



STOCKTAKING REPORT: BIODIVERSITY FINANCING CONTEXT IN BRAZIL

Sustainable Finance for Biodiversity
in Brazil and Colombia (SF4B)

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Project:

Sustainable Finance for Biodiversity in Brazil and Colombia (SF4B)

July 2022

Implementation partners:

Frankfurt School of Finance and Management
Centre for Sustainability Studies, Fundação Getulio Vargas (FGVces)
Fondo Acción

FGVces' general coordinator:

Mario Monzoni

FGVces' sustainable finance program coordinator

Annelise Vendramini

FGVces' technical team

Natalia Lutti Hummel Wicher, Camila Yamahaki,
Juliana Picoli, Gustavo Velloso Breviglieri

Graphic Design

Brunharo Comunicações

Cite as:

FGVces, 2022. Stocktaking Report: Biodiversity financing context in Brazil.

Support:

"This project is part of the International Climate Initiative (IKI). The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) supports this initiative on the basis of a decision adopted by the German Bundestag"

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LIST OF ACRONYMS

ABC	Low-Carbon Agriculture, in Portuguese
ANA	National Water and Sanitation Agency, in Portuguese
Anbima	Brazilian Association for the Capital and Financial Markets, in Portuguese
Anec	National Association of Grain Exporters
Abiove	Brazilian Association of Vegetable Oil Industries
Biofin	Biodiversity Finance Initiative
BMUV	Federal Ministry of the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
BPBES	Brazilian Platform on Biodiversity and Ecosystem Services
CAR	Environmental Rural Registry, in Portuguese
CBD	Convention on Biological Diversity
CBI	Climate Bonds Initiative
CEBDS	Brazilian Business Council for Sustainable Development
CMN	National Monetary Council, in Portuguese
CNAI	National Classification of Economic Activities, in Portuguese
Conama	Environmental National Council, in Portuguese
CPI	Climate Policy Initiative
ESG	Environmental, Social and Governance
FEBRABAN	Brazilian Federation of Banks, in Portuguese
FGVces	Centre for Sustainability Studies, Fundação Getulio Vargas
FiBRaS	Brazilian Sustainable Finance, in Portuguese
Funai	Indigenous National Foundation, in Portuguese
GDP	Gross Domestic Product
GTS	Soy Working Group
GTPS	Sustainable Livestock Working Group

LIST OF ACRONYMS

Ibama	Brazilian Institute of the Environment and Renewable Natural Resources, in Portuguese
IBGE	Brazilian Institute of Geography and Statistics, in Portuguese
INPE	National Institute for Space Research
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
Ipea	Institute for Applied Economic Research, in Portuguese
MAPA	Ministry of Agriculture and Livestock, in Portuguese
Matopiba	Cerrado regions within states of Maranhão, Tocantins, Piauí, and Bahia
MCTI	Ministry of Science, Technology and Innovation, in Portuguese
MDA	Ministry of Agrarian Development, in Portuguese
MI	Ministry of Infrastructure, in Portuguese
MinCid	Ministry of Cities, in Portuguese
MJ	Ministry of Justice, in Portuguese
MMA	Ministry of the Environment, in Portuguese
NGFS	Network for Greening the Financial System
Planaveg	National Plan for the Recovery of Native Vegetation
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
SBPC	Brazilian Society for Science Progress, in Portuguese
SF4B	Sustainable Finance for Biodiversity in Brazil and Colombia
TCFD	Taskforce on Climate-related Financial Disclosures
TNFD	Taskforce on Nature-related Financial Disclosures

EXECUTIVE SUMMARY

- **Brazil is the most biologically diverse country in the world**, hosting two biodiversity hotspots, six terrestrial biomes and three large marine ecosystems. National biodiversity targets include eliminating illegal deforestation by 2028, and restoring and reforesting 18 million hectares of forests by 2030.
- **There are two national studies quantifying public expenditures** channelled to biodiversity protection and restoration in Brazil, whereas there is neither a similar mapping for private expenditures nor an estimation of the investment needs for the country to attain its biodiversity commitments.
- **Biodiversity losses can translate into physical and transition risks** for businesses and financial institutions. Brazilian banks are exposed to both biodiversity-related risks, since a proportion of their corporate loans are concentrated in sectors highly or very highly dependent on one or more ecosystem services (46%), and are granted to firms involved in environmental controversies (7%) (Calice, Kalan, & Miguel, 2021).
- **Brazilian legislation requires banks to have a risk management** structure that allows for the identification, measurement, evaluation, monitoring, reporting, control and mitigation of social, environmental and climate-related risks.
- **In relation to biodiversity aspects, to grant rural credit**, banks must attest that rural properties do not overlap with indigenous lands, quilombola lands and Conservation Units, and that they are registered in the Environmental Rural Registry (CAR). In the Amazon biome, they must also verify whether the property is embargoed by environmental agency Ibama due to illegal deforestation.
- **In the capital market, pension funds** must consider aspects related to the economic, social, environmental and governance sustainability of investments (no explicit mention of biodiversity).
- **Banking association FEBRABAN has developed a green taxonomy**, classifying corporate credit/financing according to social and environmental contribution, as well as exposure to climate and environmental risks (no specific account of biodiversity aspects).
- **There is not yet a national database identifying credit lines** that allocate funds for biodiversity protection and restoration. Most credit lines available in Brazil to finance biodiversity conservation/restoration are provided by public financial institutions, often at subsidised rates, largely to forest restoration.
- **Some of the challenges that must be tackled** to increase private finance for biodiversity protection and restoration in Brazil include the difficulty in measuring financial flows for biodiversity conservation/restoration and financing gaps, as well as the lack of standards for defining which economic activities have the ability to directly contribute to biodiversity conservation/restoration.
- **The soy and cattle economic sectors** are deeply dependent on biodiversity, while their activities have relevant impacts on biodiversity and its capacity to provide ecosystem services.



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- **Very high materiality dependencies of these sectors include water** provision, proximity to native vegetation, soil quality, pollination, climate regulation and pest control; while very high materiality negative impacts can be loss of ecosystems, water pollution, use of fertilizers and pesticides, soil erosion, greenhouse gas emissions and invasive species.
- **Studies and initiatives related to these sectors mainly highlight** the deforestation impacts of these economic activities and suggest that the reduction of biodiversity-related risks in supply chains need clear and measurable targets, pathways to achieve them and accountability.
- **Both multilateral and company commitments offer** a lever for reducing deforestation and associated biodiversity loss, as well as greenhouse gas emissions if successfully implemented. However, the traceability and ability to accurately monitor progress toward such commitments face several challenges, such as: multiple intermediaries between producers and consumers; short-term contracts for spot markets; soy products as raw material for other products; products from multiple sources are mixed in the supply chain and the original source is lost.
- **Agreements to reduce deforestation** require full participation of both major and minor domestic buyers and improved coverage of other biomes to be more effective.
- **From 2013 to 2020, most financing provided to these sectors in Brazil** came from South America institutions, Banco do Brasil being the largest financier for both sectors. Institutions from 27 EU countries are responsible for 11% of the total financing of these sectors and 6% of this funding originated from North American institutions.
- **Loans are the most important source of financing** for the two sectors, and 90% of it is facilitated through the National Rural Credit System, which offers credit largely at subsidised interest rates. The Rural Credit Systems is under Resolution CMN No. 4,883/20 and Resolution BCB No. 140/2021.

INTRODUCTION

This report is part of the project “Sustainable Finance for Biodiversity in Brazil and Colombia” (SF4B), a research and capacity-building project focused on empowering relevant policymakers and financial market actors in the use and application of sustainable finance taxonomies in Brazil and Colombia, considering biodiversity. It also raises interest in the application of such taxonomies among companies from the most relevant sectors for biodiversity via practical examples.

This project is supported by the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV), and implemented by the Frankfurt School of Finance and Management (Germany), Fondo Acción (Colombia) and the Center for Sustainability Studies at Fundação Getulio Vargas (FGVces, Brazil).

Brazil is the most biologically diverse country in the world, containing two biodiversity hotspots, six terrestrial biomes and three large marine ecosystems. It is also home to 15-20% of the world's biological diversity, and to 70% of the world's catalogued animal and plant species (CBD, 2022). There has been, however, an increase in biodiversity loss in the country, especially due to the growing rates of deforestation in the Legal Amazon region in recent years, rising from 4,571 km² in 2012 to 13,235 km² in 2021 (INPE, 2022).

Based on desk research, the present report aims to provide a brief overview of the context of biodiversity financing in Brazil, as well as make some considerations on the extent to which the Brazilian financial sector is managing biodiversity-related risks and seizing biodiversity-related opportunities. It also examines the dependencies and impacts on biodiversity of two relevant sectors for the Brazilian economy.

This report is structured in two main parts. **Part 1** of this report starts by presenting the concept of biodiversity from the Convention on Biological Diversity (CBD) as well as the relationship between biodiversity, economic activities and financial institutions.

It then lists the country's main commitments and targets concerning biodiversity protection and restoration in Brazil. Later, it reports the current knowledge on the amount of financial flows channelled to biodiversity protection and restoration in the coun-

try. As noted, there are a couple of studies quantifying public expenditures, whereas there is neither a similar mapping for private expenditures nor an estimation of the investment needs for the country to successfully carry out its biodiversity commitments.

Focusing on the financial sector, it identifies which regulations demand financial institutions to manage environmental and biodiversity-related risks, what measures financial institutions are adopting to manage these risks, and which financial products are available for biodiversity conservation and restoration. Later, it presents Brazil's green taxonomy, developed by the Brazilian Federation of Banks (FEBRABAN), analysing whether it accounts for biodiversity aspects. It also lists the main stakeholders involved in discussions on sustainable finance and biodiversity in the country. This first part of the report concludes with a preliminary analysis of the main gaps for the increase of private financial flows for biodiversity conservation and restoration.

Examining the real economy, **Part 2** of this report analyses the dependencies and impacts on biodiversity of two economic sectors: soy cultivation and livestock. These sectors were selected due to their relevance: 25% of the country's agribusiness GDP (equivalent to R\$ 2.4 trillion) was produced by the livestock sector (CEPEA, 2022), whereas Brazil is the world's second largest soy producer (Embrapa Soja, 2022). In addition, the agriculture, forestry and fisheries sector is highly dependent on physical inputs (e.g. water), on services that enable production (e.g. pollination) and services that protect from disruption, whilst also having very high material impacts on land use change and resource exploitation, and high impacts on climate change and pollution (UN Environmental Programme, 2022). It goes on to present some initiatives of each of these sectors in reducing biodiversity-related risks and then presents an overview of soy and livestock sector financing. Finally, it concludes by summing up challenges to overcome related to the soy and livestock economic sectors.



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PART 1

RELATIONSHIP BETWEEN BIODIVERSITY, ECONOMIC ACTIVITIES AND FINANCIAL INSTITUTIONS

PART 1 - RELATIONSHIP BETWEEN BIODIVERSITY, ECONOMIC ACTIVITIES AND FINANCIAL INSTITUTIONS

The Convention on Biological Diversity (CDB, 2006) defines biodiversity as “the variability among living organisms arising from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems”. Both the EU Taxonomy (European Commission, 2022) and the Beta version of the Taskforce for Nature-related Financial Disclosures (TNFD, 2022b) apply this same definition, while the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) refers to a very similar definition.¹

Accordingly, biodiversity embraces genetic, species, habitat and ecosystem levels in a complex network that promotes resilience and supports the provision of several ecosystem services² to society, including to businesses and their supply chains (Díaz et al., 2015; TNFD, 2022b). Biodiversity, as the “stock”, and ecosystem services, as the flows of benefits generated by this stock, are deeply intertwined concepts that are very local dependent (TNFD, 2022b).

Biodiversity losses can translate into **physical and transition** risks for both businesses and financial institutions (see **Figure 1**). Habitat loss and species decline (e.g. bees) locally can lead to the disruption of a complex natural network that delivers benefits (e.g. pollination of crops) for diverse users, including businesses and their supply chains. Therefore, biodiversity-related physical risks can represent significant impact for business operations (e.g. crop productivity), affecting profitability and companies' ability to repay lenders.

Similarly, transition risks related to biodiversity (e.g. changes in regulations increasing biodiversity protection) can affect business operations, reputations and their licenses to operate, translating into financial risk for financial institutions (e.g. investor

losses on shares and bonds) and potentially the financial system as a whole (INSPIRE & NGFS, 2022; TNFD, 2022b).

In Brazil, Calice et al. (2021) found that local banks are exposed to both biodiversity-related risks, since a proportion of their corporate loans are concentrated in sectors highly or very highly dependent on one or more ecosystem services (46%), and are granted to firms involved in environmental controversies (7%).

On the other hand, biodiversity-related opportunities are activities that create positive outcomes for companies and/or financial institutions and nature by avoiding or reducing impact on nature or contributing to its restoration (TNFD, 2022b). Examples in Brazil include credit lines granted by financial institutions aiming to finance forest restoration.

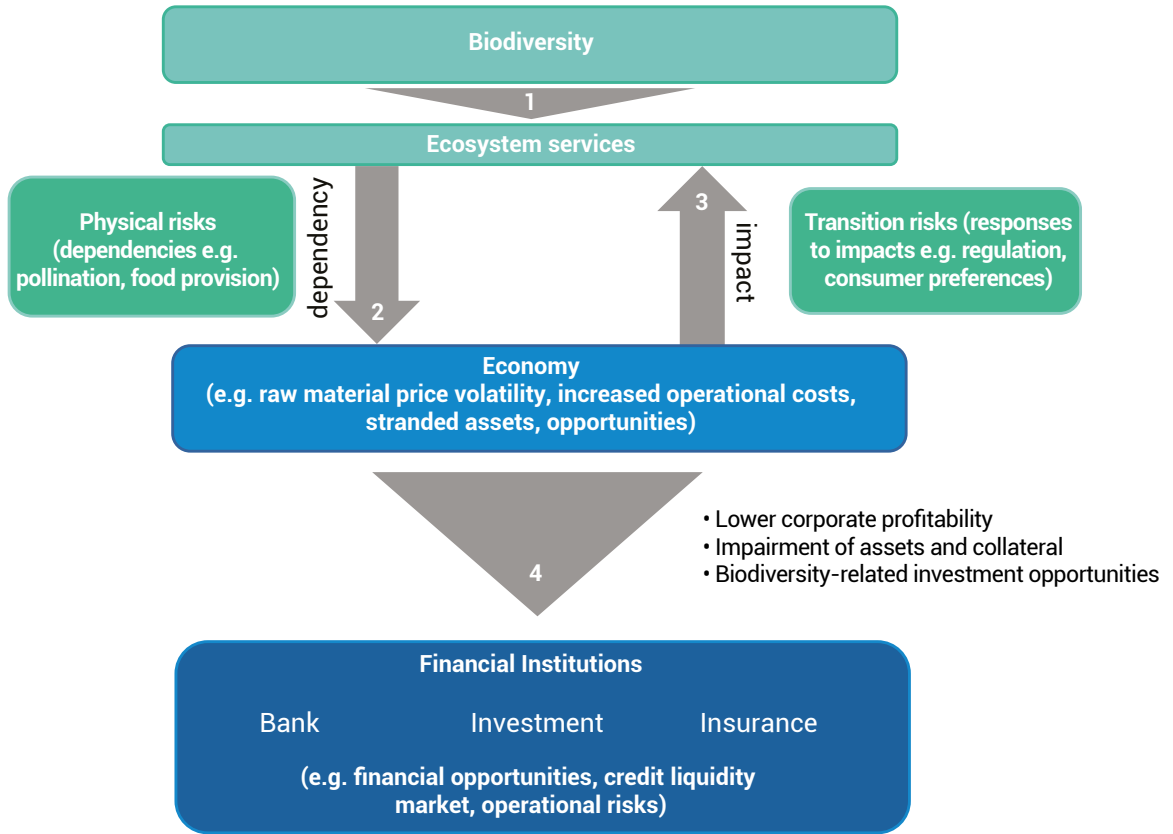
In sum, the status of biodiversity (in quantity and quality) affects company risks and opportunities, thereby affecting the risks and opportunities of financial institutions. **Figure 1** represents these connections.



¹ According to the IPBES Glossary, biodiversity is defined as “the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes variation in genetic, phenotypic, phylogenetic, and functional attributes, as well as changes in abundance and distribution over time and space within and among species, biological communities and ecosystems” (IPBES, 2021).

² According to the IPBES Glossary, “ecosystem services are defined as the benefits people obtain from ecosystems” (IPBES, 2021).

FIGURE 1 - CONNECTIONS BETWEEN BIODIVERSITY AND ECONOMIC AND FINANCIAL ACTIVITIES



Source: Adapted from INSPIRE & NGFS (2022)

The nuances of the biodiversity concept, and the fact that it is an inherent local characteristic, however, lead to no single indicator that can represent the full spectrum of biodiversity (Reyers, Polasky, Tallis, Mooney, & Larigauderie, 2012), unlike climate

change, making it difficult to measure and monitor dependencies and impacts on it. As a result, it has been a challenge to measure the amount of financing for biodiversity conservation and restoration in Brazil and globally.

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1 – COMMITMENTS CONCERNING BIODIVERSITY PROTECTION AND RESTORATION IN BRAZIL

The public policies and regulations described below (Table 1) feature the main commitments and targets concerning biodiversity protection and restoration in Brazil (further details in **Appendix 1**).

TABLE 1 – MAIN COMMITMENTS AND TARGETS CONCERNING BIODIVERSITY PROTECTION AND RESTORATION IN BRAZIL

Public policy	Type	Main objective	Biodiversity Target	Institution(s) responsible
Forest Code (Law 12,651/2012)	Federal law	Promotes vegetation protection, protection of Permanent Preservation and Legal Reserve areas, forest exploitation, origin control of forest products, and fire prevention.	Restore 12 million hectares of native vegetation by 2030 (estimated target).	Ministry of the Environment, State Environmental Departments
ABC Plan (2010)	National plan	Plans actions for the adoption of low-carbon technologies in the agriculture and livestock sectors.	E.g. Increase restoration of degraded pastures by 30 million hectares by 2030 (more details in Table 11).	Ministry of Agriculture
Planaveg (2017)	National plan	Expands and strengthens public policies, financial incentives, markets, and other measures to restore native vegetation.	Restore 12 million hectares of native vegetation by 2030	Ministry of the Environment
Guidelines for a National Strategy on Climate Neutrality (2021)	National guidelines	Describe actions and activities to reach climate neutrality by 2050.	Eliminate illegal deforestation by 2028, and restore and reforest 18 million hectares of forests by 2030.	Ministry of the Environment

Source: the authors (2022)

2 – BIODIVERSITY EXPENDITURES IN BRAZIL

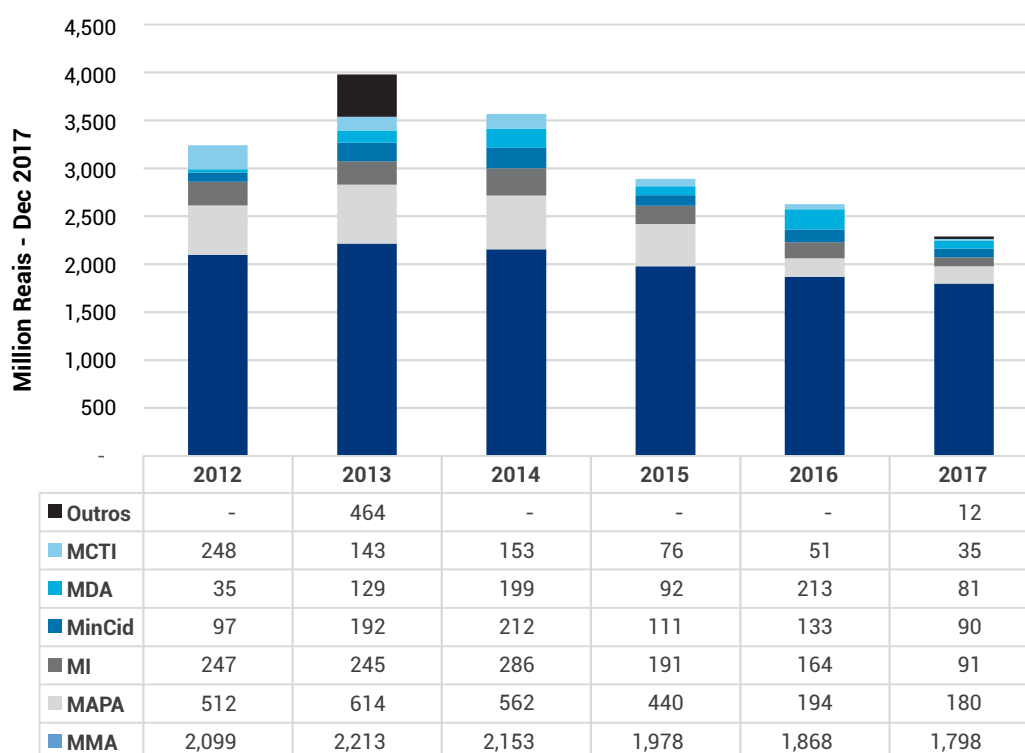
In terms of measuring biodiversity expenditures and investment gaps, the picture in the country is incomplete. There are two studies mapping public expenditures, whereas **there is no similar mapping for private finance or an estimation of the investment needs for biodiversity** - except for a study from Brancalion et al. (2019), who projected that implementing the 12 million hectares restoration target from the Forest Code would cost between US\$ 8.9 billion to US\$ 15.6 billion. In order to have a complete picture of biodiversity expenditures and investment gaps in Brazil, it would be necessary to also consider other terrestrial, maritime and aquatic ecosystems.

Managed by the United Nations Development Pro-

gramme (UNDP), the Biodiversity Finance Initiative (Bionfin) has conducted a study in Brazil to measure the amount of public expenditures allocated to biodiversity protection and sustainable use, employing Bionfin's methodology.

As shown in **Graph 1**, total expenditures by ministries of the federal administration decreased from R\$ 3.24 billion in 2012 to 2.29 billion in 2017. This figure includes expenditures related to pollution management, biosafety, benefit sharing, conservation of protected areas, and biodiversity awareness and education. It should be noted that the amount refers to federal expenditures only, not including expenditures by state and municipal governments.

GRAPH 1 - BIODIVERSITY EXPENDITURES CARRIED OUT BY MINISTRIES, ACCORDING TO BIOFIN'S METHODOLOGY (2012-2017) (R\$ MILLION)



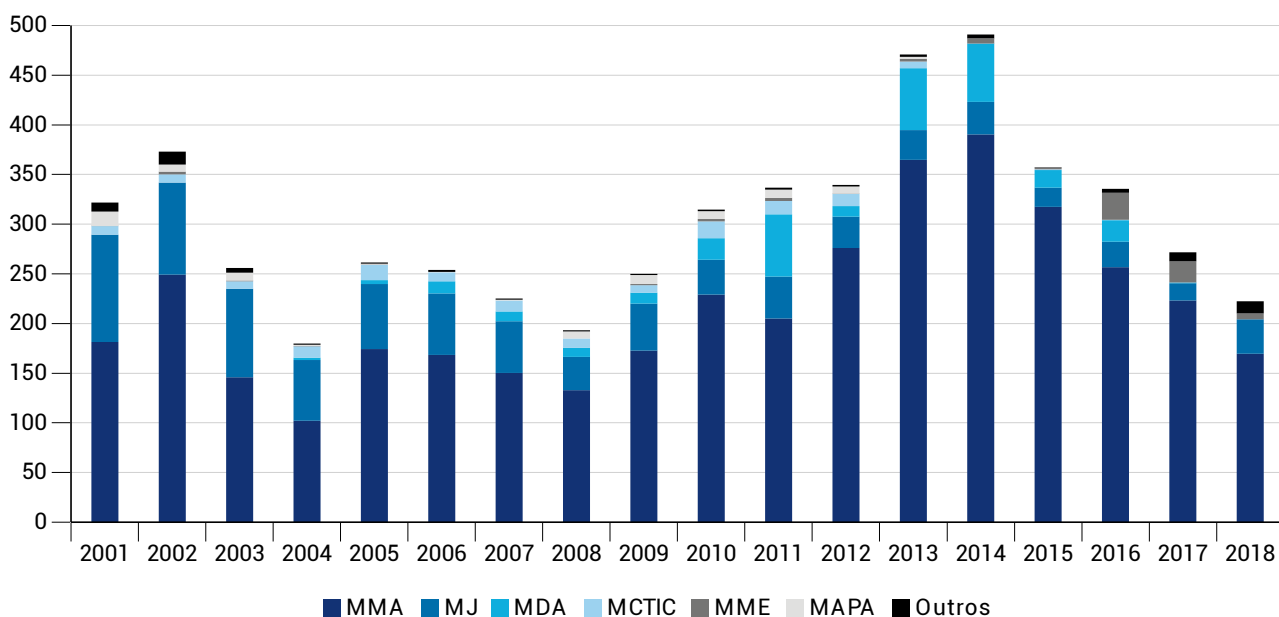
Source: (Brazil, 2021)

MCTI – Ministry of Science, Technology and Innovation; MDA – Ministry of Agrarian Development (extinct); MinCid – Ministry of Cities; MI – Ministry of Infrastructure; MAPA – Ministry of Agriculture and Livestock; MMA – Ministry of the Environment

Another study measuring public expenditures in biodiversity protection was conducted by researchers from the Institute for Economic Applied Research (Ipea) (Viana, Moura, Klug, Santana, & Diabaté, 2020), which employed the United Nations' classification of environmental activities to categorise the country's public expenditures. Analysing environmental expenditures in the 2001-2018 period, they found that the federal government spent – on activities related to protection and rehabilitation of fauna, flora, ecosystems, habitats, natural and semi natural land-

scapes – R\$ 5.45 billion (on average, R\$ 303 million per year), representing 8.3% of all environmental expenditures. As shown in **Graph 2**, 72% was spent by the Ministry of the Environment, followed by the Ministry of Justice (16%), responsible for protecting, overseeing and demarcating indigenous lands through the Indigenous National Foundation (Funai). Moreover, nearly half of the total expenditures were destined to the creation, management, oversight and implementation of federal Conservation Units and to overseeing deforestation and fires.

GRAPH 2 - BIODIVERSITY EXPENDITURES CARRIED OUT BY MINISTRIES, ACCORDING TO IPEA (2001-2018) (R\$ MILLION)



Source: (Viana et al., 2020)

MCTI – Ministry of Science, Technology and Innovation; MDA – Ministry of Agrarian Development (extinct); MAPA – Ministry of Agriculture and Livestock; MMA – Ministry of the Environment; MJ - Ministry of Justice



The difference in biodiversity expenditures found in the two studies is explained by the different methodologies employed by each study. In the case of Biofin, its methodology has a broader scope, considering expenditures that have direct and indirect benefits to conservation and the sustainable use of biodiversity.

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3 BIODIVERSITY AND THE FINANCIAL SECTOR

3.1 – SUSTAINABLE FINANCE REGULATIONS

Biodiversity loss increases financial institutions' indirect exposure to nature-related physical and transition risks. As noted earlier, according to a study from Calice et al. (2021), **Brazilian banks are exposed to both nature-related risks: 46% of bank corporate loan portfolios is concentrated in sectors highly or very highly dependent on one or more ecosystem services, a factor which may affect business processes and bank balance sheets.** In addition, 7% of corporate loans are to firms involved in environmental controversies, increasing lender reputational risks.³ These findings have risk management implications for both financial institutions and for the Brazilian Central Bank, tasked with ensuring the

stability of the currency's purchasing power, a solid, efficient and competitive financial system, and the economic well-being of society.

Since 2008, the Central Bank has issued a number of regulations requiring that financial institutions incorporate social and environmental criteria, some of which are shown in **Table 2**.

³ In order to assess the exposure to physical risks associated with the loss of ecosystems services by the banking sector, Calice et al. (2021) relied on the ENCORE database, which lists potential impacts and dependencies of sector, sub-industry and production processes on ecosystems services and natural capital.

TABLE 2 – SELECTED SUSTAINABLE FINANCE REGULATIONS IN BRAZIL

Resolution	Description
Resolution CMN No. 4,327/2014	Sets guidelines for the establishment and implementation of a Social and Environmental Policy by financial institutions (to be updated by Resolution 4,945/2021 in July, 2022). There is no explicit mention of biodiversity.
Resolution CMN No. 4,557/2017	Requires that financial institutions implement a risk management structure that allows for the identification, measurement, evaluation, monitoring, reporting, control and mitigation of social, environmental and climate-related risks. Instances of environmental risk events are characterised as the occurrence, or evidence of occurrence of "irregular, illegal or criminal conduct or activity against fauna or flora, including deforestation, provocation of forest fire, degradation of biomes or biodiversity and practices associated with trafficking, cruelty, abuse or mistreatment of animals".
Resolution CMN No. 4,883/2020	Requires that financial institutions check whether the property applying for rural credit in the Amazon biome is not embargoed due to deforestation and is registered in the Rural Environmental Registry (Cadastro Ambiental Rural, in Portuguese). The financing terms must anticipate that, in case the property is embargoed during the financing period, no new instalments will be granted until the property owner rectifies the situation. Moreover, if the property is still embargoed 12 months after the date of the embargo, the financing contract must be annulled. Financial institutions must also register the geographic coordinates of properties receiving rural credit (for working capital and investments) in cases when the financing operation is linked to a specific area of the property.
Resolution BCB No. 140/2021	Rural credit will not be granted to rural properties that totally or partially overlap indigenous lands, quilombola lands and Conservation Units, unless the activity complies with the Conservation Unit Management Plan.
Resolution CMN No. 4,661/2018	Requires that pension funds consider, whenever possible, aspects related to the economic, social, environmental and governance sustainability of investments. There is no explicit mention of natural capital or biodiversity.

Source: the authors (2022)

3.2 – SOCIOENVIRONMENTAL RISK MANAGEMENT OF FINANCIAL INSTITUTIONS

Given that it is proprietary information, financial institutions do not generally provide detailed information about their social and environmental risk management systems, more commonly citing, in public documents, only the issues that are part of the analysis (e.g. waste management, health and safety, climate change, natural resource consumption) and/or the sectors subject to additional scrutiny (e.g. mining, oil & gas, textile, pulp & paper, chemicals). A research from 2018 conducted by FGV and FEBRABAN (FGVces, 2018) about managing deforestation-related risks with ten large Brazilian banks found that most of them assess deforestation-related risks of rural producers and agricultural and livestock companies by:

- Checking whether the client's property is embargoed by Ibama due to illegal deforestation or whether the property overlaps with embargoed areas;

- Checking whether the client's property is registered in the Rural Environmental Registry of private properties (Portuguese acronym CAR) mandated by the Forest Code, analysing the property's information;
- Checking whether the client's property overlaps with Conservation Units and indigenous lands;
- Checking whether the client has the required environmental licences through consulting the National Environmental Licensing Portal or the environmental bodies responsible for issuing those licenses.

In addition, a few financial institutions have also started using free or customised geospatial monitoring softwares to monitor the deforestation patterns of clients from the agricultural sector.

unsplash/dating jungle



3.3 – BIODIVERSITY-RELATED FINANCIAL PRODUCTS



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3.3.1 – CREDIT MARKET

Shown further below are FEBRABAN's taxonomy map credit lines that allocate funds to sustainable agriculture and renewable energy. However, **there is not yet a national database identifying credit lines that allocate funds to biodiversity protection and restoration.**

According to our desk review, most credit lines available in Brazil to finance biodiversity conservation are provided by public financial institutions, often at subsidised rates, largely to forest restoration.

3.3.2 – CAPITAL MARKET

The Brazilian Capital Markets Association (ANBIMA) monitors the amount of assets under management of all Brazilian investment funds. For sustainable equity and fixed income investment funds, ANBIMA released updated rules in 2021, as follows:

- These funds will be named sustainable investment funds, showing the "IS" code in their name for identification;
- Portfolio must be aligned with the fund's objective stated as ESG (environmental, social and governance);
- The fund's ESG policies, methodology and data must be publicly available;
- if the fund tracks an index, the index must be aligned with the fund's ESG objective;

Funds complying with the criteria may register as sustainable investments funds from 3 January 2022 (ANBIMA, 2021b, 2021a).

A drawback of the classification is that it does not allow for the identification of the use of proceeds. As a result, it is not possible to verify which percentage of assets under management is allocated to biodiversity protection and restoration.

Regarding corporate bonds, Brazilian consulting firm NINT has created a database listing all green, social and sustainability-linked bonds that have been issued by Brazilian companies and institutions. Likewise, **it is not possible to verify which percentage of assets under management is allocated to biodiversity.**

3.4 – IDENTIFICATION OF EXISTING NATIONAL SUSTAINABILITY TAXONOMIES

In partnership with FGVces, in 2014, FEBRABAN created the first green taxonomy in Brazil, measuring the amount of bank financing allocated to legal entities from sectors of the green economy. Up to 2018, FEBRABAN monitored bank financing according to this methodology, and data collection depended on the voluntary reporting of the financial institutions participating in the initiative.

In 2020, the taxonomy methodology was updated by FEBRABAN to be more aligned with international standards and taxonomies. In addition, data collection no longer depends on voluntary reporting, but is retrieved from Central Bank's Credit Information System, thereby gathering data from all financial institutions from the Brazilian banking system.

The current taxonomy has three classifications:

- **Exposure to environmental risk:** Activities and organisations considered to have high exposure to environmental risk are those listed in Resolution CONAMA No. 237/1997.
- **Green Economy:** Activities are classified as having high or moderate environmental contribution according to how they are classified in the Taxonomy of the Climate Bonds Initiative (CBI), the EU Taxonomy for climate mitigation and Resolution CONAMA No. 237/1997. Activities are classified as having high or moderate social contribution according to the Social Bond Principles and to Resolution CONAMA No. 237/1997.
- **Exposure to climate risk:** Activities considered to have high climate change exposure are the 18 sectors identified by the Taskforce on Climate-related Financial Disclosures (TCFD).

As noted above, two of the three categories of FEBRABAN's taxonomy are based on international standards focusing on climate change mitigation (CBI, EU Taxonomy's technical screening for climate change mitigation and TCFD). FEBRABAN's taxonomy has no particular focus on biodiversity aspects.

3.4.1 – FINANCIAL PRODUCTS RELATED TO TAXONOMIES

One limitation of FEBRABAN's green taxonomy is that it only applies to legal entities ("Pessoa Jurídica"), which means that financing for individuals ("Pessoa Física") is not included. To minimise this limitation, the new taxonomy also maps public financial lines and programs for sustainable agriculture and renewable energy, including those lines from rural credit, constitutional funds⁴ and the Brazilian Development Bank BNDES. In total, there are 34 lines and subprograms for the agricultural sector and 10 for the energy sector (FEBRABAN, 2020).

However, as mentioned earlier, this classification does not identify which financial lines address biodiversity protection and restoration.

³ Constitutional Funds were created in 1989 with the objective of contributing to the economic and social development of the Center-West, Northeast and Northern regions. The funds receive 3% of the tax collection from the Tax on Manufactured Products (IPI) and Income Tax (IR).

4 – MAPPING KEY STAKEHOLDERS

Some stakeholders and initiatives working, or with the potential to work, with sustainable finance and biodiversity are the following:

Public sector:

- **Ministry of the Economy:** The Ministry of the Economy is working in cooperation with Projeto FiBraS to encourage a more sustainable financing market in Brazil. They are currently planning phase II of the project.
- **Institute for Applied Economic Research (Ipea):** public federal foundation linked to the Ministry of the Economy. Its research activities support the government in the (re)formulation of public policies and development programs (IPEA, 2022). Ipea also conducts research focused on environmental issues; for instance, assessing the impacts of the Low-Carbon Agriculture Program (Silva & Filho, 2020).
- **Brazilian Geography and Statistics Institute (IBGE):** public federal entity linked to the Minis-

try of the Economy, acting as Brazil's main data provider (IBGE, 2022b). IBGE started working on studies about ecosystem accounting in a project financed by the European Union in 2017. One of these studies was "Land Use in Brazilian Biomes", analysing the state of environmental conservation of the country's natural ecosystems (IBGE, 2022a).

- **National Water and Sanitation Agency (ANA):** regulatory agency responsible for implementing the National Water Resources Management System and the new legal framework for basic sanitation (ANA, 2022).
- **Central Bank:** launched BC# Sustainability agenda in 2020, aiming to promote sustainable finance in the country, improve management of social, environmental and climate risks in the National Financial System, and incorporate sustainability factors into the Central Bank's decision-making. Member of the Network for Greening the Financial System (NGFS) since 2020 (Banco Central do Brasil, 2020).

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Private sector:

- **Projeto FiBraS (GIZ):** The project “Finanças Brasileiras Sustentáveis” is organised in three themes, aiming to (i) explore, assess and elevate the importance of the green finance market in the government’s policy agenda; (ii) strengthen the conditions for implementation of regulations towards socioenvironmental risk management in the National Financial System; and (iii) increase the supply of services and financial tools for the financing of sustainable development (GIZ, 2020).

- **Biofin Brazil:** The first organisation to analyse the amount of public flows channelled to biodiversity protection and restoration in the country. Biofin Brazil is currently developing solutions to increase funding for biodiversity and for the financial sustainability of bioeconomy-related activities (BIOFIN, 2022).

- **Brazilian Federation of Banks (FEBRABAN):** FEBRABAN’s sustainability initiatives seek to (i) continuously improve the socioenvironmental and climate risk management of the banking sector; (ii) channel financial flows to green and inclusive businesses; (iii) include ESG aspects in bank business strategies; and (iv) disseminate the agenda with stakeholders (FEBRABAN, 2022).

- **Brazilian Association for the Capital and Financial Markets Entities (ANBIMA):** has updated data on investment funds and, as noted earlier, has recently released new rules for sustainable investment funds (ANBIMA, 2021a).

- **Brazilian Business Council for Sustainable Development (CEBDS):** non-profit association that promotes sustainable development by engaging

with governments and civil society as well as by disseminating concepts and current practices (CEBDS, 2022). Lead organisation of the Brazilian Hub of the Capitals Coalition.

- **Brazilian Platform on Biodiversity and Ecosystem Services (BPBES):** initially created as a Working Group of the Brazilian Society for Science Progress (SBPC). BPBES supports and encourages the development of thematic reports on ecosystem services (BPBES, 2022).

- **Financial institutions operating in Brazil:** financial institutions are required to comply with several regulations from the National Monetary Council and employ risk management procedures to avoid directly or indirectly encouraging deforestation, particularly when granting rural credit.

- **Companies operating in Brazil:** listed Brazilian companies with European shareholders/investors will likely be required to disclose according to the disclosure regulations of EU Taxonomy.

International initiatives:

- **Taskforce on Nature-related Financial Disclosures (TNFD):** seeks to develop and deliver a risk management and disclosure framework for organisations to report and act on evolving nature-related risks. Brazil-based companies Natura, Bunge and Suzano are part of the TNFD (TNFD, 2022a).

- **EU Taxonomy:** classification system, establishing a list of environmentally sustainable economic activities. The taxonomy regulation establishes six environmental objectives, one of which is the protection and restoration of biodiversity and ecosystems (European Commission, 2022).

5 – CHALLENGES TO OVERCOME

According to this desk review, the following were identified as challenges to overcome in order to increase private finance to biodiversity protection and restoration in Brazil:

– **Difficulty to measure financial flows to biodiversity:** The existing national sustainable finance taxonomies do not allow for the identification of the amount of finance allocated to biodiversity protection and restoration in the country. With regard to public funds, the data collected by Biofin Brazil and Ipea are out-dated, and the green taxonomies from Anbima and FEBRABAN do not measure financial flows to biodiversity protection.

– **Financing gaps:** Although Brazil has various goals to improve the state of natural capital (e.g. eliminate illegal deforestation by 2028), there is no assessment of financing gaps for biodiversity. Hence, it is not possible to determine how much finance is needed to improve the state of biodiversity and help the country attain its biodiversity goals.

– **Lack of standards:** Related to the previous challenges, it is necessary to define which economic activities have the ability to directly contribute to biodiversity protection and restoration. These could represent opportunities for financial institutions interested in contributing to biodiversity protection/restoration. Considering that financial institutions classify their credit activities based on a national classification system of economic activities known in Brazil as CNAE (Classificação Nacional de Atividades Econômicas, in Portuguese), it would be necessary to identify which of these activities have a positive contribution to biodiversity protection/restoration.

Likewise, it is necessary to assess what is the degree of impacts and dependencies of the different economic activities on biodiversity, considering the risks to which financial institutions might be exposed when financing these activities. These standards will help companies to disclose consistent and better quality data on their biodiversity impacts and dependencies, and help banks and investors to better assess biodiversity-related risks for borrowers and investee companies.

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PART 2

BIODIVERSITY AND THE SOY AND LIVESTOCK SECTORS

PART2 – BIODIVERSITY AND THE SOY AND LIVESTOCK SECTORS

Over the last few centuries there has been an exceptionally rapid loss of biodiversity and the subsequent loss of ecosystem services globally (Ceballos et al., 2015), with the greatest losses resulting from habitat conversion and degradation, particularly caused by agriculture for commodities production such as cattle, wood, palm oil, soy, cocoa or coffee (Dummett, Blundell, Canby, Wolosin, & Bodnar, 2021; European Commission, 2021; J. M. H. Green et al., 2019; R. E. Green, Cornell, Scharlemann, & Balmford, 2005; Reid et al., 2005; D. M. Souza, Teixeira, & Ostermann, 2015). Likewise, in the last 20 years, Brazilian biomes have undergone important changes resulting from direct and indirect human action, resulting in increasing losses of biodiversity and ecosystem services (Scariot et al., 2019).

Several studies indicate that commodity production has a great impact on biodiversity in the tropics, being a significant cause of deforestation and biodiversity loss in some of the world's most species-rich ecosystems (Chatterjee & Thakur, 2012; Chaudhary & Kastner, 2016; J. M. H. Green et al., 2019; Lenzen et al., 2012; Moran & Kanemoto, 2017). Conversely, the suppression of native vegetation, together with climate change, has great potential to directly harm agribusiness in Brazil, as they affect several ecosystem services on which agricultural activities are highly dependent. Researchers warn that with deforestation and rising temperatures, production will be affected by changes in rainfall, soil and water quality, pollinators, pests, among others (Elwin & Baldock, 2021; Flach et al., 2021; Leite-Filho, Soares-Filho, Davis, Abrahão, & Börner, 2021). Thus, understanding the dependencies and impacts of agribusiness supply chains on biodiversity is of paramount importance to map risks and opportunities (TNFD, 2022b).

The growing recognition of the materiality of biodiversity-related risks and the impacts of global con-

sumption on biodiversity elsewhere (J. M. H. Green et al., 2019; Meyfroidt, Lambin, Erb, & Hertel, 2013; Meyfroidt, Rudel, & Lambin, 2010) has led to increased pressure for companies and financial institutions to account for biodiversity damage and environmental impacts. In this context, different efforts have been made to mitigate the loss of biodiversity and limit climate change. It is worth mentioning that the European Commission,⁵ the United Kingdom and the United States are moving towards the adoption of trading regulatory measures that restrict the import of commodities grown on deforested lands (DUMMETT et al., 2021; EUROPEAN COMMISSION, 2021), potentially jeopardizing national product competitiveness in the international market. Likewise, there are commitments and national initiatives – both on a voluntary and regulatory basis – to decouple agricultural production from deforestation, particularly in agricultural commodity supply chains, from private companies, financial institutions and the public sector (FEBRABAN & FGV, 2017; J. M. H. Green et al., 2019; Lambin et al., 2018).

In this report, the soy and livestock sectors were selected for analysing the dependencies and impacts on biodiversity, due to the relevance of these sectors in the country's GDP and trade balance, and their profound relationship with biodiversity. In 2021, agribusiness had a share of 27.4% in Brazil's GDP, totalling R\$ 2.4 trillion, of which 25% was produced by the livestock sector (Cepea, 2022). At the same time, livestock in the Amazon biome and soy in the Cerrado were considered the most important drivers of deforestation in Brazil (Kuepper, Steinweg, & Piotrowski,

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⁵ Information about European Commission Proposal for regulation on deforestation – free products available at https://ec.europa.eu/environment/publications/proposal-regulation-deforestation-free-products_en Accessed on: 16 May 2022.

2020). These two productive systems commonly intersect in land use transition: while cattle ranching is usually responsible for opening forest frontiers, soy-maize⁶ production follow in occupying the land (Kaynar, Steinweg, & Piotrowski, 2020; le Polain de Waroux et al., 2019; May, 2019).

Due to the relevance of these two sectors, recent studies (e.g. Kaynar et al., 2020; May, 2019) provide a deep look in cattle ranching for beef and coproducts, and in large scale soy-maize systems for feed, oil, ethanol, sucrose and others. Although this report recognizes that all processes involved in both selected value chains can have significant dependencies and impacts on biodiversity, it focuses on the agriculture production stage of these agrifood chains, which means beef cattle ranching as well as soy farm activities.

In this context, this section aims to apply the Framework from **Figure 1**, presented in **Part 1 - Relationship between biodiversity, economic activities and financial institutions**, to the sectors covered by this work. Given that relationship No. 1 in **Figure 1** between Biodiversity and Ecosystems Services is described in **Part 1**, this section starts by exploring relationships No. 2 and No. 3 regarding the soy and beef cattle economic sectors and their relationships of dependencies and impacts on ecosystems services and biodiversity. For the analysis of the soy and beef cattle sectors, we focused on the dependencies and impacts classified as having “very high materiality” and “high materiality” by UNEP (2022) for the Agriculture, Forestry and Fisheries sector, as presented in **Table 3**.

TABLE 3 - DIRECT DEPENDENCIES AND IMPACTS FOR AGRICULTURE, FORESTRY AND FISHERIES SECTOR

	Very high materiality	High materiality
Direct dependencies	Direct physical inputs, enabling production and protection from disruption	
Direct impacts	Land use change and resource exploitation	Climate change, pollution and invasive species

Source: Adapted from (UN Environmental Programme, 2022)



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It is worth mentioning that, drawing on the direct impacts with higher materiality of UNEP (2022), this study (i) approaches only the negative impacts of these agricultural activities on biodiversity; and (ii) do not consider any cultural ecosystem services.

Regarding the “economy” box in **Figure 1**, this section goes on to list some initiatives from these economic sectors aimed to curb deforestation and loss of biodiversity. Finally, it discusses relationship n° 4 on financing these economic sectors.

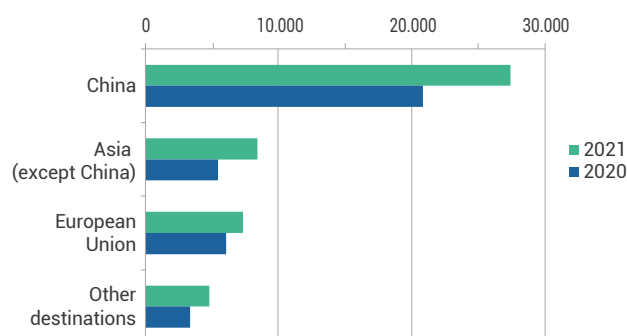
⁶ According to May and partners (2019), soy is predominantly produced in rotation with maize in Brazil. Maize is typically produced as a second crop after soy harvest (called “safrinha”), taking advantage of nutrient, pest control and soil synergies between the two crops under no-till. This increases farm income as well as providing ground cover in the post-harvest period.

6 – SOY SECTOR

Brazil is the largest soy producer in the world. In the 2020/2021 harvest, the country produced 135.4 million tons in a planted area of 38.5 million hectares. Mato Grosso is the largest producing state, responsible for 26.5% of production, followed by Rio Grande do Sul, with 14.9%, and Paraná, with 14.7% (Embrapa Soja, 2021).

Considering the soy complex (grains, meal and oil), the Brazilian Association of Vegetable Oil Industries (Abiove) estimates that, in 2021, 50% of soy meal (17.9 million tons) and 87% of soy oil (8.2 million tons) were destined for domestic consumption (Abiove, 2021). To supply the international market, the country exported the equivalent of US\$ 38.6 billion in soy, US\$ 7.4 billion in soy meal and US\$ 2 billion in soy oil, with China as the main destination (58%), Asia - except China (17%) and the European Union (15%), as shown in **Figure 2** (ABIOVE, 2022). As a result, soy was the second most exported product by the country, behind only iron ore, with a share of 13.8% in total exports (Ministério da Indústria Comércio exterior e serviços, 2022).

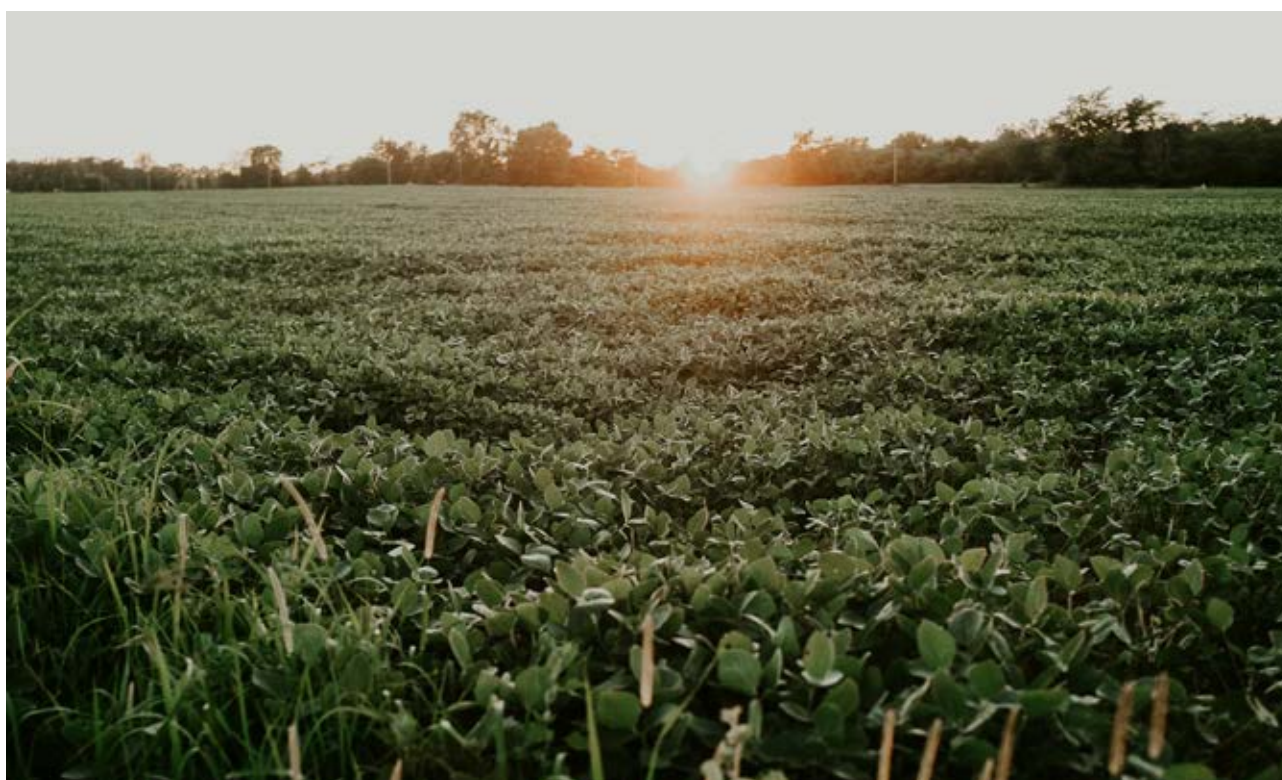
GRAPH 3 - EXPORTS OF THE SOY COMPLEX (US\$ MILLION)



Source: (ABIOVE, 2022)

Given the growing global demand, the soy cultivation area in Brazil has increased significantly, especially in the last two decades, from almost 15 million hectares in 2002 to more than 35 million hectares in 2020 (**Graph 3**), applying strong pressure over native vegetation across the country (Kaynar et al., 2020).

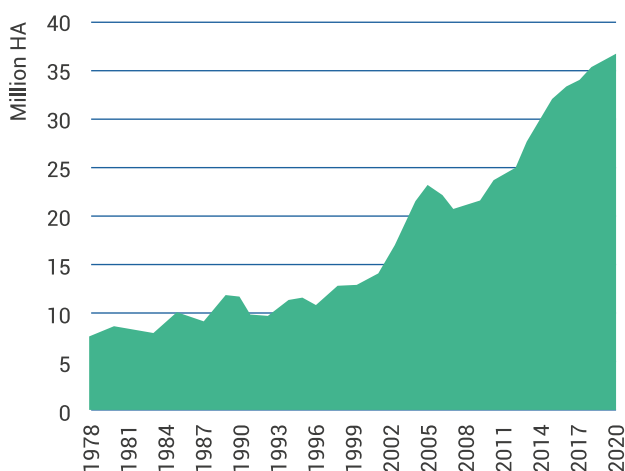
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GRAPH 4 - SOY CULTIVATION AREA IN BRAZIL



Source: (Kaynar et al., 2020)

In the Amazon biome, since a peak in the late 2000s, clearance of native vegetation for soy has decreased. In the Cerrado, however, soy continues to be a major driver of habitat loss, especially in the Matopiba region. Between 2000 and 2014, the soy area within Matopiba⁷ increased by 253% (Soteroni et al., 2019) and in 2015 only 13% of Brazil's soy production was harvested in the Amazon, while 48% came from the Cerrado biome (zu Ermgassen et al., 2020). Meanwhile, pastures have decreased 11% from 2000 to 2020, soybean and corn occupied 22,646 and 11,874 thousand hectares, respectively, in 2020, the largest crop production areas in the Cerrado (Ferraz-Almeida & da Mota, 2021).

The Cerrado is a global biodiversity hotspot with lower legal protection than the Amazon (L. L. Rausch et al., 2019; Strassburg et al., 2017). The biome is the largest savannah region in South America, which hosts some 5% of global biodiversity, including over 4,800 unique plant and vertebrate species, crossing some of the largest watersheds in Brazil and storing 13.7 billion metric tons of carbon. It occupies about 200 million hectares, or 24% of the Brazilian territory, but the biome has already lost approximately half of its size – around of 2 million km² has been deforested and occupied by pasture and agriculture (Ferraz-Almeida & da Mota, 2021; zu Ermgassen et al., 2020).

As deforestation is included in commodity production chains, Ferraz-Almeida and da Mota (2021, p. 6) estimate the soy cultivation impact assigned to different markets: domestic consumption accounts for 45% of the impacts on biodiversity of soy production in Brazil, China is responsible for 22% of the impact, and European Union 15% of the impact. The Cerrado is one of the world's most important frontiers of agricultural expansion and Brazil's soybean production is expected to continue to grow in the coming decades. As only 19.8% of undisturbed native tropical savannah remains in Brazil's Cerrado, conversion of the remaining habitat is a major threat to biodiversity.

⁷ Matopiba is a region that includes portions of the states of Maranhão, Tocantins, Piauí, and Bahia.

6.1 – SOY CULTIVATION DEPENDENCIES ON BIODIVERSITY

Although soy cultivation is dependent on biodiversity through different ecosystem services, they are all interconnected in a complex system made possible by the existence of biodiversity that promotes func-

tional and healthy ecosystems. Drawing on **Table 3**, **Table 4** compiles examples of soy production dependencies on biodiversity, scientific evidence and respective references.

TABLE 4- SOY PRODUCTION DEPENDENCIES ON BIODIVERSITY

Examples of soy cultivation dependencies	Evidence	References
Direct physical input: Water provision		
Water scarcity compromises the productivity of soy crops and is largely responsible for the variability of yields through years.	Soybeans experienced modest production losses during droughts in areas with no irrigation (-5kg ha ⁻¹ in the Cerrado biome and -26kg ha ⁻¹ in the state of Mato Grosso)	(ANA, 2021; Rattis et al., 2021; Reis et al., 2020)
Excess water is another limiting factor for soy, and regions with better distribution of rainfall, such as the state of Mato Grosso, tend to have more uniform productivity.	In fact, soy requires between 450 and 800 mm of water during its production cycle to achieve the highest yield.	(FARIAS, Nepomuceno, & NEUMAIER, 2007; Ferrari, da Paz, & da Silva, 2015)
Enabling production: proximity to native vegetation		
The proximity to native vegetation areas provides several ecosystem services that benefit soy production, including regulation of CO ₂ emissions, avoidance of soil erosion and water availability.	Through modelling ecosystem services valuation, a study compared a soy production system that kept a Legal Reserve area in the Cerrado (20% of the property) with a soy production system without the Legal Reserve area. No production practice changes in soy operations. The total value of ecosystem services generated by soy production with Legal Reserve is 11% higher than soy production without proximity to native vegetation (considering global climate regulation, water regulation and erosion control).	(Conservation International, 2014; May, 2019)
Enabling production: Soil quality		
Soy and maize yields depend on soil nutrients. Intercropping ⁸ of grain legumes and cereal has the potential to improve the use efficiency of N sources, due to competitive, complementary or facilitative interactions.	Studies have shown that maize (cereal) accumulates nitrogen released by soybean (legume), resulting from efficient utilization of nutrients and confirming the advantage of intercropping systems over sole cropping. Intercropping increases N, P, and K uptake and distribution across plant organs (root, straw and seed) of maize and soybean, accelerates the dry-matter production of intercrop-species, and compensates the slight maize yield loss by considerably increasing the soybean yield.	(Jensen, Carlsson, & Hauggaard-Nielsen, 2020; Raza et al., 2019)

⁸ According to Jensen et al. (2020), intercropping (mixed cropping, polyculture) can be defined as the simultaneous growing of two or more crops close to each other. Cereal(maize)-legume(soy) intercropping systems is different from the common practice in Brazil of harvesting maize in the winter months as a second harvest, known in portuguese as 'safrinha'

<p>Soil erosion is considered one of the most critical factors that affect agricultural productivity, accelerating soil degradation and increasing nutrient loss. Erosion, compaction and loss of organic matter, among other factors, affect almost a third of the world's land.</p>	<p>Annual loss of crops caused by erosion were estimated at 0.3% of production. If the problem continues at this rate, a total reduction of more than 10% could occur by 2050. Erosion in agricultural areas and intensive pastureland ranges from 100 to 1,000 times the natural erosion rate, and the annual cost of fertilizers to replace nutrients lost to erosion amounts to USD 150 billion.</p>	<p>(Carvalho, Silva, Avanzi, Curi, & Souza, 2007; Mateo-Sagasta, Zadeh, & Turral, 2018; May, 2019)</p>
<p>Soil compaction can reduce global incomes of agricultural crops by up to 60%. Globally, compaction has degraded an estimated area of 680,000 km², or approximately 4% of the total arable land area. Damage caused by soil compaction can be long lasting or even permanent.</p>	<p>Compaction can lead to a reduction in crop productivity up to 12 years later. Soil biodiversity is also threatened by intensified land use and the use of chemical fertilizers, pesticides and herbicides.</p>	<p>(May, 2019)</p>
<p>Enabling production: Pollination</p>		
<p>Although soy is not dependent on insect pollination, the presence of pollinating insects increases soy productivity by nearly 10% to 15%.</p>	<p>A study carried out in Paraná found that soy productivity was higher in covered areas with presence of honey bee colonies (2,757 kg/ha) and in non-covered areas (2,827 kg/ha), compared to covered areas without the presence of bee colonies (2,000 kg/ha). Similarly, in Ceará there was a 12.9% increase in grain production in areas where honeybees were introduced into the crop, compared to areas without these pollinators.</p>	<p>(Chiari et al., 2008; Giannini, Cordeiro, Freitas, Saraiva, & Imperatriz-Fonseca, 2015)</p>
<p>In Brazil, declines in pollinator species have also occurred due to deforestation, and loss or fragmentation of insect habitats.</p>	<p>An experimental study in Paraná found 38% less productivity in both conventional and genetically modified organism (GMO) soy when access to pollinators was removed.</p>	<p>(Chiari et al., 2008; Novais et al., 2016)</p>
<p>Enabling production: Climate regulation</p>		
<p>Soybean is best adapted to regions where temperatures vary between 20 and 30°C, with temperatures below 10°C or above 40°C compromising or preventing its development, especially in combination with water scarcity. The increase in the frequency of extreme events, such as high temperatures, is likely to produce severe effects on summer crop yields, especially soy and corn.</p>	<p>Studies of adaptation of Brazilian agricultural systems to climate change suggest that soy production may lose up to 40% of productivity with losses valued as high as \$7.6 billion/yr. Other study results showed that higher soy productivity are related to increases in canopy temperature during flowering/grain filling periods.</p>	<p>(FARIAS et al., 2007; Gusso, Ducati, Veronez, Arvor, & da Silveira, 2014; Pinto1, Jr1, Assad, & de Ávila1, 2005)</p>
<p>Regions that are both upwind and close to pasture and soy production areas are those that have benefited most from climate regulation functions of the standing forest.</p>	<p>For soy and beef production, reductions in productivity and rents due to diminishing climate regulation functions from deforestation average US\$1.81 and 5.43 ha/yr, respectively, but can be as high as US\$9 ha/yr (that is 30% of total rents). Such reductions are mostly concentrated on the fringes of the Amazon forest, particularly in downwind production areas in northern Mato Grosso (soy), Rondônia and eastern and southern Pará (livestock).</p>	<p>(May, 2019)</p>

Protecting from disruption: Pest control

The conservation of natural areas close to plantations has the potential to reduce the population size of agricultural pests and the consequent use of pesticides.

A study in Paraná identified that the capuchin monkey in remnants of a Semideciduous Seasonal Forest, surrounded by soy-maize crops systems, have the potential to control agricultural pest populations.

(Mikich, Liebsch, ALMEIDA, & Miyazaki, 2015)

Source: the authors (2022)

These are examples of how soy cultivation depends on ecosystem services, and ultimately on biodiversity, to be viable and productive. Conversely, specif-

ic soy cultivation practices contribute to ecosystem degradation and loss of native vegetation.

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6.2 – NEGATIVE IMPACTS OF SOY PRODUCTION ON BIODIVERSITY

There are several negative impacts that soy production can have on biodiversity, depending on the size of the plantation, management practices, location, among other variables. Green and colleagues (J. M. H. Green et al., 2019) state that significant varying impacts on endemic species can be a consequence

of trading company standards and distinct sourcing consumer countries. Drawing on Table 3's direct impacts with "very high materiality" and "high materiality, Table 5 gives examples of negative impacts of soy production on biodiversity, evidence and respective references.

TABLE 5- NEGATIVE IMPACTS OF SOY PRODUCTION ON BIODIVERSITY

Examples of negative impacts of soy cultivation	Evidence	References
Land use change: Loss of ecosystems		
The growth of soy production largely occurred over non-forest areas in the Amazon biome between the 2007/2008 and 2019/2020 crop seasons.	Increase in area occupied by soy from 1.64 million to 5.41 million hectares in the Amazon biome, while the area planted in post-2008 deforested area grew by 0.11 million hectares between the 2007/2008 and 2019/2020 crop seasons. Soy received the most pesticides, with 914.7 million hectares treated (55% of the area), followed by corn, with 244 million hectares (15%), with the predominant model being soy-maize rotation.	(ABIOVE, 2021)
In the Cerrado, soy grew over deforested areas, especially in Matopiba.	In the Cerrado, 4.19 million hectares (14.4%) of cultivated soy are in areas deforested after 2000 and 1.47 million hectares (13.4%) are in areas deforested post-2008. In Matopiba, 25.1% of soy cultivation was found in areas deforested after 2008.	(Agrosatélite, 2021; Soter-roni et al., 2019)
Pollution: Use of fertilizers and pesticides		
Fertilizers used in excess degrade the soil, contaminate water and harvested products.	Soy cultivation is the main responsible for the use of fertilizers in Brazil, accounting for 36.44% in 2012; and is the fourth most intensive crop in terms of fertilizer use per planted area, with 388.05 tons per 1,000 hectares.	(K. R. de Souza & Miranda, 2014)
Species diversity decreases due to pesticide use and predator reduction in soy and corn cultivation. The use of pesticide and the excessive and continuous application of specific insecticides do represent a source of declines in insect pollinators, which have been documented worldwide.	Factors such as pesticide spraying as well as reduced food and shelter from predators interfere in ant diversity.	(Gallai, Salles, Settele, & Vaissière, 2009; IPBES, 2016; Klein et al., 2007; Lautenbach, Seppelt, Lieb-scher, & Dormann, 2012)

Resource exploitation: Soil erosion		
Water and soil erosion due to surface runoff depends on rainfall, topography, vegetation cover and conservation practices used in production systems.	Embrapa Soils estimates that soil losses valued at US\$ 5 billion per year in foregone productivity is caused by surface erosion alone, due to improper land use. Crop residues, in turn, dissipate the kinetic energy of the rain drops, by avoiding or minimizing the initial soil disintegration, and serve as a physical barrier to the shear and transport effects of the runoff.	(Amaral, Bertol, Cogo, & Barbosa, 2008; Guadagnin, Bertol, Cassol, & Amaral, 2005)
Climate change: Emissions of greenhouse gases and deforestation		
In Brazil, agriculture accounted for approximately 30% of greenhouse gas (GHG) emissions in 2016, while change in land use and deforestation contributed to an additional 39%.	In 2016, Brazil emitted 2.27 billion tons of CO ₂ e. This represented a 9% growth in relation to the previous year and 32% in relation to 1990. Of this total, 51% arose from deforestation, especially in the Amazon and in the Cerrado.	(SEEG, 2018)
Invasive species impacts on soy		
Soybean production in Brazil has been markedly affected by invasions of non-native arthropod species that feed on the crop, severely impacting biodiversity, food security, health, and economic development. Arthropod pests are the main competitors with humans for agricultural resources, especially when high-input monocultures are practiced over large areas.	Brazil loses around 4.31 million tons of soybean yearly due to arthropod pests, representing an annual economic loss of US\$ 1.51 billion or US\$ 55 per hectare, exceeding the average amount that soybean growers spend annually on insecticides to control arthropod pests (around US\$ 30 per hectare).	(Oliveira, Auad, Mendes, & Frizzas, 2014; Pozebon et al., 2020)

Source: the authors (2022)

In summary, the impacts of soy cultivation on biodiversity reduce the availability of ecosystem services by damaging the structure on which it depends. Besides the costs of impact on the soy-maize production, there is loss of opportunities in terms of, for

instance, timber and non-timber forest production, rubber and Brazil nut extraction, due to both deforestation and the risk of forest fires, affected by forest fragmentation and drought (May, 2019).



6.3 – SOY SECTOR INITIATIVES FOR BIODIVERSITY CONSERVATION

Over the last few decades, the soy sector and its stakeholders have developed initiatives, accountability tools and commitments at national and global levels to manage risks associated especially with deforestation (FEBRABAN & FGV, 2017), while the

majority of them explicitly mention biodiversity. **Table 6** presents some of the most relevant initiatives relating to the soy sector and biodiversity, although it does not intend to be in-depth.

TABLE 6 – SOY SECTOR INITIATIVES RELATED TO BIODIVERSITY

Institution	Initiative	Commodity and value chain	Approach	Geographic coverage
Sustainable Agriculture Network - SAN (1997) ⁹	Sustainable Agriculture Framework 2021	Agricultural and livestock sector	Framework	Global
Roundtable on Responsible Soy - RTRS (2006) ¹⁰	RTRS Standard for Responsible Soy Production V4.0 (December 2021) and RTRS Standard for Supply Chain V2.3 (December 2021)	Soy production and supply chain	Certification scheme	Global
Soy Working Group - GTS (2006) ¹¹	Soy Moratorium *Refers to deforestation and does not explicitly mention biodiversity	Soy sector	Commitment	Brazilian Amazon biome
ProTerra Foundation (2006) ¹²	ProTerra Standard, Social Responsibility and Environmental Sustainability. V4.1 (September, 2019)	Agricultural sector	Certification scheme	Global
International Sustainability and Carbon Certification - ISCC (2010) ¹³	Specify documents for different types of certification	Application to many commodities sectors, including soy	Certification scheme	Global
Amsterdam Declaration Partnership (2015)	Amsterdam Declaration (2015)	Agricultural commodities, with current focus on cocoa, palm oil and soya	Political declaration ¹⁴	Global

⁹ Information available at: <https://www.sustainableagriculture.eco/> Accessed on: 16 May 2022

¹⁰ Information available at: <https://responsiblesoy.org/?lang=pt-br> Accessed on: 16 May 2022

¹¹ Information available at: https://www.soyontrack.org/public/media/arquivos/Relatorio_Ciclo_Auditoria_Soja_na_Linha_060_7039_ALT1.pdf Accessed on: 16 May 2022

¹² Information available at: <https://www.proterafoundation.org/> Accessed on: 16 May 2022

¹³ Information available at: <https://www.iscc-system.org/about/objectives/> Accessed on: 16 May 2022

¹⁴ The Amsterdam Declaration ambition is deforestation-free, sustainable commodities (Amsterdam Declaration, 2015). The nine European signatories since 2021 are: Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain and the United Kingdom.

Fifty national and international civil society organizations supported by 23 companies	Cerrado Manifesto (September, 2017) ¹⁶ Letter of business support for Cerrado manifesto (October, 2017) ¹⁷	Agricultural commodity and supply chain	Commitment	Cerrado
United Nations and New York Declaration on Forests (NYDF) Global Platform (2017) ¹⁸	New York Declaration on Forests (2014) ¹⁹ and Glasgow World Leaders Declaration on Forests and Land Use (2021)	All sectors, particularly commodities production	Political declaration	Global
Multistakeholder - hosted by World Business Council on Sustainable Development (WBCSD) and with six member companies ²⁰	Soft Commodities Forum (2019) ²¹	Soy sector	Companies commitment	Global, with initial focus on the Brazilian Cerrado

Source: Adapted from (FEBRABAN & FGV, 2017; zu Ermgassen et al., 2020)

¹⁵ Information available at: <https://www.wwf.org.br/?60722/Manifesto-convoca-o-mercado-para-atingir-desmatamento-zero-do-Cerrado> Accessed on 13 June 2022

¹⁶ Information available at: https://wwfbr.awsassets.panda.org/downloads/cerradomanifesto_september2017_atualizadooutubro.pdf Accessed on 13 June 2022

¹⁷ Information available at: <https://www.theconsumergoodsforum.com/wp-content/uploads/2017/10/2017-Letter-of-business-support-for-Cerrado-Manifesto-CGF.pdf> Accessed on 13 June 2022

¹⁸ More information available at: <https://forestdeclaration.org/about/> Accessed on: 20 May 2022

¹⁹ The New York Declaration on Forests aims to halve natural forest loss by 2020, and strives to end it by 2030 (United Nations, 2014). It was endorsed by nearly 200 governments, multinational companies, Indigenous peoples, and civil society organizations. This has been signed at the national or local level by most of the countries with soy-related biodiversity impacts in the Brazilian Cerrado, but the Brazil and China national governments were notably absent (J. M. H. Green et al., 2019).

²⁰ The six member companies are: ADM, Bunge, Cargill, COFCO International, Louis Dreyfus Company (LDC), and Viteira

²¹ Information available at: <https://www.wbcd.org/Programs/Food-and-Nature/Food-Land-Use/Soft-Commodities-Forum/Resources/Soft-Commodities-Forum-Progress-Report-December-2021>

Specifically in Brazil, one of the most successful initiatives is the Soy Moratorium, in force since 2006, which aims to ensure that the soy sold by the Moratorium's signatories and produced in the Amazon biome does not come from areas deforested after 22 July 2008. The Soy Working Group (GTS), composed by companies associated with ABIOVE and National Association of Grain Exporters (ANEC) and civil society organizations, is responsible for the Soy Moratorium's governance, operation and satellite monitoring, the latter provided by ABIOVE in partnership with the National Institute for Space Research (INPE) and Agrosatélite (Abiove, 2021).

According to the Soy Moratorium Report for the 2019/20 crop season (Abiove, 2021), from 2009 to 2019, in the 102 municipalities monitored²² by the Moratorium, the soy area in disagreement with the Moratorium commitment has increased from 11,200 ha in 2012/13 to 107,700 ha in 2019/20, currently representing 2% of the total area of soy cultivated in the Amazon biome. Rural properties identified with non-compliant soy crops receive commercial sanctions and cannot sell their production to signatory

companies. The report concludes that, while the Soy Moratorium does not prevent further deforestation, the initiative prevents soy production in the Amazon biome, discouraging the conversion of new areas to soy and encouraging land use intensification and the expansion of soy over cleared areas (Abiove, 2021). Such expansion in the Amazon, however, is over pasture areas previously deforested by livestock activities (Terra de Direitos, 2021).

Recently, as abovementioned, soy production has been closely associated with the Cerrado biome (Gibbs et al., 2015; J. M. H. Green et al., 2019; zu Ermgassen et al., 2020). According to Soterroni and partners (2019), approximately 30% of soy expansion in the Cerrado from 2000 to 2014 occurred at the expense of native vegetation. Even though soy cultivation is a major threat to the Cerrado biodiver-

²² Monitoring is limited to areas with PRODES-Amazon coverage within municipalities with over 5,000 hectares of soy extent, resulting in 102 municipalities that represent 98% (5,29 Mha) of the soy cultivation area in the biome (Abiove, 2021).

sity and it has lower legal protection than the Amazon, there are no major initiatives specifically for the Cerrado as there are for the Amazon biome. The same author estimated that if there was a Soy Moratorium in the Cerrado by 2021, the loss of 3.6 million hectares of native vegetation could be avoided. The resources and ability to monitor progress toward such commitments, in practice and with accuracy, however, has been limited (Abiove, 2021; May, 2019; that Count, 2017; zu Ermgassen et al., 2020). The six companies that are members of the Soft Commodities Forum (**Table 6**) purchased 56.2% of soy exported from the Cerrado between 2006 and 2017 (zu Ermgassen et al., 2020). As these companies have been committed to zero deforestation since 2019, the monitoring coverage focused initially on the 25 priority municipalities that are responsible for supplying 25.3% of soy from the Cerrado to member companies (zu Ermgassen et al., 2020), leaving significant uncovered area.

In general, company strategies for monitoring soy trade consist in first checking the IBAMA list of embargoed areas, which has limitations such as inconsistencies between the CAR system and producer registration or "laundering" when soy produced in embargoed areas is transferred to nonembargoed ar-

reas (Gibbs et al., 2015). More specifically, some companies demand recognised certification schemes (**Table 6**) and/or set their own commitments, targets, internal policies and conformity assessment models. However, main buyer markets – the domestic market and Asia – do not demand a zero-deforestation target or do not require biodiversity-related certification and are not willing to pay a differential price, therefore not stimulating the development of this market in Brazil (FEBRABAN & FGV, 2017)

According to Zu Ermgassen and partners (2020), both multilateral and company commitments offer a powerful lever for reducing deforestation and associated biodiversity loss and greenhouse gas emissions if successfully implemented. However, such commitments and targets face significant monitoring and transparency challenges due to: (i) limited traceability in the supply chains, whereas there are multiple intermediaries between producers and consumers; ii) usually sourced via spot markets, processed and incorporated in secondary products; (iii) products from multiple sources are mixed at storage facilities, processing plants, and maritime vessels and the original source is lost (zu Ermgassen et al., 2020).

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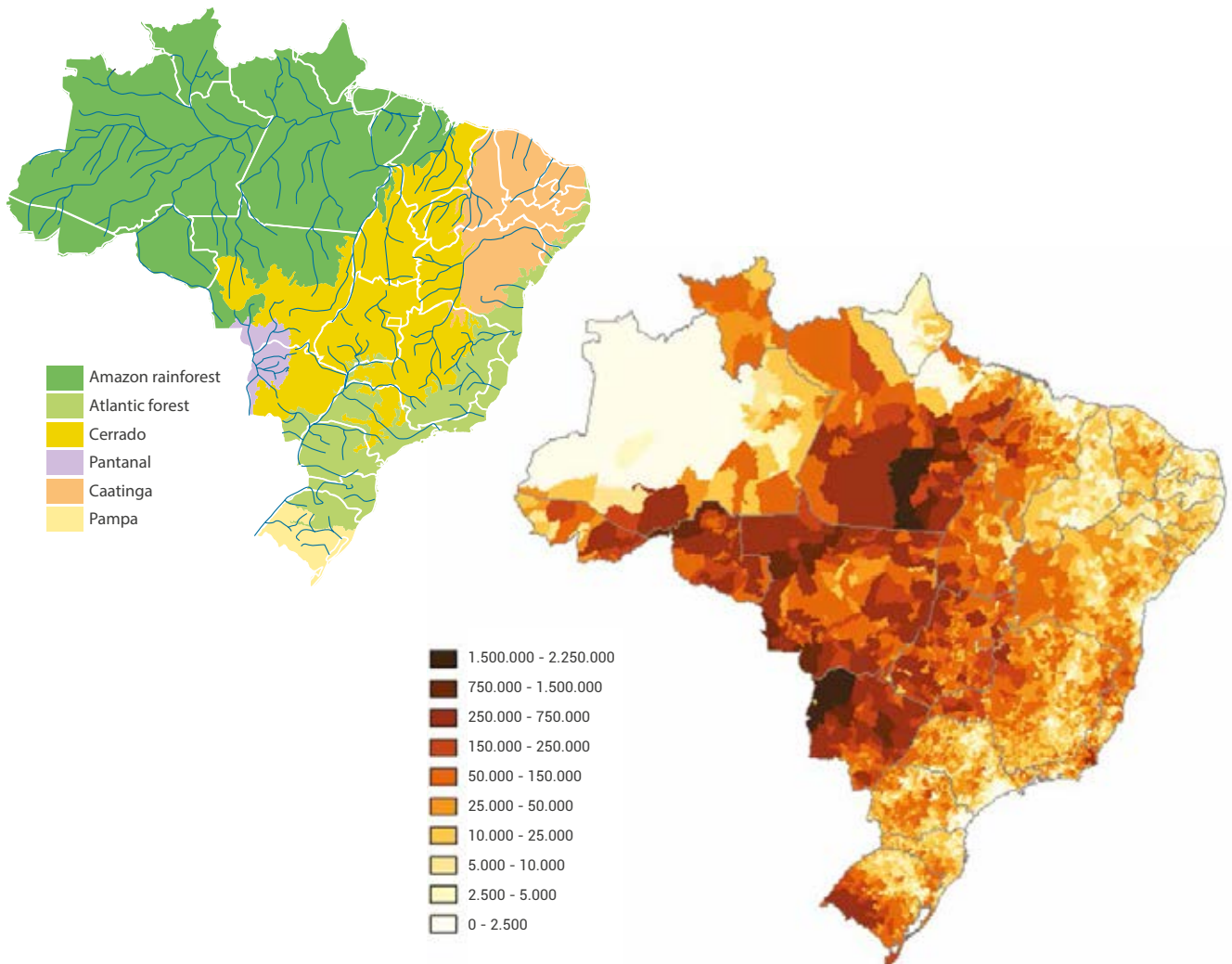
7 – BEEF CATTLE SECTOR

Brazil is the largest exporter and second largest producer and consumer of beef. With a herd of approximately 188 million cattle distributed in an area of 165.2 million hectares, the livestock sector recorded, in 2020, a slaughter of 41.5 million cattle, generating approximately R\$ 747.05 billion, and responsible for 10% of the country's total GDP (ABIEC & ApexBrasil, 2021).

Over the last four decades, livestock in Brazil has increased from around 100 millions cattle heads in the 1980s to approximately 188 million heads in the years 2020's (ABIEC & ApexBrasil, 2021; Kaynar

et al., 2020). Such expansion has taken place in all regions of the country, especially in the Legal Amazon, where there are 67.7 million heads, or 31% of the national herd. In 2020, the cattle herd was concentrated in the states of Mato Grosso (14.1%), Minas Gerais (11.3%), Mato Grosso do Sul (11.3%) and Goiás (10.0%) (ABIEC & ApexBrasil, 2021). The municipalities with the highest number of cattle are: São Félix do Xingu (Pará), Marabá (Pará), Porto Velho (Rondônia) and Vila Bela da Santíssima Trindade (Mato Grosso) (FGVEESP, 2021; May, 2019). **Figure 4** presents the distribution of the cattle herd.

FIGURE 2- BRAZILIAN BIOMES AND CATTLE HERD DISTRIBUTION IN 2020 (HEADS)



Source: Adapted from (ABIEC & ApexBrasil, 2021)



unsplash/juliana e mariana amorim

Although most of the beef cattle produced is destined to the domestic market, the share of exports has been rising, from 18% in 2015 to 26% in 2020, when 10.32 million tons of carcass equivalent were produced (ABIEC & ApexBrasil, 2021; Kuepper et al., 2020). According to Kaynar et al. (2020), such expansion is driven by increasing export demand amid favourable political, legislative, and enforcement changes. Of the total exported by Brazil in 2020, beef cattle represented 5.4%, equivalent to US\$ 8.48 billion, with the main destinations being China (48%), Hong Kong (13%), Egypt (5%), United States (5%) and the European Union (5%) (ABIEC & ApexBrasil, 2021). Beef cattle originating in the Amazon biome, however, is largely destined to the domestic market (ABIEC & ApexBrasil, 2021).

Cattle ranching is associated with large-scale deforestation, estimated to account for 80% of land clearing in every country with Amazon forest (Kuepper et al., 2020). According to INPE, approximately 62% of all land use change in the Brazilian Amazon has been traced to conversion of native forests to pastures dedicated to cattle grazing (INPE, 2022). Besides cattle products, the conversion of the land is a motivation in itself, which is later used for different commodities, as cattle rearing is a low-cost operation that prevents forests from regrowing, while timber is frequently exploited prior to the initial conversion, financing clearing operation (Kaynar et al., 2020; May, 2019).

Another main factor that facilitates forest conversion to pasture are land rents associated with access to roads and urban areas (May, 2019). The increase in slaughter capacity in the Amazon region has also been associated with cattle herd growth and the consequent expansion of the agricultural frontier (May, 2019). Barreto and partners in a study for Imazon (2017) have related the slaughterhouses' potential trade zone with 88% of the total areas embargoed by IBAMA for environmental noncompliance between 2010 and 2015.

The Brazilian beef cattle sector features diverse production systems, ranging from extensive livestock, supported by native and cultivated pastures of low productivity and low use of inputs, to so-called intensive livestock, with high productivity pastures, pasture feed supplementation and feedlots²³ (May, 2019). Most cattle operations in Brazil, however, are carried out in an extensive system, especially in the Amazon region, where only 5% adopted cattle confinement systems (May, 2019).

Different studies identify as common practices of extensive systems the use of areas with no aptitude for pasture formation; pasture formation after slashing and burning original forests; little adoption of pasture rotation practices; low consumption of feed supplementation; and cattle stocking above land capacity (EMBRAPA & WWF-Brasil, 2011; Ferraz & de Felício, 2010; May, 2019). Regarding common soil management practices, the studies list inadequate soil preparation and planting, lack of soil correction, use of poor-quality seeds of unknown origin, use of unadapted fodder species, forage monocultures and burning practices (EMBRAPA & WWF-Brasil, 2011; Ferraz & de Felício, 2010; May, 2019). As a consequence of such management practices, the degradation of pastures²⁴ has been a great problem for the sector, causing economic and environmental damage (Nogueira, 2013).

²³ EMBRAPA's National Center for Beef Cattle Research generally describes employed production systems according to the diet, including the definition of extensive, semi-intensive, intensive and confinement systems (Cezar, de QUEIROZ, Thiago, Garagorry, & Costa, 2005).

²⁴ According to Macedo (2005), pasture degradation is "the process of loss of vigor, productivity and the natural recovery capacity of the pasture making it unable to sustain the production and quality levels demanded by the animals, as well as to overcome the harmful effects of pests, diseases and invasive plants." (May, 2019).

7.1 – BEEF CATTLE RANCHING DEPENDENCIES ON BIODIVERSITY

While the dependence of cattle ranching on biodiversity occurs through different ecosystem services, all of them are interdependent and connected in a complex system that is feasible due to biodiversity and functional and healthy ecosystems. Drawing on **Table 3**, **Table 7** compiles examples of cattle ranching dependencies on biodiversity, some evidence and related references.

These are examples of how beef cattle ranching activities depend on ecosystem services and, ultimately, on biodiversity to be viable and productive. Conversely, these same activities have impacts by degrading and contributing to loss of native vegetation, which are guardians of biodiversity and providers of ecosystem services, as shown in the next section.

TABLE 7 – CATTLE RANCHING DEPENDENCIES ON BIODIVERSITY

Examples of cattle ranching dependencies on biodiversity	Evidence	References
Direct physical input: Water provision		
Water provision is a critical resource for livestock productivity.	20-25,000 liters of water are needed for each kilogram of beef produced in Brazil on pasture or semi-confined systems.	(Gerbens-Leenes, Mekonnen, & Hoekstra, 2013)
Enabling production: Soil fertility and drainage		
Soil natural fertilization and the consequent increase in productivity of livestock systems are directly related to the soil-plant-atmosphere flow; for instance, by the soil content of organic matter, microbial life and nitrogen from biological fixation.	Research on improved pasture grasses with vegetables in Acre has documented increased productivity and biological nitrogen fixation.	(Shelton, Franzel, & Peters, 2005; Zu Ermgassen et al., 2018)
Protecting from disruption: Pest control		
Proximity to habitat of native pest predators is important for pasture productivity. The loss of such forest proximity due to deforestation would conversely impact pasture productivity.	In Northwest Mato Grosso, many pastures have been decimated by the prevalence of spittlebugs of the genus Homoptera. Studies showed that the proximity to forest reserves reduced spittlebug infestation due to the presence of natural predators, resulting in net benefits of US\$ 113.28 to US\$ 233.76/ha/yr as compared to pastures without proximity to forests.	(Del Arco, May, & Rusch, 2018)
Protection from disruption: Climate regulation		
Climate vulnerability is considerably lower for cattle in confinement than for cattle relying on pasture growth because of changes in rainfall due to climate change.	For beef production, lower productivity and rents due to climate regulation functions from deforestation average US\$ 5.43 ha/yr. Such reductions are mostly concentrated on the fringes of the Amazon forest, particularly in downwind production areas in Rondônia and eastern and southern Pará.	(Raupp & Fuganti, 2014)
Regions that are both upwind and close to pasture and soy production areas are those that have benefited most from the climate regulation functions of the standing forest.		(May, 2019)

Source: the authors (2022)

7.2 – NEGATIVE IMPACTS OF BEEF CATTLE RANCHING ON BIODIVERSITY

There are several impacts that beef cattle can have on biodiversity, depending on the extent of the pasture, management practices, location, among many variables. For instance, Green et. al (2019) discuss how distinct sourcing patterns of consumer countries

and trading companies for soy and cattle result in substantially different impacts on endemic species. Drawing on **Table 3**, **Table 8** summarises examples of the negative impacts of beef cattle ranching on biodiversity, some evidence and respective references.

TABLE 8 – NEGATIVE IMPACTS OF CATTLE RANCHING ON BIODIVERSITY

Examples of livestock negative impacts	Evidence	References
Land use change: Loss of ecosystems		
Cattle ranching is one of the main factors responsible for the continuing expansion of the agricultural frontier. Between 60 – 80% of the deforested land in the Amazon is destined for cattle raising.	Livestock farming accounts for most of the human occupation in the Amazon and Cerrado, with around 56.6 million hectares in the Amazon (13% of the biome) and 47 million hectares in the Cerrado (24% of the biome). About 60% of the slaughtered cattle may be linked to deforestation at some point in the value chain.	(Chemnitz & Becheva, 2021; Mapbiomas, 2018; May, 2019; Piatto, Costa, Pinto Guedes, Medeiros, & Boas Silveira, 2018; Rajão et al., 2020)
Pollution: Water pollution		
The deposition of manure on pastures or their use as organic fertilizers contribute to water pollution, as they release contaminating substances such as nitrates, phosphates, pathogens and veterinary drugs (antibiotics, vaccines and hormones).	Dairy cows excrete between 35 and 130 kg N and 6 to 16 Kg P per year. This can contribute significantly to eutrophication and hypoxia in receiving water. In 2016, a gastroenteritis outbreak in the North Island of New Zealand was attributed to the ingestion of water contaminated by livestock faeces.	(Mateo-Sagasta et al., 2018)
Resource exploitation: Soil erosion		
Land degradation from livestock results from overgrazing, pasturing on steep slopes and on stream banks from riverine. Vegetation cover prevents erosion by maintaining the soil in a condition where it can absorb rainfall, so that runoff does not concentrate into an erosive force.	Allowing animals to graze vegetation to the ground deprives the soil of its protective cover and exposes it to erosive agents.	(Mateo-Sagasta et al., 2018)

Climate change: Greenhouse gases emissions		
Cattle ranching is one of the main source of GHG emissions in Brazil, and also the sector with the greatest margin for implementing improvements in its productive system.	The amount of GHG emitted by the beef cattle sector alone represents 65% of the emissions of the agricultural sector and 15% of overall national emissions.	(May, 2019; Piatto et al., 2018; SEEG 2018)
The main GHG contributing to emissions by the sector are methane (CH ₄), emitted by enteric fermentation of livestock and the management of animal waste, and nitrous oxide (N ₂ O), resulting from the use of nitrogen fertilizers, which has the highest growth rate.		(May, 2019; Piatto et al., 2018)
Climate change: Changes in rainfall and fire regimes		
The reduction in the volume and frequency of rainfall on a larger geographic scale is caused by the combination of the higher albedo of deforested surfaces and the lower evapotranspiration from crops and pastures in relation to natural vegetation. Consequently, intense fires are more frequent.	Deforestation in the south of the Amazon and in the Matopiba region has been altering the rainfall regime in Brazil.	(Lawrence & Vandecar, 2015; Rattis et al., 2021)
Invasive species: Loss of pollinators		
Mammalian herbivores, such as cattle, through consumption of floral or vegetative plant tissues or by direct trampling, have the potential to affect the floral or nesting resources available to pollinators.	Cattle introduced to Patagonian forests represent an invasive alien herbivore which, through trampling the vegetation, indirectly altered pollinator network structure, visitation and the reproductive success of certain plant species.	(IPBES, 2016)

Source: the authors (2022)



In sum, the negative impacts of cattle ranching on biodiversity reduce the availability of ecosystem services, damaging the very same structure on which it depends. Such damage can have financial impacts on companies developing these activities, or that have such activities in their supply chains; conversely, good practices to conserve biodiversity and the provision of ecosystem services can avoid risks and provide opportunities.

7.3 – LIVESTOCK SECTOR INITIATIVES FOR BIODIVERSITY CONSERVATION

Over the last few decades the livestock sector, together with its stakeholders, have developed initiatives, accountability tools and commitments at national and global levels aiming to manage environment-associated risks, especially regarding deforestation (FEBRABAN & FGV, 2017), while the majority of them explicitly mention biodiversity. **Table 9**

presents some of the most relevant initiatives relating to livestock and biodiversity, although it does not intend to be exhaustive. Additionally, the Working Group of Sustainable Livestock (GTPS) provides a more comprehensive map of sustainable livestock initiatives in Brazil.²⁵

TABLE 9 - LIVESTOCK SECTOR INITIATIVES RELATED TO BIODIVERSITY

Institution	Initiative	Commodity and value chain	Approach	Geographic coverage
Sustainable Agriculture Network - SAN (1997) ²⁶	Sustainable Agriculture Framework 2021	Agricultural and livestock sector	Framework	Global
Working Group of Sustainable Livestock - GTPS (2007) ²⁷	Indicators Guide on Livestock Sustainable and Practices Guide on Sustainable Livestock	Livestock sector	Indicators and Practices Guide	Brazil
Multistakeholder Initiative (signed by companies in the sector ²⁸ and proposed by Greenpeace)	Livestock Public Commitment (2009)	Livestock sector	Voluntary commitment	Brazilian Amazon
Companies from the sector (mediated by Federal Public Ministry)	Terms of Conduct Adjustment - TAC (2009)	Livestock sector	Extrajudicial agreements ²⁹	Brazilian Amazon
Global Roundtable for Sustainable Beef – GRSB (2010) ³⁰	Principles and Criteria for Sustainable Beef (2014) and Beef Cattle Global Sustainability Goals	Livestock sector	Principles and criteria and goals for sustainable meat production	Global

²⁵ The Sustainable Livestock Initiatives Maps is available at: <https://gtps.org.br/mips/iniciativas/>

²⁶ Information available at: <https://www.sustainableagriculture.eco/> Accessed on: 16 th May, 2022.

²⁷ Information available at: <https://gtps.org.br/en/who-we-are/> Accessed on: 16 May 2022.

²⁸ Signed by the three big companies JBS, Marfrig and Minerva in 2009.

²⁹ TAC agreements related to the livestock sector are compiled in "Boi na Linha" website: <https://www.boinalinha.org/categoria/compromissos/> Accessed on: 16 May 2022.

³⁰ Information available at: <https://grsbeef.org/> Accessed on: 16 May 2022.

³¹ Information available at: <https://www.unpri.org/collaborative-engagements/investor-initiative-for-sustainable-forests-engagement-results/9595.article> Accessed on 16 May 2022.

CERES and Principles for Responsible Investment - PRI ³¹	Investor Initiative for Sustainable Forests – IISF (2017)	Soy value chain and cattle supply chain	Coalition	Latin America and specifically Brazil
United Nations and New York Declaration on Forests (NYDF) Global Platform (2017) ³²	New York Declaration on Forests (2014) ³³ and Glasgow World Leaders Declaration on Forests and Land Use (2021)	All sectors, particularly commodities production	Political declaration	Global

Source: Adapted from (FEBRABAN & FGV, 2017)

³² More information available at: <https://forestdeclaration.org/about/> Accessed on: 20 May 2022.

³³ New York Declaration on Forests aims to cut natural forest loss in half by 2020, and strives to end it by 2030 (United Nations, 2014). It was endorsed by nearly 200 governments, multinational companies, Indigenous Peoples, and civil society organizations. This has been signed at the national or local government level by most of the countries with the greatest soy-related biodiversity impacts in the Brazilian Cerrado, but Brazil and China's National Governments, which have the greatest impact, are notably absent (J. M. H. Green et al., 2019).

As shown in **Table 9**, the livestock sector does not have a sustainability certification scheme commonly used by companies. Since the domestic and Asian markets, as the main consumers of Brazilian cattle products, do not demand products with biodiversity-related attributes, the market for livestock products adhering to socio-environmental criteria is not widely promoted in Brazil. Another factor is that the livestock sector works primarily with the spot market, in a competitive environment and mostly with short-term contracts, which can make it difficult to adopt and monitor socio-environmental criteria (FEBRABAN & FGV, 2017).

In 2009, following pressure from civil society and the emergence of the GTPS, those involved in the beef cattle value chain engaged in discussions about the concepts and principles that guide the sustainable livestock model in Brazil, through the dissemination and promotion of good practices compiled in the Guide of Good Practices for Sustainable Livestock Ranching (GTPS, 2016). The aim was to create a positive agenda for the development of livestock towards sustainability and social justice, which is environmentally responsible and economically viable. The GTPS represents different stakeholders from the production chain: farmers, financial institutions, industry, civil society, services and inputs, retail and restaurants, and research and education institutions. It has developed a practical tool, applicable to the Brazilian context, based on indicators and aimed toward sector transparency and dialogue (ABIEC & ApexBrasil, 2021).

Indeed, cattle supply chain zero deforestation agreements have promoted behaviour changes in big meatpacking companies toward end sourcing from noncompliant farms in the Brazilian Amazon. Companies involved in the livestock sector have adopted strategies, targets and criteria related to deforestation and demand deforestation criteria from their suppliers, in general, usually based on IBAMA's list of embargoed areas and CAR (FEBRABAN & FGV, 2017). Such commitments are usually linked to the

Public Livestock Commitment and, therefore, restricted to the Amazon biome. In this case, the area monitoring is provided via satellite, through the Project for Monitoring Deforestation in the Legal Amazon by Satellite (PRODES) in partnership with INPE and Greenpeace (FEBRABAN & FGV, 2017).

However, some authors (Gibbs et al., 2015; le Polain de Waroux et al., 2019) state that the market has rearranged trade patterns, moving beef importers from areas with stringent deforestation regulations toward other regions, while beef supply from the Brazilian Amazon and Legal Cerrado serves mainly the domestic market. Farmers can still sell to smaller companies focused on domestic market that do not participate in such agreements or experience pressure from their clients. Also, non-compliant farmers may take their cattle to compliant neighbour farms, a practice known as laundering. In this context, Waroux et al. (2019) concludes that it is unlikely that cattle agreements could be effective in reducing general deforestation without the comprehensive participation of both major and minor domestic buyers and covering other biomes.

Also, the resources and ability to monitor progress toward such commitments in practice and with accuracy has been limited (Lambin et al., 2018; le Polain de Waroux et al., 2019; May, 2019; zu Ermgassen et al., 2020). There are several challenges regarding the monitoring as domestic cattle markets are highly diffuse, with many small-scale slaughterhouses and local transactions operating in tandem with larger and more concentrated multi-national buyers. Moreover, one technical aspect is that traceability is still fragile, especially along the first links in the calf breeding and fattening chain that are very decentralised, and control of indirect impacts at this point of the chain is not yet adequately performed. Thus, despite public and corporate commitment to penalize deforestation associated with the beef chain, tracking such impacts is effective only from the slaughterhouse onward (FEBRABAN & FGV, 2017).

8 – FINANCING OF THE SOY AND BEEF CATTLE SECTORS

The fourth and final link of Figure 1 connects the economic activities and their financiers, making explicit not only the flow of financial resources, but also the shared risks and opportunities of these sectors.

From 2013 to April 2020, a study by Chain Reaction Research (Kaynar et al., 2020) found that financing provided to the beef and soy sectors in Brazil totalled US\$ 100 billion. South America institutions are responsible for 74% of the total funding to these sectors, while the 27 EU country institutions account for 11% and North American institutions for 6% of this funding. In total, the top 25 financiers accounted for 90% of the identified financing provided to these two sectors, with US\$ 60.5 billion to beef and US\$ 29.5 billion to soy (Kaynar et al., 2020).

Brazilian banks provided 81% of the total financing to the beef and soy sectors, being represented by twelve banks between the top-25 financiers (in US\$ millions), including Banco do Brasil as the largest financier providing US\$ 42.4 billion (42.3% of total) to the beef and soy sectors together in the 2013-2020 period (Kaynar et al., 2020).

Foreign financial institutions provided US\$ 14.5 billion to the beef sector and US\$ 11.2 billion to the soy industry. Among the top-25 financiers, foreign institutions with significant financing amounts are Santander (Spain) with US\$ 5.1 billion, Rabobank (Netherlands) with US\$ 3.0 billion, HSBC (United Kingdom) with USD 2.5 billion, and JPMorgan Chase (United States) with US\$ 0.9 billion (Kaynar et al., 2020).

The most important source of financing for the two sectors are loans, totalling US\$ 81.6 billion from 2013 to 2020. Underwritings of US\$ 13.2 billion were the second largest source of financing, while shareholding accounted for US\$ 4.8 million and bondholding for US\$ 663 million, the last two involving more foreign. Moreover, 90% of loans are facilitated through a financing system called Sistema Nacional de Crédito Rural (National Rural Credit System), which offers credit largely at subsidized interest rates. Because of legal requirements, around two-thirds of the funding comes from deposits at Brazilian banks, while the interest rates on approximately 75% of the credit is subsidized (Kaynar et al., 2020).

Specifically for the soy sector, the Mato Grosso In-

stitute of Agricultural Economics (IMEA) publishes data related to the composition of soy funding in the state of Mato Grosso. The survey is carried out with banks, trading companies, multinationals of fertilizers, seeds and pesticides, resellers of inputs and sowing. For the 2021/22 crop season, the total amount of funding in the state was R\$ 30.86 billion. As shown in Table 10, multinationals were the main financiers to producers in Mato Grosso (30%), followed by the financial sector (28%).

TABLE 10 - PARTICIPATION OF AGENTS IN FINANCING THE COST OF SOY IN MT FOR THE 2021/22 HARVEST

Market agents	Funding (R\$ billions)	%
Multinationals*	9.05	30%
Resales	4.60	15%
Financial system	8.61	28%
Banks with federal resources	2.44	8%
Own resources	6.14	19%
Total	30.86	100%

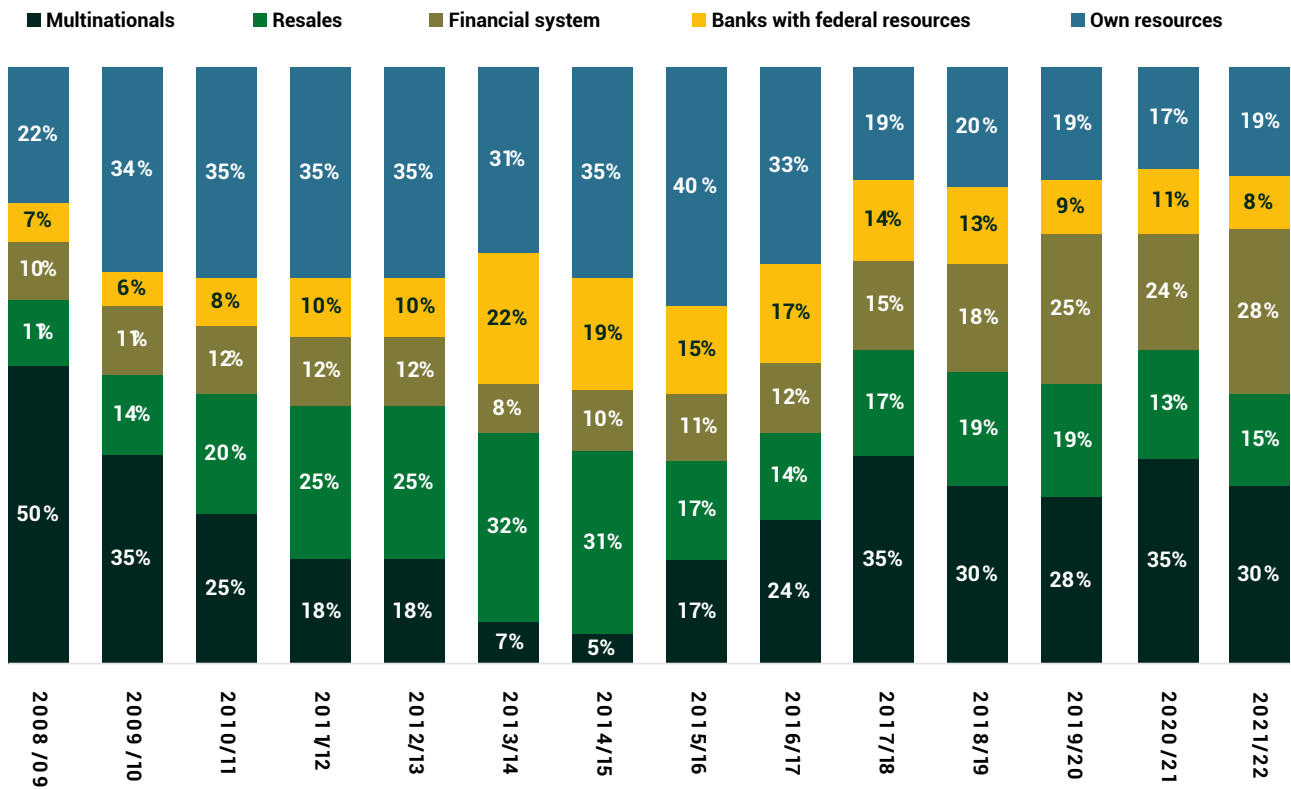
* Multinationals of agrochemicals, fertilizers, seeds and grains

Source: Imea (2022)³⁴

As shown in Table 10, the participation of each of the financing agents varies over the crop seasons, depending on factors such as macroeconomic variables. For the 2022/23 crop season, it is expected that the participation of the financial sector will decrease due to the increase in the SELIC rate, which increases the cost of credit, and the greater availability of producers' own resources, obtained from better negotiations in the grain commercialisation in previous crop seasons.

³⁴ <https://www.imea.com.br/imea-site/relatorios-mercado-detalle?c=4&s=696277717805039616>

GRAPH 5 - EVOLUTION OF SOY FINANCING BETWEEN THE 2008/09 AND 2021/22 CROP SEASONS



Source: Imea (2022)³⁵

³⁵ Source: <https://www.imea.com.br/imea-site/relatorios-mercado-detalhe?c=4&s=696277717805039616> Accessed on: 16th May, 2022

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9 – CHALLENGES TO OVERCOME

This desk review on the soy and cattle sector's dependencies and impacts on biodiversity has demonstrated that both sectors are deeply dependent on biodiversity, while its activities have several impacts on biodiversity as well. The consulted studies and initiatives related to these sectors mainly highlight the deforestation impacts of these economic activities, present related challenges and suggest that the reduction of biodiversity related-risks in supply chains need clear and measurable targets, as well as pathways to achieve them and accountability.

There are challenges for deforestation-free soy and cattle production in different levels. The main challenges found on this stocktaking exercise are grouped below:

Fragile institutions and law implementation: Governments in different levels struggles to implement the law due to (i) low institutional capacity at the regional and local scale; (ii) persistent problems with land conflicts and land tenure regularisation, (iii) a lack of incentives to farmers to comply with the Forest Code, and (iv) a recurring change in the regulatory framework related to Forest Code implementation terms (Kuepper et al., 2020; May, 2019).

Market features:

- **Biodiversity-related requirements:** The main buyer markets of soy and cattle are domestic and Asian, both of them with low demand for products with biodiversity-related attributes or even related to zero-deforestation targets, thus, not widely promoting it in Brazil (J. M. H. Green et al., 2019).
- **Spot market:** The livestock and soy sector works primarily with the spot market, in a competitive environment and with mostly short-term contracts, which can make it difficult to adopt and monitor socio-environmental criteria.

Biodiversity related commitments:

- **Transparency:** Zero deforestation commitments' lack of monitoring, verification and public communication by economic agents. One in five commitments identified has expired, or has never had an expected date, or has never had progress information available (zu Ermgassen et al., 2020).
- **Monitoring:** The monitoring needs for companies operating in agricultural chains is complex and ex-

pensive, thus can hardly be achieved by financial institutions individually. Therefore, joint action is needed for a unified database with georeferenced information and analysis on deforestation for relevant sectors in bank portfolios (FEBRABAN & FGV, 2017).

- **Traceability:** To devise and monitor solutions for sustainable production and consumption, it is necessary to identify the location of production areas to a high degree of spatial accuracy and understand the impacts on biodiversity of production in these areas. However, there are challenges related to tracking mechanisms, especially along the first links in the chain, as breeding and fattening of calves operate through decentralised and capillary supply chains among thousands of small and medium cattle ranchers, making it difficult to monitor the meat in this productive phase (J. M. H. Green et al., 2019).

- **Coverage:** The sector's initiatives mainly cover the Amazon biome, whereas most deforestation is actually happening in Cerrado. Although zero deforestation commitments coverage is increasing, it is still much higher in the Amazon than the Cerrado where there is less legal protection (zu Ermgassen et al., 2020). Expansion of the Soy Moratorium to cover the Cerrado, for instance, could lead to greater conservation benefits (Soterroni et al., 2019).

- **Forest degradation and fragmentation:** Initiatives focus mainly on supply chains (particularly of soy and beef) that aim at "zero net deforestation" in the Amazon and the Cerrado, and there is almost no support for complementary actions or the avoidance of fragmented or degraded areas.

Multiplicity of regimes and lack of coordination:

There is a plethora of regimes and initiatives regarding reducing deforestation in different jurisdictions. Improving alignment among all stakeholders and coordinating regimes could help ensure better results as well as less probable leakages (L. Rausch, 2021).

On the ground: It is noticeable the absence of a clear and extensive engagement with farmers. Small farmers usually face high up-front costs, uncertainty about returns, difficulties to access green credit (e.g. ABC Program), lack of competition, perceived insufficient grain storage capacity, lack of cooperatives and reluctance among the older generation.

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APPENDIX 1 - COMMITMENTS CONCERNING BIODIVERSITY PROTECTION AND RESTORATION IN BRAZIL

LAW 12,651/2012 (FOREST CODE)

Also known as the new Forest Code, Law 12,651 sets general rules about vegetation protection, protection of Permanent Preservation and Legal Reserve areas, forest exploitation, origin control of forest products, fire prevention and related economic tools. Among other things, the Forest Code requires rural landowners to preserve/restore a portion of their land as Legal Reserve areas – the percentage varies from 80% in forested areas of the Legal Amazon region, 35% in areas of Cerrado of the Legal Amazon region and 20% in other regions – and Per-

manent Preservation Areas from the property (e.g., mangrove areas and the surrounding bodies of water) (Brazil, 2012).

Rural landowners who do not comply with the Legal Reserve area requirements can either restore the area or compensate this environmental deficit by leasing land from a rural landowner with 'excess' vegetation cover, i.e., above the legal requirements. Both properties must be in the same biome for this compensation to be authorised (Brazil, 2012).

GUIDELINES FOR A NATIONAL STRATEGY ON CLIMATE NEUTRALITY

According to the Guidelines for a National Strategy on Climate Neutrality, one of the activities proposed to reach climate neutrality by 2050 is to restore and reforest 18 million hectares of forests, for multiples

uses, by 2030. Illegal deforestation is expected to be eliminated by 2028 – 15% a year by 2024, 40% in 2025 and 2026 and 50% in 2027 (Ministério do Meio Ambiente, 2021).

NATIONAL PLAN FOR NATIVE VEGETATION RESTORATION (PLANAVEG)

In 2017, the Brazilian federal government issued the National Plan for Native Vegetation Restoration (Planaveg), committing to recover 12 million hectares of native vegetation by 2030. This target was largely based on an assessment of the area that must be restored to meet the requirements of Law 12,651/2012³⁶ (MMA; WRI, 2017).

³⁶ This target was set by subtracting, from the total area that needs to be restored according to the Forest Code (21 million ha) (Soares-Filho et al., 2014), the portion that can be compensated via Environmental Reserve Quotas (CRAs) and via the purchase of private lands in Conservation Units (MMA & WRI, 2017).

LOW-CARBON AGRICULTURE + PLAN (ABC+ PLAN)

The Climate Change Mitigation and Adaptation Sectorial Plan for the Consolidation of a Low-Carbon Economy in Agriculture (also known as ABC Plan) seeks to plan actions for the adoption of sustainable production technologies, thereby addressing the country's commitments to reduce GHG emissions in the agricultural and livestock sectors (Ministério da

Agricultura, 2020).

The first phase of the ABC Plan ran from 2011 to 2020. According to government data, it managed to reach all targets set (Table 11). Launched in 2021, the ABC+ Plan is the second phase of the program, with targets shown in the fourth column of Table 11.

TABLE 11 - TARGETS ATTAINED BY THE ABC PLAN AND UPDATED TARGETS OF THE ABC+ PLAN

Initiative	Target - ABC Plan	Progress – ABC Plan	Target – ABC+ Plan
Increase restoration of degraded pastures	15 million hectares by 2030	27.8 million hectares (2010-2018)	30 million hectares until 2030
Increase crop-livestock-for-estry integration systems	5 million hectares by 2030	11.9 million hectares (2010-2020)	10 million hectares
Increase adoption of the no-tillage system	8 million hectares in 2020	12.7 million hectares (2010-2017)	12.5 million hectares until 2030
Increase planting with nitrogen biological fixation	5.5 million hectares in 2020	10.6 million hectares (2010-2017)	13 million hectares with bio-inputs (including nitrogen biological fixation) by 2030
Treatment of animal waste	4.4 million m ³ in 2020	38.3 million m ³ (2010-2019)	208 million m ³ by 2030
Restore and reforest	12 million hectares of forests, for multiple uses, by 2030	16 million hectares of forests, for multiple uses, by 2020	4 million hectares of planted forests by 2030
Intensive termination of animals	–	–	5 million animals by 2030
Irrigated systems	–	–	3 million hectares by 2030
Agroforestry systems	–	–	100,000 hectares by 2030

Source: (Ministério do Meio Ambiente, 2021)

To finance the ABC Plan, the federal government also created the Low-Carbon Agriculture Program (ABC Program), making available, to rural producers, credit lines at subsidised interest rates to finance the low-carbon techniques included in the Plan. Between 2010 and 2019, R\$ 17.3 billion were disbursed through the ABC Program (Ministério da Agricultura, 2021a). For the 2021-2022 crop season, the government made available R\$ 5.05 billion (Ministério da Agricultura, 2021b).



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