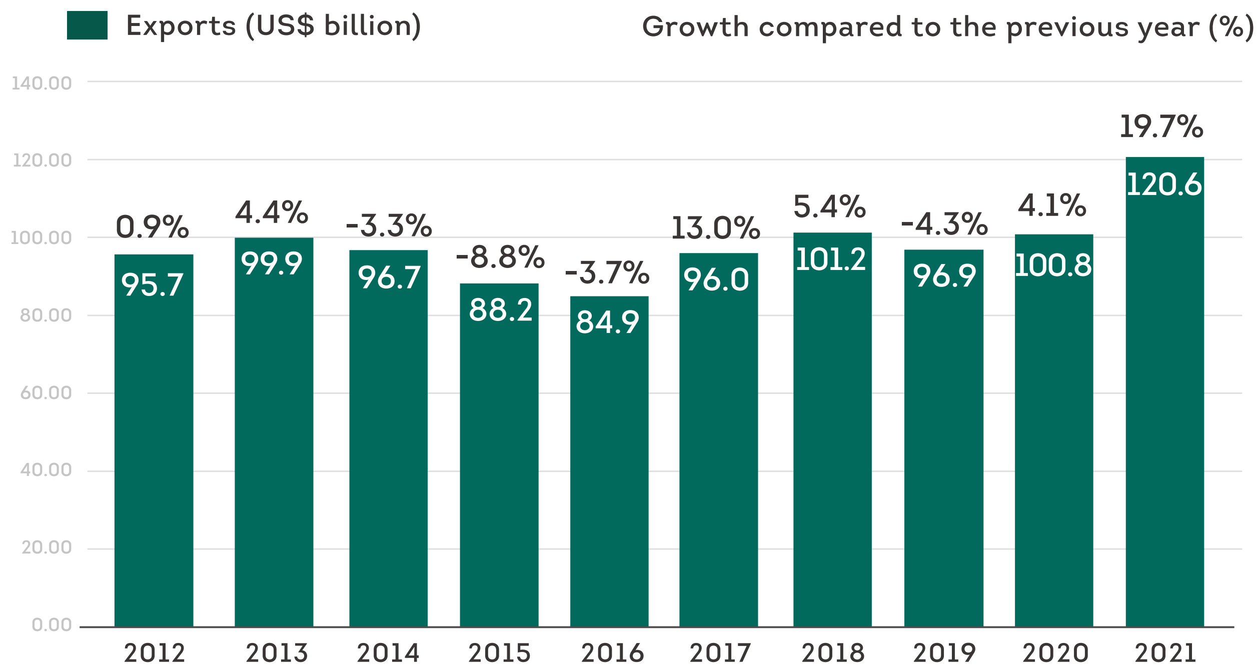
Brazil is able to remain a relevant producer in the next decade.

The country is currently ranked as the world's largest exporter of beef, chicken, soybean, 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 19.7% in value in 2021, compared to the previous year.

EVOLUTION OF AGRIBUSINESS EXPORTS



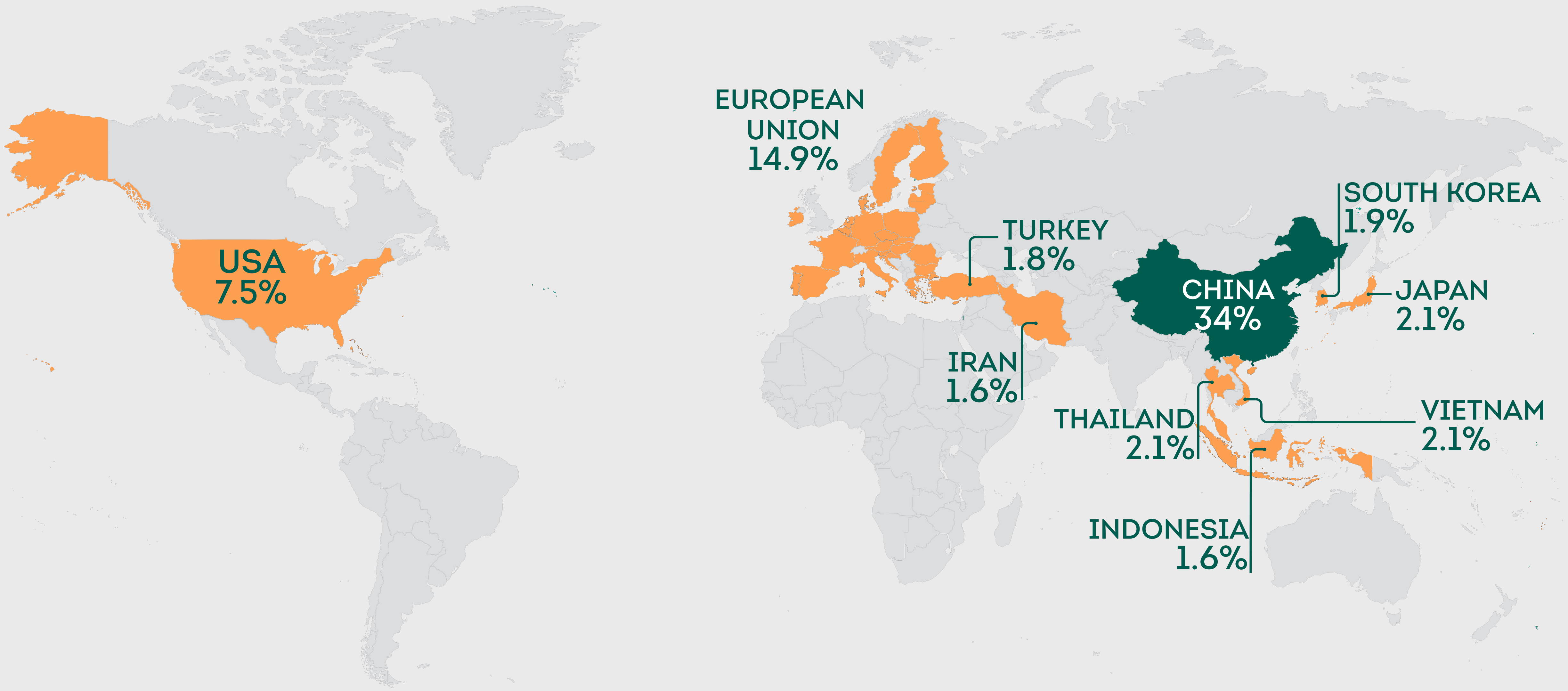
source: MDIC/ COMEX STAT (2021)

BRAZILIAN EXPORT MAIN AGRIBUSINESS PRODUCTS

Product	Exports (US$ billions)		Variation (2019 - 2020)
	2020	2021	Value
Soybeans	28.6	38.6	36.3%
Fresh beef	7.5	8.0	7.0%
Raw cane sugar	8.7	9.2	5.0%
Cellulose	6.0	6.7	12.4%
Soybean meal	5.9	7.4	24.7%
Corn	5.9	4.1	-28.5%
Fresh chicken	5.7	7.5	25.0%
Green coffee	5.0	5.8	16.7%
Cotton (not carded or combed)	3.2	3.4	5.6%
Fresh Pork	2.1	2.5	16.7%
Paper	0.7	0.9	24.5%
Unmanufactured smoke	1.6	1.5	-10.6%
Juices	1.6	1.9	16.3%
Ethyl alcohol	1.2	1.1	-10.9%
Others	17.1	22.0	3.9%
Total Agribusiness	**100.8**	**120.6**	**19.7%**

source: MDIC/COMEX STAT (2022)

MAIN DESTINATIONS OF BRAZILIAN AGRIBUSINESS EXPORTS IN 2021



source: MDIC/ COMEX STAT (2022)

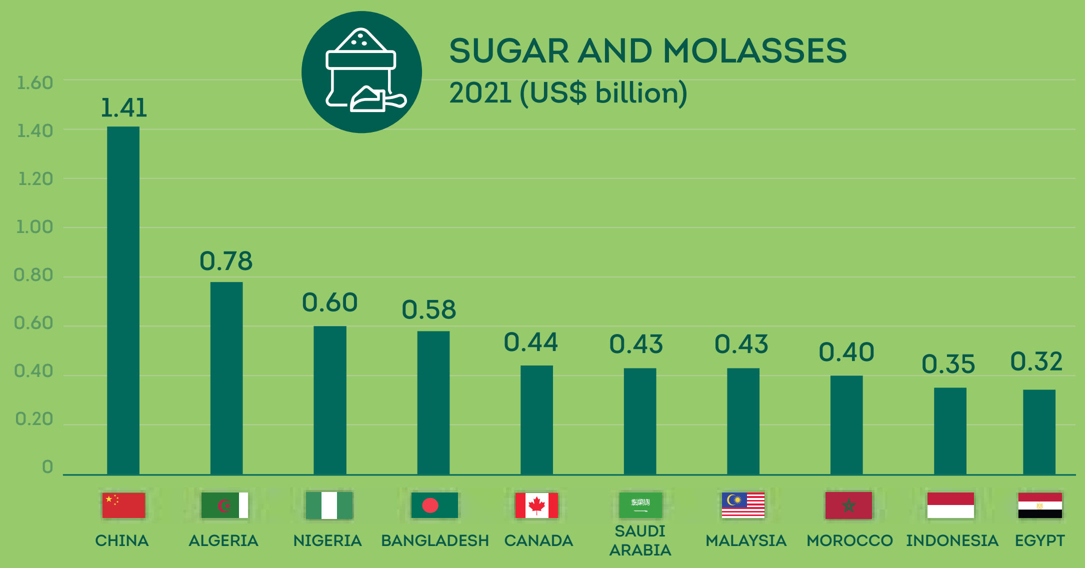
More than half of Brazil's agribusiness exports were destined for countries in the Asia and Oceania, in 2021.

In terms of the geographic distribution of Brazilian agribusiness exports, in 2021, more than half, were destined for countries in the Asia and Oceania region, and China was the main destination, with a 34% share. The European Union was the second-largest region, with 14.9%.

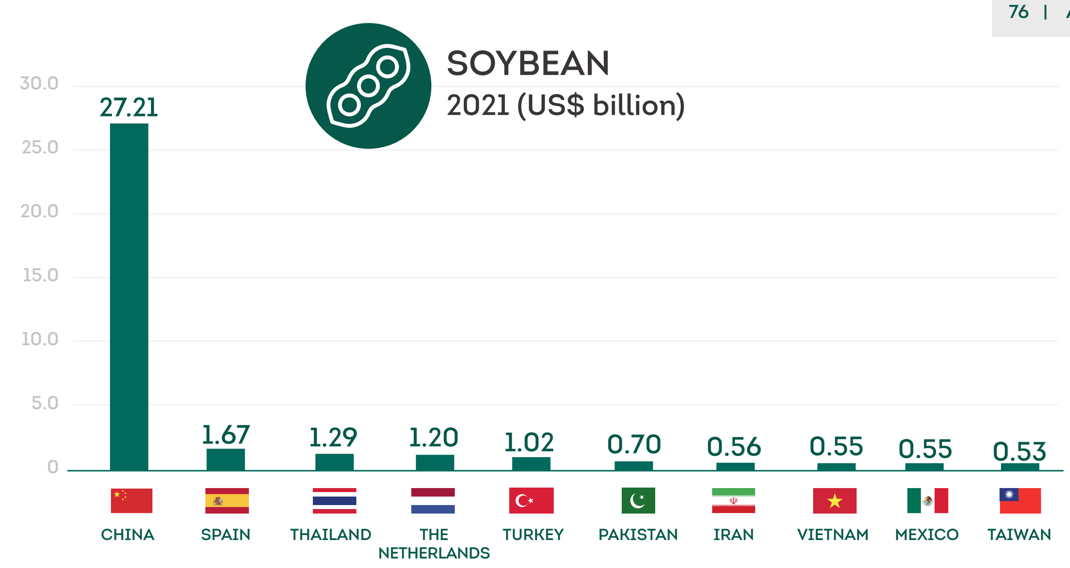
North America ranked as the third destination for agribusiness exports and the main market was the United States, with 7.5%. China is the biggest buyer of five of the agricultural products that are among the main Brazilian exports, such as soy, sugar and molasses, beef, poultry and cellulose.

In 2021, about 76% of the total agribusiness products exported to China were concentrated in two products: soy (66%) and fresh beef (10%).

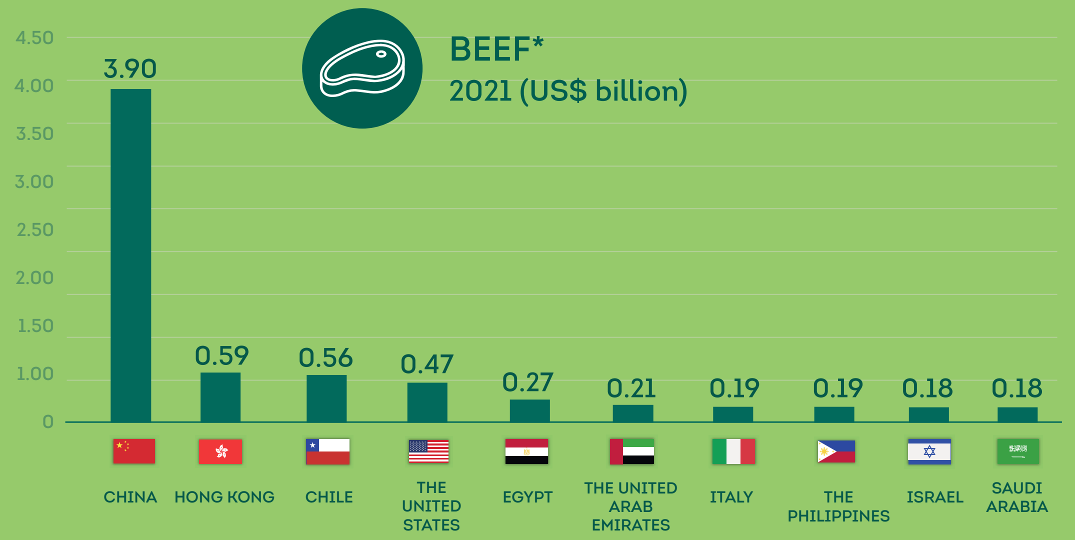
BRAZILIAN EXPORT MAIN DESTINATIONS



source: COMEX STAT (2022)



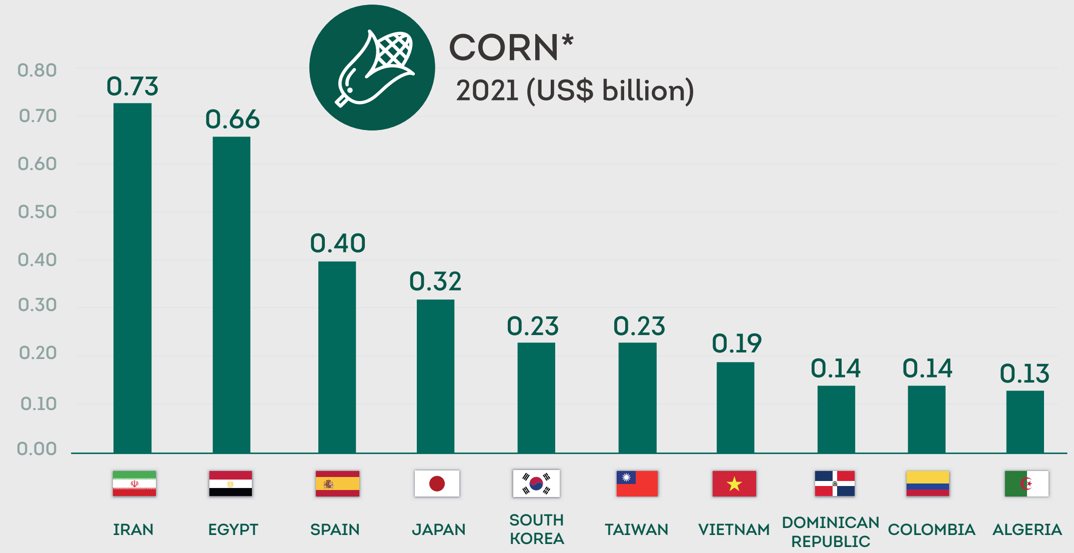
source: COMEX STAT (2022)



(*) Fresh, chilled or frozen beef

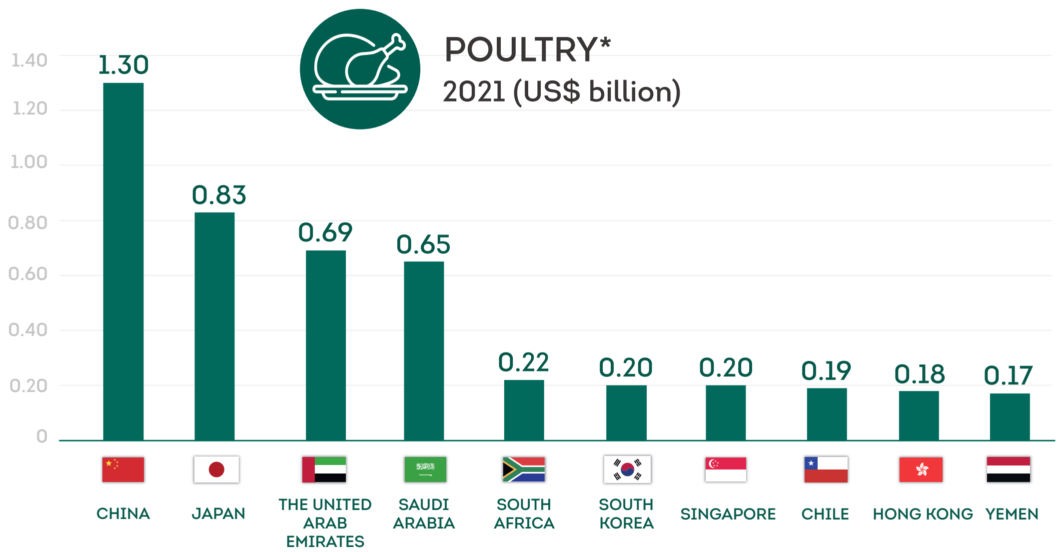
source: COMEX STAT (2022)

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



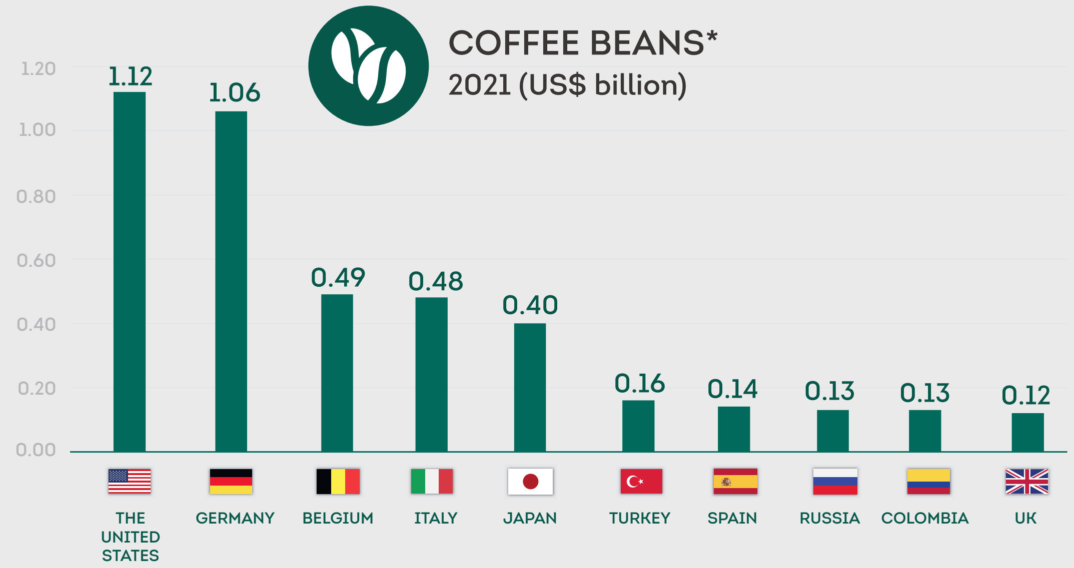
(*) NCM 10059010

source: COMEX STAT (2022)



(*) Poultry meat and its edible offal, fresh, chilled or frozen

source: COMEX STAT (2022)



(*)NCM 9011110

source: COMEX STAT (2022)

The outlook for agricultural production in Brazil is quite optimistic

In the case of grains, the area is expected to grow 17.6% compared to the 2020/2021 harvest, while the production is expected to grow 27.1%.

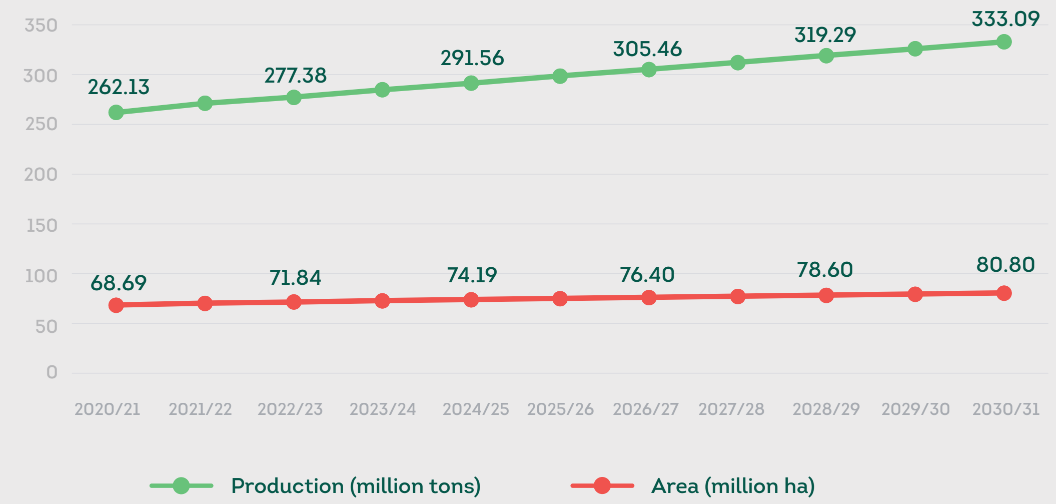
The projected growth for agriculture over the next 10 years makes Brazil continue to play this leading role in the food supply.

This projection was disclosed in the study by the Ministry of Agriculture, Livestock and Supply (MAPA) in 2021. According to the analysis, the growth of technology adoption and productivity growth are expected to continue.

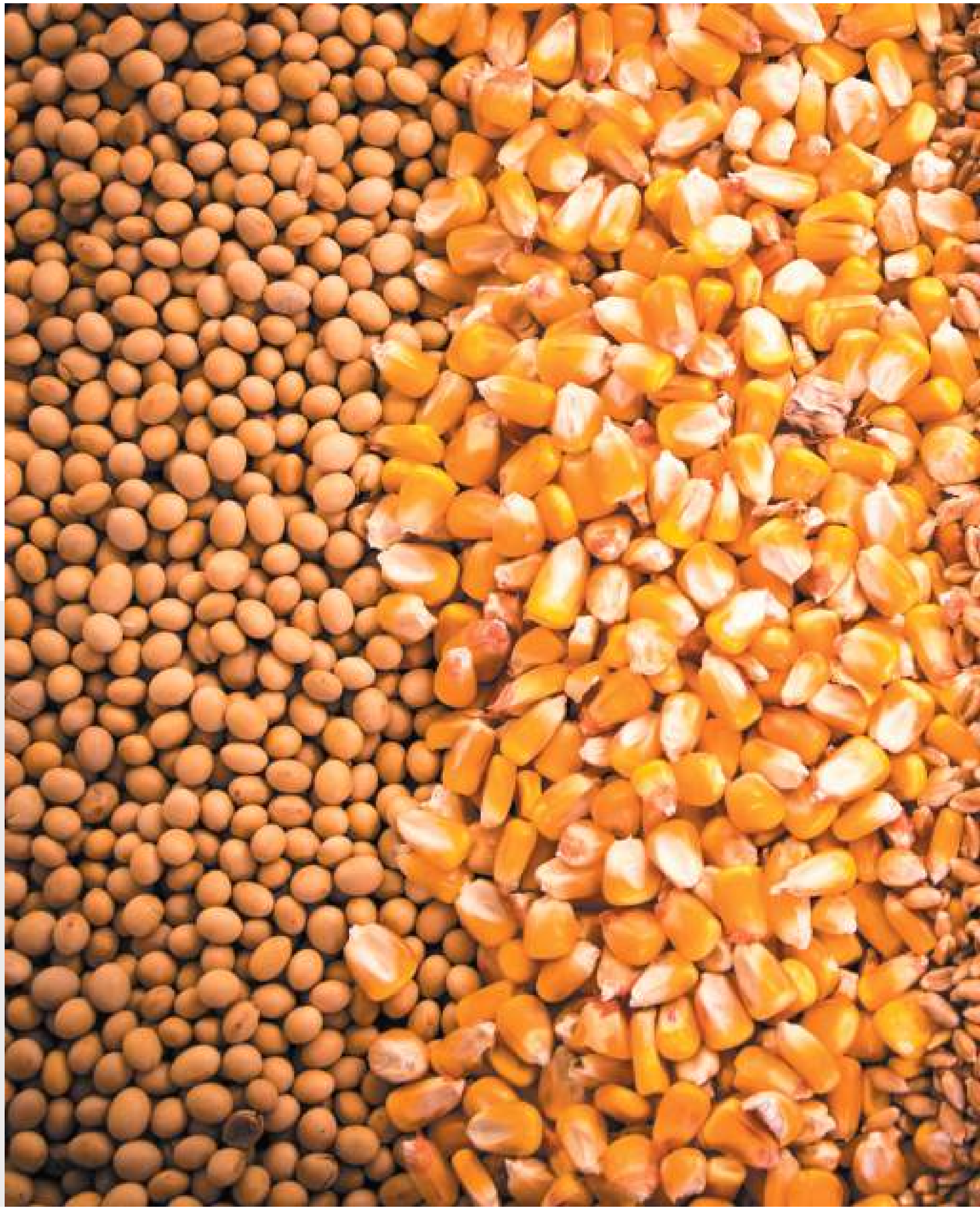
In the case of grains, the area is expected to grow 17.6% compared to the 2020/2021 harvest, while the production is expected to grow 27.1%.

CHALLENGES FOR 2031 AND THE ROLE OF BRAZIL

GRAINS (PROJECTIONS FOR 2031)

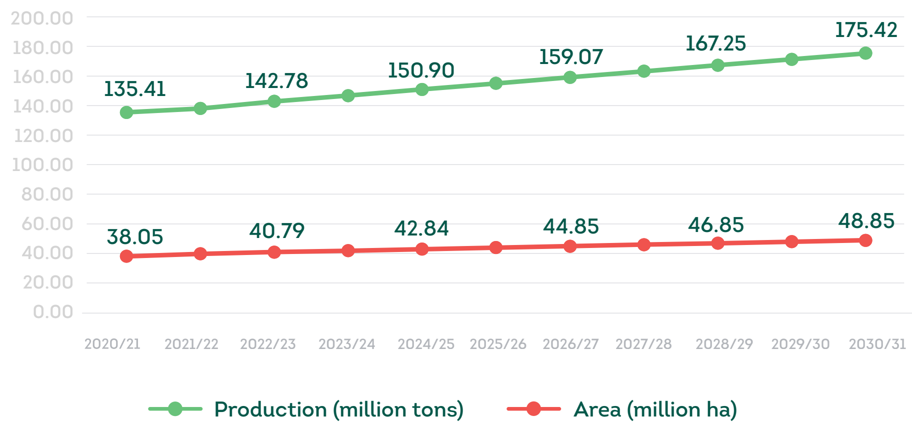


source: MAPA (2021)



SOYBEAN (PROJECTIONS FOR 2031)

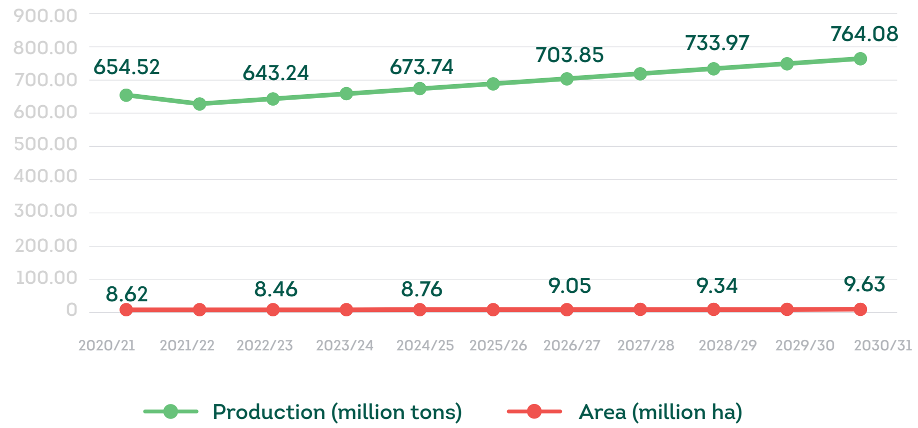
Soybean production is expected to grow by 29.5% in the period, with an increase of 26.9% in planted area.



source: MAPA (2021)

SUGARCANE (PROJECTIONS FOR 2031)

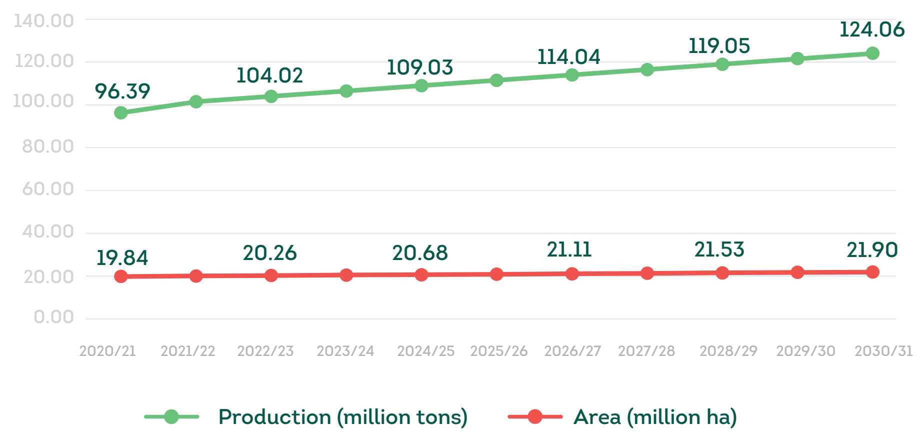
The increase in productivity will not be restricted to grains. Sugarcane, the crop that has launched commercial agriculture in Brazil 500 years ago, continues to improve productivity. By 2031, its production is expected to grow 16.7%, with an increase of 11.8% in planted area.



source: MAPA (2021)

CORN (PROJECTIONS FOR 2031)

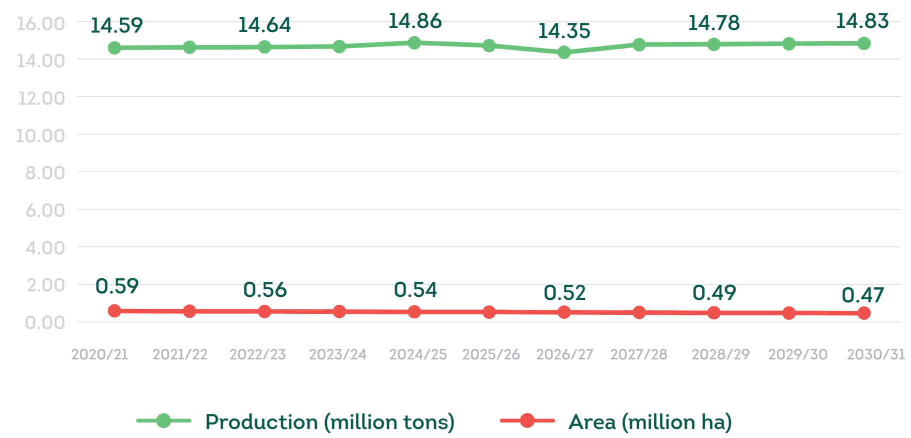
Similar to soybean, corn production is expected to grow 28.7% until 2031, with an increase of 10.6% in area.



source: MAPA (2021)

ORANGE (PROJECTIONS FOR 2031)

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 1.6% in production, with a drop of 19.8% in the planted area.

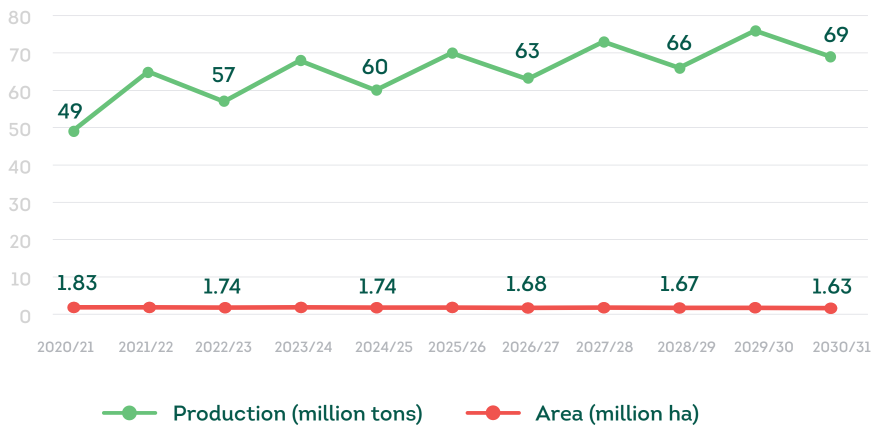


source: MAPA (2021)

Potato will probably be the most expressive case of increased productivity.

A decrease in planted area of 19.9% with a production growth of 11.7% is expected for it.

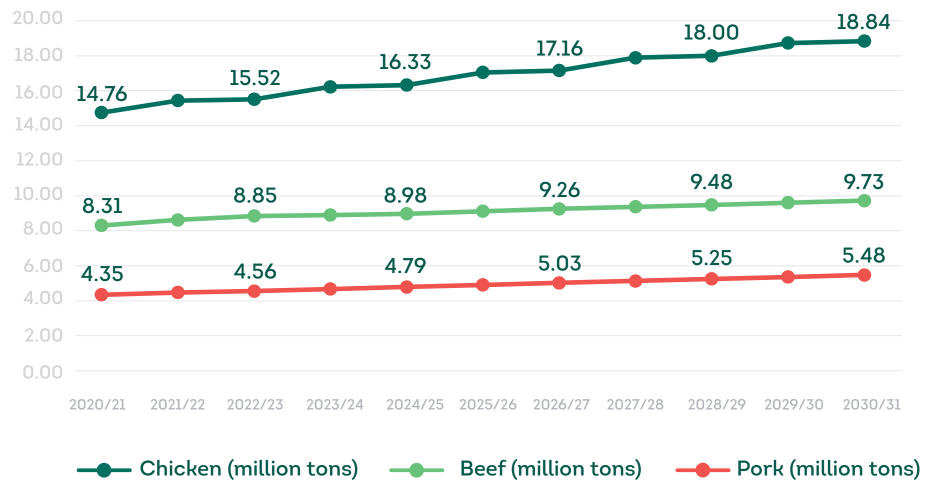
COFFEE (PROJECTIONS FOR 2031)



source: MAPA (2021)

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 10.6% with an increase of 40.8% in production is expected by 2031, which will also be a full-harvest year.

MEATS (PROJECTIONS FOR 2031)



source: MAPA (2021)

In the case of meat, the perspective is also for growth until 2031. The study projects a growth of 27.7% for chicken. Pork is expected to be slightly behind, with an increase of 25.8%. The growth of beef production is not expected to be so great, 17.0%.

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.

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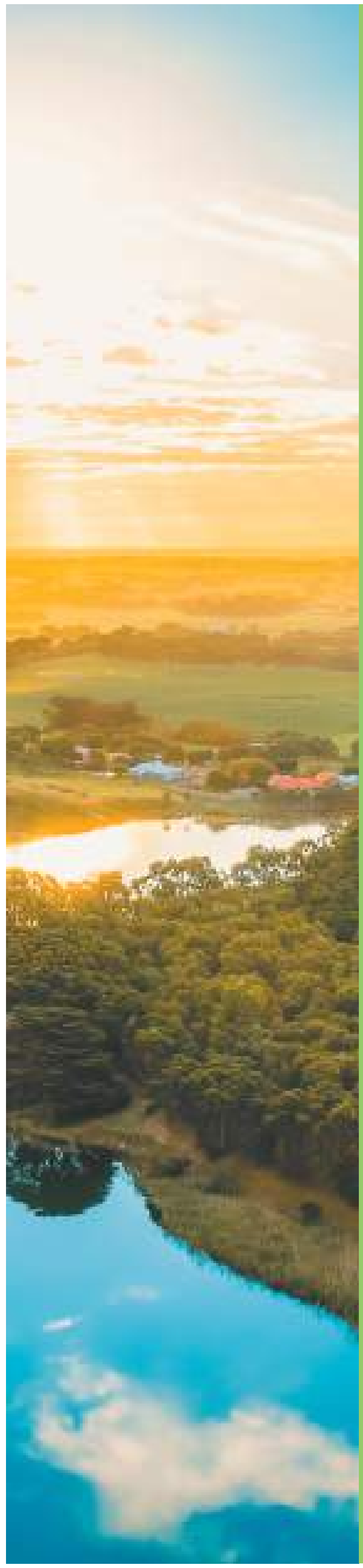

2nd Edition

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.

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