From Pastures to Plates:

The Thorny Path to Achieving Deforestation-Free Cattle from Brazil to European Consumers

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Abstract

To tackle global deforestation, the EU enacted a new regulation on deforestation-free products in 2023. The regulation aims to eliminate production-linked deforestation of specified commodities by requiring complete traceability and due diligence from importing EU companies. To explore the challenges the EU regulation will face to achieve deforestation-free cattle commodities from Brazil, we conducted 19 semi-structured interviews with stakeholders in the Brazilian cattle supply chain and drew on the concepts of telecoupling, foreign corporate accountability, and modes of governance. Our findings indicate that if European and Brazilian governments, cattle producers, and meatpacking companies are unable to address challenges, such as law enforcement, productivity enhancement, and implementing alternative sustainable production methods; as well as minimize spillover effects, such as market and production leakages; and implement a transparent and integrated public birth-to-slaughter traceability system, the EU regulation will unlikely contribute to reducing cattle commodities-related deforestation.

Versão em português

Para combater o desmatamento global, a UE promulgou um novo regulamento sobre produtos livres de desmatamento em 2023. O regulamento tem como objetivo eliminar o desmatamento ligado à produção de commodities específicas, exigindo rastreabilidade completa e diligência das empresas importadoras da UE. Para explorar os desafios que a regulamentação da UE enfrentará para obter commodities de gado brasileiro livre de desmatamento, realizamos 19 entrevistas semiestruturadas com atores da cadeia de suprimentos de gado brasileiro e nos baseamos nos conceitos de telecoupling, responsabilidade corporativa estrangeira e modos de governança. Nossas conclusões indicam que, se os governos europeu e brasileiro, os produtores de gado e os frigoríficos não conseguirem enfrentar os desafios, como cumprir as leis, aumentar a produtividade e implementar métodos alternativos de produção sustentável; bem como minimizar os efeitos colaterais, como fugas de mercado e de produção; e implementar um sistema público transparente e integrado de rastreabilidade do nascimento ao abate do animal, é improvável que a regulamentação da UE contribua para reduzir o desmatamento relacionado às commodities de gado.

Keywords: EU Regulation, Deforestation-Free Commodities, Cattle Supply Chain, Traceability, Environmental Governance, Foreign Accountability

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Abbreviations

EU	European Union
FC	Forest Code
CAR	Rural Environmental Registry (Brazilian Acronym)
GTA	Animal Transit Guides (Brazilian Acronym)
SICAR	Rural Environmental Registry National System (Brazilian Acronym)
TCWE	Ton of Carcass Weight Equivalent
TAC	Adjusted Conduct Term (Brazilian Acronym)
MPF	Federal Public Ministry (Brazilian Acronym)
CPP	Public Commitment for Cattle Ranching (Brazilian Acronym)
IBAMA	National Institute for Environment and Natural Renewable Resources (Brazilian Acronym)
SISBOV	Brazilian Service of Traceability for Cattle and Buffaloes Productive Chain (Brazilian Acronym)
RFDI	Radio Frequency Identification
SES	Socio-Ecological Systems
FCA	Foreign Corporate Accountability
SFDR	Sustainable Finance Disclosure Regulation
CNA	Confederation of Agriculture and Livestock (Brazilian Acronym)
US	United States
UK	United Kingdom
APIB	Articulation of the Indigenous Peoples of Brazil (Brazilian Acronym)
FUNAI	National Foundation of Indigenous People (Brazilian Acronym)

1. INTRODUCTION

Between 1985 and 2021, nearly 847,000 km^2 of native vegetation[1], roughly 1.5 times the size of France, has been cleared for pasture and agriculture in Brazil (Figure 1) (MapBiomas, 2022b). Cattle production for beef and leather, and land-grabbing related to it, is a key driver of ecosystem loss and degradation in Brazil (Nogueira et al., 2021; Rivero et al., 2009) and caused nearly half (425,000km^2) of the total native vegetation destruction. The Amazon biome, for instance, has lost 12% of its tree cover (approx. 370,000 km^2) to pasture between 1985 and 2021 (MapBiomas, 2022a). Cattle production in the Legal Amazon[2] region increased 611% between 1974 and 2021, from 16 million to nearly 97 million heads of cattle (IBGE, 2022), and today it concentrates 43% of the national production.

The consequences of deforestation in Brazil are numerous and far-reaching. Deforestation is a major contributor to climate change, as it releases large amounts of carbon dioxide trapped within forest vegetation and soil into the atmosphere (Palmer et al., 2023; Pan et al., 2011). Deforestation also causes loss of biodiversity and ecosystem services and has the potential to push the Amazon rainforest beyond a tipping point, which could have catastrophic consequences for the planet (Barlow et al., 2016; Lovejoy & Nobre, 2018; Sweeney et al., 2004). In addition, deforestation affects traditional and indigenous communities and small-scale rural producers that live in the region. Apart from violent land grabs and displacement of local communities, these impacts include threatening their traditional way of life (subsistence, livelihoods, and cultural heritage) and causing physical and mental health impacts due to possible displacement, diseases, and environmental degradation of their surroundings (Ellwanger et al., 2020; Wilson & Peter, 1988).

Brazil is one of the world's largest beef exporters (Aragão & Contini, 2021), and its biomes have suffered directly from this. Incentivized by land-grabbing opportunities, expansion of productive pasture areas, the economic return of global beef demands, weak law enforcement, and historical government monetary stimulus, cattle ranchers have had little motive to halt the practice. With global markets expected to increase beef demand soon (OECD & FAO, 2022), the worsening of deforestation in Brazil is imminent. For example, China, which is currently Brazil's largest beef importer, is projected to increase beef import volume by 38% between 2020 and 2030 (Beckman et al., 2022).

[1] *Flora that naturally occupies different biomes of the country and developed spontaneously in a certain region, according to its soil, climate, and ecosystem characteristics. (Pires et al., 2018; PlenaMata, 2023)*

[2] *Area within the Amazon Basin that encompasses eight Brazilian states (Acre, Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima e Tocantins) and part of the state of Maranhão.*

In 2021, the European Union (EU) proposed a regulation on Deforestation-Free Products (hereafter referred to as 'EU regulation') to ensure that commodities (including soy, cattle, palm oil, coffee, and cocoa) imported into the bloc are deforestation-free. Responsible for 16% of deforestation associated with the global international trade (Wedeux & Schulmeister-Oldenhove, 2021), second only to China, the EU is set to reduce its environmental footprint. Unless efforts to address deforestation-linked commodities in international supply chains are made, deforestation will continue to expand (Pendrill et al., 2019). Hence, the new EU regulation aims to pressure the Brazilian cattle supply chain towards more sustainable production.

1.1 Aims and Contributions

Our study investigates 1) the challenges the Brazilian private and public sectors face in adapting to the EU regulation, 2) the current barriers to implementing a traceability system, and 3) the potential effects of the regulation on the cattle supply chain and its effectiveness in reducing deforestation. We draw on existing literature and primary data collected by interviewing direct and indirect stakeholders associated with the Brazilian cattle supply chain.

We discuss the conflicts and intersections between the Brazilian Forest Code (FC), the Environmental Rural Registry (CAR), the Animal Transit Guides (GTA), the current traceability system, and the requirements of the EU regulation. By analyzing the strengths and weaknesses of the current system, we provide a critical analysis of the doubts and liabilities related to the effects of the regulation in Brazil. Consequently, we provide insights into factors that may hinder the effective and efficient implementation of the EU regulation in the country. Furthermore, we elicit the potential consequences of this new EU regulation on the Brazilian cattle supply chain.

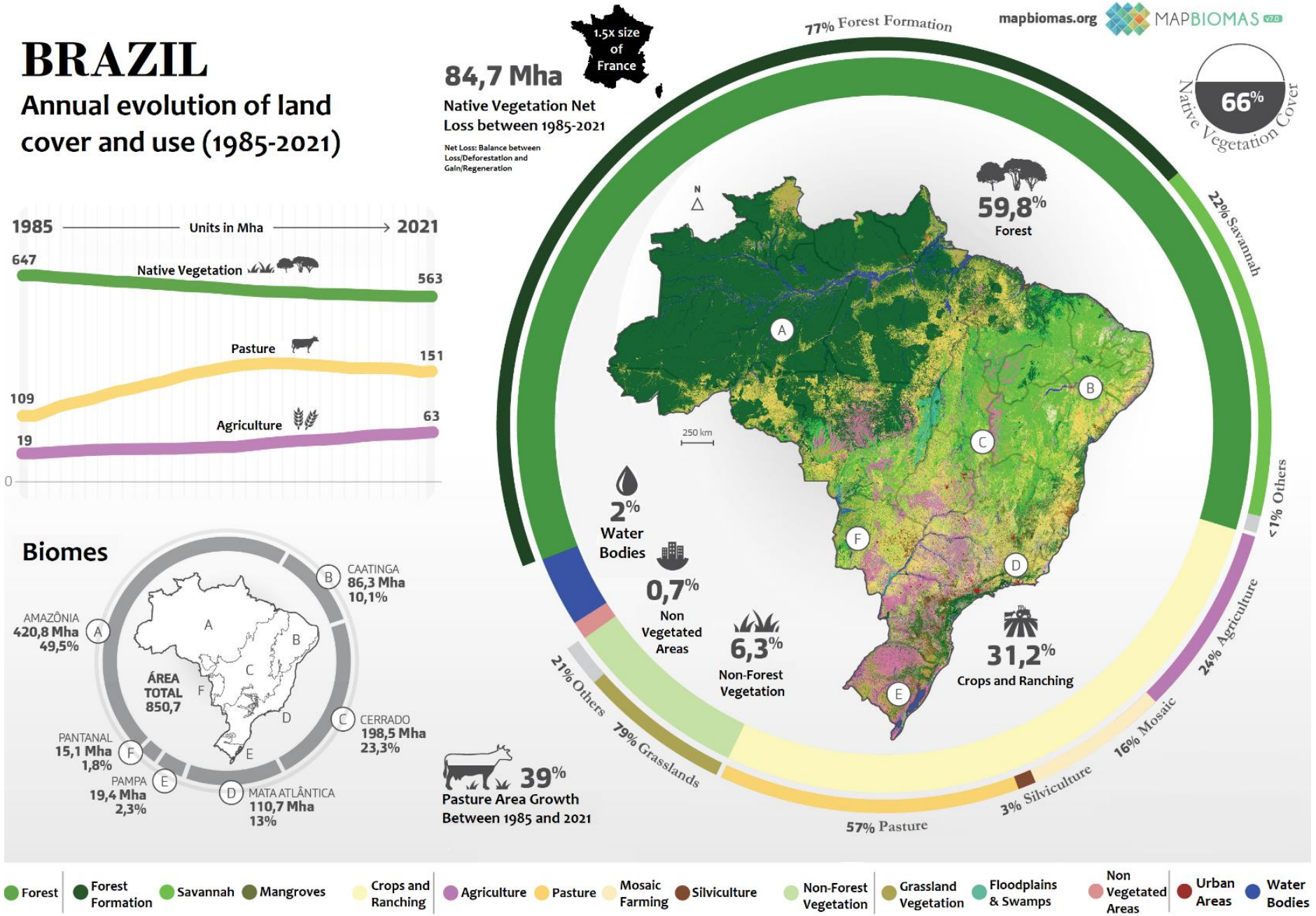

Figure 1: Annual Series of Land Use and Land Cover Maps of Brazil. Adapted from MapBiomas Project Collection 7.1 (Creative Commons).

Our research contributes to the field of sustainability science by operationalizing the concept of sustainability in the context of the new EU Regulation and the Brazilian cattle supply chain. More specifically, we develop critical knowledge about how the Brazilian cattle supply chain will respond to the regulation and increase its sustainability as a result of it. For that, we include distinctive features of science of sustainability throughout our research process, such as stakeholder involvement, interdisciplinarity, discursive methods (narratives), and a range of opinions besides scientific proofs and critical research (Spangenberg, 2011).

To reach our commitment, we investigate the following research question:

> *Main RQ: What are the main challenges for reducing deforestation in the Brazilian cattle supply chain?*

To provide a broader scope of the issue, the following two sub-questions were included:

> *RQ1: How could the regulation potentially lead to political, social, economic, and environmental effects in Brazil and its cattle supply chain?*
>
> *RQ2: How should the Brazilian cattle supply chain traceability system be designed to ensure deforestation-free products are exported to the EU?*

2. BACKGROUND

2.1 European Regulation on Deforestation-Free Products

The EU regulation's objective is to "minimize the consumption of products coming from deforestation-linked supply chains," such as soy, palm oil, and beef, and reduce their production-linked deforestation and forest degradation, thus protecting biodiversity and preventing climate change (EU Regulation 2021/0366, 2021). When the regulation was opened for public consultation in 2020, it received 1.2 million responses, becoming the second-most commented EU regulation in history (Liboreiro, 2021).

The regulation demands accountability from companies for the negative socio-environmental impacts of production, specifically deforestation caused outside the EU. To better understand how companies will be held accountable, we analyze the draft version of EU Regulation 2021/0366, considering the six questions proposed by Mashaw (2006): 1) Who is held to account? 2) To whom is accountability owed? 3) For what are they accountable? 4) What standards does an agent use to demonstrate accountability? 5) What processes demonstrate accountability? 6) What happens when the agents fail to meet these standards?

The regulation indicates that operators and traders will be held accountable (1). Operators are the companies that import or sell the relevant commodities in the European Union. In the case of the cattle supply chain, operators are the importing companies of the nine cattle products (e.g., beef products and hides) described in the regulation (Annexes EU Regulation 2021/0366, 2021). The traders are the agents (e.g., supermarkets) that commercialize the commodities, making them available on the European market (Article 2).

Accountability is directly owed to the competent authorities designated by the Member States of the EU (2). They are responsible for providing technical guidance to operators to help them comply with the regulation's requirements. Additionally, they must conduct checks on the compliance of the operators and traders based on the risk analysis in the due diligence statements, with a clear explanation of the criteria used to analyze them (Article 13, Article 14).

Operators and traders are accountable for ensuring that the relevant commodities they are trading are deforestation-free (either legal or illegal) and compliant with the laws of the country of production (3). The definition of deforestation-free depends on the definition of forest from the FAO, which states “land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ… ” (FAO, 2020). This implies that the legislation does not protect other wooded lands that do not fall under this definition, such as the *Cerrado* biome in Brazil. Furthermore, the definition of deforestation-free has a cut-off date of December 31, 2020. Therefore, the standards that the agents of the cattle supply chain must use to demonstrate accountability are ensuring that the relevant cattle commodities commercialized are not linked to deforestation after December 31, 2020 and that they do not violate any Brazilian law (4) (Article 2, Article 3).

Operators and traders are subjected to a mandatory due diligence statement to ensure that the risk of non-compliance is negligible (5). The due diligence statement must include relevant information, documentation, risk assessment, and mitigation analysis. It provides geographic information of all the plots of land where the commodities were produced (geo-location via latitude and longitude), the quantity of the product commercialized, contact information of the exporting and importing companies or individuals, and verifiable information that the products are deforestation-free and legal. The risk assessment must take into consideration specific criteria such as the assigned risk of the country or territory; the incidence of deforestation or forest degradation in the country, region, and area of production of the commodity; concern about the lack of enforcement, corruption, and armed conflict

within the territory of production; substantiated concerns; and the complexity of the supply chain in connecting the commodities with the plot of land of production. The risk mitigation analysis is based on companies' policies, controls, and procedures to manage the risk of non-compliance of commercialized products. It is worth mentioning that countries and territories will be categorized according to their deforestation risks. In countries or territories categorized as low-risk, operators and traders will be subjected to simplified due diligence, meaning that agents will not have to perform a risk assessment and mitigation analysis. This also applies to small and medium enterprises traders[3], independent of the level of risk (Article 4, Article 6, Article 8, Article 9, Article 10).

If operators and traders fail to meet the standards, they are subjected to penalties (6). These include fines, confiscation of the products and revenues, prohibition of economic activity, and exclusion from public procurement processes (Article 23).

2.2 The Brazilian Forest Code

The present Forest Code was implemented in 2012 after a lengthy and controversial political process. Elaborated to address issues related to the paradox of increasing agricultural production and the need to conserve native biomes, the FC sets out guidelines for land use and management, conservation, and restoration of forests and other native vegetation on private rural properties within the country. With 53% of Brazilian native vegetation occurring on private properties[4], proper management of these resources is crucial to reducing deforestation and reaching climate change goals (Soares-Filho et al., 2014).

Amid its main points, the law establishes ‘legal reserves’ and ‘areas of permanent preservation’ to protect native vegetation within private rural properties. For legal reserves, which allow sustainable extraction of resources, the Code states 80% native vegetation preservation on private properties within the Legal Amazon, 35% for the *Cerrado* inside the Legal Amazon area, and 20% for the remaining areas, including *Cerrado*, *Caatinga*, *Pantanal*, *Mata Atlântica*, and *Pampa* (Embrapa, n.d.). Additionally, permanent preservation areas, including riparian woodlands, hilltops, mangroves, and sandbanks, are categorized as protected vegetation, and cannot be economically exploited.

[3] *As defined on the Directive 2013/34/EU of the European Parliament and the Council.*

[4] *Land owned by private individuals and legal entities used for rural activities. (See Annex 1)*

An essential tool introduced by the FC was the National Rural Environmental Registry System (SICAR). In this georeferenced web system, landowners are required to electronically register the over 5 million rural properties in Brazil. Landowners register their properties' cartographic and environmental information through the CAR, helping build a public database to monitor and control land use and tackle illegal deforestation (Brazil, 2023). Theoretically, the system would provide transparency and facilitate environmental management by gathering nationwide land information. However, since the law's passage, many interim measures within Congress have been proposed to postpone the dates for adhering to the instruments that would allow its full implementation (Antunes, 2019).

Another point related to the FC is the heavy influence of the agribusiness sector on all levels of political activity in Brazil. During its enactment, 23% of the Brazilian Chamber of Deputies (120 members) were part of the Agricultural Parliamentary Front (Fellet, 2012). Analysts consider the Front to be the most influential interest group in Congress and have substantial power to dictate decisions on the legislative agenda (Fellet, 2012). The group acts to defend the interests of the agribusiness sector within Congress and is supported via vast financial contributions of big industries, including banks, food companies, and agrochemicals, during election campaigns (Arroyo, 2019; Redação Estadao, 2011). One of their main accomplishments was the amnesty granted to illegal deforesters in the Forest Code, where a share of landowners was not required to pay any fines or restore illegally deforested areas within their properties before July 2008 (Federal Law 12.651, 2012). This was seen as an act of impunity that effectively legitimized past environmental crimes (Baron, 2011).

Despite the criticism, the FC remains a vital instrument in Brazil for controlling land use and fostering conservation. Yet, there are ongoing discussions regarding how to appropriately enforce the law and address the country’s root causes of deforestation and land-grabbing. Some urge for more robust regulatory frameworks and enforcement mechanisms, while others support increased investment in sustainable land use practices and alternative livelihoods for rural populations (Moutinho et al., 2016).

2.3 Overview of the ‘Big Three’ meatpackers

In 2021, Brazil’s beef production was estimated at 9,71 million Tons of Carcass Weight Equivalent (TCWE), and the production of bovine leather was 91,6 million m^2. Table 1 summarizes the percentage of beef and bovine leather that stayed in the domestic market, the global share of exports, and the share of exports that went to the EU in 2021 (Brazilian beef, 2022; Brazilian leather, 2022; European Commission, 2023). Three companies dominate the industry: JBS, Marfrig, and Minerva (Slob et al., 2020), which

produced 86.7% of the beef in Brazil in 2021 and 88.7% and 15% of frozen beef and tanned or crust bovine hides and skins exported to Europe, respectively, in 2020 (Table 2) (Drost et al., 2022b; Medina, 2021). To obtain the cattle, these companies are supplied by thousands of producers, mainly located in the Amazon and *Cerrado* biomes (Table 2) (Drost et al., 2022b).

Table 1: Domestic and export share of the total production of Beef and Bovine leather in 2021. [a] Represents the percentage of global exports that go to the EU.

Category	Beef	Bovine Leather
Production	9,71 million TCWE	91,6 million m2
Domestic Market (%)	74.49	28.69
Global Export (%)	25.51	71.31
[a] EU share (%)	7	25

Table 2: Production share of beef, exports to the EU, and the number of suppliers of the three biggest meatpacking companies. [a] Suppliers located only in the Amazon biome.

Category	JBS	Marfrig	Minerva
% of Brazilian beef production (2021)	51.0%	19.5%	16.2%
% of Frozen Beef exported to Europe (2020)	46.3%	14.8%	27.6%
% of Tanned/Crust bovine hides/skins exported to Europe (2020)	6.0%	3.3%	5.7%
Number of direct producers	50,000	15,000[a]	6,000
Estimated number of indirect producers	unknown	25,000[a]	unknown

2.4 Sectoral Agreements for reducing deforestation

During the first decade of the XXI century, the high deforestation rates in the Amazon, especially in the state of Pará, were linked to the cattle supply chain (Armelin et al., 2020), and between 2004-2014, approximately 64% of the deforested areas in the Brazilian Amazon (42 million ha) were converted into pastures (Embrapa, 2016).

To help control the increasing deforestation, two commitments were imposed by public and private organizations, the Terms of Conduct Adjustment (TAC), a legally binding commitment imposed by the Federal Prosecution Office (MPF), and the Public Commitment for Cattle Ranching (CPP), a voluntary commitment imposed by Greenpeace. Several meatpackers signed the TAC in Pará (Marfrig did not sign it), while the three main meatpackers signed the CPP (Armelin et al., 2020).

The companies committed to buying cattle only reared on land that complies with the socio-environmental criteria stipulated in the agreements and a cutoff date of May 2009. These socio-environmental criteria included deforestation (for CPP, both legal and illegal), farms overlapping conservation units or indigenous land, embargoes from public institutions, and the presence of slave-like labor conditions (Armelin et al., 2020; Cammelli et al., 2022).

To comply with the commitments, companies shall implement auditable and verifiable traceability systems to monitor the origin of cattle (Armelin et al., 2020). The current traceability system is based on crossing information contained in the CAR and the GTA, the list of embargoes issued by IBAMA, the official national slave labor list, and the list of conservation units. The GTA provides information about the movement of the animals, including their origin, destination, and entry and exit dates. It is worth mentioning that for sanitary requirements in the EU, there is a System for Individual Traceability of Bovines and Buffaloes (SISBOV), which is based on Radiofrequency Identification (RFID) and contains the date of birth, health history, and other relevant information for every animal in the supply chain (Armelin et al., 2020; Khalil, 2020).

2.5 Failing commitment to stop deforestation

Despite the previous commitments, deforestation in the Legal Amazon continued. A major reason is the lack of full monitoring of the supply chain, where indirect suppliers, driving a majority of the deforestation in the cattle supply chains, are not properly monitored (Armelin et al., 2020; Cammelli et al., 2022; Skidmore et al., 2021). In addition, as the CAR and GTA documents are self-declaratory registers, some farmers use illegal practices to sell their cattle. Some alter the property limits declared in the CAR to exclude deforestation or willingly inscribe their farms inaccurately or incompletely to appear compliant (Global Witness, 2022b; Skidmore et al., 2021). Others 'triangulate' cattle and their GTAs to make it appear as if they are coming from compliant farms to sell the cattle to meatpacking companies. Hence, ranchers, especially the ones that own multiple properties, sell cattle from a "clean" property when, in reality, cattle were raised on a farm linked to deforestation. This process is known as 'cattle laundering' (Cammelli et al., 2022; Raleira et al., 2022).

As an example of the agreement's failure, studies found that between 2017 and 2019, an area equivalent to 20.000 football fields (14.280 ha) was deforested in Pará. This corresponded to purchases from 327 direct suppliers with illegal deforestation by JBS, 89 by Marfrig, and 16 by Minerva. According to satellite data, the estimated additional deforestation area linked to at least 4.000 indirect suppliers was

calculated to be around 140.000 football fields (99.960 ha) (Global Witness, 2020). In 2017, after the "cold meat" operation (*Operação 'Carne Fria'*) launched by IBAMA, which suspended the operation of some meatpacking companies due to detected irregularities, Greenpeace decided to withdraw from the CPP agreement (Global Witness, 2020).

Another issue of concern that contributes to deforestation is the practice of land-grabbing or "grilagem". This practice consists of illegally appropriating public land. One of the main methods of "grilagem" uses the CAR as a tool to prove land ownership and facilitate the legalization of illegal claims (see Figure 2) (Carrero et al., 2022; Moutinho & Azevedo-Ramos, 2023). This is relevant since 50% of the Brazilian Amazon deforestation happens on public land, which increased by around 7 percentage points between the period of 2018 and 2021 due to the weakening of environmental governance during the Bolsonaro government (Carrero et al., 2022; Moutinho & Azevedo-Ramos, 2023).

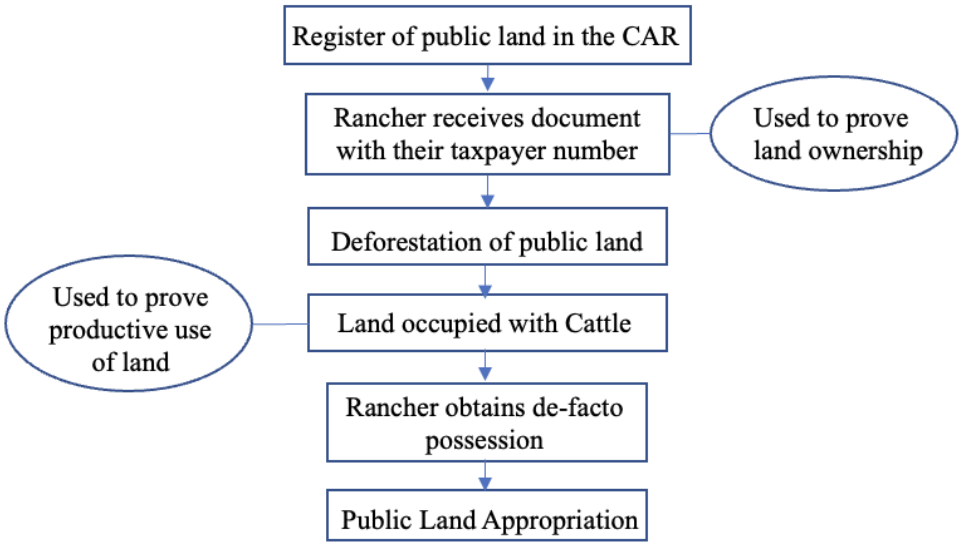

Figure 2: The process of land-grabbing using CAR and cattle.

3. CONCEPTS/THEORY

3.1 Telecoupling

To analyze the connection between the European regulation and the cattle supply chain in Brazil, we use the concept of telecoupling. Telecoupling represents the "socioeconomic and environmental interactions among coupled human and natural systems over distances" (Liu et al., 2013, p.3). It is a concept used to analyze linkages between distant regions or places, to understand how global processes

impact local Socio-Ecological Systems (SES), and to study how certain SES will adapt to changes triggered by other SES (Downing et al., 2021).

Telecoupled systems imply different scales of interaction between three big systems. First is the sending system, from where the material, energy, or information flows outwards (e.g., exporting countries). Second is the receiving system, which is the recipient of the flows from the sending system (e.g., importing countries). Finally, the spillover system is the one that receives the "unintended" impacts of the interactions between the other two (Downing et al., 2021; Liu et al., 2013).

These three systems are interconnected through flows produced by interacting agents, triggering cause-and-effect processes. The agents are autonomous decision-making entities, such as individuals or groups of humans or animals, whose interactions facilitate or hinder the interchange of flows within a telecoupling. These interactions are political, ecological, economic, cultural, and technological factors that cause processes of socioeconomic and environmental change in the telecoupling. Flows can be unidirectional or bidirectional movements of material, energy, or information, including knowledge, trade agreements, and regulations (Liu et al., 2013). The telecoupling framework provides the systems perspective necessary to understand the cross-scale and cross-system interactions, better recognize the impacts triggered by the exchange of flows, and design transformative sustainability pathways (Downing et al., 2021).

3.2 Foreign Corporate Accountability

We draw on foreign corporate accountability (FCA) to understand the accountability mechanisms used at the macro level of the telecoupled system. Using FCA, we study the accountability of companies for the negative socio-environmental impacts caused abroad by their subsidiaries or suppliers (Bovens, 2010). Accountability ensures more sustainability in supply chains riddled with corruption, lack of enforcement, and close relationship between companies and the state that historically undermined the protection of human rights and the environment, such as the Brazilian cattle supply chain. Furthermore, large lobbying and powerful business associations protect transnational companies from being held accountable by vulnerable actors, such as workers' associations and indigenous communities (Rubenstein, 2007; Schilling-Vacaflor & Lenschow, 2023).

In our research, we analyze foreign corporate accountability focusing on a state-centric discourse, to address the challenges that the EU regulation will impose on Brazilian meatpacking companies. In a

state-centric discourse, state regulation is central, and companies are held accountable through mandatory due diligence based on strict risk assessments that consider control, prevention, mitigation, reparation, and stakeholder consultation. Government sanctions on non-compliant companies ensure enforcement, aiming to hold the whole supply chain accountable (Gustafsson et al., 2022).

3.3 Modes of Environmental Governance

To analyze the challenges of governance that the European regulation might face at the micro level of the coupled cattle supply chain system in Brazil, we base our analysis on the hierarchical, network, and market modes of environmental governance.

The hierarchical mode of governance, similar to the state-centric discourse in foreign corporate accountability, is based on authoritarian control at a higher level (e.g., state), which dictates the norms (e.g., regulations) that will determine how the stakeholders interact to comply with them, resembling the traditional government (Evans, 2012).

The network mode of governance is based on governance networks that are integrated by civil society and private organizations linked by voluntary rather than legal agreements to address environmental issues (Bäckstrand, 2008). Stakeholders in a network believe that they possess complementary strengths, therefore, working together allows them to achieve common goals more effectively. This voluntary, self-regulated process has potential benefits for businesses. They can exercise influence by delaying or weakening new legislation, obtaining “social permission” to operate, and function as a role model in terms of sustainability practices. Since the agreements are voluntary, they are prone to being violated (Evans, 2012).

The market mode of governance is based on the belief that if the costs of negative environmental externalities can be included in the prices of products or services, environmental resources can be protected. If this occurs, environmentally conscious behavior can be aligned with the most profitable actions of producers and consumers. The market is the main entity that coordinates stakeholders’ actions, and the state's role is to ensure its correct functioning, giving private individuals the freedom to trade goods and services in the market to maximize its efficiency. Therefore, stakeholders' concern must be creating markets where the most profitable behaviors align with desirable environmental outcomes (Evans, 2012).

4. METHODOLOGY

We use a qualitative research method that involves a literature review and primary data collection through interviews. The literature review was conducted using academic databases, institutional reports, official media news, and raw data from official institutions. It was used to frame the context of the research, explain the theories used, and establish a dialogue between the insights provided by the interviewees and the existing scientific evidence. Primary data were collected by interviewing direct and indirect actors involved in the Brazilian cattle supply chain. Interviewees were identified through purposive sampling, which ensured that perspectives from civil society, public and private institutions were represented. Knowledge from the literature review, conversations with EPICC[5] project academic experts, and the interviewees also helped identify which institutions to interview.

To organize data, we compiled a list of stakeholders containing the potential interviewees' contact information. Of 48 stakeholders contacted, 19 interviews were conducted between February 5 and March 24, 2023, including face-to-face meetings in the cities of São Paulo, Brasilia, and Brussels, and online reunions. The final sample included private sector representatives (3), NGOs (9), investigative journalists (2), a bank (1), and government institutions (4). Unfortunately, we were not able to interview members of the exporting meatpacking companies (JBS, Minerva, and Marfrig). Other than contacting them via e-mail and phone, we visited their offices in São Paulo, but they refused to meet without a scheduled appointment.

We used semi-structured interviews, and questions were open-ended, which allowed us to explore the interviewee's perspectives and experiences. The interview questions were designed to elicit insights into the consequences of the new EU regulation on the Brazilian cattle supply chain. It is important to mention that the questionnaire was slightly adapted throughout the research, especially in the beginning, to make it simpler and more effective, but always keeping the structure and the main objectives in mind. The final version of the applied questionnaire can be viewed in Annex 3. Notably, due to meetings time constraints, and the expertise of the interviewees, some questions were not asked. For three interviews (B-PVT1, Bank, EU-GOV) we prepared a simplified questionnaire including specific questions (Annex 4).

[5] *A collaborative research project that applies a polycentric governance and environmental justice approach to investigate four selected commodity chains (cattle, palm oil, gold, and tin) that 'feed' the European market.*

In terms of ethical considerations, certain aspects were taken into account throughout the research process. Informed consent was obtained from all interviewees, and they were assured of their option of anonymity and confidentiality. The data were stored securely, and access was restricted to the research team. Throughout the research, we ensured that standards of good research ethics described by the Swedish Research Council (2017) were met.

Interviews were recorded with participants' consent, and detailed notes were taken in individual Google Docs to summarize significant insights. The collected data were subsequently analyzed using a thematic approach. Notes from each interview response were organized in an Excel spreadsheet, with separate sheets created for each question. All interviewees' notes were aggregated and compared to extract the key points of their responses. The resulting data were then categorized into distinct themes, with each theme assigned to answer a research question. Specifically, themes identified in questions 1, 2, 3, 9, and 11 were used to address RQ1, inputs from question 5 to answer RQ2, and themes in questions 4, 6, 7, 8, and 10 to address the MRQ. Finally, data were analyzed with the assistance of NVIVO software to identify similarities, controversies, and patterns, which were used to generate the study's findings.

Lastly, we were careful to engage in reflexivity in order to recognize and account for relations of power in the generation of knowledge and understand how our positionality (e.g., beliefs, values, social class, educational background, sex, and race) influenced and shaped the research design, methodology, and analysis of the data (Reid et al., 2017). The overall aim was to reduce bias in how data were collected, analyzed, and reported. However, we as researchers both recognize and understand that our personal sociodemographic traits inevitably influence field dynamics and, ultimately, the data collected with research participants.

5. RESULTS

After analyzing the content of the interviews, the main findings were categorized into 11 topics which were additionally divided into three sections related to each RQ. The statistics regarding the number of respondents for each question in the questionnaire are presented in Annex 5. It is worth noticing that we use acronyms to name every participant (B=Brazilian; EU=European; PVT=Private; GOV=Governmental; JNL=Journal). Consult Annex 1 for detailed information.

5.1.1 Market leakage

Market leakage was explained as the deviation of the cattle commodities to other markets (including Brazil's domestic market), due to the higher standards required by the EU regulation. All replies mentioned that leakage could happen to markets with looser environmental regulations since the EU regulation is creating a market barrier.

In this context, China was often mentioned as a possible destination since it is already Brazil's biggest beef export market. Additionally, B-NGO3 mentioned that non-compliant products could also stay in Brazil since its internal market is the destination of nearly 80% of the beef produced in the country. Therefore, there is a risk that the EU receives cattle commodities that are deforestation-free while the overall production does not change. B-PVT2 explained that market leakage could occur if a logic of exclusion dominates the market, meaning that producers that are not regularized in terms of deforestation commitments would be excluded from the EU market. Thus, if aid for environmental regularization is not prioritized, cattle ranchers that do not have the means to comply will choose to commercialize their products to other markets. In fact, Bager and Lambin (2022) found that excluding unregularized suppliers might cause companies to lose supply chain control and indirectly cause market leakage.

B-GOV2, B-JNL1, B-NGO2, and B-JNL2 agreed that segregation and leakage would not be new for the export of commodities in Brazil. B-GOV2 said this already happened with the Soy Moratorium[6] agreement, which established stricter environmental guidelines, and illegal soy started leaking out to the Chinese market. B-JNL1 and B-NGO2 said that sanitary requirements from the EU related to SISBOV in 2002 implied a higher cost of production, which caused producers to choose to export their cattle commodities to the growing Chinese market in that period. In fact, segregation also happened within Brazilian territories. As stated by B-NGO2, only 9 Brazilian states comply with the sanitary requirements imposed by the EU when SISBOV was implemented, with Mato Grosso being the only state in the Legal Amazon allowed to sell cattle to the EU.

[6] *A national voluntary sectoral agreement to not source soy from deforested areas before 2008 (Russo Lopes and Bastos Lima, 2022).*

Additionally, one point made by B-GOV2 is that other markets that have a lower incidence of deforestation associated with cattle farming, such as Argentina, can have competitive advantages compared to the Brazilian market, absorbing part of their production.

Lastly, EU-GOV mentioned that they are collaborating with partner countries by pressuring them to adopt similar regulations. For example, they are constantly talking to the US, which is working on a similar regulation. In the same way, EU-GOV and contacts of B-PVT3 said that China is engaged in the topic and willing to issue their own law.

5.1.2 Production leakage

Ten respondents declared they believed a risk of geographical production leakage is possible, with frequent mention of displacement to the Cerrado. EU-NGO3, B-NGO5, B-NGO1, and B-NGO4 expressed that it is likely to happen in the Cerrado since it is less protected within the Brazilian Forest Code. B-NGO3 and B-NGO6 stated that the leakage could focus on the transition areas between the Amazon and the Cerrado biomes. For B-GOV2, pressures from cattle production can also shift to other countries such as Paraguay, Uruguay, and Bolivia. Leakage of production due to forest conservation programs implemented in one country has been evidenced in the past (Gan & McCarl, 2007). Furthermore, increasing expansion of Brazilian Agribusiness in Bolivia and Paraguay has been documented (de Waroux et al., 2019; Gasparri & de Waroux, 2014).

B-PVT2, B-JNL1, B-JNL2, and B-NGO2 stated that cattle production in the Amazon would stay there since it would be too costly and ponderous to transfer production to other biomes. B-PVT2 specifically said that the trend in the cattle industry is the intensification of production, which leads to a decrease in land use. B-JNL1 mentioned that, while production itself would not be dislocated, land grabbing activities might intensify and shift to other regions, resulting in other deforestation and societal repercussions.

Analyzing these results, it is important to mention that despite the majority agreeing that production leakage is a possible scenario, none of them were able to provide specific answers on how it will happen. This shows the complexity of the issue and the hindrances to establishing causality.

5.1.3 Cutoff dates conflict: Brazil vs. EU

We asked interviewees if the EU regulation deforestation cutoff date of December 2020 could cause conflict with the Brazilian Forest Code and the TAC deforestation timeframes.

B-NGO4, B-GOV3, and B-JNL1 expressed that agribusiness can influence Congress to readapt the current Brazilian national deforestation timeframes, with B-JNL1 explicitly saying that there might be pressure for a new amnesty for the sector for the illegal deforestation caused between 2008/2009 and 2020. B-GOV3, B-NGO1, and EU-NGO2 were also concerned that the 'December 2020' timeframe could promote a message of impunity for those who have deforested before. On the other hand, most of the respondents mentioned that the set timeframe is reasonable and that there will not be conflicts since both national and EU regulation are complementary.

B-NGO3 argued that a more recent cutoff date allows producers to adapt better and makes it easier to gather high-quality satellite data to control deforestation. In the same line, EU-NGO3 thinks that satellite control is much better from 2020, giving better land control assurance. B-GOV2 expressed that the international community would not have received an older cut-off well since it would imply even more difficulties for Brazilian producers to adapt.

5.1.4 Effects on small-scale producers

Overall, the comments from the stakeholders reveal the challenges small-scale producers face in complying with the new regulation. The financial burden, technological gap, and increasing environmental demands are key themes that emerged from the stakeholder comments.

The comments from B-NGO2, B-PVT2, EU-NGO1, and B-NGO3 highlight the financial burden that the new regulation could place on small-scale producers, such as implementing the traceability system, which might induce their marginalization. Ultimately, this would lead to segregation within the producers between those who are able to produce according to stricter guidelines, and those who cannot, widening the inequality gap. In this context, EU-NGO1 and B-NGO2 expressed that the responsibility and costs of implementing due diligence can be shifted to them since there is no specific support foreseen in the regulation. Additionally, B-NGO2 says that small producers do not have the resources to implement a traceability system to comply with the EU Regulation. In the same line but with a contrary approach, B-GOV3 believes that if the system is cheap and simple, practical chances of marginalization are low. B-PVT3 expressed that if the regulation introduces private certification for deforestation-free products, it will add costs that can exclude and marginalize small producers. In addition, B-PVT2 expressed that marginalization already exists since smallholders are less competitive due to lower productivity compared to big producers who determine cattle commodity prices. Finally, B-PVT2, Bank, EU-NGO1, B-GOV1, and B-NGO6 emphasize that the increasing environmental demands placed on small-scale

producers entail the need for a support network to ensure their adaptation and inclusion in the market. In this matter, B-PVT2 notes that there could be an agreement between meatpackers and the producers to help them environmentally regularize their farms and consequently re-include them on their suppliers' list.

B-NGO2 notes a technological gap among small-scale producers, which could lead to difficulties complying with the new regulation's requirements. Additionally, the lack of literacy and validation capabilities could hinder the regularization of their lands. Regarding land concentration, B-NGO4 is concerned that the regulation could force small and traditional producers without legal land title in the Amazon and other biomes to be expelled by mainstream cattle and staples producers looking for land. B-PVT1 and B-PVT2 mentioned that competition, within the "game rules" (market), can push for land concentration if smallholders are not able to adapt. Historically, land concentration has already happened in the Amazon because of deforestation for cattle-ranching expansion (Yanai et al., 2020).

B-NGO3 explained that the EU regulation's requirement on banning legal deforestation might cause reluctance from smallholders to adhere, since it is a stricter requirement than the Brazilian national law. Due to the difficulties faced by producers, Section 3 discusses possible incentives to encourage and facilitate their adherence to the EU regulation.

5.1.5 Unaccountability of financial sector

B-JNL1, B-NGO5, EU-NGO1, and EU-NGO2 mentioned that proper due diligence should be required from banks and other financial institutions that are indirectly supporting and implicitly involved in the cattle supply chain in Brazil. Furthermore, financial institutions should be obligated to demand more environmental actions and commitment from industries as a condition for providing credits.

B-NGO3, EU-NGO3, B-NGO2, B-GOV1, and Bank mentioned that the financial sector in Brazil had already started to show commitment by demanding pre-established environmental requirements to provide credits and loans to producers. Since 2014, the Brazilian Central Bank has issued new resolutions requiring banks to incorporate socioenvironmental risk assessments into their operations. Related to the financial institutions in the EU, EU-NGO1, EU-NGO3, and EU-GOV mentioned that there are other initiatives within the EU for regulating them, such as the Sustainable Finance Disclosure Regulation (SFDR).

According to Bank, the financial sector's main duty is to provide knowledge and financial support by encouraging producers to adhere to established environmental goals, to either complying or non-complying producers, when providing credits and loans to cattle producers and other agents within the supply chain. For instance, Bank currently conducts a thorough analysis of the client's status within a specific ESG sector responsible for checking money laundering, slave labor presence, and compliance with socio-environmental requirements.

5.1.6 Indifference towards Indigenous voices

An important point expressed by EU-NGO1 and B-NGO6 was the lack of emphasis on protecting indigenous and traditional communities' rights in the regulation. EU-NGO1 mentioned indigenous representatives' demands regarding the protection of their people's rights were vaguely included in the regulation since the topic was politicized within the EU institutions. Additionally, B-NGO6 emphasized the EU did not follow the protocols to guarantee proper consultation with indigenous and traditional people. She mentioned that Indigenous people went to the EU to discuss the regulation by themselves, without a formal invitation from EU authorities.

EU-GOV was consulted on whether traditional and indigenous communities were meaningfully consulted to draft the regulation. They responded that a worldwide multi-stakeholder platform was created in 2019 to gather different comments and opinions on the regulation and that Brazilian stakeholders were actively present there.

Section 2 - Traceability System Design (RQ2)

5.2.1 Proposals for a cattle traceability system in Brazil

Interviewees expressed their views about the challenges and important factors related to the cattle traceability system, its current state, and important features that should be included within its design.

B-PVT2, EU-NGO3, B-GOV2, B-NGO2, B-NGO5, B-NGO3, B-PVT3, B-JNL2, and B-GOV1 mentioned that the main challenge for meatpacking companies in implementing a traceability system is tracking cattle from their indirect suppliers. B-PVT2, B-NGO2, B-JNL2, and B-PVT3 specifically mentioned that direct suppliers are denying meatpacking companies information regarding their locations. The issue arises because meatpacking companies could acquire sensitive competitive information that could provide them with

market advantages, such as buying cheaper cattle directly from indirect suppliers. Another issue mentioned by B-PVT2, B-GOV2, and B-JNL2 is that detecting cattle laundering is key to ensuring the traceability system's effectiveness. B-JNL2, B-NGO2, B-JNL1, and B-NGO5 mentioned that Brazilian public agencies do not effectively monitor this issue. Notably, B-PVT3 reinforces that the technology and knowledge for implementing traceability systems are available, but the lack of political will remains a significant obstacle.

Regarding the current state of traceability systems within meatpacking companies, B-GOV1 noted that they have been reshaping their systems to comply with the EU regulation. In this sense, B-NGO2 and B-PVT3 mentioned that meatpacking companies have hired specialized traceability companies to refine their systems and evaluate suppliers. Similarly, B-PVT2 and Bank informed that JBS developed a strategy to implement green desks in Pará, which intends to reintegrate irregular cattle producers into their supplier list by supporting them in environmentally regularizing their farms.

Regarding the cattle traceability system design, stakeholders made various contributions about its features (Figure 3). To begin, stakeholders have a consensus that an individual traceability system is necessary to ensure compliance with the EU regulation. B-NGO3, B-PVT2, EU-NGO3, B-GOV1, B-NGO2, B-PVT3, B-GOV2, and B-GOV3 are in favor of individual traceability. However, B-PVT3 and B-GOV3 propose that an individual traceability system based on ear tagging is needed only for high-risk deforestation areas. For low-risk deforestation areas, a traceability system that integrates the existent documentation (CAR, GTAs, embargoed areas, conservation units, etc.) is enough to ensure compliance, as demonstrated by (Rajão et al., 2020). Lastly, B-PVT2, B-NGO2, and B-NGO5 propose that the current SISBOV sanitary system can be restructured to ensure both environmental and sanitary compliance. To do that, B-NGO5 proposes integrating CAR records into the SISBOV to enable cross-checking of environmental compliance. Contrary to that, B-GOV1 believes that this integration would burden the public sector with additional financial and human resources.

B-GOV1, B-GOV2, B-PVT2, and B-PVT3 emphasize that the traceability system should be a unique integrated system, where all data and information are seamlessly connected and accessible through a single platform. B-GOV2 suggests that, if meatpacking companies adopt their own traceability systems, these must be integrated and their information available on a unique platform. Furthermore, B-PVT3 and B-PVT2 suggest that the traceability system should be based on a publicly managed platform. B-PVT3 suggests that a public traceability system is key to avoiding conflicts of interest between stakeholders

within the cattle production supply chain, such as cattle producers and meatpacking companies. In a publicly managed system, all sensitive information is hidden from standard users and used by regulators to implement law enforcement actions. EU-NGO1 emphasizes the importance of designing a feasible traceability system that companies and producers can implement. B-NGO2 suggests participatory design of a user-friendly and easy-to-navigate platform plus the implementation of a traceability system in four stages (simple design; maturation; validation; mandatory use). B-PVT3 and B-JNL2 expressed that a traceability system that is affordable, transparent, and easily accessible is the best solution.

EU-NGO1, B-NGO1, B-PVT3, B-NGO3, B-GOV2, B-NGO2, B-NGO5, and B-GOV3 mentioned the importance of transparency in the traceability system, both for accountability and traceability of the products. B-NGO5 expressed that CAR and GTA documents have always been controlled by public agencies that are resistant to making this information publicly available due to data privacy purposes, which undermines transparency. However, B-GOV1 emphasized their effort on this matter with the creation of the observatory of Brazilian agriculture and cattle ranching in 2019 to integrate and facilitate access to public data[7].

Additionally, B-NGO3, B-GOV2, and B-NGO2 discussed the importance of protecting the producers' sensitive personal and commercial data in the traceability system. B-GOV2 suggested that the traceability system design should allow companies to select which information to make available to safeguard strategic information. B-NGO2 proposed that only certified institutions should have access to the traceability system to avoid giving up producers' strategic data. B-PVT3 suggested that the traceability system should have two separate layers of data visualization. One layer should contain sensitive data about the operations of the companies and be available to certifiers and government agencies. The other should contain general data about deforestation-related producers, available to everyone.

Moreover, regarding both data protection and transparency, B-NGO3 suggested that blockchain technology could be implemented within the cattle traceability system. Nevertheless, B-JNL2 criticized the use of blockchain to keep track of the animal's movement and other similar information systems since their application in this matter is still not very trustworthy. Finally, B-PVT2 and B-NGO5 suggested creating a system like SERASA, where non-compliant producers are included in a confidential and discretionary list for potential cattle buyers to check environmental compliance.

[7] *Created in partnership with the National Confederation of Agriculture and Livestock (CNA).*

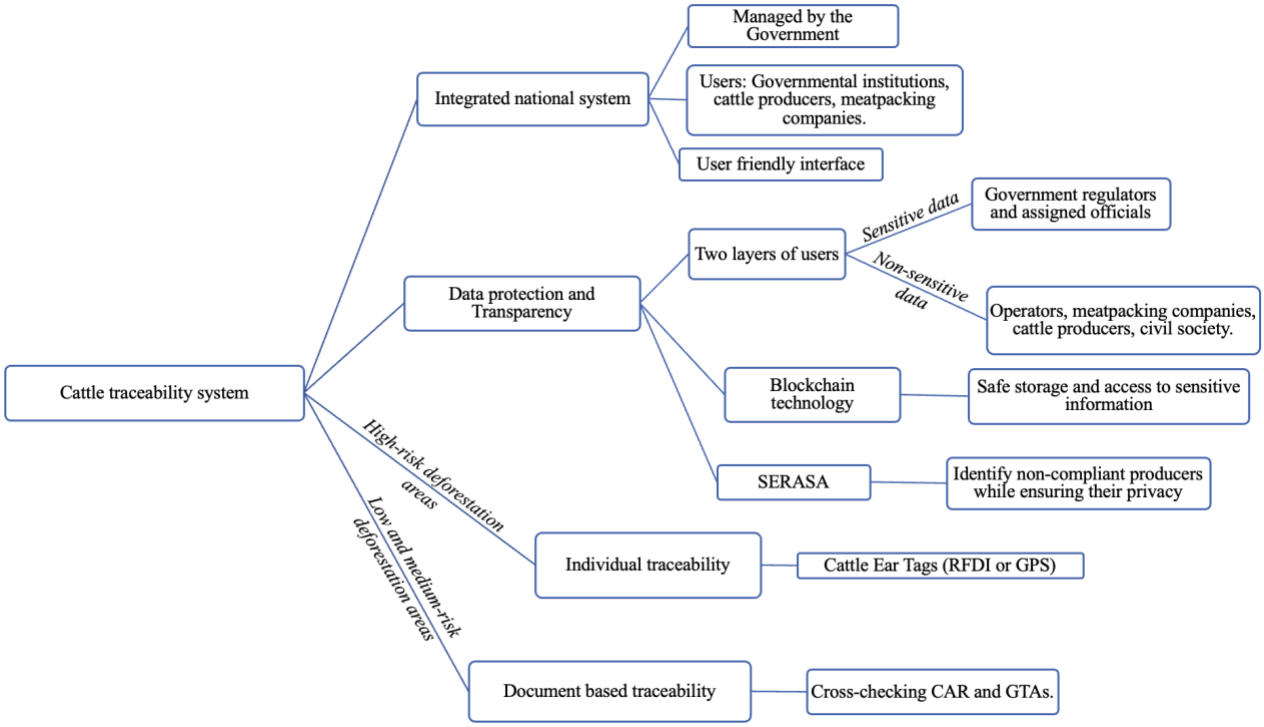

Figure 3: Summary of the main features to be considered in the design of the Brazilian cattle traceability system.

Section 3 - Challenges (Main RQ)

5.3.1 Law enforcement and CAR implementation in Brazil

Stakeholder comments suggest that there are several challenges related to law enforcement, agrarian reform, an efficient implementation of the CAR system, and the presence of a strong lobby from the agribusiness sector within Congress, to ensure environmental protection and proper land tenure.

B-PVT2, B-NGO3, B-JNL1, B-PVT1, B-GOV2, and B-JNL2 highlight that law enforcement and government supervision are crucial to ensuring compliance with the Forest Code. In this context, B-JNL1 and B-PVT2 stated that stronger law enforcement must be implemented to control land grabbing, which occurs due to the illegal use of CAR and occupation of land with cattle. B-NGO2 is concerned that producers confronting higher environmental standards might increase cattle laundering activities to avoid being detected by the current sanitary traceability system, which can jeopardize its correct operation. Additionally, EU-NGO3 explained that the falsification of CARs and cattle laundering might be exacerbated by producers experiencing difficulties in complying with the regulation within the given time frame. Finally, EU-NGO1 stressed the necessity to work simultaneously on the interconnected issues of land demarcation, indigenous rights, and deforestation. Thus, stronger law enforcement and the control

of existing land demarcation are seen as crucial for environmental preservation. Alternatively, B-JNL1 stressed for agrarian reform in Brazil due to the current corrupt and fraudulent land tenure system.

B-PVT3, B-JNL1, B-GOV2, B-NGO2, and B-NGO6 emphasized the need for an appropriate implementation of the CAR system. Centralized supervision and efficient validation of the CAR register are critical challenges to ensuring the effectiveness of the traceability system. Additionally, B-PVT3 pointed out the bureaucratic hindrance regarding the revision of blocked CARs. Proper analysis and regularization procedures do not happen at the desired speed since few technicians are available considering the high number of irregular CARs.

In another line of discussion, comments from B-GOV2 and B-NGO4 further emphasize the impact of agribusiness lobbying on delaying regulations and influencing legislation. This practice undermines efforts to tackle deforestation, as it is a driver for the expansion of pasture and cropland into the forest and protected areas, including indigenous land (Moutinho et al., 2016).

5.3.2 Multifaceted deforestation reduction strategies

The comments from the stakeholders highlight a multifaceted approach to reducing deforestation in Brazil's cattle production supply chain. This includes strategies to enhance productivity, political and economic incentives, promoting alternative sustainable production methods, and financial support from the EU.

B-GOV2, B-GOV3, and B-NGO2 mentioned that enhancing productivity in existing pasture lands is key to discouraging more deforestation. B-PVT2, B-NGO2, B-GOV1, and B-PVT1 stressed the importance of providing financial and technical assistance for the producers to improve their production techniques and increase productivity. B-NGO5 and B-NGO2 highlighted the importance of enhancing the professionalism of cattle producers and increasing productivity through integrated production methods. B-NGO5 emphasized the negative impacts of unprofessional producers, such as higher costs of production, lower productivity, and extended land occupation. Additionally, public-private partnerships were suggested by B-NGO5 as a means of supporting producers with better production methods.

B-NGO5, B-PVT3, B-NGO2, B-NGO4, B-GOV3, and B-GOV1 suggest that current public policies encourage deforestation. They stated that policies should instead incentivize the maintenance of biomes, ecosystem services, and favor sustainable production. Additionally, B-NGO2 suggests promoting inclusive policies to support non-compliant producers rather than solely relying on punitive measures to

discourage unsustainable practices. B-NGO6, however, emphasizes the importance of strengthening environmental policies and institutions, such as promoting and funding family agriculture policies for small, medium-sized, and traditional producers, noting that the destruction of these creates financial barriers to sustainable production. In addition, B-JNL2 highlights the need for political will to structurally address deforestation, meaning authorities should treat the issue as a priority.

B-NGO3, Bank, B-PVT3, B-GOV2, B-NGO2, B-NGO5, B-GOV1, B-PVT2, and EU-NGO2 mentioned several economic incentives such as tax deductions, private and public credit lines, carbon credits, pricing environmental externalities, and insurance for cattle producers. B-GOV1 suggested creating a tax deduction system to incentivize any producer to implement the traceability system and environmental conservation. Both B-PVT1 and B-NGO5 suggested generating carbon credits as an incentive to avoid deforestation, although B-JNL1 argued that carbon credits and green bonuses are speculative measures, with little proven efficiency. Additionally, B-PVT3 suggested rewarding compliant producers with better credit conditions and creating special credit lines for non-compliant producers with regular control and supervision of their progress. Moreover, B-NGO5 suggested incentivizing producers to try new technologies and methods in cattle farming and providing insurance to minimize financial risk. Further, Bank proposed better financial conditions to stimulate producers to preserve their surplus of legal reserve, thus discouraging legal deforestation. Finally, B-NGO2, B-NGO3, and B-GOV1 stated that premium payments, the extra price paid for regulation-compliant cattle, should be fairly shared among the entire supply chain, and not remain with the multinational exporting companies as currently happens in SISBOV.

One key factor stated by B-JNL1, B-PVT1, and B-NGO1 is the promotion of agroforestry, agroecology, and agrosilvopasture, which can provide an alternative to large-scale commodity commercialization and stimulate the inclusion of local species with economic potential. Similarly, B-NGO4 highlights the importance of supporting the implementation of sustainable extractivism to reduce deforestation. Also, B-NGO1 emphasizes the need for a change in the established mindset and way of doing business in the cattle farming industry, especially for farms raising cattle illegally. Additionally, B-GOV1 suggests incentivizing small-scale holders to diversify their livelihoods and reduce deforestation. Finally, B-JNL2 expressed that more funding, willpower, and knowledge are needed to implement sustainable methods and technology.

B-GOV1, B-NGO4, B-NGO2, EU-NGO3, B-NGO3, and EU-NGO1 have indicated that they are not aware of the EU regulation considering any direct financial support to countries. However, EU-NGO3 and EU-GOV mentioned that there are talks within the EU Commission about the possibility of considering it. Currently, some indirect funds are available, such as those from the Amazon Fund or specific aid from Germany, UK, and Norway, to reinforce traceability systems within the cattle supply chain.

5.3.3 Cooperation and costs for traceability system

Several stakeholders discussed the roles of the public and private sectors, the overall costs, and the need for shared responsibility and cost-sharing regarding the implementation of the cattle traceability system.

B-NGO3, B-NGO2, and B-NGO5 noted the need for cooperation between the public and private sectors, with B-NGO2 specifically suggesting that the public should provide technical assistance while the private sector provides financial incentives. Regarding the responsibility for implementing the traceability system, stakeholders had varying opinions on the issue. B-GOV1 noted that there is a debate on whether the public or private sector should be responsible for the environmental traceability and argued that the private sector should bear the responsibility of complying with the due diligence. A key point mentioned by B-PVT2 is the responsibility of meatpacking industries to impose the same standards for all their suppliers, otherwise leakage of deforestation-linked cattle will happen to industries with lower standards.

Regarding the traceability system's implementation costs, stakeholders have contrasting opinions. B-NGO3 noted that the economic cost of implementing an individual traceability system could be high, while B-PVT2, B-NGO5, B-GOV3, and B-PVT3 stated that individual traceability costs are not expensive. We believe that these contrasting opinions are due to tracking technology, such as GPS or RFID, not being specifically discussed. This is key in terms of costs since GPS technology is on average 8 times more expensive than RFID, given that GPS provides real-time location, requires more components, and higher processing power (Rowe, 2023). However, implementing RFID technology can also be expensive due to the complementing infrastructure to enable cattle tracking, such as RFID readers, licensing, antennas, and maintenance (Halstead, 2020). Additionally, B-PVT3 provided more specific cost information regarding an integrated traceability system based on documents such as GTA, CAR, and territorial information. He stated that this system can be implemented at no cost for the producers, but investment in expanding infrastructure, human resources, and training for national application is needed.

Finally, regarding the cost distribution of implementing a traceability system, EU-NGO1 suggested that compliance costs should be shared among all stakeholders in the cattle supply chain. B-PVT3, EU-NGO3, and EU-NGO2 suggested that the cost should be shared among producers and meatpacking companies, with the latter, which earns the biggest profits, contributing a higher proportion of capital than small producers. In fact, according to B-PVT3, the private sector is willing to cover the costs of the traceability system implementation.

5.3.4 Global Support

Stakeholders expressed varying opinions about the European market's strength to create changes in deforestation patterns. B-PVT2, EU-NGO1, and B-NGO4 believe that the European market is important for cattle products, especially in terms of profits since the highest added-value meat is exported to them. In contrast, B-JNL2 and B-NGO3 think that Europe is not a relevant market, therefore it does not have the power to cause changes in the current dynamics of deforestation.

Seven respondents argued that the regulation is a beginning and that establishing similar regulations by other countries is crucial to create the momentum to effectively reduce deforestation. B-PVT2, EU-NGO1, B-NGO5, B-GOV1, EU-NGO2, and B-GOV3 expressed that the regulation could have more impact if big beef importing countries such as China, US, UK, and Middle Eastern countries were on board. For EU-NGO2 the regulation will have an impact because he sees that the EU has the power to convince other regions to implement similar regulations. For B-GOV3, adherence of other markets is extremely important, otherwise a niche for sustainable products can be created with no effects in reducing deforestation.

To summarize and connect the findings from the three sections, we elaborated a scheme using the lens of the telecoupling framework (Figure 4).

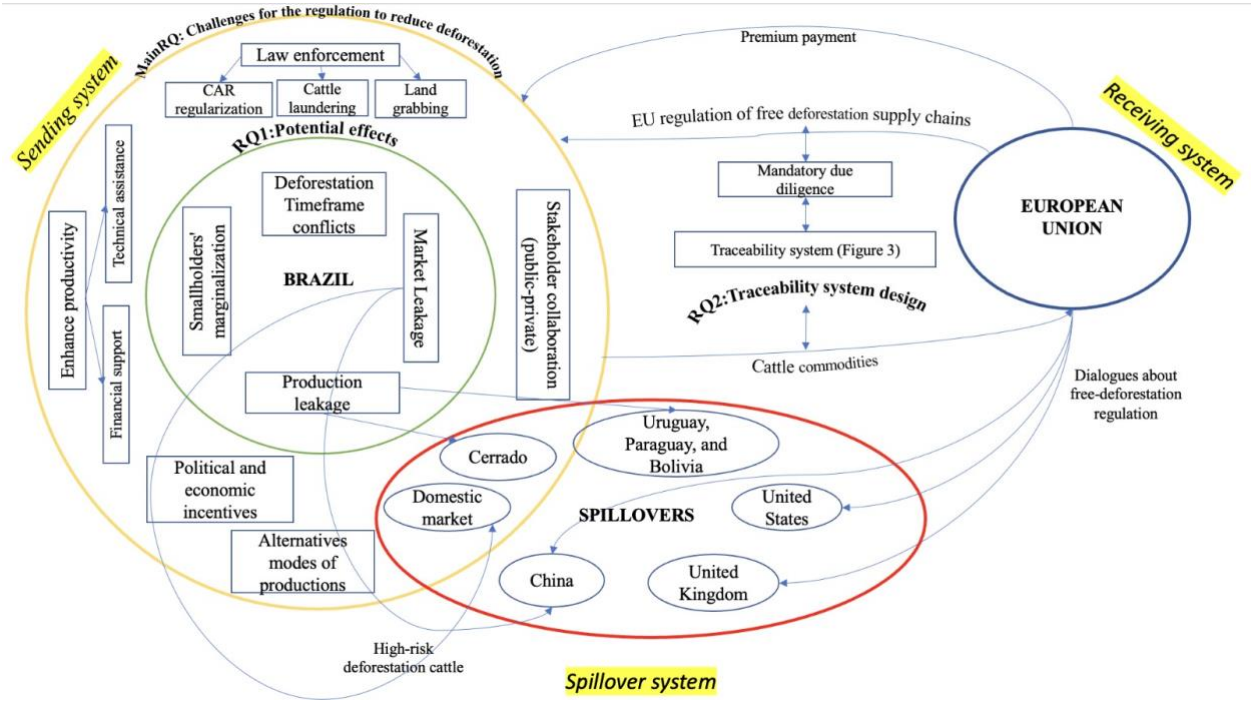

Figure 4: The telecoupling between the European regulation and the Brazilian cattle supply chain.

6. DISCUSSION

6.1 Linking Results to Research Questions

We analyze and interpret the findings in light of the research objectives and provide insights into the research finding's significance. Moreover, we contextualize them by drawing on the telecoupling and foreign corporate accountability concepts, as well as governance theory. Finally, we highlight the limitations of our study and propose potential pathways for future research.

RQ1: How could the regulation potentially lead to political, social, economic, and environmental effects in Brazil and its cattle supply chain?

Stakeholders mentioned six main topics related to the potential effects that the regulation might cause in Brazil. These include market leakage (1), production leakages to other biomes and countries (2), cutoff dates conflict (3), marginalization of small producers (4), unaccountability of financial sector (5), and indifference towards indigenous voices (6).

(1) Applying stricter environmental policies in Brazil that restrict forest conversion to agriculture can lead to increased trade of unsustainable cattle to Brazil's domestic market and countries with looser regulations (Fern, 2023). If the costs of implementing the deforestation-free policy exceed the benefits of

selling cattle to the EU, producers might choose to drop out of the EU market or segregate their products into compliant and non-compliant streams. Similar scenarios have happened such as increased market redirection leakage of palm oil from Indonesia (Wilman, 2019) and higher consumption of coal by regions with looser regulations (Felder & Rutherford, 1993).

(2) Currently, the regulation's definition of 'deforestation' is a key issue being debated. In Brazil, it means that the *Cerrado*, which has already lost 47% of its native vegetation to agriculture (MapBiomas, 2022c), and other biomes would be excluded from the regulation. With stricter environmental legislation in the Amazon, opposers fear that cattle leakage might increase in other biomes or neighboring countries, shifting environmental and social pressures to them (Drost et al., 2022a; OCAA, 2023; Villoria et al., 2022; WWF, 2022).

(3) In general, interviewees agreed that the EU regulation cut-off date will not cause any conflicts with current Brazilian legislation. However, critics argue that the December 2020 cut-off date may represent a setback concerning Brazil's historical political efforts to tackle illegal deforestation (Marzano, 2021; OCAA, 2023). This may happen since farmers who have unlawfully deforested their lands by the regulatory cut-off date may find a way to export their commodities to the EU while violating the domestic Forest Code. Consequently, agribusiness lobbyists may use this as leverage to force Brazilian timeframes to match the EU regulation, granting further amnesty to illegal deforestation occurring between 2008 and 2020.

(4) Equipped with limited resources and lower technical capacity, smallholders may bear a disproportionate burden due to the challenges in adapting to the regulation's due diligence requirements, which would incur additional costs (Drost et al., 2022a; Segara, 2022; Vernier et al., 2022). This could lead to segregation between ranchers who can produce under stricter guidelines and those who cannot. This way, regulation could marginalize smallholders while increasing poverty and inequality in vulnerable communities (Zhunusova et al., 2022).

(5) While financial institutions that lend money to cattle industries, such as BNP Paribas and Deutsche Bank, face no accountability under the EU regulation, critics fear that these institutions will continue to negligently finance and profit from ecosystem destruction, affecting the communities that rely on them (Global Witness, 2021). Hence, these institutions bear responsibility for disrupting livelihoods and violating human rights, leading to the marginalization of vulnerable communities.

(6) With the EU regulation failing to impose a more robust requirement for the respect of international indigenous rights, and thus effectively restricting the import of cattle commodities linked to indigenous rights violations, indigenous people will continue to rely on their national governments for protection. In the case of Brazil, where indigenous communities and leaders have historically endured violence from cattle ranchers, loggers, and land grabbers, the regulation could have made a stronger contribution in preventing tackling the socioenvironmental issues historically faced by them (Fern, 2022; Global Witness, 2022a; Zhunusova et al., 2022).

RQ2: How should the Brazilian cattle supply chain traceability system be designed to ensure deforestation-free products are exported to the EU?

The interviewees' recommendations and suggestions allow us to develop a summarized proposal of seven important features that an efficient cattle traceability system in Brazil should contain. (1) The traceability system should be designed as a unique integrated national system. This necessity arises from the fact that Brazilian State's public entities structure their databases differently and employ different software formats (B-PVT3). Also, meatpacking companies, such as JBS, are currently implementing their own traceability systems. With these diverse settings, it's important to design an integrated system that allows all users (including government, companies, institutions, and cattle producers) to access, input, and manage information. (2) Despite the Ministry of Agriculture representative's differing opinion, there is widespread agreement among stakeholders that the system should be managed and overseen by a public institution, ensuring impartial system management and the authority to supervise and institute law enforcement if illegal activities are detected. (3) Another concern raised was the system's feasibility and the importance of a user-friendly interface. Its feasibility relates to the expenses and degree of technical implementation capacity that would ensure that all stakeholders, from smallholders to large corporations, could adhere to the traceability system. A user-friendly interface will guarantee that all users, especially less educated rural farmers, can access and use the system.

(4) Since tracing cattle from multiple producers to their slaughter requires dealing with a large amount of personal and market-sensitive information, an efficient and secure data protection system is imperative to ensure privacy and fair competition among sector stakeholders. However, interviewees also emphasized the importance of transparency, where users and designated authorities can access and monitor data to ensure the system functions properly and detects illegalities. In light of this issue, one interesting proposal is to set up a two-tier system whereby sensitive information is only accessible to government regulators and designated officials, and non-sensitive traceability data is accessible to all

users and operators. Two other supplementary ideas mentioned the (5) potential use of blockchain technology and the (6) development of a system similar to SERASA. The first would allow safe storage and access to the animal's owners' information and route history, while the latter would aggregate cattle producers' environmental compliance status into a database, allowing cattle buyers to identify non-compliant farmers while protecting their privacy.

(7) Lastly, a compelling suggestion was to provide individual traceability via ear tags solely in high-risk deforestation zones. Since implementing individual traceability technology throughout the country could be costly and challenging, the idea would be to implement this technology only in critical deforestation areas and implement a document-based (cross-checking CAR, GTA, embargoed areas, conservation units, indigenous territories, etc.) traceability system for the rest, thereby reducing the financial and technical burden required for system implementation.

Main RQ: What are the main challenges for reducing deforestation in the Brazilian cattle supply chain?

It is crucial to address the following eight points to overcome key challenges discussed throughout this research and ensure the successful implementation of the EU deforestation-free regulation in the Brazilian cattle supply chain. (1) Stronger law enforcement of the Brazilian Forest Code is necessary to hold those who violate environmental regulations accountable. Furthermore, the possibility of agrarian reform in Brazil to structurally address the problem of deforestation and land tenure should be evaluated. (2) Implementing an effective CAR system to ensure recognized non-compliant farmers are managed swiftly and accurately is critical for monitoring land usage, ensuring recovery of deforested land, and enforcing legislation. (3) Increasing cattle productivity among farmers by improving pasture management, breeding techniques, and technology used to maximize output in existing pastures will reduce the pressure to deforest new areas. (4) Economic incentives, such as tax breaks and subsidies, can encourage sustainable practices among producers, and well-designed public policies must be implemented to promote environmental conservation. (5) Promoting alternative sustainable production methods, such as agroforestry and agrosilvopasture, can help promote systemic transformation in the cattle supply chain by enhancing productivity, promoting biodiversity, soil health, and lowering deforestation. (6) Clearly defining the roles and responsibilities is necessary to ensure all stakeholders understand their tasks within the regulation, guaranteeing clear communication and coordination among everyone. (7) Establishing a cost-sharing strategy would guarantee that the costs of implementing the traceability system are equitably allocated among supply chain participants. (8) Finally,

stronger collaboration among Brazilian stakeholders, support from other countries (via similar regulations), and international support to producing countries are vital for ensuring the regulation's effective implementation and enforcement.

6.2 Linking Results to Framework/Theories

Applying the telecoupling, modes of governance, and foreign corporate accountability framework/theories provided a more comprehensive understanding of the complex relationships and interactions between the agents and systems involved in the Brazilian cattle supply chain. With the telecoupling framework, we unveiled the challenges and flows that the EU regulation would cause in Brazil and the connection to other countries. This is crucial to understand the governance challenges and accountability process that stakeholders will face when the regulation enters into force.

A combination of hierarchical, network, and market modes of governance is necessary to govern the challenges faced by the EU regulation and effectively decrease deforestation in the Brazilian cattle supply chain. In the context of hierarchical governance, findings reveal the State's pivotal role in guiding behavior and promoting sustainable practices to stop deforestation. This is evident in the reliance on government agencies and regulatory authorities to set rules, enforce compliance, and strengthen government supervision to stop cattle laundering, land-grabbing, and illegal deforestation, thus ensuring adherence to the Forest Code. This is in line with other research findings, where strengthening law enforcement and public policies have been found to be effective in curving deforestation in the Brazilian Amazon (Arima et al., 2014; Tacconi et al., 2019). Furthermore, instruments such as policies promoting sustainable cattle production and support for non-compliant producers further highlight the government’s role in implementing and enforcing regulations. Lastly, the importance of other countries establishing similar regulations emphasizes the focus on top-down coordination and control.

Related to network governance, findings highlight the importance of collaboration, partnerships, and knowledge sharing among various stakeholders to address deforestation. Public-private partnership is crucial to provide technical and financial support for smallholders to comply with the regulation. Collaborative methods such as agroforestry, agroecology, and agrosilvopasture are also proposed. To implement the traceability system, private and public partnership based on shared responsibility and cost-sharing among different stakeholders is needed. The interviewees also emphasize the importance of collaboration and coordination among countries such as China, US, and the UK to adhere to similar regulations and build momentum for changes to stop deforestation. A study shows that public-private

partnerships allow governments to align domestic public policies with supply chain initiatives to reduce deforestation, which leads to enhanced multistakeholder engagement and policy synergies (Furumo & Lambin, 2020). However, unbalance of power dynamics in private-public multi-stakeholder initiatives within the governance of large supply chains might shadow the social, environmental, and economic goals of vulnerable actors in the supply chain (Gustafsson et al., 2022), and exacerbate market and production leakages (Panwar et al., 2023).

In terms of market governance, the findings highlight the importance of economic incentives and market forces to stop deforestation. Tools such as tax deductions, credit lines, carbon credits, and pricing environmental externalities are proposed as incentives to encourage compliance with the regulation and promote sustainable cattle production. For example, some of these financial instruments have been used as a strategy to promote sustainable methods of production in the State of Mato Grosso (Silva et al., 2017). The fair sharing of premium payments throughout the supply chain is also highlighted. Notably, economic interests and lobbying efforts can also impact governance outcomes, as seen in the influence of agribusiness lobbying on delaying regulations and influencing legislation (Moutinho et al., 2016). Finally, findings suggest that the market could adapt and influence deforestation outcomes, for example through market leakages or by transforming Europe into a niche market for deforestation-free cattle commodities.

Using the lens of foreign corporate accountability, the EU regulation is based on a state-centric discourse where operators who want to place cattle products in the European market are subject to government sanctions and required to provide mandatory due diligence, risk control and prevention, and traceability of the entire supply chain to ensure that the products are deforestation-free (EU Regulation 2021/0366, 2021; Gustafsson et al., 2022). Based on the findings, meatpacking exporting companies will need to consider the implications of the regulation to ensure compliance while minimizing their negative socioeconomic and environmental impacts. However, the challenges that meatpacking companies may face in adhering to regulations may push them to resort to market leakage and dislocate the negative impacts of cattle production to other less regulated regions, which could have implications for their accountability.

Furthermore, the request for tracing the whole supply chain poses an enormous challenge, since meatpacking companies have historically failed in tracing the indirect suppliers. Generally, this is a key issue why voluntary commitments adopted by transnational companies have failed in addressing

deforestation (Garrett et al., 2019). The regulation pushes companies to implement an effective traceability system able to geolocate cattle from birth-to-slaughter while contemplating environmental data to detect deforestation. The transparency and accessibility of cattle suppliers' and meatpacking companies' data are key for certified institutions and government agencies to assure accountability. However, data protection is necessary to safeguard producers' sensitive and private information and avoid conflicts of interest.

As previously discussed, another point of controversy is the failure to demand accountability of financial institutions due to the sector's exclusion from present regulation. In the context of the cattle supply chain in Brazil, this is extremely important, since foreign financial institutions have made billions in profits from agribusiness companies in the last years (Global Witness, 2021).

Finally, it is interesting to see how a regulation that intends to make private companies accountable triggers a variety of systemic interactions that imply the involvement of public institutions to ensure compliance. This suggests the importance of applying a polycentric governance approach to the cattle supply chain, where transnational mechanisms are mixed with national and subnational public and private regulatory spaces to shape sustainability (Oberlack et al., 2018). Additionally, the regulation challenges the sovereignty of Brazilian legislation in deciding that legal deforestation will not be allowed anymore, requiring stakeholders in the cattle supply chain to act above their own national law.

6.3 Research Limitations

The first limitation of this study is that we do not distinguish between different types of cattle commodities, including live cattle, fresh and frozen meat, raw hides, and leather. Because these different products may have specific traceability features, this limitation could impact the results. Since the focus was primarily on beef products and their participation in the European market, this lack of differentiation may impact the analysis of market leakages. Leather, for example, is not included in the SISBOV system, making it more difficult to trace, and has a bigger market share of export to Europe than beef products, making market leakages of leather products less likely in comparison to beef. This restriction may influence the findings' comprehensiveness, since various stakeholders may have different viewpoints and interests based on the individual cattle commodity they are involved with.

A second limitation is that the meatpacking companies ignored our petitions for interviews. This limitation could impact the findings, as insights from meatpacking companies would have been

particularly important to understand how they are currently implementing traceability systems, providing support to producers, and their willingness to collaborate in a public-private partnership.

A third limitation is that the specificities between legal and illegal deforestation were not addressed within the result's analysis and discussion. Addressing legal deforestation, for example, may require legislative measures to promote sustainable land use practices, while addressing illegal deforestation may require law enforcement and measures to combat illicit logging and land-grabbing. Distinguishing between these two types of deforestation is relevant since the drivers, impacts, and potential solutions may differ significantly, influencing the analysis of economic and political incentives, as well as governance strategies to reduce deforestation.

Finally, another obstacle regarding the research was the lack of data collection from indigenous and traditional communities representatives. Unfortunately, attempts to contact the Articulation of the Indigenous People of Brazil (APIB) and National Indigenous People Foundation (FUNAI) were not successful. As a result, a better understanding of their concerns and positions on the subject was not acquired and not reflected in this research.

6.4 Directions for Future Studies

Based on the findings of this study, future research could delve deeper into strategies to avoid market leakage if other nations do not establish similar regulations. Furthermore, studies must closely monitor potential mechanisms of production leakage and their consequences for other biomes, with a focus on the Cerrado. This would provide scientific evidence to include other biomes in the regulation. Furthermore, a cost-effectiveness analysis of technologies for developing individual traceability systems could be conducted to better understand their economic viability in detecting cattle linked to deforestation. Additionally, more research and development of sustainable and enhanced cattle and agricultural production methodologies would provide additional alternatives to avoid further environmental destruction. Finally, given the difficulties in reducing deforestation in the cattle supply chain, more research is needed to incorporate a differentiated understanding of the mechanisms for preventing legal and illegal deforestation and better address efforts to achieve a deforestation-free cattle supply chain.

7. CONCLUSION

This master thesis provides a comprehensive analysis of the main challenges to be addressed for the implementation of the EU deforestation-free regulation in the Brazilian cattle supply chain. It also explores the potential socioenvironmental, economic, and political effects of the regulation and recommends features for an efficient cattle traceability system. Our findings reveal eight main challenges that must be addressed to achieve the deforestation commitments, along with six potential impacts the regulation may instigate in Brazil. Furthermore, to fulfill the regulation's geolocation requirements and ensure transparency, data protection, and management in the cattle supply chain, seven features are proposed for designing an effective birth-to-slaughter cattle traceability system.

Overall, it is evident that the issue of deforestation in the Brazilian cattle supply chain is a complex problem and despite the potential of the EU regulation to reduce deforestation, its success relies on the effective cooperation of national and international stakeholders, and the application of comprehensive governance and accountability mechanisms for meatpacking companies. Specifically, stronger law enforcement, land tenure regularization, reduction of agribusiness' lobby influence in Brazilian politics, and scaling up methods of sustainable cattle and agricultural production are crucial to envision a deforestation-free cattle supply chain. Moreover, financial support must focus not only on providing money for developing the traceability system but also on giving producers the capacity to enhance their cattle productivity or explore other sustainable cattle and agricultural production methods that ensure their well-being. Finally, it is crucial for other countries, such as the US and China, to implement similar regulations, and expand the protection to other non-forest biomes to avoid market and production leakages.

As the first of its kind, the EU regulation is undoubtedly an important step towards tackling the problem of deforestation, however, it is naive thinking that the regulation alone will overcome the systemic problem of deforestation caused by cattle commodities production in Brazil. Our findings show that if European and Brazilian governments, cattle producers, and meatpacking companies are not able to address structural challenges, minimize spillover effects, and implement an effective birth-to-slaughter traceability system, the EU regulation will unlikely contribute to reducing cattle commodities-related deforestation.

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ANNEXES

ANNEX 1: LAND OCCUPATION IN BRAZIL (Source: Embrapa, 2019)

	Land Use Category	% of Brazil Area	Agg. %
Native Vegetation Cover	Preserved Native Vegetation in Private Rural Properties (Legal Reserves and Areas of Permanent Preservation)	25.60%	66.30%
	Official Conservation Units	10.40%	
	Indigenous Territories	13.80%	
	Native Vegetation in Non-allocated Public Land	16.50%	
Rural Activities	Native Pastures	8.00%	30.20%
	Planted Pastures (Cattle Ranching)	13.20%	
	Crop Lands (Agriculture)	7.80%	
	Planted Forests (Silviculture)	1.20%	
Urban	Urban Areas & Infrastructure	3.50%	3.50%
Total			100.00%

ANNEX 2: LIST OF STAKEHOLDERS INTERVIEW

ID	Date of Interview	Place	Name of the institution	Acronym
1	07-02-23	SãoPaulo	Brazilian NGO	B-NGO1
2	10-02-23	Online	Instituto para o Desenvolvimento Humano (IDH)	B-NGO2
3	14-02-23	Online	Brazilian bank	Bank
4	15-02-23	São Paulo	Votorantim	B-PVT1
5	15-02-23	São Paulo	Amigos do Terra	B-NGO3
6	16-02-23	Online	De Olho nos Ruralistas	B-JNL1
7	17-02-23	Online	Repórter Brasil	B-JNL2
8	23-02-23	Online	AidEnvironment	EU-NGO1
9	28-02-23	Brasilia	Instituto Sociedade, População e Natureza (ISPN)	B-NGO4
10	02-03-23	Brasilia	Associação Brasileira das Indústrias Exportadoras de Carne (ABIEC)	B-PVT2
11	03-03-23	Brasilia	Ministério da Agricultura, Pecuária e Abastecimento (MAPA)	B-GOV1
12	03-03-23	Brasilia	Brazilian Governamental Institution	B-GOV2
13	07-03-23	Online	Instituto do Homem e Meio Ambiente da Amazônia (IMAZON)	B-NGO5
14	08-03-23	Brasilia	Instituto de Estudos Socioeconómicos (INESC)	B-NGO6
15	21-03-23	Online	Ministério Público Federal (MPF)	B-GOV3
16	22-03-23	Online	Profundo	EU-NGO2
17	22-03-23	Brussels	Fern	EU-NGO3
18	23-03-23	Brussels	European Commission	EU-GOV
19	05-04-23	Online	Inteligência Territorial	B-PVT3

ANNEX 3: QUESTIONNAIRE

Contextual: Have you heard about the EU deforestation-free supply chains regulation? To what extent have you and your institution been involved in discussions related to the EU deforestation-free supply chains regulation?

Contextual: Você já ouviu falar sobre a regulamentação da UE para cadeias de abastecimento sem desmatamento? Até que ponto você e sua instituição estiveram envolvidos em discussões relacionadas com a regulamentação da UE sobre cadeias de abastecimento sem desmatamento?

What kind of potential trade-offs or unintended consequences the regulation might have once it comes into effect? Do you think it's possible a market shift/segregation to countries with weaker socio-environmental regulation might occur? Do you believe that a similar regulation (geo-localization, due diligence, risk analysis) could be implemented to the Brazilian internal market?

PBR: Que tipo de possíveis trade-offs ou consequências não intencionais o regulamento pode ter uma vez que entre em vigor? Você acha que é possível uma mudança/segregação de mercado para países com regulamentação socioambiental mais fraca? Você acredita que uma regulamentação semelhante (geolocalização, due diligence, análise de risco) poderia ser implementada no mercado interno brasileiro?

Do you see any positive or negative impacts related to the exclusive focus on forests of the regulation? Do you see risks for other ecosystems to suffer impacts due to the dislocation of pressures from the Amazon (e.g., the Cerrado and other biomes are not included in the EU regulation (definition of forest)?

PBR: Você vê algum impacto positivo ou negativo relacionado com o foco exclusivo nas florestas do regulamento? Você vê riscos de outros ecossistemas sofrerem impactos devido ao deslocamento de pressões da Amazônia (por exemplo, o Cerrado e outros biomas não estão incluídos na regulamentação da UE (definição de floresta)?

The EU regulation obligates companies to comply with the regulation rules (no sourcing of cattle from areas deforested after 2020) and the local country's laws, however it overlooks treaties such as the TAC da Carne and the CPP (which set agreements of no cattle sourcing in deforested, illegal labor and embargoed areas after 2008). Regarding this, do you see that this can create conflicts within the national context?

PBR: A regulamentação da UE obriga as empresas a cumprir com as regras da regulamentação (não fornecimento de gado de áreas desmatadas após 2020) e com as leis locais do país, no entanto, ela ignora tratados como o TAC da Carne e o CPP (que estabelecem acordos de não fornecimento de gado em áreas desmatadas, trabalho ilegal e áreas embargadas após 2008). Com relação a isso, você vê que isto pode criar conflitos dentro do contexto nacional?

What is the current state of progress regarding the due diligence/traceability of companies? What are the difficulties you see for companies/public institutions to implement stronger due diligence with a focus on deforestation in Brazil?

PBR: Qual é o estado atual do progresso no que diz respeito à devida diligência/rastreabilidade das empresas? Quais são as dificuldades que você vê para que as empresas/instituições públicas implementem a devida diligência no Brasil?

Given the land extension, cattle mobility and a robust integrated information systems needed (fusion of CAR, GTA, IBAMA Embargo, Conservation and Protected Units, etc), in your view, how should the traceability system be designed? Which features should the information system have in order to be auditable and transparent? (*Selo verde)

PBR: Dada a extensão da terra, a mobilidade do gado e um robusto sistema de informação integrado necessário (fusão de CAR, GTA, IBAMA Embargo, Unidades de Conservação e Protegidas, etc.), em sua opinião, como deve ser projetado o sistema de rastreabilidade? Que características o sistema de informação deve ter para ser auditável e transparente? (*Selo verde)

In monetary terms, who will bear the costs of the implementation and operation? How should the Public and Private sectors provide technical and financial support to help small/medium producers to implement the traceability system?

PBR: Em termos monetários, quem suportará os custos de implementação e operação? Como os setores público e privado devem fornecer apoio técnico e financeiro para ajudar os pequenos/médios produtores a implementar o sistema de rastreabilidade?

Taking into account that sometimes farmers / ranchers' livelihoods rely on certain culturally embedded unsustainable practices. How should producers be incentivized to stop, on the one hand illegal deforestation, and on the other hand legal deforestation?

PBR: Levando em conta que, às vezes, o sustento dos agricultores / fazendeiros depende de certas práticas insustentáveis culturalmente incorporadas. Como os produtores devem ser incentivados a deter, por um lado, o desmatamento ilegal e, por outro lado, o desmatamento legal?

Do you see any financial, technical support from the EU towards Brazil to implement this new law? Is the EU engaged in supporting reforestation initiatives or reparation for the territories?

PBR: Você vê algum apoio financeiro e técnico da UE em relação ao Brasil para implementar esta nova lei? A UE está empenhada em apoiar iniciativas de reflorestamento ou reparação para os territórios?

What socioeconomic impacts, for example livelihoods and inequality, do you think the regulation might have in Brazil and Europe? Do you think that the EU regulation can marginalize small producers that won't be able to adapt or generate land concentration from the bigger companies which are seeking cattle grown in compliant lands?

PBR: Que impactos socioeconômicos, por exemplo, a subsistência e a desigualdade, você acha que a regulamentação pode ter no Brasil e na Europa? Você acha que a regulamentação da UE pode marginalizar os pequenos produtores que não serão capazes de se adaptar ou gerar concentração de terras das grandes empresas que buscam gado cultivado em terras conformes?

In relation to the financial system, who finance the big meatpacking company's operations, how do you think the government should engage with this sector since they are out of regulation and cannot be held accountable? Is it possible to hold them accountable, perhaps by other means?

PBR: Em relação ao sistema financeiro, quem financia as operações da grande empresa de frigoríficos, como você acha que o governo deveria se envolver com este setor, uma vez que eles estão fora de regulamentação e não podem ser responsabilizados? É possível responsabilizá-los, talvez por outros meios?

Considering that the traceability system works 100%, the external market will increase demand for cattle, and the productivity challenges that climate change will bring, do you believe that the current regulation will be able to help decrease deforestation and forest degradation in the next years and long-term future?

PBR: Considerando que o sistema de rastreabilidade funciona 100%, o mercado externo aumentará a demanda de gado e os desafios de produtividade que a mudança climática trará, você acredita que a regulamentação atual será capaz de ajudar a diminuir o desmatamento e a degradação das florestas nos próximos anos?

ANNEX 4: ADAPTED QUESTIONNAIRES

I - BRAZILIAN BANK

Contextual: How do you define your bond/relation/participation to the EU deforestation-free supply chains regulation?

What would be the role of the bank in the implementation of the EU deforestation-free supply chain regulation?

PBR: Qual seria o papel do banco na implementação da regulamentação da cadeia de abastecimento livre de desmatamento da UE?

According to the Amazon plan launched in June 2020, one of the prioritized points is to tackle deforestation associated with beef production. In this sense, what is the roadmap to fulfill the goals that the bank has defined to reduce deforestation ? What is the progress of this initiative so far?

PBR: De acordo com o plano amazónico lançado em Junho de 2020, um dos pontos prioritários é o combate ao desflorestamento associado à produção de carne bovina. Neste sentido, qual é o roteiro para cumprir os objetivos que o banco definiu para reduzir o desflorestamento? Qual é o progresso desta iniciativa até agora?

Banks play a key role in reducing deforestation by pushing companies to fulfill deforestation commitments. How does the bank make sure that meatpacking industries are compliant regarding deforestation-free supply chains? What is the bank position when it comes to finance meatpackers that have been linked to deforestation in their supply chain?

PBR: Os bancos desempenham um papel fundamental na redução da desflorestação ao pressionar as empresas a cumprir os compromissos de desflorestação. Como é que o banco se certifica de que as indústrias de empacotamento de carne estão em conformidade com as cadeias de fornecimento sem desflorestamento? Qual é a posição do banco quando se trata de financiar os produtores de carne que foram ligados ao desflorestamento na sua cadeia de abastecimento?

How can the bank support the producers in implementing the traceability system?

PBR: Como pode o banco apoiar os produtores na implementação do sistema de rastreabilidade?

The bank published an analysis stating that since meatpacking companies' income is only 2% from the EU, the regulation will not impact the companies. In a sense, this statement goes against the overall effort to implement an effective compliance regarding deforestation. This is not against the bank's environmental commitment towards ending deforestation in Brazil?

PBR:O banco publicou uma análise afirmando que, uma vez que o rendimento das empresas de embalamento de carne é apenas 2% da UE, que o regulamento não terá impacto nas empresas. De certa forma, esta declaração vai contra o esforço global para implementar um cumprimento efectivo no que diz respeito à desflorestação. Isto não é contra o compromisso ambiental do banco no sentido de acabar com o desflorestamento no Brasil?

How can the private sector help to stop illegal deforestation?

PBR: O setor privado pode ajudar a conter o desmatamento ilegal de áreas?

II - VOTORANTIM

Contextual: How do you define your bond/relation/participation to the EU deforestation-free supply chains regulation?

How can forest conservation be fostered in order to avoid deforestation from productive agriculture? In what kind of projects is Votorantim engaged to fulfill this task? How do you see the commitment of the communities in forest conservation projects?

PBR: Dado que a Votorantim está envolvida para conservação de florestas? Como pode ser fomentada a conservação das florestas para evitar o desmatamento da agricultura ou agropecuária? Como você vê o comprometimento das comunidades em projetos de conservação florestal?

What should be the role of Public and Private sectors in providing technical and financial support to help small/medium producers to (implement the traceability system) adapt to the new regulation?

PBR: Qual deveria ser o papel dos setores público e privado no fornecimento de apoio técnico e financeiro para ajudar os pequenos/médios produtores a se adaptarem à nova regulamentação ou no caso, para estabelecer uma cultura de preservação?

Due to the limited amount of compliant land available for the different economic activities, do you think that the EU regulation can marginalize small producers that won't be able to adapt or generate land concentration from the bigger companies which are seeking for cattle grown in compliant lands?

PBR: Devido à quantidade limitada de terras conforme disponíveis para as diferentes atividades econômicas, você acha que a regulamentação da UE pode marginalizar os pequenos produtores que não serão capazes de se adaptar ou gerar concentração de terras das grandes empresas que estão procurando por gado cultivado em terras conformes?

III - MEMBER OF THE EU COMMISSION

1.- How will the EU support the Brazilian institutions (either private or public) in implementing the EU deforestation-free products regulation in the cattle supply chain? Specifically speaking about the small and medium producers, who will have more difficulties adapting, is there any specific support measures to help these stakeholders to adapt?

2.- Due to the large shortcomings of the current self-declaratory system related to the CAR and GTA documents, how does the EU Commission envision a traceability system specifically for cattle commodities? What features must the traceability system include in order to be auditable, transparent, and trustworthy?

3.- What is the exact information that will be required for the operators in the due diligence statement and risk assessment?

4.- Will the revision time for including other biomes such as the Cerrado be maintained in light of the controversies of possible dislocation of pressures?

5.- How is the EU Commission planning to convince other large importing countries of cattle products to adopt similar regulations to govern the cattle supply chain and thus avoid market leakages?

6.- Until to what extent the voices from Brazilian stakeholders were considered to draft the regulation? How many participated? Were indigenous and traditional communities meaningfully consulted?

ANNEX 5: STATISTICS OF RESPONDENTS FOR EVERY QUESTION

(STAKEHOLDERS FROM ADAPTED QUESTIONNAIRES NOT INCLUDED)

Q #	B-NGO1	B-NGO2	B-NGO3	B-JNL1	B-JNL2	EU-NGO1	B-NGO4	B-PVT2	B-GOV1	B-GOV2	B-NGO5	B-NGO6	B-GOV3	EU-NGO2	EU-NGO3	B-PVT3	Response %
1	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	94%
2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	100%
3	x		x	x	x	x	x	x	x	x	x		x	x	x	x	88%
4	x	x	x	x	x		x	x	x	x	x			x	x	x	81%
5		x	x	x		x	x	x	x	x	x	x	x	x	x	x	88%
6	x	x			x			x	x		x		x	x	x	x	63%
7	x	x	x	x			x	x	x		x	x	x	x	x	x	81%
8		x	x			x	x	x	x				x	x	x		56%
9		x	x	x			x	x	x		x	x	x		x	x	69%
10		x	x	x			x		x		x			x	x		50%
11		x	x		x	x	x	x	x	x	x		x	x	x	x	81%
Total	6	10	10	8	6	6	10	10	11	6	10	4	9	10	11	9	