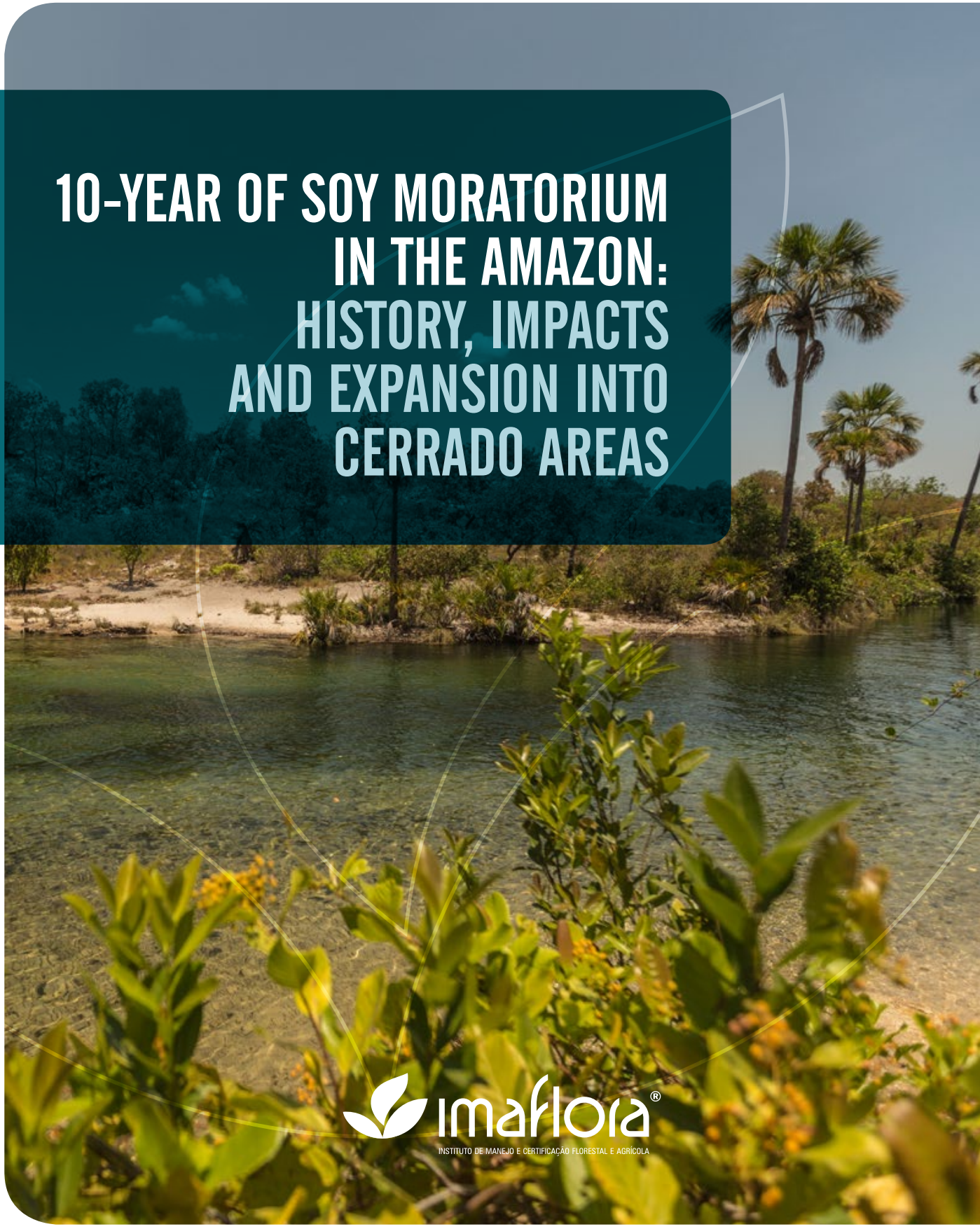
10-YEAR OF SOY MORATORIUM IN THE AMAZON: HISTORY, IMPACTS AND EXPANSION INTO CERRADO AREAS



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INDEX

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THE SOY MORATORIUM IN THE AMAZON BIOME

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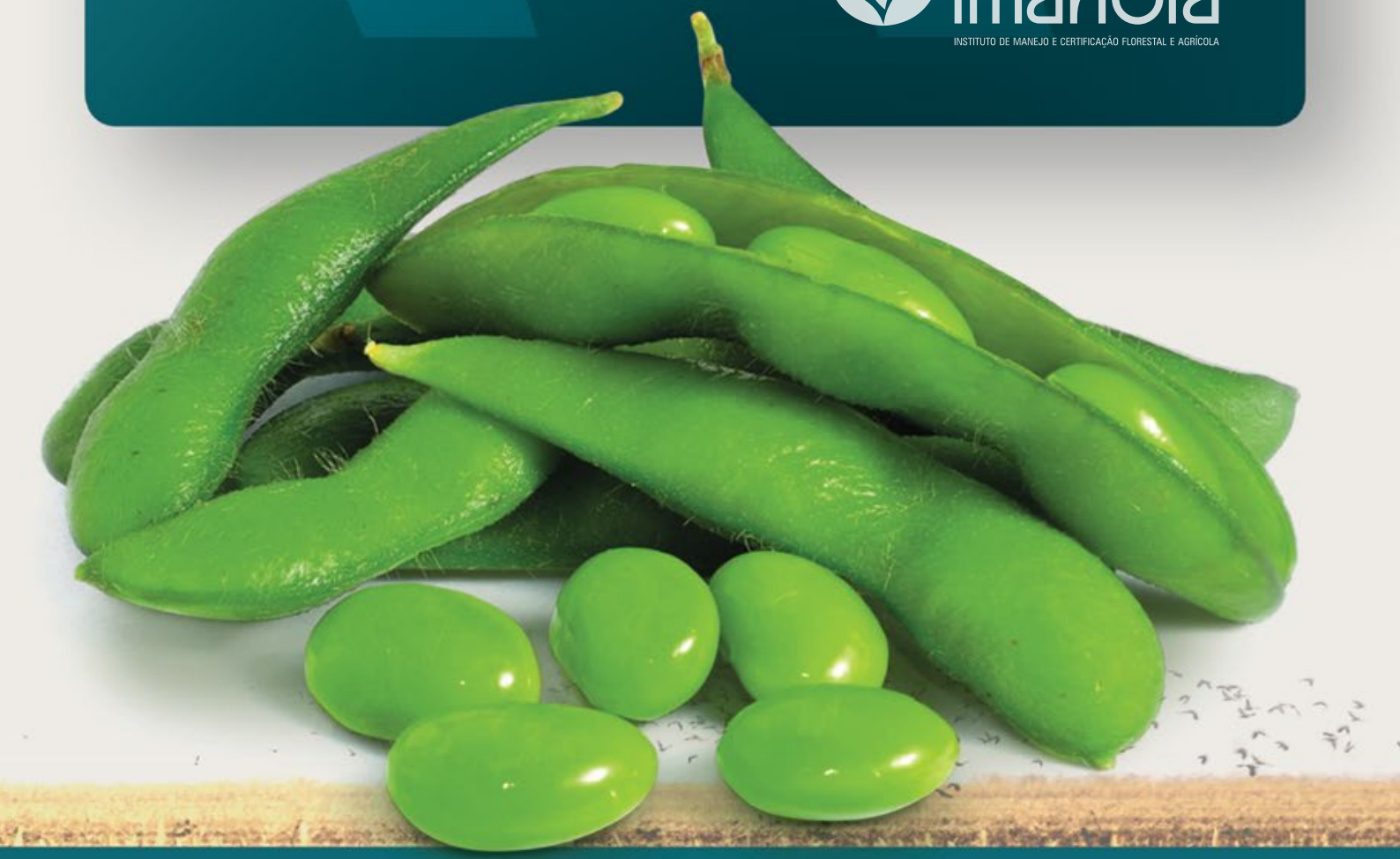


An example to be replicated

The Soy Moratorium is a major zero deforestation commitment for the preservation of rain forests. It is a voluntary agreement made by the soybean production chain with the aim of putting an end to deforestation to make way for soybean crops in the Amazon biome by making sure that soybean trading companies will not buy raw materials produced in areas deforested after 2008.

The Moratorium was established in 2006, after the Greenpeace report (1) Eating up the Amazon pointed out that soybeans were being increasingly grown in the Amazon biome and had become a major driver of deforestation in the area. The report warned about a stark increase in deforestation in 2004 and 2005 and indicated that transnational commodity traders and food companies in Europe were co-responsible for the expansion of soybean crops into the Amazon region.

The main factor that drove the expansion of soybean crops into the Amazon biome was the implementation of infrastructure projects in the early 2000s with the original purpose of supporting the domestic agricultural sector in its storage and transportation needs and of offering competitive advantages to it on the international market. These projects were initially implemented mainly in the north region of Mato Grosso state, where port and road infrastructure projects led to a land rush for new crop areas in spite of the legal, social, and environmental issues involved.

PRODUCTION FLOW AXIS (AND FOREST)

The development of infrastructure with the aim of providing access to international markets was the main cause of the expansion of soybean crops into the Amazon biome. Nearing completion, the BR-163 highway - or the "soya highway" - is a highway connecting consolidated crop areas in central Brazil to the Santarém port in the northern Amazon region. The construction of the highway opened the doors of the region to a "development" process bedeviled by corruption, land grabbing and the establishment of large farms (Greenpeace 2016).

TRANSPORTATION INFRASTRUCTURE FOR SOYBEANS AND DEFORESTATION FRONTS IN 2006

The embarrassment caused by the Greenpeace campaign forced European soybean consumers to react in the face of findings of research into the custody of soybeans between farms with deforested areas in the Amazon region and retail networks. The illegality of the situation, as confirmed by their demonstrated complicity in deforestation acts, forced them to take a firm stand against the value chain and in favor of civil society, resulting in the establishment of the European Soy Consumer Group led by McDonald's and in a call for soybean traders to establish mechanisms to put an end to deforestation in the supply chain.

On July 24, 2006 the Brazilian Association of Vegetable Oil Industries (ABIOVE) and the National Association of Grain Exporters (ANEC) signed a Two-Year Soy Moratorium under which companies affiliated to those organizations and signatory companies took on the commitment not to buy soybeans grown on land cleared from forests from that date. It was time to develop and implement governance alternatives to ensure minimum sustainability criteria in the soybean chain.

Thus, companies represented by the president of ABIOVE, Carlo Lovatelli, and civil society organizations represented by Paulo Adário, Senior Forest Strategist for Greenpeace, launched the successful initiative of the Soy Moratorium.

Multistakeholder governance model – Dialogue for solutions

The Moratorium was then led by the Soy Working Group (GTS), a multistakeholder dialogue forum where agreements and mechanisms for monitoring and evaluating the Moratorium are negotiated, defined and reviewed, i.e. where the agreement on zero deforestation in the chain within the Amazon biome was made possible and continues to be monitored to this day.

Initially, the Soy Working Group (GTS) was only made up of representatives of civil society organizations and of companies affiliated to ABIOVE and ANEC. However, as of 2008, the year of the first renewal of the Moratorium, a major and key actor became a signatory to the initiative, namely, the Brazilian Government. The signature of the Brazilian federal government strengthened the commitments of the parties involved and raised the dialogue to a new decision-making and influence level, paving the way for the development of long-term strategies. As a result, the National Institute for Space Research (INPE) was also involved with the aim of supporting and validating the geospatial monitoring of the commitment, as well as Banco do Brasil, a long-time funder of the Brazilian agricultural sector, and the European Soy Consumer Group represented by Carrefour.

The Soy Moratorium was renewed annually in the following seven years. These processes paved the way for rich discussions on how to improve the agreement on an ongoing basis, including through gradual improvements in its monitoring and transparency system, adjustments in the new Forest Code of 2012, when the Moratorium reference date was changed from July 24, 2006 to July 22, 2008 (the date of the amnesty for deforestation), and a decision recently made in May 2016 to keep the Soy Moratorium in force indefinitely. All the results achieved clearly show the level of maturity of the GTS and of the dialogue held in it during these 10 years of hard and remarkable work, achievements and learning.

MAIN CRITERIA OF THE COMMITMENT FOR GUIDING COMPANIES ON THE RENEWAL OF THE SOY MORATORIUM ON THE AMAZON BIOME, MAY 2016

Article 2 - ABIOVE - Brazilian Association of Vegetable Oil Industries - and ANEC - National Association of Grain Exporters - have taken the commitment to:

a. *Not sell, purchase and finance soy from areas deforested in the Amazon biome after July 2008, as well as from areas included in IBAMA's list of embargoed areas due to deforestation and/or from areas included in the list of the Brazilian Ministry of Labor and Employment (MTE) of areas where labor in slave-like conditions prevails according to the conditions described in this agreement.*

b. *(...)*

c. *Carry out external audits into soybean purchases by affiliated companies in the harvest year (from July to June) and make the results available to the Soy Working Group.*

d. *Look for feasible solutions to improve the monitoring of soybean purchases from indirect suppliers.*

e. *Request confirmation of registration with the CAR (Rural Environmental Registry) for purchase and financing operations as of now, indicating that from the 2017-18 season, in line with the legal provision for financial institutions, they will no longer purchase soy from farms not registered with the CAR.*

Article 5 - This agreement shall remain in force until the Soy Moratorium is no longer necessary.

Credibility of the Soy Moratorium – The Assurance System that sustains it

The Soy Moratorium initiative is organized around a monitoring, reporting and verification system structured into two core and complementary tools designed to ensure the enforcement of the provisions of the GTS Term of Commitment.

These tools consist in spatial analysis and monitoring for detecting areas that were recently deforested to make way for soybean crops in the Amazon biome and independent verification of companies to check whether they are complying with the provisions of the Moratorium, i.e. to validate their compliance with the commitment not to buy soybeans from farmers included in the list of blocked areas due to deforestation, slave labor and environmental embargo.

Monitoring of soybeans grown in deforested areas – technology in favor of the Amazon region

The Agrosatélite company carries out spatial analysis and monitoring of municipalities and uses a combination of images from sensors with different spatial and temporal resolutions obtained during the crop cycle to identify and map out soybean areas with a high success rate, including areas where soybeans are being grown that were cleared after July 2008. This monitoring uses deforestation data from PRODES/INPE and the GTS determined that polygons of 25 hectares or more are to be monitored, whether individual or created as a consequence of smaller groupings resulting from sequential deforestation and deforestation in different years (2). It should be noted that the actual existence and accuracy of soybean polygons cleared after 2008 are audited by INPE.

During these 10 years of the Moratorium the space monitoring system adopted different technological approaches as the available tools and methodologies were improved and their effectiveness increased year after year.

In the first three years of deforestation monitoring, the methodology only allowed for the sampling of polygons with more than 100 ha of deforested area, which was a crucial ini-

1 INPE. Disponível em: <http://www.obt.inpe.br/prodes/index.php>.

THE MORATORIUM REORIENTED LAND USE IN THE BIOME BY OPTIMIZING THE USE OF ALREADY CONSOLIDATED AREAS AND PROTECTING THE FOREST

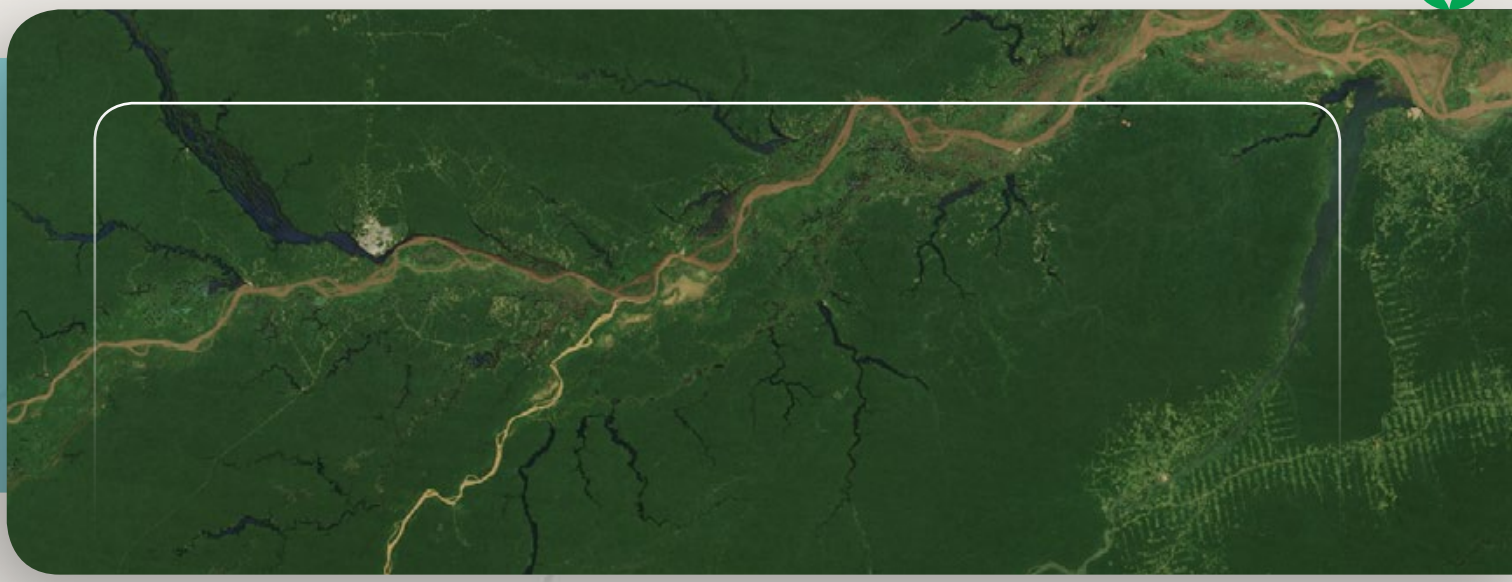
tial effort for learning and developing the technological base for the current monitoring. In addition, areas identified as deforested were checked in the field for validation purposes. Under such conditions, the methodology only made it possible to identify non-compliant areas in a small number of municipalities, but it did send the message to the value chain that deforestation would not be tolerated any longer.

From the 4th year on, the monitoring methodology covered 100% of polygons of PRODES/INPE, adopted the agricultural calendar for evaluating areas with deforestation, included the criterion of not monitoring rural settlements and began to consider all polygons with soybean crops covering more than 25 ha. As a result of these improvements, the number of monitored municipalities and polygons increased in the three states contemplated in the Moratorium (Mato Grosso, Pará and Rondônia).

As the monitoring increased its capacity for action, soybean growing in the biome also evolved to occupy more space and cause more soil changes in the biome, evincing all its potential as a driver of deforestation. However, the results of the monitoring made it possible to see that the Moratorium led soybean growing in the biome to expand mainly into pasture areas with agricultural potential, i.e. the Moratorium reoriented land use in the biome by optimizing the use of already consolidated areas and protecting the forest.

In the evaluation cycles that followed the 2013/14 harvest, the methodology that was developed reached such a high level of security and assertiveness that it made it possible to eliminate the exhausting, risky and costly aerial monitoring and ground check stage. A new level of reliability was achieved.

For identifying areas with soybean crops in deforestation polygons, the Crop Enhanced Index is used, which is a vegetation index that can highlight the annual crops amid other land uses in satellite images.

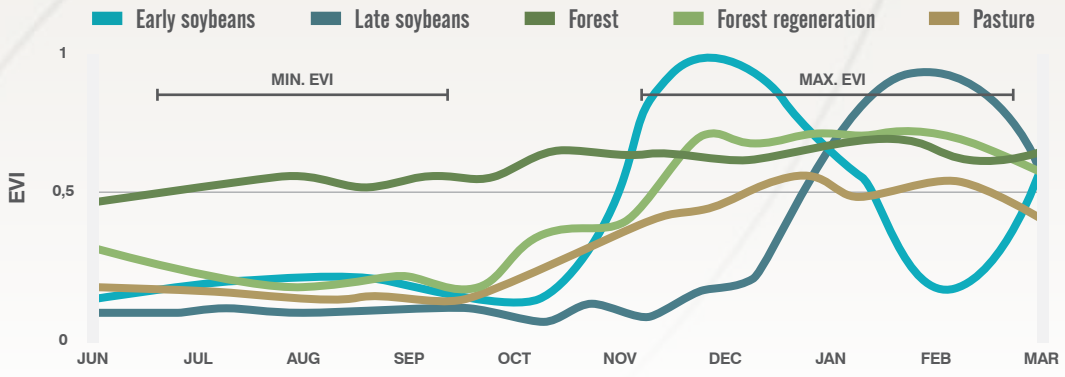


CROP ENHANCED INDEX (3)

The monitoring of the Soy Moratorium selects deforested polygons identified by PRODES/INPE and applies the Crop Enhanced Index (CEI) methodology to detect polygons where soybeans are being grow.

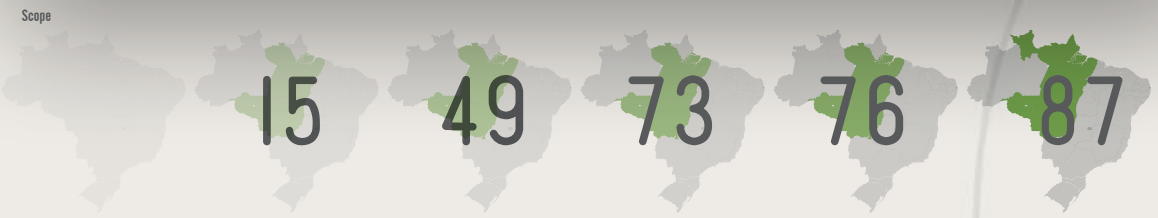
The CEI is an approach that detects the seasonality of annual crops based on the significant difference between the values of the Enhanced Vegetation Index (EVI) acquired at two specific moments of the vegetative growth of the crop: (I) prior to the harvest period, when the EVI value reaches its minimum for the annual crop, and (II) in the middle of the harvest season, when the EVI value reaches its maximum for the annual crop.

The typical distribution observed for annual crops, as shown in the two green lines in the chart below, makes it possible for these areas to be differentiated from other types of land use such as natural regeneration (blue line), forest (black line) or pasture (red line).



In 2016, the monitoring was expanded to also include municipalities where soybeans were being grown in areas exceeding 5,000 hectares in the states of Amapá and Roraima, thus covering 87 municipalities in the states of Mato Grosso (MT), Pará (PA), Rondônia (RO), Amapá (AP) and Roraima (RR), which account for almost all (98%) the area planted with soybeans in the biome. However, due to the fact that the PRODES programs only contemplate analysis of areas of forest physiognomy, areas with soybean crops in the states of Amapá and Roraima are not monitored because they fall under the Cerrado physiognomy category.

EVOLUTION FOR MONITORING SYSTEMS ON DEFORESTATED IN AREAS WITH SOYBEAN CROPS IN THE AMAZON BIOME



Period	2006/ 07	2007/09	2009/13	2013/14	2014/15	2015/16
Methodology	• No monitoring, beginning of the period 2006-2007, coincided with the annual evaluation period of PRODES deforestation*. Therefore, there was no deforestation to be monitored in the first year and signed by the signing of the Moratorium.	• Accumulated deforestation as of August 2006 (PRODES-2007 in the 2007/08 harvest and PRODES-2007 and 2008 in the 2008/09 harvest). • Selection of Polygons by sampling. • Overflight of deforestation samples followed by field visit to identify soybean crops.	• Monitoring accumulated deforestation from August 2006 (PRODES-2007 a 2009 in the 2009/10 harvest; PRODES- 2007 to 2010 in the 2010/11 harvest; PRODES 2007 to 2011 in the 2011/12 harvest; and PRODES 2007 to 2012 in the 2012/13 harvest). • Monitoring by satellite images to identify agricultural crops, followed by overflight and field visit to identify the soybean.	• Monitoring accumulated deforestation from August 2006 (PRODES-2007 to 2013). • All deforestation monitored by satellite images (American and Indian).	• Monitoring accumulated deforestation from August 2008 (PRODES-2009 to 2014). • All deforestation monitored by satellite images (American and Indian).	• Monitoring accumulated deforestation from August 2008 (PRODES-2009 to 2015). • All deforestation monitored by satellite images (American, Indian and European).

In addition, the spatial analysis uses two other new satellites that add analytical capabilities to identify deforestation associated with areas planted with soybeans in the 2015/2016 harvest.

Based on the results obtained by spatial analysis, the resulting polygons are compared with data for existing farms contained in the Rural Environmental Registry of the states concerned. The resulting products are the lists of farmers on whom supply restrictions during the harvest were imposed.

The lists are made readily available to the signatory companies of the Soy Moratorium to be fed into their corporate purchasing system and inform them on farmers from whom they should not buy soybeans in order to meet the deforestation criterion of the Moratorium. Once the lists are defined, companies can implement their control systems and carry out their ordinary process of marketing deforestation-free raw materials from the Amazon biome.

Verification audits and evaluation of the process – completion of the cycle

Once the harvest season is over, a new agenda of activities of the Soy Moratorium must be fulfilled, namely, that of independent verification. Companies that purchased soybeans in the biome must undergo third-party audits to check their purchases, as provided for in the Terms of Reference (ToR) of the Soy Moratorium. To carry out the verification process, the signatory companies are given materials prepared by the GTS annually that supplement the farmers' lists to guide the audit firms in their work, namely: Annex I to the ToR, the Template for the Report on Independent Verification of Compliance with the Soy Moratorium; and the Audit Flowchart.

Independent verification audits have been carried out since 2010, when the effectiveness of the list of non-compliant suppliers for the 2008/09 harvest was put to the test for the first time. After that, an independent verification process was put in place followed by an evaluation by a team of representatives of civil society and of ABIOVE and ANEC until 2013, when the process was suspended for two consecutive years and was only resumed in 2016.

VERYFICATION SYSTEMA: CYCLE

The results of the evaluation of the audits are submitted to the GTS and specific reports are sent to the companies. These reports are intended to obtain clarifications and make it possible for comments and recommendations on the audit process and on the company's performance to be made. All of this is part of a virtuous and effective process of continuous improvement and increased transparency for the benefit of the stakeholders.

Challenges to follow the path of continuous improvement

The independent verification audits and the spatial monitoring for assessing compliance with the Soy Moratorium criteria described above, in addition to the evaluation carried out by members of civil society, are the basic components that complete the cycle of the monitoring, reporting and verification system of the Soy Moratorium. The result of the above-described processes is the key element for validating the transparency and credibility process of the initiative.

However, regardless of the proper functioning and maturity reached by the parties involved, opportunities for improvement are detected and identified with the aim of strengthening the established system on an ongoing basis.

The result of the evaluation carried out in 2016 drew attention to four priority areas to be addressed by the Soy Working Group (GTS), namely: the Moratorium's Management System, Indirect Soy Supply, Access to CAR data and Monitoring of the Cerrado Physiognomy.

Process and Information Management System

The set of information and documents that support the verification and transparency system of the Soy Moratorium is organized under a management framework that provides easy, simple and safe access to information by the parties involved and stakeholders.

The basic documents of the process are appropriately established and agreed upon between the parties. The procedures inherent in the spatial and documentary monitoring are implemented and updated, and the records of the system stages from the meetings of the GTS to the evaluation of the audit reports and through the delicate process of defining the list of non-compliant suppliers are filed and made available to the stakeholders.

However, given the context of renewing the Moratorium indefinitely and the potential of the initiative to be replicated for other biomes, countries and value chains, it is only natural that improvements in the management of information and processes are required to ensure the continuous improvement of the established tools.

Thus, developing and implementing a Soy Moratorium management system should be given priority with the aim of improving its organization and building capacity for the Moratorium to actually become a benchmark verification system.

Indirect supply – the need to avoid any possible leakage

Soybeans are purchased by traders basically from two types of suppliers, namely, direct and indirect suppliers.

Direct suppliers are those farmers and companies that sell soybeans directly to traders. The suppliers are usually the ones who have their own storage facilities or even had their production funded by the trading companies themselves.

Indirect suppliers are those farmers and companies that sell soybeans through cooperatives or intermediate storage companies that have no business relations with traders. They are usually small and medium farmers without storage and primary processing facilities. These actors of the value chain end up not being monitored through the mechanisms of the signatory traders because they don't do business directly or have tax or legal links with them.

Therefore, if these suppliers are not complying with the Moratorium, the soybeans they grow can enter the supply chain without being identified by the system or by the signatory to the Moratorium. This means that products from inadequate sources according to the Moratorium can contaminate compliant soybeans, allowing non-compliant products to leak into the supply chain.

Currently, indirect supply to traders is only checked by evaluating whether or not clauses on the Moratorium were included in soybean purchase contracts or in declarations of the supplier. What this means is that compliance with the Moratorium is not being evaluated, but only the intention to comply with it.

Gaps in the CAR for generating lists

Non-compliant farmers and farms are identified based on information contained in the Rural Environmental Registry (CAR), which can be accessed through public CAR databases available in the states of Pará and Mato Grosso. After being spotted by geospatial monitoring companies, non-compliant areas are triangulated and identified with CAR data to be appropriately held accountable for their non-compliance.

However, the CAR data have limitations, as those available were not updated by the SiCAR (National System of Rural Environmental Registry) database and the updated data accessed recently are not fully available for consultation, making it impossible to identify the owner of each polygon registered in the system. Access to the CAR database is a

limiting factor for the ideal addressing of cases of non-compliance identified in the soybean supply chain, potentially weakening the monitoring mechanism provided for in the Soy Moratorium.

Monitoring the Cerrado physiognomy (states of Amapá and Roraima) – a monitoring blind spot

The significant expansion of soybean crops into the Amazon biome observed recently has taken place in areas of natural vegetation in the states of Roraima and Amapá. However, in both states soybeans are being grown in areas with high agricultural potential in which the typical physiognomy of Cerrado vegetation prevails due to their soil and relief characteristics.

Because the PRODES was designed to monitor forest physiognomies and not other physiognomies, the spatial information for monitoring available for the purposes of the Moratorium does not allow for potential situations of non-compliance to be analyzed in these two states in connection with the soybean chain in the Amazon biome with all its different forms of vegetation.

Steps to be taken over the next 10 years

The results of monitoring the Soy Moratorium during the 2015/16 harvest season speak for themselves in terms of how effective the initiative has become as a deforestation reduction tool in the Amazon region. Covering 98% of all areas planted with soybeans in the biome (around 39,000 km2), the monitoring detected only 371.55 km2 with soybean crops that were not compliant with the Moratorium, which are equivalent to 1.2% of the area cleared in the biome in the five monitored states during the whole period of the Moratorium (2008-2015) (2).

The Moratorium should therefore be designed as an associated strategy for expanding the command and control or voluntary mechanisms for protecting natural ecosystems.

> *The fact that the pace of implementation of the Forest Code is slower than the pace of change seen in scenarios and markets, added to ongoing deforestation in the Amazon and Cerrado regions and to the increasing adoption of private governance mechanisms, reveals the weakness of command and control mechanisms in the short or medium term and suggests that the Moratorium has a key role to play toward solving this problem. (4)*

According to imaflora® and IPAM, replicating the transparency initiative in other value chains, biomes and regions that produce agricultural commodities in Brazil and in the world is a must for achieving zero deforestation in natural ecosystems and reducing GHG emissions from land use change.

IS IT POSSIBLE TO COMBINE PRODUCTION AND CONSERVATION?

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SOYBEAN GROWING IN BRAZIL

The timeline shows the dynamics of soy production in Brazil and the main factors that influenced the expansion of this crop, which became the country's main agricultural export product (SECEX 2016). Soybean crops have a great influence on the economy, on land use and on environmental and social policies and have been growing significantly, as shown in the figure below. The continued growth of domestic soybean production is the result an increase in the area planted with it and of increases in agricultural productivity over the years.

3000 AC

ASIAN SPECIES

Soy (Glycine max) originated in China and has been grown for at least 5,000 years.

1882 DC

BROUGHT TO BRAZIL

It was grown for the first time in Brazil in 1882, in the state of Bahia, and later Japanese immigrants brought the grain to the state of São Paulo.

1910

INTERNAL MIGRATIONS

Soybeans began to be grown in Rio Grande do Sul state, where climate and soil conditions are more suitable for growing them.

1930

LITTLE USE

Between 1920 and 1940, soybeans were mainly grown as a forage species rather than for exploring their potential for vegetable oil production.

1950

EXPANSION OF THE CROP

The São Paulo State Department of Agriculture launches a "Soy Campaign" to disseminate knowledge about this crop and promote its expansion.

1960

EXPANSION INTO THE SOUTH

98% of all soybean crops in Brazil were located in the country's south region. Three factors have influenced the expansion of soybean crops (see box below).

1970

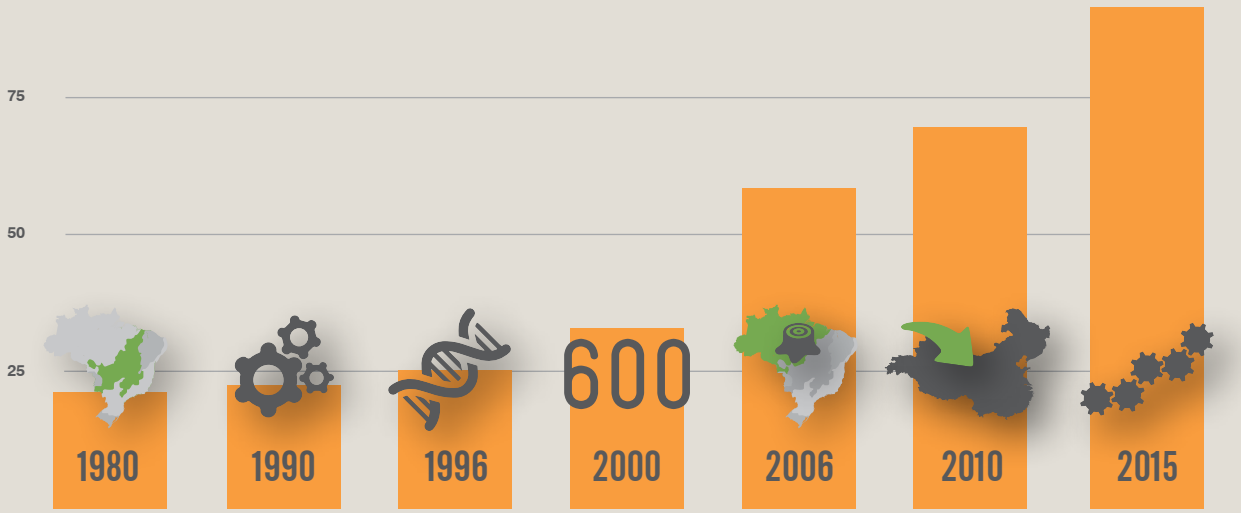
FOREIGN MARKET

Interruption of exports in the US. Brazil's entry into the international market. Second largest soybean producer in the world.

FACTORS THAT INFLUENCED THE EXPANSION OF SOYBEAN CROPS

- The need for diversification in agricultural exports due to a decline in Brazil's exports of coffee (which was the country's main agricultural export product).
- Soybeans began to be grown as a summer crop after the wheat harvest in the south.
- Increasing demand for soybean bran as feed for pigs and poultry.

EVOLUTION OF SOYBEAN PRODUCTION IN BRAZIL IN MILLION TONS



NEW VARIETIES

Expansion of the crop in varieties adapted to tropical soils, such as those found in the Cerrado region.

INCENTIVES AND RESULTS

Consolidation of technologies, agricultural credit, expansion of the planted area and a 40-percent increase in productivity.

CIENTIFIC ADVANCES

Transgenic seeds resistant to herbicides begin to be used in the US and Argentina.

EXPORT BOOM

Exports rise by almost 600 percent, especially to China.

ENVIRONMENT BALANCE

About 1.2 million hectares planted with soybeans in the Amazon biome. Intensive deforestation. Creation of the Moratorium.

STRATEGIC PARTNER

The Chinese account for 40% of Brazil's global imports and the fact that the harvest season in Brazil coincided with a non-harvest period in China.

HEATED MARKET

Prospect of increased soybean cultivation in Brazil to meet a demand for a diet richer in protein.

IMPORTANT NOTE

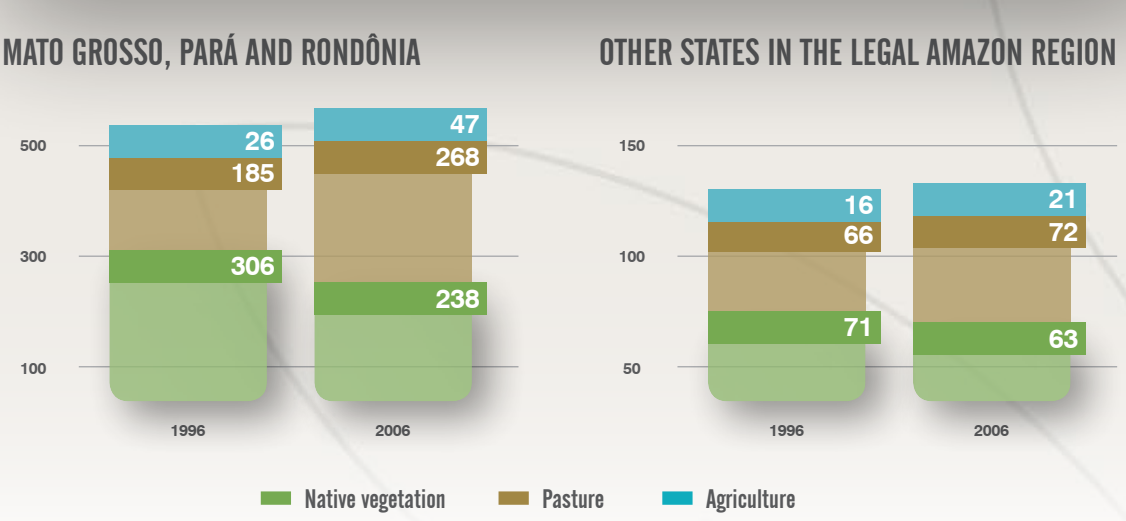
Soybean growing in the Cerrado Biome has expanded mainly in areas occupied by pastures and other crops, but most new soybean crops in the Matopiba region are the result of conversion of native vegetation. This conversion poses a great risk to the sustainability of the crops and to the region. Due the land use change, climate regulation (temperature and humidity, rainfall production etc), pollination, erosion control and other services provided by the biome cease to exist. The result is severe droughts increasing progressively each year, as has been seen in recent years.

The paths that turned soybean crops from a driver of deforestation into a solution against deforestation

Historically, deforestation in the Brazilian Amazon region has always been linked to the influence of agricultural production chains, especially the soybean and livestock production chains. This feature became quite evident in the second half of the 1990s and in the early 2000s, when technological advances made it possible for soybean and other crops to expand into the biome (5), a process that was largely influenced by the interests of large commodity traders.

It was a time when agricultural production areas expanded into forest areas, particularly in the states of Mato Grosso (MT), Pará (PA) and Rondônia (RO), which absorbed 83% of the expansion of crops and 93% of the expansion of cattle-raising in the biome between 1995 and 2006 (6) (Figura 1). During this period, the Amazon Deforestation Calculation Program (PRODES) (7) recorded the highest deforestation rates since the program was launched in 1988, averaging 20,000 km²/year and a total of 240,000 km² of converted forests.

FIGURE 2 – LAND USE IN PRIVATE FARMS ACCORDING TO THE AGRICULTURAL CENSUS (THOUSAND KM²)



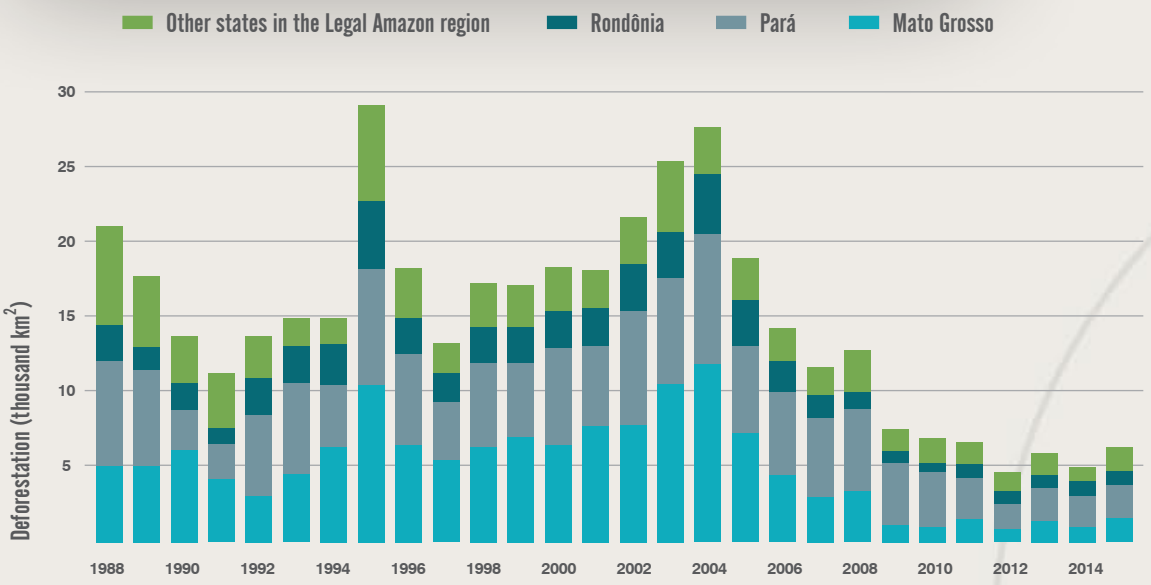
The voracity of agricultural production chains in those states resulted in the so-called "Deforestation Arc," a region of conflict between the agricultural expansion front and forested areas in the Amazon region. This region comprises municipalities known as the champions of deforestation in the biome and also the champions in terms of agricultural production, with soybeans being the best example of the dichotomy between conservation and production that prevailed in the Amazon region – and in Brazil at large – until the first half of the 2000s. The Forest Code (8) – the main mechanism adopted to regulate the use and conservation of natural vegetation on private land – was seen as too restrictive and unworkable by farmers and large landholders, who knew they could get away with clearing larger areas than was legally allowed due to the lack of appropriate inspection.

The lack of governance in the Amazon region was apparent and the image of Brazilian agribusiness began to deteriorate as a result of repeated international stories and publications exposing the social conflicts and environmental crimes that prevailed in agricultural areas. As of 2002, when a new government was elected in Brazil, the participation of environmentalists in official decisions and the development of closer relations between government and organized civil society led to a series of public and private actions that culminated in reducing deforestation in the biome (9).

Still in 2002, the Amazon Region Protected Areas Program (ARPA) was launched, through which several Conservation Units and Indigenous Lands were created, totaling 487,000 km² (or 12% of the total area of the biome) of protected areas between 2003 and 2006. In 2004, the government also created the Action Plan for Deforestation Prevention and Control in the Legal Amazon Region (PPCDAm), which entailed a series of additional measures designed to ensure increased monitoring, inspection and control in the Amazon region. In that same year, INPE launched the DETER system, which began to issue real-time deforestation alerts to IBAMA, thereby expanding its inspecting and controlling capacity.

This set of measures played a key role in creating a turning point in annual deforestation rates as of 2004, as those rates dropped by 32% between 2004 and 2005 (from 27,000 km²- to 19,000 km²) (Figure 2). However, despite this significant reduction, deforestation in the Amazon biome remained at worrying levels, evincing the need for further measures to fight the rampant expansion of agribusiness into the biome.

FIGURE 3 – HISTORICAL DEFORESTATION SERIES IN THE AMAZON BIOME (7)



As indicated in the previous section, after Greenpeace launched a major campaign against large soybean traders operating in Brazil, the Soy Moratorium was launched in 2006 as a market initiative entailing more restrictive requirements than those provided for in the Forest Code itself, as it called for zero deforestation[2] in soybean-growing areas, preventing non-compliant soybeans from entering the European market. The message was clear: deforestation would not be tolerated any longer in the production chain of soybeans grown in the Amazon region.

Between 2007 and 2008, relying on the positive results achieved until then, the federal government, in a joint effort involving federal ministries and state and municipal administrations, regulated public acts designed to inhibit the advance of deforestation in munici-

2 The Soy Moratorium does not allow soybeans grown in areas cleared after July 22, 2008 to be marketed by its signatory traders, ABIOVE and ANEC, even if the farmers have an environmental license authorizing the removal of vegetation.

palities seen as critical. The main measures were intended to combine land and environmental regulation, suspend credit to farmers involved in illegal deforestation activities in the biome and penalize actors of production chains involved in environmental crimes (10).

In this environment of lower tolerance of deforestation, the Soy Moratorium was gradually improved and became more and more successful in fighting deforestation associated with soybean-growing and, as a result, it became a benchmark for similar initiatives in other supply chains, such as in the livestock chain. In 2009, once again after a Greenpeace campaign, the largest slaughterhouses operating in the Amazon region signed a Public Commitment on Meat, which is still effective today and defines minimum criteria for operations with livestock and meat products in the biome, among which the requirement of zero deforestation in livestock farms. This was another victory against predatory agricultural practices.

This set of actions and other conjunctural factors, such as a drop in international commodities prices, led to a reduction in annual deforestation rates in the Amazon region, which continued to decrease until they hit the mark of 4,600 km² in 2012 - the lowest rate recorded in all the PRODES monitoring series. In that same year, after twelve years of discussions between large farmers and environmentalists in the Brazilian National Congress, the Brazilian Forest Code was revised (11), resulting in more lenient requirements in relation to those provided for in previous legislation being adopted and amnesty being granted for most illegal deforestation activities carried out in the past (12). These changes, coupled with delays in implementing the CAR and the PRA, created a climate of tolerance of environmental crimes and deforestation rates began to rise again between 2012 and 2015, totaling 6,200 km² (36%) in the last year (Figure 2).

This period of negative results raised concerns among environmental institutions and researchers and cast doubts as to the effectiveness of the new Forest Code to reduce illegal deforestation in the Amazon region. On the other hand, the Soy Moratorium was gradually strengthened and managed to put an end to deforestation in the soybean production chain while making it possible for the area planted with soybeans to grow from 18,000 to 44,000 km², or to 14% of the planted area in Brazil, between 2006 and 2015 (13).

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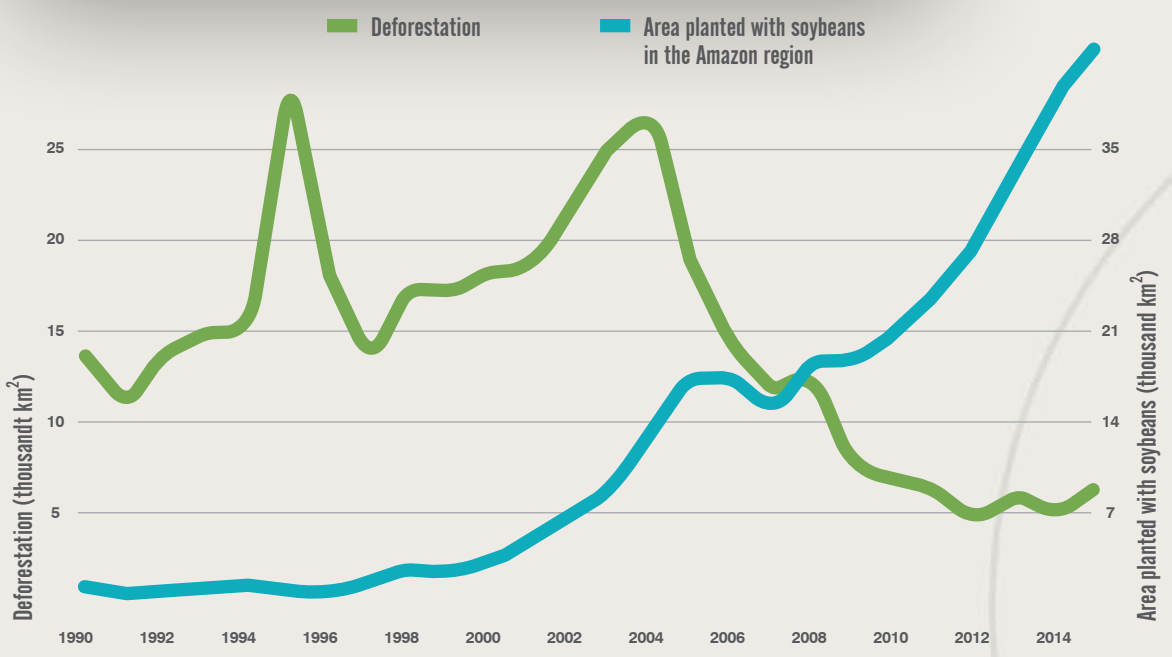
3 The CAR (Rural Environmental Registry) and the PRA (Environmental Compliance Program) are mechanisms introduced by the new law designed to assist farmers in complying with environmental laws and regulations in their farms and informal land holdings.

FIGURE 4 – EVOLUTION OF THE AREA PLANTED WITH SOYBEANS COMPARED TO DEFORESTATION IN THE AMAZON REGION



This increase in the area planted with soybeans in the biome is mainly attributed to the substitution of already cleared grazing areas (14), i.e. soybean-growing increased with virtually no new forest conversions[4]. Thus, soybean growing in the Amazon region serves as a great – if not the best – example that increasing agricultural production while respecting the environment is possible[5].

4 Between 2009 and 2015, 372 km² planted with soybeans were identified in areas cleared after 2008, meaning that they were non-compliant with the criteria set in the Soy Moratorium. This area accounts for approximately 4% of all deforested areas detected in municipalities monitored by the Soy Moratorium and for 1% of all soybeans grown in the Amazon region (14).

Therefore, Imaflora® and IPAM have proposed the replication of the model used in the soy chain for other commodities and also in other biomes, which would make it possible to put an end to deforestation in agricultural production chains in Brazil as a whole while contributing to strengthening environmental policies, especially the Brazilian Forest Code.

Market initiatives for strengthening public environmental policies: The example of the Soy Moratorium

Despite Brazil's success in fighting predatory agricultural practices, illegal deforestation in the Amazon region has not been fully eradicated yet. Annual deforestation rates in the biome, which were already high in the 2012-2015 period (average of 5,700 km²/year), began to rise again between January and October 2016, when a 31% increase in relation to the same period in the previous year was recorded (15). Of all deforested areas, it is estimated that more than 50% are private areas and that most of them were cleared illegally, i.e. beyond the limits allowed by the Forest Code and/or without a license for forest suppression (16).

These figures suggest that the practices adopted so far to fight deforestation in the Amazon region have not been as efficient as in the past, reinforcing the need to review and improve public policies designed to stop the felling of forests in the biome, such as the PPCDAm itself. The fight against deforestation must involve other actors (and sectors), which should share the responsibility for curbing predatory practices with the federal government (and its institutions). Similarly, the government must understand the importance of involving civil society in this process of change by listening to its proposals and acting proactively in building an agenda with shared responsibilities.

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5 Despite this result, indirect effects can be perceived that were not sufficiently evaluated and measured, such as the displacement of low-productivity cattle-raising to border areas, causing new deforestation. In other words, deforestation directly associated with soybean growing decreased sharply, but the expansion of soybean crops into previously cleared areas occupied by pastures may have caused an indirect deforestation effect in extensive livestock farms by displacing these activities to the deforestation border. This is a phenomenon that needs to be studied in greater detail.

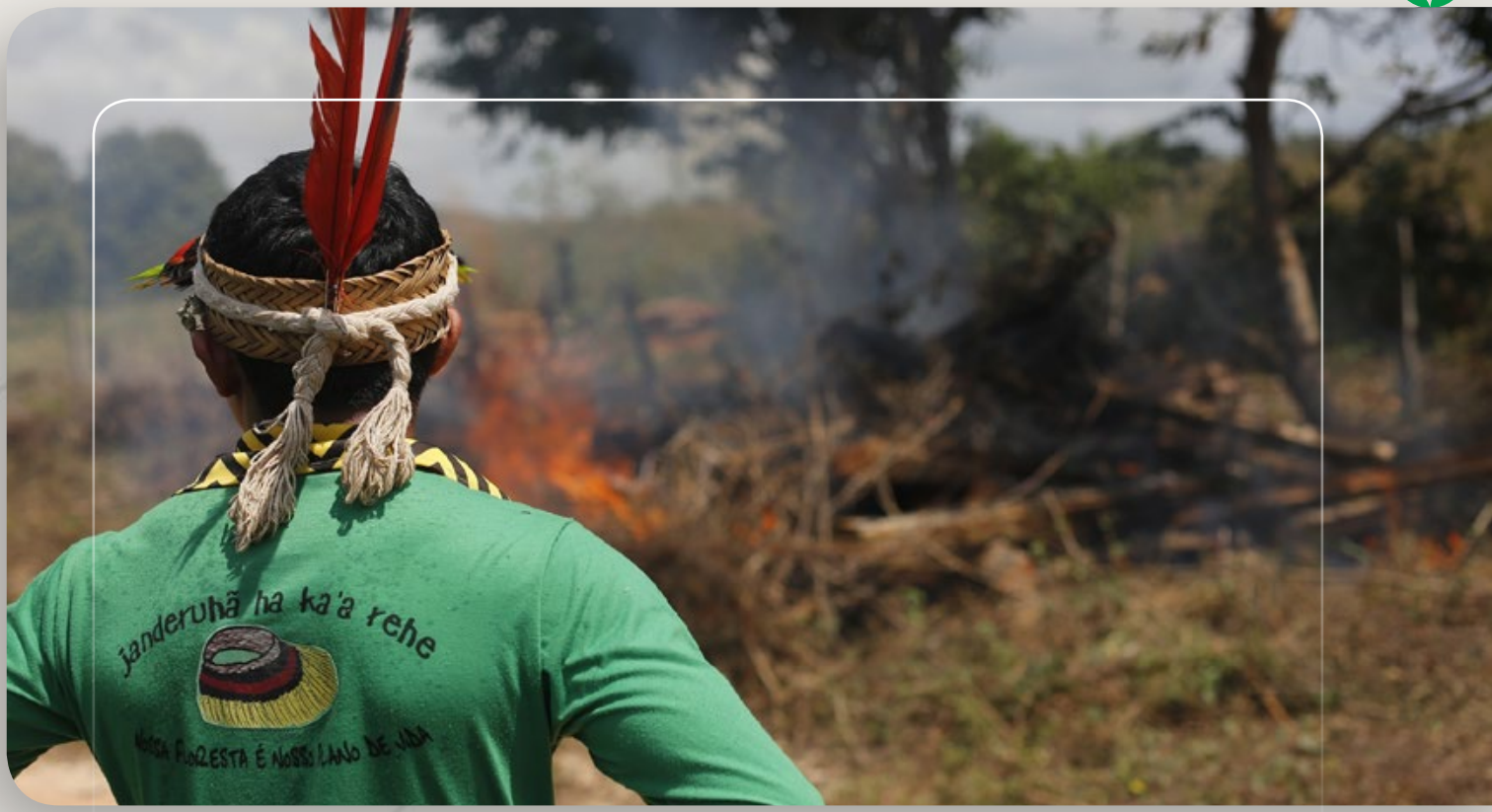
From this perspective, Imaflora® highlights the example of the Soy Moratorium, an initiative that was born in response to a demand from the consumer market and was supported by civil society in its design and improvements, and which the Brazilian government joined later. In such a multistakeholder space, the soybean production chain recognized that it is responsible for its suppliers and began to work together with civil society and government in developing minimum criteria to be complied with in soybean production areas in the Amazon region.

O Imaflora® believes that this interaction between public and private mechanisms is important to lend greater sustainability to agricultural/livestock production in Brazil, but it emphasizes that such mechanisms should be designed to be complementary, rather than substitutive tools, so as to enhance their efficiency and capacity to promote lasting positive changes (17). If we take as an example the interaction between the Soy Moratorium and the Forest Code, clear opportunities can be observed for their interactions to become even more positive.

First, it should be noted that, notwithstanding the success of the Soy Moratorium in curbing deforestation in soybean growing areas in the Amazon region, the current mechanism does not prevent deforestation on farms where soybeans and other crops are grown or cattle is raised, provided that cleared areas are not planted with the grain. Thus, even though it is more restrictive than the Forest Code, the Moratorium cannot ensure that the produce is coming from environmentally compliant farms[6], as a farm compliant with the Moratorium may not, for example, be compliant with the Forest Code for having a deficit of natural vegetation in a Permanent Preservation Area (APP) or in a Legal Reserve (RL).

In addition, in its current form the Moratorium does not require soybean suppliers to be registered with the CAR, making it difficult to identify cases of non-compliance and individual taxpayer's cards (CPFs) whose holders are not allowed to sell their produce to the signatories to the Moratorium. Although the deadline for registration with the CAR was extended to December 2017, the Moratorium could retain its position as a pioneering ini-

6 The Soy Moratorium does not analyze farms as a whole, as it focuses only in sections where soybean is being grown in recently cleared areas (after July 22, 2008). After they identify a non-compliant area, the members of the GTS gather information about its owners, who are then prevented from selling the grain to signatory traders.



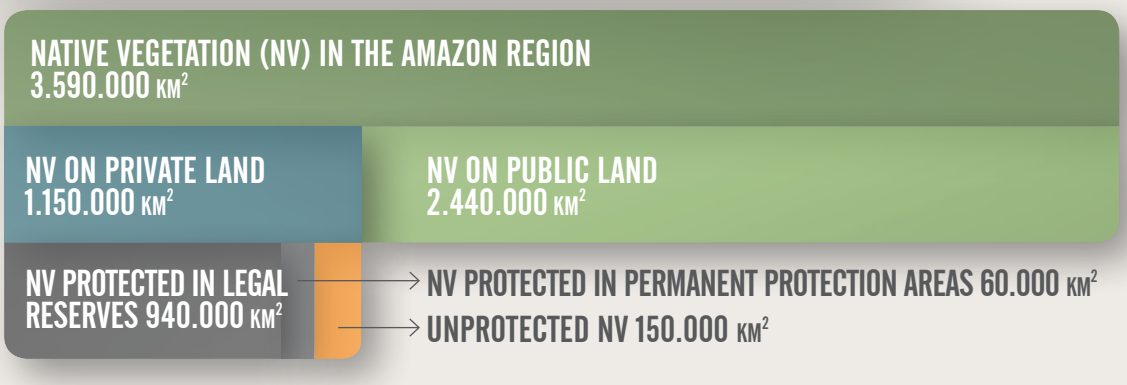
tiative and move the closing date up, requiring soybean farms to confirm that they are registered to be allowed to market their produce. Thus, the Soy Moratorium would not only be expanding its governance of soybean farms, but also encouraging farmers to register with the CAR, which is a key step for the Forest Code to actually become an effective mechanism for protecting natural vegetation

Despite the aforementioned improvement opportunities, imaflora® stresses that the Soy Moratorium is a pioneering mechanism for controlling deforestation in the Amazon region as the first market agreement that imposed a zero deforestation requirement on a production chain. Precisely because it does not allow new conversions, it can be said that the Soy Moratorium is complementary to the Forest Code, as it helps to preserve forests that could otherwise be legally cleared, as in cases of forest cover exceeding the requirements of Legal Reserves or Permanent Preservation Areas.

Estimates indicate that such forest cover areas exceeding the requirements provided for in the code can be as large as 150,000 km² in the biome (18, 19), or have about the same size as Ceará state (Figure 4). In terms of greenhouse gas emissions, these areas store

a stock of 11 Gtons of CO_2e, or 5.5 times the total emissions from Brazil in 2015 (20). The magnitude of these numbers expresses the conservation potential of a mechanism such as the Soy Moratorium, which despite the above-mentioned improvement opportunities is a model to be followed by other production chains that has a direct bearing on land occupation and use in the Amazon region, such as the corn, rice, cassava and livestock chains.

FIGURE 5 – DISTRIBUTION OF NATURAL VEGETATION IN THE AMAZON BIOMA



Creating and implementing market-oriented agreements for key production chains operating in natural ecosystems and subjecting their activities to monitoring, reporting and verification mechanisms along the lines of the Soy Moratorium are key actions for reconciling agricultural/livestock production and environmental conservation. Until this is a reality, public zero deforestation commitments made by large multinational corporations will be nothing more than good ideas doomed to fail for lack of a practical and objective approach that can actually engage commodity chains to finally reconcile production and conservation.

ZERO DEFORESTATION IS ESSENTIAL, BUT SHOULD NOT BE THE ONLY GOAL

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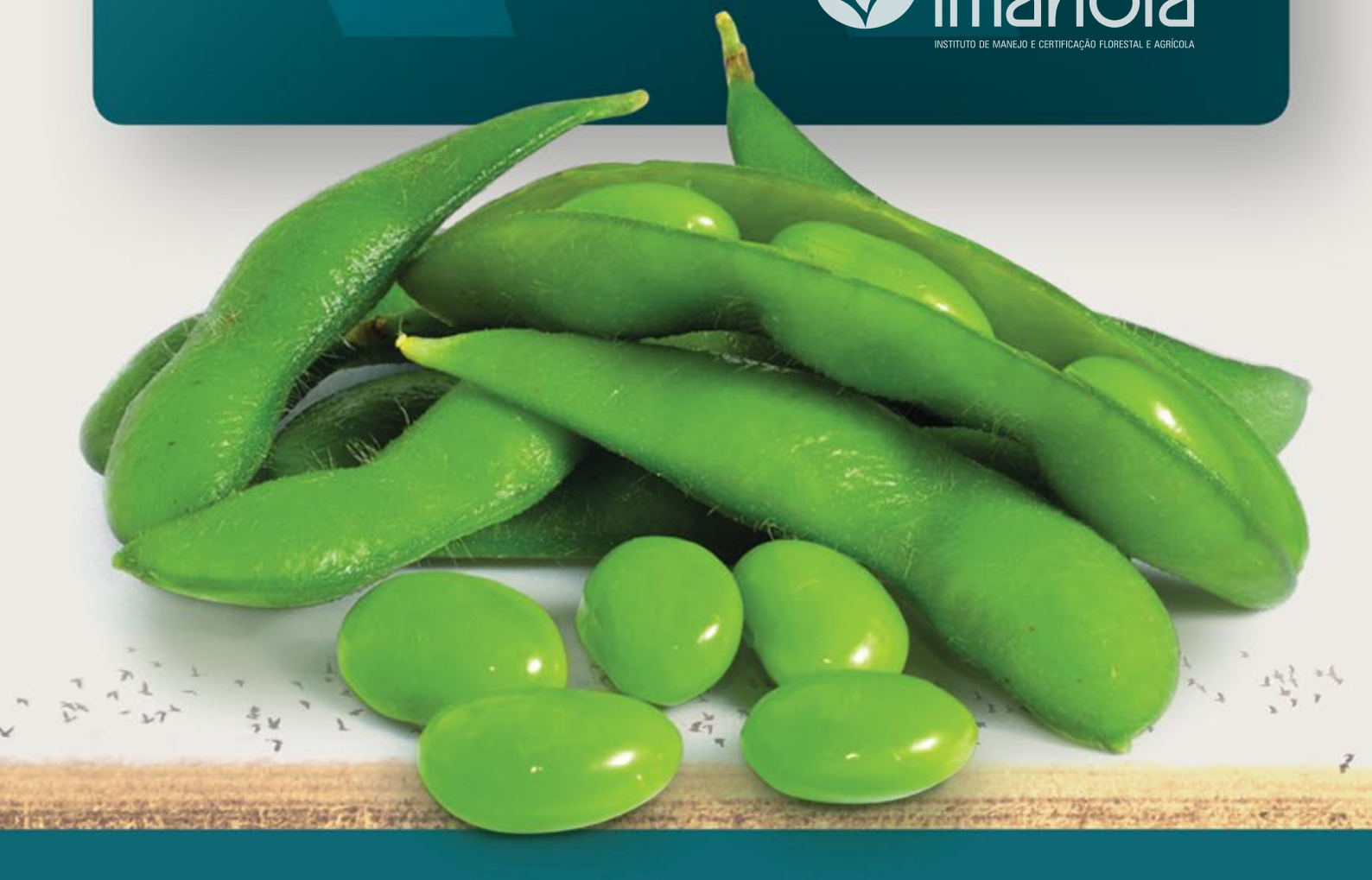


Multistakeholder commitments – Common goals

Deforestation of tropical forests is the second largest source of greenhouse gas (GHG) emissions in the world (12%). It is estimated that 9.9 million hectares of these forests are converted annually. The production chains of soybean, wood and paper, palm oil and livestock accounted for one-third of that deforestation and these are therefore known as forest-risk commodities. In recent years, the number of corporations that have committed to zero deforestation in supply chains has grown remarkably and the pressure from consumers and civil society has played a key role in leading companies to implement strategies to reduce and eliminate deforestation (16, 21).

In 2016, the Soy Moratorium, as described in Chapter 1, was a pioneering agreement on zero deforestation in the Amazon region involving different companies in a supply chain. This pioneering spirit has served and continues to serve as an example for other production chains, showing that it is possible to reduce and even eliminate deforestation associated with agricultural commodities.

Internationally, the Consumer Goods Forum (CGF) was a major initiative that led companies to join zero deforestation commitments. Created in 2009, the CGF is made up of multinational retail and manufacturing companies operating in 70 countries. The forum set a zero net deforestation target to be achieved by 2020, recognizing the responsibility of multinationals for the current impacts on natural ecosystems. The CGF and its members have influenced the development of other initiatives such as those of the Tropical Forest Alliance 2020 (TFA2020) and of The Sustainability Consortium (TSC) with the aim of supporting their member companies in achieving the set targets. The box below shows the main initiatives and international forums involving governments, the private sector and civil society (22).

The New York Declaration on Forests (NYDF) is another major international initiative that during the UN Climate Summit in 2014 reinforced the urgency of launching zero deforestation campaigns and influenced global leaders from different sectors to come up with deforestation targets and strategies to reduce deforestation. That declaration was endorsed by a total of 179 representatives of countries, states, multinational corporations, organizations representing indigenous peoples and civil society organizations. The industries involved agreed to join in the commitment to reduce deforestation by 50% by 2020 and to

MOST RELEVANT INITIATIVES

- ***Consumer Goods Forum (CGF):*** founded in 2009, the CGF's governance framework involves 50 leaders of companies and organizations. It involves a set of 400 companies and actors operating in value chains in 70 countries. The CGF is intended to raise funds to achieve the zero net deforestation (ZND) target by 2020. The CGF set up a soy working group to work directly with ZD.
- ***Tropical Forest Alliance 2020 (TFA):*** the TFA is a public-private partnership established during the Rio+20 summit (2012) with the aim of encouraging its members to implement voluntary actions designed to achieve zero net deforestation in production chains by 2020. This alliance was founded by the US government and the CGF and other governments and NGOs joined in later. The TFA allows civil society to participate, as opposed to the CGF, which focuses on companies.
- ***Sustainable Trade Initiative (IDH):*** the STI is a European coalition made up of more than 400 stakeholders (NGOs, companies and financial institutions) that collaborates with governments in financing strategies. In the soybean industry, the STI is intended to support production and industrialization actors in achieving the zero net deforestation target by 2020 and the target that 50% of all soybeans traded with Europe should come from responsible sources.
- ***The Sustainability Consortium (TSC):*** the TSC was designed to create mechanisms and indicators to measure social and environmental impacts in production chains and disseminate the results to decision-makers. The TSC joined forces with the CGF in 2012 for the purpose of strengthening the ZD commitments made by the forum. However, the TSC has not been adopted widely.
- ***Cattle G4 Agreement:*** agreement involving the largest meat processing companies in Brazil. This agreement set minimum criteria for industrial meat operations in the Amazon biome, including the criterion of zero deforestation in the supply chain.
- **Soy Moratorium:** pioneering agreement involving the largest soybean traders operating in the country in the commitment not to trade soybeans from areas in the Amazon region deforested after 2008.

THE SOYBEAN VALUE CHAIN

STAKE-HOLDERS

Actors in the chain

International trade in soybeans has a turnover of USD 50 billion annually. Six stakeholders are the main actors in the soybean value chain: suppliers of agricultural inputs; farmers; originators (warehouses and cooperatives), the crushing industry, the vegetable oil and distribution industries. The products included in the "Soy Complex" are the following ones: **soybeans in grain, soybean bran and soybean oil.**

PRODUCTION
(DISTRIBUTION OVER BIOMES)

AGRICULTURAL INPUTS:
SEEDS, FERTILIZERS
CROP PROTECTION

40% of all soybeans in grain remain in Brazil

72% are processed into soybean bran

18% are processed into soybean oil

10% are processed into other products

DISTRIBUTION:
WHOLESALE
RETAIL
INSTITUTIONAL MARKET

ORIGINATORS:
WAREHOUSES
COOPERATIVES
TRADERS

60% of all soybeans in grain are exported

CRUSHERS:
COOPERATIVES
PRIVATE COMPANIES

50% of all soybean bran

20% of all soybean oil is exported

INDUSTRY:
OIL DERIVATIVES

CONSUMPTION FORMS

Final use

Approximately 87% of all soybeans grown worldwide are processed and used to produce oils, feed and food products. The remaining 13% are directly consumed by the population in the form of **grains, sprouts, cheese and other products.**

DEMAND

Asian influence

Asian countries are the main importers of soybeans in grain and soybean oil processed in Brazil. China is Brazil's main grain customer, accounting for 75% of its imports. India's imports of soybean oil from Brazil have been on the rise, amounting to almost 50% of all the domestic production in 2015. Soybean bran and soybean oil exports amount to USD 5.0 and USD 1.1 billion, respectively.

FOUR COMPANIES

Mayor players

Global trade in and processing of soybeans are concentrated in four multinational US- and Europe-based companies that have been investing heavily in expanding crushing capacity in Asia and Latin America: Archer Daniel Midlands (ADM), Bunge, Cargill and Louis Dreyfus. Amaggi and Caramuru (Brazil), Marubeni (Japan) and Nidera (China-the Netherlands) are other major players. The products processed by these companies are passed on to companies operating in the food and cosmetic industries, which is dominated by companies such as: Unilever, Danone, Procter&Gamble, Mondelez and Nestlé[2].

RELEVANCE

Relevance domestically

Brazil is the second largest producer and the number-one exporter of soybeans on the world, with a 40-percent market share in 20153. It is also the country with the greatest potential for increasing production and the area planted with soybeans. **Domestic production is projected to exceed 100,000 tons by 2020, when the country will account for 40 percent of the global trade in soybean grains and for 73% of the global trade in soybean oil.**

TRANSFORMATION

Processing

Between 40% and 50% of all soybeans are processed in Brazil by crushing companies, with approximately 75% being processed into soybean bran and 20% into oil[1].

[1]BRADESCO, 2016; EMBRAPA, 2014. [2] Lima, 2016; Profundo, 2014. [3] ITC/trademap.org 2015.

eradicate deforestation by 2030 (Zero Gross Deforestation). It is also intended to support commitments to achieve zero deforestation targets linked to commodities by 2020 (23).

Both the CGF and the NYDF set 2020 as the deadline for ZD targets to be achieved. At first, the targets set by the NYDF may seem more lenient than those set by the CGF, but the CGF is only intended to eradicate deforestation in agricultural production chains and in chains associated with pulp and paper in the forestry sector, which account for one-third of global deforestation. The NYDF is in turn intended to reduce global deforestation altogether, covering mineral commodities and other production chains that change land use.

What Zero Deforestation is and what its implications are

Harmonizing the definitions used in zero deforestation commitments is essential for ensuring appropriate understanding and transparency among the parties to the agreements. The need for actors in the chains to adopt similar targets becomes evident for the impacts on deforestation to be consistently monitored and reported and for supply chains to be able to take appropriate steps to meet the collectively set deadlines, otherwise the targets are unlikely to be achieved.

In the case of governments, illegal deforestation is clearly a target aimed at, but ZND or ZGD are more ambitious targets and allow for better monitoring of a given region or biome. In addition, the ZGD is essential in a context of weak implementation of effective command and control mechanisms, i.e. the Forest Code in the Brazilian case. In addition, it can encourage the restoration of ecosystems, since its scope is not restricted the production area of a commodity, but rather to a jurisdiction.

Besides the risk, the companies' reputation and the elimination of the worst practices from their supply chains, eradicating deforestation is also a priority for contributing to mitigating the effects of climate change. The 2015 Paris Agreement requested countries to declare their targets for contributing to mitigation, poverty eradication and inequality reduction (24). The debate was therefore expanded beyond zero deforestation to include social goals in climate change negotiations.

Brazil ratified the Paris Agreement and presented its targets to reduce emissions by 37% below 2005 levels by 2025. With regard to land use, Brazil is committed to zero illegal

DEFINITIONS OF ZERO DEFORESTATION

- **Zero Gross Deforestation (ZGD)):** it means that no natural vegetation area was converted or cleared for implementing the supply chain in question. ZGD commitments become fragile when they are only applied to the production areas of a specific commodity and do not necessarily include deforestation criteria for other commodities on the same farm, thus making it possible for leaks to occur. However, it is an essential mechanism while no public policies offering economic alternatives for preserving natural vegetation are available.
- **Zero Net Deforestation (ZND):** this definition allows the conversion or clearing of natural vegetation provided that another area of the same size is reforested or regenerated. The risk of this definition lies in the difference between a mature forest, which has much more complex levels of diversity, carbon storage and structure, and a young forest and which, for this reason, should not be addressed only in terms of area.
- **Zero Illegal Deforestation (ZND):** this definition takes into account the area of deforestation permitted by law for the region or country in question. The risk of this type of commitment is that the laws of some countries or regions may be quite permissive, limiting the impact of commitments of this kind. In addition, when laws are enforced, they are often amended or adjusted, so the targets of this type of commitment may be excessively dynamic.

deforestation by 2030 and to restore 12 million hectares. The goal related to illegal deforestation is not very ambitious, as the long term set for achieving it and the lack of partial indicators for this urgent issue do not allow for the forest areas that will be actually protected within the set deadline to be established.

The current high rate of illegal conversion of natural ecosystems requires more stringent actions to bring down the increasing deforestation rates observed today in a context of implementation of the Forest Code.

Despite the big challenge ahead, Brazil is one of the most successful countries in reducing deforestation and its voluntary and sectoral actions to ensure zero deforestation, such as the Soy Moratorium, are essential for achieving the targets set in the Paris Agreement.

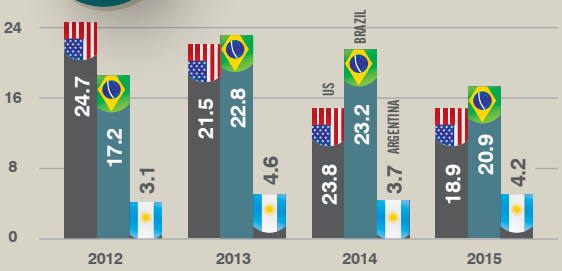
Corporate commitments to zero deforestation

In an analysis of corporate commitments to zero deforestation it was seen that of the 566 companies that made such commitments, most set 2020 as the deadline for achieving the target (25). However, little transparency still prevails in reporting the targets, strategies and monitoring tools that will be used for that purpose. Only one-fourth of the companies report their results regularly and, given the short deadline for achieving the target, they should report not only their commitments, but also the monitoring systems they will be adopting to keep track of their zero deforestation targets.

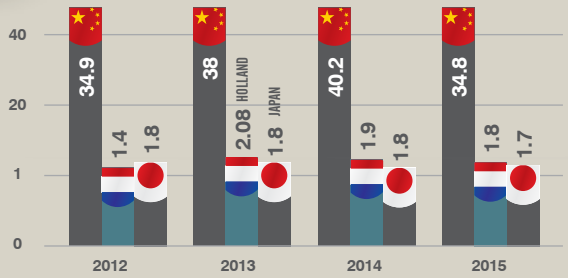
In the soybean chain, this evaluation indicated that 76 companies took on commitments to enhance their sustainability and to improve their traceability, certification and support to farmers. Among these companies, 39 issued zero deforestation declarations, but most of them adopt ZND and only one adopts ZGD (25). Companies operating in the European market are making an effort to meet the sustainability criteria set by the European Union and are using certification and verification systems to measure indicators and report their sustainability actions in the soybean chain. The RTRS, ProTerra and ISCC certifications are the most cited ones. Few Asian companies, which are the main destination of Brazilian soybeans, have joined in the zero deforestation commitments.

GLOBAL TRADE: MAIN COUNTRIES OF THE SOYBEAN COMPLEX

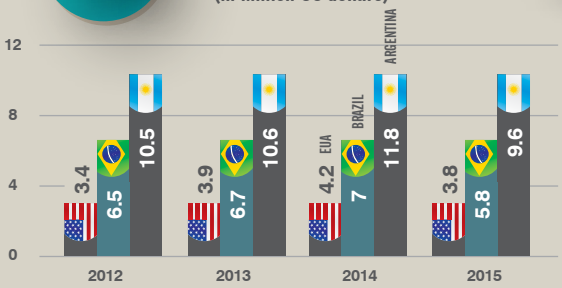
YEAR-BY-YEAR GRAIN SALES
(in million US dollars)



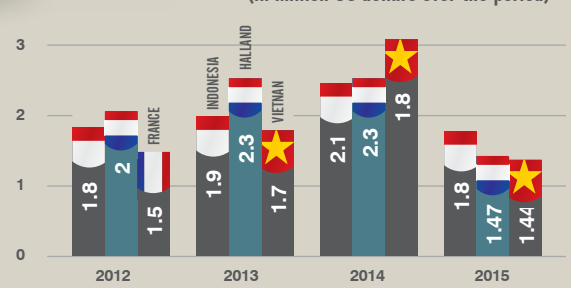
YEAR-BY-YEAR GRAIN PURCHASES
(in million US dollars over the period)



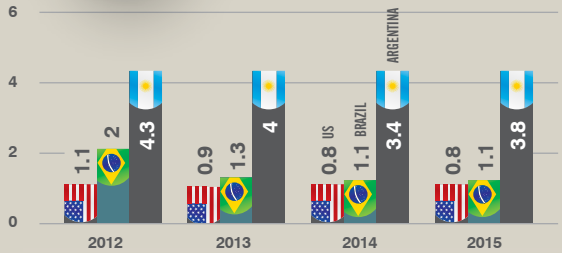
YEAR-BY-YEAR SOYBEAN BRAN SALES
(in million US dollars)



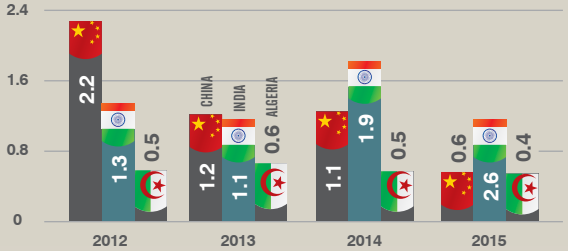
YEAR-BY-YEAR SOY BEAN BRAN PURCHASES
(in million US dollars over the period)



YEAR-BY-YEAR OIL SALES
(in million US dollars)



YEAR-BY-YEAR OIL PURCHASES
(in million US dollars over the period)



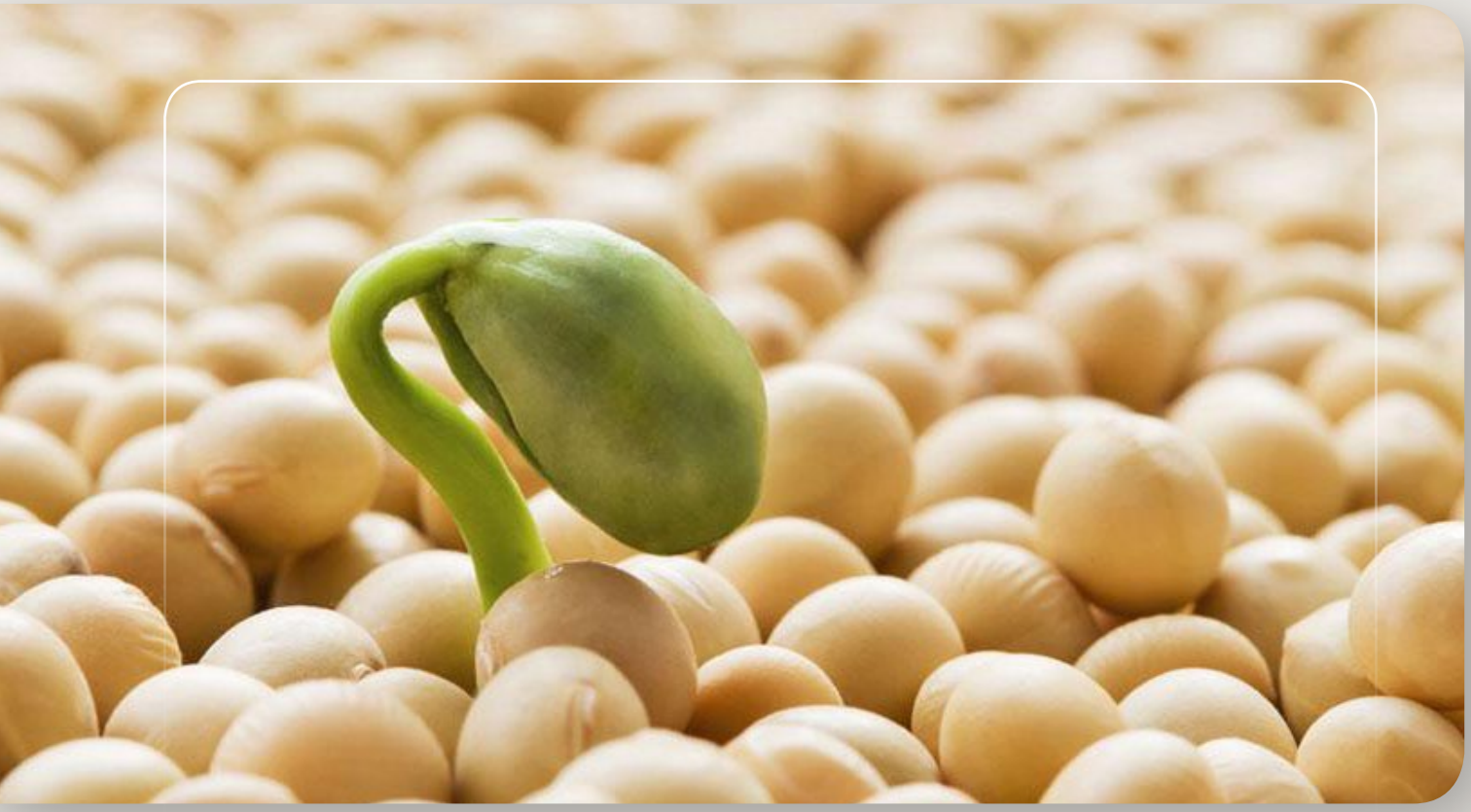
Certification standards are a means used by companies to monitor the performance of suppliers against sustainability criteria. All the evaluated standards are based on criteria of legality or have a deadline for the conversion of forests or ecosystems. However, access to certification is limited to more capitalized farmers with greater access to information. Certification in the soybean chain was not sufficiently promoted to become a significant factor of change in reducing deforestation. Thus, certification standards are key for raising sustainability levels in the production chain, but they should not be adopted as the only strategy to eradicate deforestation in supply chains.

PROGRAMS AND TARGETS ADOPTED BY RETAIL AND PROCESSING COMPANIES

- **Nestlé:** The company shares the CGF commitments for zero net deforestation by 2020. Nestlé was the first company to declare a ZD commitment and to report a comprehensive strategy to eliminate deforestation through actions that include: the development of Sustainable Origination Policies; the establishment of annual targets; investment of funds to ensure traceability and verification; use of third-party certification; use of the conversion deadline proposed by the FSC, RSPO and RTRS; supporting farmers through agricultural extension services provided by the company; increased transparency for customers and consumers; and engagement with stakeholders (26).
- **Unilever:** The company uses about 1% of all soybeans grown globally and it joined the TFA by launching a public commitment to eliminate deforestation associated with soybeans, palm oil, paper, and meat with zero net deforestation to be achieved by 2020. Unilever's strategy to achieve zero deforestation is based on promoting changes in the value chain to ensure that purchases can be tracked and certified. The company also encourages the industrial sector to adhere to mechanisms that go beyond certification and has been working with governments and partners to influence public policy (27, 28).
- **Wallmart:** The company took on a public commitment to promote zero deforestation in the soybean, meat and wood chains in Brazil. The company is one of the largest supermarket chains in the world and it has plans to invest in supporting farmers and communities

in their efforts to increase their production with less resources and waste and their supply of products with sustainability certifications.

- **Mcdonalds:** The corporation joined the Soy Moratorium in 2007 and endorsed the New York Declaration on Forests in 2014. In 2015, it announced its commitment to eradicate deforestation by 2030. The priority supply chains for eradicating deforestation are the following ones: the meat, paper (fiber), coffee, palm oil, fish and chicken chains. For each chain, the company develops verification and monitoring mechanisms (29).
- **Cargill:** Commitment to deforestation-free soybeans in the Amazon region, to adopt monitoring mechanisms and to use certification and verification systems: RTRS, ISCC, 2BV.
- **Bunge:** The company announced a commitment that 100% of the soybeans it sources from the Amazon region would be deforestation-free as of 2006, presented the results of its monitoring actions in 2014 and managed to fully fulfill that commitment.
- **ADM:** The company has committed to zero deforestation and uses a verification standard of its own (ADM Responsible Soybean Standard) and ISCC and ProTerra certification standards.
- **LDC:** No commitment by the company to reduce deforestation was found.
- **Amaggi:** The company was a pioneer in joining the Soy Moratorium and adopted policies and procedures to eradicate deforestation. In addition, it supplies non-GMO soybeans to the market and uses environmental certifications to monitor the impact of its operations.



Zero Gross Deforestation (ZGD) and transparency are key elements to ensure the credibility of the commitments

Corporate commitments are key elements of the strategy to eliminate deforestation in tropical ecosystems, but companies must first adopt a single ZD concept as a benchmark and internalize transparency in relation to monitoring processes as a key element for reporting reductions in deforestation and its eradication.

Transparency allows for appropriate links to be established between stakeholders, the production chain and civil society for evaluating the effectiveness of methods and changes in the field, apart from making it possible to improve the system continually and ensuring compliance with the targets set.

The Soy Moratorium is an exemplary case for other production chains, mainly because the targets proposed are being achieved and the process of monitoring, reporting and checking the achievement of targets is transparent, generating data accessible to stakeholders. As a rule, commitments made in relation to other production chains or regions are not as transparent and lack the same level of coordination between business actors and civil society.

EXPANDING THE SOY MORATORIUM INTO THE CERRADO REGION

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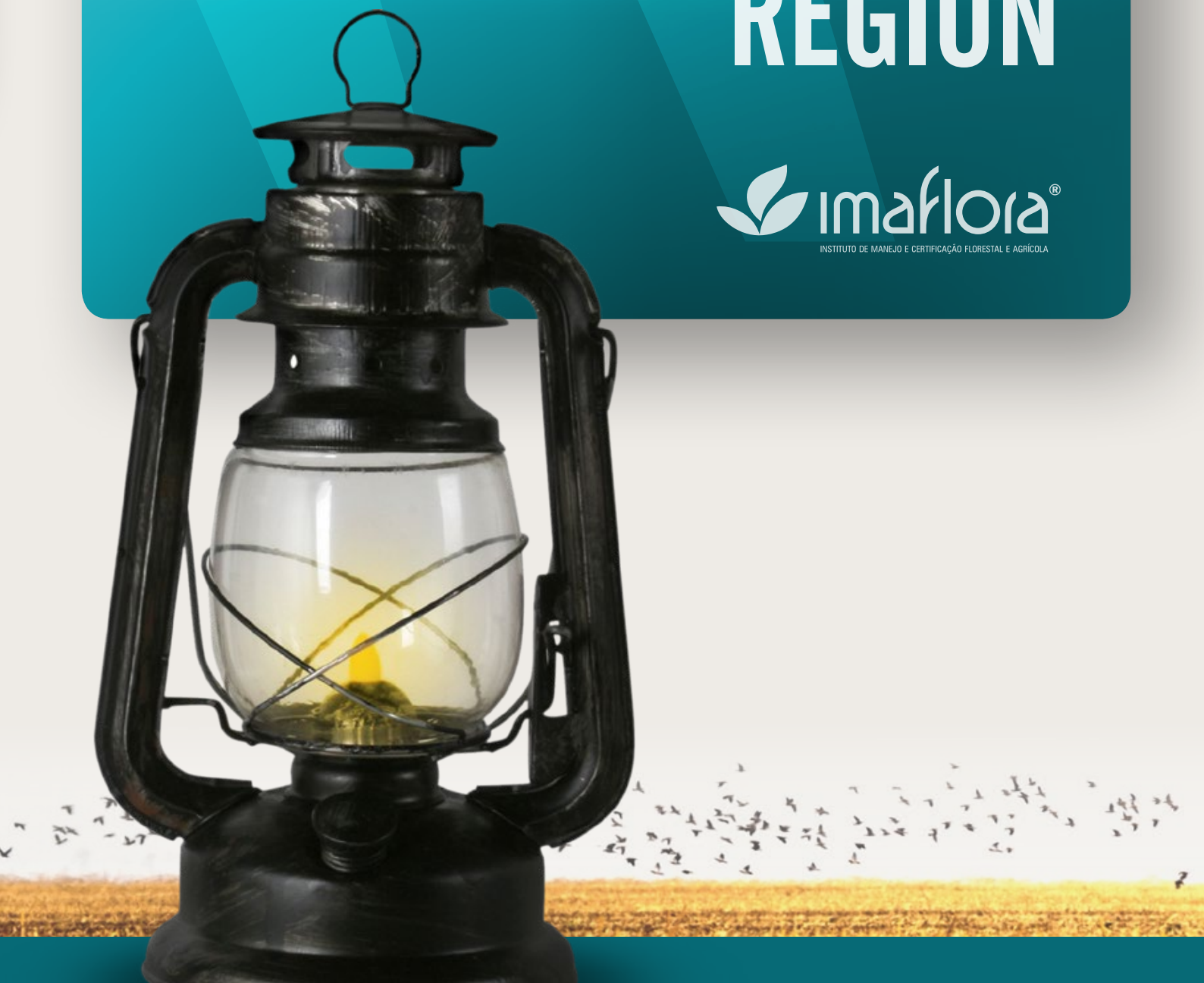


THE MATOPIBA territory (a portion of the Cerrado biome in the states of Maranhão, Tocantins, Piauí and Bahia), as well as the Cerrado as a whole, lacks appropriate land use planning mechanisms and sectoral commitments that respect existing cultural, social and environmental values. The role played by vibrant entrepreneurial farming in raising socioeconomic benchmarks in the region deserves special mention, but it is not sufficient to assure and sustain that a regional development process is actually under way and much less that it meets the yearnings and needs of people living in the Matopiba territory.

Considering that this is a new agricultural frontier, it is extremely important to establish public and private mechanisms for land use planning and that they include social and environmental safeguards to prevent mistakes made in the past in this and other regions of the country from being repeated or intensified.

However, the reality in this region of Brazil is characterized by the absence of a dialogue between local stakeholders, a fact that contributes to weakening public policies and to the lack of land occupation criteria in the area. Additionally, and perversely, the financial mechanisms available to promote development in the region's agricultural sector, such as agricultural credit and private financing of production, are structured to meet the interests of agribusiness. The process of converting natural vegetation to attract investors and speculators pushes land prices up, consequently expelling locals to even more marginalized regions and with less possibilities of economic return.

What is therefore seen in Matopiba today is a model based on promoting development at all cost, regardless of social and environmental issues, where the real needs of the local population are neglected in favor of the interests of large companies and interest groups, expanding and consolidating the huge social inequality that prevails in that territory.

Characterization of the last agricultural frontier - Matopiba

The expression Matopiba was coined and consolidated recently based on technical studies and recommendations issued by EMBRAPA as part of its Strategic Territorial Development

FIGURE 6 – MAP OF WHERE THE MATOPIBA TERRITORY IS LOCATED

Project for the Matopiba Region[7]. The decisive factor was the presence of the Cerrado biome in the four states making up the name of the territory: Maranhão, Tocantins, Piauí e Bahia (Figura 5). The area of the territory covers approximately 731,000 km² distributed in 31 micro-regions and 337 municipalities, where 91% of the total area is covered by typical Cerrado vegetation (30).

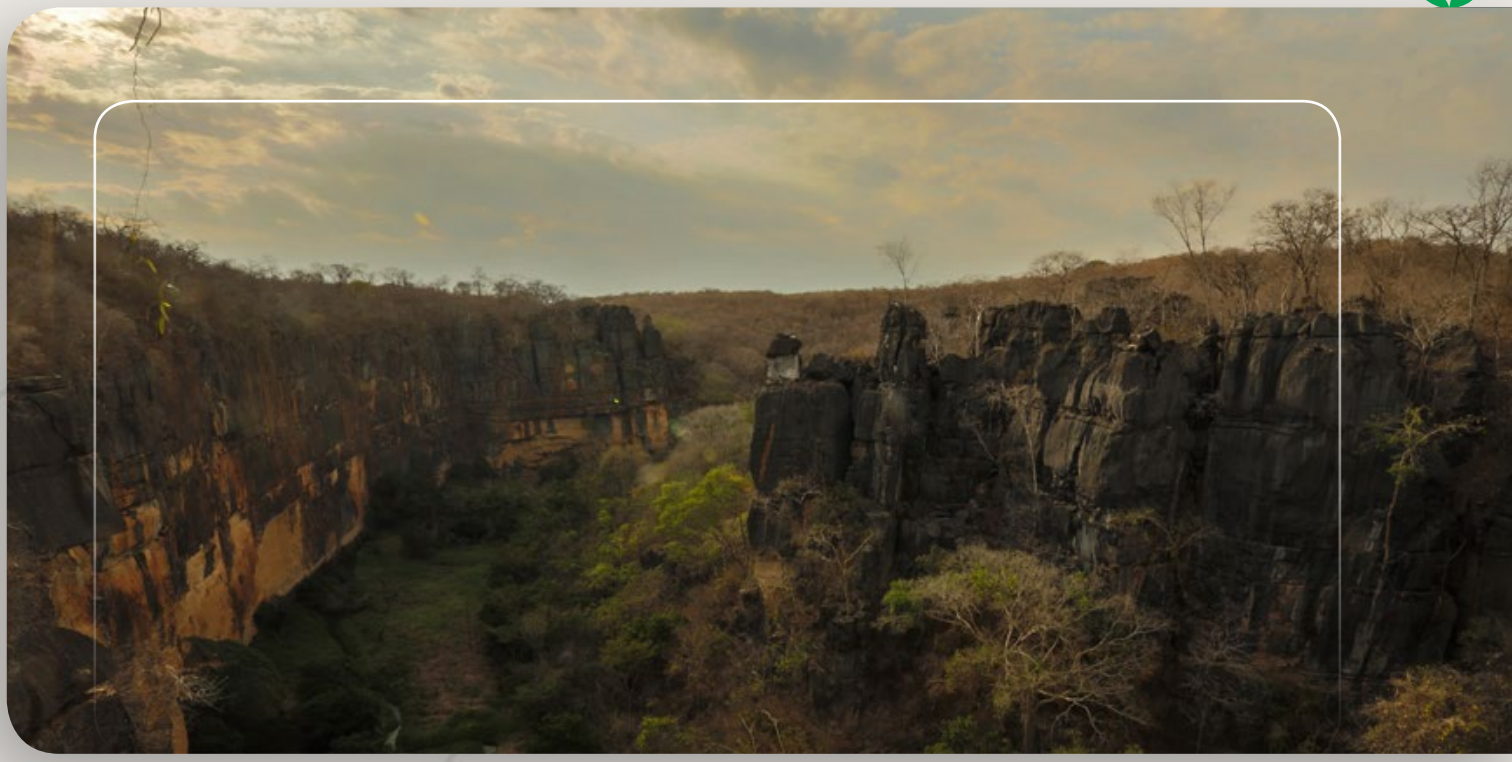
However, the socioeconomic characteristics of the region covering this new agricultural frontier are very different in terms of space and time from those of the agricultural frontier of the Amazon biome and of other Cerrado regions in central Brazil, as they have a rich and diverse land use and occupation history.

With a total population of 5.9 million mainly concentrated in the states of Maranhão (3.4 million) and Tocantins (1.5 million) (31), its occupation is ancient and diverse, and often consolidated, following the pattern of other occupation processes and migratory flows of Brazil's colonization. Thus, it can be said that the institutionalization of the name Matopiba is a way to present something new only to sectors of the Brazilian economy and society that are not aware of it with the aim of promoting land-use changes in a context of agricultural consolidation in favor of agribusiness and to the detriment of a pre-existing reality of land use and occupation.

Reinforcing the argument above, the land structure of Matopiba already comprises about 320,000 identified farms, which occupy 47% of the whole territory (30). In addition, other legally assigned areas are divided between 27 Indigenous Lands (TIs), 28 Conservation Units (UCs), 925 Rural Settlements and 34 Quilombo Communities, covering another 14% of the territory (32). These figures do not take into account the 18 Environmental Protection Areas (APAs) existing in the territory due to the low effectiveness of this category of conservation units to preserve natural vegetation and its overlap with other types of land occupation and use.

These figures reveal lack of knowledge of who are the owners of a significant portion of the territory, which is probably mostly covered by the biome's natural vegetation. Therefore, there is a clear demand for a development plan for the territory that takes into account the

7 Available at: <https://www.embrapa.br/gite/projetos/matopiba/>



region's complex land structure and recognizes the existence of areas of high conservation value in it to make sure that agricultural/livestock expansion is truly sustainable and can actually contribute to reducing regional inequalities.

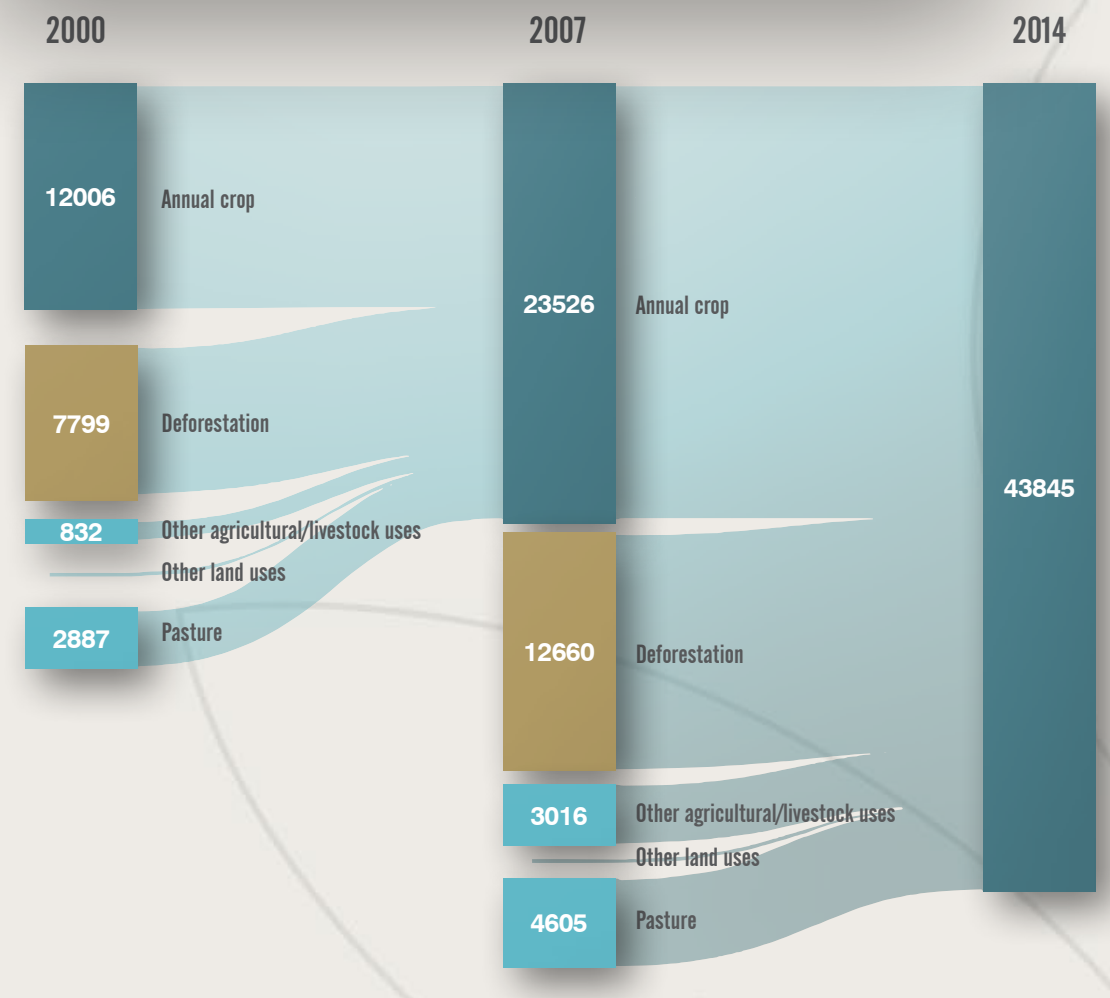
It is believed that the social inequalities prevailing in the region, as measured by gross disposable income, is the combined result of the lack of advanced technologies and land concentration, which may have occurred due to market imperfections resulting from the difficulties faced by the region's most disadvantaged populations to have access to more productive land and technologies. (33). However, it is clear that other variables are not considered in this equation and that a territorial development plan should tackle all knowledge bottlenecks before it can be actually implemented.

Soybean-oriented agricultural expansion

The region has experienced a remarkable expansion of agricultural and livestock activities in recent years in a process referred to as the "last agricultural frontier" in Brazil (34, 35, 36). As a result of this expansionist movement, Matopiba has been experiencing high deforestation rates and rapid changes in land use, particularly as a result of the conversion of natural vegetation to make way for soybean crops.

A report prepared by Agrosatélite (2015) analyzed the agricultural expansion process in the Matopiba territory during the 2000-2014 period and identified a 3.7-time increase in the area planted with annual crops, which increased from 12,000 km² to about 44,000 km² over this period. Almost 65% of this increase of 32,000 km² resulted from the direct conversion of natural vegetation and 24% from the substitution of pasture areas (FIGURE 7).

FIGURE 7 – LAND USE CHANGE IN THE MATOPIBA TERRITORY BETWEEN 2000 AND 2014 (37)



These figures raise concerns about the conservation of the Cerrado biome in the Matopiba territory, providing opportunities for discussing three major aspects related to land-use reorganization against the expansion of annual crops and conservation of areas with natural vegetation. The first one refers to the region's soil, climate and relief characteristics and expresses its productive capacity or agricultural suitability for growing grain crops; the second one refers to a complex land reality, which implies great challenges for orderly and sustainable agricultural expansion; and the third one is related to the potential increase in productivity in agricultural areas as a result of the development and adoption of technologies.

The longevity of agricultural systems depends on the suitability of the soil

Historically, the pattern of land occupation and use in Brazil has been proven effective in the consolidation process, with the establishment of entrepreneurial agricultural/livestock production systems in suitable areas for them, but it has been proven inefficient in the conversion of natural areas for agricultural purposes. In many regions, large tracts of cleared land are abandoned due to their low productivity and, consequently, low economic return in the medium term. Rational land use should be based on the assumption that only areas with high agricultural potential should be used for production purposes at local and regional level (e.g. through ecological-economic zoning) or at the level of production systems (e.g. through planning of the agricultural production unit).

When agricultural areas in the Matopiba territory are analyzed, it can be seen that they are concentrated in areas with high or very high agricultural potential[8], which cover 71% of the entire production area, leading us to believe that factors related to their environmental and economic feasibility were considered in the land use transition in the region (Figure 8). However, 29% of the areas occupied by agriculture have limited agricultural potential and will probably face difficulties or limitations in the future to remain productive and will require more intensive use of technology by farmers.

Cattle-raising in the Matopiba territory concentrated in turn in areas of low agricultural suitability for growing grains, covering only 26% of the areas with high or very high agricultural potential (40,000 km^2), an amount of land close to the total area being used for agricultural purposes today (44,000 km^2). These figures show the potential for agricultural

8 For this analysis, a land use and cover map was prepared from the compilation of maps of the projects Earth Class Cerrado (38) and Amazônia (39). An agricultural suitability map, published in (18), was also used

FIGURE 8 – AGRICULTURAL SUITABILITY AND LAND USE AND COVER MAP

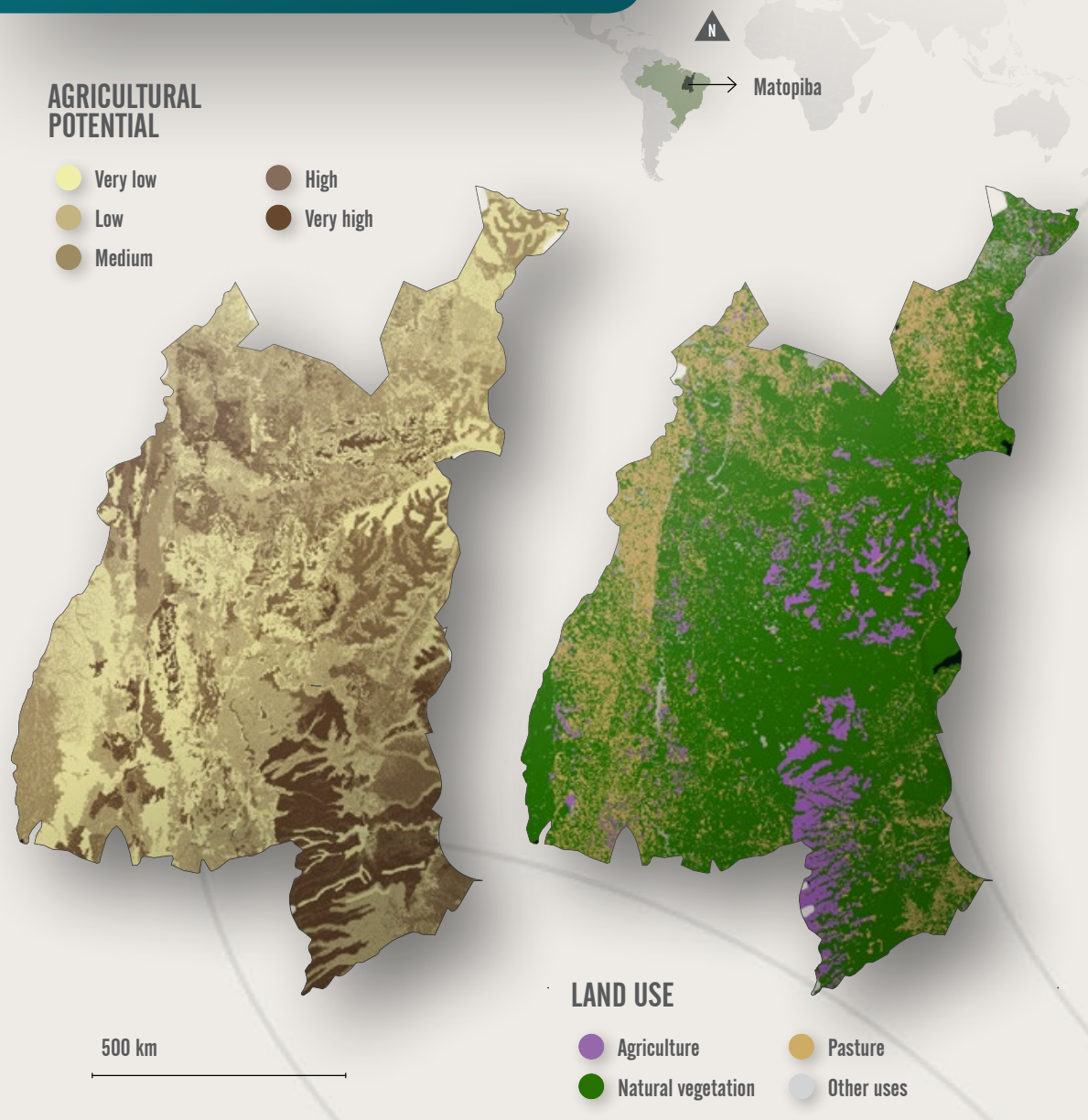
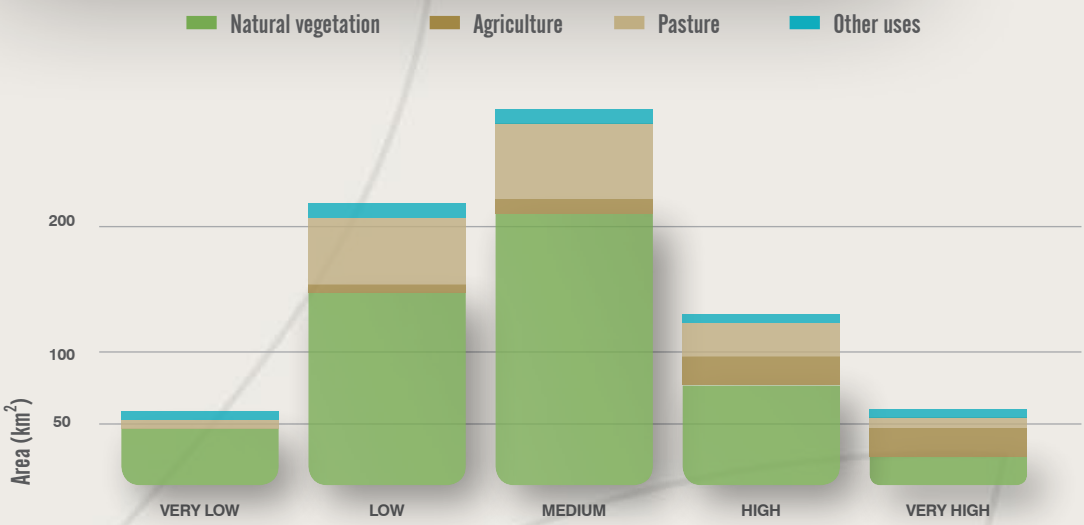


FIGURE 9 – AGRICULTURAL SUITABILITY FOR GRAINS ACCORDING TO LAND USE CATEGORIES IN THE MATOPIBA TERRITORY



expansion into pasture areas, which could double in size without the need for any further conversion of natural vegetation (Figure 9).

Even though it is possible to physically allocate agricultural areas to tracts of land highly suitable for pastures, it should be stressed that livestock production also requires highly fertile soils as well as annual crops. Thus, the linear logic of allocating livestock to marginalized areas should not always be considered. In this regard, it is also necessary to consider the indirect impact of pasture substitution by agriculture, which is likely to shift cattle-raising to other regions of Brazil, increasing the pressure on natural vegetation in those regions.

These issues open up interesting opportunities for discussing agricultural expansion in Matopiba and its territorial development, raising new challenges for ensuring the sustain-

ability of these processes in the medium and long term. Progress should be promoted gradually and in a well-planned manner, respecting the needs and aspirations of the local population and exploiting the region's natural resources rationally.

The complex land network of Matopiba – rediscovering an ancient territory

Transparency in the data contained in the Rural Environmental Registry (CAR) constitutes a new landmark for accessing information of public interest that can increase the analysis and monitoring capacity of the productive sector, academia, companies and civil society, which can ultimately contribute to raising the bar of sustainability in agricultural production chains.

With the information made available by the Brazilian Forest Service (SFB)[9] for areas legally allocated to rural settlements and protected areas (UCs and TIs), excluding APAs, it was possible to identify the territorial dominion of approximately 400,000 km² or 54% of the total area of the Matopiba territory.

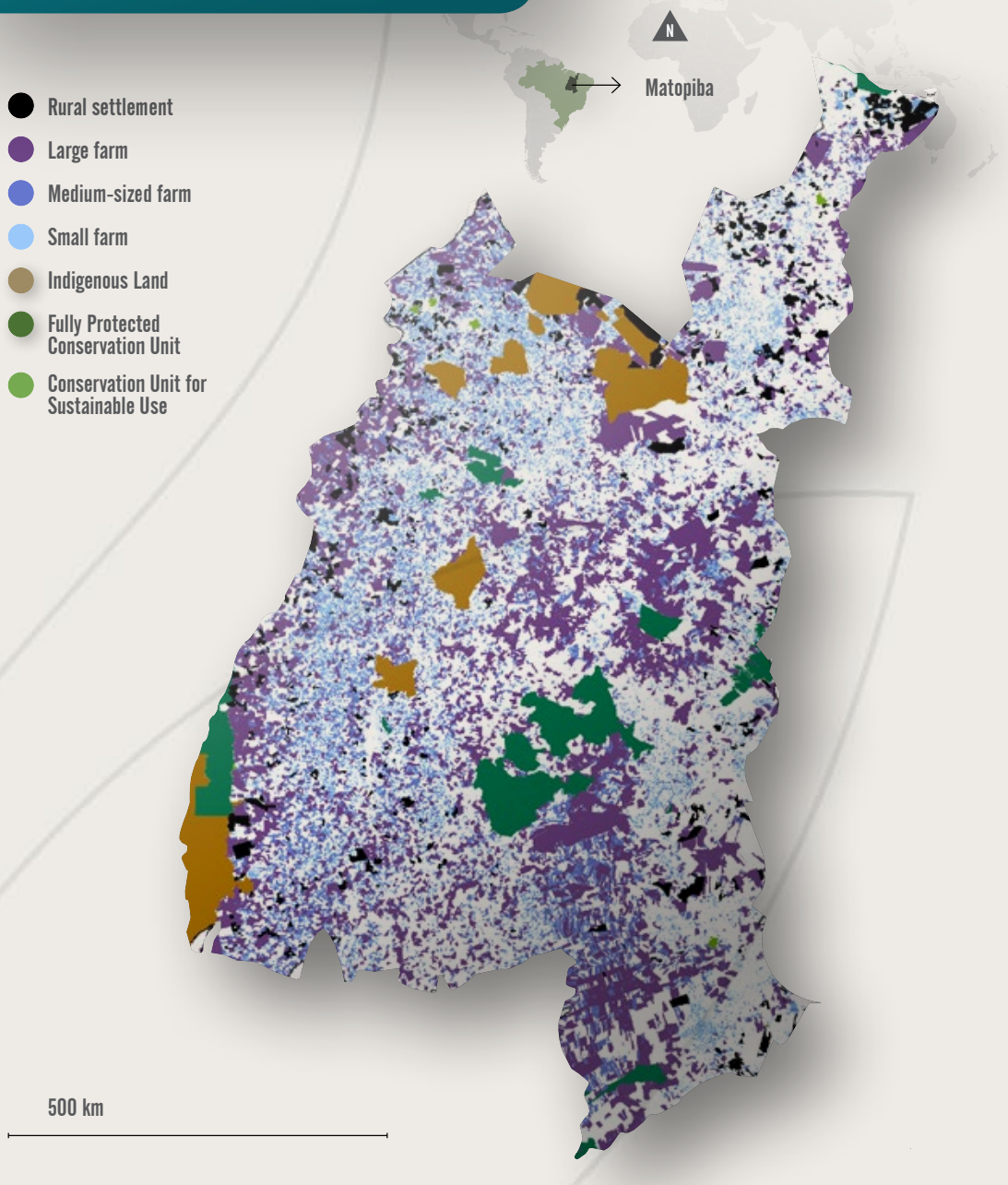
Analyzing CAR data yet to be validated, 121,091 farms were identified covering about 295,000 km² (40% of the total area). Of this total, 91% (or 109,716) of the farms fall under the category of small farms, i.e. farms with up to four fiscal modules, and 8,788 are located inside or in contact with the boundaries of rural settlements. The remaining 9% are divided between medium and large farms (Figure 10).

Compared to the data available in the literature, according to which over 300,000 farms cover approximately 340,000 km² (30), there is still a significant number of farms that have not yet registered with the CAR. Based on the profile of the farms registered with the CAR until then, it is likely that most non-registered farms belong to small farmers who are not being provided with any technical assistance from government and are at the mercy of the increasing and sustained land speculation that has been plaguing all the established land structure.

Of the 400,000 km² that were legally allocated, 262,000 km² (66%) are covered by natural vegetation, 64,000 km² of which are located in public and protected lands (UCs and TIs)

9 Available at <http://www.car.gov.br/publico/imoveis/index>

FIGURE 10 – MAP OF LAND CATEGORIES IN THE MATOPIBA TERRITORY



and the rest in private areas. Considering that 24% (47,000 km²) of the natural vegetation on private land is located in areas of high agricultural potential, the data suggest that there is a significant amount of conserved areas at high risk of being converted for agricultural/ livestock purposes, and even more if we consider that most of the natural vegetation in these farms can be legally converted in accordance with the Forest Code.

With the available public data, it was not possible to identify the land dominion of the remaining 330,000 km² that make up the Matopiba territory, but it is believed that most of these areas are occupied by small farmers. This unknown land universe has 226,000 km² covered by natural vegetation, 44,000 km² of which are located in highly suitable areas for growing grains.

Understanding the land allocation logic in the region, where government encourages, at all costs, the occupation of fallow land, i.e. land covered by natural vegetation that does not generate any dividends for the government, and indirectly encourages land grabbing practices and land speculation, imaflora® stresses that other significant areas with natural vegetation are also at high risk of conversion, whether legally or illegally.

Thus, there is a total of 91,000 km² of areas covered by natural vegetation with agricultural potential in Matopiba. This figure expresses the magnitude of the problem that society will have address in the coming years, as land use processes are fostered by a logic that is not necessarily based on rational use, i.e. on good agricultural practices.

Finally, the figures are even more alarming when confronted with the reality in the region, where it is often very easy for new agricultural entrepreneurs to obtain an environmental license for their projects, facilitating their expansion into natural vegetation areas and, particularly, the concentration of land ownership and the displacement of the local rural population, following a narrative that strengthens the social inequality process.

The alternative is not to expand agriculture in the area, but rather its productivity

When discussing the expansion of agricultural areas into natural vegetation areas in a region marked by a fragile land structure, we must consider that there are misconceptions in the purposes proposed in discourses that take our attention away from what is really at stake.

TABLE 1 – LAND USE AND AGRICULTURAL POTENTIAL BY LAND CATEGORY

Land use category	Total area by land use category	Agri-cultural potential	Small farm	Medium farm	Large farm	Rural Assis-tance	UC	TI	Total area by class of agri-cultural potential
Natural vege-tation	255.728	Low	14.790	16.790	35.905	10.072	7.632	6.757	85.189
		Medium	12.441	14.612	39.155	7.593	21.169	23.240	118.210
		High	6.305	9.535	27.724	3.660	2.833	2.342	52.398
Agri-culture	40.666	Low	238	640	2.143	174	2	8	3.206
		Medium	723	1.929	5.486	141	25	17	8.321
		High	1.966	8.215	18.643	180	107	28	29.139
Pas-ture	84.088	Low	8.189	7.345	10.819	4.572	53	144	31.122
		Medium	9.007	6.064	10.022	4.586	210	489	30.368
		High	4.950	4.666	9.958	2.839	69	116	22.598
Outher uses	10.696	Low	868	711	1.691	901	587	430	5.188
		Medium	425	489	1.601	509	607	660	4.291
		High	113	165	510	158	90	181	1.217
Total area by land category			60.015	71.152	163.656	35.384	33.385	34.412	398.005

Nota: Note: Of the 731,175 km² that make up the Matopiba territory, 13,227 km² are located in the Caatinga Biome and were not covered by the analysis presented here. Of the remaining 717,948 km², 398,005 km² (55%) fall under the land categories presented in the table above and the land dominion for the rest of them could not be determined for lack of spatial coverage of the compiled data (e.g. absence of CAR registration for part of private land areas).

In fact, the expansion of land use into natural vegetation areas does not constitute an agricultural expansion process, but rather a process of production and expansion of wealth by actors with greater economic power who use agriculture and cattle-raising to support their noble justifications. If the purpose is to produce food for the world, we must analyze the process of intensification of agricultural frontier areas from the perspective of the sustainable intensification of the activity itself and not from that of the occupation of the territory.

The Matopiba territory experienced severe and extreme climatic events in the past five years that exposed a harsh reality in the agricultural frontier, with its low water availability and seasonality. We can list some of the results of this situation, such as low absolute grain production followed by crop failures, low agricultural productivity, the existence of continuous converted areas not being used for agricultural purposes and the intensification of conflicts between local populations and entrepreneurs.

The situations described here point out what needs to be done in the short and medium term, namely, invest in technology as opposed to the discourse of clearing new areas in a scenario of lack of public and private mechanisms.

The technological development capacity shown by Brazil throughout the process of occupying the Cerrado region in the last 40 years shows that there is a way forward. A way that recognizes and assumes the possibility of increasing agricultural production without deforesting natural ecosystems.

imaflora® is therefore aware of the need to define a path for promoting development strategies resulting from dialogue and focused on ensuring rationality in the occupation of spaces, but above all focused on meeting the aspirations of local populations that occupied and developed the Matopiba territory in their own ways, strengthening productive, cultural and environmental capacities and, above all, promoting the integration of those populations to Brazil and other consolidated regions.

FINAL CONSIDERATIONS

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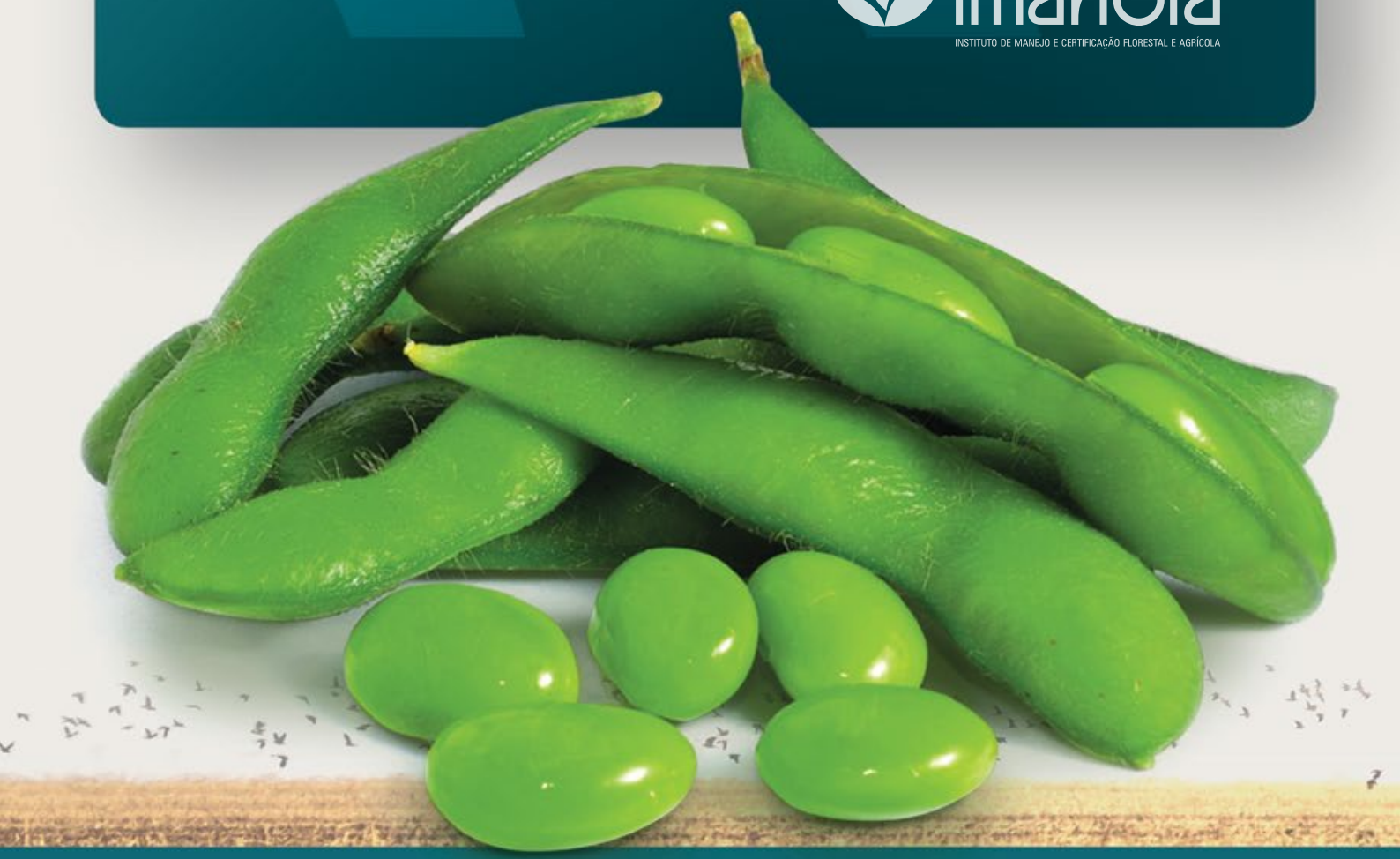

THE GOVERNANCE of territories located on the agricultural frontier has a key role to play in organizing the development of agribusiness in those regions. Government has the duty to ensure the right to land for all, but the low educational level of the local population, added to a fragile social organization, makes it difficult to strike a balance that is suitable for all stakeholders with an interest in occupying the region, so that the local development strategy can ensure minimum rights to society and preserve natural resources in the long term.

According to the 2006 Agricultural Census of IBGE, more than 60% of all farms in Brazil have a revenue of less than two minimum wages a month and account for only 3% of the sector's gross revenues. These farms are not covered by existing public policies and therefore have no access to agricultural credit or to the technical assistance they need. For them, intense collaboration and dialogue with the private sector are key factors to prevent inequality from rising and make sure that this opportunity will actually help to build a fairer and more balanced society.

We have a country to build where the political and economic structures should not reflect the interests of its ruling classes only, but rather focus on creating jobs, on ensuring greater access to health care and education, on promoting income distribution, on reducing imbalances and on providing basic services to society. In the agricultural sector, actions to increase the productivity of agricultural systems and intensify them, as well as to promote their diversification, should be mainly focused on areas with low productivity, small farmers and family farming and on preventing the predominant production model from benefiting only the owners of farms with medium to high productivity already, thus further increasing income concentration, inequalities and rural poverty.

Like access to land, access to technology and to modern agriculture should be ensured to all farmers: rural credit, machinery, implements, inputs, seeds, services, technical assistance, certification, agricultural insurance and markets. The systems should certainly be customized according to the region, the farmer's profile and the production management approach adopted. In all cases, public-private integration and dialogue between different actors are the only means through which it will be possible to ensure a territorial planning model that actually promotes legitimate rural development.

REFERENCES

1. Greenpeace. Eating Up the Amazon. (2006).
2. ABIOVE, AGROSATÉLITE, GTS & INPE. Moratória da Soja: Safra 2015/2016. (2016).
3. Rudorff, B. F. T. et al. Remote Sensing Images to Detect Soy Plantations in the Amazon Biome-The Soy Moratorium Initiative. Sustainability 4, 1074–1088 (2012).
4. Sparovek, G. Além da Moratória da Soja: Organizando a Casa. Seminário de 10 anos da Moratória da Soja. GeoLab – USP/Esalq. 7 (2016).
5. Barretto, A. G. O. P., Berndes, G., Sparovek, G. & Wirsenius, S. Agricultural Intensification in Brazil and its Effects on Land-use Patterns: an Analysis of the 1975-2006 Period. Glob. Chang. Biol. 19, 1804–1815 (2013).
6. IBGE. Censo Agropecuário. (2016).
7. INPE/MCTI. Projeto PRODES Monitoramento da Floresta Amazônica Brasileira por Satélite. (2016). Available at: **http://www.obt.inpe.br/prodes/index.php**.
8. BRASIL. Lei n. 4.771, de 15 de setembro de 1965. (1965).
9. Nepstad, D. et al. Slowing Amazon Deforestation Through Public Policy and Interventions in Beef and Soy Supply Chains. Science (80-). 344, 1118–1123 (2014).

10. Lima, A., Capobianco, J. P. R. & Moutinho, P. Desmatamento na Amazônia: Medidas e Efeitos do Decreto Federal 6.321/07. (Instituto de Pesquisa Ambiental da Amazônia, 2008).
11. BRASIL. Lei n. 12.651, de 25 de maio de 2012. (2012).
Soares-filho, B. et al. Cracking Brazil's Forest Code. Science (80-). 344, 363–364 (2014).
13. IBGE. Produção Agrícola Municipal. (2016).
14. Agrosatélite Geotecnologia Aplicada Ltda. Moratória da Soja: Safra 2015/2016. (2016).
15. Imazon. Sistema de Alerta de Desmatamento (SAD). (2016).
16. Moutinho, P., Guerra, R. & Azevedo-Ramos, C. Achieving Zero Deforestation in the Brazilian Amazon: What is Missing? Elem. Sci. Anthr. 4, 125 (2016).
17. Lambin, E. F. et al. Effectiveness and Synergies of Policy Instruments for Land Use Governance in Tropical Regions. Glob. Environ. Chang. 28, 129–140 (2014).
18. Sparovek, G., Barretto, A. G. O. P., Matsumoto, M. & Berndes, G. Effects of Governance on Availability of Land for Agriculture and Conservation in Brazil. Environ. Sci. Technol. 150804113924002 (2015). doi:10.1021/acs.est.5b01300.
19. Freitas, F. L. M., Sparovek, G. & Matsumoto, M. H. in Mudanças no Código Florestal Brasileiro: Desafios para a Implementação da Nova Lei (Eds. Silva, A. P. M. da, Marques, H. R. & Sambuichi, R. H. R.) 125–158 (Instituto de Pesquisa Econômica Aplicada – IPEA, 2016).
20. SEEG. Sistema de Estimativa de Emissão de Gases de Efeito Estufa. (2016).
21. Fishman, A. Understanding 'Deforestation - Free': The State of Play and Issues to Consider During TFD's October 2014 Dialogue. Underst. 'Deforestation-Free' Scoping Dialogue 37 (2014).
22. CGF. The Consumer Goods Forum Website. (2016).
23. UNCS. New York Declaration on Forests. United Nations, New York, NY (2014).
24. UNFCCC. Conference of the Parties (COP). Adoption of the Paris Agreement. Proposal by the President. Paris Clim. Chang. Conf. – Novemb. 2015, COP 21 21932, 32 (2015).
25. McCarthy, B., Rothrock, P., Leonard, J. & Donofrio, S. Supply Change. Tracking Corporate Commitments to Deforestation-free Supply Chains, 2016. (2016).
26. Nestlé. Nestlé Responsible Sourcing Guideline. (2013).

27. Unilever. Unilever Sustainable Sourcing Programme for Agricultural Raw Materials, Scheme Rules v. 3.0. (2014).
28. Unilever. Unilever – Eliminating Deforestation. (2015). Available at: **https://www.unilever.com/sustainable-living/transformational-change/eliminating-deforestation/**. Accessed: 19 set. 2016.
29. McDonald's. McDonald's Corporation Commitment on Deforestation. (2015).
30. Miranda, E. E., Magalhães, L. A. & Carvalho, C. A. Nota Técnica 1: Proposta de Delimitação Territorial do MATOPIBA. Gite – Embrapa 1, 1–18 (2014).
31. Mangabeira, J. A. de C., Magalhães, L. A. & Daltio, J. MATOPIBA: Quadro Socioeconômico. 1–55 (2015).
32. Fonseca, M. F. & Miranda, E. E. de. Nota Técnica 6 – MATOPIBA: Caracterização do Quadro Agrário. 1–40 (2014).
33. Alves, E., da Silva Souza, G. & de Miranda, E. E. Renda e Pobreza Rural na Região do MATOPIBA. 1–46 (2015).
34. Richards, P. What Drives Indirect Land Use Change? How Brazil's Agriculture Sector Influences Frontier Deforestation. Ann. Assoc. Am. Geogr. 105, 1026–1040 (2015).
35. Spera, S. A., Galford, G. L., Coe, M. T., Macedo, M. N. & Mustard, J. F. Land-use Change Affects Water Recycling in Brazil's Last Agricultural Frontier. Glob. Chang. Biol. n/a-n/a (2016). doi:10.1111/gcb.13298.
36. Câmara, G. et al. Modelling Land Use Change in Brazil: 2000–2050. (2015).
37. Agrosatélite Geotecnologia Aplicada Ltda. (Cords.) Rudorff, B. & Risso, J. Análise Geoespacial da Dinâmica das Culturas Anuais no Bioma Cerrado: 2000 a 2014. (2015).
38. MMA, M. do M. A. Mapeamento do Uso e Cobertura do Cerrado: Projeto TerraClass Cerrado 2013. (2015).
39. Almeida, C. A. de et al. High Spatial Resolution Land Use and Land Cover Mapping of the Brazilian Legal Amazon in 2008 Using Landsat-5/TM and MODIS data. Acta Amaz. 46, 291–302 (2016).

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