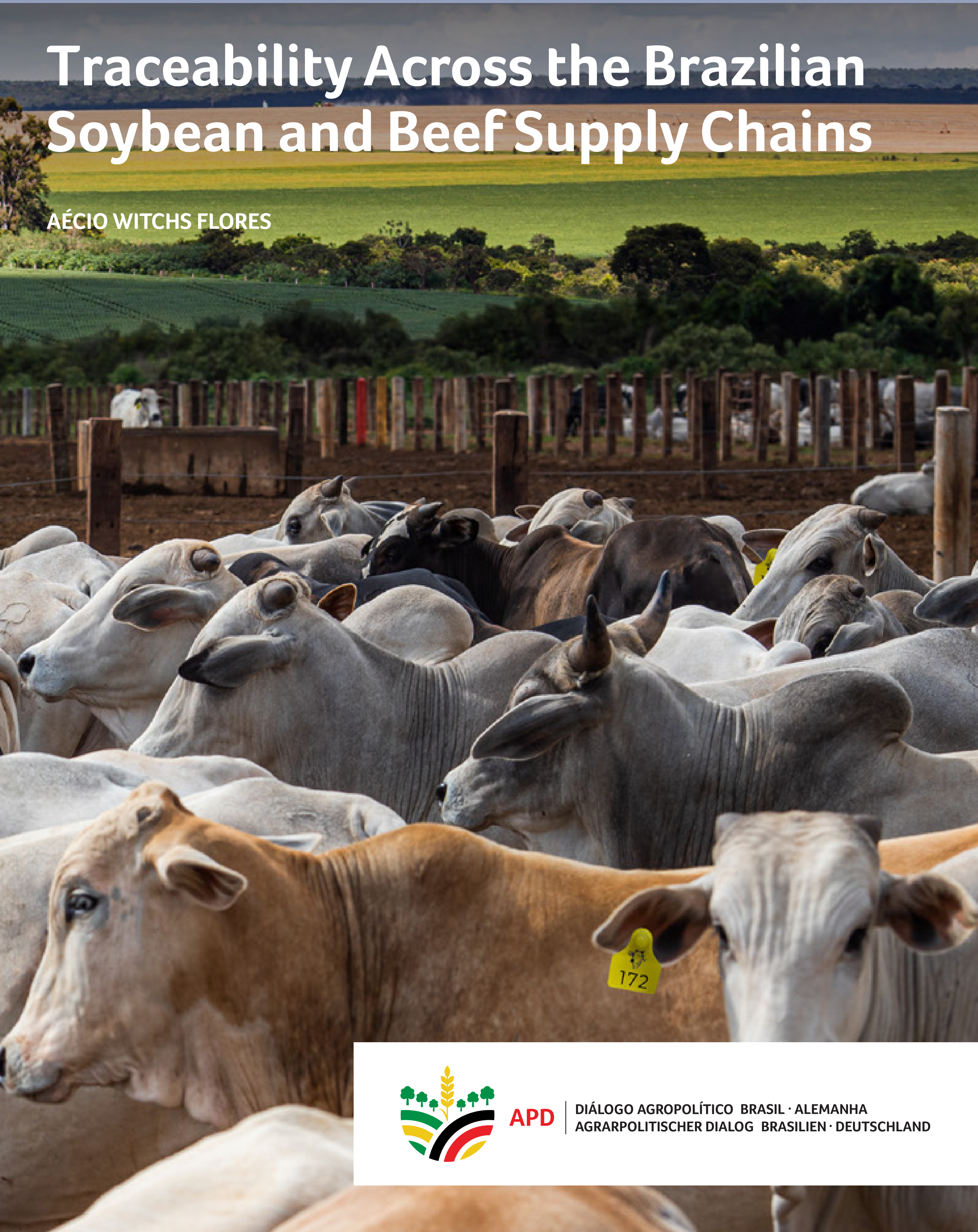
AGRICULTURAL POLICIES IN DEBATE

Traceability Across the Brazilian Soybean and Beef Supply Chains

AÉCIO WITCHS FLORES



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ABOUT THIS STUDY

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Aécio Witchs Flores holds a bachelor's degree in business administration from the University of Vale do Rio dos Sinos and an MBA in IT Management, Finance and Controllership from the Getulio Vargas Foundation. He has 35 years of experience in developing technological solutions for agribusiness, including the Brazilian System for the Identification and Certification of Cattle and Buffaloes (SISBOV, acronym in Portuguese) and traceability platforms. He acts as a strategic leader in private institutions. He was responsible for implementing Brazil's first 100% web-based cattle traceability system, which monitors more than 20 million animals. He currently coordinates innovative projects in traceability and agricultural management.

Table of contents

Acronyms

ABCAR	Associação Brasileira das Empresas de Certificação (Brazilian Association of Certification Companies)
ABIEC	Associação Brasileira das Indústrias Exportadoras de Carnes (Brazilian Association of Meat Exporting Industries)
ABIOVE	Associação Brasileira das Indústrias de Óleos Vegetais (Brazilian Association of Vegetable Oil Industries)
ABPA	Associação Brasileira de Proteína Animal (Brazilian Association of Animal Protein)
ABRAFRIGO	Associação Brasileira de Frigoríficos (Brazilian Meatpacking Association)
ANEC	Associação Nacional dos Exportadores de Cereais (Brazil's National Association of Cereal Exporters)
CAR	Cadastro Ambiental Rural (Rural Environmental Database)
CEPEA	Centro de Estudos Avançados em Economia Aplicada (Center for Advanced Studies in Applied Economics, a research institution associated with Esalq/USP)
CSA	Controle de Supressão Autorizada (Authorized Suppression Control)
CTe	Conhecimento de Transporte Eletrônico (Electronic Bill of Lading)
e-GTA	Padrão eletrônico da Guia de Trânsito Animal (Electronic Livestock Transport File)
EUDR	European Union Deforestation Regulation - European Union Anti-Deforestation Law or European Union's Regulation on Deforestation-Free Products
GTA	Guia de Trânsito Animal (Livestock Transport File)

IE	Inscrição Estadual (State Registration)
IoT	Internet of Things
ISCC	International Sustainability and Carbon Certification A global certification system covering all types of biomass and renewable energies. It aims to ensure sustainable, traceable, deforestation-free supply chains
LGPD	Lei Geral de Proteção de Dados Pessoais (Brazil's General Law on the Protection of Personal Data)
MAPA	Ministério da Agricultura e Pecuária (Brazil's Ministry of Agriculture and Livestock)
MBPS	Mesa Brasileira da Pecuária Sustentável (Brazilian Round Table of Sustainable Livestock Farming)
MMA	Ministério do Meio Ambiente e Mudança do Clima (Ministry of Environment and Climate Change)
MTE	Ministério do Trabalho e Emprego (Brazilian Ministry of Labor and Employment)
NF-e	Nota Fiscal Eletrônica (Electronic Tax Receipt)
OESAS	Órgãos Estaduais de Sanidade Agropecuária (State Agricultural and Livestock Health Agencies)
PGA	Plataforma de Gestão Agropecuária (Agricultural Management Platform)
PGFN	Procuradoria-Geral da Fazenda Nacional (Attorney General's Office of the National Treasury)
GDP	Gross Domestic Product
PNIB	Plano Nacional de Identificação de Bovinos (National Cattle Identification Plan)
ProTerra	A certification standard that promotes sustainability and social responsibility in the agri-food supply chain.

RFB	Receita Federal do Brasil (Federal Internal Revenue Office of Brazil)
RFID	Radio-Frequency Identification
RTRS	Round Table on Responsible Soy, a global certification system that promotes responsible soybean production, processing, and trade
SDA	Secretaria de Defesa Agropecuária (Agricultural Defense Secretariat)
SDI	Secretaria de Desenvolvimento e Inovação (Development and Innovation Secretariat)
SEMAS	Secretaria de Estado de Meio Ambiente e Sustentabilidade (State Secretariat for Environment and Sustainability)
SERPRO	Serviço Federal de Processamento de Dados (Brazilian Data Processing Service)
SICAR	Sistema Nacional de Cadastro Ambiental Rural (National Rural Environmental Registration System)
SIFMA	Sistema de Fiscalização e Monitoramento do Agronegócio (Agribusiness Inspection and Monitoring System)
SIGEF	Sistema de Gestão Fundiária (Land Management System)
SISBOV	Sistema Brasileiro de Identificação e Certificação de Bovinos e Bubalinos (Brazilian System for the Identification and Certification of Cattle and Buffaloes)
SNCR	Sistema Nacional de Cadastro Rural (National Rural Registration System)
SUASA	Sistema Unificado de Atenção Veterinária (Unified Veterinary Care System)
TAC	Termo de Ajustamento de Conduta (Consent Decree)

1. Introduction

The purpose of this study is to analyze the traceability systems currently in place and those under development in the Brazilian soybean and beef supply chains.

Brazil is one of the world's leading producers and suppliers of food. It is the largest producer and exporter of soybeans and beef and plays a strategic role in supplying multiple markets, which makes the agricultural sector highly relevant to the Brazilian economy.

On the national and international scene, the connection between agricultural production, deforestation, animal welfare, and climate mitigation is key. There is a growing global demand for food with socio-environmental attributes, driven by international regulations, such as the European Union Regulation on Deforestation-Free Products, also known as the European Union's Anti-Deforestation Law (EUDR, created in 2023). The EUDR prohibits the import of products connected with deforestation. These factors have generated stronger pressure within the Brazilian domestic market for information on the origin and production of food, making traceability a high priority. This scenario has begun to spark local consumers' interest in the origin of food, how it has been produced, and its environmental impacts.

The demand for traceability, which is the ability to identify, monitor, and determine the origin, location, and history of a product throughout its production chain, emerges as an essential tool. This tool aims to ensure quality, safety, and sustainability in the value chains of beef and soy in Brazil.

- **In soybean farming** - Traceability is designed to demonstrate sustainable production and provide transparency in logistical and storage segregation;

- **In livestock farming** - Traceability is essential for managing cattle transport, as it provides information on production sites throughout the cattle life and the control of health events.

Therefore, the implementation of traceability systems is a priority for Brazil to strengthen its agricultural production with sustainability and therefore guarantee access to the global markets.

Traceability plays a key role in food safety, public health, and combating fraud and illegal activities, such as deforestation and slave labor. It strengthens the image of Brazilian agribusiness, which is pivotal in the context of the climate crisis.

Methodology

This study utilized a methodology that integrated different approaches to ensure an in-depth understanding of traceability systems in the beef and soybean value chains in Brazil. It involved the following stages:

- **Document review** - Literature review of publications, scientific articles, and sectoral studies on soybean and beef production, agribusiness, and traceability. Laws, decrees, ordinances, normative instructions, and other official documents regarding traceability and sustainability in Brazil were analyzed. Focus was placed on the federal legislation to identify the legal framework, its gaps, and any adjustments required for the effective implementation of traceability systems.

- **Production chain knowledge base** - A detailed analysis of sources that included reports, terms of reference, meetings with experts, handbooks, and technical documents produced by different institutions and initiatives. These include the Agricultural Policy Dialogue Brazil-Germany (APD); Coalizão Brasil Clima, Agricultura e Florestas (Brazilian Coalition on Climate, Forests, and Agriculture); the Brazilian Association of Vegetable Oil Industries (ABIOVE); and the Dutch government.

- **Comparative analysis** - Literature and documentary data were critically and systematically organized using content analysis and comparison approaches. This highlighted convergences and divergences between traceability initiatives and systems in the soybean and beef supply chains in Brazil. Effective practices, as well as gaps and challenges, were evaluated. The study also incorporated the context of international regulations, such as the EUDR, and the expectations of global stakeholders and markets. The comparison of soybean traceability initiatives also revealed key technologies and their unique features.

2. Contextualization of soybean and beef value chains

Brazil plays a key role in the global production and export of soybeans and beef. Since 2021, agribusiness has accounted for about 43% of Brazil's total exports.

The soybean and beef sectors are pillars of the Brazilian economy and have a strong presence in international trade. However, they face considerable socio-environmental challenges, particularly those related to deforestation, as their production chains extend across several biomes in the country.

In this scenario, it is essential to reconcile production with sustainability. This has driven the appreciation of traceability as a strategic tool to ensure transparency, meet the demands of global markets for sustainable products, and maintain Brazil's competitiveness internationally.

2.1. Overview of the soybean sector

Soybean production has significant economic importance and represents a considerable portion of Brazil's national and agribusiness GDP, and it generates millions of jobs.

From January to March 2025, 10 million tons of soybeans were exported. This is an increase of 25% compared to the same period last year. In 2025, 107 million tons of exports are estimated. This represents an increase of 8% compared to the 98.81 million tons exported in 2024.

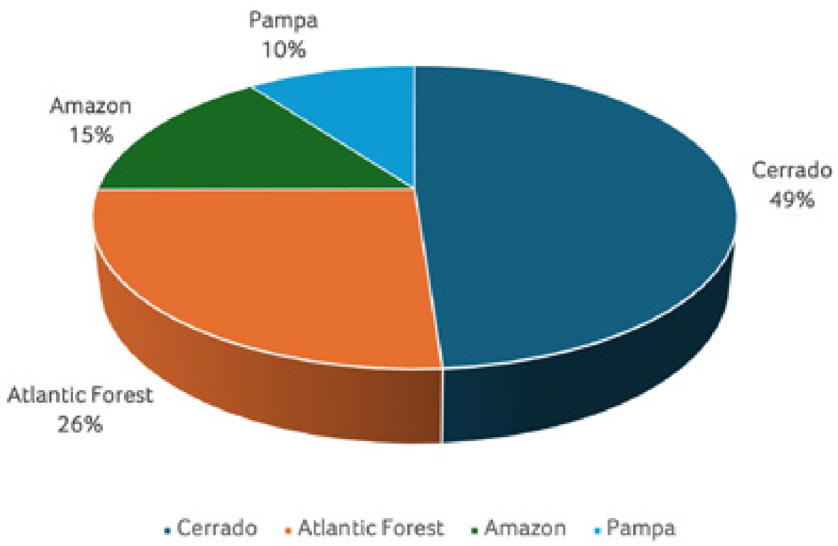
The soybean production chain is lengthy and complex. It goes from soybean growing to industrial processing, marketing on the domestic market, storage, and export. Traceability in this chain seeks to monitor the product across all stages, from its origin on the farm to its final destination, with socio-environmental compliance status and total segregation at all stages of production.

2.1.1. Production and exports

Brazil is the world's largest producer and exporter of soy and soybean products. It accounted for 37% of global production in the 2022/2023 harvest (Seraphim, 2025). Brazilian soybean production plays a strategic role in supplying the animal protein industry in key markets, such as the European Union (EU) and China. It is a key piece in the global food chains (Dias de Sá; Konig; Søndergaard, 2022).

With crops distributed across different biomes, the soybean chain is exposed to market variations and socio-environmental pressures. In 2024, Brazilian soybean exports totaled US$42.9 billion-a decline of 19.4% compared to 2023. Despite this, the EU remains one of the most relevant soy destinations. This reinforces the need to strengthen sustainable practices to remain competitive in the global markets.

Graph 1 – Production % by biome



Source: MapBiomas (2021)

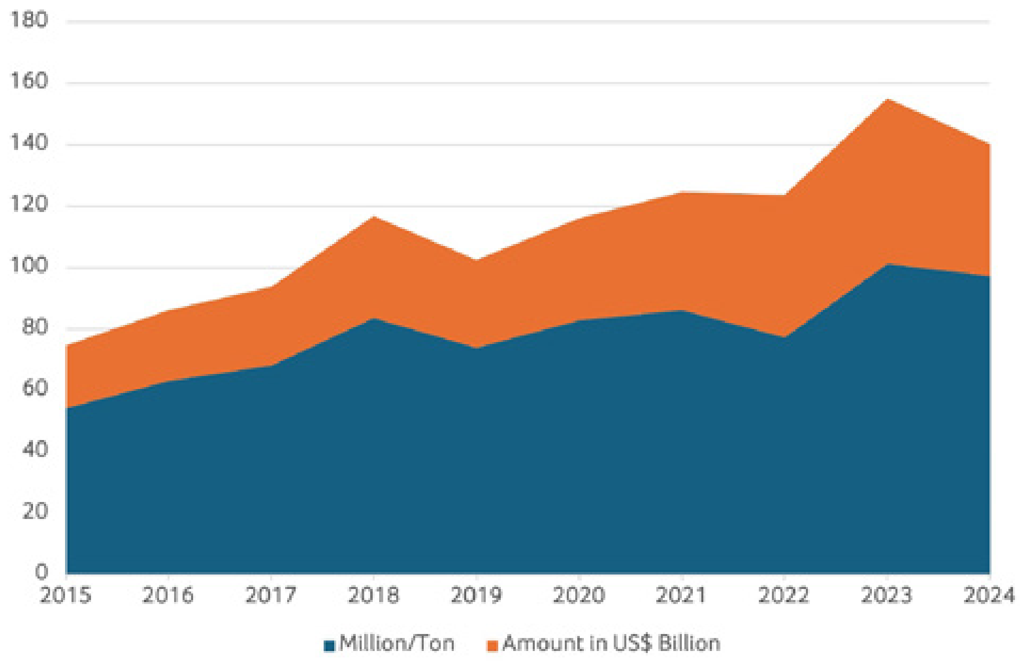
The main socio-environmental challenges of the sector include compliance with the Forest Code; illegal deforestation; occupation of indigenous and quilombola lands; environmental embargoes; land titling conflicts, and cases of slave labor. The growth of soybean farming in Brazil has historically been associated with the conversion of native vegetation, which has driven the emergence of traceability and responsible production initiatives. The Amazon Soy Moratorium, for example, aims to prevent soybean crops in areas deforested after 2008. In the Cerrado, members of ABIOVE and the National Association of Cereal Exporters (ANEC) have committed, through the Authorized Suppression Control mechanism (CSA Cerrado), not to sell or finance soybean crops in areas illegally deforested from August 2020.

2.1.2. The role of the soybean sector in the economy

The soybean production chain has played a crucial role in Brazil's economy. In 2023, the GDP of this segment rose 21% compared to the previous year, totaling R$637 billion. This represented 5.9% of the national GDP (Dias de Sá; Konig; Søndergaard, 2022).

In addition to its significant economic contribution, the soybean sector is an important generator of jobs. In 2023, the population employed in the soybean, and biodiesel chain increased by 10.7%, totaling 2.32 million workers (Epea/ABIOVE). This growth reflects the expansion of croplands, and the strengthening of related activities, cementing the relevance of the soybean sector for Brazil's socioeconomic development.

Graph 2 – Soybean exports



Source: MDIC

2.1.3. Main players

The soybean chain involves a wide network of players with essential roles in the production, marketing, certification, and traceability of soybeans.

Farmers and cooperatives - These are responsible for soybean farming, management, and storage; therefore, they guarantee the supply of soybeans. Brazil has 243,000 soybean farmers, according to the Brazilian Association of Soybean Growers (Aprosoja), and around 1,179 soybean cooperatives, according to the Organization of Brazilian Cooperatives - OCB System.

Independent certifiers and organizations - These promote traceability, such as the Round Table on Responsible Soy (RTRS), ProTerra,1 and the International Sustainability & Carbon Certification (ISCC). They play a leading role in ensuring the socio-environmental compliance of production, to make sure that soybeans meet the criteria required by international markets.

Private soybean processors - These transform soybeans into bran, oil, and biodiesel, while logistics and transport companies channel the production to the domestic and foreign markets. Large trading companies and processors carry out pilot projects to monitor and segregate production, ensuring that exported grains comply with environmental and social requirements. Bunge and Bayer are examples of companies that use internal traceability systems and socio-environmental verification tools. Those include the cross-referencing of satellite image data; the CAR; lists of environmental embargoes; and supplier checks. This procedure ensures supply chain compliance in international trade. The objective is to serve consumers that include the European Union, China, and other international markets and their requirements.

The government - At the federal and the state levels, it plays a fundamental regulatory and supervisory role by setting out standards and guidelines for sustainable production.

The third sector - NGOs and sector coalitions, such as the WWF, The Nature Conservancy (TNC), and Coalizão Brasil Clima, Florestas e Agricultura (The Brazilian Coalition on

1 Traceability at ProTerra refers to the ability to track the origin and the route of certified products, ensuring that they are produced sustainably, and free of genetically modified organisms (GMOs).

Climate, Forests, and Agriculture), collaborate in implementing good practices and reducing the socio-environmental impacts of soybean production.

2.1.4. The existing traceability systems

Traceability in the soybean chain has evolved to meet the global market demands, promoting greater transparency and socio-environmental compliance. Many private initiatives use systems and technologies to track the production, logistics, and distribution of soybeans. These ensure that the products comply with national and international standards.

The traceability models adopted in the soybean chain are classified as:

- **Certification systems** - These are programs such as the RTRS, ProTerra, and ISCC, which ensure sustainable practices and the segregation of certified production.

- **Alternative and transitional models** - Mass balance, which allows partial traceability by mixing sustainable and conventional products in certain proportions.

- **Private traceability and compliance systems** - Soybean traders and processors, such as Cargill, Bunge, and ADM, have developed their own supplier-tracking systems. This ensures socio-environmental compliance through audits, data cross-referencing, and georeferencing.

- **Technological initiatives** - The adoption of tools like GPS Tracking, blockchain, QR Codes, and platforms like Agro Brasil + Sustentável (still under development) has been increasing to enhance traceability.

Soybean traceability is not limited to the origin of the product. It is essential to track logistics, storage, and distribution to ensure compliance with socio-environmental and regulatory criteria based on segregation control. The following items come into play:

- **Electronic documentation** - The Electronic Bill of Lading (CTe) tracks cargo and identifies the origin of products throughout the logistics chain.

- **Integrated storage systems** - Certified soybean stocks must be segregated and monitored by audits and silo control, especially to meet certifications such as the RTRS, and the ISCC.

- **Export transparency** - Large exporters adopt traceability practices to demonstrate compliance with international regulations, such as the European Deforestation-Free Regulation (EUDR2).

Government digital platforms, such as Agro Brasil + Sustentável, are designed to play a strategic role in traceability and control over production segregation and tracking, promoting greater transparency, integrity, and traceability throughout the supply chain.

Agro Brasil + Sustentável is designed to offer producers, exporters, and processors the guarantee of compliance with national and international regulations. It meets the growing demand for sustainable products in international markets.

Despite all the advances made by the private sector and the government in implementing and building control systems and processes, some challenges are yet to be overcome, including the standardization of systems and their implementation costs, as well as adaptation to new regulatory requirements.

2.2. Overview of the beef sector

Brazil has the world's largest cattle livestock size and is the largest global exporter of beef (Armelin et al., 2023). A census conducted in 2023 by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística - IBGE) found 238.6 million cattle heads in the country, of which 17.8% were bred in the Amazon biome and 44% in the Cerrado.

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2 The European Union Regulation on Deforestation-Free Products (EUDR) or the European Union's (EU) Anti-Deforestation Regulation is an EU regulation created in 2023 to establish requirements for products, including soy, to be considered deforestation-free, and produced according to the producing country's laws. It came into force in June 2023 and will be fully enforced in October 2025. The effective date for the requirement to comply with the legislation, for most operators and traders, is December 30, 2025. It requires operators to provide verifiable production information, including geolocation data of the areas of origin. Compliance with environmental, human rights, labor, tax, and anti-corruption laws in the producing country must be demonstrated. The regulation requires due diligence to ensure the legality and sustainability of production, imposing strict traceability, and continuous tracking requirements.

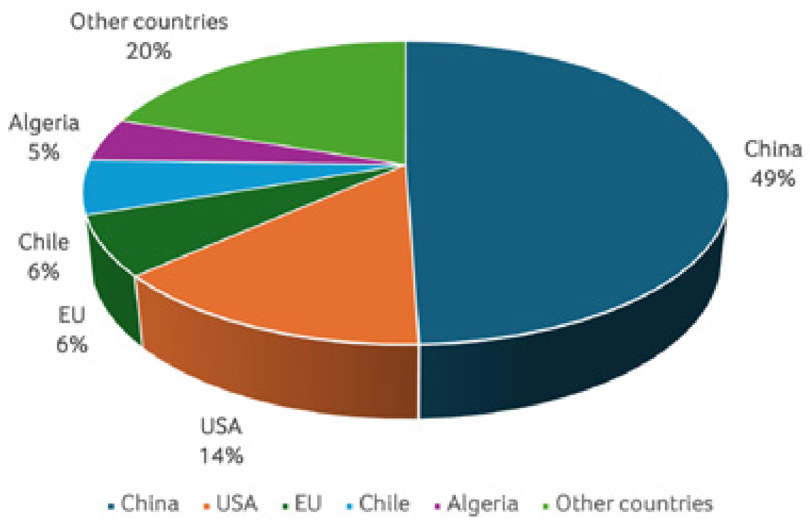
Beef cattle farming had a significant impact on the Brazilian economy, with an approximate production of 10.9 million tons in 2024, according to estimates based on the slaughter record of 39.27 million cattle heads (IBGE, 2025). Although the domestic market consumes the majority, exports driven by demand from countries that include China, the United States, the United Arab Emirates, and the European Union, continue to expand, totaling 2.89 million tons and US$ 12.8 billion in 2024 (Exame, 2025), with new markets such as Malaysia, Vietnam, and the Philippines contributing to this growth.

From a socio-environmental perspective, livestock farming has been considered the main activity associated with deforestation in Brazil, especially in the Amazon. It is considered a high-risk commodity by some international markets. Although bovine traceability is already well-established for health purposes, it needs to expand its scope to include socio-environmental aspects, becoming a key piece to secure access to demanding markets and add more value to Brazilian beef.

2.2.1. Production and exports

In 2024, Brazilian beef production was estimated at 11.38 million tons of carcass weight equivalent (CWE). Production rose 2% over the previous year. Exports hit the record of 3.57 million tons of CWE, which makes Brazil the largest global exporter of beef.

Graph 3 – % exported by amount (US$) 2024

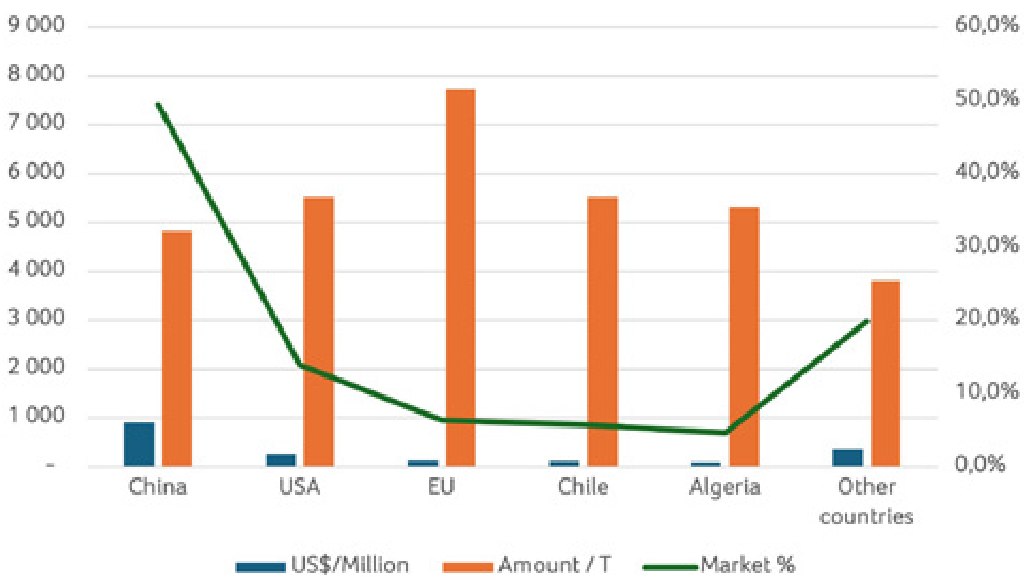


Source: ABIEC, 2025

Between January and September 2024, 1.8 million tons were exported. China was a major export destination (50% of the total). The United States, Chile, and the European Union accounted for revenues of US$8.5 billion (as of September), and new markets, such as Canada and the Philippines, were opened.

In the first two months of 2025, beef exports totaled 456,146 tons, a slight decline of 2% compared to the same period in 2024. However, revenues totaled US$2.066 billion, representing an increase of 12%. In January 2025, Brazil exported 209,192 tons of beef, generating a turnover of US$1.002 billion, the best result ever reported for the month.

Graph 4 – Graph 4 - Cross-referencing of information related to volume, price, tons, and market share for 2024



Source: ABIEC, 2025

Importantly, despite some domestic sectors' unwillingness to meet the requirements imposed by the EUDR, data presented by ABIEC regarding the 15 leading export markets reveal the clear importance of the European bloc. The European bloc absorbs 3 to 4% of beef exports and is the buyer that pays the best for the Brazilian beef, which is around 73.02% more than the average price paid by the 14 main markets. It pays up to 150% more than Egypt, currently the 10th largest market in terms of volume.

In addition to the better prices, the European Union and its traceability requirements are now a benchmark for Brazilian beef. Socio-environmental compliance via EUDR sets a strong market trend that is already having an impact on China, Canada, and other buyers of Brazilian beef.

2.2.2. The role of the beef sector in the economy

Cattle farming is a significant branch of agribusiness. It is a strategic sector for Brazil and, over the last decade, it has contributed on average 30.2% of the agribusiness GDP and 7% of the national GDP. (CNA, CEPEA, CFNews)

The economic contribution of exports related to cattle slaughter includes beef, leather, and by-products. The following data are based on sources from ABIEC, MAPA, CICB, Secex, and projections adjusted for 2024.

- 2.89 million tons of beef (fresh and processed beef), a 26% rise compared to 2023;

- US$12.8 billion in revenues, which is 22% higher than in 2023;

- Fresh beef represented more than 90% of this amount, with the main markets being China (1.330 million tons), the USA (147,000 tons), the United Arab Emirates (132,000 tons), and the European Union (82,300 tons);

- Tanneries received 40.08 million whole pieces of raw bovine leather in 2024 (IBGE), a 16.8% rise over 2023 levels;

- 45% of leather is exported. About 18 million pieces were exported as finished or semi-finished leather.

- Leather exports generated approximately US$450 million.

- By-products such as tallow, bones, viscera, and meals (used in feed, cosmetics, and fertilizers) do not have an exact volume reported for 2024 but account for around 10 to 15% of the carcass weight.

- By-products generate approximately US$960 million.

Adding up beef **US$12.8 billion**, leather **US$450 million** (estimate), and by-products **US$960 million** (average estimate), we can conclude that the beef chain generates an estimated annual amount of **US$14.21 billion**.

2.2.3. Main players

The beef chain involves different players responsible for producing, processing, tracking, and marketing beef both domestically and internationally. The main players include:

Farmers - Responsible for livestock breeding and fattening;

Meatpacking plants - These carry out livestock slaughter and process the meat;

Transport and logistics companies - Distribute the production, while traders, retailers, and exporters channel the products to the consumers, serving strategic markets;

The government - Brazil's Ministry of Agriculture and Livestock (MAPA) plays a vital role in the regulation, health control, and certification of Brazilian beef. It is responsible for SISBOV.

The third sector - NGOs and sectoral coalitions, such as WWF; The Nature Conservancy (TNC); Coalizão Brasil Clima, Florestas e Agricultura; and Mesa Brasileira da Pecuária Sustentável (MBPS) collaborate in the implementation of individual cattle traceability and in reducing the socio-environmental impacts of livestock production.

2.2.4. The existing traceability systems

Cattle traceability in Brazil is based on permanent markings, such as fire branding and tattooing, and the use of GTAs to track livestock. Individual electronic identification using Radio Frequency Identification (RFID) ear tags is now mostly used, as it provides more accurate tracking.

Implemented through a combination of official systems, and specific traceability protocols, its main initiatives are:

- **Brazilian System for the Identification and Certification of Cattle and Buffaloes (SISBOV)** - It has been in operation since 2002. It is Brazil's official individual traceability system for export to countries that require individual traceability, such as the European Union. Joining the system is voluntary. It establishes the individual identification of livestock through electronic devices and/or ear tags. Since its creation, this voluntary system has been used to handle exports to the European Union.

- **Agro Brasil + Sustentável** (under construction) - A platform coordinated by the Secretariat of Development and Innovation (SDI) of MAPA in collaboration with the Federal Data Processing Service (SERPRO). It aims to facilitate traceability by offering transparency and compliance with international regulations, such as the EUDR. It is based on the premise of organizing, standardizing, and facilitating access to public databases, including the Rural Environmental Database (CAR), and embargoes put by the Federal Prosecution Office (MPF) and the Ministry of Labor and Employment (MTE).

- **Agricultural Management Platform (PGA)** - A system set up by MAPA to collect livestock transport and traceability data to track livestock. The PGA system currently generates unified codes for the State Agricultural Health Agencies (OESAS) to register properties, farmers, and exploration units.

- **National Plan for Cattle Identification (PNIB)** - A plan launched by MAPA in December 2025. It aims to implement mandatory traceability in Brazil progressively over the next eight years. It is divided into three stages: two years to build a single platform and integrate it with the states' health databases. Six years to implement the rules until they are made mandatory. PNIB made significant progress in the process of implementing mandatory individual traceability. The plan was based on the production chain proposals taken to SDA/MAPA. It is based on consensus among the main entities in the sector, including CNA, ABIEC, ABRAFRIGO, ABPA, ABCAR, MBPS, and others. It is still too early to determine the impact of its implementation. In February 2025, the list of entities that participated in the plan's management and monitoring committee was published. On March 20th, the first MAPA meeting was held to define the format of the subsequent meetings; how the management platform will be developed; and which will be the entity responsible for financing its development.

- **Amazon Cattle Supplier Monitoring Protocol (PMFGA - Boi na Linha) and the Cerrado Protocol** - These initiatives are designed to assess the environmental and social compliance of cattle farms. These initiatives aim to ensure the supply of beef produced in areas free of illegal deforestation, and with no slave labor.

- **Selo Verde Brasil** (Brazil's Green Seal Program) - Established by Decree No. 12063 of June 2024. It is a mechanism of the Ministry of Development, Industry, Commerce, and Services (MDIC) that certifies properties and meatpacking plants that meet strict traceability and sustainability criteria. This certification program sets out sustainability criteria for agricultural products and uses independent audits to ensure compliance with the requirements.

- **Traceability and Transparency Task Force** - Multisectoral initiative coordinated by Coalizão Brasil Clima, Florestas e Agricultura with the participation of Proforest, ABIEC, ABIOVE, MBPS, and other companies and entities that are dedicated to improving livestock tracking systems in Brazil.

- **Private traceability programs** - Meatpacking plants such as JBS, Marfrig, and Minerva adopt their own supplier tracking systems. They cross-reference CAR data, satellite images, and lists of environmental embargoes;

- **Specific private protocols** - Some certification authorities have already launched their own protocols. This is the case of the Individual Traceability and Indirect Monitoring Program (Primi) focusing on tannery compliance.

These initiatives, combined with the efforts of certifiers and meatpacking plants, are designed to find alternatives to ensure that sustainability, and environmental compliance criteria are met. These are required by consumers and international regulators.

Despite these efforts, some recent surveys carried out by ABCAR - based on properties already certified for export to the European Union - have found that only 10% of cattle exports have information on livestock birth (livestock identified up to weaning or 10 months of age). Traceability is what makes it possible to establish production compliance throughout livestock life. This shows that the beef and tannery sectors do not have, and are unable to make, effective commitments to eliminate deforestation from their supply chains. This highlights the need for more forceful actions to face the challenges of implementing full traceability in the sector.

There are successful examples of beef traceability that serve as a reference for the sector:

- **Traceable beef exports to the European Union** - Farmers that utilize the SISBOV system, and strictly comply with the EU beef export protocol rules.

- **State programs** - Initiatives such as the Mato Grosso Land Monitor, the Consent Decree (*Termo de Ajustamento de Conduta* - TAC) in Pará, and the Green Seal Program in Minas Gerais, lead to the identification of socio-environmental risks and improve livestock traceability. The state of Santa Catarina was a pioneer and, for 9 years, it has ensured full traceability of its cattle livestock.

These initiatives demonstrate that the combination of technology, public policies, and farmer engagement can overcome the limitations of implementing traceability. Private initiatives and pilot projects have expanded tracking possibilities.

The traceability systems used in Brazil today, such as SISBOV (since 2001), Agro Brasil + Sustentável (under construction) and PNIB (MAPA project for mandatory traceability across the Brazilian territory by 2032), present different levels of maturity and scope. Despite the advances, the challenges are significant. Obstacles to full implementation: small farmers' resistance to the adoption of individual traceability; lack of standardization across states; and need for greater integration of digital platforms.

2.2.4.1. The importance of tracking indirect suppliers

Monitoring in livestock farming is one of the keys to ensuring deforestation-free value chains. Not only for direct suppliers (farms that sell directly to meatpacking plants) but also for indirect suppliers (farms through which livestock has passed in previous stages). A significant challenge in this industry is the lack of a clear definition of what constitutes an indirect supplier. There are no parameters to determine how many indirect suppliers supply to one direct supplier. This can be seen mainly in risk analyses based on the control of livestock handled in batches.

Meatpacking plants currently face difficulties in accessing data from indirect suppliers, such as CAR, and GTA.[3] A recent survey conducted by ABCAR has found that, on average, one property certified by SISBOV has 5 to 25 indirect suppliers/year. A study by Imaflora has found 1 to 5 indirect suppliers/year. These data suggest the requirement for traceability and individual livestock tracking. This is a way to ensure segregation

3 Including production area information (as in CAR) in the GTA document is viewed as an alternative solution to individual traceability, in order to provide information about the production territory. As in Brazil all cattle transport operations are tracked in batches through GTA, CAR information can be used to establish the supply risk based on the analysis of the territory of origin of the transported animals.

between compliant and non-compliant livestock according to the market requirements, regardless of their level within the supply chain.

2.3. Challenges associated with deforestation

Deforestation represents a central challenge that involves economic, environmental, social, and governance issues in both the beef and soy chains. Added to these factors is the growing pressure from the global markets. Consumers are becoming increasingly more conscious and demand increasingly more efficient and comprehensive traceability and tracking systems. They want mechanisms capable of guaranteeing deforestation-free production across the production chains. It is of paramount importance to combine the efforts of the government, the private sector, and society to overcome these challenges and promote sustainable agricultural production in Brazil (Dias de Sá; Konig; Søndergaard, 2022).

Accordingly, traceability has become an essential tool. It guarantees sustainable production and product tracking and ensures that the products come from deforestation-free properties and comply with the country's socio-environmental regulations.

2.3.1. In the soybean production chain

The expansion of soybean farming in Brazil continues to be one of the main causes of deforestation despite advances in the implementation of initiatives such as the Amazon Soy Moratorium. This initiative managed to dissociate significantly the development of soy farming from deforestation. However, the Cerrado still faces high rates of removal of native vegetation due to agricultural expansion. Pressure for deforestation-free value chains and traceability systems has been mounting and is now driven by international regulations such as the EUDR. This requires proof of no deforestation after 2020 and precise geolocation data.

Implementing an effective system is challenging. These challenges include the limitations of current tools, such as CAR and SIGEF, which do not guarantee full compliance with international standards. This is because the CAR database has low levels of validation.

SIGEF's greatest difficulty is the integration with other systems. Additionally, it is difficult to determine and track all suppliers, and thus collect logistics data from the production chain.

Another major hurdle in the pursuit of sustainable supply chains is balancing the economic costs of reducing legal deforestation in a way that rewards farmers and avoids the division of markets between “clean” and “dirty.” This complexity lies in the fact that Brazilian legislation allows deforestation within certain legal limits (legal reserves, for example) as long as the appropriate authorizations are sought. However, regulations such as the EUDR do not differentiate between legal and illegal deforestation if it occurred after December 31, 2020. Both are treated as non-compliant by the EU. For the farmers to meet this international requirement of “zero deforestation” post-2020, they need to give up the economic use of areas where deforestation would be legal. This entails costs (compliance opportunity costs) that require compensation and economic incentives.

Mechanisms such as Payment for Environmental Services (PES) are essential, although the lack of clear incentives is still an obstacle. Without this effective compensation to cover conservation costs in legally deforestable areas (post-2020), the farmers may have their products rejected by markets that follow the EUDR. This creates a risk of fragmentation, where “dirty” non-compliant products are diverted to other destinations, potentially impacting Brazil’s competitiveness.

2.3.2. In the beef production chain

Livestock farming is the driving force of deforestation and conversion of natural habitats in Brazil, especially in agricultural borders such as the Amazon. One of the biggest challenges is tracking indirect suppliers, which are mostly uncovered by meatpacking plant tracking systems. Practices such as "triangulation" or "cattle laundering" allow livestock from deforested areas to enter the production chain through "clean" farms. Thus, expanding tracking efforts to include indirect suppliers is a critical hurdle.

Proving zero deforestation throughout the production chain is essential to maintaining access to international markets, as required by the EUDR. Regular land titling and robust traceability systems still represent considerable challenges. The National Plan to

Combat Deforestation in the Amazon (PPCDAm) recognizes that the lack of a national traceability system benefits the drivers of deforestation. This confirms the necessity of integrating socio-environmental requirements with health traceability on all properties involved in meat production.

3. Detailed analysis of traceability systems

The traceability of soy and beef in Brazil presents levels of implementation and maturity that vary according to the country's regulatory requirements. There is no clear solution to segregating the production chain of soybean farming, especially in the short term, even with private and sectoral initiatives aimed at tracking the origin of production. Beef cattle farming faces challenges to ensure the full traceability of livestock along the production chain. Before being sent for slaughter, livestock passes, on average, through three properties in the processes of breeding, rearing, and fattening. With no confirmation of a sustainable status at all stages of production, it is practically impossible to meet market requirements in the short and medium terms.

3.1. Traceability across the soybean chain

In soybean farming, traceability systems use CAR as a critical tool to track the origin of production. Private and sectoral initiatives have adopted technologies such as CTe, QR Codes, and blockchain to ensure greater transparency and control. This allows tracking production from the farms to shipment at ports and ensures that sustainably produced items are segregated.

One of the proposals to improve soybean tracking involves including the CAR information in the tax receipt and informing the IE number of each farm. The objective is to strengthen the connection between production and sales data. Agro Brasil + Sustentável emerges as a strategic instrument to consolidate information on sustainability, and legal compliance in soybean production.

There is no mandatory regulation that guarantees the full traceability of Brazilian soybean production for all international markets. There is an urgent need to establish a standard for the traceability of soy within its internal production chains. The implementation of a traceability standard would help the properties to demonstrate the necessary compliance and enable production segregation in transportation and storage.

3.2. Traceability across the beef supply chain

In beef production, mandatory traceability focuses on the collective identification of livestock for health purposes by using documents that include the GTA, which reports livestock transport. SISBOV allows for the individual identification of livestock, but it is voluntary. It is only mandatory for exports to specific markets, such as the European Union.

In December 2024, the Ministry of Agriculture and Livestock launched the National Cattle and Buffaloes Individual Identification Plan (PNIB), which aims to implement mandatory individual traceability in Brazil. This Plan is designed to be implemented progressively over the next eight years. By the end of this period, it will be mandatory to identify cattle with an official MAPA number, with the prefix 076 (ISO Brazil standard). The PNIB determines:

1. Mandatory use of the official number 076 to identify cattle;

2. Creation of a MAPA database integrated with the 27 Brazilian states;

3. Start of plan implementation in 2025. States are authorized to impose more restrictive rules and/or speed up the process within their own systems;

4. The standard of use of identifiers (format and color), and the option to identify with one or two elements. However, when choosing an element, it must be electronic;

5. Numbering acquisition/generation directly via MAPA, and the setup of distribution centers throughout the country to issue identifiers. These centers can be state sanitary surveillance agencies, private companies, and states;

6. In 2025 and 2026, the system will be rolled out in MAPA, and the databases of the 27 Brazilian states will be integrated;

7. From 2027 to 2029, the following will be made mandatory: identifying females; conducting health control, and livestock control in general, both included in private protocols;

8. Between 2030 and 2032, it will be mandatory to identify livestock before their first transport.

The mounting pressure for deforestation-free production chains determines progress towards the implementation of individual traceability, and livestock tracking. Meatpacking plants that export beef have been implementing their own tracking systems. They cross-reference CAR data, satellite images, and environmental embargo lists to demonstrate compliance with socio-environmental standards. However, the difficulty in establishing the monitoring and control of indirect suppliers4 (suppliers' suppliers at the most diverse levels) limits traceability and monitoring to around six months of livestock life.

3.3. Common hurdles to the implementation across the chains

The adoption of comprehensive, and interoperable traceability systems in Brazil faces several structural, technological, and regulatory challenges. The lack of standardization across the systems, their limitations, and farmers' resistance make it difficult to implement an efficient widely accepted model. The main challenges include:

- **A unified national system** - The lack of a single traceability standard in the states, and centralized governance generates fragmentation and makes it difficult to supervise and ensure the transparency of the production chain. Different databases and methodologies are used. This undermines the reliability of information and complicates the process of complying with international regulations.

- **Low levels of adoption of traceability and transparency programs** - Due to costs, bureaucracy, and the practically specific purpose of export. The rates of adoption of traceability programs such as SISBOV and the Soy Moratorium are still low. Regarding SISBOV, it currently has only around 1,400 certified properties that are eligible under the protocol to export to countries that require individual traceability of cattle. The Soy Moratorium is restricted to the territory of the Legal Amazon;

- **Integration of systems and databases** - Traceability requires a continuous flow of information between farmers, state governments, the federal government, and the private sector. However, it is quite difficult to integrate the databases of different authorities, such as MMA, and MAPA. This overlapping of systems and the lack of

4 No study establishes an average number of indirect suppliers per property sending livestock out for slaughter. The Boi na Linha and Cerrado monitoring protocols indicate one to five indirect suppliers per direct property. In contrast, ABCAR's survey of properties certified under the Europa protocol has found up to 25 suppliers.

interoperability across platforms present challenges to obtaining a full picture of the production chain.

- **High costs and poor infrastructure** - Implementing robust traceability systems requires investments in technology, capacity-building, and adaptation of production chains. The cost of traceability with segregation is one of the biggest challenges, especially for small, and medium farmers. Additionally, poor digital infrastructure in rural areas limits the adoption of advanced technologies.

- **Traceability of indirect suppliers** - One of the main bottlenecks is the monitoring of indirect suppliers, that is, the triangulation of production. Many of these producers are in areas with no environmental regulation, which increases the risk of connections with illegal deforestation.

- **CAR validation** - The CAR is an essential tool for traceability, but its validation is still insufficient. Without a full check of records, embargoed areas, or areas with environmental liabilities, may not be accurately identified. The analysis may also be challenged due to the lack of validation of territorial information.

- **Standardized socio-environmental monitoring** - Poorly organized public databases, combined with different analysis standards established by private companies, demonstrate weaknesses in the monitoring process.

- **Farmers' resistance** - Many farmers view traceability as a potentially exclusionary bureaucratic requirement. They fear that stricter environmental and social criteria will limit their access to the market.

- **Incentive mechanisms** - These can provide the necessary encouragement for producers to adopt traceability and sustainable production practices.

- **Regulatory gaps and legal insecurity** - Brazilian legislation still has regulatory gaps that hinder effective traceability. Imprecise definitions of legal versus illegal deforestation; inconsistent requirements across international markets; and the lack of a robust regulatory framework increase the complexity of the scenario. Also, the legal security of traceability systems and the protection of farmers' data need to be strengthened to ensure broad and reliable adoption.

- **Clear definition of deforestation** - To comply with regulations such as the EUDR, it is essential to establish a clear definition of "compliance-relevant deforestation." Ambiguities in this concept can generate disagreeing interpretations, and complicate the application of standards, both for farmers and international buyers.

Despite these limitations, traceability is advancing in Brazil, driven by private initiatives, new regulations, and the growing international demand for transparency and sustainability in agricultural production.

Table 1 – Similarity of traceability systems

Criterion	Soy	Beef
Traceability Model	Based on batches and records of production declared by farmers	Based on individual identification (SISBOV) or transport of livestock batches (GTA).
Checkpoints	Monitoring connected to the origin of production and voluntary certifications	Health and transport control via GTA, with challenges in data integration
Full traceability	More advanced in exports to demanding markets (e.g.: 100% segregated certified soy)	Limited, especially for indirect suppliers in the production chain
Sectoral regulations and agreements	Soy Moratorium as a benchmark for restricting deforestation in the Amazon	Beef TAC and state protocols, but without a unified national commitment
Challenges for EUDR compliance	Lack of national integration of state, and federal databases	Difficulty to achieve full traceability, especially of calves, and indirect suppliers.

The improvement of government platforms, such as Agro Brasil + Sustentável, and PNIB, combined with the adoption of emerging technologies, and incentives to attract the farmers, will be the key to establishing a robust system for tracking agricultural products in Brazil.

Table 2 – Analysis of strengths and bottlenecks in soybean supply chain traceability

Soybean supply chain traceability	
Strengths	**Bottlenecks**
• Well-established certifications, and voluntary adoption, such as the Soy Moratorium • Production tracking through CAR, making it easier to control the origin of soybean	• Lack of mandatory full traceability for the whole national production • Difficulty integrating state databases, and setting consistent requirements

Table 3 – Analysis of strengths and bottlenecks in beef supply chain traceability

Beef supply chain traceability	
Strengths	**Bottlenecks**
• Well-established health control systems (SISBOV, GTA, PGA) • Ability to identify livestock batches along the production chain	• Difficulty tracking calves, and indirect suppliers, which undermines full transparency • Lack of a mandatory national system for individual traceability of cattle outside SISBOV

Overcoming these major hurdles is the only way to ensure an effective, and globally accepted model. It is necessary to align systems and databases; reduce implementation costs; increase data integration across the states; and offer real incentives for producer buy-in. Measures like these are the possible way to ensure more sustainable, and competitive production chains aligned with the new demands of international trade.

3.4. Ability to comply with international regulations

The EUDR sets strict criteria on the import of commodities like soybeans and beef. It requires that the products have not been produced in areas deforested after December 31, 2020, and that production complies with the legislation of the country of origin.

To comply with these requirements, operators must provide detailed information about the origin of the products. This includes the exact geolocation of each production polygon. It is also necessary to prove zero deforestation, the properties' land rights, compliance with tax requirements, and compliance with anti-corruption regulations.

Table 4 – Comparison between international certifications and Brabzilian systems

Criterion	Brazilian systems	International certifications
Coverage	National coverage focusing on legal compliance	Global coverage, serving different markets and consumer profiles
Level of traceability	Variable - Full traceability is not yet mandatory for the whole chain	Detailed traceability is required from the origin to the final destination
Environmental requirements	Connected to the Forest Code and the CAR	Stricter criteria for zero deforestation and carbon emissions
Supplier monitoring	Challenges tracking indirect suppliers	Require full control of direct and indirect suppliers
International Credibility	It depends on compliance with foreign regulations, such as the EUDR	Recognized globally by importers and consumers

3.4.1. EUDR compliance challenges

The traceability systems currently used and/or under construction represent important achievements. However, significant challenges are yet to be overcome regarding the provision of a full guarantee in line with the EUDR requirements, particularly in the following aspects:

- **Collecting georeferenced information** - The regulation requires the exact geolocation of production areas. This requires efficient collection, validation, and integration of spatial data. Traceability in Brazil currently depends on the CAR. Although the CAR is mandatory, it still has low levels of validation in many states. The integration of public and private databases (e.g.: CAR, SIGEF, SNCR, and satellite tools) still needs to be improved to allow reliable tracking.

- **Tracking indirect suppliers** - The EUDR requires the entire supply chain to be traceable, including indirect suppliers. Traceability is often lost in the early stages of livestock breeding and fattening. The lack of a system to track the transport of calves before confinement or fattening makes it difficult to prove environmental compliance throughout the production chain.

- **Guarantee of segregation** - Tracking the logistics and storage stages along the production chain is currently an unsolved problem. The ways to control and verify segregation are not standardized. It is not possible to provide the necessary guarantees to make sure that the product has not been contaminated (has been mixed with products without the same compliance status).

- **Proof of legal compliance** - In addition to traceability, the EUDR requires that the products comply with all applicable national laws, including tax, labor, and environmental regulations.5 In Brazil, there is no unified system holding all this data together in an accessible and standardized way, which makes it difficult to verify compliance in exports.

3.4.2. Eu undefinition of proof of compliance

The EUDR sets out detailed requirements for traceability and socio-environmental compliance. However, it is still unclear how exporters and importers (traders) will prove compliance. The main undefined points are:

- **Criteria for validating georeferenced data** - It is not clear which platforms and methodologies will be officially accepted to prove the origin of products. This creates insecurity for Brazilian operators, who need to anticipate which systems will be recognized by the EU.

- **Due diligence standard for importers** - The European Union has not yet defined which audits and verification mechanisms will be mandatory for importers. This gray area may impact the methods to be adopted by Brazilian exporters.

- **Validation of certificates and private traceability systems** - Companies and certification bodies should adapt their systems to comply with the EUDR. However, there is no confirmation of which certifications will be accepted as proof of compliance.

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5 One of the main conflicts of interpretation lies in the difference in coverage between the EUDR (risk assessment for all Indigenous Lands, including those that are not approved) and the focus or capacity of the current compliance and legal definition mechanisms in Brazil. These tend to focus on approved areas or face challenges regarding the clarity and validation of boundaries and land rights for these populations. The lack of a clear definition by the EU on how to deal with unapproved Indigenous Lands, combined with Brazil's legal and land governance complexities, makes room for uncertainty and potential conflict in the practice of due diligence.

- **Definition of sanctions and corrective measures** - The EU needs to clarify how the products will be inspected and which penalties will be applied to those who fail to meet the EUDR requirements.

These gray areas make it difficult to plan and adapt Brazil's production chains. The production chains need to take a proactive instance and address the requirements that do not yet present a clear guideline regarding which methodologies will be valid and which data will be accepted for the declaration of compliance with the EUDR.

3.4.3. Solutions and pathways to comply with the EUDR

The Agro Brasil + Sustentável Platform has the potential to become a key player in Brazil's adaptation to the EUDR, as it amasses information on agricultural production, environmental compliance, and legal compliance. However, its success will depend on:

- Greater integration of public and private databases, including CAR, GTA, SISBOV, PGA, PNIB (in the early stages), and the states' livestock and agricultural health database.

- Improving the validation and cross-referencing of geospatial information to ensure greater data accuracy, and setting a standard to present the analyses.

- Increasing the acceptance and adoption of the Agro Brasil + Sustentável Platform by producers and exporters. Farmers' registration in the platform is not mandatory. The only way to make this platform an effective reference for international compliance is by making it widely adopted by the farmers.

Another solution to comply with the EUDR is traceability by segregation. This isolates soy and beef coming from chains that comply with international requirements. Although this model entails higher costs, it is a viable alternative to be implemented, as it represents a safe way to offer export guarantees. It ensures that the products fully meet the European regulation's criteria, provided that a database is maintained for due diligence to be carried out as set out in the regulation.

In this scenario, the sectors involved in the production and export of soy and beef must invest in integrating the database, strengthening individual traceability, and seeking technological solutions that are able to meet the European regulation's criteria. This needs to happen before the EUDR is definitively in effect and new government systems such as Agro Brasil and PNIB are fully implemented, considering that proactive adaptation will be key to maintaining Brazil's global competitiveness and avoiding trade restrictions in the future.

3.4.4. Other regulations

In addition to the EUDR, other importing countries are implementing their regulations to ensure the traceability and sustainability of agricultural products. The growing demand for transparency in the origin of commodities is not limited to the European Union and is already influencing strategic markets such as China, Canada, and the United States.

China, the largest importer of Brazilian soy and beef, has made progress in the implementation of requirements related to traceability and sustainability. In 2024, the Dalian Commodity Exchange (DCE) kicked off studies to incorporate traceability criteria into its trading operations, which could directly impact Brazilian exports in the future. In addition to that, Chinese importers have been showing greater interest in certified products, such as those that meet the ISCC certification and the RTRS standard.

Canada has also followed this trend, with stricter regulations on sustainable land use and traceability of production chains. Canada is discussing a full traceability model for agricultural imports which is similar to the EUDR.

In the United States, traceability is driven by environmental regulations and, primarily, by private sector requirements. Major retail chains and food processors, such as Walmart and Cargill, are already imposing internal traceability requirements. Therefore, they prioritize suppliers that demonstrate commitment to sustainable practices.

Brazil's ability to comply simultaneously with different international regulations will be decisive in maintaining Brazilian agribusiness competitive on the global stage. More than a regulatory challenge, adding robustness and flexibility to the traceability systems may become a strategic advantage. This makes the country a reliable supplier of sustainable commodities. Companies that invest proactively in full traceability will be better prepared to win markets that demand socio-environmental transparency and compliance.

4. Public policies and government platforms

Brazil has a solid legal framework that can help to strengthen the traceability of soy and beef in order to promote greater transparency, socio-environmental compliance, and alignment with international regulations, including the EUDR, the Paris Agreement, and Nationally Determined Contributions (NDCs). The Brazilian government, through government departments, such as MAPA, MMA, and state and federal agencies, has taken action to improve tracking and inspection systems.

The main regulatory instruments and public policies that play a central role in this process are the following:

- **Legal basis and regulatory instruments**

The legal basis for agricultural traceability in Brazil includes the Forest Code (Law No. 12651/2012) and CAR. These are critical to monitor the environmental compliance of properties.

Initiatives such as the Amazon Soy Moratorium demonstrate the positive impact of voluntary agreements to reduce deforestation associated with agricultural production. The Consent Decrees (TACs) of beef have driven the adoption of stricter tracking systems by meatpacking plants.

- **Policies and programs to incentivize traceability**

The National Policy on Payment for Environmental Services (Law No. 14119/2021) and the National Plan for Monitoring Plant-Based Products (PNMonitor - SDA Ordinance No. 571/2022) are initiatives designed to promote environmental conservation and production compliance in Brazil. The former provides financial incentives to farmers that adopt sustainable practices. Traceability can be used as a criterion for granting benefits.

The latter monitors plant-based products, such as soybeans. It strengthens tracking and certification processes to meet international requirements.

Additionally, regulations such as the Anvisa-MAPA Regulatory Instruction No. 02/2018 and Regulatory Instruction MAPA No. 39/2017 set guidelines for the traceability and inspection of plant-based and animal products. It lays the foundations for expanding these procedures to soy and beef. Law No. 12097/2009 and Decree No. 7623/2011 underscore the importance of individual identification of livestock in the meat production chain.

- **Integration with international commitments**

Brazil should bring its traceability programs into compliance not only with national regulations, but also with global agreements, as mentioned above, that require the reduction of emissions, and the fight against deforestation. There are robust regulations and public policies capable of supporting effective traceability systems in the soy and beef supply chains. However, multiple actions taken by different public agencies generate legal insecurity and make it difficult to define clear and integrated procedures for the implementation of these systems. There are overlapping regulations, and difficulty determining the competent authority to take charge.

It is of paramount importance to consolidate and simplify this legal framework. Without the organization and publication of more straightforward and consistent regulations, traceability tends to face obstacles that compromise the effectiveness of programs coordinated by the government.

In this context, the publication of regulations related to the Agro Brasil + Sustentável platform represents progress. The Agro Brasil + Sustentável initiative supports the establishment of CAR and strengthens policies such as the Beef Consent Decree and the Soy Moratorium. It offers a promising pathway to surmount legal obstacles and increase legal certainty.

In addition to this, MAPA, MMA, and state agencies must invest in digital traceability platforms, and enhance regulation and inspection efforts. By improving these tools, Brazil cements its status as a global reference in sustainable agribusiness, ensures access to demanding markets, and avoids trade barriers, thus adding value to its production chain.

Regardless of the existence of a relevant legal and regulatory framework, there are gaps that need to be filled to ensure the broad and effective implementation of traceability. To remain competitive in the global market, it will be essential to strengthen public policies, overcome technical and economic barriers, and ensure more efficient governance over agricultural production. The following actions are the top priorities:

- Making traceability mandatory
- Integrating and standardizing data
- Establishing centralized governance
- Promoting economic incentives for traceability
- Ensuring legal security by setting out clear regulations and normative definitions
- Implementing verification and monitoring mechanisms

4.1. Major barriers to traceability

For Brazil to be able to implement efficient and competitive traceability on the global stage, it must strengthen public policies, unify the system's governance, and launch solid farming incentives. The EUDR's coming into effect in 2026, and the heightened traceability requirements from markets including China and Canada underscore the pressing need to modernize Brazil's systems. These systems must overcome the following barriers:

- **Technical barriers** - These make it difficult to track suppliers: low information technology resources, and difficulties in adopting tracking technologies. Lack of interoperability between public and private traceability systems.

- **Economic barriers** - High cost of traceability. Lack of financial incentives to encourage voluntary adoption. Inequality in access to technological infrastructure and connectivity in the countryside.

- **Institutional barriers** - Fragmented governance. The lack of a unified national system leads to inconsistent or poorly detailed regulations. This complicates the adaptation of production chains, increases bureaucracy, and causes delays in the validation of environmental and land registrations. The lack of MAPA and MMA integration is clear.

4.2. Expectations and scenarios for the implementation of the EUDR (2026)

The EUDR has a regulatory framework that will require exporters around the world to prove the full traceability of their agricultural products. However, there are uncertainties about how Brazil will adjust to these requirements.

Optimistic scenario

Advancing in the integration of public and private databases. Developing Agro Brasil + Sustentável and PNIB. Offering financial incentives to producers that implement traceability. Improving national regulations.

Realistic scenario

Gradually implementing traceability. As required by importers, sectoral adaptations are spearheaded by leading meatpacking plants and grain processors intending to take a central role in checking the socio-environmental compliance of their suppliers. Helping small farmers to overcome adaptation difficulties, which may generate risks of market exclusion.

Pessimistic scenario

Lack of structuring actions. Regulatory and inspection gaps remain, making compliance difficult and generating the risk of trade restrictions and sanctions on Brazilian products. This would have an impact on exports. It would generate a loss of global competitiveness due to the inability to meet requirements.

4.3. Agro Brasil + Sustentável Platform - Status

The official launch of this digital tool aims to qualify Brazilian agricultural production and promote sustainability, traceability, and certification. The platform is voluntary, universal, and free of charge for producers. It consolidates information from multiple government databases to facilitate access to farming loans and connect Brazil to demanding markets.

Its structure consists of three main modules: compliance, good practices, and traceability. The objective is to cross-check information from different public databases regarding the socio-environmental status of rural properties to attest to production compliance based on data declared by the farmers.

Established by MAPA Ordinance no. 745, of December 20, 2024, it aims to qualify national agricultural production. To date, the following normative acts have been established to operationalize the platform:

- **MAPA Ordinance No. 745/2024** - It establishes the legal basis for the platform operation, outlining its purposes and guidelines for complementary regulations.

- **SDI/MAPA Ordinance No. 721/2025** - Imperative to operationalize the platform, it allows the tool to be used by the production sector, and to be recognized by the purchasing markets.

- **SDI/MAPA Ordinance No. 739/2025** - It strengthens the data inspection and validation structure. It adds reliability to the traceability of agricultural production based on the integration and validation of private databases. Compliance is achieved through monitoring and traceability carried out by these entities.

4.3.1. Benefits and operating costs

Implementing the platform provides significant benefits. These include: facilitated access to farming loans; increased production chain transparency; and strengthened position of Brazilian agribusiness in the international market. However, the operating costs incurred with building and implementing the platform have a direct impact on its effective application.

Table 5 – Projected benefits and operational costs for the traceability platform

Benefits	Operating costs
• Greater production chain transparency by facilitating access to farming loans based on alignment with international standards. • Providing incentives to the adoption of good socio-environmental practices, traceability, and guaranteeing production compliance.	• Investments in the construction and maintenance of technological infrastructure integrated with public databases (Ibama, SICAR, PNIB, ICMBio, SEMAS, SIGEF, OESAS, RFB, PGFN, MTE). • Expanded service capabilities, and the need of engagement promoted by capacity-building (training and technical support to broaden the adoption of the platform). • Continuous monitoring based on geoprocessing and audits. These represent considerable costs and are indispensable processes in improving compliance verification mechanisms.

With the enactment of executive orders No. 745, No. 721, and No. 739, the platform becomes an important regulatory framework. It creates an avenue for aligning Brazilian agricultural production with global demands. It expands access to markets that demand sustainability and transparency across the production chains.

Its ability to meet regulations such as the EUDR will depend on continual improvements, especially in the collection of georeferenced data, and detailed traceability across the supply chain. Making the platform a successful and effective tool to ensure sustainability and competitiveness in the global market will require coordinated action between the government, the private sector, and farmers.

4.3.2. Expansion potential

The expansion of Agro Brasil + Sustentável is connected to a range of structuring actions to broaden its reach and effectiveness. SERPRO has been working with SDI to build the platform, but the participation of MMA, Embrapa, production chain representatives and society is essential to speed up the process.

5. Conclusion

This analysis revealed a dynamically evolving scenario regarding traceability systems in the beef and soy value chains in Brazil. The country has made significant progress driven by government initiatives such as the Agro Brasil + Sustentável Platform, PNIB, and projects conducted by the private sector, and coordinated by the industry. The participation of ABIOVE and ABIEC in the construction of viable solutions connected to multisectoral entities, such as Coalizão Brasil Clima e Florestas, strongly supports the formulation of strategies to meet the EUDR requirements. These actions support MAPA and MMA.

Traceability is the key to ensuring the socio-environmental compliance of production. However, the initiatives currently in place are not capable of presenting unified and standardized information that connects territorial, fiscal, socio-environmental, transport, and distribution data on a large scale. These initiatives are hardly expected to provide this data in the short term.

In soybean production, tracking and monitoring initiatives are already using advanced technologies. Examples include: satellite georeferencing; risk analysis; and blockchain registration. These mechanisms are capable of guaranteeing sustainable origin, production chain segregation, and compliance with environmental, and commercial regulations. They enable access to premium markets and enhance the transparency required by consumers. However, all these initiatives are undertaken by private entities. Government coordination is critical to offer scale and expand traceability across the supply chain.

In the beef industry, individual traceability is the pillar for control and monitoring, as it is necessary to provide information on production sites, health events, and nutritional conditions. Brazilian legislation has evolved, particularly with Law No. 12097/2009, which lays the foundations for mandatory traceability. However, some challenges persist: the lack of integration between systems, the need to track indirect suppliers, and the harmonization of state regulations. These challenges, combined with the resistance of some sectors to establishing mandatory individual identification in cattle livestock, are significant obstacles to its enforcement.

Five key items are the foundation for robust traceability systems. However, despite the sectoral initiatives, and advances in government programs, these issues have not yet been resolved.

1. High costs for producers and industries vs. lack of clear incentives;

2. The complexity involved in the supply chain, especially in tracking indirect suppliers, segregating production, and controlling supply triangulation;

3. Validating CAR, which is the main source of accurate geolocation data, and a way to demonstrate production legality;

4. Harmonizing state regulations, ensuring standardization, efficient processes, and, above all, legal security for all stakeholders;

5. Publishing regulatory acts on mandatory and official cattle identification and using Agro Brasil + Sustentável as a basis for qualifying production.

It is necessary to establish the integration of Agro Brasil + Sustentável and PNIB. This is a logical procedure, and it is considered a natural path. With individually identified livestock, PNIB conducts the traceability of cattle, and Agro Brasil + Sustentável establishes the socio-environmental traceability of the production territory, the livestock transport file, and the territory information via CAR. This is the basis for establishing beef compliance.

Agro Brasil + Sustentável and PNIB represent a step forward in enhancing transparency and consolidating information, but short-term solutions are still needed to meet the EUDR requirements that begin to take effect in January 2026.

Brazil now has a strategic opportunity to strengthen its production traceability and monitoring systems. The advancement of traceability is directly linked to the implementation of the EUDR, and the growing global demand for sustainable agricultural products. To maintain access to the European market, and establish itself as a reliable supplier, Brazil will have to set up robust, transparent, and integrated systems for beef and soy.

In the short term - Agile compliance models are an avenue of choice. These must be based on Agro Brasil + Sustentável, through integrated bases, which must be made mandatory for aggregate annual production declarations. QR codes for simplified traceability throughout the production and processing chain.

In the long term - Measures such as including the CAR information in the tax receipts and assigning one state registration number per farm. Mandatory identification of cattle with official PNIB numbers can provide accurate information on the origin of production and the sites through which the livestock has passed throughout its trade flow, and this can reduce fraud, and ensure transparency.

Success depends on coordination between the government, the private sector, and society. It is necessary to focus on engaging, and raising the awareness of rural producers, especially the small, and medium-sized ones, to ensure a widely held adoption of the systems.

The integration of technologies such as remote sensing, blockchain, and big data analysis will be critical for the real-time tracking of production chains. In addition to these resources, more independent audits must be conducted to validate compliance, combat illegal deforestation, and avoid triangulation schemes. The setup of a unified national database, in compliance with the LGPD, will lead to greater transparency and social control.

There is a consensus in the production chains that the problem is not technology. The main concern is how to implement a fast and safe solution for traceability.

5.1. Brazil's global positioning

Brazil is in a prime position to become a leader in traceability, transparency, and sustainable production. It can even serve as a role-model of compliance with the EUDR and other international regulations. However, this will require overcoming operational challenges, such as unequal capabilities among farmers and across the chain. Traceability can ensure that all links in the chain - especially small producers, and family farmers - have access to premium technologies and markets.

The need for political coordination, efficient inspection, and a specific regulatory structure can ensure that the initiatives and potential solutions do not remain just on paper but become a reality. With well-coordinated planning, and investments in innovation, Brazil can transform traceability into a competitive edge, aligning agricultural production, environmental conservation, and access to high-value global markets.

6. Appendix

6.1. References

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6.2. Legal framework for traceability

Table 6 – Classification of the legal basis for traceability

Category	Examples of laws and regulations
With a direct impact	Law No. 12651/2012, Law No. 10711/2003, Law No. 9973/2000, Law No. 9605/1998, Law 12097/2009, Decree 5741/2006, Decree 7623/2011, Normative Instruction 6/2014, Normative Instruction 23/2015, Normative Instruction 51/2018, Normative Instruction 9/2021
With an indirect impact	Law No. 12305/2010, Law No. 9985/2000, Lei No. 6938/1981 Law No. 5868/1972, Decree No. 9013/2017, Normative Instruction 5/2018, Ordinance 745/2024, Ordinance 721/2025, Ordinance 739/2025
Infrastructure and logistics	Law No. 12815/2013, Law No. 10233/2001), Sinief Adjustment 07/05, Law 1283/1950
Financial and tax-related	Law No. 11076/2004, Complementary Law No. 87/1996, Law No. 9393/1996, Law 13465/2017
Environmental and inspection-related	Decree No. 6514/2008, Conama Resolution No. 237/1997, SDA Ordinance no. 573/2022, Law 4504/1964, Law 4974/1966, Decree 24548/1934, Law 569/1948, Law 1283/1950, Law 11515/2007, Ordinance 196/2021
Sanitary and phytosanitary	Anvisa-MAPA Normative Instruction No. 02/2018, MAPA Normative Instruction No. 39/2017, Decree No. 24114/1934, Law 569/1948, Law 11515/2007, Law 8171/1991

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