USDA United States Department of Agriculture
Foreign Agricultural Service

GAIN Global Agricultural Information Network

Voluntary Report – Voluntary - Public Distribution **Date:** April 26, 2024

Report Number: BR2024-0006

Report Name: Sustainable Agriculture Programs in Brazil- Past Present and Future

Country: Brazil

Post: Brasilia

Report Category: Agricultural Situation, Agriculture in the News, Climate Change/Global Warming/Food Security

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Report Highlights:

Brazil, a BRICS emerging economy, is the world's sixth-largest greenhouse gas (GHG) emitter. Change in land use and forests (including deforestation and wildfires) is the main source of GHGs in Brazil, followed closely by agricultural production. Following COP 28, Brazil updated its Nationally Determined Contributions (NDC), committing to reducing greenhouse gas emissions by 48 percent by 2025 and 53 percent by 2030, compared to 2005 emissions. Given the importance of agriculture, Brazil has adopted and implemented regulations to make these activities more sustainable, with the main goals of mitigating GHGs and adapting to climate change. The Low-Carbon Agriculture (ABC) Plan, the Safra Plan, and the National Program for the Conversion of Degraded Pastures into Production Systems (PNCPC) are among the most significant recent initiatives. This report highlights Brazil's programs to mitigate carbon emissions in the agricultural sector and promote sustainable practices.

Sustainable Agriculture Programs in Brazil

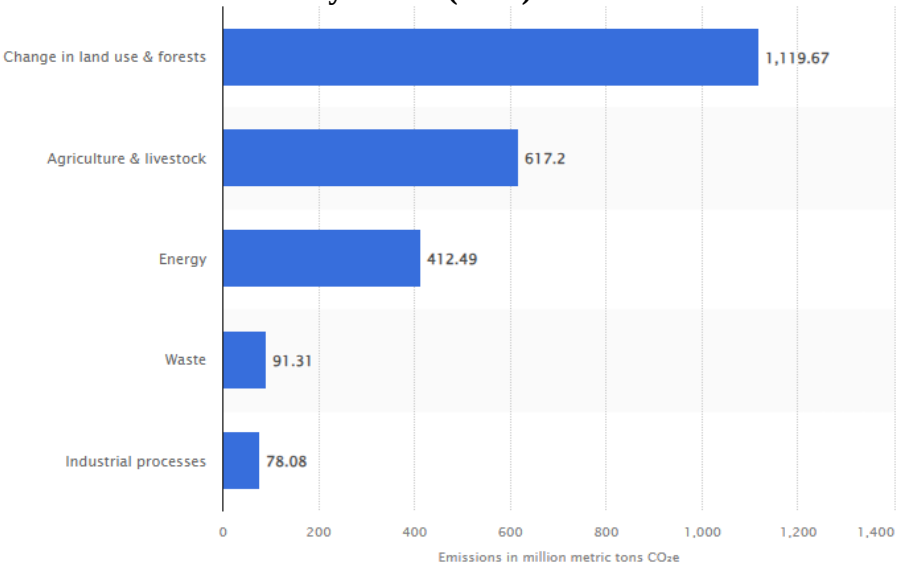
Past, Present, and Future

Contents

Introduction

Brazil is an agricultural powerhouse. It is the top producer and exporter of soy, coffee, and sugar and ranks second in the world's chicken, livestock, and cotton production, behind the United States. Change in land use and forests, including deforestation and wildfires, is the main cause of greenhouse gas emissions in Brazil, accounting for almost half of total greenhouse gas emissions in 2022. The agriculture and livestock sector ranked second, generating an estimated 617 million metric tons of CO_2 equivalent worth of emissions that year.

Figure 01 –Greenhouse Gas Emissions by Sector (2022)



***Source**: Statistica, based on IPCC data*

Since the 1990s, Brazil has adopted and implemented regulations to make agriculture and livestock more sustainable, with the main goals of mitigating greenhouse gas emissions (GHGs) and adapting to climate change. To address international commitments as well as domestic concerns, Brazil's Ministry of Agriculture (MAPA) has formulated projects and programs to stimulate low-carbon agriculture and improve productivity without expanding land use. In 2023, Brazil updated its Nationally Determined Contributions (NDC) and committed to reducing greenhouse gas emissions by 48 percent by 2025 and 53 percent by 2030, compared to 2005 emissions.

This report highlights the primary actions of the Ministry of Agriculture to mitigate carbon emissions in the agricultural sector and promote sustainable practices. The focus will be on the most prominent programs: the ABC Plan, the Safra Plan, and the National Program for the Conversion of Degraded Pastures into Production Systems (PNCPC). Other Brazilian government initiatives, such as the Ministry of Finance's Ecological Transformation Program will also be explained.

A note about data: Post uses information from Embrapa (2018) and the Brazilian Institute of Geography and Statistics IBGE (2020). Both institutions are recognized but use different data collection methods and different classification terminology. Therefore, information from both sources was included for the purpose of comparison, analysis, and complementarity. Also, Post uses the hectare (ha) measure, equivalent to 10,000 square meters, to avoid conversion losses.

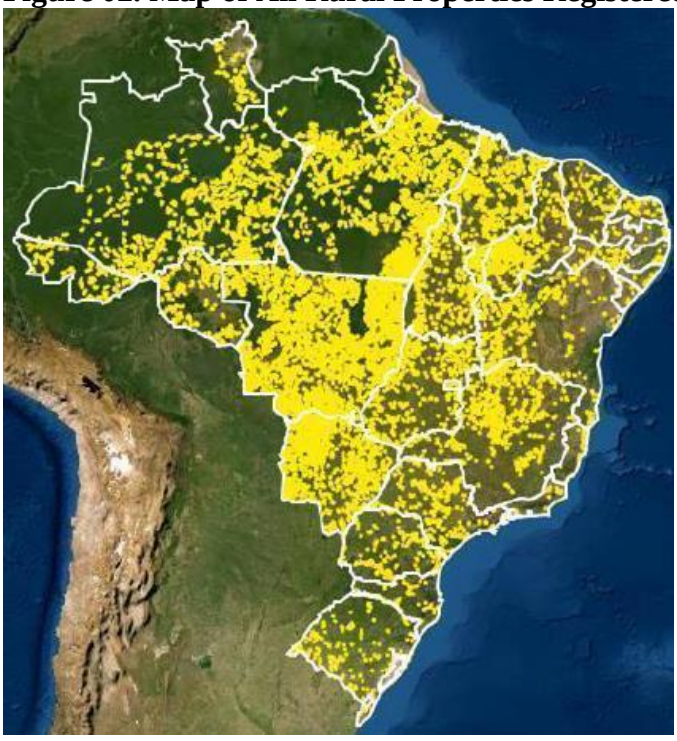
Overview of Brazil's Land Area

Brazil is the fifth largest country in the world, occupying 850,280,588 hectares. In 2012, the Brazilian Forest Code (Código Florestal, in Portuguese) was created to reduce forest exploitation and protect native vegetation. With the Forest Code, rural properties are required to be registered in the Rural Environmental Registry (CAR, in Portuguese). CAR is the main instrument for integrating environmental information of rural properties with protected areas, composing the database for control, monitoring, planning, and combating deforestation.

According to the National Environmental Information System (SINIMA), as of October 2023, Brazil had 7.2 million rural properties registered, across 671.9 million hectares in all Brazilian states. From this total, 39.3 million hectares are traditional territories of indigenous communities, 52.2 million hectares refer to agrarian reform settlements, and the remaining 580.3 million hectares refer to general rural properties, including private farms.

As of October 2023, only 1.4 percent (101,349 properties) of the self-reported registers in CAR were fully analyzed and comply with the environmental legislation. The Brazilian Forest Service is responsible for the SINIMA and for analyzing the registered properties. The high number of properties registered in the SINIMA and delays in formalizing compliance pose challenges for completing the environmental accountability and hinders the identification of areas in need of restoration or conservation.

Figure 02. Map of All Rural Properties Registered in the (CAR), 2023



***Source**: Ministry of Environment and Climate Change*

Embrapa conducted a comprehensive mapping of land use in 2018. On average, the area dedicated to preserving native vegetation on rural properties - registered and mapped in the Rural Environmental

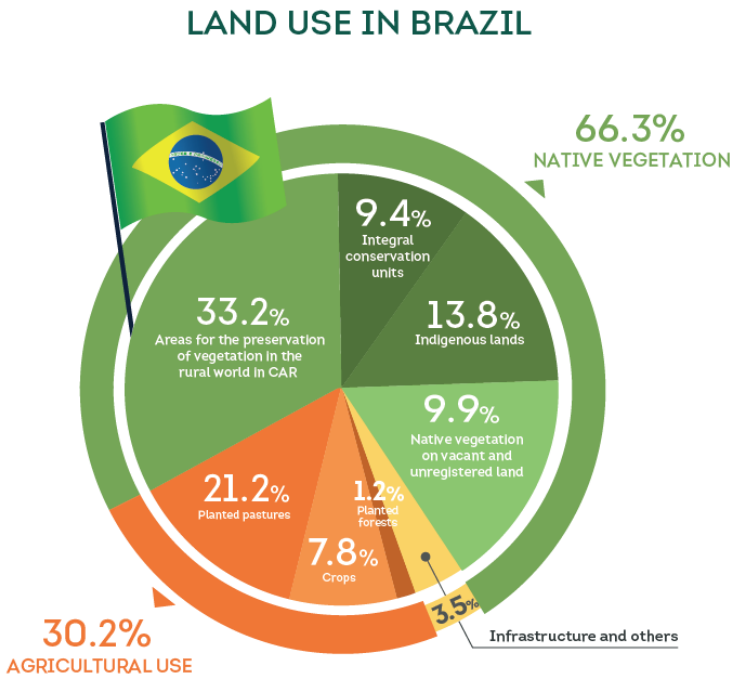
Registry (CAR) - represents a quarter of the area (25.6 percent) or approximately 218 million hectares. The areas protected by law are composed of integral conservation units (national parks, ecological stations, 10.4 percent of the total) and 600 indigenous lands (13.8 percent), both occupying 206 million hectares (24.2%).

Chart 01 – Land Use in Brazil (2018), in million hectares.

Land use in Brazil	Areas in millions of hectares	Percentage of the total area
Areas for the preservation of native vegetation in properties registered in the Rural Environmental Registry (CAR)	218,245,801	25.6%
Integral Conservation Units	88,429,181	10.4%
Indigenous Lands	117,338,721	13.8%
Native Vegetation on Vacant and Unregistered Land	139,722,327	16.5%
Infrastructure and Others	29,759,821	3.5%
Planted Forests	10,203,367	1.2%
Planted Pastures	112,237,038	13.2%
Native Pastures	68,022,447	8.0%
Crops	66,321,886	7.8%
Total	**850,280,588**	**100**

***Source**: Embrapa, Chart Post Brasilia*

Figure 03. Distribution of Land Use in Brazil, 2018



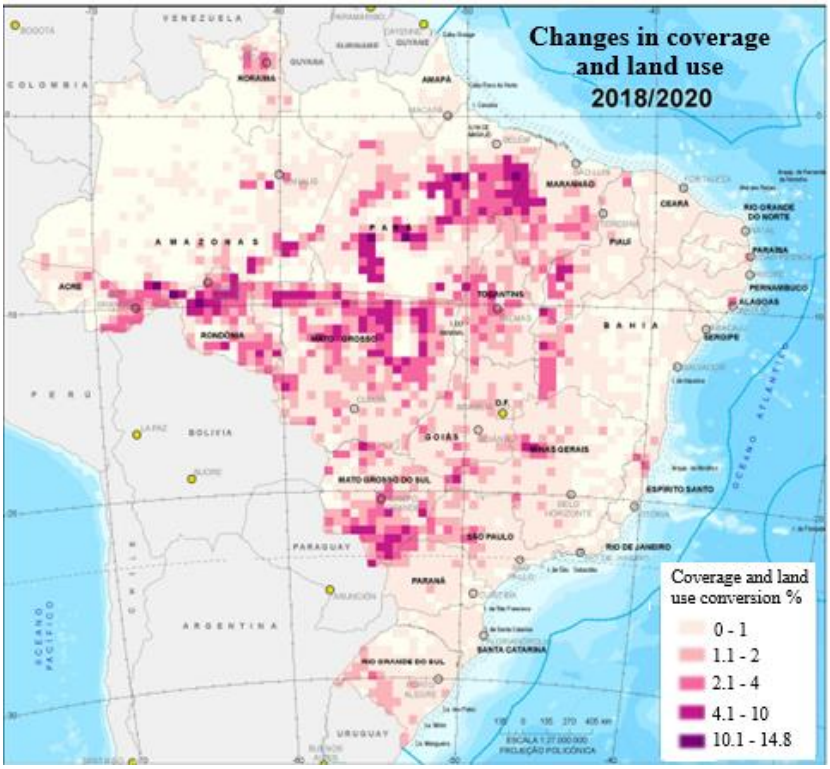
***Source**: CropLife*

Every two years, the Brazilian Institute of Geography and Statistics (IBGE) provides statistical data and systematic satellite mapping of Brazil to identify changes in the land occupation and organization. The report, Coverage and Land Use Monitoring of Brazil, is part of the Brazilian government's efforts to comply with the World Conferences on Environment and with the Sustainable Development Objectives of the United Nations. The reports have been used to support decision-makers, technicians and the academia with the creation or improvement of public policies.

According to IBGE, between 2018 and 2020 the main areas of conversion and changes in the land use were in the states of Pará, Rondônia, Acre, and Amazonas, Mato Grosso, Roraima, and in the areas of the region known as MATOPIBA (acronym for the new agriculture frontier and main soybean states in the Mid-West region: Maranhão, Tocantins, Piauí, and Bahia), Mato Grosso do Sul, Goiás, and Minas Gerais. Those states are important agricultural producers, including livestock. The main conversions were managed pasture into agricultural area, forest area into managed pasture, and forest vegetation into mosaic of occupation in forest area[1].

The following chart shows the changes in the type of coverage and land use in Brazil between 2018 to 2020. The darker areas refer to considerable conversion of land use. For the mapping, IBGE divided Brazil in blocs measuring 450 km x 450 km. The color of the blocks signifies the size of the changes made to the land use, with darker blocks indicating a bigger modification to in the type of occupation.

Figure 04 – Changes in the Coverage and Land Use (2018 – 2020)



[1] Area characterized by the mixed occupation of agriculture, pasture and/or forestry, whether or not associated with forest remnants, in which it is not possible to individualize its components. For the classes of coverage and land use, see the Attachment section.

***Source**: IBGE; Chart Post Brasilia*

In just two years, between 2018 to 2020, managed pasture areas effectively increased 0.6 percent, expanding particularly in the states of the North region, Mato Grosso and Maranhão. Agricultural area increased 3.2 percent, mainly in Mato Grosso, Mato Grosso do Sul, Goiás, Minas Gerais, and Pará.

Forestry areas increased 0.8 percent, particularly in Mato Grosso do Sul, Pará, Maranhão, Bahia, and São Paulo. During that time, the loss of natural coverage registered an effective decrease of 0.4 percent in 2018 and 0.6 percent in 2020 in areas of forest vegetation and grassland vegetation, particularly in Pará, Mato Grosso, Rondônia, Amazonas, and Acre.

The IBGE report concluded that conversion of pasture into agricultural and forestry lands continued increasing in all regions. The charts below indicate the inventories of coverage areas and land use in 2018 and 2020. The most notable change was the 3.5 percent increase in agricultural areas, which corresponds to 24,116 km².

Chart 02 - Inventories of area coverage and land use in Brazil (2018 and 2020)

BRAZIL – Inventory (KM²)

	Artificial Area	Agricultural Area	Managed Pasture	Mosaic of Occupations in Forest Area	Forestry	Forest Vegetation
Inventory (2018)	38,294	664,784	1,125,194	829,071	85,951	3,732,236
Inventory (2020)	37,366	688,900	1,132,213	820,941	86,610	3,718,891

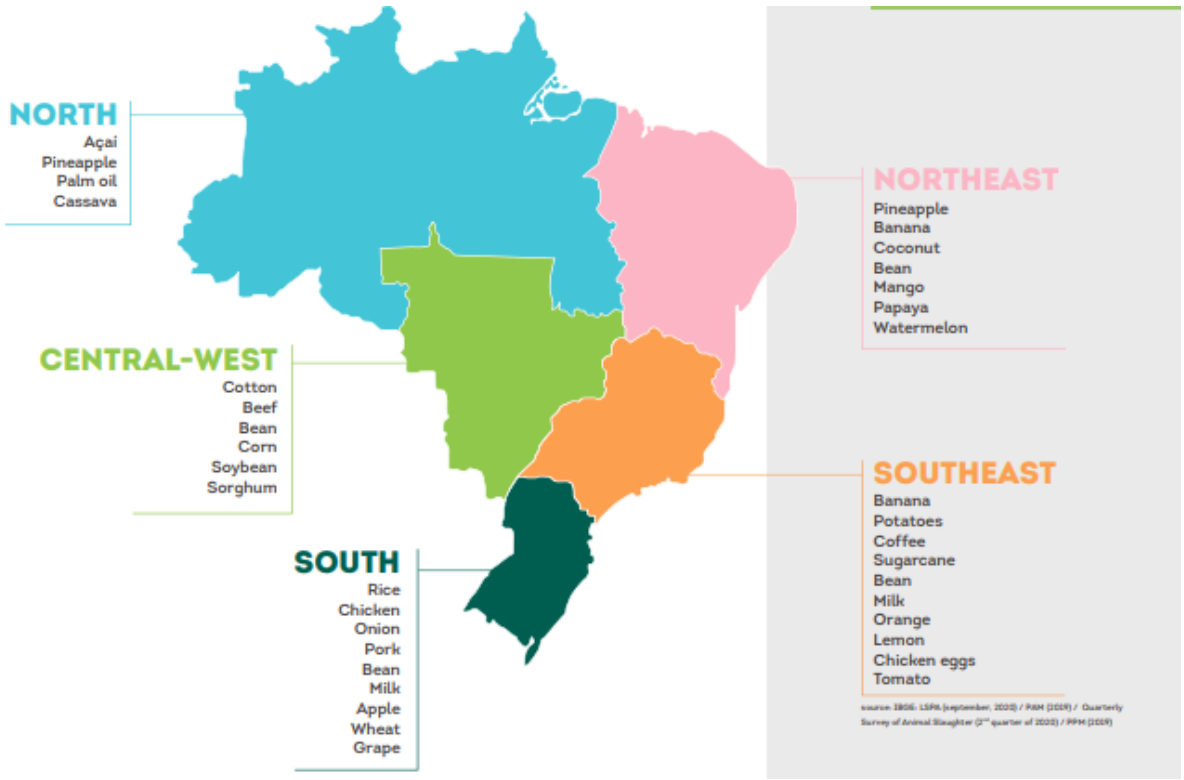
BRAZIL – Inventory (KM²) - *Continuation*

	Wetland	Grassland Vegetation	Mosaic of Occupations in Countryside	Continental Water Body	Coastal Water Body	Uncovered Area
Inventory (2018)	33,868	1,635,447	252,609	128,902	222,461	3,749
Inventory (2020)	33,585	1,625,591	253,204	127,128	224,395	3,742

***Source**: IBGE; Chart Post Brasilia*

In 2023, the total value of Brazilian agriculture and livestock production reached BRL677 billion (US$ 136 billion[2]), an increase of 15 percent compared to 2022. The three main crops are soybeans, corn, and sugarcane, primarily grown in the Central-West and Southeast regions. Beyond these commodities, agricultural production in Brazil is highly diversified, as depicted in Figure 5.

Figure 05 – Regional Distribution of the Main Agricultural Products



***Source**: Crop Life*

According to the IBGE, about 32 percent of Brazil's land has good (30 percent) or very good (two percent) potential for agricultural development, such as soil characteristics that are favorable to agriculture. On the other hand, 32 percent of the territory is restrictive to the development of farming practices, due to hilly terrains, fertilization difficulties, and restraints to farm management and mechanization (21 percent), and unsuitable soils or very steep slopes (11 percent).

Brazil has six biomes, each with distinct climate, vegetation, and fauna. These are the Amazon, the Cerrado, the Atlantic Forest, the Caatinga, the Pampa, and the Pantanal.

1. **The Amazon:** The most extensive biome characterized by a hot and humid climate and dense forest, the rainforest. It is considered the most significant biological reserve in the world due to the variety of plants and animal species. The Brazilian Amazon is 4.2 million km², which corresponds to 49 percent of Brazil's land area and is present in nine states: Acre, Amapá, Amazonas, Pará, Rondônia,

[2] Official currency rate of BRL4.95, calculated on March 1st, 2024.

Roraima, Tocantins, Mato Grosso, and Maranhão. Native vegetation covers 84 percent of the Brazilian Amazon, approximately 3.52 million km².

2. **The Cerrado:** It has a warm tropical climate with distinct rainy and dry seasons, Savanna-type vegetation, and forests. The biome covers about two million km² or 24 percent of Brazil's land area. The Cerrado has been the central area of agricultural expansion in Brazil in recent decades. According to the Brazilian Agricultural Research Corporation (Embrapa), deforestation has affected about 50 percent of the Cerrado biome.

3. **The Atlantic Forest:** Approximately 60 percent of the Brazilian population (145 million people) live in Atlantic Forest areas comprising the Southeast and South regions, which total 1.1 million km². The main vegetation of this biome is rainforest, which can be dense or open and dependent on regular rainfall without marked dry periods. Among all Brazilian biomes, it is the most endangered and degraded. According to Embrapa, only 0.05 percent of the original Atlantic Forest area remains preserved.

4. **The Pampa:** The Pampa biome is in the state of Rio Grande do Sul and has steppe vegetation with few forests. Rains are regular and the climate is marked by of polar fronts and sub-zero temperatures in winter. Pampa covers approximately 178,000 km² and about one-third of the original area is preserved.

5. **The Pantanal**: Located in the states of Mato Grosso and Mato Grosso do Sul, it is a floodplain of central-west Brazil. It is covered by the waters of the Paraguay River basin for several months a year. Pantanal´s vegetation is savannah with forests. The Pantanal covers approximately 151,000 km², and about 84 percent of its area still is preserved.

6. **The Caatinga:** It is the biome of the semiarid region of Brazil, covering nine states: Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia and Minas Gerais. With approximately 800,000 km², the characteristic vegetation is savannah-like, with species capable of withstanding prolonged droughts interspersed with short and irregular rainy periods. The climate is hot and forests are sparse.

Figure 06. Brazilian Biome Diversity

***Source**: CropLife Brazil; Chart Post Brasília*

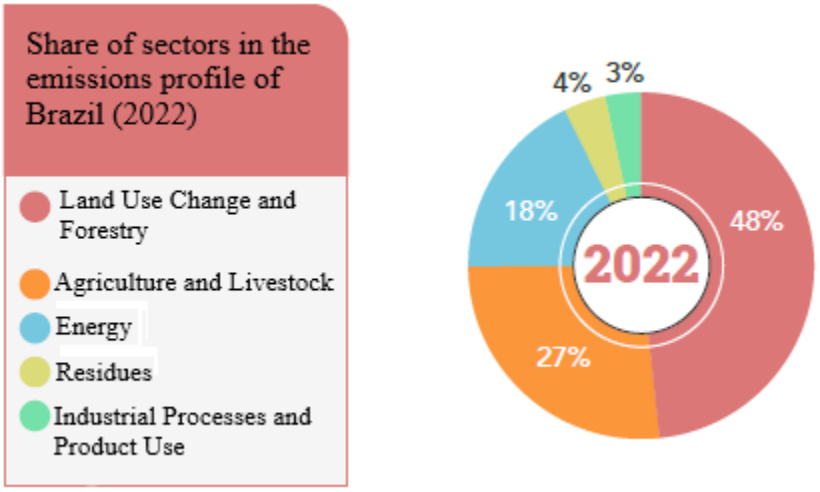
Agricultural Greenhouse Gas Emissions

In 2023, Brazil updated its Nationally Determined Contributions (NDC), committing to reducing greenhouse gas emissions by 48 percent by 2025 (equivalent to 1.32 billion tons of carbon dioxide equivalent – bi tCO_2e) and 53 percent (1.20 bi t tCO_2e) by 2030, compared to 2005 emissions.

According to the System for Estimating Greenhouse Gas Emissions and Removals (SEEG), Brazil emitted 2.3 billion metric tons of greenhouse gases in 2022, the third highest since 2005 and eight percent lower when compared to the previous year (2.5 billion tons). The decrease was the direct result of the drop in the Amazon deforestation. Brazil is the sixth largest climate polluter, with three percent of the global total, behind China, the United States, India, Russia, and Indonesia.

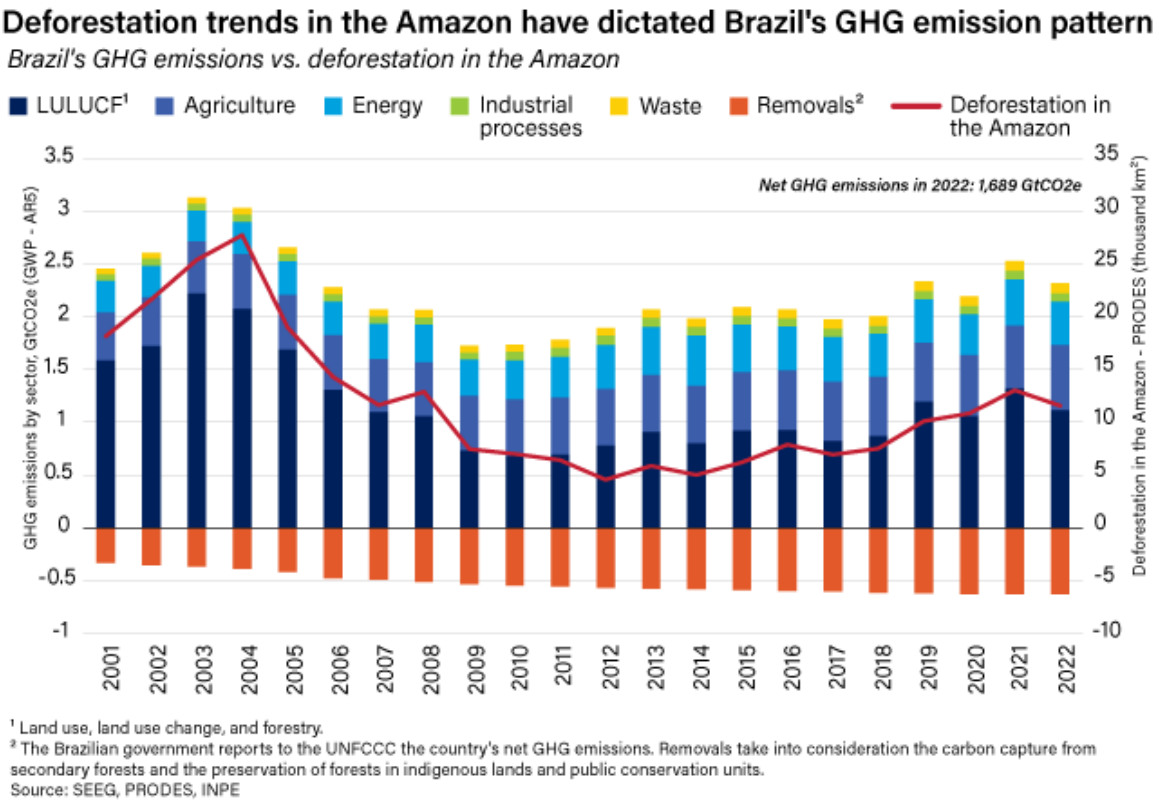
Agriculture and livestock are responsible for 27 percent of the total emissions in Brazil. To achieve the NDCs proposed in 2023, Brazil would need to eliminate deforestation in all biomes by 2030.

Figure 07 – Share of Sectors in the Brazilian Emissions Profile (2022)



***Source**: SEEG; Chart Post Brasilia*

Figure 08 – Greenhouse Gas Emissions by Sector (2001 to 2022)



¹ Land use, land use change, and forestry.
² The Brazilian government reports to the UNFCCC the country's net GHG emissions. Removals take into consideration the carbon capture from secondary forests and the preservation of forests in indigenous lands and public conservation units.
Source: SEEG, PRODES, INPE

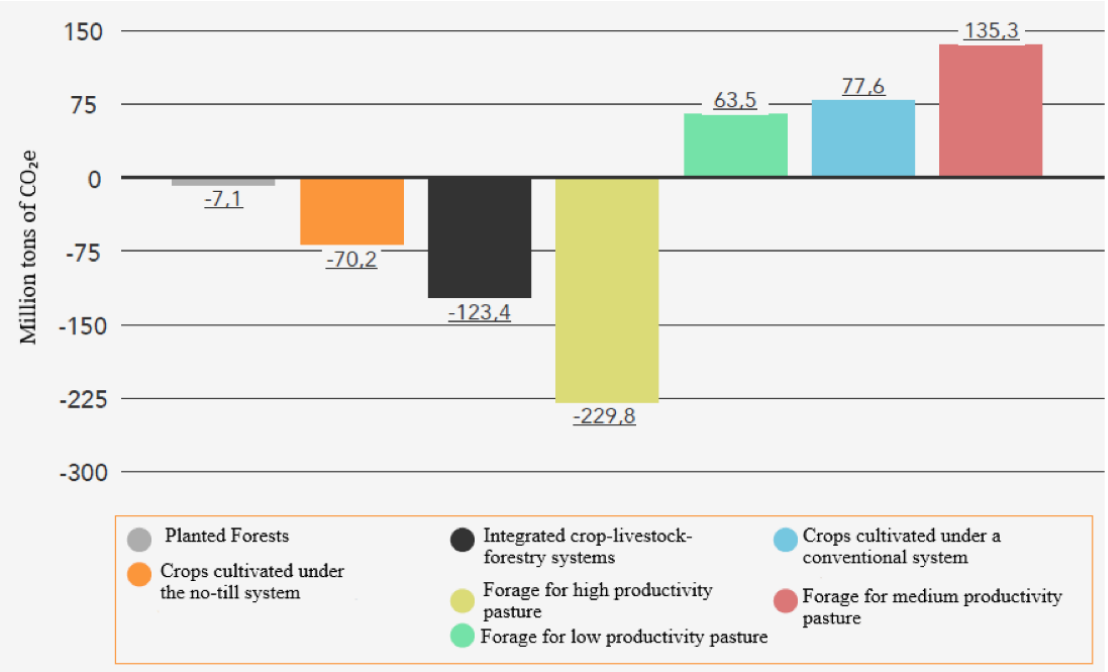
***Source**: Eurasia*

Although agriculture is one of the main sectors emitting GHGs, it also has the potential to greatly remove carbon from soil. The removals largely come from practices promoted by the ABC and ABC+ programs and play an important role in the quest to meet international targets, as well as increasing productivity.

Sources of carbon emissions from soil include crops that still use the conventional planting system and pastures with loss of productivity, a process that leads to degradation. Sequestration, on the other hand, comes from no-till farming, pastures with high productivity, planted forests, and integrated crop-livestock-forest systems. In 2022, the Brazilian soil carbon balance resulted in an estimated net removal of 154.1 million tons of CO_2 ($MtCO_2$), an increase of 1.3 percent compared to the 2021 balance (152.1 million tons of CO_2).

The graph below shows gross soil carbon emissions and sequestration from the agricultural sector in 2022. The bars above the line represent the emissions. Around 72 percent (198.8 $MtCO_2$) came from medium and low productivity pastures, which are pastures that show a worsening capacity to sustain an animal population. Pastures that use traditional cultivation are responsible for 28 percent of gross emissions, as this preparation and management practice results in the disturbance of the upper layers of the soil, causing carbon loss. In terms of sequestration, the bars below the line in the graph show that 53 percent (229.8 $MtCO_2$) came from pastures which use good management practices and favor the increase and maintenance of the carbon stock in the soil. Crop-livestock-forest integration systems then accounted for 29 percent of gross removals (123.4 $MtCO_2$). Areas under no-till systems resulted in gross removals of 16 percent (70.2 $MtCO_2$). Finally, planted forests removed around two percent of the total (7.1 $MtCO_2$).

Figure 09 – Carbon Emissions and Sequestration by the Agricultural Soil in 2022

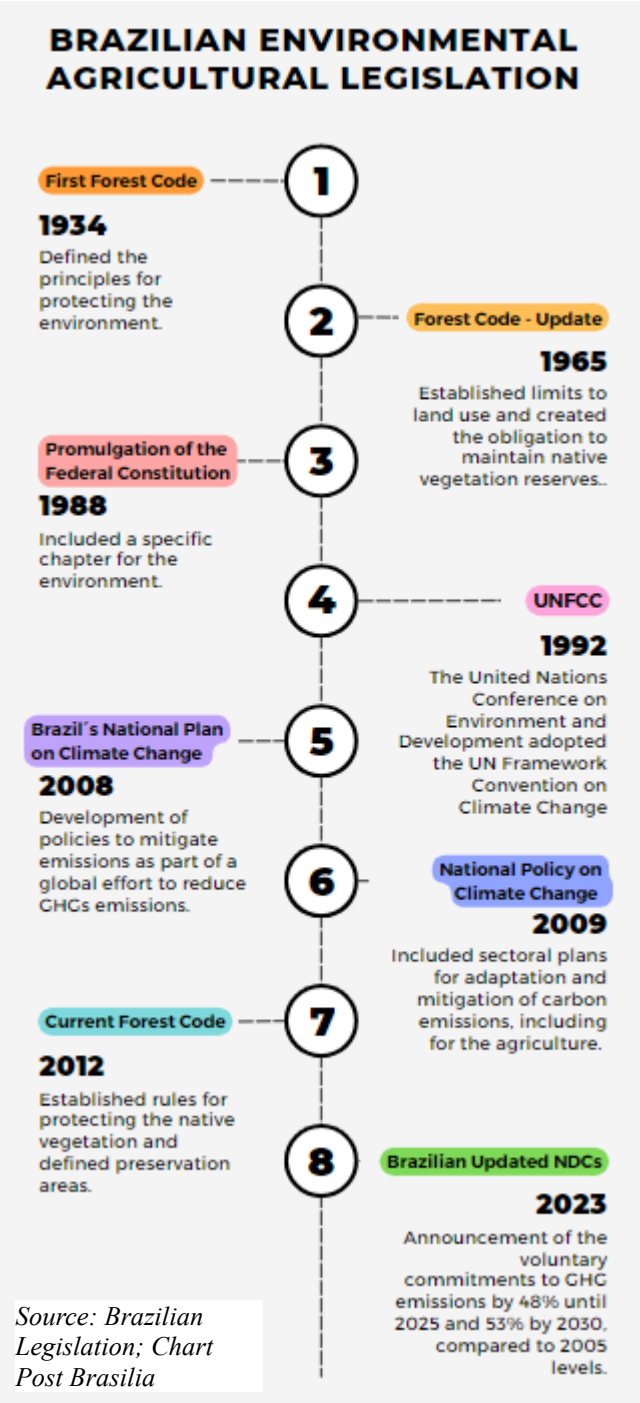


***Source**: SEEG; Chart Post Brasilia*

The ABC+ Plan aims to mitigate 1.1 $GtCO_2e$ (gigatons of carbon dioxide equivalent) by the end of 2030. In order to achieve that target, Brazil must overcome challenges such as monitoring the adoption and expansion of the ABC technologies, harmonizing calculation methodologies, and making ABC+ credit lines more accessible, particularly through the RenovAgro program.

Legislation

Figure 10 – Brazilian Legislation



Source: Brazilian Legislation; Chart Post Brasilia

In 1934 Brazil instituted its first Forest Code, establishing the types of forests to be protected. The Forest Code was updated in 1965, requiring rural properties to have permanent preservation areas and created the obligation for properties to maintain a portion of land to preserve native vegetation, ranging from 20 percent to 50 percent of the property.

In 2012, the current Forest Code was published and replaced the 1965 version. The new Code established general rules for protecting vegetation and permanent preservation areas, regulating forest exploitation. The Code also established that all properties should have a minimum reserve area for native vegetation, called Legal Reserve, which, depending on the type of vegetation and biome, should occupy 20 percent to 80 percent of the property´s area. In the Amazon biome, the area destined for the Legal Reserve must be 80 percent of the total; in the Cerrado, it is 35 percent, and in the other biomes, it is 20 percent of the total area.

In addition to the Legal Reserve, producers must protect the areas on the banks of large and small watercourses, ponds, and lakes. They must also preserve other regions, such as those surrounding the springs, steep slopes, and hilltops, called Permanent Protected Areas (APP, in Portuguese).

To ensure compliance, the Forest Code established two instruments. The first is the Rural Environmental Registry (CAR, in Portuguese), in which the producer self-registers their property,

including productive and preserved areas, with the Ministry of Agriculture. If the property fails to comply with environmental legislation, the producer must use the second instrument, the Environmental Regularization Program (PRA), to come into compliance. As mentioned before, the full implementation of CAR faces challenges related to the continental size of Brazil and the number of properties registered.

In 1988, Brazil´s Congress approved a new Constitution with a chapter dedicated to the environment. Article 225 ensures that an ecologically balanced environment is a common right and should be defended and preserved for present and future generations. In 1998, the Environmental Crimes Law was approved and provided punishment for acts and activities that harm the environment.

At the federal level, MAPA and the Ministry of Environment (MMA) are primarily responsible for government actions in environmental protection. All states and most municipalities also have specific bodies to act in agricultural production and the environment.

During the 1992 United Nations Conference on Environment and Development, the climate agenda was a critical topic of discussion, with Brazil actively participating in its negotiation and in the establishment of the United Nations Framework Convention on Climate Change (UNFCCC). In Brazil, growing demand for new areas for agriculture and livestock had resulted in the intense conversion of native regions into open areas for agricultural production, resulting in land use changes as the primary source of greenhouse gases emissions (GHG) in the country.

Brazil adopted domestic climate legislation to align with international environmental commitments. The main instruments include the National Plan on Climate Change, launched in 2008, followed by the creation of the Brazilian Panel on Climate Change, the National Climate Change Fund, and the National Policy on Climate Change (NPCC), all adopted in 2009. The NPCC included plans for mitigating and adapting to climate change, focusing on a low-carbon economy in all sectors. Also, in 2009, Brazil announced voluntary commitments to reduce between 36.1 percent and 38.9 percent of its forecast GHG emissions by 2020 in the form of a Nationally Appropriate Mitigation Action, including actions linked to agriculture.

The main actions presented by Brazil to achieve the proposed target were:

> **i)** reduce the rate of deforestation in the Amazon by 80 percent and in the Cerrado by 40 percent.
>
> **ii)** increase energy efficiency, the use of biofuels, the offer of hydroelectric plants and alternative sources of biomass and renewable energy, and the use of coal from planted forests in the steel industry.
>
> **iii)** intensively adopting the recovery of degraded pastures in agriculture, promoting the adoption of Crop-Livestock-Integration or Crop-Livestock-Forestry Integration, expanding the adoption of No-Till System and Biological Nitrogen Fixation to mitigate emissions by the agricultural sector.

In 2015, during the 21st Conference of the Parties to the UNFCCC (COP21), Brazil presented a new commitment to reduce GHG emissions in absolute terms, named Nationally Determined Contribution (NDC). The country´s NDC established the target to reduce emissions by 37 percent below 2005 levels

by 2025 and 43 percent by 2030. As potential actions, the annex to the NDC mentions the strengthening of the ABC Plan, including the additional recovery of 15 million hectares of degraded pastures and the increase of five million hectares of Integrated Crop-Livestock-Forestry systems by 2030. In 2023, Brazil updated the NDCs and announced that it will reduce GHG emissions by 48 percent until 2025 and 53 percent by 2030, compared to 2005 levels.

The ABC Plan - Sectoral Plan for Mitigation and Adaptation to Climate Change for the Consolidation of a Low-Carbon Economy in Agriculture

The Sectoral Plan for Mitigation and Adaptation to Climate Change for the Consolidation of a Low-Carbon Economy in Agriculture – the "ABC Plan", is one of the main instruments of Brazilian agricultural policy for promoting sustainability and tackling the effects of climate change on agriculture.

The ABC Plan aims to strengthening the farmer's production capacity and income by increasing the efficiency of sustainable systems. The ABC Plan encouraged technologies, practices, and processes to increase the resilience, adaptation to the adverse impacts of climate change, and efforts to reduce deforestation.

The Ministry of Agriculture and Livestock (MAPA) and the extinct Ministry of Agrarian Development (MDA) approved the ABC Plan in May 2011. The Plan focused on promoting a set of systems, technologies, products, and processes to reduce GHG emissions over a period of ten years known as "ABC Technologies." To achieve the Brazilian voluntary national commitment established in the NPCC, the actions to reduce GHG emissions under the ABC Plan for the agricultural sector were:

- Recover 15 million hectares of degraded pastures.
- Expand the adoption of integration systems by four million hectares.
- Expand the adoption of no-till systems in eight million hectares.
- Expand the adoption of biological nitrogen fixation in 5.5 million hectares of cultivated areas, as a substitute for nitrogen fertilizers.
- Expand the planting of forests by three million hectares.
- Expand the use of technologies to treat 4.4 million m^3 of animal waste.

Between 2011 and 2020, ABC technologies were adopted on 54 million hectares throughout the country, amounting to 194 million tons of carbon dioxide equivalent (Mg Co2 eq) emissions avoided. The Plan also includes reporting and accountability of the efforts to achieve its commitment to tackling climate change.

Each program consisted of training for technicians and farmers; technology transfer events; research, development, and innovation activities; creation of a credit line; land and environmental regularization; and provision of materials, among others. Over ten years, 57,121 training events were offered to technicians and producers, totaling more than 140,000 thousand people trained. MAPA's partner institutions offered the trainings including the National Agricultural Confederation (CNA), National Rural Learning Service (Senar), Institute for Applied Economic Research (IPEA), among others. Embrapa conducted around 500 research and development projects in a broad portfolio that covered all

the technologies proposed in the Plan, with particular attention to the topic of adaptation to climate change.

Another significant action was the implementation of Technical Demonstration Units (TDU) and Technological Reference Units (TRU) by Embrapa. These innovative concepts of technology transfer brought together all the players responsible for making new technologies available and disseminated them to producers. During the life of the ABC Plan, 613 TRUs were implemented.

The governance structure of the ABC Plan included federal, local, and municipal levels, with and over 40 institutions involved. By 2020, all 27 Brazilian states had so-called "State Management Groups," committees responsible for identifying the potentially strategic regions of each state to implement the technologies included in the ABC Plan. About 3,004 municipalities have adopted ABC Plan technologies, corresponding to 54 percent of all Brazilian municipalities.

The ABC Plan was revised in 2020, a process that culminated in the launch of 2021 of its new phase, called ABC+, which will run until 2030.

ABC Technologies - Low Carbon Agriculture Programs

The technologies proposed in the ABC consist of the following systems:

Recovery of Degraded Pasture: The Ministry of Agriculture and Livestock (MAPA) estimates that the country has around 168 million hectares of pastures and that 26.7 percent of this area is in a state of severe degradation, 38.7 percent is moderately degraded and 41.1 percent is in good condition. The recovery of degraded areas has the potential to increase productivity through the greater stocking of animals and improved forage, mitigating carbon emissions. Between 2010 and 2018, the degraded area recovered under the ABC Plan was equivalent to 26.8 million hectares, corresponding to 179% of the established target of 15 million hectares of pastures by 2020.

Integrated Crop-Livestock-Forestry (ICLF): ICLF is a sustainable production strategy that integrates agriculture, livestock, and planted forests in combinations such as Integrated Crop-Livestock, Crop-Livestock-Forestry, Livestock-Forestry, and Crop-Forestry. In addition to ICLF, Agroforestry Systems (AFS) are also useful for efficient land use and occupation, in which perennial woody plants are managed in association with herbaceous plants, shrubs, trees, agricultural crops, and forage in the same management unit, according to a spatial and temporal arrangement, with a diversity of species and interactions between these components.

Despite the potential benefits, the area occupied by ICLF systems in Brazil is still relatively small: 11.5 million hectares, or five percent of the area occupied by agriculture and livestock. The main reasons for low adoption of ICLF systems are cultural farming traditions, high cost of initial investment, shortage of qualified labor, lack of information, and insufficient technical assistance. Despite the small percentage, Brazil still well exceeded its goal in the ABC plan, which was for adoption of ICLF techniques in four million hectares by 2020. Embrapa has developed 105 research projects to improve and expand ICLF systems in Brazil.

No-till Farming: This practice consists of reducing soil mobilization at the time of planting by limiting it to the sowing line or pit. Thus, it maintains the ground cover between the harvest and new planting. No-till improves fertilizing efficiency and soil organic matter content, as well as reducing machinery demand. This practice has been increasingly adopted in Brazil and has been one of the main factors responsible for the growth of Brazilian agriculture in recent decades. During the first decade of the ABC Plan, Embrapa developed 61 research projects, and 2.6 million hectares received financing for the development of no-till projects, resulting in an expansion of 14.59 million hectares, 182 percent of the original target set in the Plan.

Planted Forests: Planted forests reduce the pressure on native forests and capture CO_2 from the atmosphere, helping to minimize the effects of climate change. The Plan aimed to increase the supply of wood for industrial, energy, and construction purposes, reducing the pressure of deforestation on native areas and promoting the capture of carbon dioxide from the atmosphere. The goal was to expand the reforested area to produce fibers, wood, and cellulose on three million hectares. During the first phase of the ABC Plan, Embrapa created 94 research projects related to developing GHG emissions indicators from Planted Forests. Between 2010 and 2019, there was an expansion of 1.88 million hectares, about 63 percent of the original proposed target.

Biological Nitrogen Fixation (BNF): 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 is observed in soybean production. Other crops that can benefit from BNF are sugarcane, corn, common beans, cowpeas, rice, and wheat.

BNF is a technology that can be used to recover degraded areas, especially where the unsustainable use of the soil has resulted in the loss of soil organic matter and productivity. Embrapa worked with institutions that trained more than 40 cooperatives in Rio Grande do Sul, Santa Catarina, Paraná, Minas Gerais, and São Paulo. Embrapa also developed 91 research projects considering BNF in beans, sugarcane, rice, corn, and wheat crops. To help achieve the target of expanding the Brazil's agricultural area by 5.5 million hectares using BNF, 473 tons of inoculants were distributed to 893 family farmers and rural reform settlements. The actions contributed to the expansion of 11.78 million hectares from 2013 to 2020, exceeding the target by 214 percent.

Animal waste management: Animal waste emits methane gas, one of the main causes of the greenhouse effect. The ABC Plan encouraged the adoption of composting and biodigestion technologies in the production of fertilizer and biogas not only to mitigate GHG emissions but also to provide another source of income, as well as to promote energy security in rural areas.

The power plant Itaipu was directly and primarily involved in carrying out the actions set out in this program. Itaipu created the International Center for Renewable Energies-Biogas (CIBiogas), which trained 1,481 people between 2010 and 2020. The Center currently has 11 national demonstration units and one international, which encourages the use of biogas and develops strategies related to generating knowledge and technology transfer. The National Electric Energy Agency (ANEEL) acted as an indirect partner and supported nine research projects, investing around US$ 26 million (R$129 million) in the generation of electricity from biogas produced in waste and liquid effluent treatment plants for companies in the electricity sector.

Embrapa has developed 19 research projects related to obtaining indicators of GHG emissions from pig farming. The expected result of applying AWT technology was to treat 4.4 million m^3 of animal waste, and from 2010 to 2020, about 38.34 million m^3 of waste were treated, corresponding to 871 percent of the target.

The ABC Plan Financing Mechanisms

One of the operational financial instruments of the ABC Plan was the credit line called ABC Program, created to support producers in adopting low carbon technologies. Over ten years, the ABC Plan invested approximately US$40 billion (BRL197 billion) in resources financed with MAPA's budget or through agricultural credit lines. From this total, about US$31 billion (BRL157 billion) was made available via rural credit to finance the adoption of ABC technologies.

The most sought-after ABC technologies were recovery of degraded pastures (51 percent of total contracted resources) and the no-till system (30 percent). In third place was ABC Forestry (12 percent), with 1.4 million hectares. It is worth noting that many farmers have implemented practices, technologies, and systems with other funding sources, such as other rural credit lines or even their own resources.

The Safra Plan also offers credit lines to finance the ABC Plan’s technologies. The Safra Plan is a federal government program that incentivizes the agricultural sector with specific credit lines and subsidies. The subsidies offered to support ABC Technologies can be granted via the programs Modernization of Agriculture and Conservation of Natural Resources (Moderagro), the Incentive Program for Technological Innovation in Agricultural Production (Inovagro), the investments credit lines of the National Program to Strengthen Family Farming (Pronaf) and the National Program for Support to Medium-Sized Farmers (Pronamp).

Climate Change Adaptation Program (CCAP) Under the ABC Plan

The Climate Change Adaptation Program has been considered a cross-cutting strategy with the ABC Plan, reflecting the multipurpose nature of ABC technologies, which allow the reduction of GHG emissions and resilience increase of agricultural systems. Embrapa was MAPA’s main partner in implementing the CCAP and invested approximately R$74.7 million in 174 R&D projects under its Climate Change portfolio, related to climate change (adaptation and mitigation), from 2008 and 2023.

Embrapa and other partner institutions have been working on the development and application of tools and simulation models of crop growth and productivity, considering predicted climate change. Among

the products is the Agricultural Climate Risk Zoning (ACRZ), which helps to reduce risks by recommending the most favorable times to plant agricultural crops, genetic and animal breeding, and intensive and integrated production systems.

ABC Plan and the National Adaptation Plan

The ABC Plan was included in the National Plan for Adaptation to Climate (NAP), instituted by the Ministry of Environment (MMA) in 2016, with actions related to various sectors, including agriculture. The ABC Plan already provided for adaptation actions, and it was an essential reference during the NAP development process, contributing to developing cross-cutting proposals and concepts and specific contributions from the other economic sectors considered.

The agricultural strategy of the NAP was based on assessing the vulnerabilities of agriculture, supporting the sector in implementing actions to foster the resilience of agroecosystems, promoting the transfer of technologies, and providing input for the ABC Plan review process, with a focus on its adaptation program. The NAP set two overarching goals for agriculture, aimed at developing and implementing the Agricultural Risk and Vulnerability Monitoring and Simulation System and promoting studies and projects by the Agricultural Climate Intelligence Center to apply risk to agriculture.

The ABC+ Plan - Sectoral Plan for Adaptation to Climate Change and Low-Carbon Emissions in Agricultural and Livestock

In 2021, the Ministry of Agriculture and Livestock (MAPA) launched the next phase, called the ABC+ Plan, to further incorporate technologies in agricultural production that lower carbon emissions and develop guidelines and certifications for sustainable agriculture for 2020-2030.

The focus of ABC + was to strengthen governance along with monitoring and evaluation systems to provide integrated data for continuous improvement and transparent management, especially at the regional level.

ABC+ remains as a strategy to achieve Brazil's NDC of reducing emissions. The four programs of the ABC+ Plan are:

- Program for Credit and Financing;
- Program for Adoption and Maintenance of Sustainable Systems, Practices, Products, and Production Processes (SPS-ABC);
- Program for Strategic Cooperation; and
- Program for Valuation and Recognition.

The main improvements from the ABC+ compared to the previous plan involve expansion of degraded pasture recovery, which will include restoration of pastures with different levels of degradation, renamed as Practices for Recovery of Degraded Pastures (PRDP). Also, the strategy of BNF was renamed Bioinputs (BI), and the agroforestry system was separated from the ILPF. The ABC+ includes three new systems: Direct Planting of Vegetables within the Direct Planting System, Irrigated Systems, and Intensive Termination.

ABC+ Targets and Partial Results

Chart 03 - ABC+ Targets and CO2 Emissions Mitigation 2021-2030

ABC+ Technologies		Targets (million ha / m³ / animals)	Mg CO2 eq Mitigation Target (Million)
Practices for Recovering Degraded Pastures		30.0	113.7
Direct Planting System	Direct Planting System of Grains	12.5	12.1
	Direct Planting System of Vegetables	0.08	0.88
Integration Systems	Crop-Livestock-Forest Integration System	10.0	34.1
	Agroforestry System	0.1	37.9
Planted Forests		4.0	510.0
Bioinputs		13.0	23.4
Irrigated Systems		3.0	50.0
Animal Production Waste Management		208.4	277.8
Intensive Termination		5.0	16.24
Total ABC+	**72.68 million ha + 208.40 million m³ + 5 million animals**		**1.076,14 million Mg CO2 eq**

***Source**: MAPA; Chart Post Brasilia*

According to MAPA, in 2021, Brazil had 83.8 million hectares with potential for the adoption of the recovery of degraded pastures. Approximately 20 million hectares are referred to as priority areas for adopting Practices for Recovering Degraded Pastures (PRPD). The indicated area for PRPD adoption is approximately 35 million hectares, and the area with the current application of PRPD amounts to 29 million hectares. ABC+ established an objective to recover 30 million hectares of degraded pastures by 2030.

Between 2020 and 2021, through the ABC+ technologies, about 1.17 million hectares were recovered in all biomes, representing 3.91 percent of the total. The biome Caatinga registered the largest percentage of recovered area, with 26.91percent of the total, followed by the Cerrado (1.65 percent), the Amazon (0.83 percent), and Atlantic Forest (0.04 percent). The Pantanal and the Pampa registered negative figures, with -0.63 percent and -9.70 percent, respectively.

ABC+ Joint Cooperation Projects

ABC Cerrado Project: The ABC Cerrado Project lasted five years between 2014 and 2019. The purpose was to promote Cerrado producers' adoption of low-carbon agricultural technologies through training and technical assistance. The project was coordinated by MAPA with resources from the World

Bank. Approximately US$10.7 billion were invested for the training of 18,401 producers. As result, about 93,800 hectares of land were directly benefited from the adoption of ABC technologies.

Sustainable Rural Project, Phase 1: The United Kingdom sponsored the project, the main purpose of which was to mitigate GHG emissions and increase the income of small and medium-sized producers through low-carbon technologies in the Atlantic Forest and the Amazon. The project had a budget of US$25 million from 2014 to 2019, resulting in 25,966 producers trained and 46,472 hectares with areas of sustainable management. The project was expanded from 2019 to 2023 with US$23 million resources, and the expected results are the training of 9,000 producers and the recovery of 300,000 hectares of degraded pastures.

- **Sustainable Rural Project – Caatinga:** The United Kingdom government also sponsored this project, aiming at mitigating GHG emissions in the Caatinga biome. From 2019 to 2023, approximately US$5 million were invested for training and technical assistance to recover 200 hectares of native vegetation, recover of 600 hectares of degraded pastures, and the training of 1,500 producers.

- **Sustainable Rural Project – the Amazon:** Aiming at mitigating GHG emissions in the Amazon biome through the promotion of nature-based solutions and the development of sustainable supply chains, the UK government financed US$9.63 million for the period of 2022 to 2025 to avoid 5,640 hectares of deforestation, implementation of ABC technologies in 4,550 hectares and mitigate the emission of two million tons of CO2 equivalent of GHG.

Rural Landscape Project: The ongoing project is sponsored by the German cooperation agency GIZ and aims to strengthen the adoption of environmental conservation and restoration practices for low carbon agriculture in river basins in the Cerrado biome for the period of 2018 to 2025. The results expected are technical assistance to 4,000 producers, the recovery of 7,000 hectares of native vegetation, and the implementation of ABC technologies in 100,000 hectares.

GEF Biogas Project: Sponsored and executed by the United Nations Industrial Development Organization (UNIDO) Global Environment Facility (GEF), the project aimed to mitigate GHG emissions and the use of fossil fuels through the adoption of biogas in the mobility sector and strengthening the national supply chain of the biogas technology. Approximately seven million dollars were invested to generate 15,7 million MWh/year in biogas pilot plants and avoid the emission of 535,000 tCO2eq. The project was implemented between 2019 and 2023.

- **GEF Strands Project:** UNIDO's GEF will invest US$24.57 million between 2022 and 2026 to boost the production of beef and grains by adopting sustainable practices and restoring natural habitats. In this project, the Ministry of Agriculture works jointly with the Ministry of Environment to recover approximately 500,000 hectares of pastures, restore 7,000 hectares of natural habitats, and assist 5,000 producers.

SPD Agro+ Project: The European fund Euroclima is investing US$724,000 between 2023 and 2024 to disseminate the benefits of the direct planting system to preserve natural resources and increase food production without deforestation. The expected outcome is to map the carbon and nitrogen stocks in the soil, carbon sequestration rates, and carbon balance in the direct planting system.

National Program for the Conversion of Degraded Pastures into Production Systems

In December 2023, the federal government officially launched the National Program for the Conversion of Degraded Pastures into Production Systems (PNCPC), aiming at recovering degraded areas and converting up to 40 million hectares of low-productivity pastures into arable areas within ten years in all biomes. The PNCPC supports primarily producers enrolled in the CAR.

Embrapa is responsible for mapping the low-productivity areas. The PNCPC focuses on raising foreign investment through BNDES for the conversion and recovery of pastures and is part of the government's actions to comply with the Brazilian international environmental commitments. It is estimated the need to invest approximately US$120 billion to recover all the areas degraded.

In January 2024, the interagency working group met to create the guidelines to implement the Program, which should be announced by the end of May 2024. The focus will be promoting low-carbon technologies, particularly no-till, agroforestry and reforestation.

Among the main challenges raised by experts are the high cost for implementing the program, the size and scale of the land, difficulties in comply with the law, insufficient studies, lack of transparency, and direct participation of the agricultural sector in the creation and implementation of the rules.

Ecological Transition Plan

Lastly, in December 2023, during the 28th UN Climate Change Conference (COP28), held in Dubai, the Brazilian government announced the Ecological Transition Plan (ETP), headed by the Ministry of Finance with the primary goal to improve productivity and create green jobs, reduce environmental impacts and GHGs emissions, and promote equitable development. To achieve those targets, the ETP is based on six pillars: sustainable finance, technological development, bioeconomy, energy transition, circular economy, and new infrastructure and adaptation.

The ETP is a blueprint for the Brazilian bioeconomy strategy for the G20, which Brazil is hosting in 2024. In the pillar of bioeconomy, which includes actions for the agricultural sector, the ETP addresses a decarbonization path through the reduction of deforestation and adoption of low carbon agriculture systems. The government is working to implement regulations to control deforestation and support alternative economic models, particularly for the Amazon region. The efforts should include the use of biotechnology, integrating agriculture with forests, forest products exports programs, concessions for forest preservation, payments for environmental services, and research and development.

Moreover, one of the objectives of the ETP is to integrate the Safra Plan with the ABC+ Plan. The idea is to implement positive incentives for rural producers who adopt sustainable practices to have better credit financing conditions under the Safra Plan. For the Safra Plan 2023/2024, rural producers already have better credit access in case of compliance with sustainable practices, as mentioned before.

The Safra Plan

The Safra Plan is a government program headed by the Ministry of Agriculture (MAPA) with resources from the Federal treasury and the National Development Bank (BNDES) to support the agricultural sector by offering credit lines, subsidies, and agricultural policies for rural producers.

The Safra Plan 2023/2024 incentivized sustainable production systems with lower interest rates for the recovery of degraded pastures and improved conditions for producers that adopt sustainable agricultural practices. In total, MAPA made available BRL364 billion (USD73 billion) for rural credit for medium and larger producers, an increase of 26.8 percent compared to 2022/2023. From the total, approximately BRL272 billion (USD54 billion) are for costing and commercialization, and BRL92 billion (USD18 billion) for investments. Small producers are benefited through the National Program to Strengthen Family Farming (Pronaf) and the National Program to Support Medium-sized Rural Producers (Pronamp). Total credit made available for all producers (small, medium, and large size) amounts to BRL435.8 billion (USD87 billion).

Under the Safra Plan, rural producers who are up to date with the Rural Environmental Registry (CAR, in Portuguese) and/or adopt sustainable agricultural practices are entitled to a reduction of up to one percentage point (one percent) in the cost and commercialization interest rate.

For sustainable agriculture, the Safra Plan incentivizes projects aiming at climate change adaptation and low-carbon agriculture included in the Program for Financing Sustainable Agricultural Production Systems (RenovAgro, in Portuguese). RenovAgro provides financing for the ABC technologies, especially ICLF, organic agriculture, recovery of permanent preservation areas or legal reserves, bioinputs or biofertilizer production, among others. RenovAgro offers a seven percent interest rate per year for producers interested in recovering degraded pastures, focusing on converting land for agricultural production.

Additional programs that also finance sustainable practices included in the Safra Plan are:

Chart 05 – Safra Plan´s Programs for Sustainable Agriculture (2023)

Name of the Program	Description	Interest rates per year
Program for the Modernization of Agriculture and the Conservation of Natural Resources (Moderagro)	Moderagro finances items related to activities classified as pig farming, poultry farming, fruit farming, fishing and aquaculture and dairy farming, as well as works resulting from sanitary and environmental adjustments.	10.5%
Program to Incentivize Technological Innovation in Agricultural Production (Inovagro)	Inovagro supports investments in technological innovation on rural properties, aimed at increasing productivity and adopting good agricultural practices.	10.5%
Financing Program for Irrigated Agriculture and Protected Cultivation (Proirriga):	Proirriga finances all the items for irrigation, including the electrical infrastructure and the construction of the water reservoir.	10.5%
Program to Modernize the Fleet of Agricultural Tractors and Associated Implements and Harvesters (Moderfrota)	Moderfrota can finance tractors, implements, harvesters, and sprayers	12.5%

***Source**: MAPA; Chart Post Brasília*

From July 2023 to January 2024, Safra Plan disbursed BRL270.9 billion (USD54 billion), of which BRL209 billion (USD42 billion) refers to costing and trade and BRL62 billion in investments through 1,369,816 contracts for medium and large-size producers. For 2024, MAPA plans to expand sustainable actions and spread credit access and rural insurance.

Regional Programs

Northeast+ Sustainable

The **Plan Northeast+ Sustainable** was launched in 2019 by MAPA, focusing on sustainable actions to develop the Northeastern region of Brazil, including parts of Minas Gerais and Espírito Santo. The priorities include family agriculture and cooperatives, land regularization, promotion of irrigation, and use of renewable energy sources. The main objective of the Northeast+ Sustainable is to increase the region's agricultural competitiveness, incorporating new technologies and integrated financing for the region's productive chains.

The **Project for Territorial Development** is being implemented in each of the 16 territories included in the Plan and will benefit 478,150 agricultural and livestock farms located in specific production zones by 2027. Between 2019 and 2022, over 30,000 rural producers benefited. In 2023, MAPA announced the plan's second phase, and the Interamerican Development Bank (IDB) announced US$230 million to strengthen productive chains, support land registration, provide technical assistance, and sustainable production.

Looking Ahead: Partnerships for a Climate-Smart Future

Over recent decades as Brazil’s agricultural production and area have rapidly expanded, so too have its programs and by extension, partnerships to stimulate the adoption of low-carbon and sustainable practices. The United States, as another prominent agricultural producer in the Western Hemisphere, has many shared commitments with Brazil that have sustainability as a focus: the Agriculture Innovation Mission for Climate (AIM4C), Sustainable Productivity Growth (SPG) Coalition, and the Methane Pledge (see GAIN report for more details). In addition, USDA and Embrapa have a long history of partnership in agricultural research. This includes programs such as Fertilizers for Life (see GAIN report), which aims to increase fertilizer-use efficiency, reduce dependency on imports, mitigate the amount of greenhouse gas emissions from agriculture, and provide lasting solutions to advance sustainable agricultural systems.

Opportunities for further engagement could include technical exchanges for scaling integration of crop-livestock-pasture, adaptation and mitigation of climate change in the agricultural sector, monitoring, report, and verification (MRV), as well as exchanges with Agricultural Climate Risk Zoning (ACRZ) and the Agricultural Climate Intelligence Center. Investment in these areas will be critical to advance research and innovation, not only for producers in Brazil and the United States, but for the rest of the world.

As the host of the G20 in 2024, Brazil has placed a special emphasis on the interconnected issues of bioeconomy, agriculture, and hunger. Through these themed working groups, Brazil is leading multilateral discussions on how countries can work together to feed the world while protecting the planet. In 2025, Brazil will be hosting COP30 in the Amazonian city of Belem. These high-profile engagements will present robust opportunities to unite countries around the world in a joint effort toward making agriculture part of the solution in creating a climate-smart future.

ATTACHMENT

Categories of Coverage and Land Use according to IBGE

Category	**Description**
Artificial Area	Area where non-agricultural anthropogenic surfaces predominate. It is structured by buildings and road systems, and includes metropolises, cities, towns, indigenous villages and quilombola communities, areas occupied by industrial and commercial complexes, and buildings located in peri-urban areas. Also includes areas with exploration or extraction of mineral substances.
Agricultural Area	Area characterized by temporary, semi-perennial and permanent crops, irrigated or not, where the land is used to produce food, fibers, fuel and other raw materials. Includes all cultivated areas, including those that are fallow or located on flooded land. It can be represented by heterogeneous agricultural zones or extensive areas of plantations. Includes aquaculture ponds.
Managed Pasture	Area used for grazing cattle and other animals, with cultivated herbaceous vegetation or (natural) grassland vegetation, both of which show high levels of anthropogenic interference. This interference can include planting, land clearing, mechanical or chemical elimination of weeds, harrowing, liming, fertilizing, and others that de-characterize the natural cover.
Mosaic of Occupations in Forest Areas	Area characterized by the mixed occupation of agriculture, pasture and/or forestry, whether or not associated with forest remnants, in which it is not possible to individualize its components. It also includes areas with natural and man-made disturbances, mechanical or non-mechanical, which make it difficult to characterize the area.
Forestry	Area characterized by forest plantations of exotic or native species as monocultures.
Forest Vegetation	Area occupied by forests. Forests are considered to be tree formations over five meters in height. This category includes areas of Dense Ombrophilous Forest, Open Ombrophilous Forest, Seasonal Forest and Mixed Ombrophilous Forest. It includes other features due to their height of more than 5 meters, such as Forested Savannah, Forested Campinarana, Forested Steppe Savannah, Mangrove Swamps and Buritizais.
Wetlands	Area characterized by natural herbaceous or shrub vegetation (10% or more cover), permanently or periodically flooded by fresh or brackish water. It includes marshes, swamps, wetlands, estuaries, among others. The flooding period must be at least two months a year. Shrub or tree vegetation can occur, as long as they occupy less than 10% of the total area.
Forest Vegetation	Area characterized by grassland formations. Grasslands are

	understood to be the different categories of vegetation that are physiognomically different from forests, i.e. those characterized by a predominantly shrubby layer, sparsely distributed over a grassy-ligneous layer. This category includes savannas, steppes, steppe savannas, pioneer formations and ecological refuges. It is spread across different phytogeographic regions, comprising different primary typologies: plateau steppes, coastal rupestrian grasslands and coastal hydro-sandy grasslands (restinga). These areas may be subject to grazing and other low-intensity anthropogenic interference, such as the unmanaged pasture areas in the state of Rio Grande do Sul and the Pantanal biome.
Mosaic of Occupations in Grassland Areas	Area characterized by the mixed occupation of agriculture, pasture and/or forestry, whether or not associated with remnants of the countryside, in which it is not possible to individualize its components. It also includes areas with natural and man-made disturbances, mechanical or non-mechanical, which make it difficult to characterize the area.
Continental Water Body	It includes all inland waters, such as rivers, streams, canals and other linear bodies of water. It also includes naturally enclosed bodies of water (natural lakes) and artificial reservoirs (artificial water impoundments built for irrigation, flood control, water supply and power generation. It does not include aquaculture ponds.
Coastal Water Body	Includes waters within 12 nautical miles.
Uncovered Area	It includes places without vegetation, such as rocky outcrops, cliffs, reefs and land with active erosion processes. It also includes beaches and dunes, both coastal and inland, and accumulations of gravel along rivers.

Source: IBGE, 2022. *Available at https://biblioteca.ibge.gov.br/visualizacao/livros/liv101966.pdf*

Attachments:

No Attachments.